FIATAGRI

WINNER

FIAT

F100 F110

F120 F130 Turbo

WORKSHOP MANUAL

06910101

S E R V I Z I   T E C N I C I   D I   A S S I S T E N Z A

WORKSHOP MANUAL

SECTIONS

S E R V I Z I T E C N I C I D I A S S I S T E N Z A

FOREWORD

◊ *This Manual is subdivided into Sections, each identified by a two–digit number and with separately numbered pages.*
For ready reference, these Sections maintain the same identification number and group description of the corresponding Flat Time Rate Manual.

◊ *Topics and information can be easily retrieved by consulting the Index on the following pages.*

◊ *Manual Print no. and respective edition/updating date appear on the bottom of each page.*

◊ *Revised sheets will carry the same print number followed by a 2–digit number (e.g. first revision 603.54.276.01; second revision 603.54.276.02 etc.) and date of issue.*
These pages will be accompanied by a specifically revised and updated index.

◊ *Information contained in this Manual are updated to the date reported on the print. As FIATAGRI maintains a constant improvement program for its product range, some information may not result updated because of modifications motivated by reasons of a technical or marketing nature as well as by the legal requirements of different Countries. In case of discordance, consult FIATAGRI Sales and Service Organizations.*

◊ *The imperial weights and measures are given for operators' convenience and though the closest approximation is sought, they are normally rounded off for practical reasons. In case of discrepancies only the metric units should be considered.*

IMPORTANT NOTICES

◊ *All maintenance and repair work reported and described in this Manual is the exclusive reponsibility of the FIATAGRI Service Network, which must carry it out by strictly following directions and using, wherever necessary, the specific service tools specified therein.*

◊ *Anybody carrying out service operations dealt with in this manual without abiding strictly to its prescriptions makes himself personally responsible for of any ensuing damage.*

◊ *The Manufacturer and all of the Organizations associated with its distribution network, including but not limited to national, regional or local distributors, decline any and all responsibility for damages that may derive from the abnormal behaviour of parts and/or components not specifically authorized by the Manufacturer, including those utilized in maintenance and/or repair work on its products, manufactured or commercialized by the same.*
In no case, warranties of any kind may be issued or forced on the products fabricated or distributed by the Manufacturer for damages deriving from any abnormal behaviour of parts and/or components unauthorized by the Manufacturer itself.

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GENERAL INSTRUCTIONS

IMPORTANT NOTICE

All service interventions dealt with in this Manual are intended to be the exclusive competence of the **FIATAGRI Service** world network organization and must be carried out in the absolute respect of the indications given hereafter, using, whenever necessary, the envisaged special service tools and equipment.
Anyone attempting to or carrying out work and operations included in this Manual without following full instructions and specifications makes himself personally and directly responsible for resulting damages.

SHIMS

At each adjustment operation, select shim packs by measuring shims one by one with a micrometer gauge and summing up readings obtained: do not preventively rely on shim pack thickness or on nominal values of shims.

ROTARY SHAFT OIL SEALS

When installing oil seals on rotary shafts, pay attention to the following:
– prior to fitting, keep seals dipped for at least half an hour in the very fluid which is to be retained at work;
– thoroughly clean the shaft and make sure working surfaces are free from damages or faults of any kind;
– place seal with the lip facing the fluid; if the seal is of the thrower–lip type, grooves must be so oriented that during shaft rotation the fluid tends to be thrown back towards the inside of the machine part or component containing it.
– coat the sealing lip with a thin film of lubricant (possibly oil instead of grease) and pack the space between sealing lip and dust shield with grease;
– fit the seal in place pressing it or driving it with a flat–head tool or ram of the right diameter: on no account strike it with a hammer or mallet;
– when being pressed or driven in place, make sure that the seal is introduced perpendicularly to the seat surface and, once fitted, check that the seal is fully home and seated properly;
– to prevent seal lip damage during fitting, use some sort of protection interposed between mating surfaces of seal and shaft.

TOROIDAL "O–RING" OIL SEALS

Lubricate O–ring seals prior to installation to prevent their rolling over themselves and remain twisted during fitting.

JOINT SEALING COMPOUNDS

Upon joining mating surfaces indicated by an "X", apply one of the following sealing compounds: RTV SILMATE, RHODORSIL CAF 1 or LOCTITE PLASTIC GASKET.
Prior to sealing compound application, prepare the joint surfaces as follows:
– remove scales or encrusted matter using a wirebrush;
– thoroughly degrease surfaces using one of the following detergents: solvent (trichloroethylene), kerosene or water/soda solution.

BEARINGS

Suggested bearing preparation procedure prior to installation:
– heat to 80 to 90°C (176 to 194°F);
– cool them off before force fitting in place.

ROLL PINS

When fitting split pins make sure the cut is facing in the direction of force in order to put the pin under stress.
Instead, spiral pins do not require any particular way of fitting.

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SPARE PARTS INFORMATION

Use exclusively FIATAGRI genuine spare parts **identified with the trademark shown below.**

FIATAGRI Parts

Fiatagri
Original
Controlled
Quality

These are the same and only spares assuring the standards of quality, safety and service life of the original parts fitted at the Factory.
Only the FIATAGRI original spare parts **can offer this guarantee.**
When ordering spare parts make sure to state:

– tractor model (marketing denomination) and chassis serial number;
– engine type and serial number;
– part number, found on "Microfiches" or printed "Spare Parts Catalogue".

SERVICE TOOL INFORMATION

The service tools that FIATAGRI proposes and illustrates in this Manual are:

– studied and designed specifically for the FIAT tractor range;
– essential for technically reliable repairs and service work;
– manufactured and tested conforming to strict quality standards to offer efficient and long lasting service.

Service workshops and staff are also reminded that being equipped with the right tools means:

– operating in optimum working conditions;
– obtaining the best results;
– saving time and fatigue;
– working in more safety.

NOTE

Permissible wear limits suggested in this Manual for some of the parts or components are to be considered indicative only and absolutely not binding.
"Front", "rear", "right" and "left" indications given throughout this Manual are referred to the tractor operator seated on board and facing the direction of forward travel.

WHEN PUTTING IN MOTION A TRACTOR WITHOUT BATTERY

Outside feeder cables must be connected exclusively to the respective positive and negative cable terminals of the tractor using using efficient clamps ensuring an adequate and stable electric contact.
Disconnect all user circuits (lights, windshield wipers, etc.) prior to starting the tractor.
Should it be necessary to make functional checks of the tractor electrical system, make sure the feeder is connected; upon completion of check, disconnect all user circuits and put off the feeder before disconnecting the cables.

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SAFETY RULES

PAY ATTENTION TO THIS WARNING SIGN

This symbol alerts you for important messages involving your safety.
Read messages attentively and strictly follow suggested precautions designed to avoid potential dangers and safeguard your health and personal safety.
You will find, throughout this manual, this sign associated with the following keywords:

***CAUTION** – Warning intended to prevent unsuitable repair procedures with potential consequences to repairman's safety.*

***DANGER** – Associated with warnings of specific potential dangers for the repairman and any other people directly or indirectly involved.*

AVOID ACCIDENTS

Most accidents occurring in the workshop are a consequence of the failure to follow some simple and prudential safety rule. For this reason MOST ACCIDENTS CAN BE AVOIDED: it is enough to recognize possible causes and act consequently, using the necessary attention and precautions.

Handling any type of machine, regardless of how well it has been designed and manufactured, cannot exclude the possibility that an accident may occur.

A cautious and alert repairman is the best guarantee against accidents.

Scrupulous observance of a single elementary safety rule would already be sufficient to avoid many serious accidents.

DANGER. Never attempt to clean, lubricate or service a tractor with engine running.

SAFETY RULES

GENERAL

◊ Pay your best attention to given maintenance and repair procedures.

◊ Do not wear rings, wrist watches, jewelry, loose or hanging apparel such as ties, torn clothing, scarves, unbottoned or unzipped jackets that can catch on moving or rotating mechanical parts. Wear instead safety prevention clothing, for example: anti–skid shoes, gloves, safety glasses, helmets, etc.

◊ Do not carry on any work on the machine with anyone on the operator' seat unless recognized as a qualified operator called to assist with the work at hand.

◊ Never attempt to operate the machine or any attached implement or equipment in any position other than the operator's seat.

◊ Never attempt any intervention of any kind on the machine when engine is running, unless the case is conforming to instructions

◊ Shut the engine off and check that hydraulic fluid is no longer under pressure before removing caps, covers, valves, etc.

◊ All servicing operations deserve best care and attention.

◊ Shop or field ladders and service stands should conform to present accident prevention regulations.

◊ Disconnect batteries and put signs on all controls to warn that the machine is being repaired or serviced. Lock the machine and any attached implement or equipment to be lifted.

◊ Never check or fill fuel tanks and batteries, or use preheating fluid, while smoking or when there are open flame sources in the vicinity, as fluids involved are highly inflammable.

◊ Brakes are inactive when manually released for servicing: in such cases the machine should be secured with blocks or similar devices.

◊ The fuel gun must be steadily kept in contact with the filler cap while re–fuelling: the contact must be maintained until fuelling is completed to avoid the possibility of sparks consequent to accumulation of static electricity.

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◊ When towing use exclusively the prescribed towing or pulling points. take care in making attachments: be sure pins and locks are sure before pulling. Stay clear of drawbars, cables or chains under load.

◊ To move a disabled machine, use a trailer or low–body truck if available.

◊ Load or unload the machine on level grounds affording full support to the trailer or truck wheels. Fix the machine securely to the trailer or truck platform and block wheels as required for transport.

◊ Use exclusively grounded auxiliary power sources to feed electric heaters, battery–chargers and similar equipment in order to avoid the hazards of electric shocks.

◊ If necessity arises to handle or transport heavy parts and components, make sure to use hoists or similar equipment of appropriate lifting capacity.

◊ Always watch out for presence of people in the vicinity.

◊ Never pour gasoline or diesel fuel into open or wide and low containers.

◊ Never use gasoline, diesel fuel or other flammable liquids detergents: use, instead, non–flammable and non–toxic solvents available in commerce.

◊ When using compressed air to clean parts, wear safety glasses with side protections.

◊ Limit the pressure within a maximum of 2.1 bar, conforming to local or national legislation.

◊ Do not run engines in closed premises not adequately ventilated.

◊ Do not smoke and neither use or allow open flames or sparking in the vicinity, when re–fuelling or handling easly flammable materials.

◊ Do not use flames for lighting purposes when searching for sources of fluid leaks on the machine.

◊ Move very carefully when working under the machine and also on it or in the vicinity of the same. Wear the prescribed safety equipment: helmets, glasses and special shoes.

◊ When carrying on checks requiring engine running, call for the help of a qualified assistant remaining in the operator seat at all times with the repairman in sight.

◊ For field service, bring the machine possibly on level grounds and block it. If the job must be necessarily carried out on a gradient, preventively block the machine and move it on a level area as soon as feasible and affording adequate safety.

◊ Beware of kinky or bent chains and cables, do not use them for lifting or towing. To handle them, wear thick gloves.

◊ Chains should always be anchored securely: check that anchoring point is robust enough to carry the load. Keep people clear of anchor point, chains or towing cables.

◊ Keep maintenance and servicing areas always CLEAN and DRY. Remove any water or oil puddles immediately.

◊ Do not pile up grease or oil–impregnated rags: they are a fire hazard. Always keep them in a closed metal container. Before moving the machine or attached implement, check, adjust and block the operator seat. Also make sure no people are in the immediate vicinity within operating area of machine or implements.

◊ Do not hold in your pockets objects that may fall, unseen, inside the machine.

◊ Where metal particles or objects are apt to fly or fall, wear protective equipment such as goggles or safety glasses with side shields, hard hats or helmets, safety shoes and heavy gloves.

◊ When welding is required, wear the specific protective accident–prevention equipment: dark glasses, helmets, overalls, special gloves and shoes. Dark glasses must be worn also by anyone standing by while welding is in progress. DO NOT LOOK AT ARK WITHOUT ADEQUATE EYE PROTECTION.

◊ Wire ropes develop metallic sleevers with use: protect yourself by wearing adequate safety equipment (heavy gloves, glasses ect.).

◊ Handle all parts with extreme care. Keep hands and fingers off rotating parts, closed parts and open joints and similar. Always use the authorized accident prevention clothing items, such as safety glasses, heavy gloves and safety shoes.

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STARTING

◊ Do not run engines inside closed premises without adequate ventilation or equipped with suitable means for removal of exhaust gases.

◊ Never bring head, body, arms and legs, feet, hands and fingers close to running fans or drive belts.

ENGINE

◊ Before removing the radiator cap, turn it very slowly in order to remove inside pressure. Add coolant only with engine stopped or idling, if warm.

◊ Do not let the engine run when re–fuelling, particularly if still hot, owing to the possibility of fire hazard if fuel is spilled over.

◊ Never attempt to check or adjust fan belts when engine is running. Do not adjust the engine fuel pump when the machine is in motion.

◊ Never lubricate the machine when the engine is running.

ELECTRIC SYSTEM

◊ When using auxiliary batteries, remember that cables must be connected at both ends following the prescribed procedure: (+) with (+) and (–) with (–).Avoid short–circuiting battery posts. BATTERY GAS IS HIGHLY INFLAMMABLE. When re–charging, let the battery compartment open, thus affording a better ventilation. Never check battery charge by "bridging" across posts with metal objects. Avoid sparks or flames in the battery area. Do not smoke, to prevent explosions.

◊ Prior to servicing interventions of any sort, make sure there are no fuel or electrical leaks or losses: remove and rectify them before proceeding with work.

◊ Do not re–charge batteries inside closed premises: make sure ventilation is adequate to prevent the possibility of accidental explosions caused by the accumulation of battery gas produced during the charging process.

◊ Always disconnect batteries prior to interventions of any kind involving the electric system.

HYDRAULICS

◊ Fluid escaping under pressure through a small hole can be almost invisible and can develop sufficient striking force to penetrate the skin; in these cases, should it be necessary to verify the leak, protect yourself using a cardboard or a piece of wood. NEVER DO IT WITH YOUR BARE HANDS: if the fluid spray penetrate the skin, see a doctor immediately. In fact, without qualified medical assistance, a serious infection or skin reaction may develop.

◊ When measuring fluid pressure, use a gauge compatible with expected values.

WHEELS AND TYRES

◊ Make sure tyres are inflated correctly to the pressure specified by the Manufacturer.
Periodically check for damages at wheel rims and tyres.

◊ Stand to one side when correcting pressure or inflating tyres.

◊ Check tyre pressure on unloaded machines and with cold tyres only in order to avoid erroneous readings with resulting overinflation. Do not use recovered wheel parts because improper welding, brazing or heating may have weakened them and caused failures.

◊ Never cut or weld on the rim of mounted and inflated tyre.

◊ To remove wheels, block the machine at front and rear on all wheels. After lifting the machine, place supports underneath to prevent it from falling, according to present regulations.

◊ Deflate the tyre before attempting to remove objects caugt in the threads.

◊ Never inflate tyres using an inflammable gas: explosions with injuries to nearby people may occur.

REMOVAL – INSTALLATION WORK

◊ Lift and handle all heavy parts using means and equipment of adequate capacity. Make sure appropriate hooks and slings are used. Use the lifting eyes specifically provided. Watch out for people in the vicinity of the load to be lifted.

◊ Handle all parts with extreme care. Keep hands and fingers away from open joints between parts components. Wear homologated accident–prevention safety clothing such as goggles, gloves and special shoes.

◊ Guard against twisted and kinking chains and cables. Always wear safety gloves to handle chains or cables.

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GENERAL FEATURES AND SPECIFICATIONS

Engine, technical type:	
– model F100	8065.06.A 330
– model F110	8065.05.A 325
– model F120	8065.05.B 330
– model F130	8065.25.A 220
Cycle	diesel, 4–cycle, direct fuel injection
Supercharging (model F130 only)	by compressor–type turbocharger
Number of cylinders	6, in–line
Cylinder liners	dry, force–fitted in crankcase
Piston diameter:	
– model F100	100 mm (3.937 in)
– models F110, F120 and F130	104 mm (4.094 in)
Piston stroke	115 mm (4.527 in)
Total capacity:	
– model F100	5419 cu.cm (330.5 cu.in)
– models F110, F120 and F130	5861 cu.cm (357.5 cu.in)
Compression ratio	17:1
Maximum power rating:	
– model F100	72 kW (98 HP)
– model F110	81 kW (110 HP)
– model F120	88.2 kW (118 HP)
– model F130	95.6 kW (130 HP)
Maximum power speed	2300 r.p.m.
Maximum torque speed	1500 r.p.m.
Number of main bearings	7
Oil sump	supporting, cast–iron
Valve timing	O.H.V., w/ camshaft in crankcase
Intake:	
– commencement: before T.D.C.	12 deg.
– end: after B.D.C.	31 deg.
Exhaust:	
– commencement: before B.D.C.	50 deg.
– end after T.D.C.	16 deg.
Valve clearance for timing check	0.45 mm (.018 in)
Operating valve clearance, cold engine:	
– intake	0.30 ± 0.05 mm (.012 ± .002 in)
– exhaust	0.30 ± 0.05 mm (.012 ± .002 in)
Fuel system	
Air cleaning	dry, twin–cartridge type w/ centrifugal pre–cleaner and automatic dust discharge (optional: self–cleaning device of the DONASPIN type)
Turbocharger (model F130)	actuated by exhaust gases
Fuel filter (on feed pump delivery)	two series filters w/ in–built cartridge (both w/ water decanter) (optional: sedimenter filter)
Feed pump	double–diaphragm
Drive	cam–type

(follows)

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GENERAL FEATURES AND SPECIFICATIONS

(cont.)

Fuel injection pump	rotary distributor type
BOSCH type:	
– model F130	VE 6/11 F150 RV114462 – 98405596
C.A.V. type:	
– model F100	DPS 8521 A 750 A – 98417239 (1) DPS 8524 A 120 A – 98459640 (2)
– model F110	DPS 8521 A 760 A – 98417236 (1) DPS 8524 A 130 A – 98459638 (2)
– model F120	DPS 8521 A 770 A – 98417238 (1) DPS 8524 A 140 A – 98459639 (2)
In–built, all–speed governor:	
BOSCH and C.A.V.	mechanical, centrifugal weights
In–built, automatic advance device:	
BOSCH and C.A.V.	hydraulic
Fixed advance, commencement of delivery, before T.D.C.:	
– BOSCH	8 ± 1 deg.
– C.A.V.	0 ±1 deg.
Injectors with nozzles	3–hole (four holes on model F 100)
Injector type	see page 10–12
Pressure setting	260 to 268 bar (265 to 273 kg/cm^2 – 3770 to 3886 psi)
Injection sequence	1 – 5 – 3 – 6 – 2 – 4
Lubrication	force–feed, w/ gear–type pump
Oil pump drive	crankshaft
Oil cleaning	screen–type filter on intake and two in–built cartridges
Pressure relief valve location	in pump body, delivery side.
Lube pressure w/ engine running at max power speed:	
– models F100, F110 and F120	2.9 to 3.9 bar (3 to 4 kg/cm^2 – 42 to 56.5 psi)
– model F130	6 bar (6.1 kg/cm^2 – 87 psi)
Engine oil cooling (models F120 and F130)	through heat–exchanger unit operating with engine cooling fluid
Cooling	water circulation activated by centrifugal pump
Radiator:	
– models F100 and F110	3–tubelets, vertical, copper
– models F120 and 130	4–tubelets, vertical, copper
Auxiliary expansion tank	semi–transparent plastics material
Fan, attached to water pump pulley	suction–type, sheet metal
Temperature control	through thermostat
Chronotachometer	incorporated in instrument panel
Drive	derived from camshaft gear
Hourmeter set at engine speed of	1800 r.p.m.

(1) Pre–modification – (2) Post–modification

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CRANKCASE MAIN DATA

	F 100	F 110 F 120 F 130
Diameter, cylinder liner housing bores in crankcase	102.850 to 102.900 mm (4.0492 to 4.0512 in)	106.850 to 106.900 mm (4.2067 to 4.2087 in)
Outside diameter, cylinder liners	103.020 to 103.050 mm (4.0559 to 4.0571 in)	107.020 to 107.050 mm (4.2134 to 4.2146 in)
Interference fit of liners in crankcase	0.120 to 0.200 mm (.0047 to .0079 in)	
Oversize, cylinder liners outside diameter	0.2 mm (.008 in)	
Inside diameter, cylinder liners	100.000 to 100.024 mm (1) (3.9370 to 3.9379 in)	104.000 to 104.024 mm (1) (4.0945 to 4.0954 in)
Maximum permissible ovalization or taper of cylinder liners consequent to wear (2)	0.12 mm (.005 in)	
Oversize, cylinder liner inside diameter	0.4 to 0.8 mm	
Dimeter, camshaft bearing housing bores:		
– front	55.280 to 55.305 m (2.1764 to 2.1773 in)	
– intermediate front	54.780 to 54.805 mm (2.1567 to 2.1577 in)	
– intermediate rear	54.280 to 54.305 mm (2.1370 to 2.1380 in)	
– rear	53.780 to 53.805 mm (2.1173 to 2.1183 in)	
Diameter, standard valve tappet housing in crankcase ...	15.000 to 15.018 mm (.5905 to .5912 in)	
Oversizes, spare tappets	0.1 – 0.2 – 0.3 mm (.004 – .008 – .012 in)	
Diameter, crankshaft rod bearing housing bore	84.200 to 84.230 mm (3.3149 to 3.3161 in)	

(1) Measured after force–fitting by reaming
(2) Measure in correspondence of the piston ring working areas, both in parallel and perpendicular to the engine longitudinal axis.

CYLINDER HEAD MAIN DATA

	F 100	F 110 F 120 F 130
Diameter, standard valve guide housings in cylinder head	13.950 to 13.983 mm (.5492 to .5505 in)	
Oversizes, spare valve guides	0.2 mm (.008 in)	
Valve seat dimensions on cylinder head	–	
Valve recess below cylinder head reference plane	0.7 to 1.0 mm (.03 to .04 in)	
Maximum permissible recessing	1,3 mm (.05 in)	
Fuel injector projection above cylinder head reference plane:		
– BOSCH injectors:		
•type 4824164 and 4824170	0.3 to 1.1 mm (.01 to .04 in)	
•type 98413846	0.5 to 1.3 mm (.02 to .05 in)	
• type 98458216 and 98458214	0.1 to 1.1 mm (.004 to .040 in)	

(follows)

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CYLINDER HEAD MAIN DATA

(cont.)

	F 100	F 110 F 120 F 130
Cylinder head original height	92 mm (3.62 in)	
Maximum grinding depth in case of refacing	0.5 mm (.02 in)	

ENGINE CRANKSHAFT AND BEARING MAIN DATA

	F 100	F 110 F 120 F 130
Diameter, standard main bearings	79.791 to 79.810 mm ([1]) (3.1414 to 3.1421 in)	
Undersizes, main bearing diameter	0.254 – 0.508 – 0.762 – 1.016 mm (.010–.020–.030–.040 in)	
Thickness, standard main bearing shells	0.022 to 0.091 mm (.0009 to .0036 in)	
Undersizes, spare main bearing shell inside diameter	0.254 – 0.508 – 0.762 – 1.016	
Running clearance, main bearings and crankshaft journals	0.022 to 0.091	
Wear limit	0.180 mm (.0071 in)	
Diameter, standard connecting rod bearings	63.725 to 63.744 mm ([1]) (2.5088 to 2.5096 in)	
Undersizes, connecting rod bearing diameter	0.254 – 0.508 – 0.762 – 1.016 mm (.010–.020–.030–.040 in)	
Thickness, standard connecting rod bearings	1.805 to 1.815	
Undersizes, spare connecting rod bearing shell inside diameter	0.254 – 0.508 – 0.762 – 1.016	
Running clearance, connecting rod bearings and pins	0.033 to 0.087 mm (.0013 to .0034 in)	
Wear limit	0.180 mm (.0071 in)	
Thickness, engine crankshaft standard thrust washers	3.378 to 3.429 mm (.1330 to .1350 in)	
Oversize, spare thrust washer thickness	0.127 – 0.254 – 0.381 – 0.508 mm (.005–.010–.015–.020 in)	
Width, crankshaft and support with thrust washers	31.766 to 31.918 mm (1.2506 to 1.2566 in)	
Length of associated crankshaft journal	32.000 to 32.100 mm (1.2598 to 1.2638 in)	
Crankshaft and play	0.082 to 0.334 mm (.0032 to .013 in)	
Wear limit	0.40 mm (.016 in)	

(follows)

([1]) On the assembly line, allowance is made for installation of engine crankshafts with main and connecting rod journals 0.1 mm (.0039 in) undersize, mated with associated bearings correspondingly undersized.

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ENGINE CRANKSHAFT AND BEARING MAIN DATA

(cont.)

	F 100	F 110 F 120 F 130
Maximum permissible ovalization or taper on main and connecting rod bearing journals after grinding	0.01 mm (.0004 in)	
Maximum permissible ovalization or taper on main and connecting rod bearing journals consequent to wear	0.05 mm (.0020 in)	
Maximum permissible tolerance on alignment of main bearing journals and crankshaft with the latter supported on the two outer journals	0.10 mm (.0040 in)	
Maximum permissible tolerance on alignment of each pair of connecting rod pins with main bearing journals (in both directions) ..	0.25 mm (.0100 in)	
Tolleranza massima sulla distanza fra superficie esterna perni di biella ed asse albero motore	± 0.10 mm (.0040 in)	
Maximum permissible tolerance on perpendicularity of the flywheel mating flange plane with respect to the engine crankshaft longitudinal axis (measured with a comparator gauge applied frontally, A page 10–64, on a circumference with diameter 2 mm (.08 in) smaller than that of the flange); total comparator reading	0.025 mm (.0010 in)	
Maximum permissible tolerance on the co–axiality of the flywheel mounting seat (B, page 10–64) with respect to the crankshaft main bearing journals; total comparator reading	0.04 mm (.0016 in)	

CONNECTING ROD MAIN DATA

	F 100	F 110 F 120 F 130
Diameter, bearing seat on connecting rod small end	41.846 to 41.884 mm (1.6475 to 1.6490 in)	
Outside diameter, connecting rod small end bearing	41.979 to 42.017 mm (.6527 to 1.6542 in)	
Interference fit, bearing and connecting rod small end	0.095 to 0.171 mm (.0037 to .0067 in)	
Inside diameter, connecting rod small end bearing (after force fitting)	38.004 to 38.014 mm (1.4962 to 1.4966 in)	
Diameter, connecting rod half–bearing housing	67.407 to 67.422 mm (2.6538 to 2.6544 in)	
Tolerance on parallelism between the connecting rod big and small end center lines, checked at 125 mm (4.92 in)	± 0.07 mm (.003 in)	
Maximum permissible weight difference among connecting rods on same engine	25 g (.88 oz) 0.082 to 0.334 mm	

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ENGINE PISTON MAIN DATA

	F 100	F 110 F 120 F 130
Diameter, standard pistons at 12 mm (1/2 inch) from the base of skirt, measured perpendicularly to the pin axis	99.852 to 99.870 mm (3.9312 to 3.9319 in)	103.852 to 103.870 mm (4.0886 to 4.0894 in)
Running clearance of pistons in cylinder liners	0.130 to 0.172 m (.0051 to 0.0068 in)	
Wear limit	0.30 mm (.012 in)	
Oversizes, spare pistons	0.4 to 0.8 mm (.016 to .031 in)	
Projection above crankcase of pistons at T.D.C.	0.355 to 0.761 mm (.0140 to .0300 in)	
Diametro del perno per stantuffo	37.983 to 37.990 mm (1.4954 to 1.4957 in)	
Diametro sedi perno sullo stantuffo	38.000 to 38.006 mm (1.4961 to 1.4963 in)	
Clearance fit, piston pin	0.010 to 0.023 mm (.0004 to .0010 in)	
Clearance fit, piston pin and connecting rod small end bushing	0.014 to 1.031 mm (.0005 to .0406 in)	
Wear limit	0.06 mm (.0024 in)	
Maximum weight difference among pistons on same engine	20 g (.71 oz)	
Assembly clearance of piston rings and seats (vertically):		
– 1st ring, measured on the 97 mm dia. (3.82 in) on model F100 or on the 101mm dia. 3.98 in) on F 110, F 120, F 130	0.105 to 0.155 mm (.0041 to .0061 in)	
– 2nd ring	0.060 to 0.092 mm (1) (.0024 to .0036 in)	
– 3rd ring	0.040 to 0.075 mm (.0016 to .0030 in)	
Wear limit:		
– 1st ring	0.50 mm (.020)	
– 2nd and 3rd rings	0.20 mm (.008 in)	
Assembly end clearance on piston rings installed inside cylinder liners:		
– 1st ring	0.40 to 0.60 (.016 to .025 in)	
– 2nd ring	0.40 to 0.65 mm (.016 to .025 in)	
– 3rd ring	0.30 to 0.60 mm (.012 to .024 in)	
Wear limits	1.20 mm (.047 in)	

(1) Clearance is 0.060 to 0.095 mm (.0024 to .0037 in) on model F100.

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TIMING GEAR MAIN DATA

	F 100	F 110 F 120 F 130
Timing gear tooth backlash	0.160 mm (.0063 in)	
Diameter, idler gear pin	36.975 to 37.000 mm (1.4557 to 1.4567 in)	
Inside diameter, idler gear pin bushings (force–fitted and finished after installation)	37.050 to 37.075 mm (1.4586 to 1.4596 in)	
Clearance fit, pin and bushings	0.050 to 0.100 mm (.0020 to .0040 in)	
Wear limit	0.15 mm (.006 in)	
Interference fit, bushings and idler gear	0.063 to 0.140 mm (.0025 to .0055 in)	

CAMSHAFT MAIN DATA

	F 100	F 110 F 120 F 130
Outside diameter, camshaft bearing bushes:		
– front	55.375 to 55.430 mm (2.1801 to 2.1823 in)	
– intermediate front	54.875 to 54.930 mm (2.1604 to 2.1626 in)	
– intermediate rear	54.375 to 54.430 mm (2.1407 to 2.1429 in)	
– rear	53.875 to 53.930 mm (2.1210 to 2.1232 in)	
Interference fit, bearing bushes in crankcase housings	0.070 to 0.150 mm (.0027 to .0059 in)	
Inside diameter, camshaft bearing bushes (force–fitted and finished after installation):		
– front	51.470 to 51.630 mm (2.0264 to 2.0327 in)	
– intermediate front	51.080 to 51.130 mm (2.0110 to 2.0130 in)	
– intermediate rear	50.580 to 50.630 mm (1.9913 to 1.9933 in	
– rear	50.080 to 50.130 mm (1.9716 to 1.9736 in)	
– Diameter, camshaft journals:		
– front	51.470 to 51.500 mm (2.0264 to 2.0275 in)	
– intermediate front	50.970 to 51.000 mm p73 (2.0067 to 2.0079 in)	
– intermediate rear	50.470 to 50.500 mm (1.9870 to 1.9882 in)	
– rear	49.970 to 50.000 mm (1.9673 to 1.9685 in)	
Clearance fit, journals and bearing bushes	0.080 to 0.160 mm (.0031 to .0063 in)	
Wear limit	0.20 mm (.008 in)	

(follows)

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CAMSHAFT MAIN DATA

(cont.)

	F 100	F 110 F 120 F 130
End play, thrust plate and seat on camshaft	0.070 to 0.220 mm (.0027 to .0087 in)	

VALVE TAPPET MAIN DATA

	F 100	F 110 F 120 F 130
Outside diameter, standard tappets:		
– measured at center	14.950 to 14.970 mm (.5886 to .5894 in)	
– measured on top and base	114.740 to 14.780 mm (.5803 to .5819 in)	
Clearance, tappets and their crankcase housings	0.030 to 0.068 mm (.0012 to .0027 in)	
Wear limit	0.15 mm (.006 in)	
Oversizes, spare valve tappets	0.1–0.2–0.3 mm (.004–.008–.012 in)	

ROCKER ARM MAIN DATA

	F 100	F 110 F 120 F 130
Bore dia., rocker arm carrier axle (in rocker arms)	18.016 to 18.034 mm (.7093 to .7100 in)	
Axle dia., rocker arm carrier	17.982 to 18.000 mm (.7079 to .7087 in)	
Assembly clearance, rocker arm carrier axle and seats.	0.016 to. 0.052 mm (.0006 to .0020 in)	
Wear limit	0.15 mm (.0059 in)	
Rocker arm spacer spring specifications:		
– nominal free length	58 (2.283 in)	
– length under load of 46 to 52 N (4.7 to 5.3 kg or 10.3 to 11.7 lb)	44 (1.732 in)	

VALVE, VALVE GUIDE AND SPRING MAIN DATA

	F 100	F 110 F 120 F 130
Diameter, valve head:		
– intake valve	45,300 to 45,500 (1.7838 to 1.7927 in)	
– exhaust valve	37,500 to 37,750 (1.4775 to 1.4873 in)	
Diameter, valve stem	7,985 to 8,000 (.3135 to .3152 in)	

(follows)

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VALVE, VALVE GUIDE AND SPRING MAIN DATA

(cont.)

	F 100	F 110 F 120 F 130
Inclination angle, valve head working surface:		
– intake valve	60º 30' ± 7'	
– exhaust valve	45º 30' ± 7'	
Clearance, valves and rocker arms, for timing check	0.45 mm (.018 in)	
Clearance, valves and rocker arms, operational (for both cold and warm engine):		
– intake valves	0.30 ± 0.05 (.012 ± .002 in)	
– exhaust valves	0.30 ± 0.05 (.012 ± .002 in)	
Cam lifting stroke:		
– intake valve	5.67 (.223 in)	
– exhaust valve	5.95 (.234 in)	
Outside diameter, standard valve guides	13.993 to 14.016 mm (.5509 to .5518 in)	
Outside dimeter oversize, for spare valve guides	0.2 mm (.008 in)	
Interference fit, valve guides and seats on cylinder head	0.010 to 0.066 (.0004 to .0026 in)	
Inside diameter, valve guides (force–fitted and finished after installation)	8.023 to 8.043 mm (.3159 to .3166 in)	
Clearance fit, valve stems and their guides	0.023 to 0.058 mm (.0009 to .0023 in)	
Wear limit	0.13 mm (.005 in)	
Maximum permissible out–of–center, valve guided on stem through a full turn, with comparator gauge applied centrally on the tightness conical surface	0.03 mm (.001 in)	
Spring specifications, intake and exhaust valves:		
– nominal free length	44.6 mm (1.76 in)	
– length with valve closed, under a load of 256 to 284 N (26.1 to 28.9 kg or 57.5 to 63.7 lb)	34 mm (1.34 in)	
– length with valve open, under a load of 502 to 504 N (51.2 to 56.5 kg or 112.9 to 124.5 lb) (51.2 to 56.5 kg)	23.8 mm (.94 in)	

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LUBRICATION SYSTEM MAIN DATA

	F 100	F 110 F 120 F 130
Oil pump	gear–type, crankshaft driven	
Engine/oil pump r.p.m. ratio	1:1.27	
Normal oil pressure, warm engine running at maximum speed:		
– models F100, F110 and F120	2.9 to 3.9 bar (3 to 4 Kg/cm^2 – 41.2 to 55.5 psi)	
– model F130	6 bar (6.1 kg/cm^2 = 87 psi)	
Diameter, drive gear shaft	17.989 to 18.000 mm (.7082 to .7087 in)	
Inside diameter, drive gear shaft bushings (force–fitted)	18.016 to 18.059 mm ([1]) (.7093 to .7110 in)	
Clearance fit, drive gear shaft and housing	0.016 to 0.070 mm (.0006 to .0027 in)	
Interference fit, bushings in housings	0.023 to 0.091 mm (.0010 to .0036 in)	
Interference fit, driven gear axle and cover housing	0.012 to 0.050 mm (.0005 to .0020 in)	
Diameter, driven gear shaft	14.989 to 15.000 mm (.0590 to .05905 in)	
Inside diameter, force–fitted bushing	15.016 to 15.043 mm (.5912 to .5922 in)	
Clearance, driven gear pin and housing	0.016 to 0.054 mm (.0006 to .0021 in)	
Interference fit, bushings in housings	0.051 to 0.073 mm (.0020 to .0029 in)	
Spring specifications, pressure relief valve (models F100, F110 and F120):		
– free length	45 mm (1.77 in)	
– length under a load of 45 to 49 N (4.6 to 5 Kg or 10.1 to 11 lb)	37.5 mm (1.47 in)	
– length under a load of 88 to 94 N (9 to 9.6 Kg or 20 to 21 lb)	30.5 mm (1.20 in)	
Spring specifications, pressure relief valve (model F130):		
– free length	35.9 mm (1.41 in)	
– length under a load of 127 to 141 N (13 to 14.4 Kg or 28.6 to 31.7 lb)	29 mm (1.14 in)	
– length under a load of 233 to 258 N (23.7 to 26.3 Kg or 52.2 to 58 lb)	23.2 mm (.91 in)	

([1]) Force–fitted bushing, after reaming.

COOLING SYSTEM MAIN DATA

	F 100	F 110 F 120 F 130
Water pump	centrifugal, vane–type	
Speed ratio, engine/water pump r.p.m.	1:1.403	

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COOLING SYSTEM MAIN DATA

(cont.)

	F 100	F 110 F 120 F 130
Interference fit, shaft and water pump impeller	0.017 to 0.059 mm (.0007 to .0023)	
Interference fit, shaft and fan hub	0.024 to 0.058 mm (.0009 to .0023 in)	
Interference fit, front–end seal bushing and impeller	0.012 to 0.058 mm (.0005 to .0023 in)	
Radiator:		
– models F100 and F110	3–row vertical copper tubelets	
– models F120 and F130	4–row, vertical copper tubelets	
Fan:		
– models F100 and F110	aspirating, sheet metal, 4 blades	
– models F120 and F130	aspirating, sheet metal, 6 blades	
Water temperature gauge	colour scales, three sectors	
Temperatures in each sector:		
– starting white sector	30° to 65° C	
– central green sector	65° to 105° C (1) 65° to 110° C (2)	
– final red sector	105° to 115° C (1) 110° to 115° C (2)	

(1) Pre–modification – (2) Post–modification

FUEL SYSTEM MAIN DATA

	F 100	F 110 F 120 F 130
Feed pump	twin–diaphragm	
Drive	actuated by engine timing gear	
Minimum fuel output with drive shaft turning at 1600 r.p.m.	100 l/hr (22 UK or 26.4 US gal)	
Excentricity, drive shaft	3 mm (.12 in)	
Feed pump drive		
Diameter, drive shaft at bearing bushing locations	31.975 to 32.000 mm (1.2588 to 1.2598 in)	
Inside diameter, force–fitted bushings and finished after installation	32.050 to 32.075 (1.2618 to 1.2628 in)	
Clearance fit, shaft and bearing bushings	0.050 to 0.100 mm (.0020 to .0040 in)	
Interference fit, force–fitted bearing bushings	0.063 to 0.140 mm (.0025 to .0055 in)	
Thickness, inner washer	1.45 to 1.50 mm (.057 to .059 in)	
Thickness, outer washer	2.93 to 3.00 mm (.115 to .118 in)	

(follows)

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FUEL SYSTEM MAIN DATA

(cont.)

	F 100	F 110 F 120 F 130
Turbocharger, F 130 model		
– GARRETT type	–	TO – 4B – Y8 /.84E
Injection pump	distributor, integral speed governor and advance device	
BOSCH pump:		
– model F 130	VE 6/11 F 1150 RV 11462 – 98405596	
C.A.V. pump:		
– model F 100	DPS 8521 A 750 A – 98417239 (3) DPS 8524 A 120 A – 98459640 (4)	
– model F 110	DPS 8521 A 760 A – 98417236 (3) DPS 8524 A 130 A – 98459638 (4)	
– model F 120	DPS 8521 A 770 A – 98417238 (3) DPS 8524 A 140 A – 98459639 (4)	
Rotation	clockwise	
Firing order	1 – 5 – 3 – 6 – 2 – 4	
Injectors:		
– BOSCH type	4824164 (3)	4824170 (1) 98413846 (2)
– C.A.V. type	98458216 (4)	98458214 (4)
– nozzle holders type	4791124 (3)	4791124 (3)
– nozzle type	4824165	4824171 (1) 98419045 (2)
Quantity, nozzle holes	n. 4	n. 3
Diameter, nozzle holes	0.31 mm (.012 in)	0.35 mm (.014 in)
Pressure setting	260 to 268 bar (265 to 273 Kg/cm^2 or 3770 to 3886 psi)	
Delivery lines for BOSCH pump (model F 130):		
– type	98412531	
– dimensions	6 x 1.75 x 650 mm (.24 x .07 x 25.59 in)	
Delivery lines for C.A.V. pump (models F 100, F 110 and F 120):		
– type	98420679 (3) 98458220 (4)	
– dimensions	6 x 2.25 x 650 mm (3) (.24 x .09 x 25.59 in) 6 x 2 x 650 mm (4) (.24 x .08 x 25.59 in)	

(1) Models F 110 and F 120 – (2) Model F 130 – (3) Pre–modification – (4) Post–modification.

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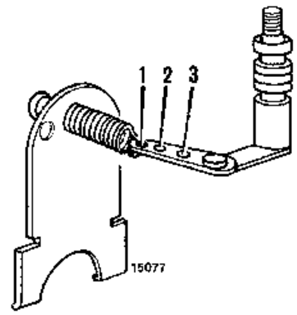
MODEL F100 – CALIBRATION DATA – C.A.V. INJECTION PUMP TYPE DPS 8521 A 750 A – 98417239 (PRE–MODIFICATION)

ASSEMBLY DATA

Pump rotation (drive end) .... clockwise
Firing order 1–5–3–6–2–4
Governor bracket stud to metering valve pin distance .... 40.45 to 41.05 mm (1.59 to 1.62 in)
Pump timing: commencement of delivery 0° ± 1° before T.D.C. in cylinder no.1 on compression stroke.
Flange guide dia .... 50 mm (1.96 in)
Pump delivery connection to cylinder no.1: marked with letter **U.**



Governor spring hole: 3

TEST CONDITIONS

Test machine complying with ISO 4008/1.../2 standards.
Injectors complying with ISO 7440 A11 standards.
Test fluid: ISO 4113 at 42 ± 2°C (108 ± 1.8° F).
Feed pressure: 0.1 bar (Kg/cm^2 – 1.4 psi).
Graduated glass drain time: 30".
Injector pressure setting: 172 to 175 bar (175 to 178 kg/cm^2 – 2483 to 2492 psi).
Fuel lines: 6x2x600 mm (ISO 4093.1 standards).
Set max. delivery adjustment screw to project 9 mm (.354 in) higher than locknut.

Loosen transfer pressure adjustment screw, then tighten 3.5 turns.

Set the latch valve adjustment screw just below the locknut surface.

Loosen maximum speed, idling speed and anti–stall screws.

A 2 mm (.08 in) shim is installed in the advance device, spring end plug; no other shim is required.

Test No.	Throttle lever	Speed rpm	Advance degrees	Transfer pressure bar (kg/cm^2)	Unit delivery cm^3/200 shots	Spread cm^3/200 shots	Excess fuel cm^3/100 shots
1(1)	max	200	–	–	–	–	–
2(2)	max	1150	–	6.4	9.8±0.02(*)	–	–
3	max	100	–	≥ 0.3	–	–	–
4(+)	max	1000	–	–	–	–	–
5(3) – 6	max	1000	4.25 to 4.75(15)	4.0 to 5.4	–	–	–
7	max	1150	5.75 to 6.75(16)	–	–	–	–
8(4)	max	1000	4.25 to 4.75(15)	–	–	–	–
9	max	1150	5.75 to 6.75(16)	–	–	–	–
10 – 11	max	600	–	–	11.1 to 11.3(*)	≤1.2	40 to 80(°)
12(5)	max	1150	–	–	–	–	–
13(6)	max	1260	–	–	4.0 to 4.4	–	–
14(x)	max	1300	–	–	≤1.4	–	–
15(7)	max	1150	–	–	–	–	–
16(8)	max	250	2.75 to 3.75(17)	–	–	–	–
17(9)	max	200	0	–	≥17.0	–	–
18(10)	min	850	–	–	–	–	–
19(11)	min	325	–	–	2 to 2.5	–	–
20(12)	min	325	–	–	≤0.8	–	–
21(13)	min	325	–	–	≤0.5	–	–
22(14)	–	–	–	–	–	–	–

1) Delivery to all injectors.
2) Let pump turn 3'.
3) Adjust pressure setting screw for specified advance, check pressure vs. specs.
4) Stop test machine, disconnect transfer and pump inside pressure gauges, install shut–off device, activate it, start test machine.
5) Measure mean delivery.
6) Adjust max. speed screw and lock it in position.
7) Delivery shall not be less than in test no.10. Allowance: 0.4 cm^3/200 shots less.
8) Prior to tests, run machine to 100 revs then stop it. Tighten latch valve adjusting screw, start machine, loosen screw until obtaining specified values.
9) Prior to tests, run machine to 100 revs, stop and restart machine.
10) Adjust anti–stall screw to deliver 2 to 3 cm^3/2000 shots then lock it in position.
11) Adjust idling speed screw.
12) Shut–off lever closed.
13) With shut–off device de–activated and shut–off lever open, wait 5" before performing test.
14) Connect delivery fitting "U" to injector tester and maintain 55 bar (797 psi) pressure. Use timing tool to bring about hydraulic lockup, then set pump timing plate at 9°.
15) 3.4 to 3.8 mm (.13 to .15 in)
16) 4.6 to 5.4 mm (.18 to .21 in)
17) 2.2 to 3.0 mm (.09 to .12 in)
x) If delivery is more, adjust rod length at minimum (see above).
+) Pump inside pressure as measured with gauge connected at vent screw hole: 0.1 to 0.3 bar (kg/cm^2 – 1.4 to 4.2 psi).
*) Take reading after 15"
°) Flow. 240 to 280 cm^3/min.

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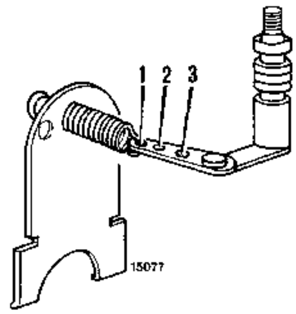
MODEL F110 – CALIBRATION DATA – C.A.V. INJECTION PUMP TYPE DPS 8521 A 760 A – 98417236 (PRE–MODIFICATION)

ASSEMBLY DATA

Pump rotation (drive end) .... clockwise
Firing order 1–5–3–6–2–4
Governor bracket stud to metering valve pin distance .... 40.45 to 41.05 mm (1.59 to 1.62 in)
Pump timing: commencement of delivery 0° ± 1° before T.D.C. in cylinder no.1 on compression stroke.
Flange guide dia .... 50 mm (1.96 in)
Pump delivery connection to cylinder no. 1: marked with letter **U**.



TEST CONDITIONS

Test machine complying with ISO 4008/1.../2 standards.
Injectors complying with ISO 7440 A11 standards.
Test fluid: ISO 4113 at 42 ± 2 °C (108°F ± 1.8°F).
Feed pressure: 0.1 bar (kg/cm^2 – 1.4 psi).
Graduated glass drain time: 30".
Injector pressure setting: 172 to 175 bar (175 to 178 kg/cm^2 – 2483 to 2492 psi).
Fuel lines: 6x2x600 mm (ISO 4093.1 standars).
Set max. delivery adjustment screw projecting 9 mm (.354 in) higher than locknut.

Governor spring hole: 3

Loosen transfer pressure adjustment screw, then tighten 3.5 turns.

Set the latch valve adjustment screw just below locknut surface.

Loosen maximum speed, idling speed and anti–stall screws.

A 2 mm (.08 in) shim is installed in the advance device, spring end plug; no other shim is required.

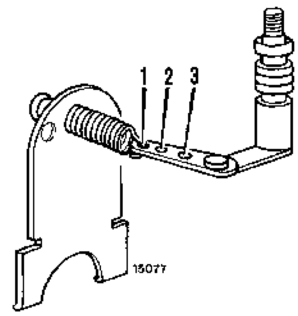
Test No.	Throttle lever	Speed rpm	Advance degrees	Transfer pressure bar (kg/cm^2)	Unit delivery cm^3/200 shots	Spread cm^3/200 shots	Excess fuel cm^3/100 shots
1(1)	max	200	–	–	–	–	–
2(2)		1150	–	6.4	9.8±0.02(*)	–	–
3		100	–	≥ 0.3	–	–	–
4(+)		1000	–	–	–	–	–
5(3) – 6		1000	4.25 to 4.74(15)	4.0 to 5.4	–	–	–
7		1150	5.75 to 6.75(16)	–	–	–	–
8(4)		1000	4.25 to 4.74(15)	–	–	–	–
9		1150	5.75 to 6.75(16)	–	–	–	–
10 –11		600	–	–	12.1 to 12.3(*)	≤1.2	40 to 80(°)
12(19)		1000	4.25 to 4.74(15)	–	–	–	–
13(5)(18)		1150	–	–	10.0 to 10.2(*)	–	–
14(6)		1260	–	–	4.0 to 4.4	–	–
15(x)		1300	–	–	≤1.4	–	–
16(7)		1150	–	–	–	–	–
17(8)		250	2.75 to 3.75(17)	–	–	–	–
18(9)		200	0	–	≥17.0	–	–
19(10)	min	850	–	–	–	–	–
20(11)		325	–	–	2 to 2.5	–	–
21(12)		325	–	–	≤0.8	–	–
22(13)		325	–	–	≤0.5	–	–
23(14)	–	–	–	–	–	–	–

1) Delivery to all injectors.
2) Let pump turn 3'.
3) Adjust pressure setting screw for specified advance. check pressure vs specs.
4) Stop test machine, disconnect transfer and pump inside pressure gauges, install shut–off device, activate it, start test machine.
5) Measure mean delivery.
6) Adjust maximum speed screw and lock it in position.
7) Delivery shall not be less than in test no.10. Allowance: 0.4 cm^3/200 shots less.
8) Prior to tests, run machine to 100 revs then stop it Tighten latch valve adjustment screw. start machine, loosen screw until obtaining specified values.
9) Prior to tests, run machine to 100 revs, stop and restart machine.
10) Adjust anti–stall screw to deliver 2 to 3 cm^3/2000 shots then lock it in position.
11) Adjust idling speed screw.
12) Shut–off lever closed.
13) With shut–off device de–activated and shut–off lever open, wait 5" before performing test.
14) Connect delivery fitting "U" to injector tester and maintain 55 bar (797 psi) pressure Use timing tool to bring about hydraulic lock–up, position pump timing plate at 10°.
15) 3.4 to 3.8 mm (.13 to .15 in)
16) 4.6 to 5.4 mm (.18 to .21 in)
17) 2.2 to 3.0 mm (.09 to .12 in)
18) Adjust the torque check set screw.
19) Adjust it necessary.
x) If delivery is more, adjust rod length at minimum (see above).
+) Pump inside pressure as measured with gauge connected at vent screw hole shall be 0.1 to 0.3 bar (kg/cm^2 – 1.4 to 4.2 psi).
*) Take reading after 15".
°) Flow 240 to 280 cm^3/min.

MODEL F120 – CALIBRATION DATA – C.A.V. INJECTION PUMP TYPE DPS 8521 A 770 A – 98417238 (PRE–MODIFICATION)

ASSEMBLY DATA

Pump rotation (drive end) .... clockwise
Firing order 1–5–3–6–2–4
Governor bracket stud to metering valve pin distance .... 40.45 to 41.05 mm (1.59 to 1.62 in)
Pump timing: commencement of delivery 0° ±1° before T.D.C. in cylinder no. 1 on compression stroke.
Flange guide dia .... 50 mm (1.96 in)
Pump delivery connection to cylinder no.1: marked with letter **U**.



TEST CONDITIONS

Test machine complying with ISO 4008/1.../2 standards.
Injectors complying with ISO 7440 A11 standards.
Test fluid: ISO 4113 at 42 ± 2°C (108° ± 1.8°F).
Feed pressure: 0.1 bar (kg/cm^2 – 1.4 psi).
Graduated glass drain time: 30".
Injector pressure setting: 172 to 175 bar (175 to 178 kg/cm^2 – 2483 to 2492 psi).
Fuel lines: 6x2x600 mm (ISO 4093.1 standars).
Set max. delivery adjustment screw to project 9 mm (.354 in) higher than locknut.

Governor spring hole: 3

Loosen transfer pressure adjustment screw, then tighten 3.5 turns.

Set the latch valve adjustment screw just below locknut surface.

Loosen maximum speed, idling speed and anti–stall screws.

A 2 mm (.08 in) shim is installed in the advance device, spring end plug; no other shim is necessary.

Test No.	Throtthe lever	Speed rpm	Advance degrees	Transfer pressure bar (kg/cm^2)	Unit delivery cm^3/200 shots	Spread cm^3/200 shots	Excess fuel cm^3/100 shots
1(1)	max	200	–	–	–	–	–
2(2)		1150	–	6.4	9.8±0.02(*)	–	–
3		100	–	≥ 0.3	–	–	–
4(+)		1000	–	–	–	–	–
5(3) – 6		1000	4.25 to 4.75(15)	4.0 to 5.4	–	–	–
7		1150	5.75 to 6.75(16)	–	–	–	–
8(4)		1000	4.25 to 4.75(15)	–	–	–	–
9		1150	5.75 to 6.75(16)	–	–	–	–
10 – 11		600	–	–	13.3 to 13.5(*)	–	40 to 80(º)
12(19)		1000	4.25 to 4.75(15)	–	–	–	–
13(5)(18)		1150	–	–	11.4 to 11.6(*)	≤1	–
14(6)		1260	–	–	4.0 to 4.4	–	–
15(X)		1300	–	–	≤1.4	–	–
16(7)		1150	–	–	–	–	–
17(8)		250	2.75 to 3.75(17)	–	–	–	–
18(9)	min	200	0	–	≥17.0	–	–
19(10)		850	–	–	–	–	–
20(11)		325	–	–	2 to 2.5	–	–
21(12)		325	–	–	≤0.8	–	–
22(13)		325	–	–	≤0.5	–	–
23(14)	–	–	–	–	–	–	–

1) Delivery to all injectors.
2) Let pump turn 3'.
3) Adjust pressure setting screw for specified advance, check pressure vs. specs.
4) Stop test machine, disconnect transfer and pump inside pressure gauges. install shut–off device, activate it, start test machine.
5) Measure mean delivery.
6) Adjust max. speed screw and lock it in position.
7) Delivery shall not be less than in test no.12. Allowance: 0.4 cm^3/200 shots less.
8) Prior to tests, run machine to 100 revs then stop it. Tighten latch valve adjustment screw, start machine, loosen screw until obtaining specified values.
9) Prior to tests, run machine to 100 revs, stop and restart machine.
10) Adjust anti–stall screw to deliver 2 to 3 cm^3/2000 shots then lock it in position.
11) Adjust idling speed screw.
12) Shut–off lever closed.
13) With shut–off device deactivated and shut–off lever open, wait 5" before performing test.
14) Connect delivery fitting "U" to injector tester and maintain 55 bar (797 psi) pressure. Use timing tool to bring about hydraulic lockup, set pump timing plate at 10°.
15) 3.4 to 3.8 mm (.13 to .15 in)
16) 4.6 to 5.4 mm (.18 to .21 in)
17) 2.2 to 3.0 mm (.09 to .12 in)
18) Adjust the torque check set screw.
19) Adjust if necessary.
x) If delivery is more adjust rod at minimum (see above).
+) Pump inside pressure as measured with gauge connected at vent screw hole shall be 0.1 to 0.3 bar (kg/cm^2, – 1.4 to 4.2 psi).
*) Take reading after 15".
º) Flow: 240 to 280 cm^3/min.

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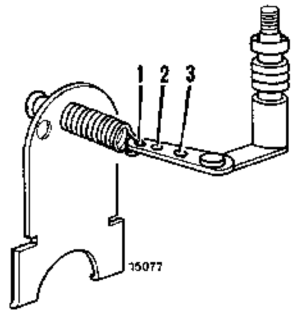
MODEL F 100 – CALIBRATION DATA – C.A.V. INJECTION PUMP TYPE DPS 8524 A 120 A – 98459640 (POST–MODIFICATION)

ASSEMBLY DATA

Pump rotation (drive end) .... clockwise
Firing order 1–5–3–6–2–4
Governor bracket stud to metering valve pin distance .... 40.45 to 41.05 mm (1.59 to 1.62 in)
Pump timing: commencement of delivery 0° ± 1° before T.D.C. in cylinder no. 1 on compression stroke.
Flange guide dia .... 50 mm (1.96 in)
Pump delivery connection to cylinder no. 1 marked with letter **U**.



Governor spring hole: 2

TEST CONDITIONS

Test machine complying with ISO 4008/1.../2 standards.
Injectors complying with ISO 7440 A11 standards.
Test fluid: ISO 4113 at 42 ± 2°C (108°F ± 1.8°F).
Feed pressure: 0.1 bar (kg/cm^2 – 1.4 psi).
Graduated glasse drain time: 30".
Injector pressure setting: 172 to 175 bar (175 to 178 kg/cm^2 – 2483 to 2492 psi).
Fuel lines: 6x2x600 mm (ISO 4093.1 standards).
Set max. delivery adjustment screw to project 9 mm (.354 in) higher than locknut.

Loosen transfer pressure adjustment screw, then tighten 3.5 turns.

Set the latch valve adjustment screw just below locknut surface.

Loosen maximum speed, idling speed and anti–stall screws.

A 2 mm (.08 in) shim is installed in the advance device, spring end plug; no other shim is necessary.

Test No.	Throttle lever	Speed rpm	Advance degrees	Transfer pressure bar (kg/cm^2)	Unit delivery cm^3/200 shots	Spread cm^3/200 shots	Excess fuel cm^3/100 shots
1(1)	max	200	–	–	–	–	–
2(2)		1150	–	6.4	9.8±0.02(*)	–	–
3		100	–	≥ 0.3	–	–	–
4(+)		1000	–	–	–	–	–
5(3) – 6		1000	4.25 to 4.75(15)	4.4 to 5.6	–	–	–
7		1150	5.75 to 6.75(16)	–	–	–	–
8(4) (18)		1000	4.25 to 4.75(15)	–	–	–	–
9		1150	5.80 to 6.70	–	–	–	–
10 – 11		600	–	–	11.5 to 11.7(*)	≤1.2	40 to 80(°)
12(5)		1150	–	–	–	–	–
13(6)		1260	–	–	4.0 to 4.4	–	–
14(x)		1300	–	–	≤1.4	–	–
15(7)		1150	–	–	–	–	–
16(8)		250	2.75 to 3.75(17)	–	–	–	–
17(9)		200	0	–	≥17.0	–	–
18(10)	min	850	–	–	–	–	–
19(11)		325	–	–	2 to 2.5	–	–
20(12)		325	–	–	≤0.8	–	–
21(13)		325	–	–	≤0.5	–	–
22(14)	–	–	–	–	–	–	–

1) Delivery to all injectors.
2) Let pump turn 3'.
3) Adjust pressure setting screw for specified advance, check pressure vs. specifications.
4) Stop test machine, disconnect transfer and pump inside pressure gauges, install shut–off device. activate it, start test machine.
5) Measure mean delivery.
6) Adjust max. speed screw and lock it in position.
7) Delivery shall not be less than in test no 12. Allowance: 0.4 cm^3/200 shots less.La portata non deve essere inferiore alla prova n. 12. Accettabile 0,4 cm ^{3}/200 mandate in meno.
8) Prior to tests. run machine to 100 revs and stop it. Tighten latch valve adjustment screw, start machine, loosen screw until obtaining specified values.
9) Prior to tests, run machine to 100 revs, stop and restart p73 machine.
10) Adjust anti–stall screw to deliver 2 to 3 cm^3/2000 shots then lock it.
11) Adjust idling speed screw.
12) Shut–off lever closed.
13) With shut–off device de–activated and shut–off lever open, wait 5" before performing test.
14) Connect delivery fitting "U" to injector tester and maintain 55 bar (797 psi) pressure. Use timing tool to bring about hydraulic lockup, set pump timing plate at 10°.
15) 3.4 to 3.8 mm (.13 to .15 in)
16) 4.6 to 5.4 mm (.18 to .21 in)
17) 2.2 to 3.0 mm (.09 to .12 in)
18) Adjust if necessary.
x) If delivery is more, adjust rod length at minimum (see above).
+) Pump inside pressure as measured with gauge connected at vent screw hole: 0.1 to 0.3 bar (kg/cm^2 – 1.4 to 4.2 psi)
*) Take reading after 15".

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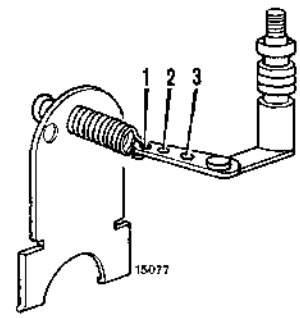
MODEL F 110 – CALIBRATION DATA – C.A.V. INJECTION PUMP TYPE DPS 8524 A 130 A – 98459638 (POST–MODIFICATION)

ASSEMBLY DATA

Pump rotation (drive end) .... clockwise
Firing order .... 1 – 5 – 3 – 6 – 2 – 4
Governor bracket stud to metering valve pin distance .... 40.45 to 41.05 mm (1.59 to 1.62 in)
Pump timing: commencement of delivery 0° ± 1° before T.D.C. in cylinder no.1 on compression stroke.
Flange guide dia .... 50 mm (1.96 in)
Pump delivery connection to cylinder no. 1 marked with letter **U**.



Governor spring hole: 2

TEST CONDITIONS

Test machine complying with ISO 4008/1.../2 standards.
Injectors complying with ISO 7440 A11 standards.
Test fluid: ISO 4113 at 42 ± 2°C (108°F ± 1.8°F).
Feed pressure: 0.1 bar (kg/cm^2 – 1.4 psi).
Graduated glass drain time: 30".
Injector pressure setting: 172 to 175 bar (175 to 178 kg/cm^2 – 2483 to 2492 psi).
Fuel lines: 6x2x600 mm (ISO 4093.1 standards).
Set max. delivery adjustment screw to project 9 mm (.354 in) higher than locknut.

Loosen transfer pressure adjustment screw, then tighten 3.5 turns.

Set the latch valve adjustment screw just below locknut surface.

Loosen maximum speed, idlinge speed and anti–stall screws.

A 2 mm (.08 in) shim is installed in the advance device, spring end plug; no more shim is necessary.

Test No.	Throttle lever	Speed rpm	Advance degrees	Transfer pressure bar (kg/cm^2)	Unit delivery cm^3/200 shots	Spread cm^3/200 shots	Excess fuel cm^3/100 shots
1(1)		200	–	–	–	–	–
2(2)		1150	–	6.4	9.8±0.02(*)	–	–
3		100	–	≥ 0.3	–	–	–
4(+)		1000	–	–	–	–	–
5(3) – 6		1000	3.75 to 4.25	4.4 to 5.6	–	–	–
7		1150	5.75 to 6.75(16)	–	–	–	–
8(4) (18)		1000	3.75 to 4.25	–	–	–	–
9	max	1150	5.80 to 6.70	–	–	–	–
10 – 11		600	–	–	12.3 to 12.5(*)	≤1.2	40 to 80(°)
12(5)		1150	–	–	–	–	–
13(6)		1260	–	–	4.0 to 4.4	–	–
14(x)		1300	–	–	≤1.4	–	–
15(7)		1150	–	–	–	–	–
16(8)		250	2.75 to 3.75(17)	–	–	–	–
17(9)		200	0	–	≥17.0	–	–
18(10)		850	–	–	–	–	–
19(11)	min	325	–	–	2 to 2.5	–	–
20(12)		325	–	–	≤0.8	–	–
21(13)		325	–	–	≤0.5	–	–
22(14)	–	–	–	–	–	–	–

1) Delivery to all injectors.
2) Let pump turn 3'.
3) Adjust pressure setting screw for specified advance, check pressure vs. specifications.
4) Stop test machine, disconnect transfer and pump inside pressure gauges, install shut-off device and activate it, start test machine.
5) Measure mean delivery.
6) Adjust max. speed screw and lock it in position.
7) Delivery shall not be less than in test no.12. Allowance: 0.4 cm^3/200 shots less
8) Prior to tests, run machine to 100 revs then stop it. Tighten latch valve adjustment screw, start machine, loosen screw until obtaining specified values.
9) Prior to tests, run machine to 100 revs then stop and re–start machine.
10) Adjust anti–stall screw to deliver of 2 to 3 cm^3/2000 shots then lock it in position.
11) Adjust idling speed screw.
12) Shut–off lever closed.
13) With shut–off device de–activated and shut–off lever open, wait 5" before performing test.
14) Connect delivery fitting "U" to injector tester and maintain 55 bar (797 psi) pressure. Using timing tool to bring about hydraulic lockup, set pump timing plate at 10.5°.
16) 4.6 to 5.4 mm (.18 to .21 in)
17) 2.2 to 3.0 mm (.09 to .12 in)
18) Adjust if necessary.
x) If delivery is more, adjust rod length at minimum (see above).
+) Pump inside pressure as measured with gauge connected at vent screw hole: 0.1 to 0.3 bar (kg/cm^2 – 1.4 to 4.2 psi).
*) Take reading after 15"

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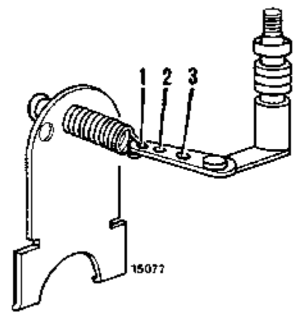
MODEL F 120 – CALIBRATION DATA – C.A.V. INJECTION PUMP TYPE DPS 8524 A 140 A – 98459639 (POST–MODIFICATION)

ASSEMBLY DATA

Pump rotation (drive end) .... clockwise
Firing order 1–5–3–6–2–4
Governor bracket stud to metering valve pin distance .... 40.45 to 41.05 mm (1.59 to 1.62 in).
Pump timimg: commencement of delivery 0° ± 1° before T.D.C. in cylinder no. 1 on compression stroke.
Flange guide dia .... 50 mm (1.96 in)
Pump delivery connection to cylinder no. 1 marked with letter **U**.



Governor spring hole: 2

TEST CONDITIONS

Test machine complying with ISO 4008/1.../2 standards.
Injectors complying with ISO 7440 A11 standards.
Test fluid: ISO 4113 at 42 ± 2°C (108°F ± 1.8°F).
Feed pressure: 0.1 bar (kg/cm^2 – 1.4 psi).
Graduated glass drain time: 30".
Injector pressure setting: 172 to 175 bar (175 to 178 kg/cm^2 – 2483 to 2492 psi).
Fuel lines: 6x2x600 mm (ISO 4093.1 standards).
Set max. delivery adjustment screw projecting 9 mm (.354 in) higher than locknut.

Loosen transfer pressure adjustment screw, then tighten 3.5 turns.

Set the latch valve adjustment screw just below locknut surface.

Loosen maximum, minimum and anti–stall screws.

A 2mm (.08 in) shim is installed in the advance device, spring end plug; no other shim is necessary.

Test No.	Throttle lever	Speed rpm	Advance degrees	Transfer pressure bar (kg/cm^2)	Unit delivery cm^3/200 shots	Spread cm^3/200 shots	Excess fuel cm^3/100 shots
1(1)		200	–	–	–	–	–
2(2)		1150	–	6.4	9.8±0.02(*)	–	–
3		100	–	≥ 0.3	–	–	–
4(+)		1000	–	–	–	–	–
5(3) – 6		1000	3.75 to 4.25	4.4 to 5.6	–	–	–
7		1150	5.75 to 6.75(16)	–	–	–	–
8(4) (18)		1000	3.75 to 4.25	–	–	–	–
9	max	1150	5.80 to 6.70	–	–	–	–
10 – 11		600	–	–	13.3 to 13.5(*)	≤1.2	40 to 80(°)
12(5)		1150	–	–	–	–	–
13(6)		1260	–	–	4.0 to 4.4	–	–
14(x)		1300	–	–	≤1.4	–	–
15(7)		1150	–	–	–	–	–
16(8)		250	2.75 to 3.75(17)	–	–	–	–
17(9)		200	0	–	≥17.0	–	–
18(10)		850	–	–	–	–	–
19(11)	min	325	–	–	2 to 2.5	–	–
20(12)		325	–	–	≤0.8	–	–
21(13)		325	–	–	≤0.5	–	–
22(14)	–	–	–	–	–	–	–

1) Delivery to all injectors.
2) Let pump turn 3'.
3) Adjust pressure setting screw for specified advance, check pressure vs. specifications.
4) Stop test machine. disconnect transfer and pump inside pressure gauges. install shut–off device. activate it, stop test machine.
5) Measure mean delivery.
6) Adjust max speed screw and lock it in position.
7) Delivery shall not be less than in test no.12. Allowance: 0.4 cm^3/200 shots less.
8) Prior to tests. run machine to 100 revs then stop it. Tighten latch valve adjusting screw, start machine. loosen screw until obtaining specified values.
9) Prior to tests, run machine to 100 revs, stop and re–start.
10) Adjust anti–stall screw to deliver 2 to 3 cm^3/2000 shots. lock it in position.
11) Adjust idling speed screw.
12) Shut–off lever closed.
13) With shut–off device de–activated and shut–off lever open, wait 5" before performing test.
14) Connect delivery fitting "U" to injector tester and maintain 55 bar (797 psi) pressure, use timing tool to bring about hydraulic lockup then set pump timing plate at 11°.
16) 4.6 to 5.4 mm (.18 to .21 in)
17) 2.2 to 3.0 mm (.09 to .12 in)
18) Adjust if necessary.
x) If delivery is more, adjust rod length at minimum (see above)
+) Pump inside pressure as measured with gauge connected at vent screw hole: 0.1 to 0 3 bar (kg/cm^2 – 1.4 to 4.2 psi)
*) Take reading after 15".

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MODEL F130 Turbo – CALIBRATION DATA – BOSCH PUMP TYPE VE 6/11 F 1150 R 394 – 98405596

ASSEMBLY DATA

Pump timing: commencement of delivery 8° ± 1° before T.D.C. in cylinder no. 1 on compression stroke.
Pre–lifting of pumping element for timing the pump on engine: 1 mm (.039 in) from B.D.C. (w/ special tools **291754** – **291755**).
Pump delivery connection to cylinder No. 1: marked with letter A.

ASSEMBLY DIMENSIONS

SYMBOLS	K	KF	MS
mm (in)	3.30 (.130)	5.30 (.209)	1.10 (.043)

TEST CONDITIONS

Test machine complying with ISO 4008/1.../2 standards.
Injectors complying with ISO 7440–A61 standards – (1688901020 w/button 1680103096).
Injector pressure setting: 172 to 175 bar (175 to 178 kg/cm^2 – 2483 to 2492 psi).
Feed pressure: 0.35 bar (Kg/cm^2 – 5.0 psi).
Fuel lines: (ISO 4093.2): (1680750017) 6x2x840 mm
Graduated glass drain time: 30 sec.
Test fluid: ISO 4113 at 40° ± 2°C.

1. COMMENCEMENT OF DELIVERY

Pre–lifting of pumping element from B.D.C.: 0 ± 0.02 mm (.0008 in)	Pump rotation (drive end): clockwise	Firing order: 1–5–3–6–2–4

2. ADVANCE DEVICE STROKE

Rpm: 700	LDA pressure: 100 kPa	Advance stroke: 1.7 to 2.1 mm (.067 to .082 in)

3. FEED PUMP PRESSURE

Rpm: 700	LDA pressure: 100 kPa	Inside feed pressure: 4.0 to 4.6 bar

4. FULL–LOAD DELIVERY

Rpm: 1000	LDA pressure: 100 kPa	Delivery/1000 shots: 83.5 to 84.5 cm^3	Spread: cm^3 ≤ 3.0

5. FULL–LOAD DELIVERY

Rpm: 500	LDA pressure: 0 kPa	Delivery/1000 shots: 74.5 to 75.5 cm^3	Spread: – cm^3

6. GOVERNOR SPREAD CURVE AT IDLING

Rpm: 325	LDA pressure: kPa	Delivery/1000 shots: 16 to 20 cm^3	Spread: cm^3 ≤ 3.0

7. GOVERNOR SPREAD CURVE AT MAX SPEED

Rpm: 1260	LDA pressure: 100 kPa	Delivery/1000 shots: 37 to 43 cm^3	Spread: – cm^3

8. DELIVERY AT IDLING SPEED

Rpm: 100	Delivery/1000 shots: 90 to 120

9. TRANSFER PRESSURE

LDA pressure	kPa	100		
Rpm		700	550	1000
Inside feed pressure	bar	4.0 to 4.6	3.2 to 3.8	5.2 to 5.8

10. ADVANCE

LDA pressure	kPa	100		
Rpm		700	550	1000
Advance stroke	mm	1.7 to 2.1	0.8 to 1.6	2.9 to 3.7

11. EXCESS FUEL BACK FLOW

Rpm		500	1150
LDA pressure	kPa	0	100
Back leakage	cm^3	41 to 83 (26 to 98)	55 to 138 (40 to 153)

(follows)

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(cont.)

12. DELIVERIES

Rpm	LDA pressure, kPa	Delivery/1000 shots: cm^3
500	35 (*)	79.5 to 80.5
1300	100	0 to 0.5
1260	100	37 to 43
1150	100	80 to 83
650	100	86 to 90
500	100	84 to 88

13. DELIVERY CHECK AT LOW IDLING SPEED

Rpm	325	250	400
Delivery/1000 shots: cm^3	16 to 20	32 to 36	0 to 2.0

(*) Act on LDA spring pre–load adjusting ringnut. LDA stroke: 4.7 to 5.7 mm (.18 to .22 in).

ENGINE PERFORMANCE – DYNAMOMETER BRAKE TEST DATA

Test conditions

Engine without fan, air cleaner and exhaust muffler.

Atmospheric pressure: 740 ± 5 mm Hg at 239 meters (785 ft.) above sea level.

Ambient temperature: 20 ± 3°C.

Relative humidity: 70% ± 5.

Specific weight of diesel fuel: 830 ± 10 grams/liter.

Fixed advance before T.D.C. of cylinder No.1 on compression stroke:

– model F 100, C.A.V. pump . . . . 0° ± 1°
– model F 110, C.A.V. pump . . . . 0° ± 1°
– model F 120, C.A.V. pump . . . . 0° ± 1°
– model F 130, BOSCH pump . . . . 8° ± 1°

MODEL F 100 – C.A.V. INJECTION PUMP

Throttle	Engine braking load	Engine speed rpm	Power output w/ engine running–in time of: 2–hour total kW (metric HP)	50–hour total kW (metric HP)	Fuel consumption kg/hr
Max	For maximum power output	2300	≥ 70 (95)	72 to 74.6 (98 to 101.5)	16.2 to 16.8
Max	For maximum torque output	1400	≥ 47.8 (65)	50.6 to 54.3 (68.8 to 73.8)	11.0 to 11.8
Max	No–load	2500 to 2550	–	–	–
Min	No–load	625 to 675	–	–	–

MODEL F 110 – C.A.V. INJECTION PUMP

Throttle	Engine braking load	Engine speed rpm	Power output w/ engine running–in time of: 2–hour total kW (metric HP)	50–hour total kW (metric HP)	Fuel consumption kg/hr
Max	For maximum power output	2300	≥ 76.5 (104)	79 to 81.6 (107.5 to 111)	17.7 to 18.3
Max	For maximum torque output	1400	≥ 53 (72)	55.4 to 58.8 (75.3 to 80)	12.0 to 12.8
Max	No–load	2500 to 2550	–	–	–
Min	No–load	625 to 675	–	–	–

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MODEL F 120 – C.A.V. INJECTION PUMP

Throttle	Engine breaking load	Engine speed rpm	Power output w/ engine running time of: 2–hour total	50–hour total kW (metric HP)	Fuel consumption kg/hr
Max	For maximum poswer output	2300	≥ 83.2 (113)	85.6 to 88.2 (116.5 to 120)	19.2 to 19.8
Max	For maximum torque output	1400	≥ 57.4 (78)	59.6 to 63.4 (81.1 to 86.3)	12.8 to 13.8
Max	N0–load	2500 to 2550	–	–	–
Min	N0–load	625 to 675	–	–	–

MODEL F 130 – BOSCH INJECTION PUMP

Throttle	Engine braking load	Engine speed rpm	Power output w/ engine runningin time of: 2–hour total kW (metric HP)	50–hour total kW (metric HP)	Fuel consumption kg/hr
Max	For maximum power output	2300	≥ 92 (125)	94.5 to 97.5 ([1]) (128.5 to 132.5)	21.1 to 21.7
Max	For maximum torque output	1300	≥ 62.6 (85)	64 to 68.4 ([2]) (87 to 93)	14 to 14.8
Max	No–load	2500 to 2550	–	–	–
Min	N0–load	625 to 675	–	–	–

([1]) Air outlet pressure bar (kg/cm^2): 0.73 to 0.79 – ([2]) Air outlet pressure bar (kg/cm^2): 0.43 to 0.49.

SERVICE TOOLS

Attention – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code **(X).** Besides, to work safely and achieve the best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjunction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

List of the special tools necessary to perform service operations covered by this section of the Manual:

	292320	Tractor splitting stand.
	292888	Dowel pins, clutch–transmission case and engine alignment.
	293542	Adapter, front support screws.
	290740/1	Hook, engine lifting.
	290090	Revolving floor stand, engine overhauling.
	293860	Bracket set (use w/ **290090**)
X	**291309/1**	Tester, compression, complete (w/ false injector **293862**).
	296118	Wrench, belt tension check.
	293240	Check set, turbocharger.
	292870	Check set, lube oil pressure.
X	**293270**	Reconditioning set, injector seats, w/:
		292240 Tap (M12x1.75), injector sleeve.
		292243 Clean–up tool, for injector sleeve seat in cylinder head.
		293784 Puller, injector sleeve.
		293861 Burnisher, injector sleeve.
		293746/1 Pilot bushing.
		293747 Reamer.
		293790/1 Grinder.
X	**292248**	Graduated device, angular tightening (**99395202 IVECO**).
	294006	Universal lathe, valve seats.
X	**293814/1**	Retaining block, turbocharger impeller (model F 130).
	292307	Pliers, turbocharger impeller bearing circlips (model F 130).
X	**291046/1**	Remover–replacer tool, engine valve guides.

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X **291177** Reamer, valve guides (**99390310 IVECO**).

X **293231** Pilot bushing, intake/exhaust valve installation(w/ **291046/1**) (**99360923 IVECO**).

290064 Valve grinder, compressed air.

X **291050** Remover–installer tool, valve springs (**99360357 IVECO**).

X **291883** Wrench, valve clearance adjustment (**99350108 IVECO**).

X **293329** Installer, crankshaft front seal (w/ **293709**)

X **293709** Grab (**99360365 IVECO**).

X **293299** Installer, crankshaft rear seal (w/ **293708**) (**99360365 IVECO**).

X **293708** Grab (**99370006 IVECO**).

X **291504** Puller, crankshaft pulley hub.

X **291160** Pliers, piston rings (**99360183 IVECO**).

X **291048** Compressor, piston rings (**9930605 IVECO**).

293273 Lifting hook, crankshaft (**9930500 IVECO**).

293780 Hand pump, injector pressure test.

293671 Kit, nozzle cleaner.

X **293760** Support, injector removal–replacement (BOSCH–CAV– OMAP).

X **293761** Wrench set, injector removal–replacement.

293786 Wrench, injection pump delivery connections.

293830 Adapter, injector removal (w/ **292297**).

X **291182/1** Puller, water pump impeller.

X **293280** Seal remover–replacer.

On–bench injector pump test

292131 Splined coupling, bench test.

292133 Coupling, bench test.

290239 Adapter, pump overhauling.

290756 Coupling, bench test.

290765 Delivery lines to injectors (6x2x850 mm).

290752 Supporting plate, pump.

293149 Test bench, injection pumps.

292197 Comparator gauge, (1/100 mm, 30 mm stroke, 60 mm dia.) (model F 130).

291754 Comparator gauge, (1/100 mm, 5 mm stroke, 40 mm dia.) (model F 130).

X **291755** Measuring device, injection pump installation on engine.

293401 Test kit, injection pumps (installed on tractor).

BOSCH distributor type pump

292137 Wrench, splined hub.

292173 Puller, splined hub.

X **290664** Cup, vane–type pump rotor removal–installation.

X **290774** Stroke measuring device, distributor piston.

X **290779** Installer, O–ring seal.

X **290780** Hook, O–ring seal removal.

X **292548** (Bushing)–ring seal installation.

X **291750** Extension, M8x1 thread (w/ **290774**).

X **292553** Puller, split pin, pressure control valve.

X **292554** Protection, roller ring.

X **292555/1** Remover–installer, pump shaft.

X **292557/1** Compressor, pressure control valve adjustment.

X **291747** Wrench, governor shaft installer/adjuster.

X **291748** Wrench, pumping element access plug.

X **291752** Spacer, starting excess fuel stroke measurement.

X **291912** Wrench, governor support triangular–head screw.

X **292139** Bushing, o–ring installation.

X **291751** Advance checking device.

292197 Comparator gauge, (1/100 mm, 30 mm stroke, 60 mm dia).

X **292239** Bushing, o–ring installation.

X **291749** Wrench, pressure control valve.

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X 292823 Wrench, injection pump screws.

C.A.V. distributor type pump

290741 Remover, throttle pin.

X 290744 Remover–installer, vane–type pump (to be used in conjonction w/ a torque wrench).

X 290745 Guide, o–ring installation on advance device fuel cut–off.

290746 Guide, o–ring installation on advance variator plugs.

X 290757 Graduated tool, pump timing on flange.

X 290758 Bushing, removal–installation of eccentric ring drive pin.

X 292249 Advance degrees tester (with pins).

X 292251 Imprinted wrench (TORX 15).

X 292252 Imprinted wrench (TORX 20).

X 292253 Imprinted wrench (TORX 25).

X 292254 Guide, drive shaft seal installation.

X 292822 Wrench, hydraulic head securing screw.

X 293403 Pressure gauge, 0 to 1.5 bar (of kit **293401**), (w/ **292439**).

X 293405 Flex (of kit **293401**).

X 292411 Timing pin.

X 292414 Adjuster, fuel transfer pressure.

X 292415 Connections, fuel delivery/return

292439 Connection, pump body pressure check (w/ **293403**, **293405** of kit **293401**).

X 292440 Plug, pump fluid tightness check (w/ **292249**).

X 290742 Installation guide, throttle and stop pin lower seal rings.

290755 Pressure limiter, external timing (w/ **290284**).

X 292397 Connection, fuel transfer pressure.

ENGINE TROUBLE–SHOOTING CHART

Fault	Diagnosis	Correction
Engine fails to start.	**1.** Partially discharged batteries.	Check, recharge batteries or replace them if necessary.
	2. Slack or corroded battery terminal connections.	Clean, check, tighten nuts and, if necessary, replace battery terminals and heavily corroded nuts.
	3. Empty fuel tank.	Refuel.
	4. Accumulation of water and/or foreign matter inside fuel lines.	Remove fuel lines, injection pump and clean them thoroughly; if necessary, clean and dry the fuel tank.
	5. Air inside fuel system.	Inspect fuel lines and connections, feed pump, filters and injection pump for presence of air inside the system; finally, bleed it.
	6. Injection pump starved.	Check and, if necessary, replace fuel lift pump.
	7. Wrong timing of injection pump installed.	Time injection pump correctly..
	8. Damaged starter motor.	Repair or replace starter motor.
	9. Faulty thermostarter.	Check or replace thermostarter.
Engine stops.	**1.** Clogged fuel filters.	Replace fuel cartridges.
	2. Air inside fuel system.	Inspect fuel lines and connections, feed pump, filters and injection pump for presence of air inside the system; finally, bleed it.
	3. Damaged injection pump controls.	Replace any damaged part.

(follows)

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ENGINE TROUBLE–SHOOTING CHART

(cont.)

Fault	Diagnosis	Correction
	4. Idling speed too low.	Adjust low idling speed.
	5. Accumulation of impurities or water inside fuel lines.	Remove fuel lines, injection pump, clean them thoroughly; if necessary, clean and dry fuel tank.
	6. Wrong valve/rocker arm clearance.	Adjust valve/rocker arm clearance.
	7. Burnt or cracked valves.	Replace valves.
	8. Erratic injection pump deliveries.	Check deliveries on test machine.
Engine overheats.	**1.** Air cleaner clogged up.	Clean complete unit; if necessary, replace filtering element.
	2. Cooling fluid (insufficient quantity).	Top up coolant level in expansion chamber using the prescribed type of fluid.
	3. Insufficient tension of the fan and centrifugal pump drive belt.	Check and adjust belt tension.
	4. Thermostat inefficient.	Replace thermostat.
	5. Inefficient cooling plant centrifugal pump.	Overhaul pump; if necessary, replace it.
	6. Partially inefficient radiator.	Wash out any incrustation, find and repair any leak point on tubelets.
	7. Encrusted cooling fluid ducts and passages in crankcase and cylinder head.	Wash thoroughly.
	8. Wrong engine timing.	Check engine, time it correctly.
	9. Wrong injection pump setting, in excess or in defect.	Calibrate injection pump on test machine according to specification charts.
Engine lack of power and erratic operation.	**1.** Air cleaner clogged up.	Clean complete unit; if necessary, replace filtering element.
	2. Damaged or partially closed injectors.	Clean, overhaul and pressure set injectors.
	3. Accumulation of impurities or water inside fuel lines.	Remove fuel line, injection pump and clean them thoroughly; if necessary, clean and dry fuel tank.
	4. Wrong valve/rocker arm clearance.	Adjust valve/rocker arm clearance.
	5. Misadjusted length of throttle/injection pump tie–rod.	Adjust rod length.
	6. Damaged fuel lift pump.	Replace fuel lift pump.
	7. Injection pump with misadjusted max speed regulation screw.	Adjust max speed screw.
	8. Wrong pump/engine timing.	Correct injection pump/engine timing.

(follows)

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ENGINE TROUBLE–SHOOTING CHART

(cont.)

Fault	Diagnosis	Correction
	9. Damaged injection pump automatic advance device.	Overhaul injection pump and calibrate it on test machine according to specification data charts
	10. Erratic injection pump deliveries.	Overhaul injection pump and calibrate on test machine according to specification data charts.
	11. Worn distributor pin.	Overhaul injection pump and calibrate it on test machine according to specification data charts.
	12. Damaged all–speed governor.	Overhaul injection pump and calibrate it on test machine according to specification data charts.
	13. Low compression in cylinders.	Check compression; if necessary, recondition engine.
Unusual engine pinging or knocking noise.	**1.** Damaged or partially closed injectors.	Clean, overhaul and pressure set injectors.
	2. Accumulation of foreign matter in fuel lines.	Clean fuel lines and replace those with heavy dents; if necessary, clean injection pump.
	3. Wrong injection pump/engine timing.	Correct injection pump/engine timing.
	4. Crankshaft pinging noise due to excessive clearance of one or more main or connecting rod bearings, or to excessive end play.	Grind crankshaft pins, install oversize bearings and thrust washers.
	5. Unbalanced crankshaft.	Check crankshaft alignment and balancing; if necessary, replace it.
	6. Slack flywheel bolts.	Replace slack screws and tighten all screws to torque + angle specifications.
	7. Connecting rod misalignment.	Straighten connecting rods, check axis alignment; if necessary, replace connecting rods.
	8. Piston pinging noise caused by wear.	Bore cylinder liners and install oversize pistons.
	9. Noisy piston pins caused by excessive clearance in piston bosses and connecting rod bushing.	Replace piston pin with an oversized one, ream piston boss seats and connecting rod bushings. Renew bushings.
	10. Clicking caused by noisy valve timing.	Check for broken springs, excessive valve stem/guide, tappet/seat clearance; adjust valve/rocker arm clearance.
Abnormal engine smoking: black or dark grey smoke.	**1.** Air cleaner clogged up.	Clean complete unit; if necessary, replace filtering element.
	2. Partially and/or totally closed injectors, wrong pressure setting.	Clean, overhaul, pressure set injectors; if necessary, replace them.
	3. Excessive injection pump max output.	Calibrate injection pump on test machine according to specification data charts.

(follows)

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ENGINE TROUBLE–SHOOTING CHART

(cont.)

Fault	Diagnosis	Correction
	4. Too retarded injection pump or damaged automatic advance device.	Correct injection pump/engine timing or check automatic advance device.
	5. Too advanced injection pump.	Correct injection pump/engine timing.
	6. Loss of engine compression due to: – stuck piston rings; – cylinder liner wear; – deteriorated or misadjusted valves.	Replace damaged parts; if necessary, recondition engine.
	7. Damaged fuel injection pressure lines.	Verify piping conditions; if necessary, replace them.
Blue, blue–grey or grey–to–white colour smoke.	**1.** Stuck or defective injectors.	Clean, overhaul, pressure set injectors; if necessary, replace them.
	2. Engine will not reach operating temperature (damaged thermostat).	Replace thermostat.
	3. Too retarded injection pump or damaged automatic advance device.	Correct injection pump/engine timing or check automatic advance device.
	4. Oil leakage past piston rings because of stuck rings or cylinder liner wear.	Replace damaged parts; if necessary, recondition engine.
	5. Oil leakage past intake valve guides because of valve guide or stem wear.	Overhaul cylinder head.
Engine will not stop.	**1.** Damaged shut–off solenoid.	Replace solenoid.
	2. Damaged all–speed governor.	Overhaul injection pump and calibrate it on test machine according to specification data charts.

ANGULAR TORQUE DATA

Note – For torque tightening procedure see pages quoted in following data chart.

DESCRIPTION	Thread size	Torque			Angle
		Nm	kgm	ft. lb	
Capscrews, cylinder head (6, page 10–53)	M 12 x 1.25	70	7.1	51.3	90° + 90°
Capscrews, main bearibg caps (1, page 10–51)	M 14 x 1.5	80	8.2	59.3	90°
Capscrews, connecting rods (3, page 10–52)	M 11 x 1.5	40	4.1	29.6	60°
Capscrews, engine flywheel (7, page 10–51)	M 12 x 1.25	40	4.1	29.6	60°

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TORQUE DATA

DESCRIPTION	Thread size	Torque		
		Nm	kgm	ft. lb
Capscrews, crankcase rear cover (4, page 10–51)	M 8	25	2.6	18.8
Capscrews, timing gear case and cover (12, page 10–54) (3, page 10–50)	M 8	25	2.6	18.8
Union, piston cooling port (5, page 10–50)	M 12 x 1.25	50	5.1	36.9
Capscrews, intake manifold (11, page 10–55)	M 8	25	2.6	18.8
Capscrew, intake manifold and hook (12, page 10–55)	M 10 x 1.25	55	5.6	40.5
Capscrews, exhaust manifold (8, page 10–56)	M 8	25	2.6	18.8
Nuts, timing gear case cover (10, page 10–54)	M 8	15	1.5	10.8
Capscrews, rocker arm axle supports (4, page 10–54)	M 8	25	2.5	18.1
Nuts, tappet adjustment setscrews	M 8	22	2.2	15.9
Nut, engine crankshaft hub (4, page 10–57)(7, page 10–76)	M 30 x 1.5	310	31.6	228.6
Capscrews, fan and alternator drive pulley (9, page 10–57)	M 10 x 1.25	55	5.6	40.5
Capscrews, intermediate flanged pin (7, page 10–50)	M 10 x 1.25	55	5.6	40.52
Capscrews, camshaft thrust plate (8, page 10–50)	M 8	35	3.6	6.0
Capscrews, injection pump (9, page 10–54)(3, page 10–82)	M 8	25	2.6	18.8
Nut, injection pump bushing	M 14 x 1.5	70	7.1	51.3
Capscrews, fuel filters (6, page 10–55)	M 10 x 1.25	55	5.6	40.5
Capscrews, turbocharger (10, page 10–56)	M 10 x 1.25	55	5.6	40.5
Capscrews, oil pump and cover (5, page 10–53)	M 8	25	2.6	18.8
Valve, oil pressure	M 22 x 1.5	220	22.4	162.0
Capscrew, oil pressure valve securing/retainer	M 8	25	2.6	18.8
Capscrews, heat exchanger (2, page 10–56)	M 10 x 1.25 M 12 x 1.75	55 85	5.6 8.7	40.5 62.9
Capscrews, engine cooling plant pump (6, page 10–58)	M 10 x 1.25	55	5.6	40.5
Capscrew, compressor	M 10 x 1.25	49	5	40.5
Nut, alternator (12, page 10–58)	M 12 x 1.25	95	9.7	70.2
Capscrews, belt tension adjuster (11, page 10–58)	M 10 x 1.25	55	5.6	40.5
Nuts, injector studs (2, page 10–55)	M 8	25 (*)	2.6 (*)	18.8 (*)

(*) Tighten nuts at two subsequent stages (see page 10–55).

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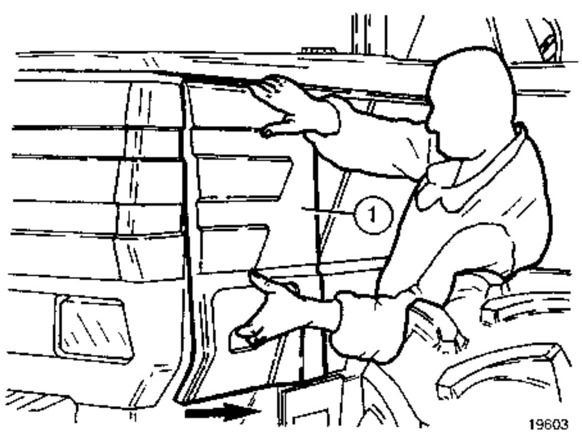
ENGINE
Removal – Installation (Op. 10 001 10)

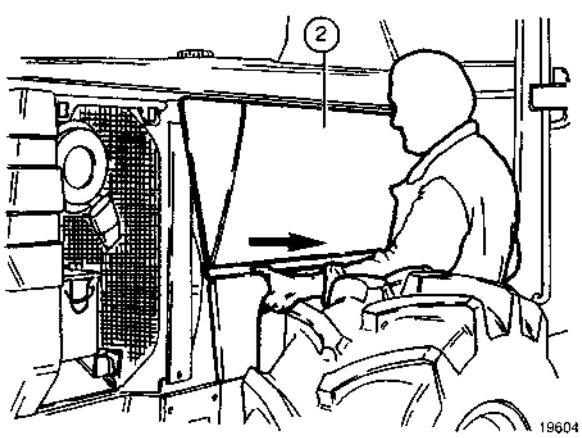
Removal of engine from tractor is preceded by its splitting away from the front or live axle and clutch–transmission case.

DANGER

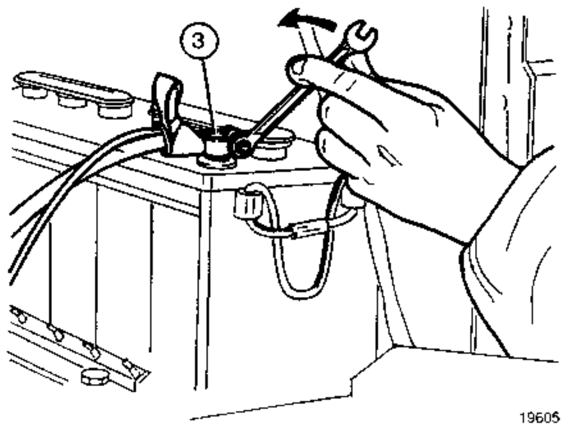
Lift and handle all heavy components using a suitable lift.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.

Proceed as follows:

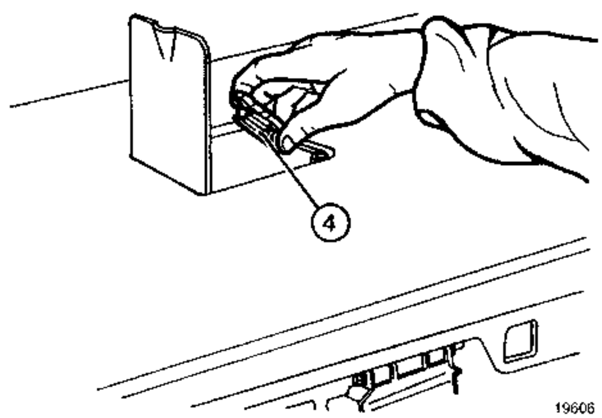




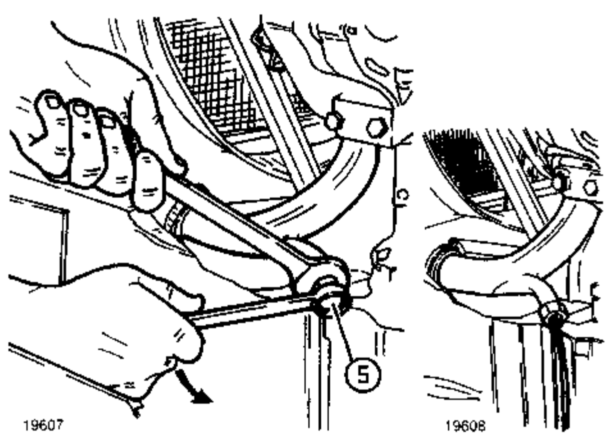
1. Remove the hood panels (1 and 2) from both sides.



2. Remove the battery positive cable and insulate it.



3. Remove plug (4) from the engine cooling system radiator.



4. Remove plug (5) from drain pipe and empty the engine cooling system.

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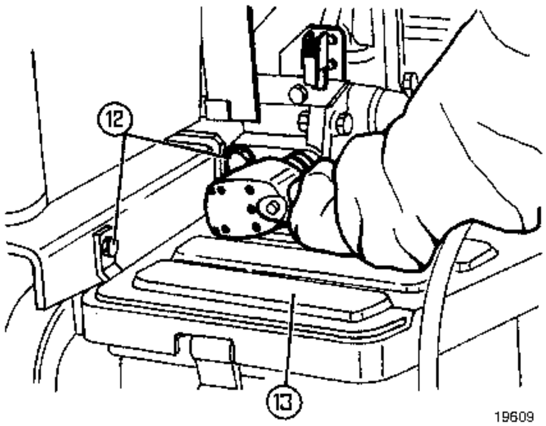
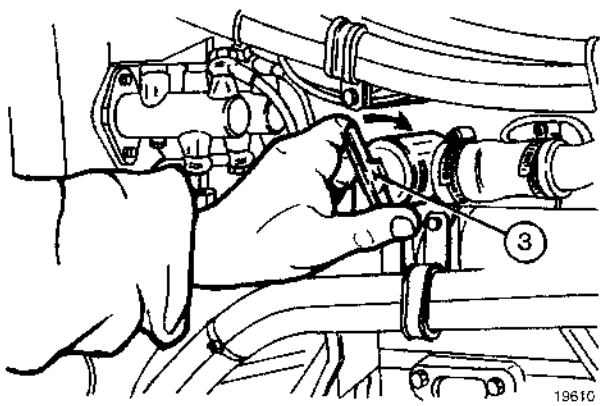
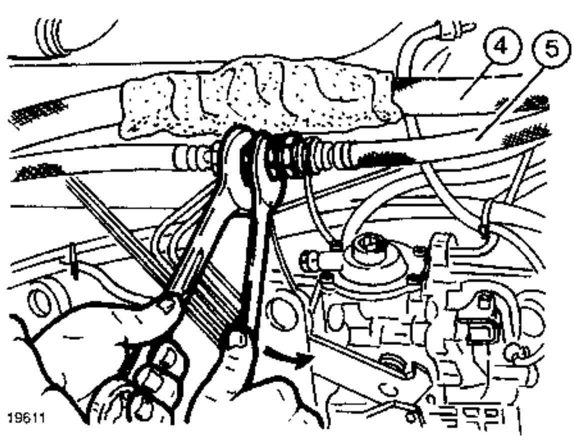


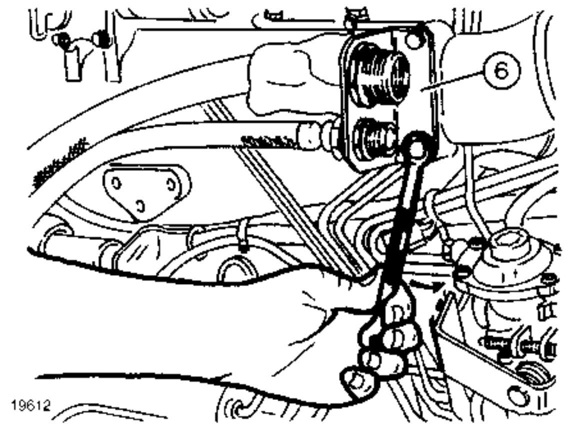
5. Remove screws (12) first and then the tractor toolbox (13).



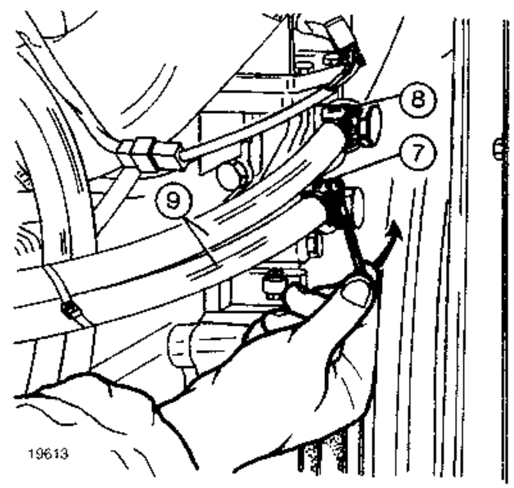
6. Close line cock (3) connecting main and auxiliary tank.



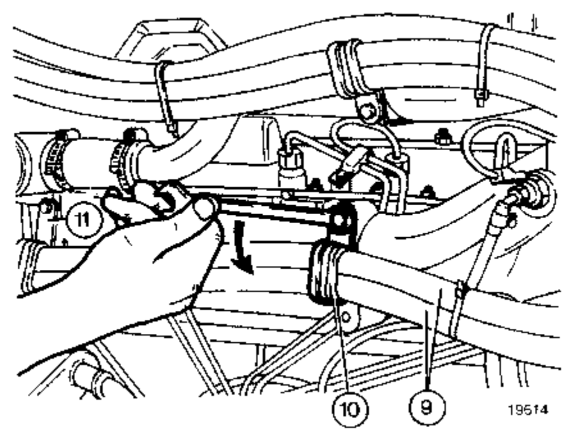
7. Disconnect lines (4 and 5) of the cab conditioning plant (if installed).



8. Remove screws first and then the supporting bracket (6) for lines (4 and 5).



9. Unscrew clamps (7 and 8) securing lines (9), the latter connecting the heater to engine.



10. Remove screws securing the band clamps (10 and 11) and then lines (9) from engine.

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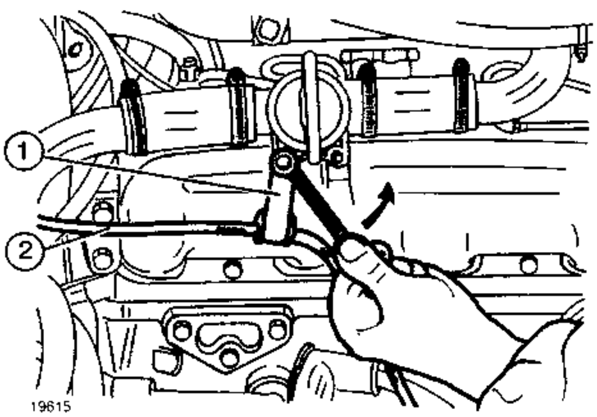
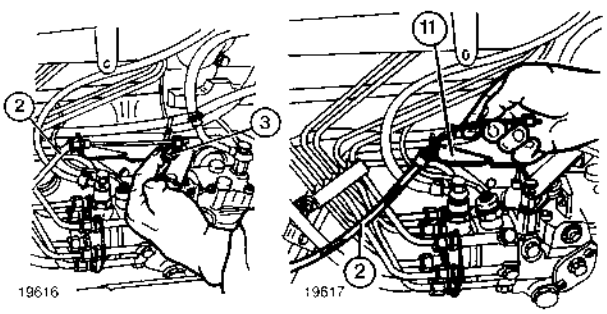
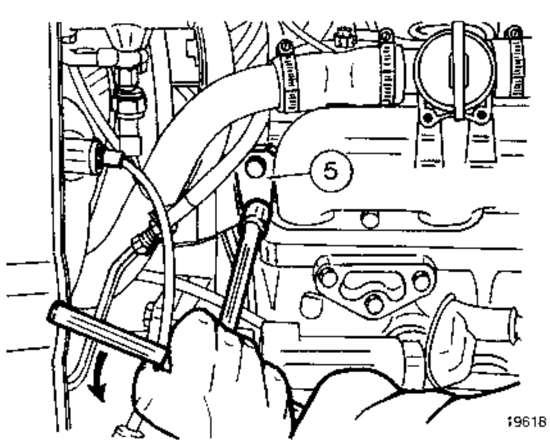


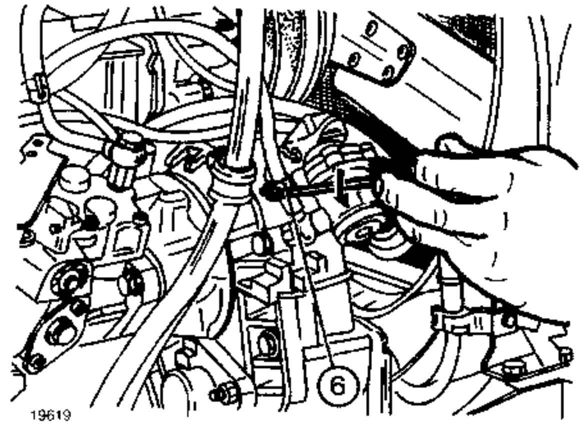
11. Remove the engine accelerator cable clamp (1) screw.



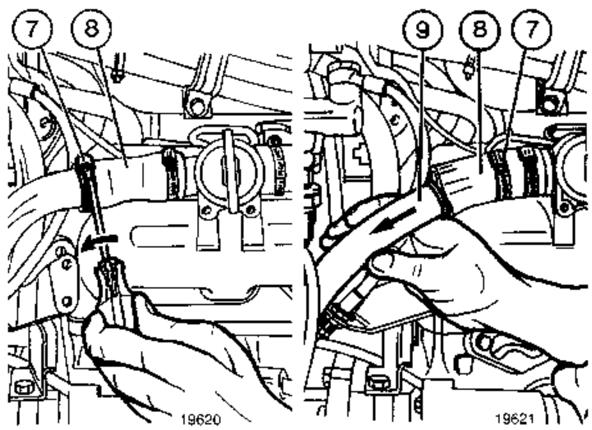
12. Disconnect the retaining spring (3) and free the end of cable (2), then withdraw the latter from securing bracket (11).



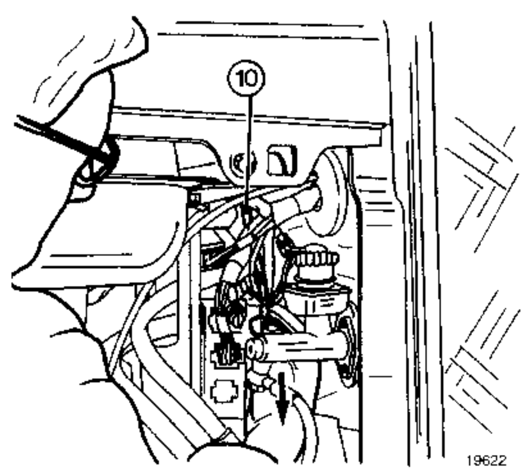
13. Remove the brake line supporting bracket (5), then the latter from the engine.



14. Unscrew the feed line securing clamp (6), then disconnect the former from its union.



15. Drain fuel tank through plug (6, page 21–14), loosen band clamp (7) and withdraw the hose (8) from the associated line (9).



16. Withdraw the glass washer fluid tubelet (10) by pulling it off.

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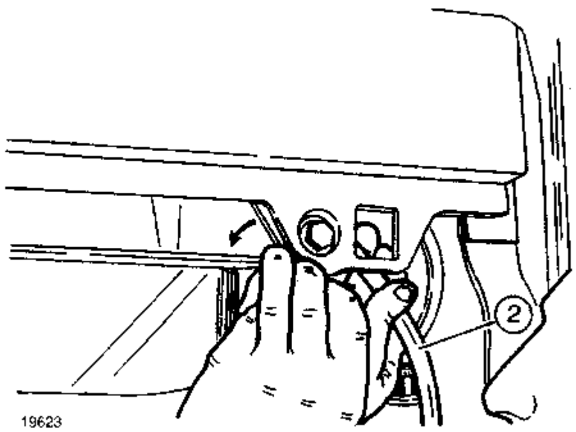
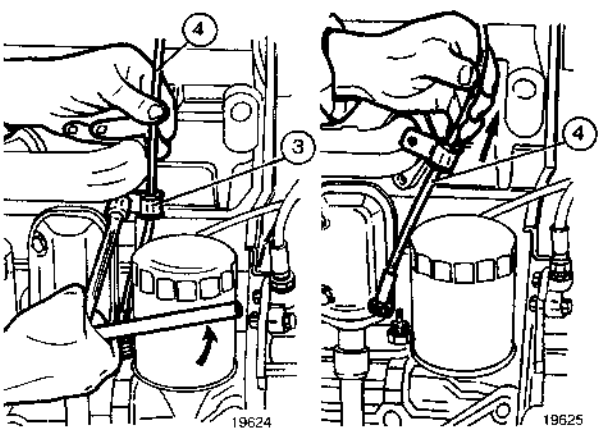
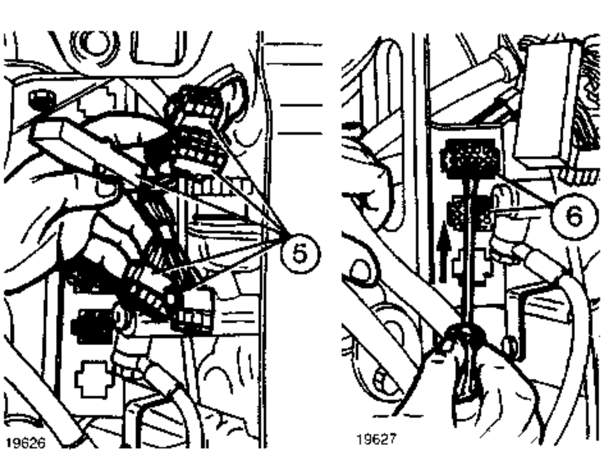


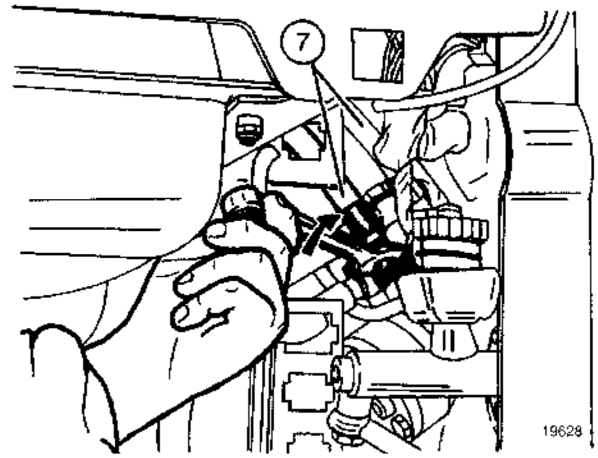
17. Unscrew the band clamp securing the breather line (2), under the hood.



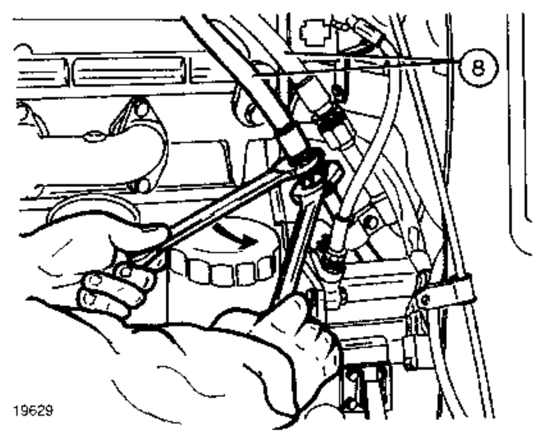
18. Remove both the band clamp (3) securing the chronotachometer cable (4) and its connection, then the cable itself.



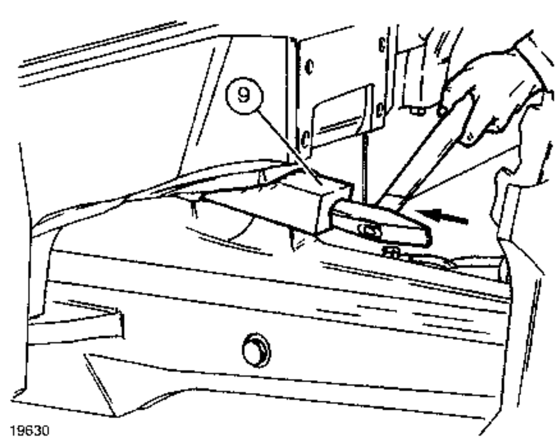
19. Disconnect electrical connections (5 and 6).



20. Unscrew connections of the power steering cylinder fluid lines (7), then remove them.



21. Unscrew connections and remove the power steering lines (8).



22. Block the engine, with respect to front or live axle, by inserting two wooden wedges (9) (one on each side), as shown in the figure.

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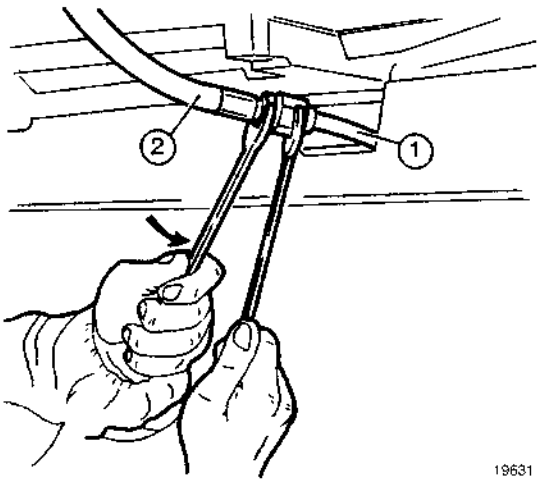
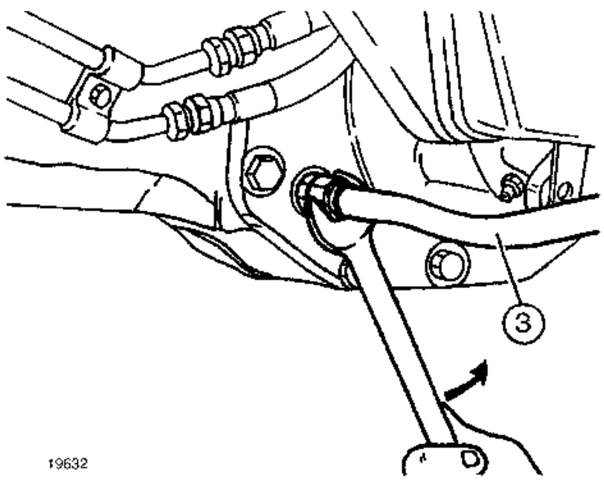
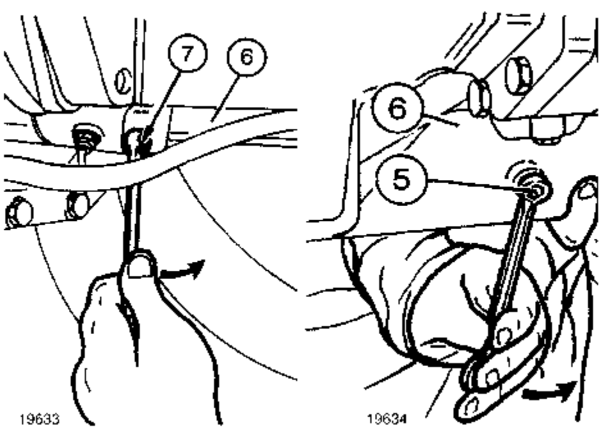


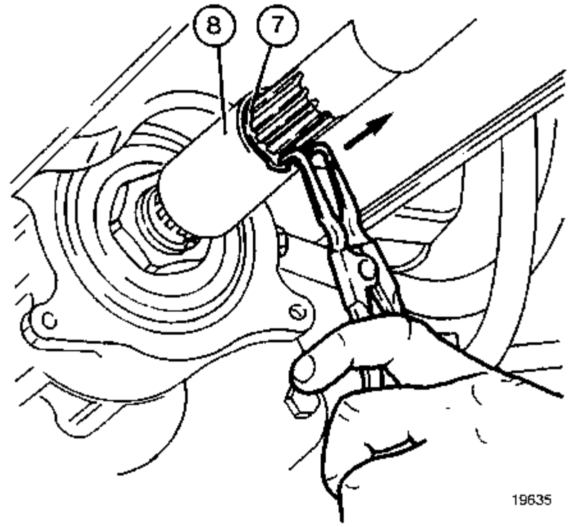
23. Disconnect hose (2) from the live axle differential lock control pipe (1).



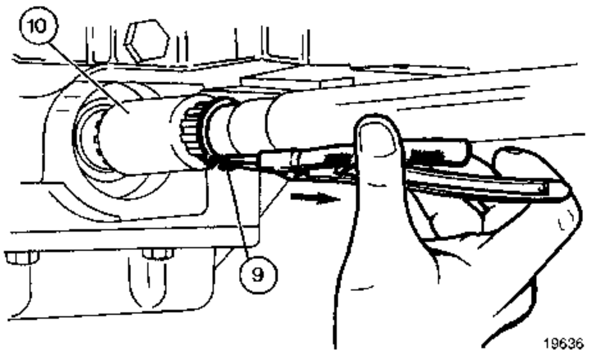
24. Disconnect hose (3) from live axle.



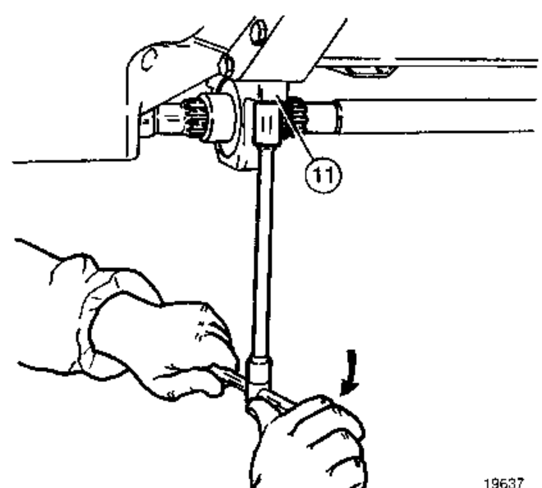
25. Remove the screws, front (4), central (5) and rear ones securing the live axle drive shaft guard plate (6).



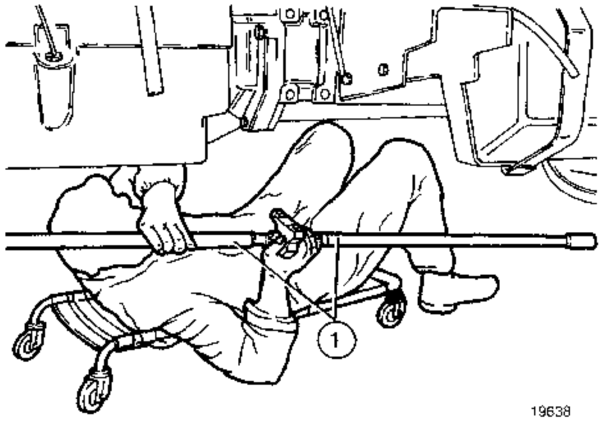
26. Free the spring retainer ring (7), then move the sleeve (8) back in order to disconnect it from the drive splined section.



27. Remove circlip (9) and move sleeve (10) forward to free it from the drive box spline.

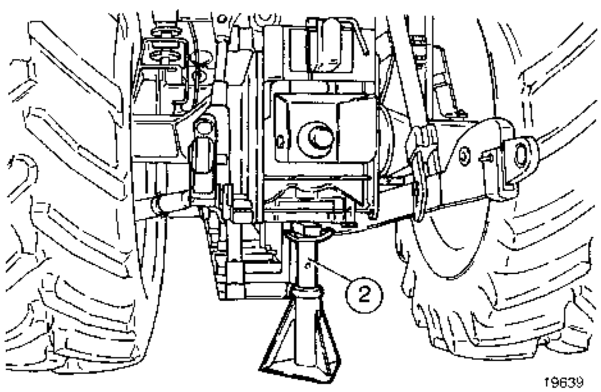


28. Remove the screws securing the front drive shaft supporting block (11).

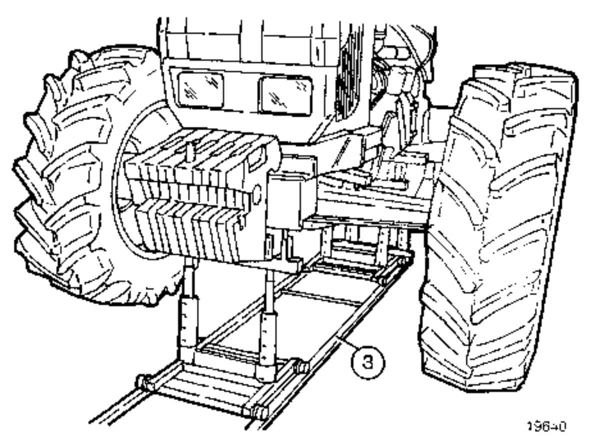


29. Recover shafts (1) and associated supporting block.

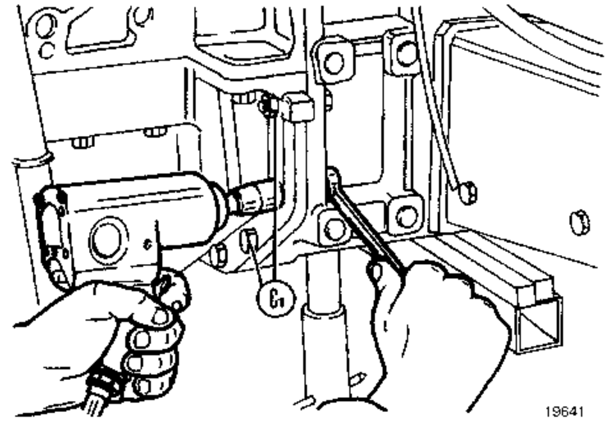
Note – Operations 23 through 29 apply in case of 4W drive tractors only.



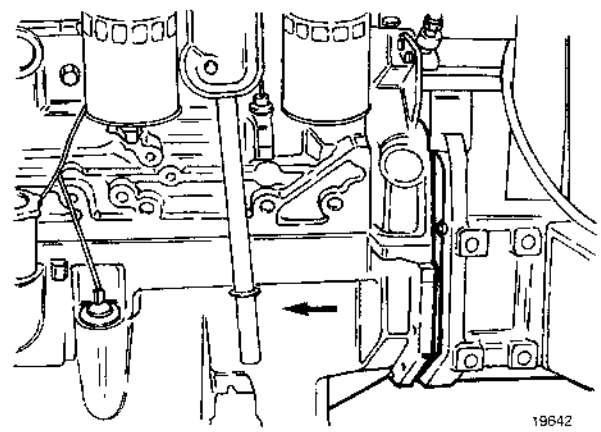
30. Place a shop stand (2) under the rear transmission case back end.



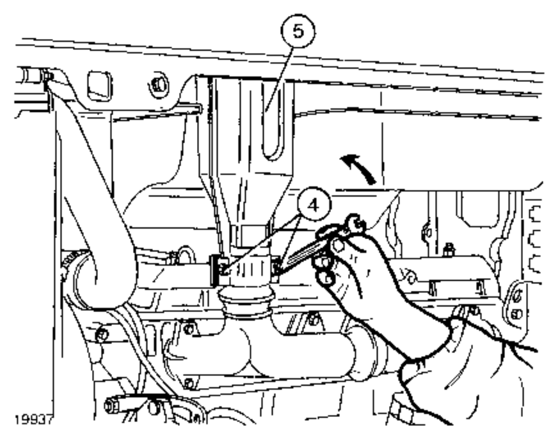
31. Place service tool **292320** (3) with the fixed stand under the tractor clutch case and the two mobile stands as follows: one under the ballast weights and the other one under the engine oil sump, as evidenced in the figure.



32. Lock the tractor rear wheels by applying the hand brake or by wedging them up with suitable wooden blocks, then unscrew the bolts (C_1).



33. Split engine from clutch case, moving the former forward and making sure there are no hard spots or parts still connected.



34. Remove screws (4) first and then the exhaust muffler (5).

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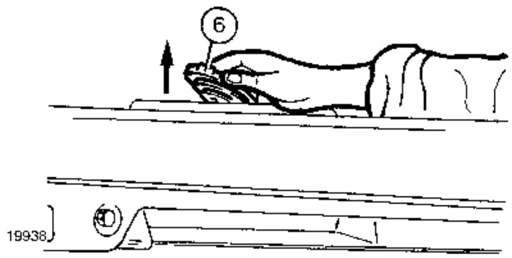
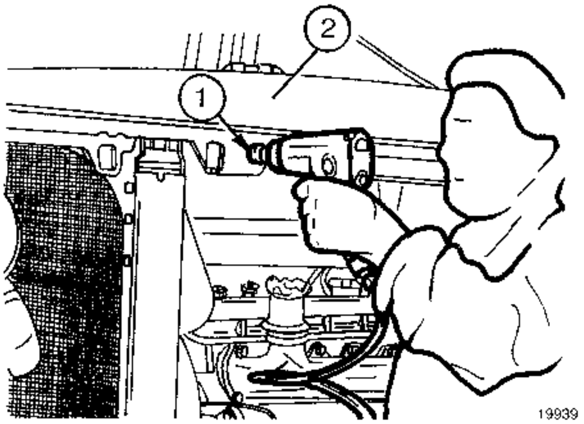
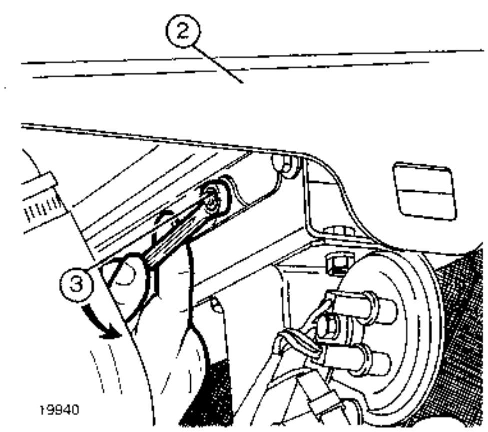


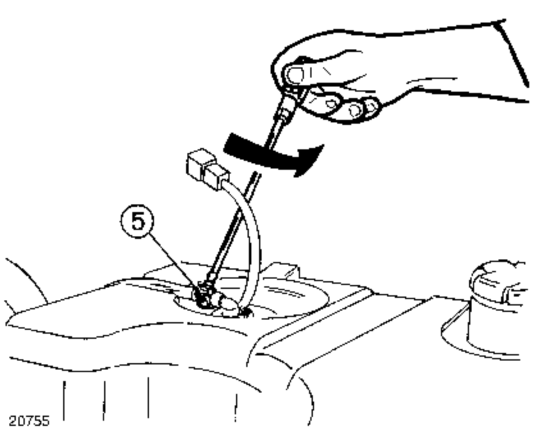
35. Remove plug (6) from the fuel auxiliary tank.



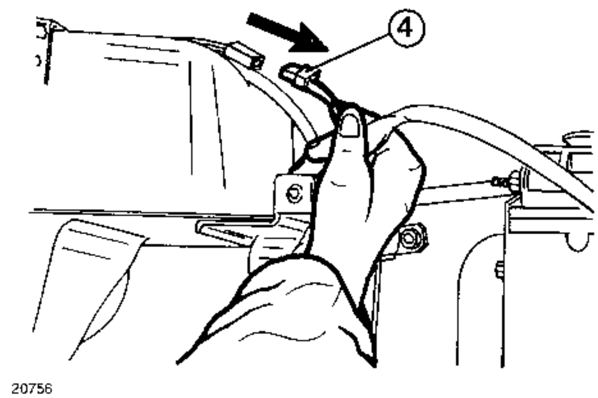
36. Remove screws (1) securing the hood top, from both sides.



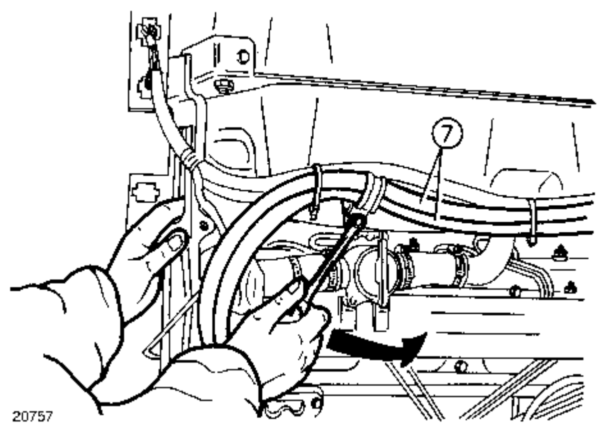
37. Remove front screws (3) first and then the hood top (2).



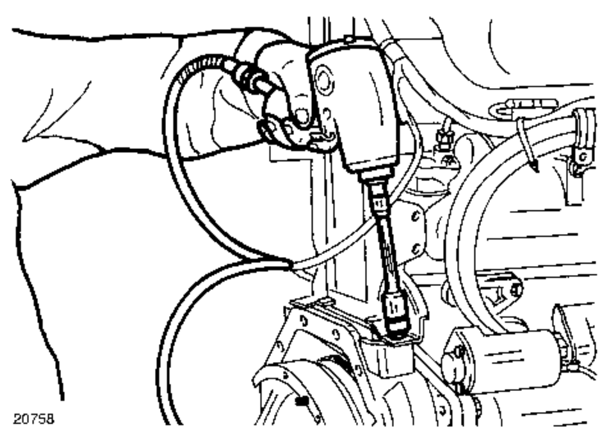
38. Loosen band clamp (5) first and then disconnect the fuel return line from secondary tank.



39. Disconnect the fuel level terminal (4).



40. Remove the securing screws first and then the power steering lines (7).



41. Empty the auxiliary tank (if containing fluid), then remove the rear securing screws.

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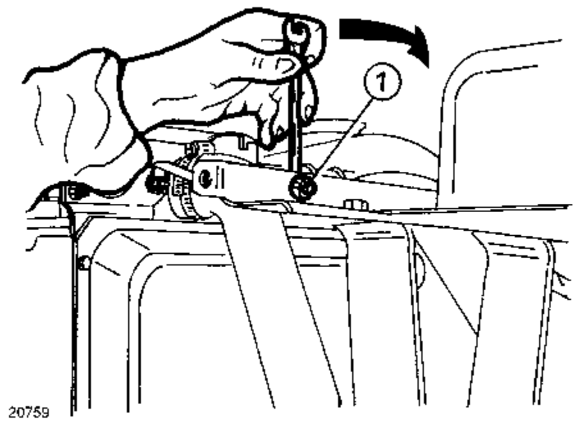
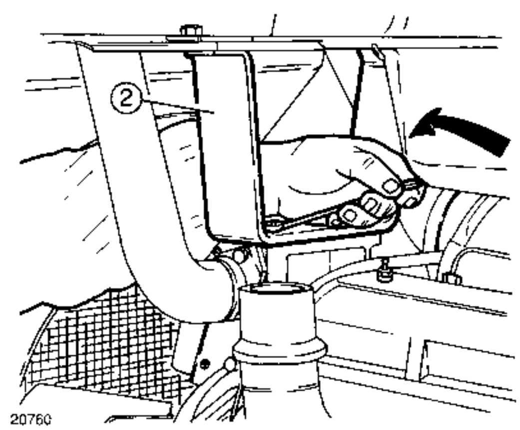
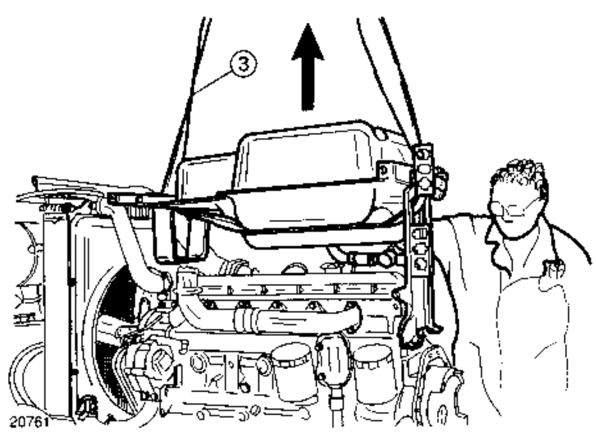


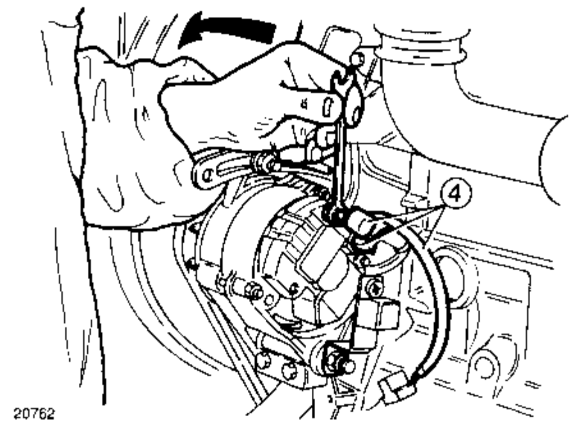
42. Remove the radiator supporting strap screws (1).



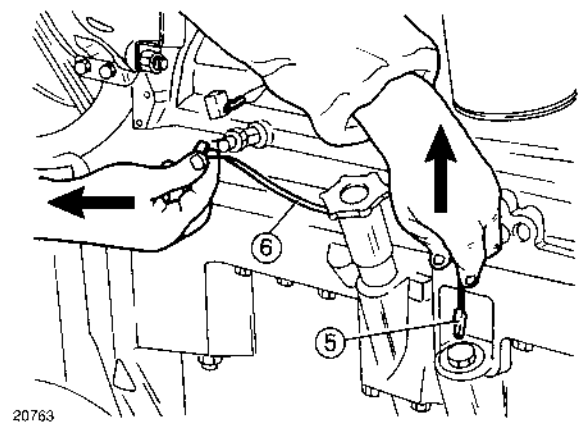
43. Remove the auxiliary tank supporting bracket (2) screws.



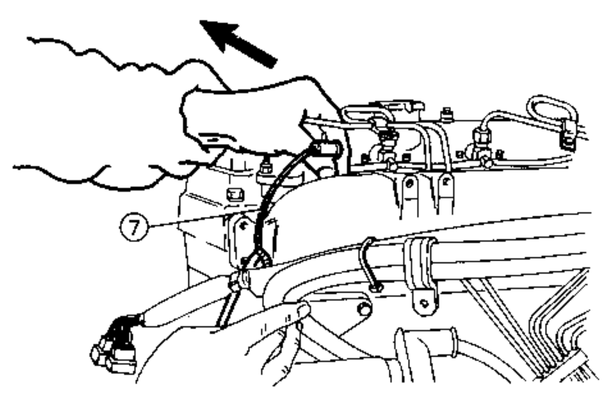
44. Remove the auxiliary fuel tank from tractor by means of a hoist and nylon rope (3).



45. Disconnect the alternator electrical connections (4).



46. Detach the engine oil level and low oil level connections (5 and 6, respectively).



47. Detach the engine cooling fluid temperature gauge connection (7).

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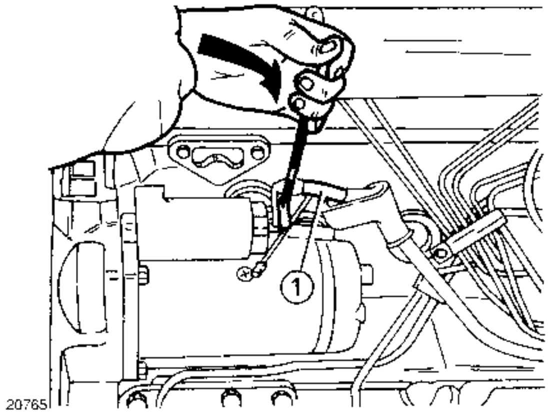
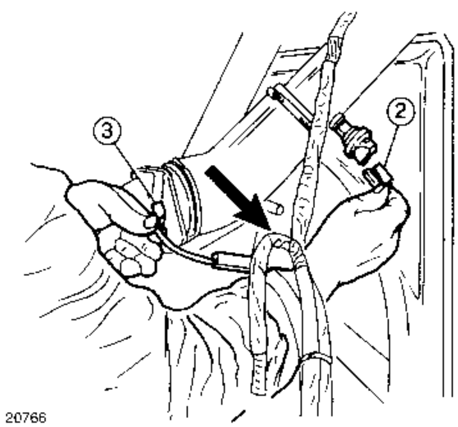
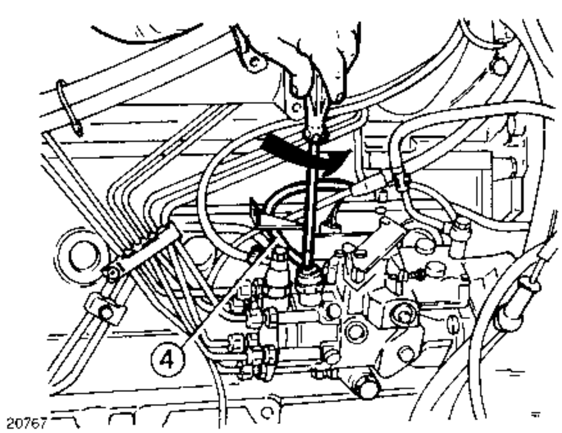


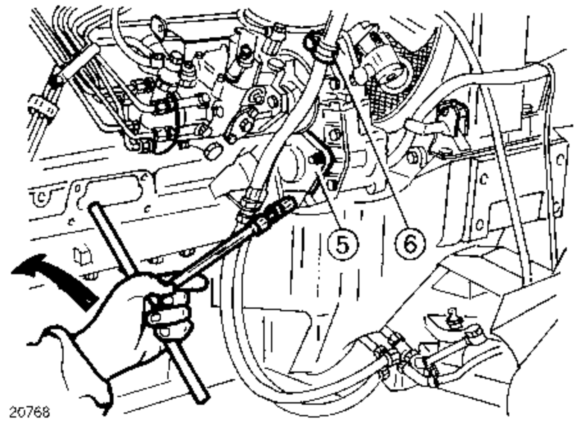
48. Detach electrical connection (1) from starting motor.



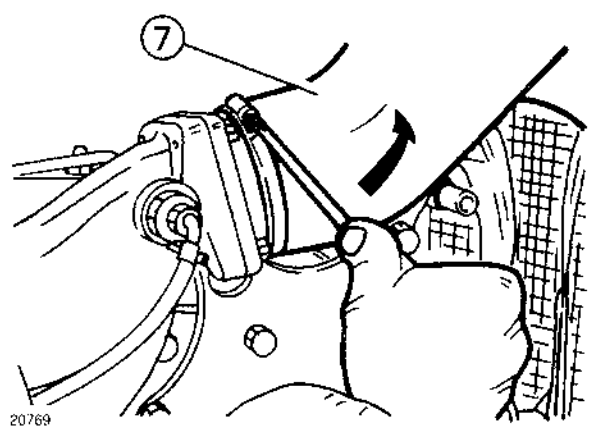
49. Detach air cleaner clogging and starting aid monitor electrical connections (2 and 3, respectively).



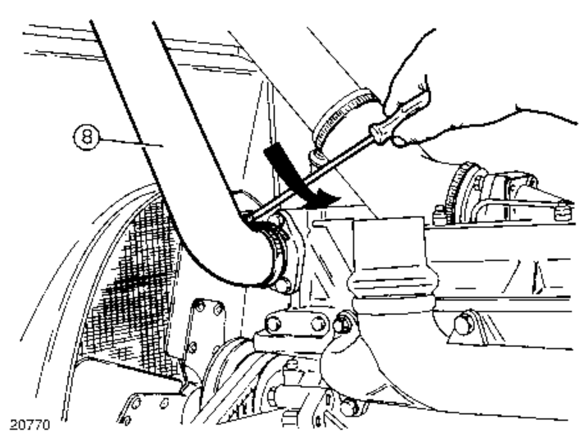
50. Detach connection (4) from stopping electromagnet.



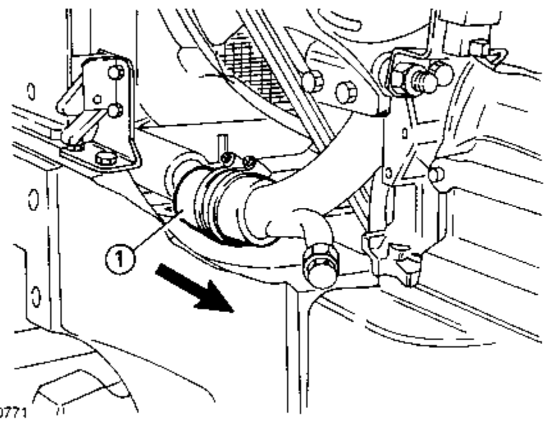
51. Back out the bracket and band clamp screws (5 and 6, respectively), in order to free the power steering fluid lines and bring the latter on the front or live axle.



52. Loosen the band clamp first, then take off the hose (7) connecting air cleaner and associated air inlet duct.

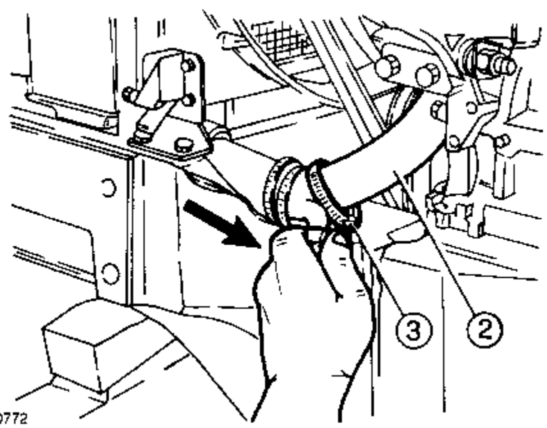


53. Loosen the band clamp first, then take off the hose (8) connecting radiator with engine.



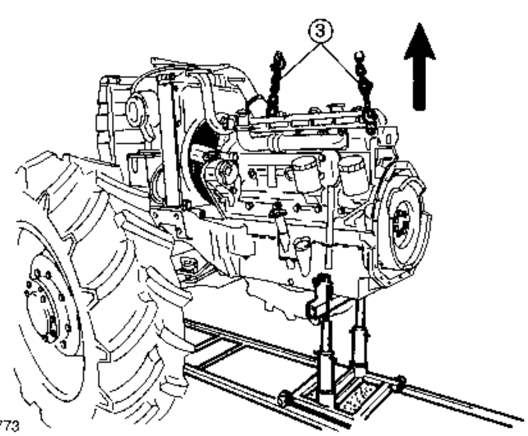
20771

54. Loosen band clamps and withdraw hose (1) from radiator connection.



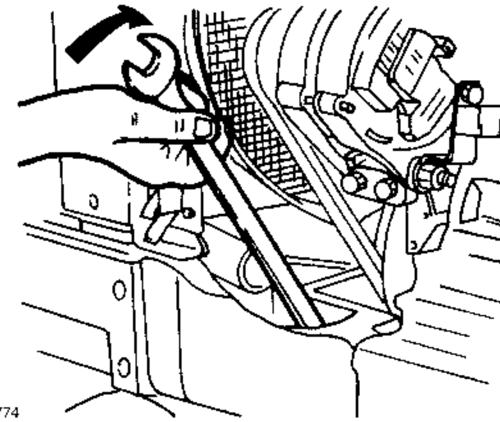
20772

55. Loosen upper clamp (3), then remove pipe (2).



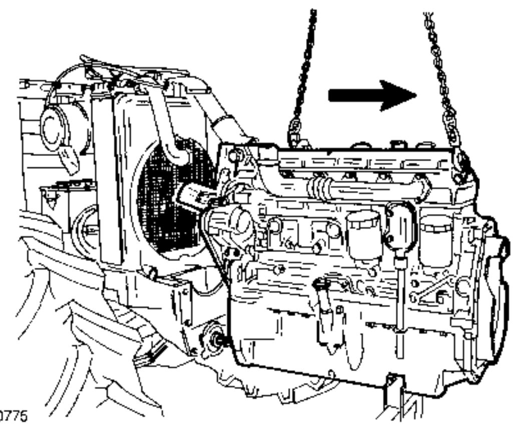
20773

56. Sling up engine with chain tool no. **290740/1** (3) attach it to a hoist and put it under tension.



20774

57. Remove bolts securing engine to live axle (shown above) or to 2WD front axle (on both sides).



20775

58. Move engine away from front axle and make sure that the guide screws of the mobile stand of shop stand tool no. **292320** are slack before lifting engine up.

59. When re–installing the engine, consider the following points:

a. proceed by reversing the removal sequence of operations starting from no. 58 back to no. 1;

b. tighten all fittings to torque specifications given on pages 10–26 and 10–27 of this manual, except for the torque tightening value for the bolt (C_1, page 10–33) which is given instead on page 18–2;

c. spread **TUTELA G9** grease over the clutch disc splined section.

d. fit the two dowel guide pins tool no. **292888** in order to facilitate the correct alignment of engine and clutch–transmission case at installation, making sure that no interference will occurr during this operation.

e. prior to re–fitting the engine to the clutch transmission case, thoroughly clean and degrease mating surfaces and apply a sealing compound bead of

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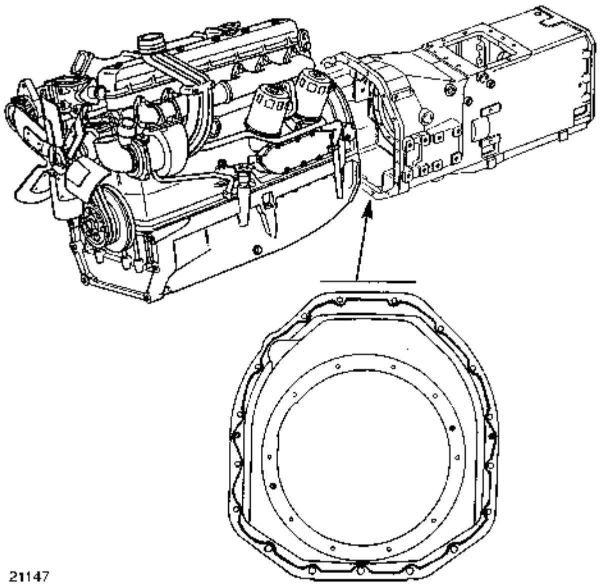
about 2 mm dia (.08 in) following the scheme shown in the figure below.



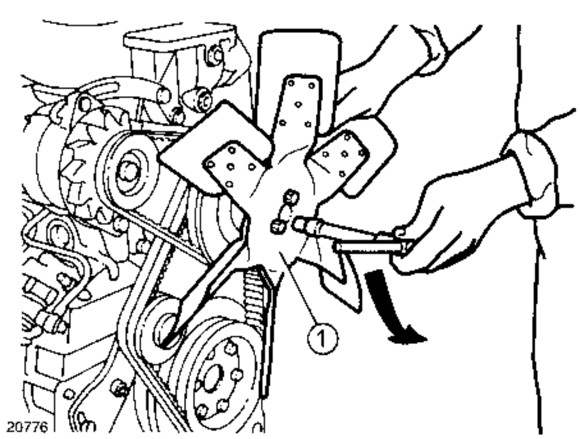
Sealing compound application scheme for engine and clutch–transmission case re–fitting.
Suitable types of sealing compounds for this application are given on page 00–9 of this manual.

ENGINE
Disassembly–Assembly (Op. 10 001 54 – 10 001 56 – 10 101 21 – 10 101 32 – 10 102 12 – 10 103 10 – 10 105 10 – 10 106 20 – 10 106 40).

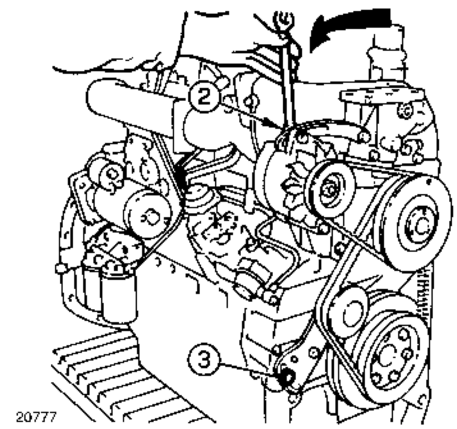
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

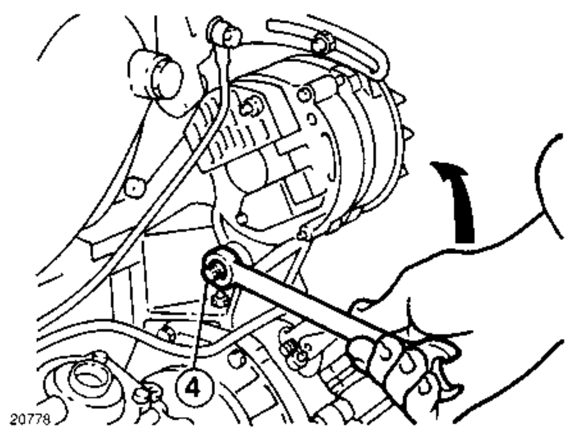
Proceed as follows:



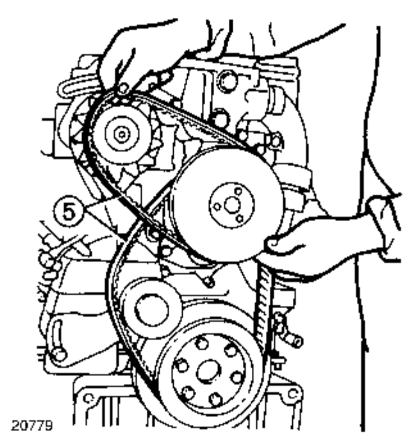
1. With engine suitably supported, remove attaching screws first and then the fan (1) together with its spacer.



2. Loosen the alternator securing nut (2) and the belt tightener screw (3).



3. Loosen nut (4) securing the alternator lower end.



4. Move alternator and belt tightener enough to free belts (5) and then remove the latter.

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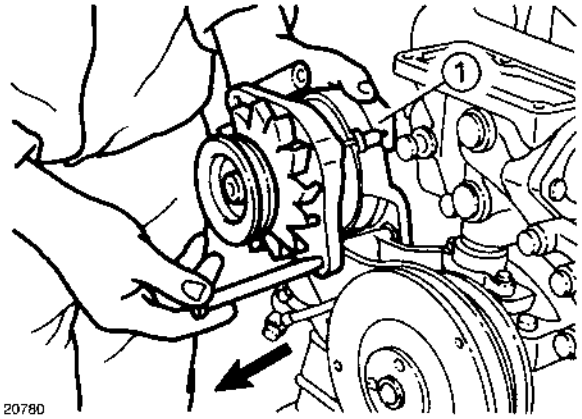
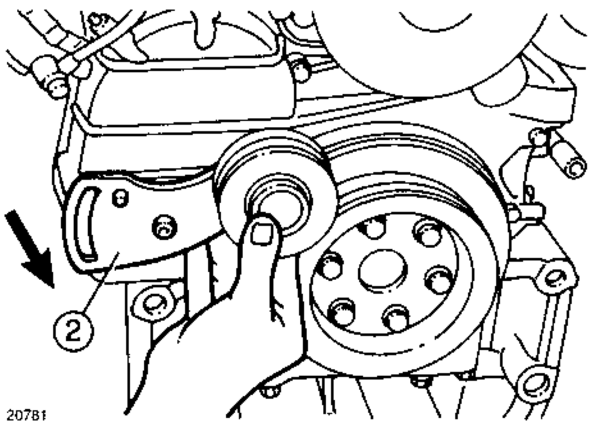


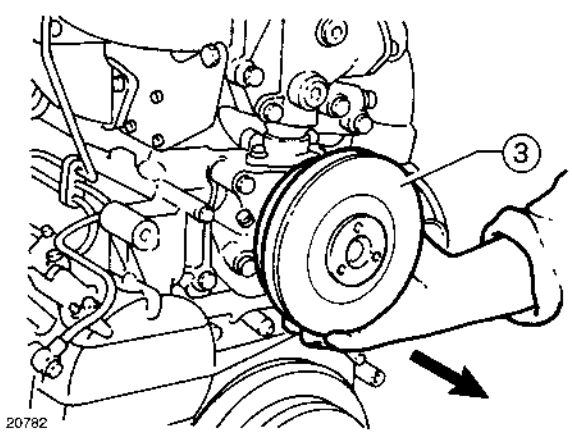
20780

5. Back off the alternator mounting screws completely and then remove the alternator (1).



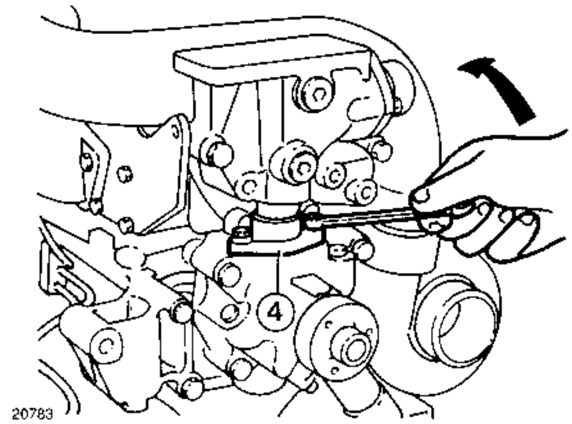
20781

6. Back off the securing screws completely and then retrieve the belt stretcher (2).



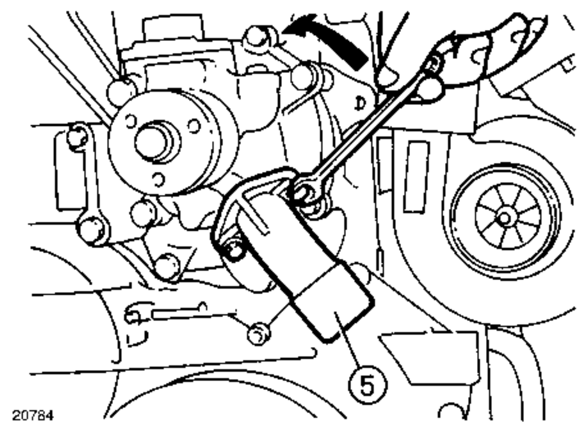
20782

7. Withdraw the fan pulley (3).



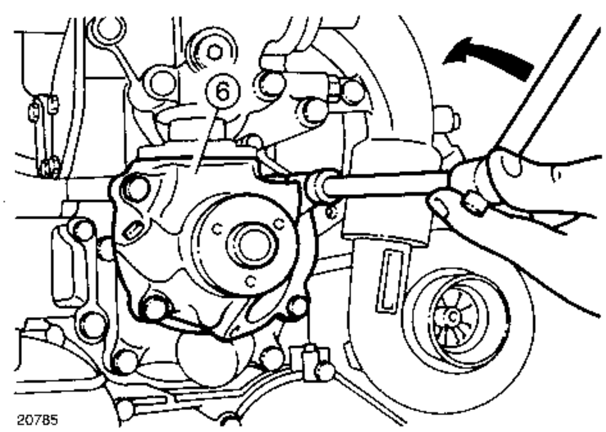
20783

8. Unscrew the screws securing sleeve (4) connecting pump to thermostat.



20784

9. Remove securing screws and then the connection (5).



20785

10. Remove the screws securing the water pump (6) and then the latter; should the pump be sticked use a plastic hammer to detach it.

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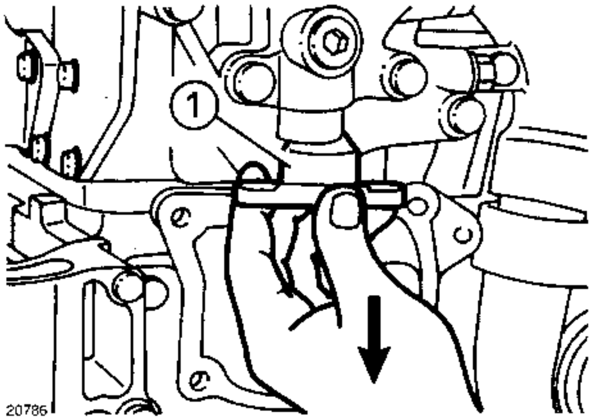
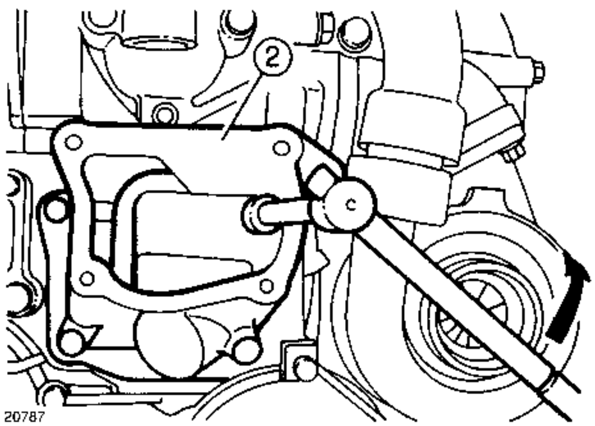
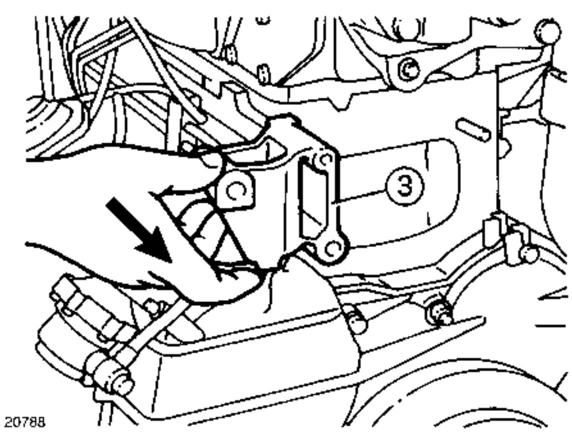


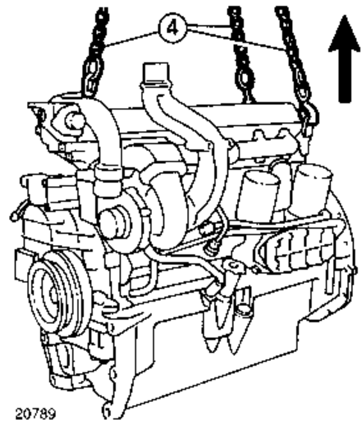
11. Retrieve the sleeve (1) connecting the cooling system pump to the thermostat.



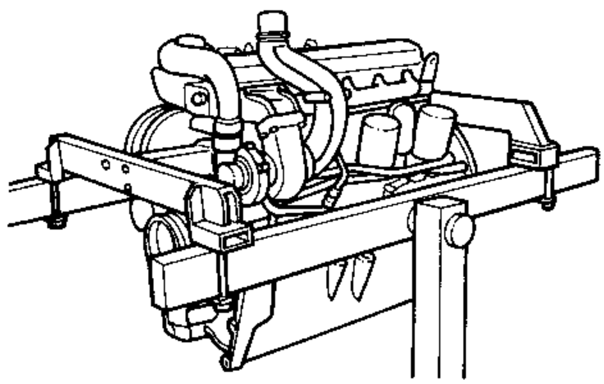
12. Remove the screws securing the pump spacer–mounting support (2) and then the latter.



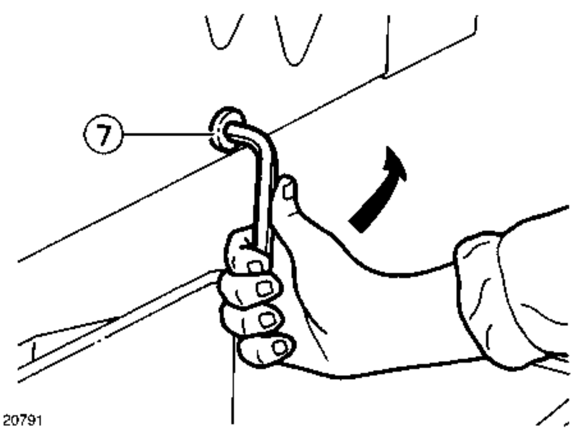
13. Remove screws firts and then the alternator mounting bracket (3).



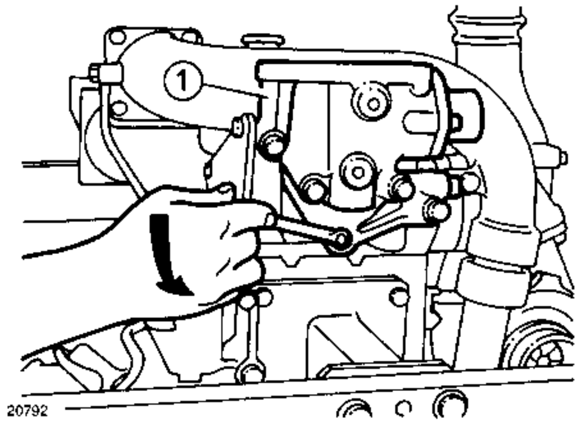
14. Lift the engine using a hoist and special hook **290740/1** (4).



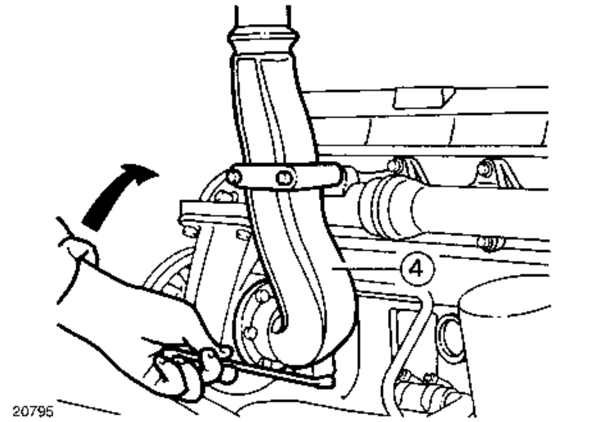
15. Place and block the engine on the turn–over shop stand **290290** (5) using special brackets of the **293860** tool set.



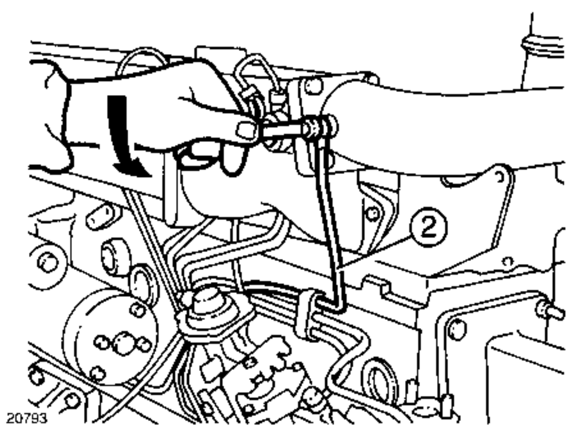
16. Unscrew the engine oil sump drain plug (7) and recover the oil using a suitable container.



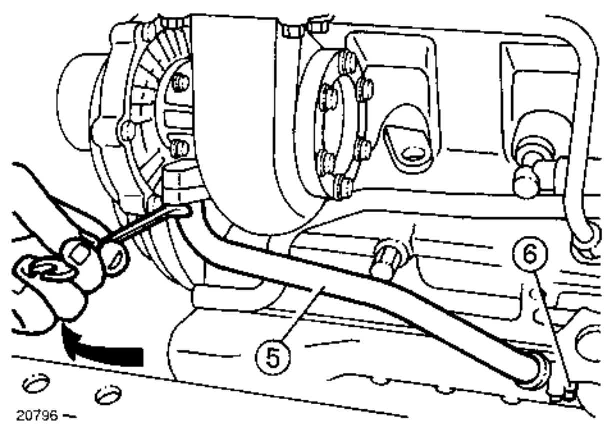
17. Remove attachment screws first and then the thermostat (1).



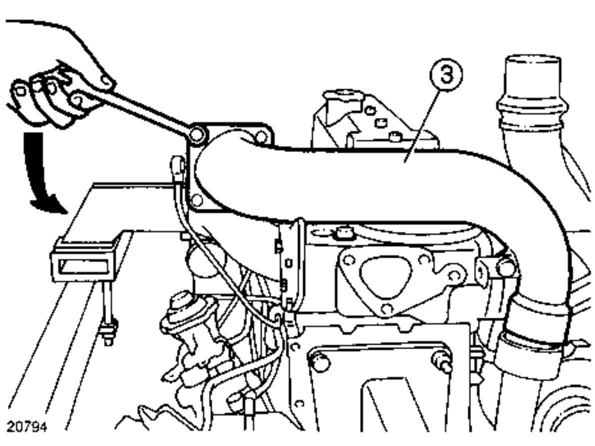
20. Unscrew the mounting screws firts and then the connecting pipe (4) from turbocharger to exhaust muffler and remove it.



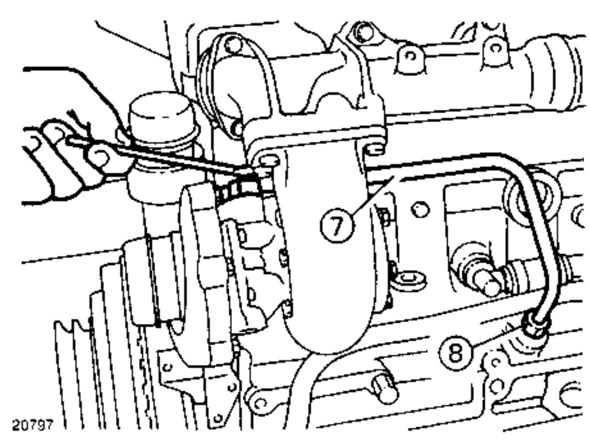
18. Unscrew the union of the injection pump air line connection (2).



21. Remove the attachment screws first, loosen the band clamp (6) and then detach the turbocharger lube oil drain pipe (5).



19. Remove attachment screws first and then the air conveyor (3) from turbocharger to air intake manifold.



22. Unscrew the mounting screws and connection (8), then remove the lube oil delivery line (7) to the turbocharger.

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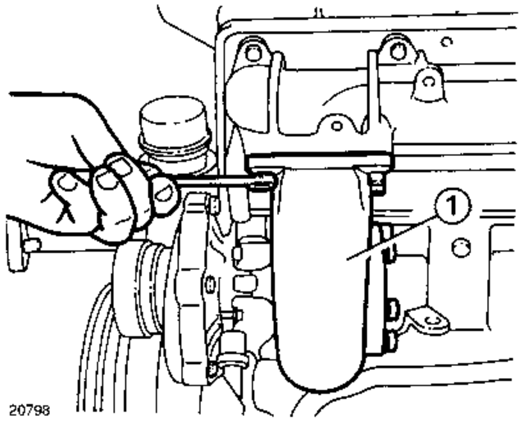
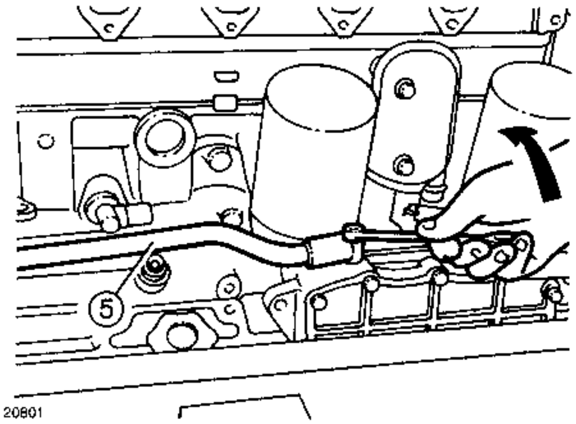
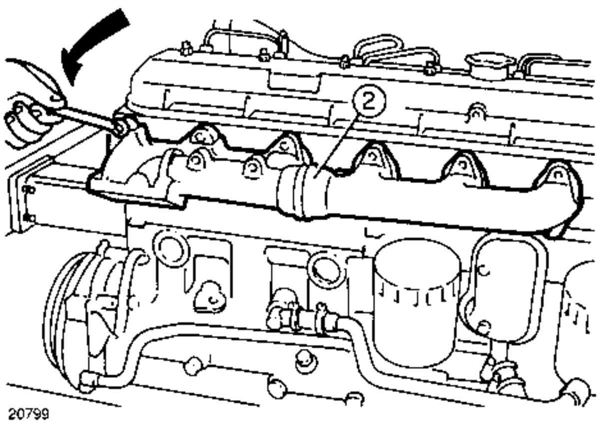


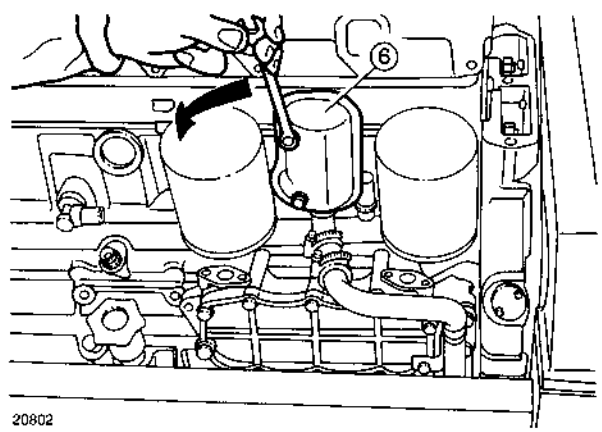
23. Remove the mounting screws first, then the turbocharger unit (1) and retrieve the metallic gasket.



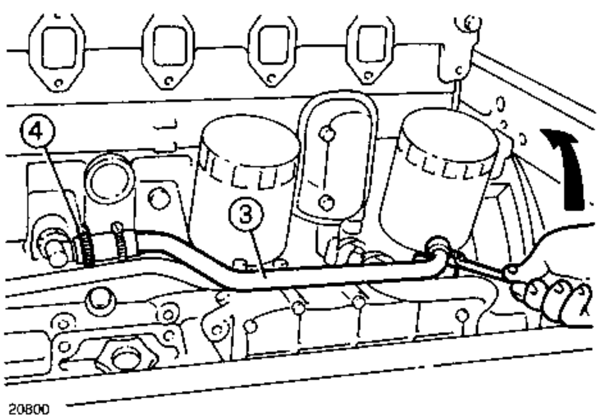
26. Remove attachment screws first then the pipe (5) connecting heat exchanger and radiator.



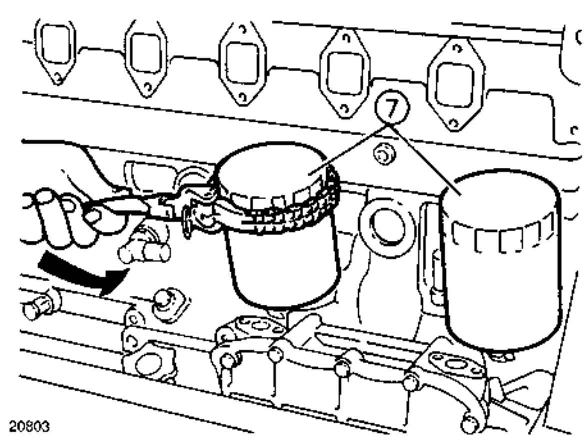
24. Remove the attachment screws first, then the exhaust manifold (2) and retrieve the associated metallic gaskets.



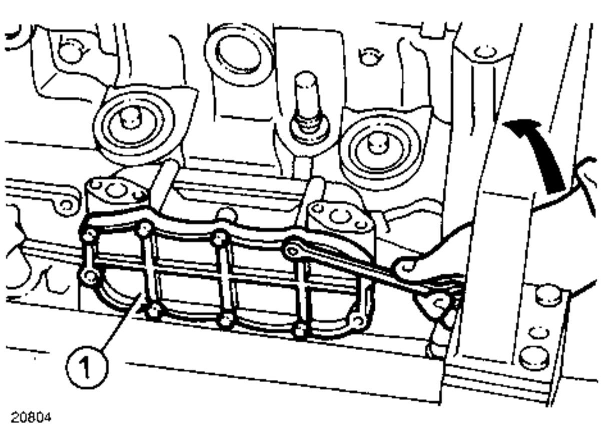
27. Unscrew attachment screws and then remove the exhaust vapour duct (6).



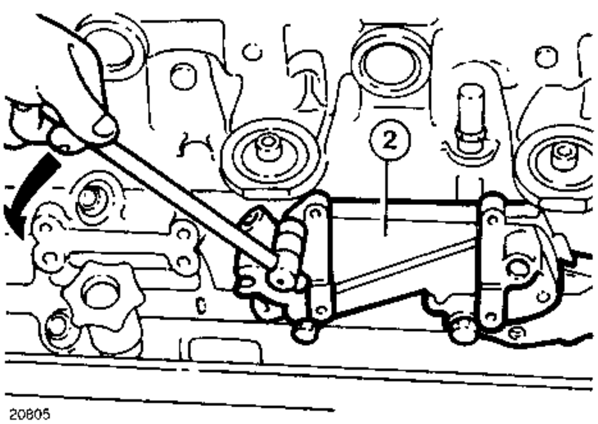
25. Unscrew the attachment screws and loosen the band clamp (4) first and then detach the pipe (3) connecting heat exchanger to engine.



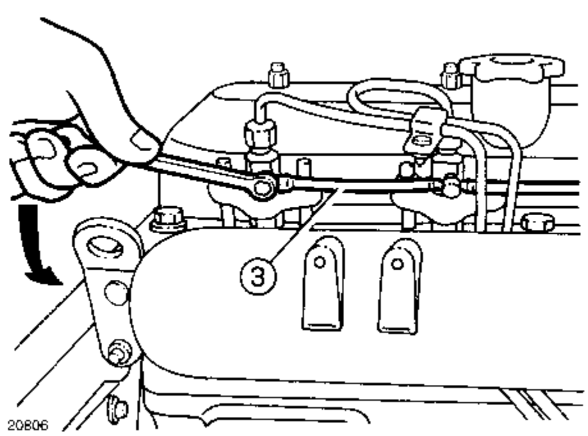
28. Unscrew and remove both filters (7).



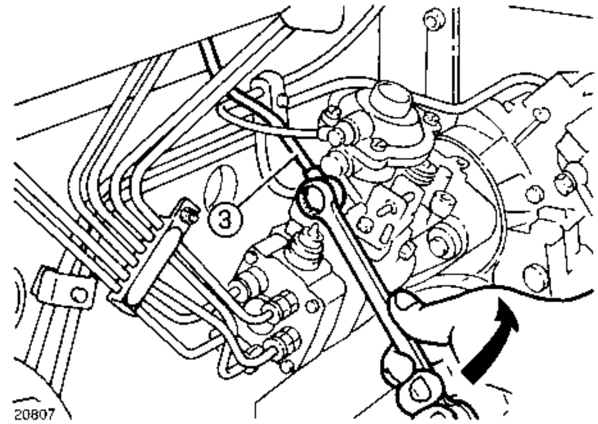
29. Remove attachment screws first and then the heat exchanger unit (1).



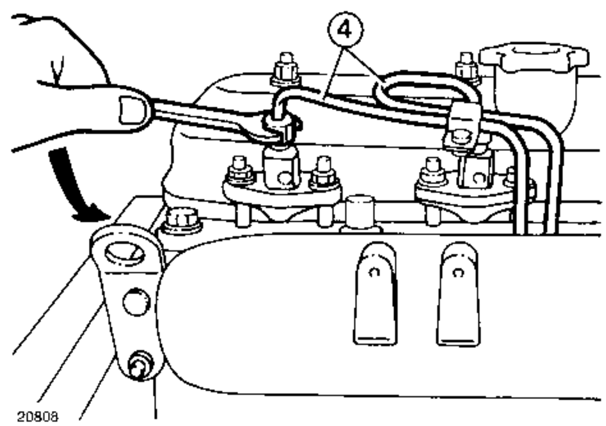
30. Remove attachment screws first and then the heat exchanger mounting spacer (2), retrieving the O–ring.



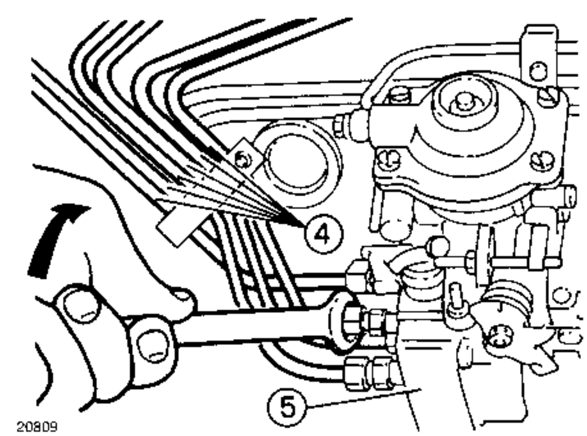
31. Remove the fuel injector leakage recovery line (3).



32. Unscrew the connection and remove the complete fuel leakage recovery line (3).



33. Unscrew the fuel delivery line (4) connections from injectors.



34. Unscrew the connections of the fuel delivery lines (4) from injection pump (5).

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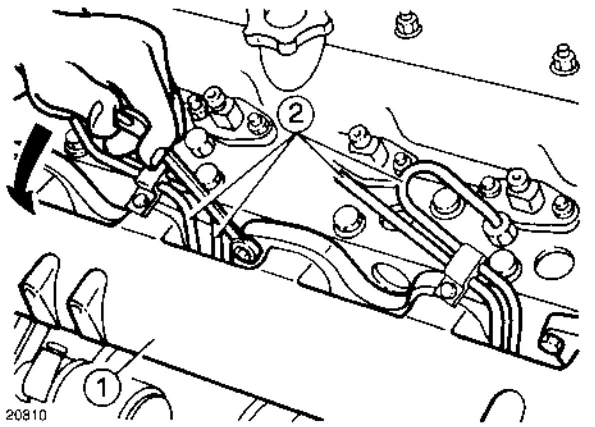
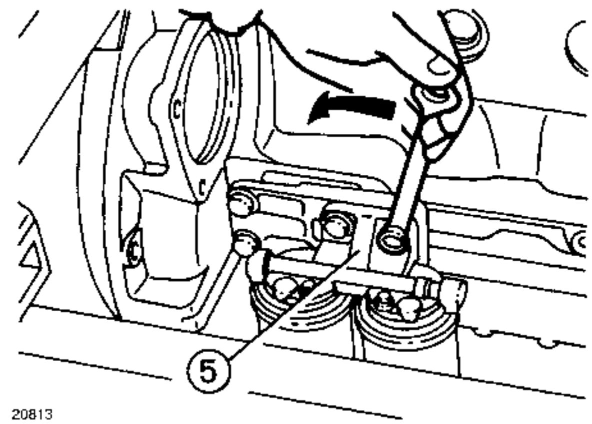
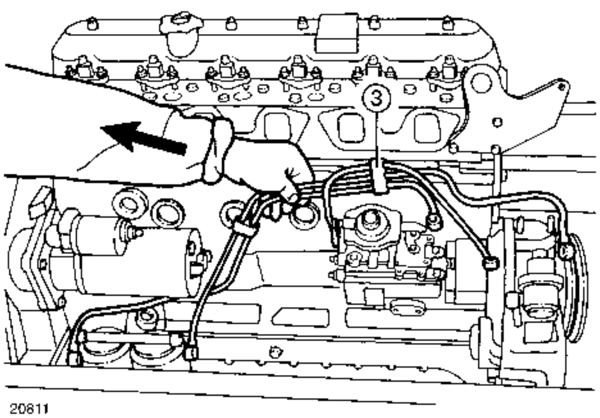


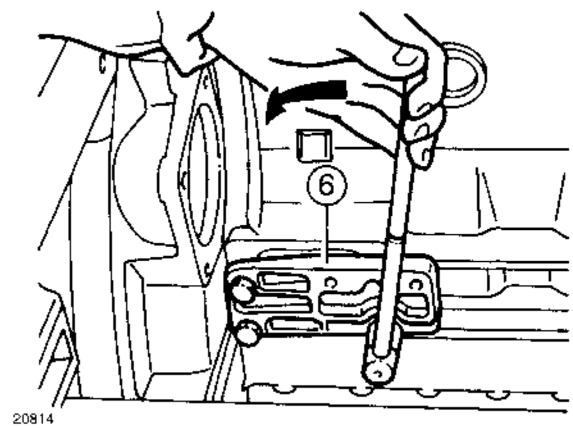
35. Remove mounting screws first and then the inlet manifold (1) together with fuel delivery lines (2) to injectors.



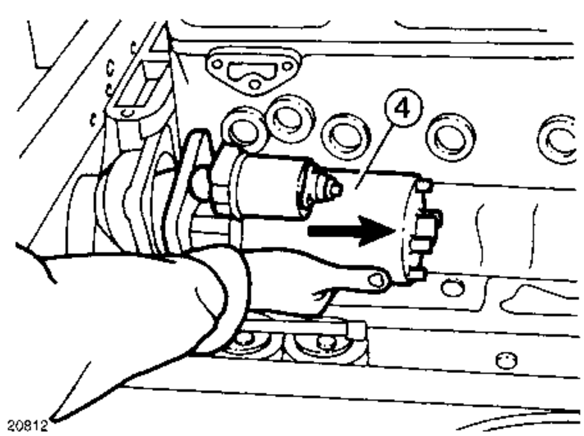
38. Remove the attachment screws first and then the supporting bracket (5) complete with fuel filters.



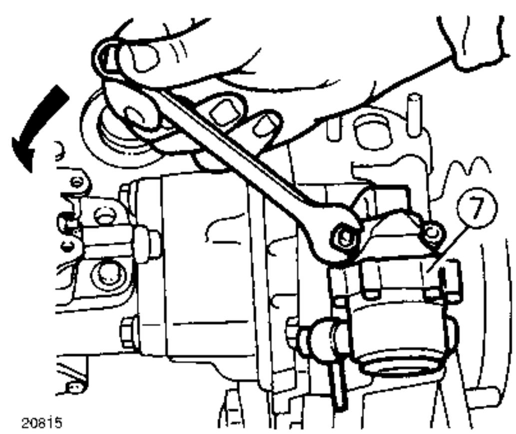
36. Disconnect fuel lines (3) from filters, injection pump and feed pump, then remove them.



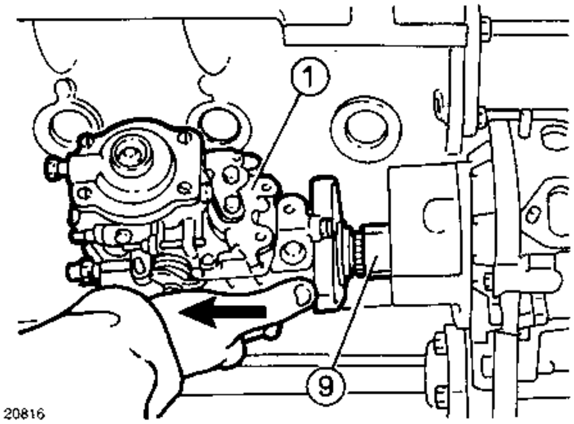
39. Remove attachment screws first and then the fuel filter mounting support spacer (6).



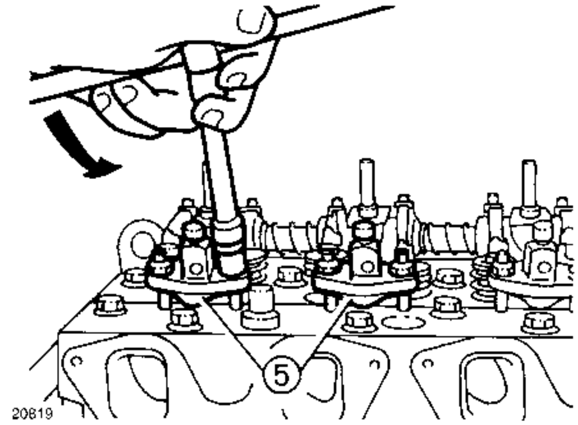
37. Remove mounting screws first and then the starter motor (4).



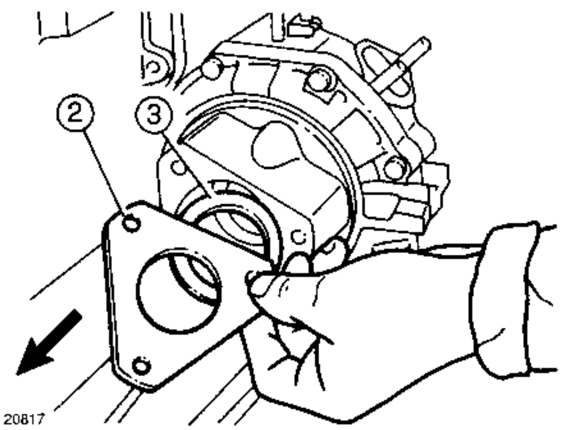
40. Remove mounting screws and then the complete fuel feed pump (7).



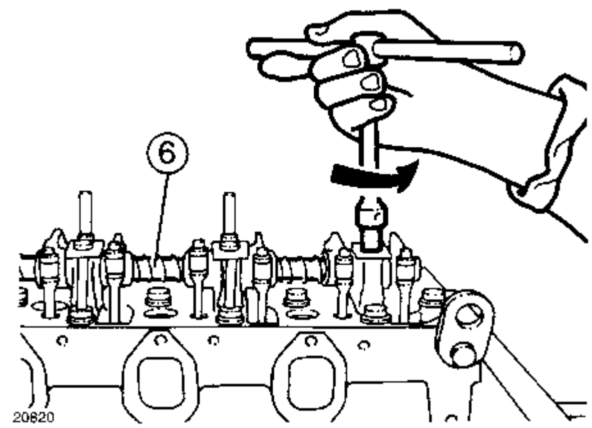
41. Remove mounting screws first and then the fuel injection pump (1) together with the associated drive coupling (9).



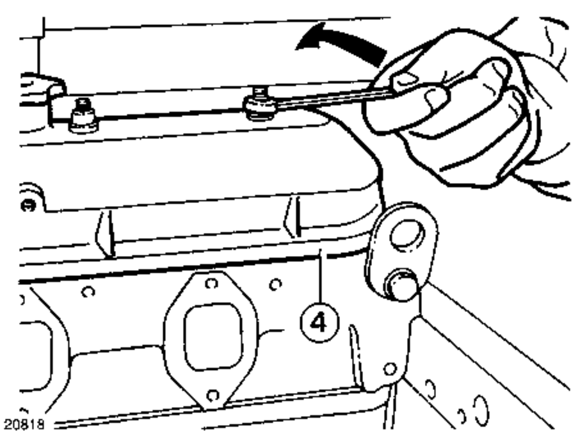
44. Unscrew the mounting bracket screws, then withdraw fuel injectors (5) from cylinder head.



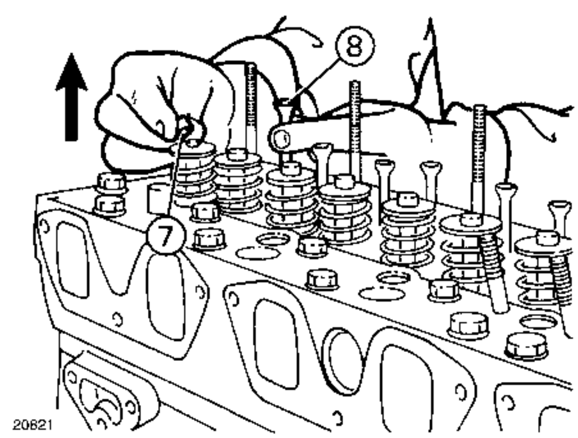
42. Retrieve gasket (2) and inside spacer (3).



45. Remove attachment screws first and then the complete valve rocker arm shaft (6).



43. Remove atachment screws first and then the valve rocker arm compartment cover (4).



46. Remove valve dogs (7) and withdraw valve guide stems (8).

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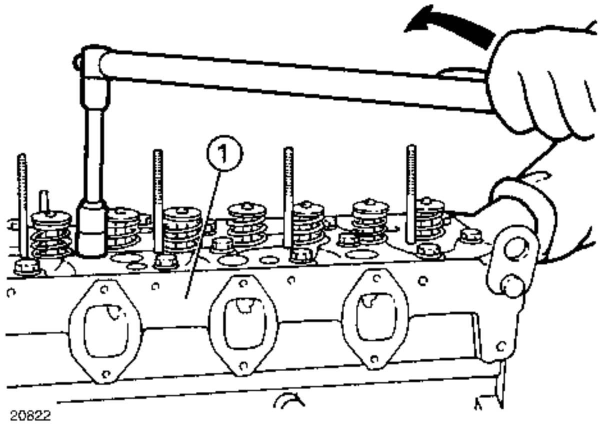
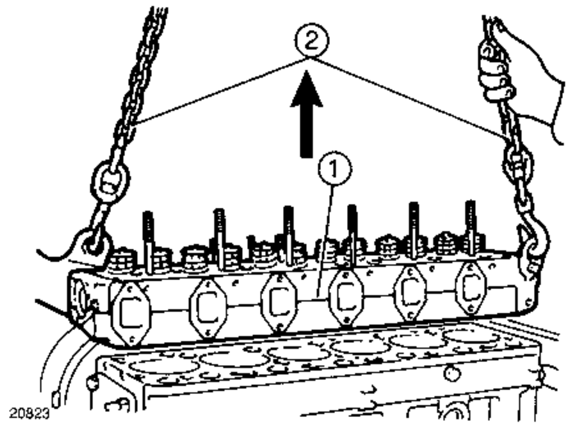
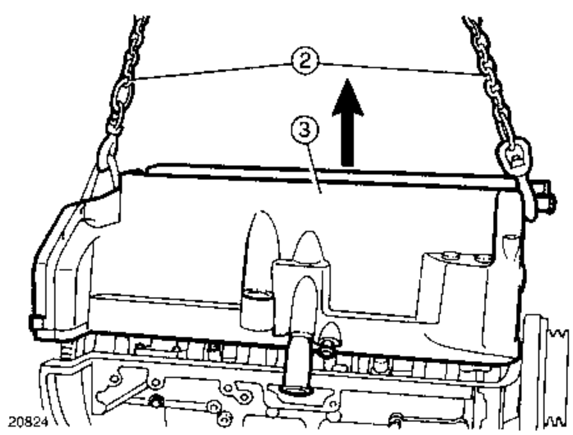


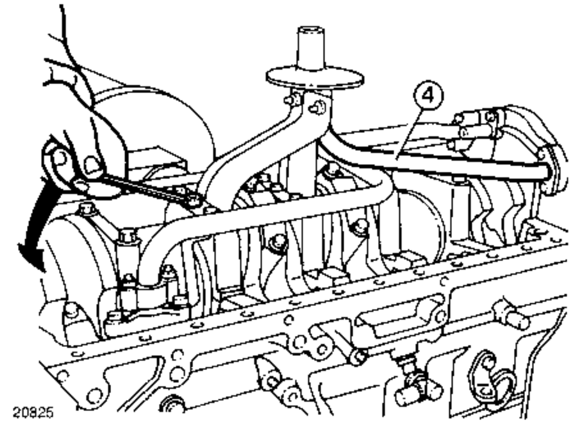
47. Unscrew all of the cylinder head (1) bolts.



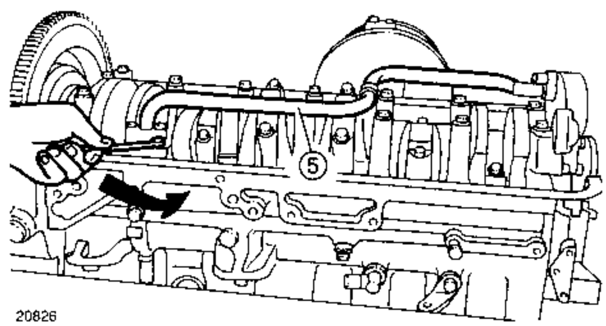
48. Remove the cylinder head (1) using a hoist and special hook tool no. **290740/1** (2).



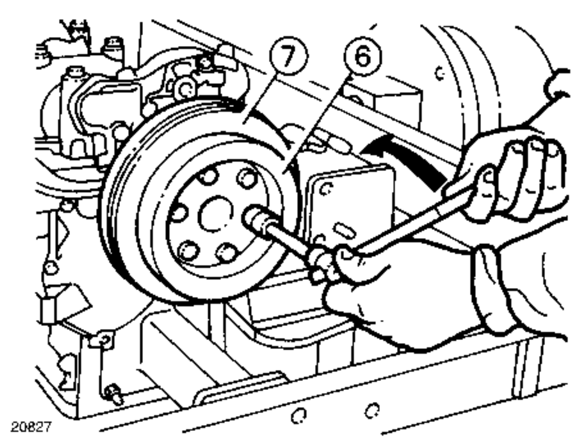
49. Rotate the engine 180 deg., unscrew the oil sump (3) attachment bolts and then remove the sump itself using a hoist, special hook **290740/1** (2) and suitable lift eyes.



50. Remove attachment screws first and then retrieve the complete lube oil suction line (4).



51. Unscrew the attachment bolts and then remove the lube oil delivery line together with chronotachometer drive.



52. Remove attachment screws first and then the pulley (6) together with damper flywheel.

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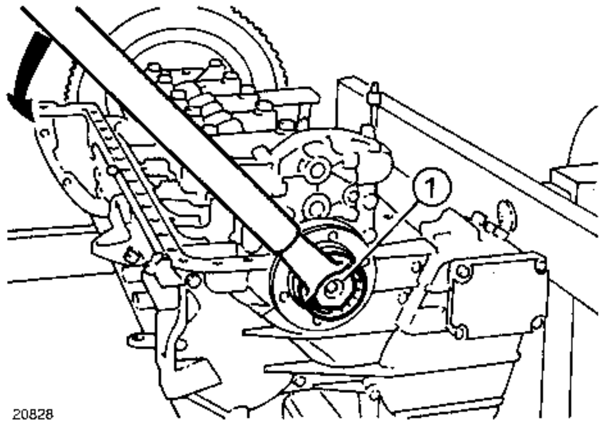
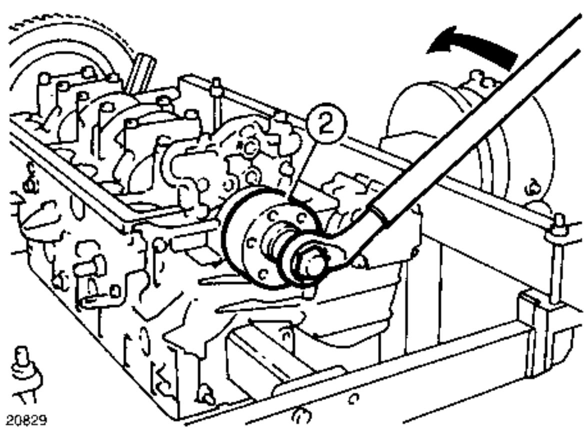
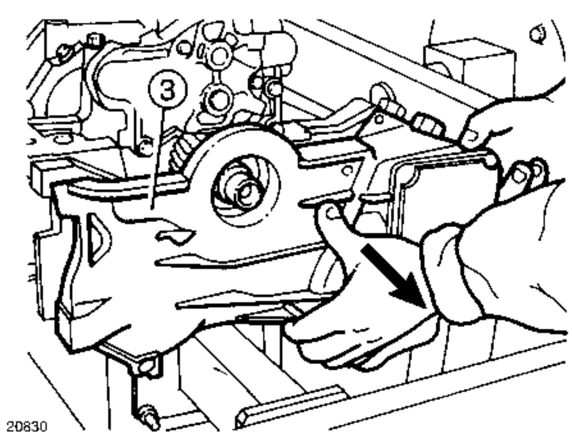


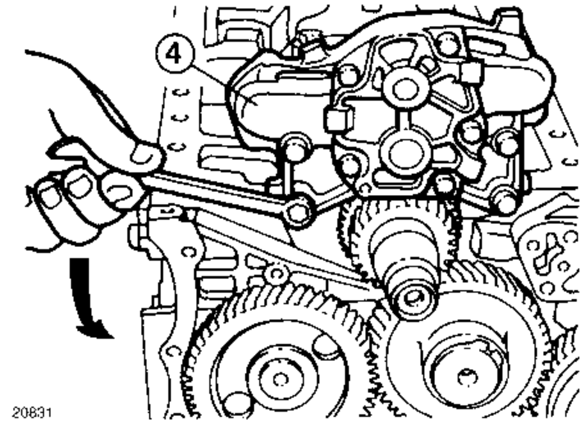
53. Unbend the safety tab first and then unscrew nut (1), suitably preventing the crankshaft from turning.



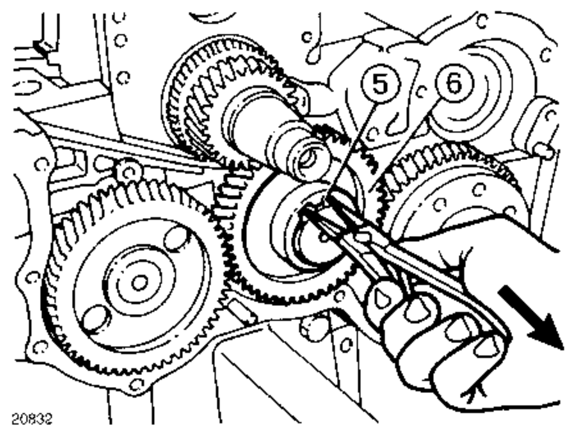
54. Remove the crankshaft hub using puller **291504** (2) and suitably preventing the shaft from turning.



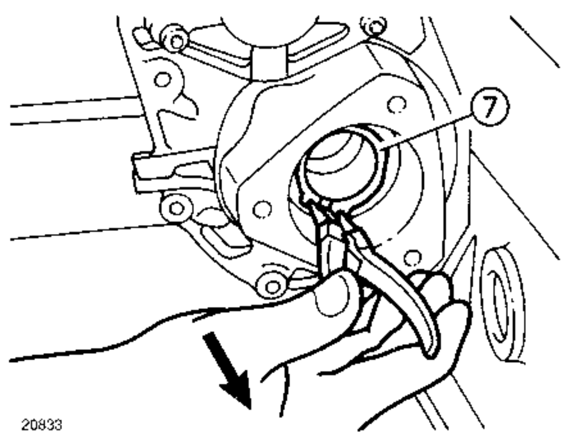
55. Remove attachment screws first and then the timing cover (3).



56. Remove attachment screws first and then the lube oil pump (4).



57. Remove snap ring (5) and then retrieve the idler gear (6).



58. Remove snap ring (7) and then retrieve, from opposite end, the fuel injection pump drive gear.

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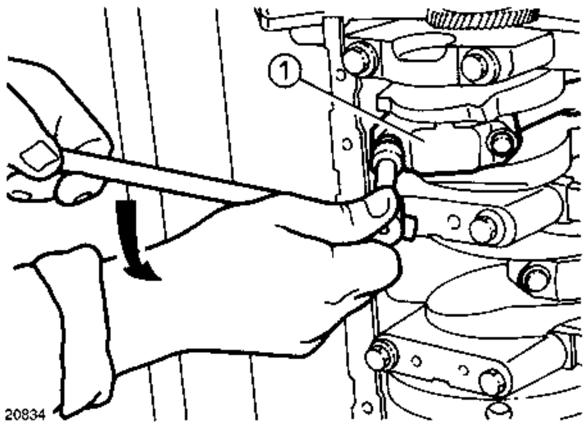
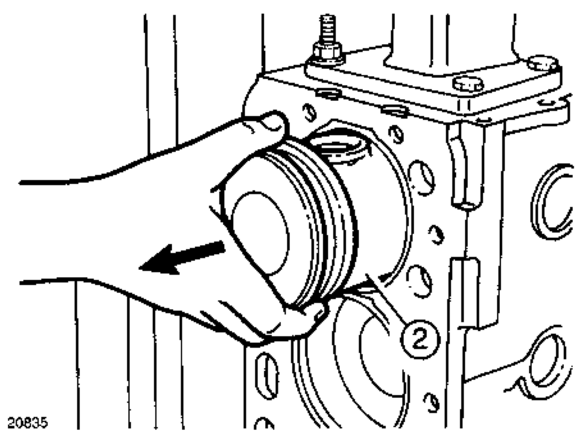
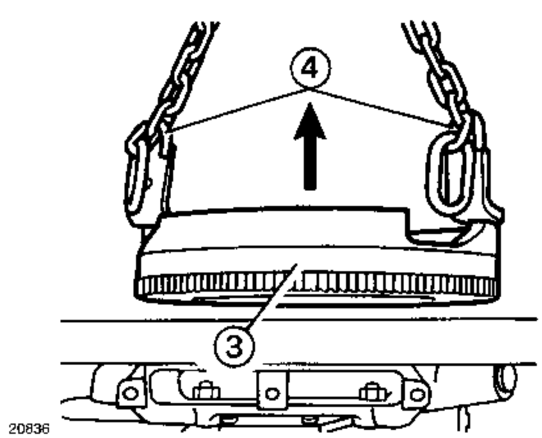


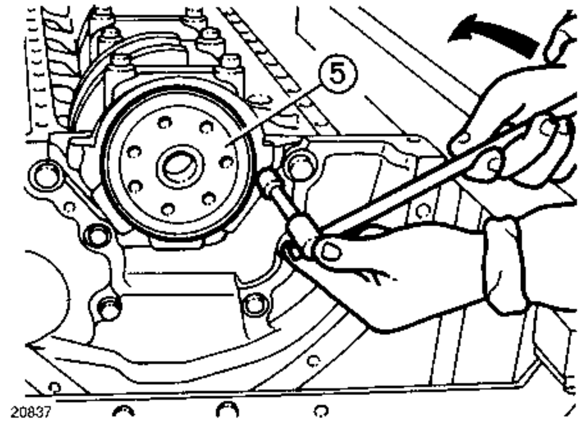
59. Rotate the engine 90 deg., unscrew mounting bolts first and then the connecting rod caps (1) and associated bearings.



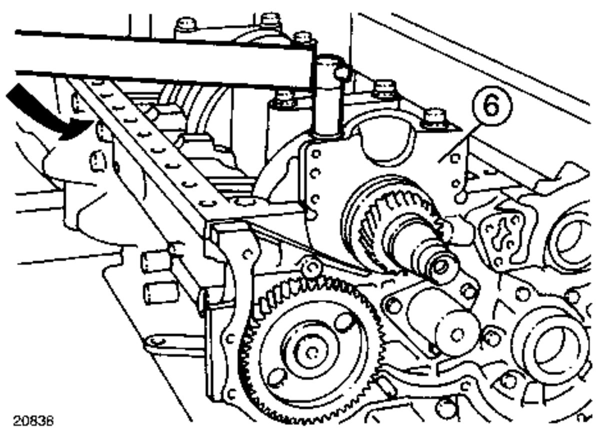
60. Slide pistons (2) out together with their rings, pins and connecting rods.



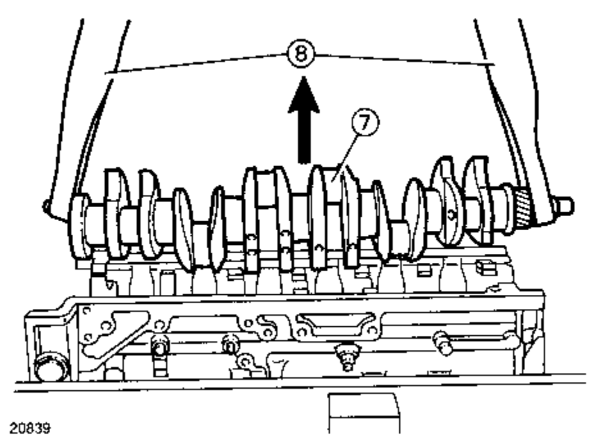
61. Remove mounting bolts first and then the complete flywheel (3) with hub, using a hoist and special hook **290740/1** (4).



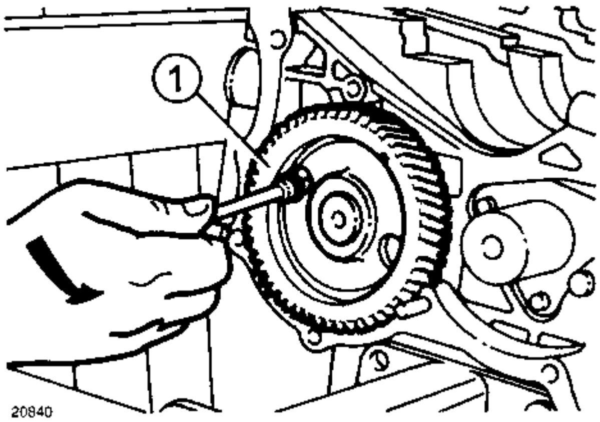
62. Remove attachment screws first an then the rear cover (5) complete with seals.



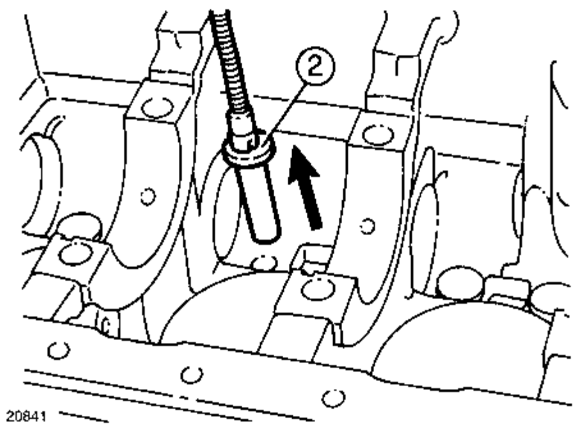
63. Unscrew the bolts first and then remove the main bearing caps (6), bearings and thrust washers.



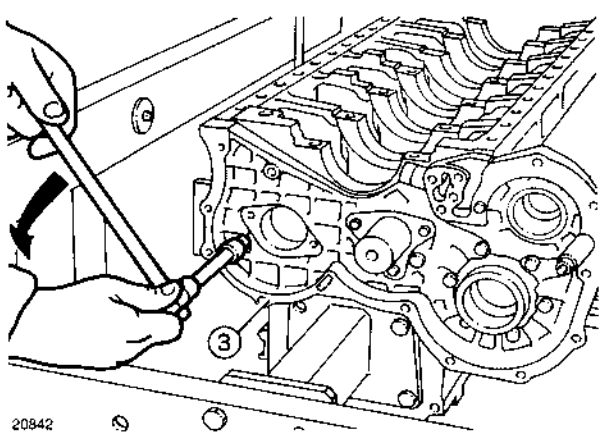
64. Remove the engine crankshaft (7) using a hoist and nylon rope (8), and finally retrieve bearings and thrust washers.



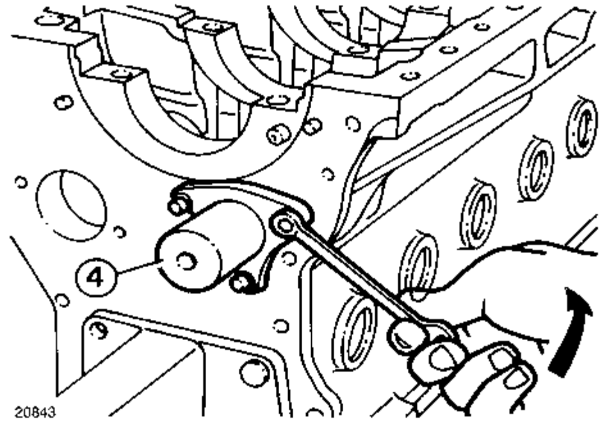
65. Remove screws first and then withdraw the camshaft (1).



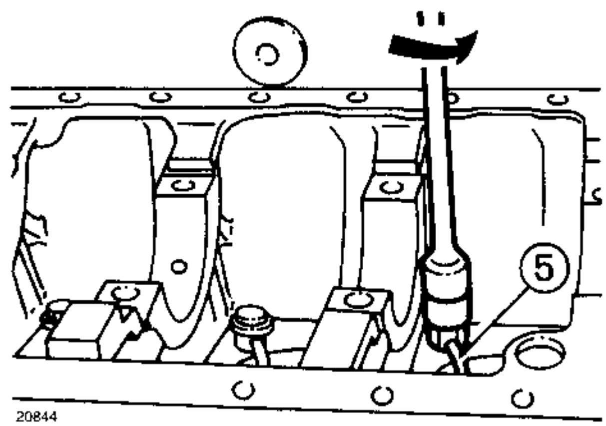
66. Remove engine valve tappets (2).



67. Unscrew the mounting bolts first and then remove the valve timing gear case (3).



68. Remove attachment screws first and then the idler gear axle (4).



69. Unbend the safety tab, unscrew the connection and retrieve the piston lube nozzle (5).

70. Re–assemble engine as follows:

CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

All gaskets and seals must be replaced **everytime the engine has been totally or partially dismantled.**

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

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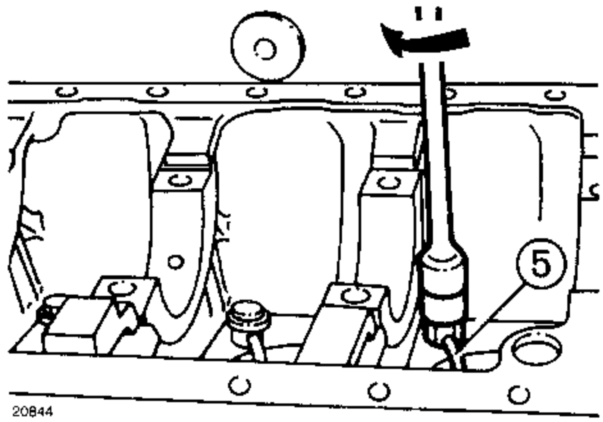
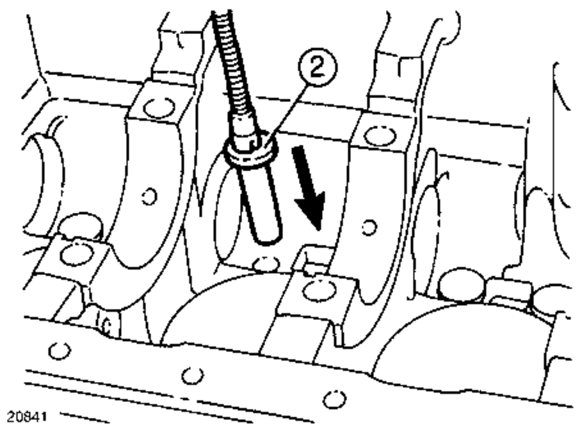
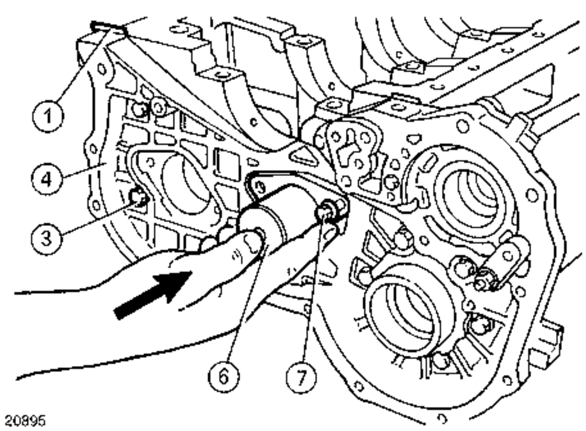


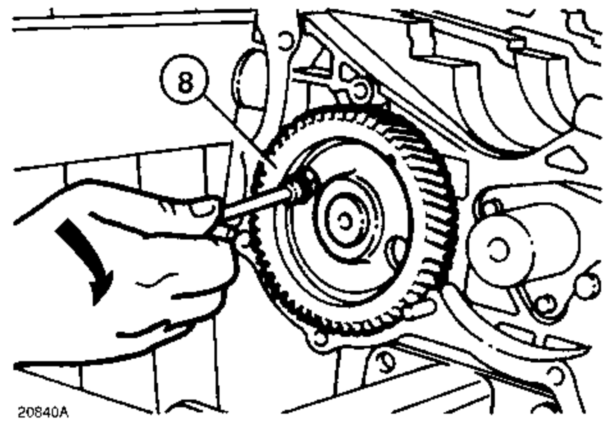
71. Fit the piston lube nozzle (5), torque tighten it to specifications (see on page 10–27) and finally bend the safety tab.



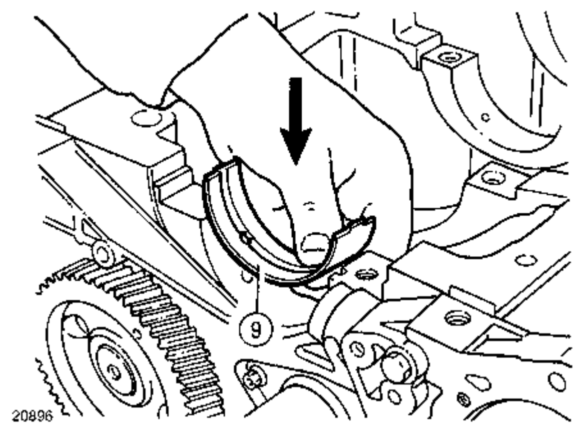
72. Lubricate valve tappets (2) using engine oil and then introduce them in their respective crankcase seats.



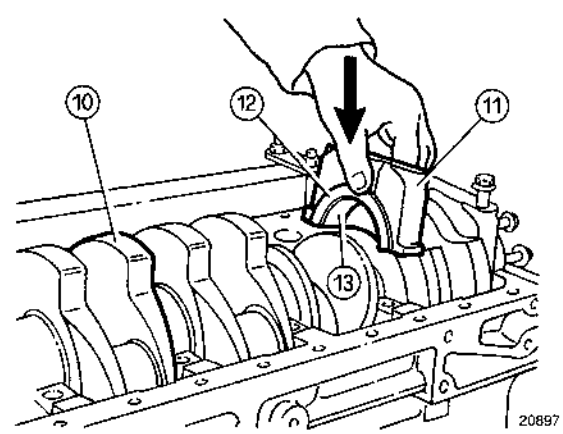
73. Place gasket (1) in contact with the crankcase mating surface, install the timing gear case (4), torque tighten the associated screws (3) to torque specifications (see data on page 10–27), introduce the intermediate pin (6) and finally tighten bolts to torque specifications also.



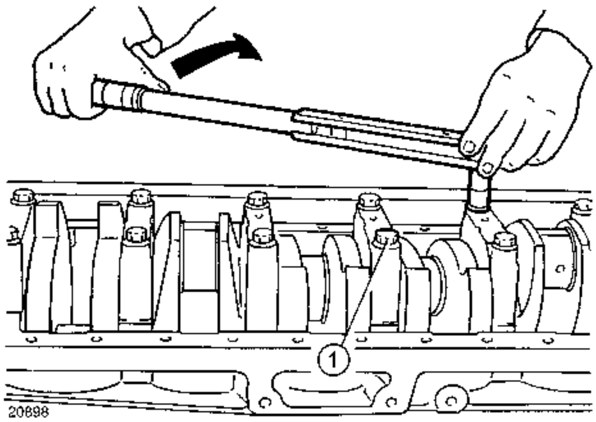
74. Lubricate and then introduce the valve timing gear camshaft and finally torque tighten its securing screws (8) to specifications (data on page 10–27).



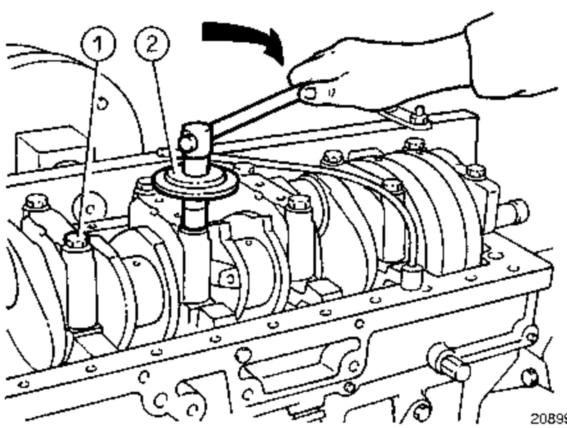
75. Place and position bearing shells (9) on crankcase.



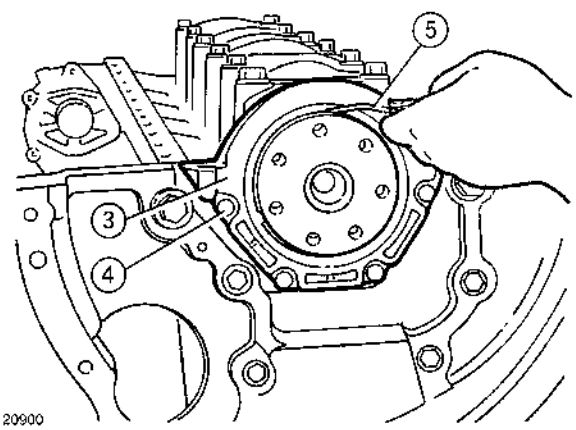
76. Install the engine crankshaft (10) complete with thrust half–rings, place main bearing caps (1) together with associated bearing shells (13) keeping in mind that thrust rings (12) are associated with and fitted on the sixth main bearing cap.



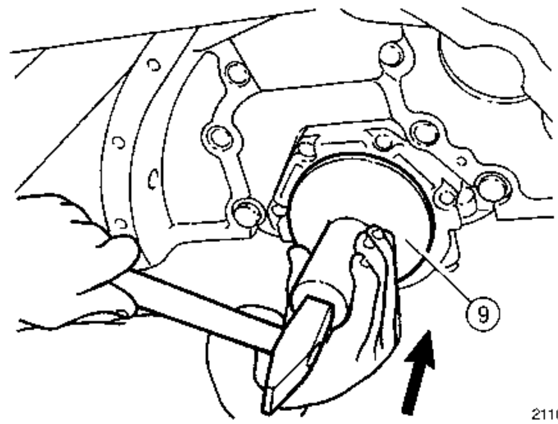
77. Torque tighten all main bearing cap bolts (1) at 80 Nm (8.2 kgm – 59.3 lb.ft).



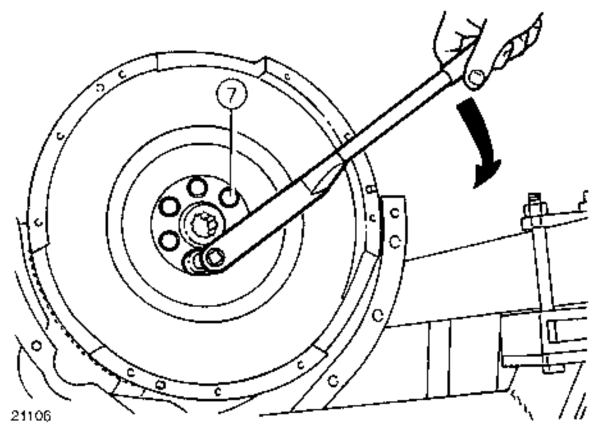
78. Use special tool **292248** (2) to further tighten each and every main bearing cap screw (1) through a 90 deg. angle.



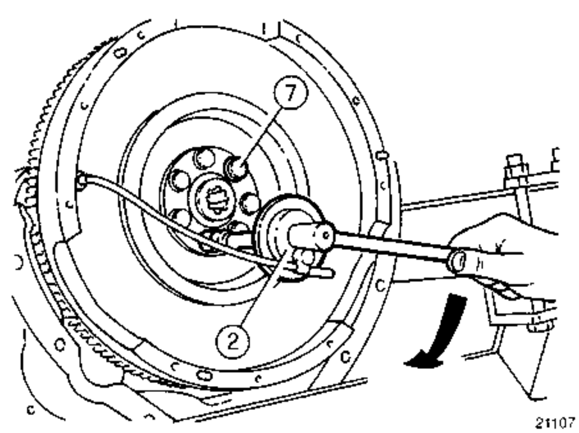
79. Fit the rear cover (3) together with its gasket, torque tighten the associated screws to specifications (data on page 10– 27) and finally, using a feeler gauge (5), make sure that the crankshaft flange is axially aligned with cover.



80. Force fit the rear seal using special tool **293299** (6) and associated grip **293708**.



81. Torque tighten all screws (7) at 40 Nm (4.1 kgm – 29.6 lb.ft).



82. Use special tool **292248** (2) to further tighten each flywheel screw (7) through a 60 deg. angle.

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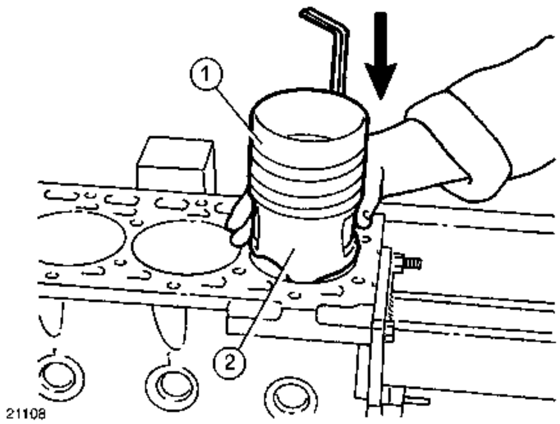
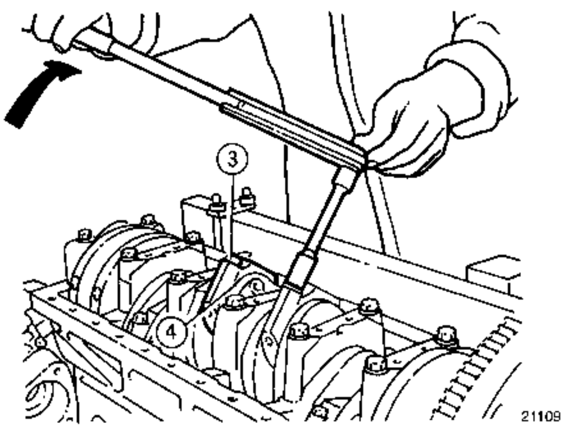
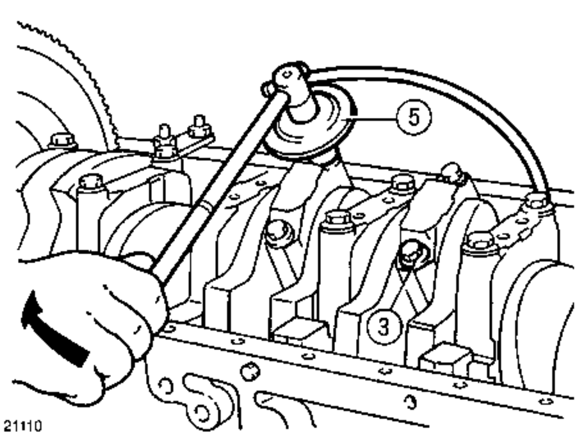


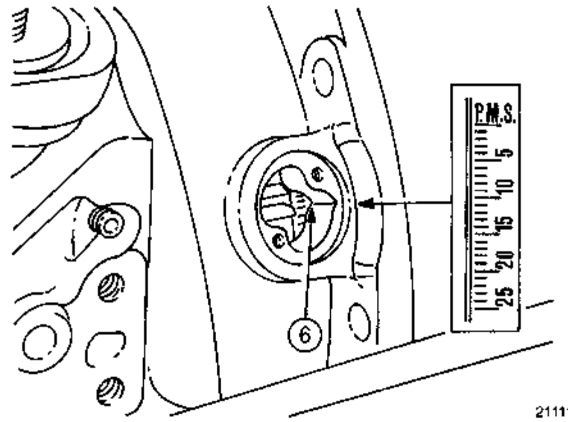
83. Use special tool **291048** (1) to introduce the complete pistons (2), with rings, connecting rods and pins.



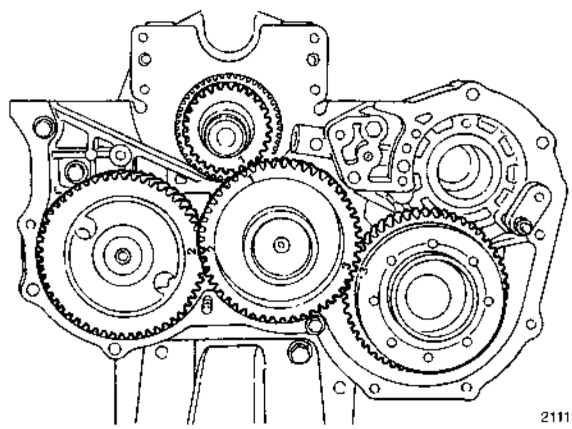
84. Place and fit the complete connecting rod caps (4) and bearings onto the engine crankshaft and torque tighten screws (3) at 40 Nm (4.1 kgm – 29.6 lb.ft).



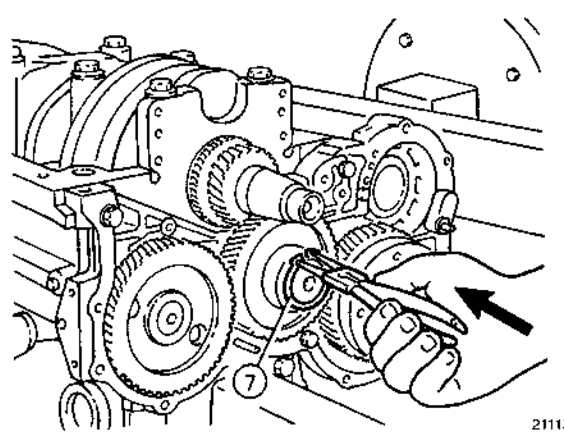
85. Use special tool **292248** (5) to further tighten all connecting rod bearing cap screws through a 60 deg. angle.



86. Bring pistons no. 1 and no. 6 to T.D.C. and check, through the bore, the alignment of the T.D.C. mark with the angle (6) of the bore itself.



87. Install the timing gears making sure that reference numbers etched on gears coincide.



88. Lock the intermediate gear in place by fitting the snap ring (7).

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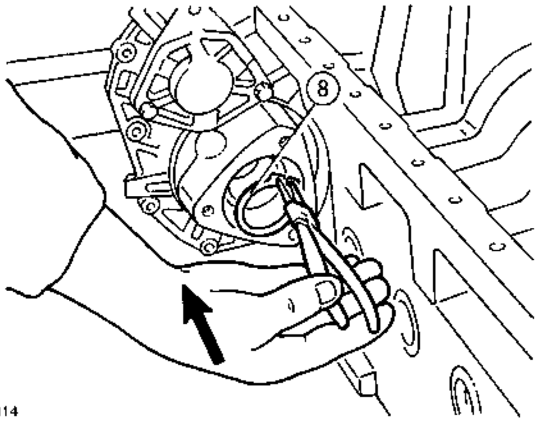
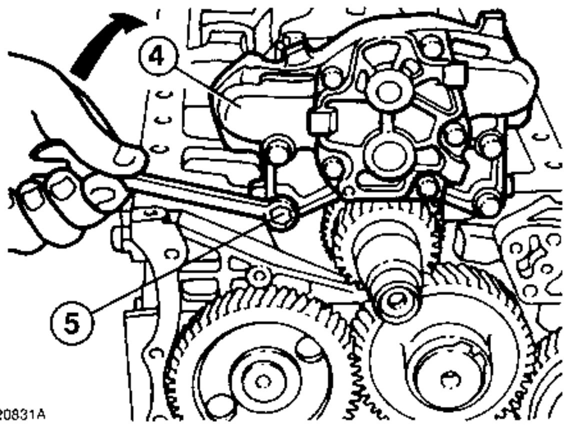


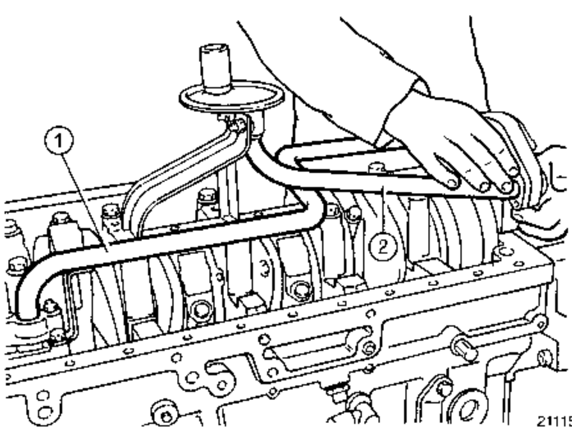
21114

89. Block the fuel injection pump drive gear by fitting the snap ring (8) in its seat.



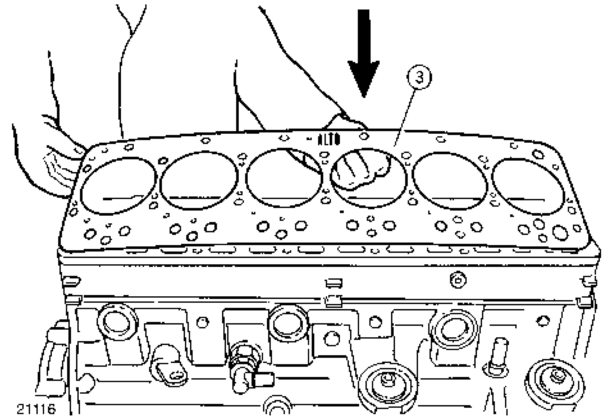
20831A

90. Place the lube oil pump (4) and secure it in place by torque tightening its mounting screws to specifications (refer to data on page 10–27).



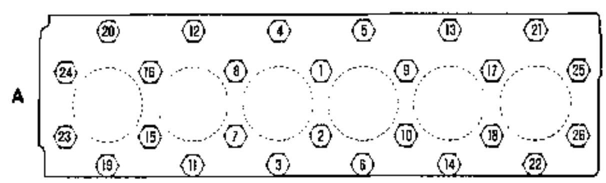
21115

91. Install the oil delivery line (1) and its sealing gasket and the complete suction line (2) also complete with filter and gasket and finally secure all by tightening the associated screws.



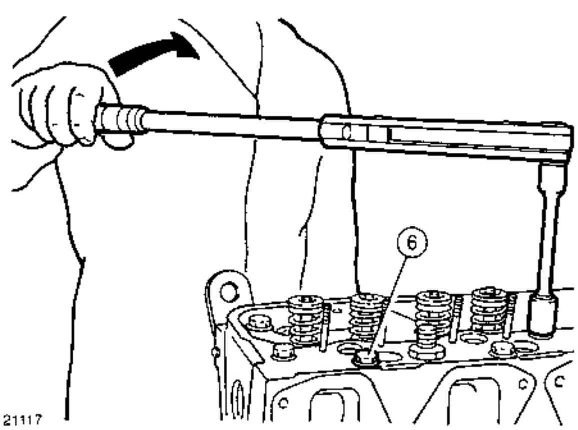
21116

92. Rotate engine through 180 deg. and place the cylinder head gasket (3) with the mark ALTO turned upwards.



20864

93. Cylinder head bolt tightening sequence for each of the 4 phases of tightening (A = fan side).



21117

94. Place the cylinder head on crankcase, screw on bolts (6) until contacting the head and then torque tighten the same at 70 Nm (7.1 kgm – 51.3 lb.ft) in the sequence shown in the figure above (1st stage). Re–check torque on all bolts (2nd stage).

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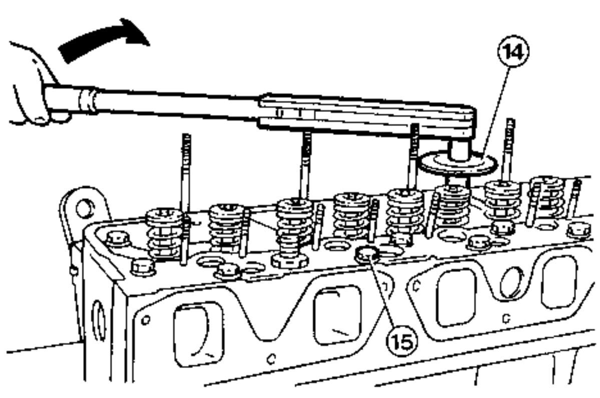
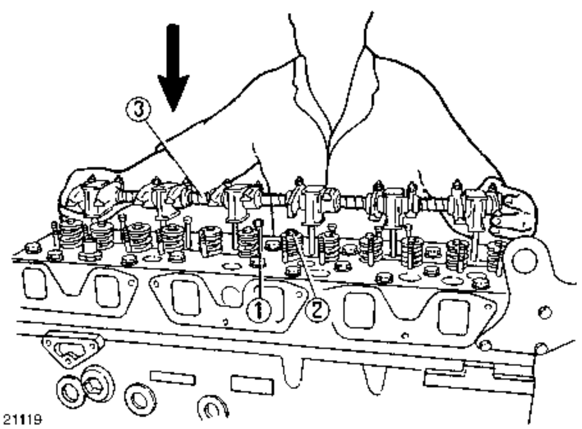


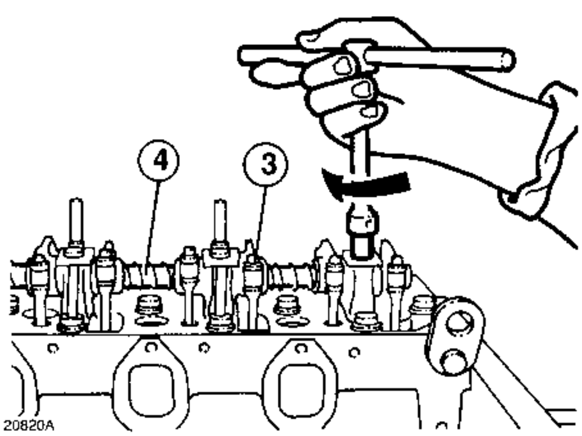
21118

95. Use tool **292248** (14) to screw on each cylinder head bolt (15) through a 90 deg. angle (3rd stage) and, finally, further screw them on another 90 deg. (4th stage), always following the sequence scheme shown in the figure of page 10–53.



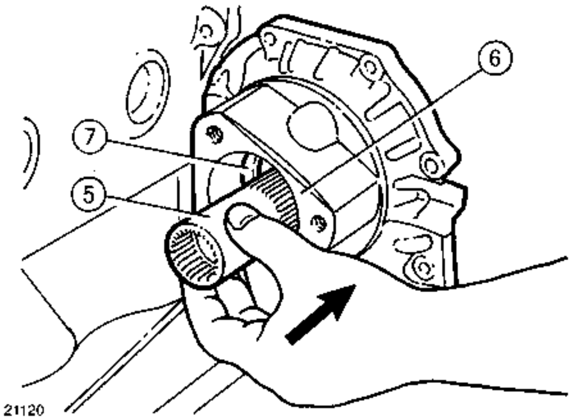
21119

96. Fit the valve tappet rods (1), place caps (2) on valves and install the complete shaft (3) with rocker arms.



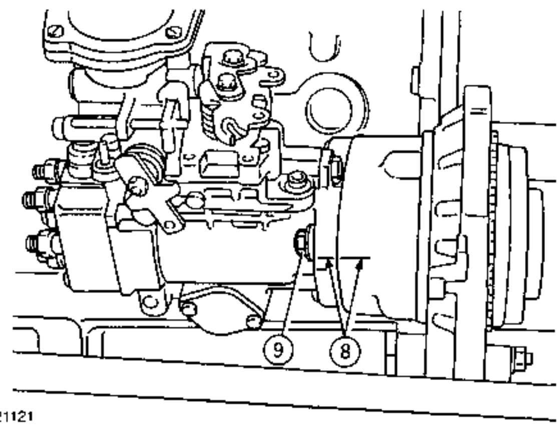
20820A

97. Torque tighten the rocker arm shaft (4) supporting bracket attachment screws (3) to specifications (see on page 10–27) and adjust valve clearance (see directions on page 10–77).



21120

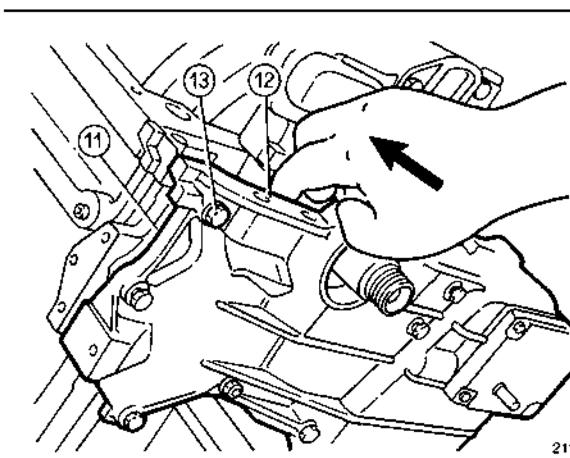
98. Fit the spacer washer (7), place the gasket (6) and introduce the drive joint (5).



21121

99. Place the injection pump in its final installation position on the engine, make reference signs (8) coincide and tighten screws (9) to torque specifications (see on page 10–27).

Note – Should reference marks (8) be missing or unreliable, proceed to time the injection pump for correct phasing with engine by following directions given on pages 10–80 through 10– 86.



21122

100. Fit gasket (11), timing gear cover (12) and tighten screws (13) to torque secifications (see on page 10–27).

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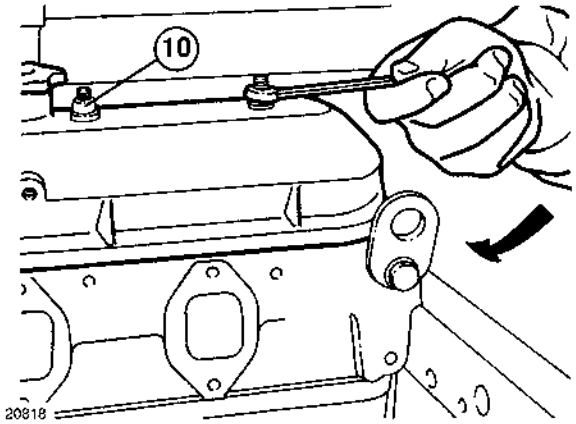
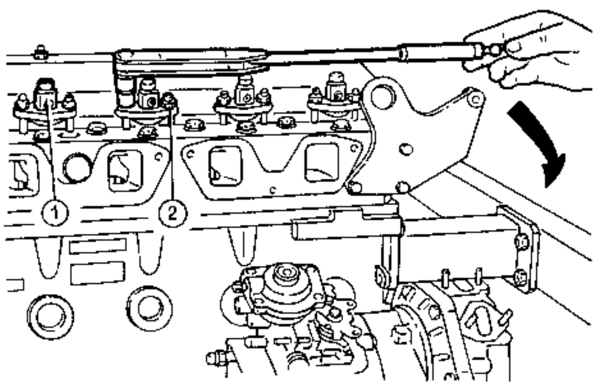
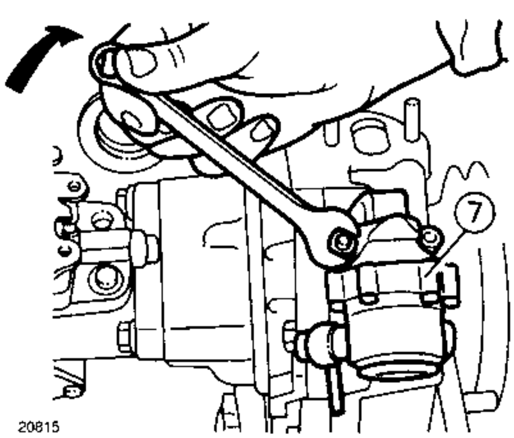


101. Install the valve rocker arm compartment cover, associated gasket and tighten nuts (10) to torque specifications (see on page 10–27).

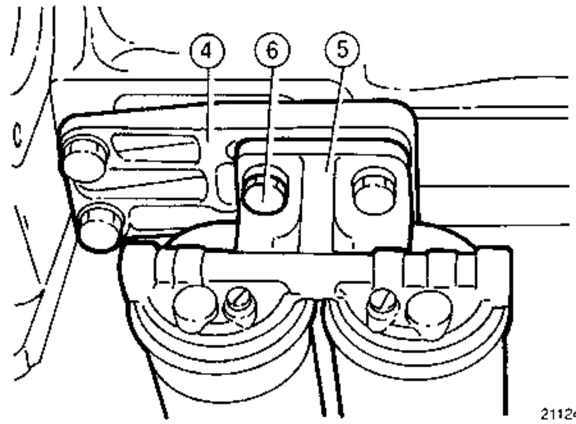


21123

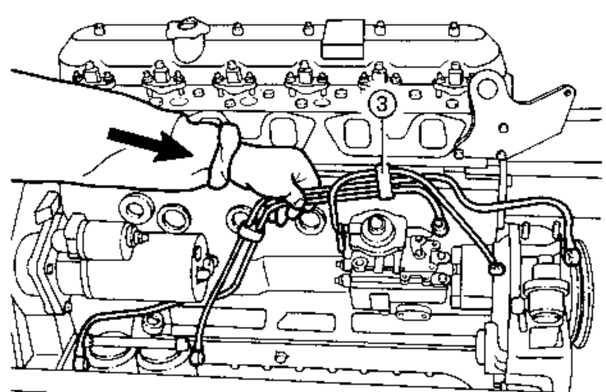
102. Introduce injectors (1) in their respective housings on cylinder head and screw on all nuts (2) until abutting against the injector bracket. Torque tighten all nuts (2) at 10 Nm (1 kgm – 7.23 ft–lb) (1st stage) and subsequently a further 25 Nm (2.6 kgm – 18.8 ft–lb) (2nd stage).



103. Install the fuel injection pump and secure it by tightening its screws.

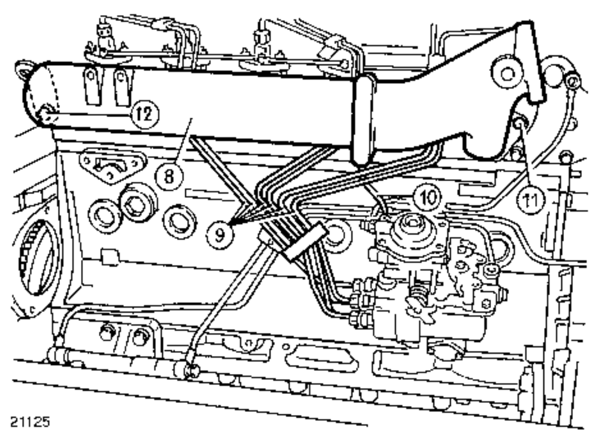


104. Fit the fuel filter support (5) together with spacer (4) and filter elements, then torque tighten screws (3) to torque specifications (see on page 10–27).



20811

105. Fit the injection pump, feed pump and connecting fuel lines (3).



106. Fit the intake manifold (8) and associated gaskets together with injectors–pump connecting lines (9) and then torque tighten the screws (11 and 12) to specifications (see on page 10–27). Fit the injector excess fuel recovery line (13) complete with washers.

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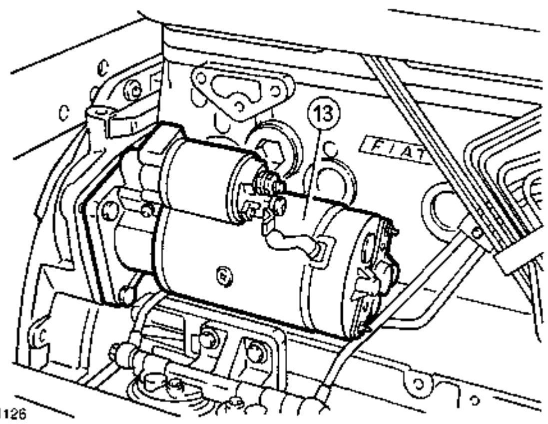
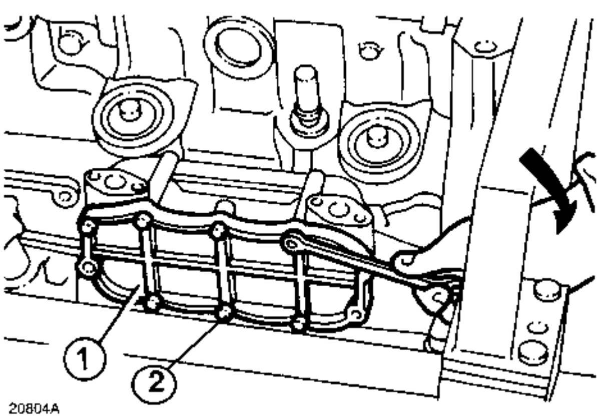


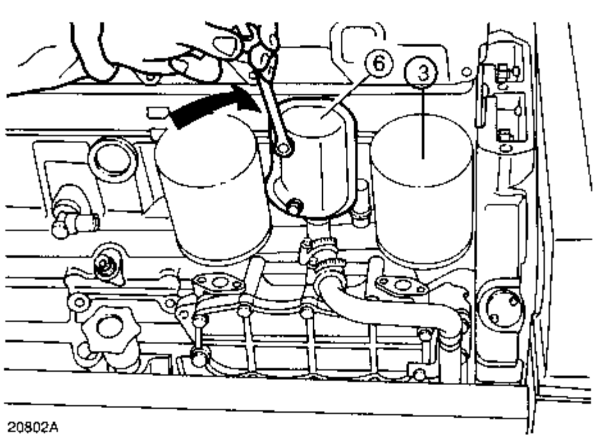
21126

107. Install the starter motor (13) and secure it in place by tightening the screws.



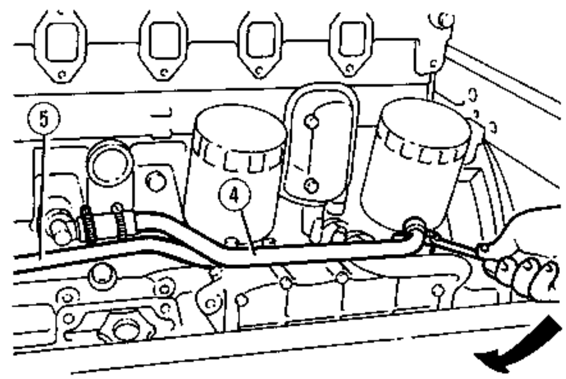
20804A

108. Place the heat exchanger (1) in position together with the associated spacer and then torque tighten screws (2) to specifications (see on page 10–27).



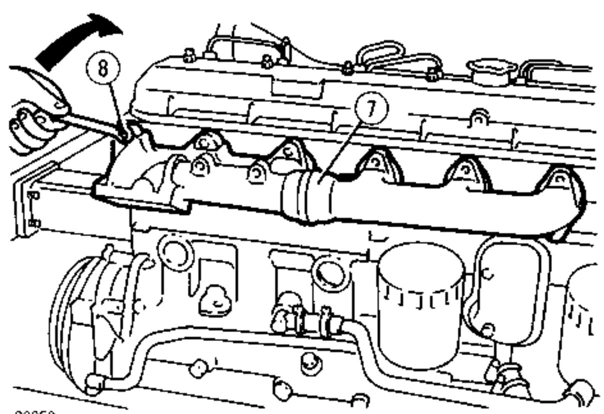
20802A

109. Install oil filters (3),after wetting their gaskets in oil, and the exhaust vapour duct (6).



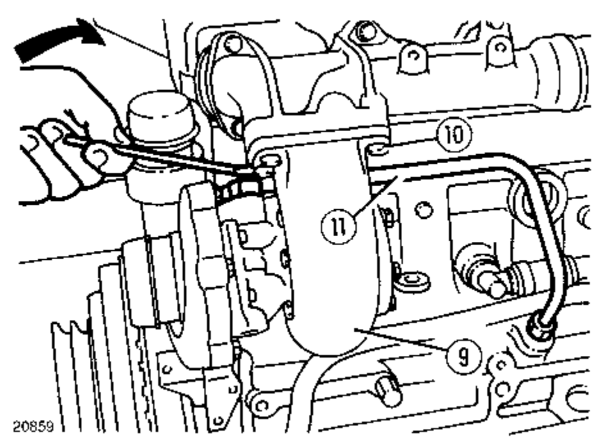
20857

110. Place pipes (4 and 5) connecting, respectively, heat exchanger to crankcase and heat exchanger to radiator, together with their sealing gaskets.



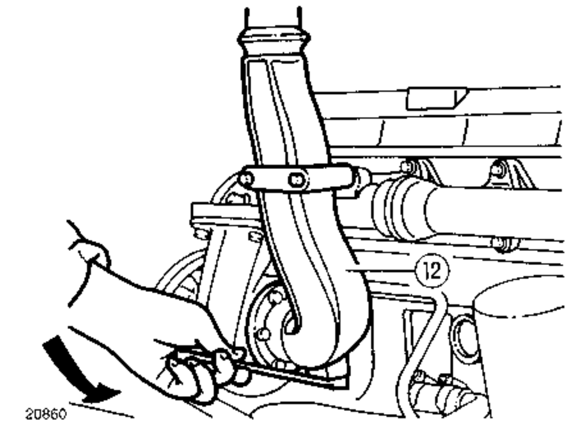
20858

111. Install the exhaust manifold (7), associated gaskets and torque tighten attachment screws (8) to specifications (see on page 10–27).

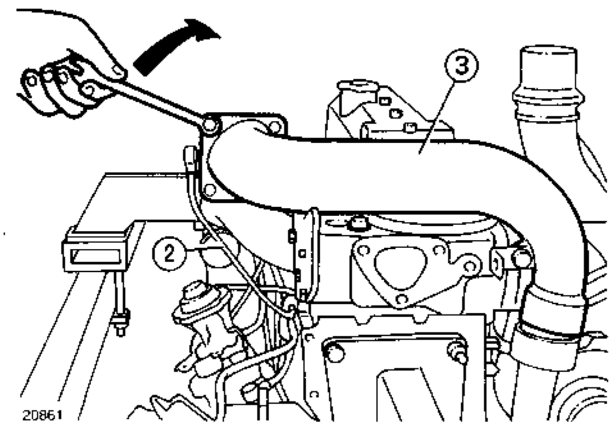


20859

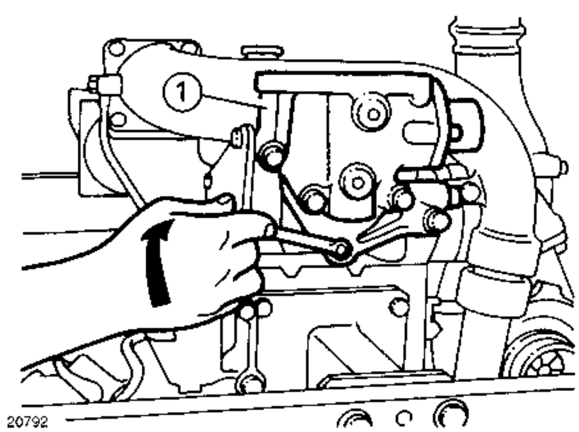
112. Install the turbocharger unit (9), its gasket and the secure it in place by torque tightening screws (10) to specifications (see on page 10–27). Fit the lube oil delivery line (11) and sealing gaskets.



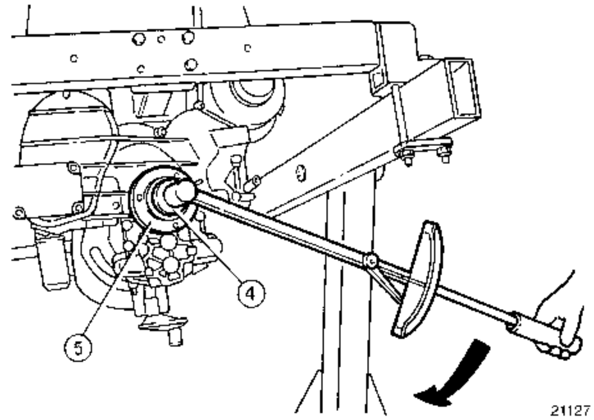
113. Fit duct (12) connecting the turbocharger to the exhaust muffler and associated gasket.



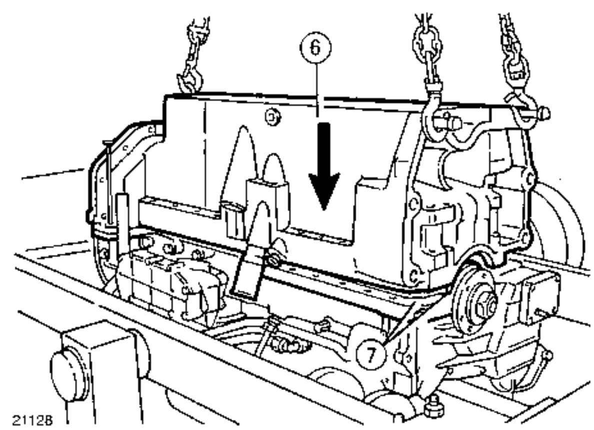
114. Fit conveyor (3) connecting the turbocharger to the air intake manifold, its gasket and secure the connecting line (2) to injection pump.



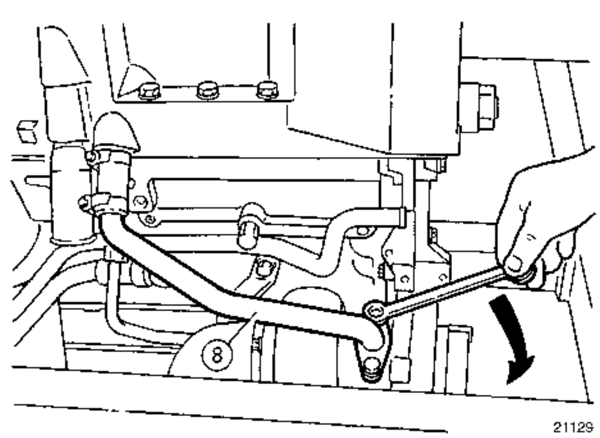
115. Place thermostat (1) with gasket and tighten the mounting screws.



116. Place hub (5) on engine crankshaft, fit the nut (4) with projecting side facing the shaft, safety plate and torque tighten to specifications (see on page 10–27). Lock punch the safety plate.



117. Place the engine oil sump (6), gaskets (7) and tighten mounting bolts.



118. Fit the turbocharger drain pipe (8) and associated gasket.

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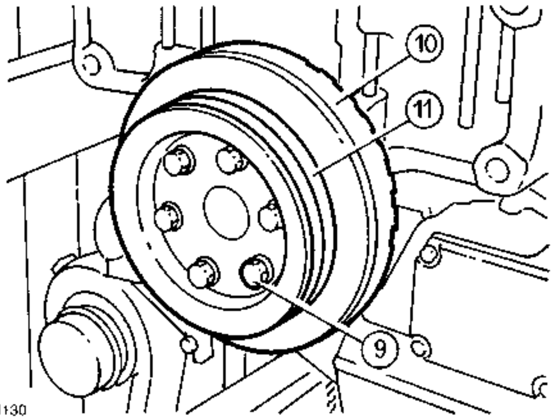
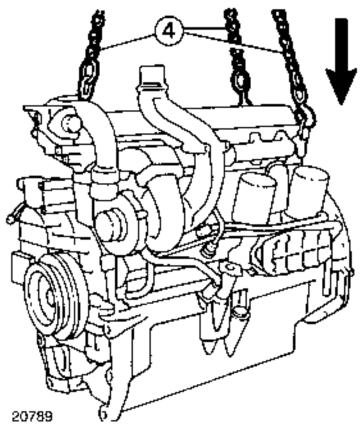


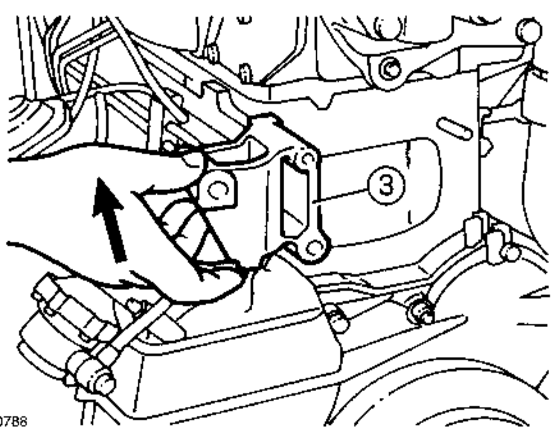
21130

119. Place the damper flywheel (13), drive pulley (14) and torque tighten screws (15) to specifications (see on page 10–27).



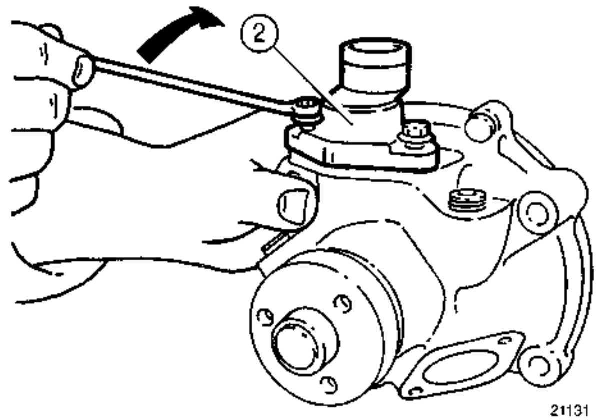
20789

120. Using the special sling tool no. **290740/1** (4) hoist up the engine assembly from the turn–over shop stand and place it on a suitable support.



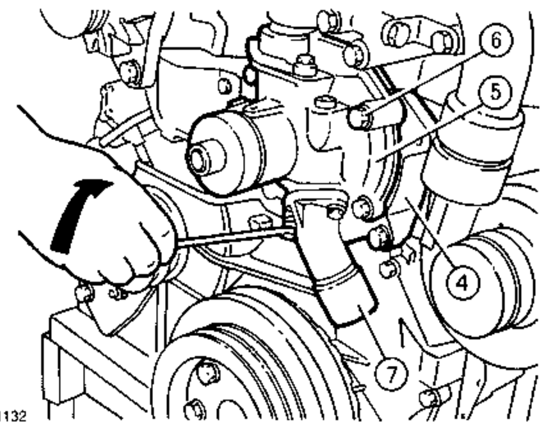
20788

121. Fit the alternator mounting bracket (3) and tighten its screws.



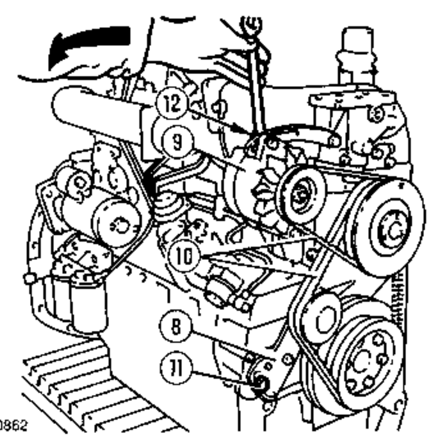
21131

122. Fit hose (2) and gasket on the engine cooling plant pump.



21132

123. Fit spacer (4) and gasket. Place the cooling plant pump (5) in position, with gasket, and then torque tighten securing bolts (6) to specifications (see on page 10–27). Finally, fit the flanged connection (7) and gasket.



20862

124. Install the belt tightener (8), its screws (11), the alternator (9), its nut (12), belts (10) and adjust the latter at the correct tension (see data on page 10–71, 10–72 and 10–73). Finally, tighten the screws (11) and nut (12) to torque specifications given on page 10–27.

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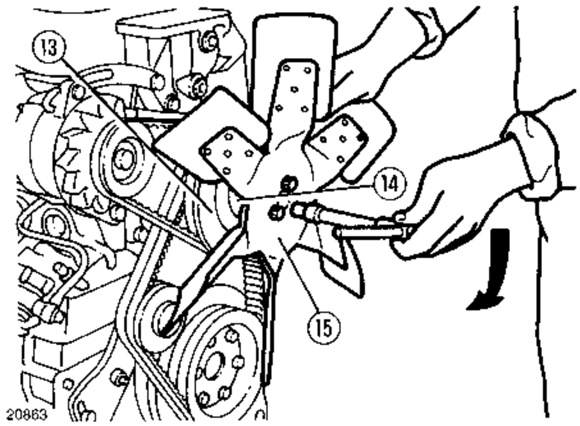
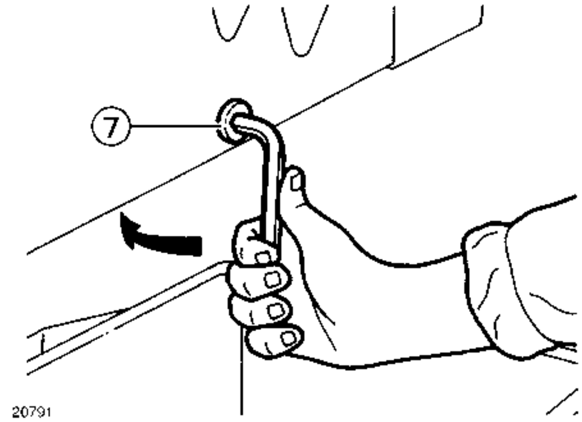
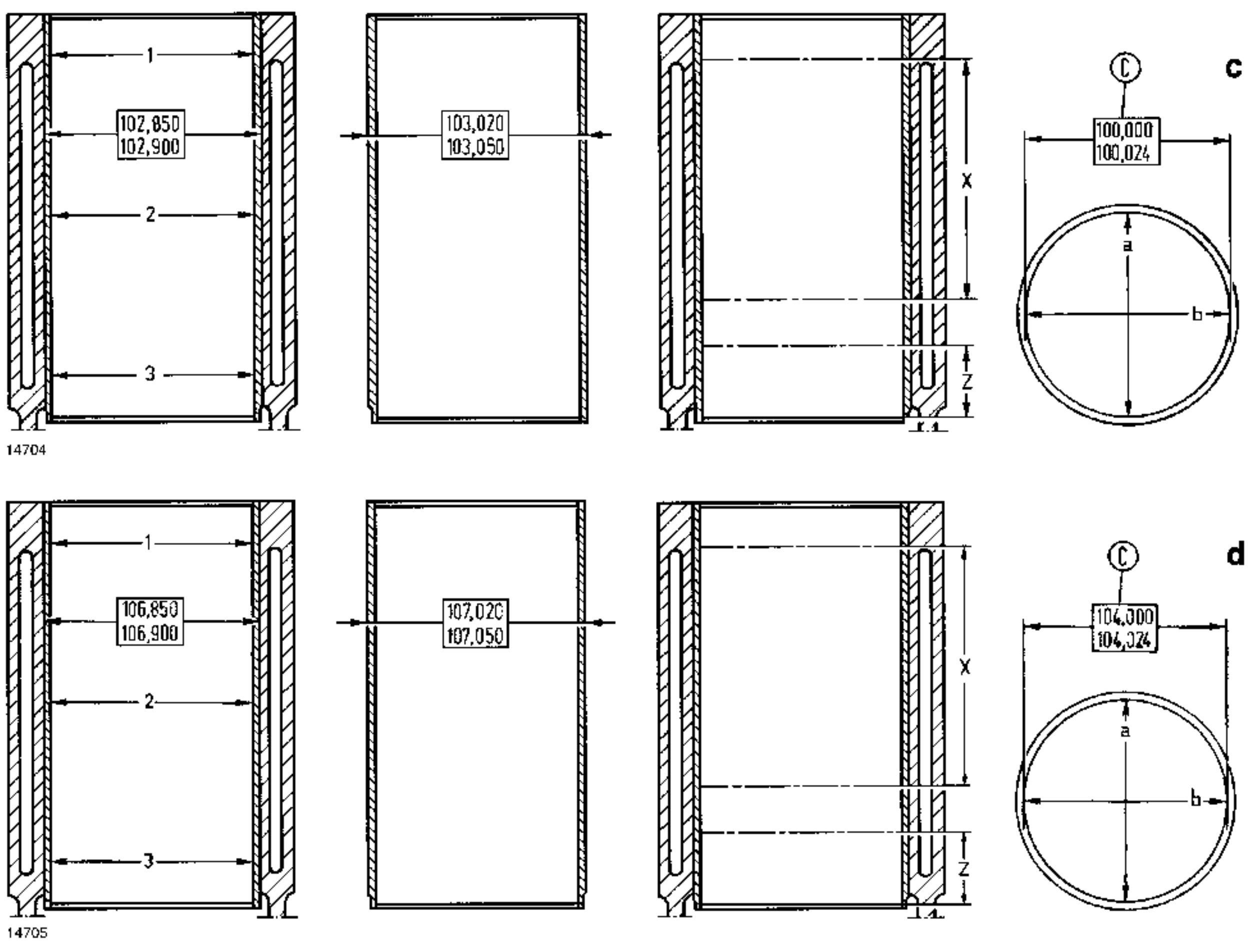


125. Install the pulley (13), spacer (14) and fan (15).



126. Fit the drain plug (7) on engine oil sump and fill–up with lube oil of prescribed type and quantity.



Standard cylinder liner and crankcase seat dimensions (mm)

a, b. Comparator gauge cross–measurement planes – c. Model F100 – d. Models F 110, F 120 and F 130 – C. Dimension obtained by reaming after cylinder liner force–fitted installation – Z. Worn cylinder liner I.D. measuring position to find the mating clearance fit with pistons (measure along axis b perpendicular to the crankshaft) – X. Worn cylinder liner I.D. measuring position (corresponding to piston ring working area) to find ovalization and taper (measure along axes a – b, parallel and perpendicular to crankshaft, respectively) – 1,2 and 3 . New or bored cylinder liner I.D. cross–measuring plane, along two perpendicular axes (a,b).

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CHECKING, MEASURING AND REPAIRING THE CRANKCASE

Before starting, clean parts thoroughly.

Note – Cylinder liners should never be measured under removed or loose conditions because of deformations; measurement of the inside diameter should always be made after force–fitting cylinder liner in crankcase.

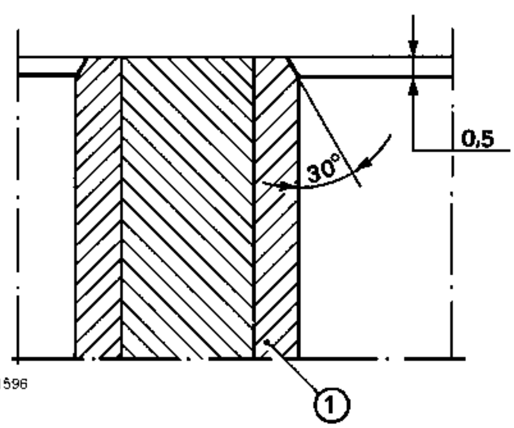
Check cylinder liners for wear as follows:

- measure I.D. in the piston ring working area (X, page 10–59);
- measure this area both at higher and lower locations along axis (a, page 10–59), parallel to crankshaft, and axis (b), perpendicular.
- compare readings to establish liner ovalization and taper.

To check piston/liner mating clearance, measure the I.D. of each liner in area (Z, page 10–59), solely along axis (b) perpendicular to crankshaft.

In case of out–of–round or taper greater than 0.12 mm (.005 in) or of piston/liner running clearance greater than 0.3 mm (.01 in), boring and grinding of liners is required (or their replacement) to obtain one of the available oversized dimensions (see page 10–3).
Subsequently, mate cylinder liners with pistons of the same oversize class (see page 10–3).

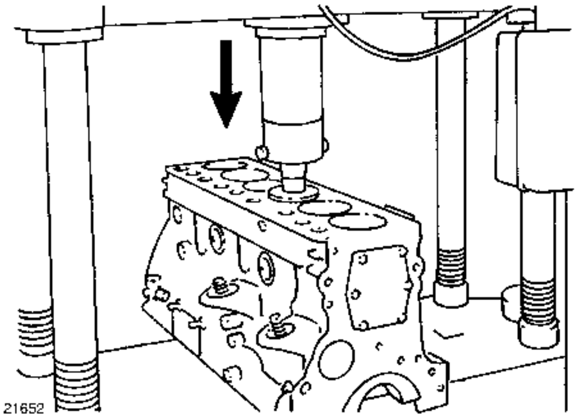
Note – If processed, all liners are subject to same oversize.



21596

After grinding, restore cylinder liner (1) chamfer = 0.5 mm (.2 in) at 30°.

Both removal and installation of cylinder liners on crankcase are cold–processed under a press as follows:



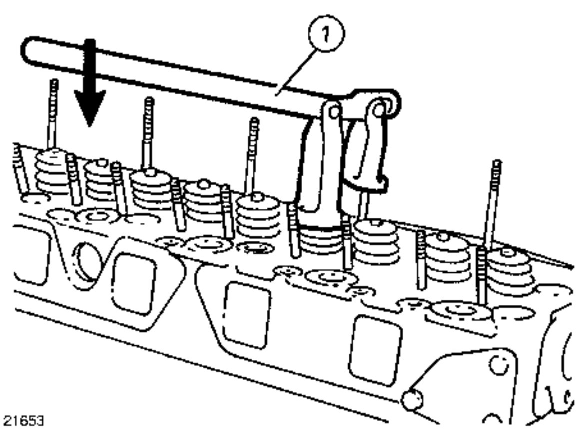
21652

– remove worn liner under a press, acting from crankcase bottom side and using the specific plates;
– verify crankcase bore for out–of–round; if necessary, re–bore it bringing diameter to 0.2 mm (.01 in) class oversize;
– install a new liner (in case, 0.2 mm oversize) by force–fitting from the crankcase upper side, under a press and using the specific plate;
– bore and grind liner to bring I.D. within specifications (see page 10–3).

Attention – If the crankcase/cylinder head mating surface is not perfectly flat, process it on a surface grinder at the least feasible depth.

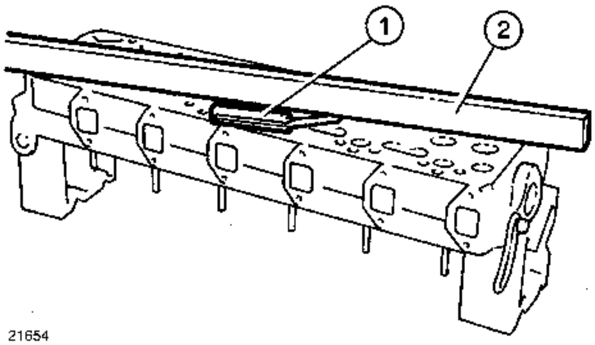
CHECKING, MEASURING AND REPAIRING THE CYLINDER HEAD

Before starting, clean parts thoroughly.



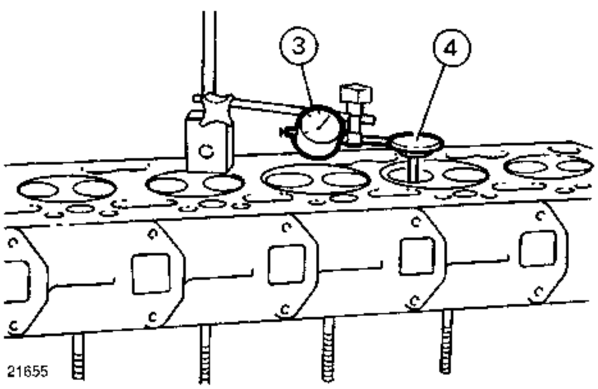
21653

At valve removal/installation make use of tool **291050** (1).



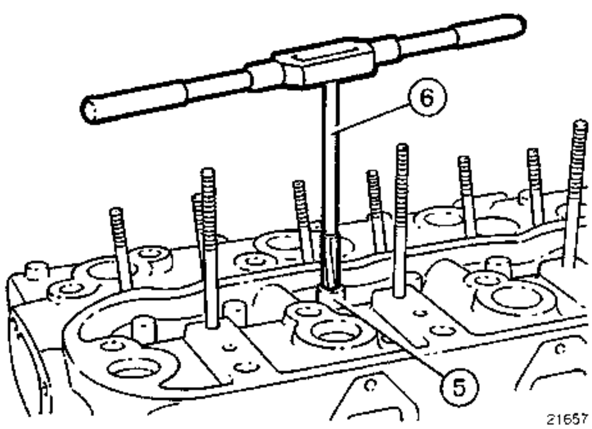
21654

Check the crankcase/cylinder head mating surface using a straightedge (1) and feeler gauge (2). If, over the entire length of face distortions greater than 0.15 mm (.01 in) are found, reface head on surface grinder.



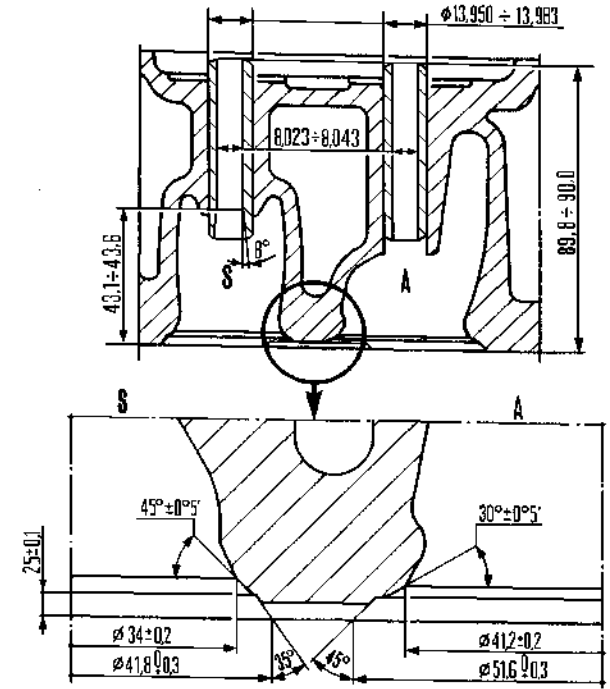
21655

Using a comparator gauge w/magnetic base check alignment and clearance of valve stem (4) and seat. In case of excessive play replace the valve and valve guide also, if necessary.



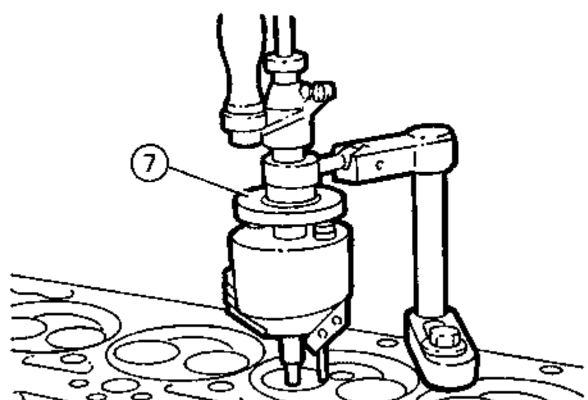
21657

Remove valve guide using punch **291046/1**. Force–fit the new valve guide (5) using punch **291046/1** and bushing **293231**; finally, process the hole with reamer **291177** (6) (exhaust valve guides also require the 8° inside boring shown in the following illustration).



21693

Valve and valve guide bore housing bore and seat dimensions (mm)
A. Intake – S. Exhaust.



21656

To reface valve seats on cylinder head in order the obtain optimum tightness, make use of the universal portable lathe **294006** (7), removing as little material as possible.

INJECTOR HOLDER CASING
Replacement (Op. 10 101 60)

After any refacing of the cylinder head mating plane, check that injector projection above surface level is within values given on page 10–3.If projection is greater, replace the injector casing using kit **293270** and proceed as follows:

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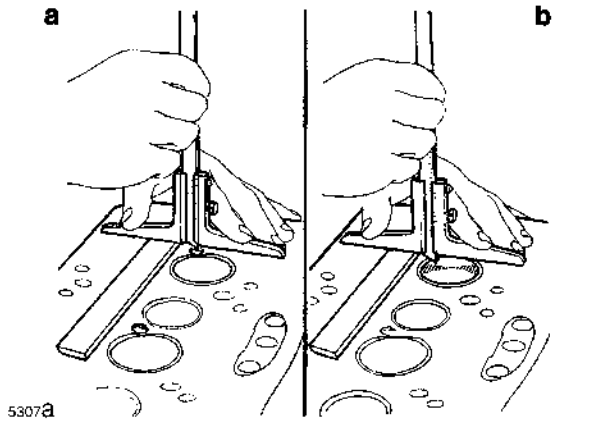
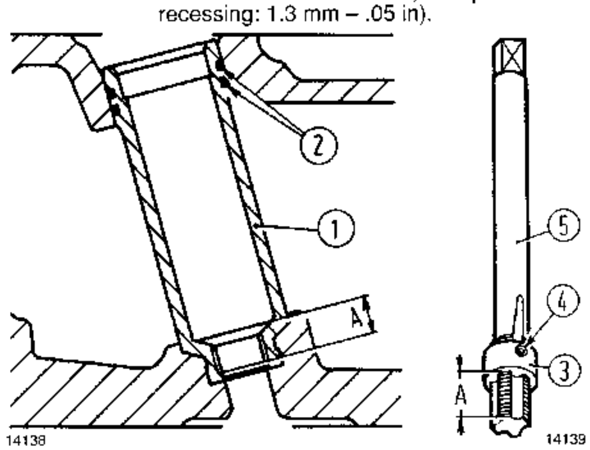
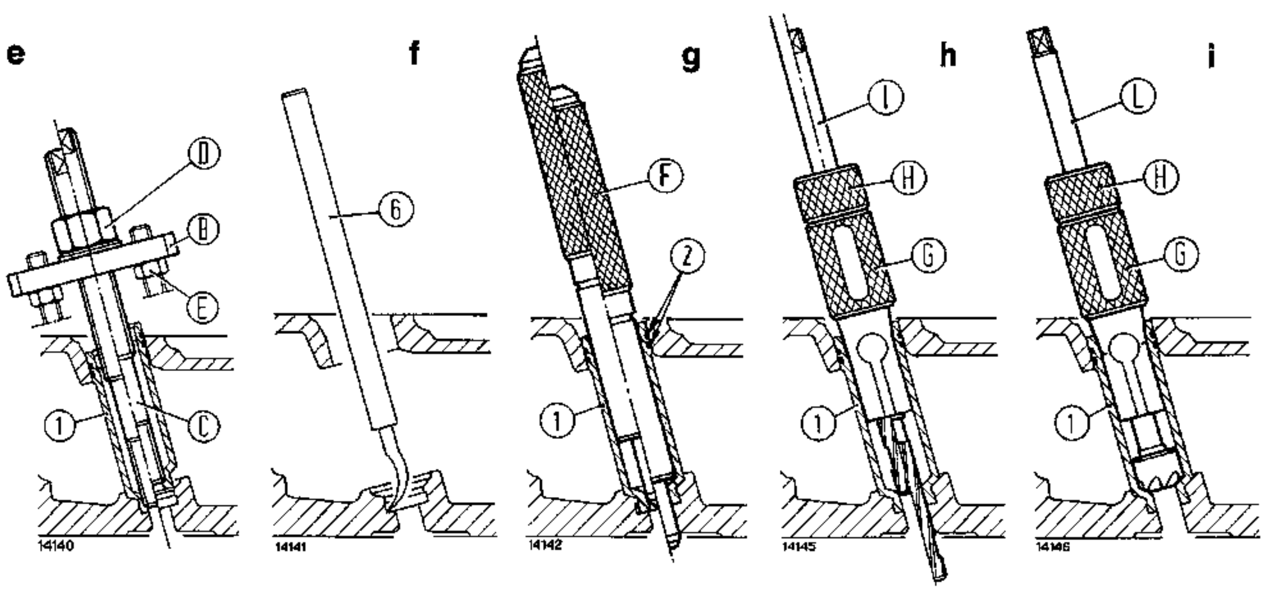


Checking injector and valve positions with respect to the cylinder head surface plane.
a. Injector projection check (see page 10–3) – b. Valve recess check: 0.7 to 1.0 mm – .03 to 0.4 in ; max permissible recessing: 1.3 mm – .05 in).



1. Set dimension (A) on tool (5)**292240** at 9 mm (.35 in) through ring nut (3), then lock it with set screw (4).
2. Thread the inside seat of the injector holder casing to be removed with tool **292240** (M12 x 1.75), paying attention to thread the casing only.
3. Attach tool (B) **293784** to cylinder head by tightening nuts (E) M8 x 1.25 onto the injector studs.
4. Screw on tight, on the previously made thread, part (C) and turn nut (D) so to pull holder (1) out of the cylinder head.
5. Using tool (6) **292243**, remove, from cylinder head, any residual material (copper) left by the casing previously pulled out, proceeding as shown in figure f.
6. Fit seals (2, Fig. g), on the new casing, prior to installation, introduce it in its seat making sure that lower abutting end is against cylinder head seat, then proceed to burnishing with punch **293861** (F, Fig. g).
7. Place, inside the newly fitted casing (1, Fig. h), sleeve (G) **293746/1**, secure it in its seat by turning ring nut (H) clockwise, introduce reamer (I) **293747** in sleeve (G) and ream the holder lower end.
8. Remove reamer (I) and loosen ring nut (H) 10 mm (.4 in) approx.
9. Press manually, or by tapping lightly with a plastic–head hammer, on the ring nut (H) until freeing the inside part of sleeve (G) **293746/1**.



Removal (e), removal of residual material (f), installation (g) and refacing (h,i) of the injector holder casing on cylinder head using tool kit 293270.

B, C, D. Injector holder puller **293784** – E. Injector nuts M8x1.25 – F. Injector holder burnishing tool **293861** – G, H. Pilot sleeve **293746/1** – I. Reamer **293747** – L. Cutter **293790/1** – 1. Injector holder casing – 2. O–ring seal – 6. Residual material removing tool **292243**.

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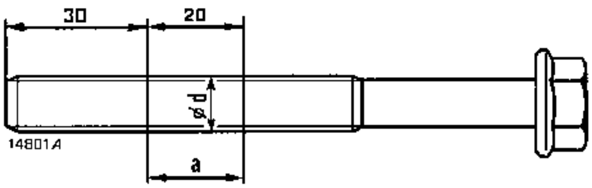
10. Remove sleeve, introduce cutter (L, Fig. i) **293790/1** inside the same, place the latter in the casing (1) and secure it by turning ring nut (H) clockwise.

11. Operate cutter to remove material until seat surface feels perfectly smooth and void of any residue.

12. Once completed the reaming operation, fit injector in holder casing (1) and check that installation projection above surface is that indicated on page 10–3.



Cilinder head studs

When re–using studs, check dia. **d** (measured as shown in the illustration above, length a) which should measure not less than 11.5 mm (.45 in); if less, replace studs.

CHECKING, MEASURING AND REPAIRING THE CRANKSHAFT, BEARINGS AND FLYWHEEL

Crankshaft

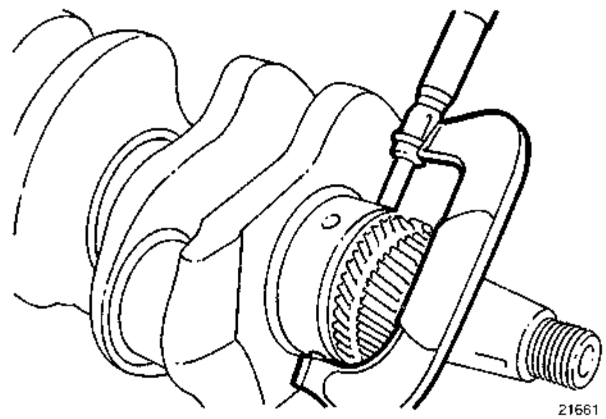
Before starting, clean parts thoroughly.

Inspect crankshaft accurately: any crack, even minor, requires shaft replacement.

Inspect main and connecting rod bearing journals:

– light superficial scoring or pick–up marks can be eliminated by rubbing with extra fine emery cloth;

– deep scoring, out–of–rounds or taper greater than 0.05 mm (.002 in) require crankshaft re–grinding;

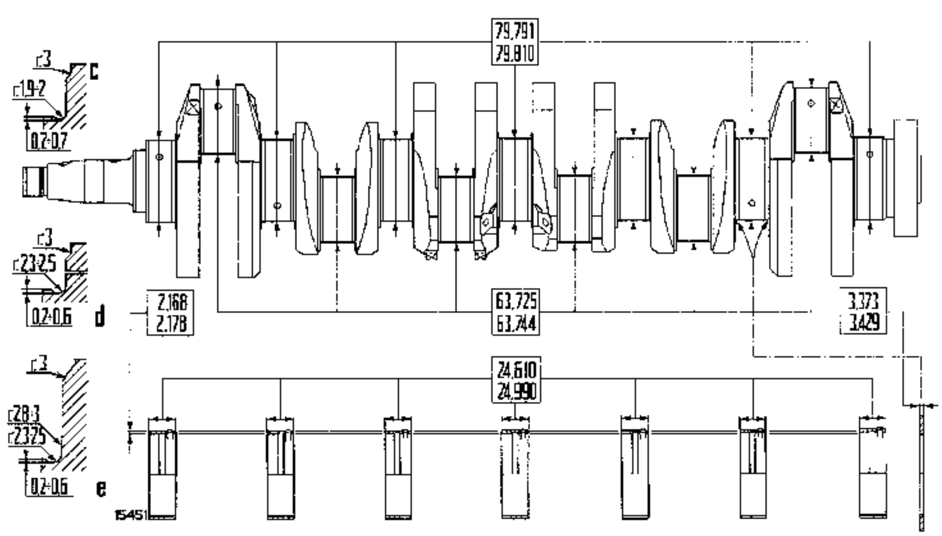


– measure journal dimensions to establish nearest undersize (see page 10–4).

Once ultimated grinding operation, blend fillets on journal shoulders as shown in the drawing details below and finally check following items:

– journal out–of–round must not exceed 0.008 mm (.0031 in);

– taper on each journal should be less than 0.01 mm (.0004 in);



Standard dimensions (mm) of crankpins, main and connecting rod bearings, thrust washers.

c. Detail of connecting rod bearing journal fillets – d. Detail of standard main bearing journal fillets – e. Detail of main bearing journal w/thrust washer fillets.

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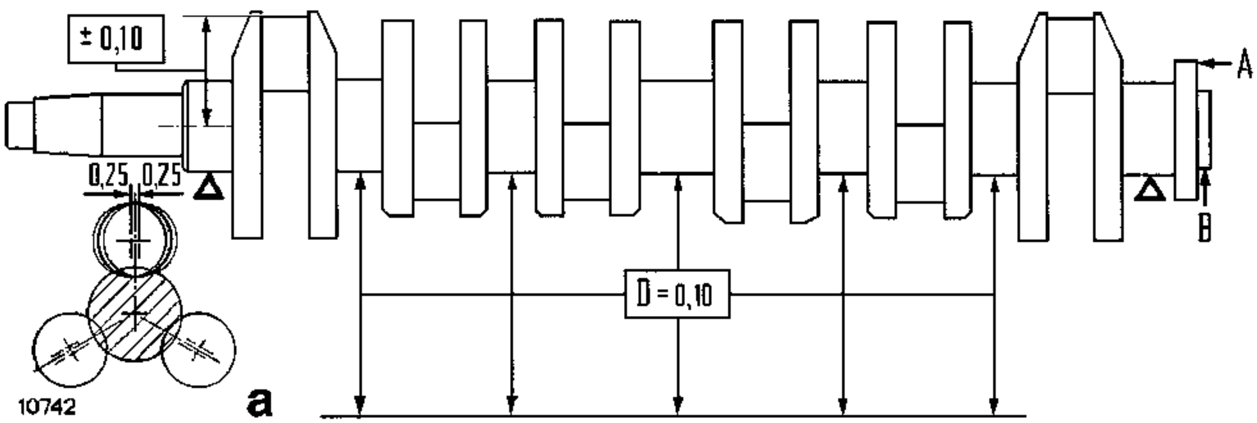


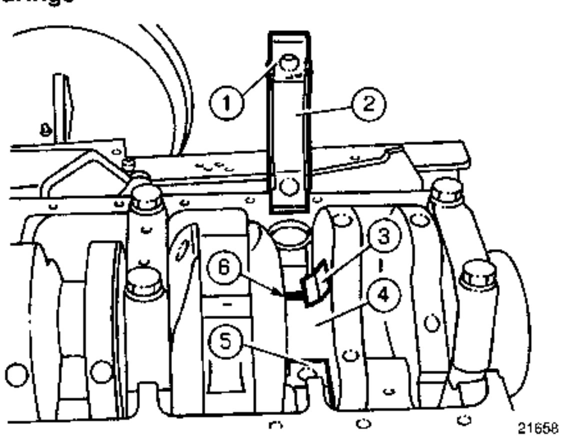
Max permissible allowances on main and connecting rod journal alignment w/respect to crankshaft axis and of connecting rod/main journal alignment (a).

A and B. Comparator gauge positioning for flywheel flange squareness and centering check – D. Max permissible differences on main journal alignment.

- w/ crankshaft on V–blocks the max difference of alignment among main journals must not exceed 0.10 mm (.004 in) (d);
- the axis of each pair of connecting rod journals should lie on the same plane of the main journal axis, with a max difference of ± 0.25 mm (.01 in) measured normally w/respect to the same plane;
- distance between connecting rod journal outer surface and crankshaft axis must be within ± 0.10 mm (.004 in) tolerance;
- a comparator gauge tip applied at point (A) or (B) should not show differences in reading greater than the ones indicated on page 10–5.

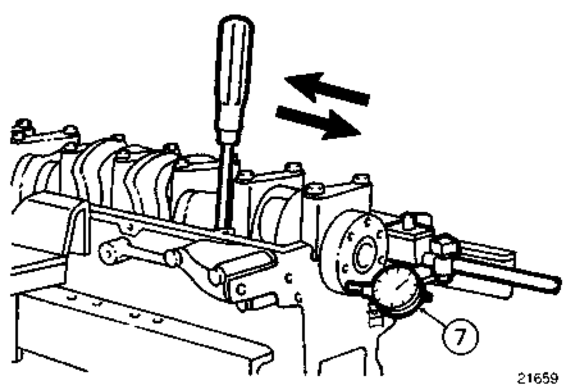
Check tightness of oil plugs at 14.7 bar (15 kg/cm^2 – 213 psi) pressure; in case of replacement, after force–fitting, punch–lock plugs and re–check circuit w/pressurized oil.

Bearings

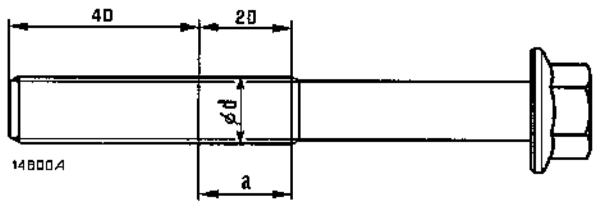


Check existing crankpin bearing clearance using calibrated wire and proceeding as follows:

- make sure all parts involved are perfectly cleaned and free from oil residues;
- install half–bearing shells in their seats (5);
- install crankshaft;
- place a calibrated wire segment (6) on the crankpins (4) aligned with the longitudinal crankshaft axis;
- install caps (1), complete with half–bearing shells (2), on their seats;
- wet the cap screws with engine oil and torque tighten to specifications (see page 10–26);
- remove caps from seats and find clearance between half–bearings and main cranckshaft journals, measuring the width of the flattened wire , at its max extension, vs. the graduated scale appearing on the paper bag (3) containing the graduated wire.

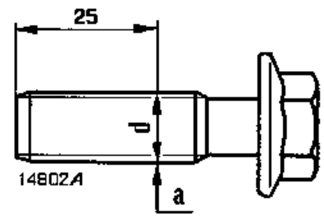


After re–installing the crankshaft and main bearing caps in the crankcase, check, using a comparator gauge (7), the shaft end float at the cap before the last one; if the end float is greater than the specified one (see page 10–4), replace the existing thrust half–washers with new ones, oversized in thickness.



Main bearing cap screws.

If re–using these screws, check diameter **d** (measured as shown in the above figure, over the length "a") which should be greater than 13.5 mm (.53 in); if not, renew the screws.



Engine flywheel screws.

If re–using these screws, check diameter **d** (measured as shown in the above figure, over the length "a") which should be greater than 11.5 mm (.45 in); if not, replace screws.

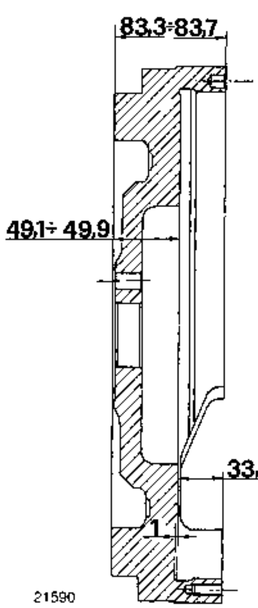
Engine flywheel

The flywheel is attached to the crankshaft by means of self–locking screws and includes the outer starting crown gear, installed by force–fitting after heating.

In case of required replacement of the starting crown gear, the same must be oil–heated (80° – 90° C – 176 to 194°), prior to force–fitting on flywheel, and installed with chamfer facing on the inside.

The flywheel is fitted to the crankshaft in a pre–determined position; in fact, the screw holes are suitably spaced to exclude other possibilities.

In case of overhauling, it is possible to reface working surface by removing material to a max. depth of 1 mm (.04 in).Once this operation is completed, restore both the 33.8 to 34.2 mm (1.33 to 1.35 in) dimension between clutch disc/flywheel and clutch casing/flywheel mating planes and the 1 mm (.04 in) outer under–cut.



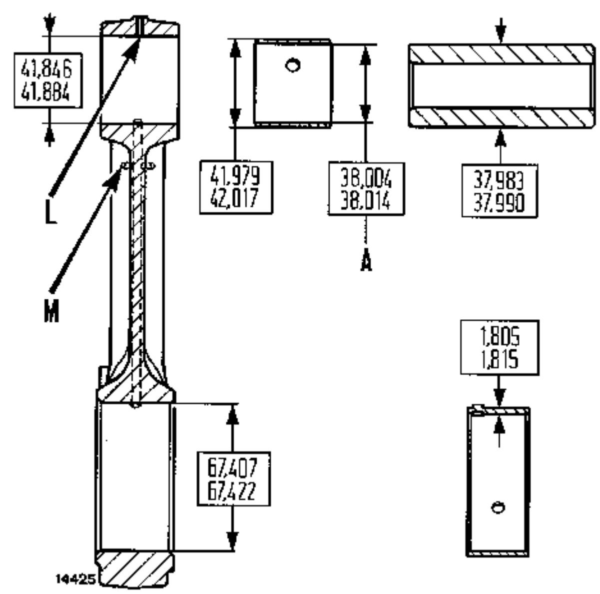
Flywheel original dimensions (mm).

CHECKING, MEASURING AND REPAIRING CONNECTING RODS

Before starting, clean parts thoroughly.

Check connecting rod small end bushings (interference fit) for looseness and make sure they are flush with the outer bosses of the small end.

If necessary, replace bushings and ream after force–fitting to restore prescribed dimension (A).



Dimensions (mm) of connecting rods, bearings, bushings and standard–size pins.

A. Dimension obtained by reaming after force–fitting – L, M. Lube oil ducts.

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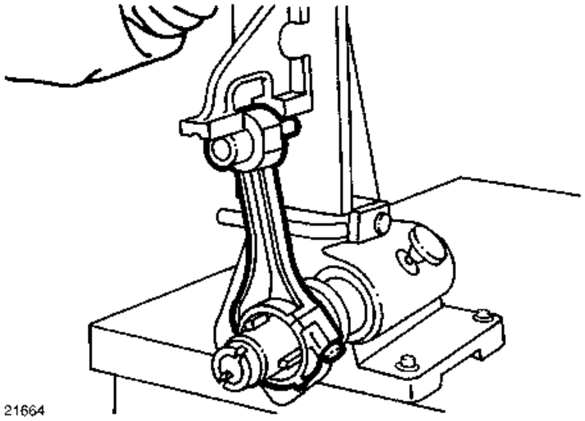


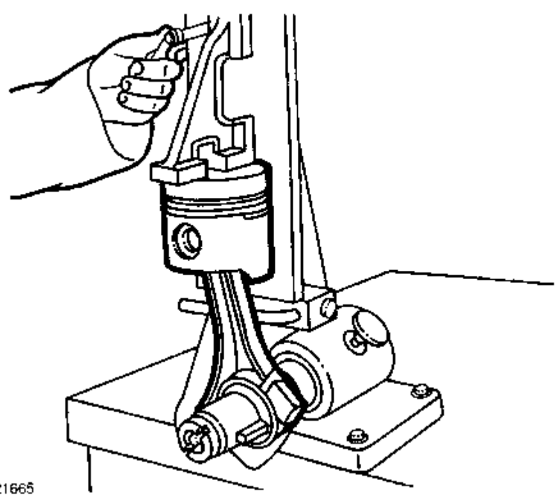
21664

Check connecting rod alignment. Max permissible misalignment: 0.07 mm (.003 in) measured at 125 mm (4–15/16 in) from the longitudinal axis.

Light distortions can be normally corrected under a press, if not, replace connecting rod.

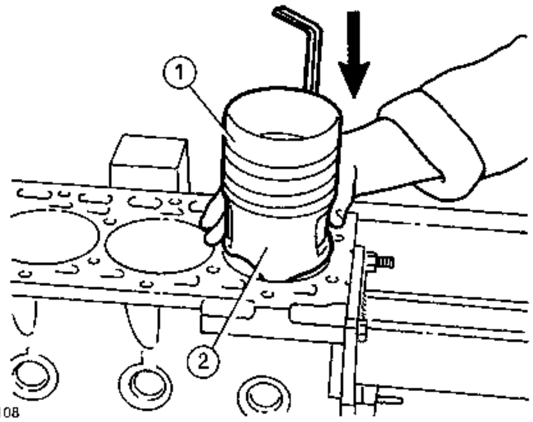
New connecting rods must be marked with the numbers of the cylinders in which they are fitted; besides, make sure that, in the same engine, weight difference among connecting rods, does not exceed 25 grams (.80 oz).

Check connecting rod lube oil ducts (L and M) for unwanted presence of scales or foreign matter.



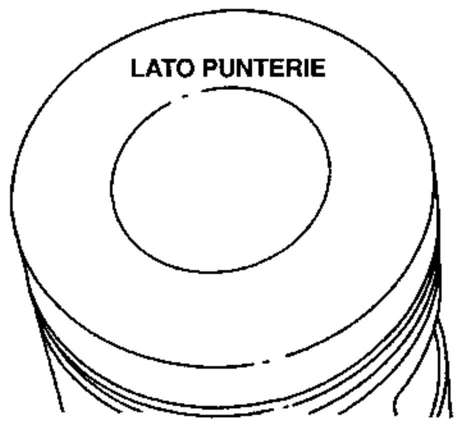
21665

Prior to re–installing the connecting rod–piston assembly in the crankcase, it is essential to check alignment. If not responding to specifications, investigate possible causes and replace parts involved.



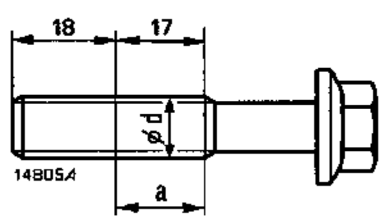
21108

Wet thoroughly, with engine oil, the pistons, including their rings, and the inside surface of cylinder liners.
Use tool **291048** (1) to install pistons (2) complete with rings, connecting rods and pins.
Check connecting rod number designation mark corresponds to that of the cylinder.



21667

Install piston in crankcase so that the indication "LATO PUNTERIE" (Valve tappet side) marked on the piston top faces the engine timing camshaft and that the connecting rod identification number is also facing the same shaft.

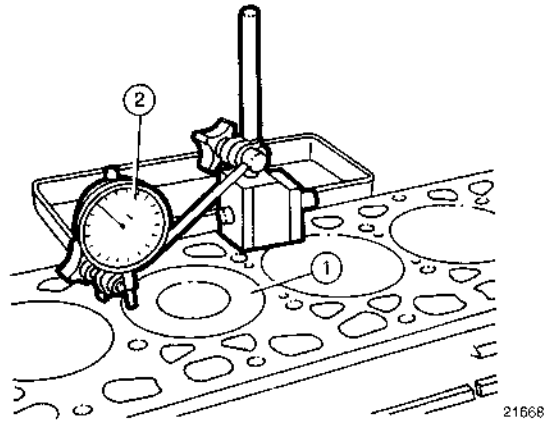


14805A

Connecting rod cap screws.

If re–using these screws, check diameter **d** (measured as shown in the above figure, over the length "a") which should be greater than 10.5 mm (.41 in) ; if not, replace screws.

Note – In case of connecting rod removal, it is always advisable to renew the cap screws.



At completed installation, check for location of pistons (1) with respect to the crankcase surface, vs. specifications (see page 10–6), using dial gauge w/magnetic base.

CHECKING, MEASURING AND REPAIRING PISTONS

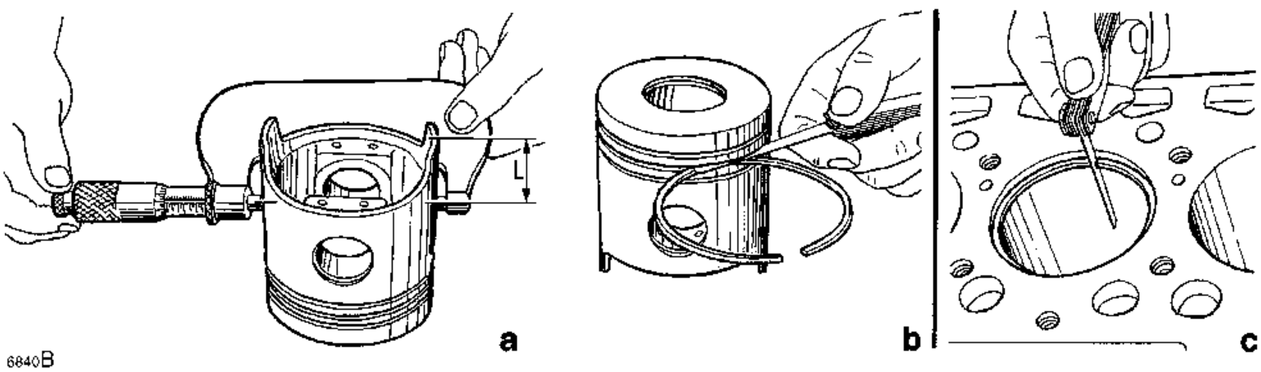
Before starting, clean parts thoroughly.

Assess the state of wear of pistons and cylinder liners, as indicated on page 10–60 and in the illustrations below.

If clearance exceeds 0.30 mm (.01 in), re–bore, grind the cylinder liners and install oversize pistons and rings (see page 10– 6).

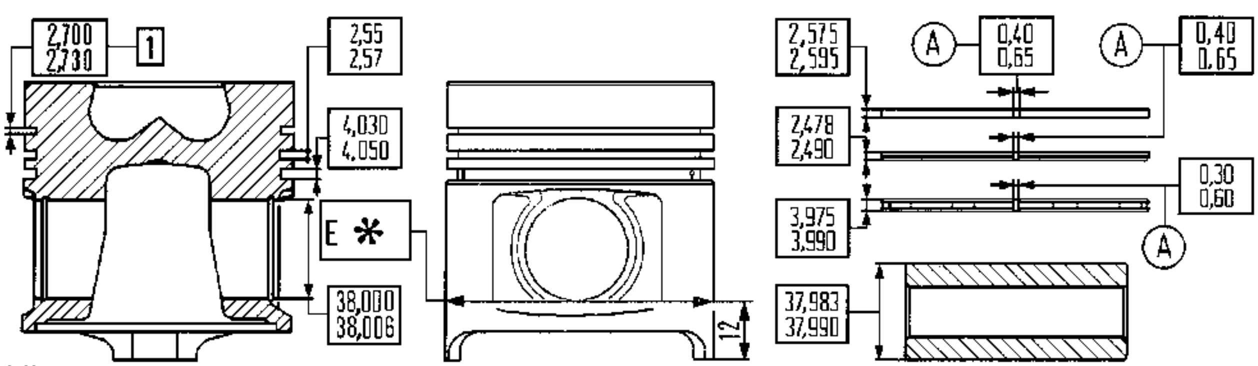
In case of piston renewal, consider that the weight spread among pistons in the same engine must not exceed 20 grams (.64 oz).

Check that the piston ring clearance (b) and gap (c) are the prescribed ones. Should the gap be less than prescribed, dress ends.



Checking pistons and their rings.

a. Measuring piston diameter at height (L) from skirt base – b. Checking the piston ring and clearance – c. Checking piston ring gap after installation in cylinder liner – L. Measuring dimension: 12mm (.47 in).



Dimensions (mm) of standard pistons, pins and rings.

A. Dimension to be measured after installing piston rings in cylinder liners – E. Piston diameter measured at 12 mm (.47 in) from skirt base: 99.852 to 99.870 mm (3.9312 to 3.9319 in) on model F 100 or mm 103.852 to 103.870 (4.0886 to 4.0894 in) on models F 110, F 120 and F 130 – 1. Measured on the 97 mm (3.81 in) dimension, (model F 100) or 101 mm (3.98 in) dimension (models F 110, F 120 and F 130).

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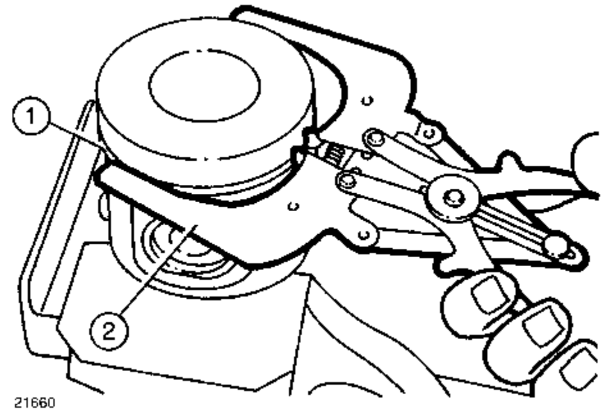


Use expander tool **291160** (2) to remove/install piston rings (1).

Install rings in piston seats following the order indicated on page 10–67.

At piston installation in cylinder liners, make sure that the ring end gaps are offset 180°.

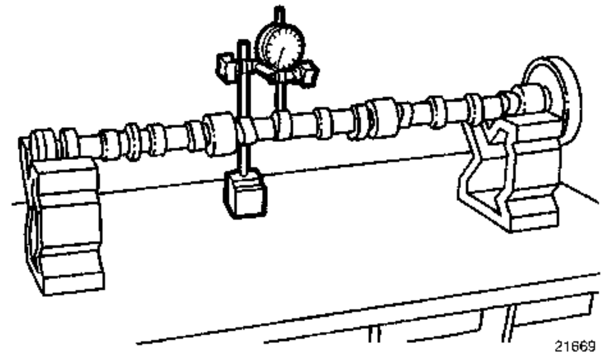
CHECKING, MEASURING AND REPAIRING TIMING CAMSHAFT, TAPPETS AND VALVES

Before starting, clean parts thoroughly.

Camshaft

To check camshaft, place it on two V–blocks and, using a dial gauge, measure excentricity of cam lobes w/respect to shaft axis which should not exceed 0.02 mm (.0008 in).

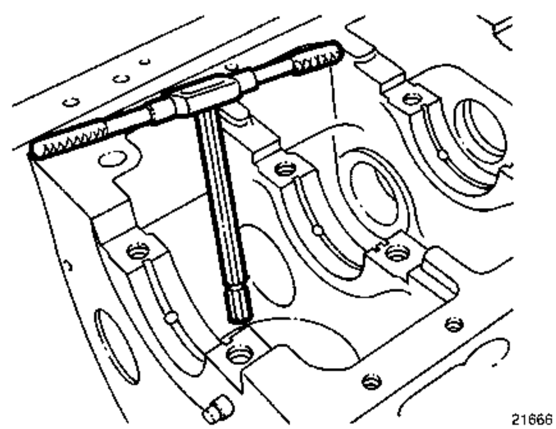
Straighten camshaft under a press, in case the excentricity does not exceed 0.2 mm (.008 in); if more, replace it.



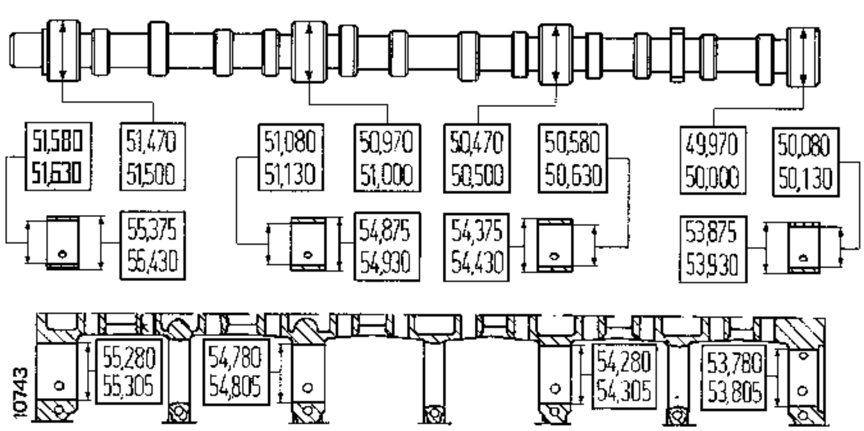
Check, using a comparator dial gauge, the cam lobe lift:
– 5.97 mm (.235 in), intake lobe;
– 6.25 mm (.246 in), exhaust lobe.

Replace worn bearing bushings, using adequate pullers and installer tools, and ream them to bring inside dia. at the dimension indicated in the illustration below.

Tappets



Check for free tappet movement in their seats, without play.



Dimensions (mm) of camshaft journals and bearing seats in crankcase.

Note – I.D. values are given for press–fitted bushings.

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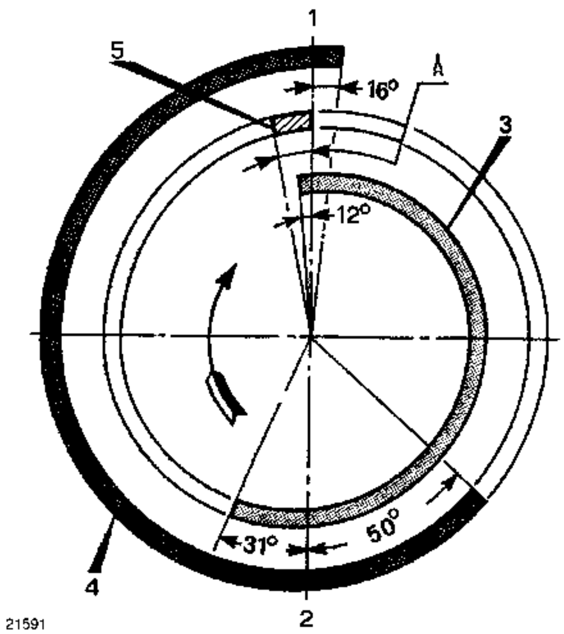
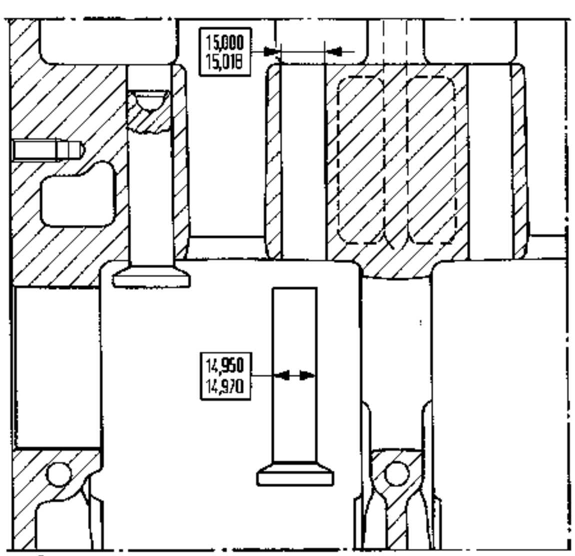


Valve timing diagram

A. Fixed advance: 8° (model F 130) – 1. T.D.C. – 2. B.D.C. – 3. Intake – 4. Exhaust – 5. Injection (model F 130).

Attention – In order to check the diagram after completing overhauling operations , pre–adjust the valve/rocker arm gap at 0.45 mm (.018 in). Rotate crankshaft and check, on a graduated timing scale, the correspondance of valve opening and closing to the angular values appearing in the above illustration. Restore normal operating gap at specified values (see page 10–9).



Dimensions (mm) of tappets and seats on crankcase.

Tappet replacement, for excessive play, requires installation of new, oversized ones (see page 10–8) and re–boring seats using an appropriate tool (see page 10–68).

Pushrods should be checked for perfect straightness; besides, the concave seating contacting the associated rocker arm adjustment screw must be perfectly smooth and free from pick–up or wear marks; if any, replace pushrod.

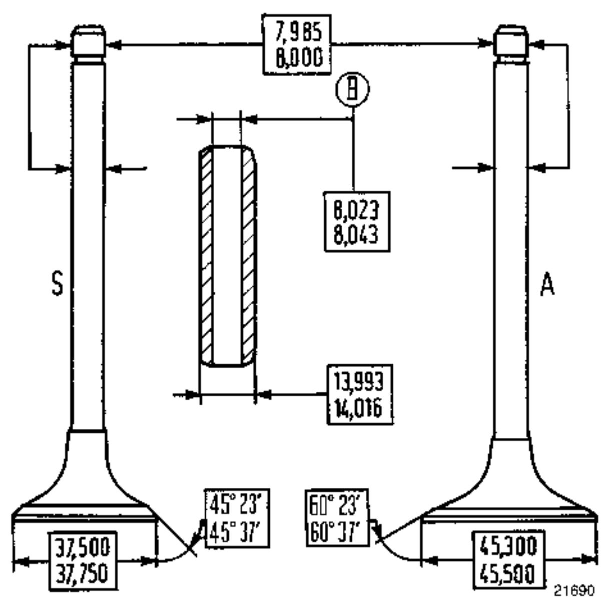
At rocker arm disassembly, to remove the end bearings, firstly remove the setscrew securing them on the axle.

When dressing gap ends of rocker arms and set screws, remove as little material as possible.

Valves

In case of light tightness faults, valves and their seats in cylinder head can be dressed using the specific pneumatic grinder **290064** or universal, portable lathe **294006**. In case of more pronounced faults, re–face seats as illustrated under the specific heading and grind the valves.

After grinding, make sure that the thickness of the step at valve head edge measures 0.5 mm (.02 in), at least.



Dimensions (mm) of valves and valve guides

A. Intake – B. Dimension to be obtained by reaming after press–fitting – S. Exhaust

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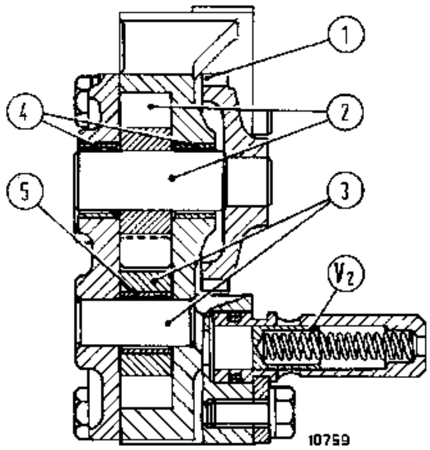
CHECKING, MEASURING AND REPAIRING OF LUBE COMPONENTS

Before starting, clean parts thoroughly.

Remove oil sump first to gain access to the oil pump.



At overhauling, check pump parts for wear by comparing dimensions with data on page 10–10.

CHECKING, MEASURING AND REPAIRING COOLING SYSTEM COMPONENTS

Before starting, clean parts thoroughly.

The cooling plant installed on tractors model **F** 100, F 110, F 120 and F 130 is supplied with a permanent anti–freeze mixture consisting of water and **FIAT "PARAFLU 11"** (at 50% strength), assuring resistance to freezing under the conditions reported in the following chart:

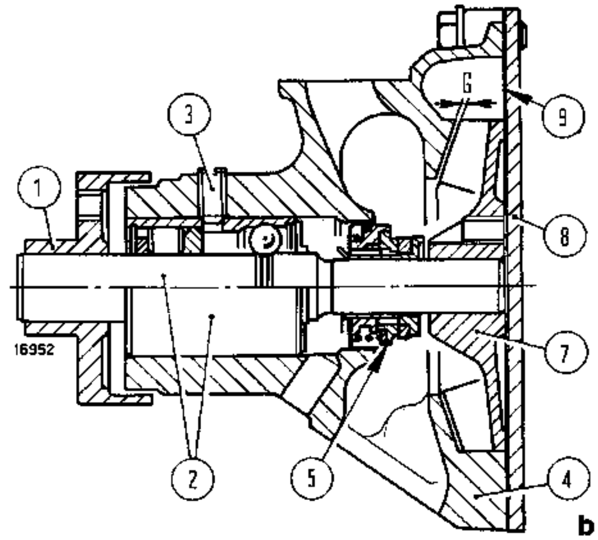
Degrees °C	–8	–15	–25	–35
% volume of **"PARAFLU 11"**	20	30	40	50

This mixture has, in addition, oxydation, corrosion, foaming and scale proof characteristics which assure plant protection for long periods of time.

This same fluid can be kept in the cooling plant for a maximum of 2 years or 1600 hours of work, whichever comes first, after which the supply must be renewed.

Water pump

Vane–type, centrifugal water pump. The bearing (2) is integral with the drive shaft, is seal–tight and requires no lubrication.



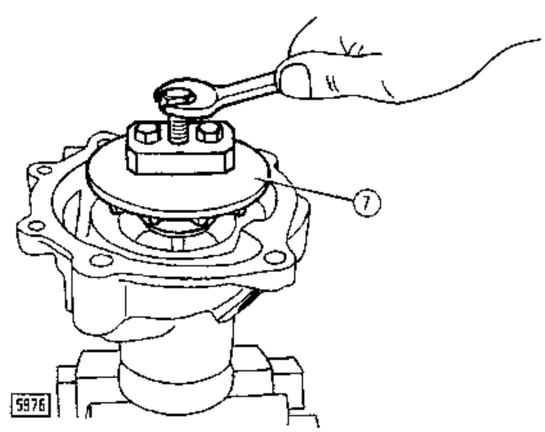
Water pump cut–out

G = 0.5 to 0.7mm (.020 to .027 in). Vane clearance – 1. Pump and fan drive hub – 2. Drive shaft w/in–built sealed bearing – 3. Bearing set screw – 4. Pump housing – 5. Oil seal – 6. Front–end seal bushing – 7. Impeller – 8. Cover – 9. Gasket.

To overhaul pump, proceed as follows:

- remove cover (8) and shaft–bearing (2) retaining set screw (3);
- tap on shaft end lightly to break the oxydation film located between shaft and impeller, then remove the latter using puller **291182/1**;
- using a drive punch of adequate dimension to remove shaft–bearing and fan hub from pump housing.

Note – Remove oil seal (5) in case of replacement only.



Removing the water pump impeller using puller 291182/1.

7. Impeller.

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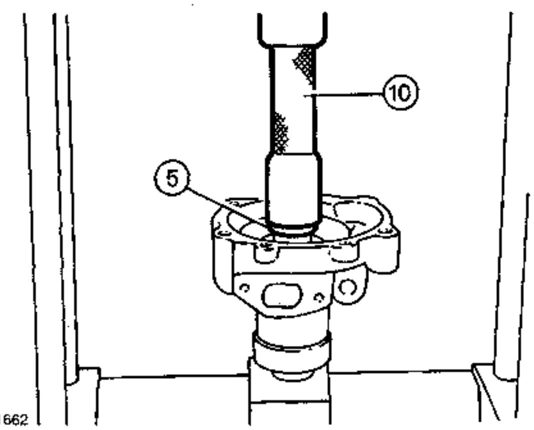
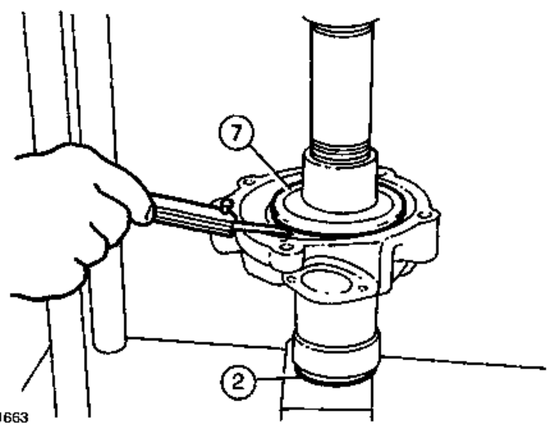


21662

At re–assembly, proceed as follows:

- Install shaft (2, page 10–70) complete with bearing and hub (1), on pump housing (4) and lock it in place by tightening the retaining set screw (3) after applying LOCTITE 242 on the latter;
- wet the seal seat (5) with LOCTITE REFRIGERANT SEALANT 554, then force–fit seal in place using tool **293280** (10);
- heat impeller (7) in an oven (in air) until obtaining a difference in temperature, between the same and the shaft (2), of 130° to 150°C (266° to 302°F);



21663

- force–fit the impeller (7) over the shaft (2) supported on end to avoid damaging the bearing, until obtaining working clearance G = 0.5 to 0.7 mm (.020 to .027 in) (see page 10–70);
- fit gasket (9) and cover (8) and tighten the associated retaining screws;

Radiator

Two valves are incorporated in the radiator cap, one for compression and the other for vacuum; check at intervals for normal operation of these valves.

At overhauling, eliminate scales in the radiator using a water and **Disincrostante FIAT** (scale remover) solution, at the strength indicated on the container.

Never wash the radiator only,rather wash the complete cooling plant, supplying the engine with the solution previously mentioned. Let the engine run for about one hour, then stop engine and discharge the solution through drain hole.

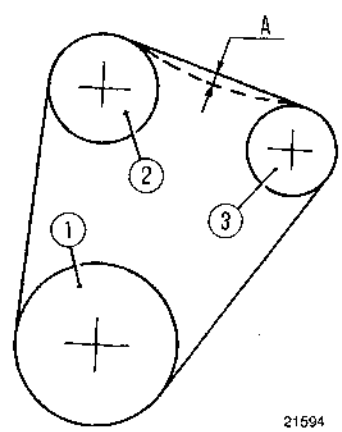
Radiator tightness is checked by immersion in a water tank, at a temperature varying from 20 to 40°C (68 to 104°F), and subsequent introduction of compressed air in the radiator, 0.98 bar (1 kg/cm^2 = 14.2 psi) for about two minutes; repeat this test three times.

WATER PUMP AND GENERATOR DRIVE BELTS
Tension adjustment (Op. 10 414 10).
Water pump and alternator drive belts (models F 100, F 110 and F 120).

Check, periodically and using tool **296118**, that to a belt depression of 10 mm (.40 in) corresponds a load (applied at A) greater than 37 N (3.8 kg – 8.4 lb); if less, slacken alternator nut (3) and move the alternator until obtaining, under the same conditions, an applied load, at A, of 52 to 62 N (5.3 to 6.3 kg – 11.6 to 13.9 lb); finally, tighten alternator nut.

Note – This check should always be carried out at engine temperatures comprised between 20° and 40°C (68° and 104°F).

Attention – When replacing belts, install the new ones so that under a load (applied at A) of 105 to 125 N (10.7 to 12.7 kg – 23.5 to 28 lb) belts will depress 10 mm (.40 in). Let engine run one hour, then check belt tension (10 mm depression under a load of 85 to 105 N = 8.7 to 10.7 or 19 to 23.5 lb, applied at A).



21594

Alternator and water pump belt tension scheme – Models F 100, F 110 and F 120.

A. Load application point for belt tension adjustment – 1. Crankshaft pulley – 2. Fan pulley – 3. Alternator pulley.

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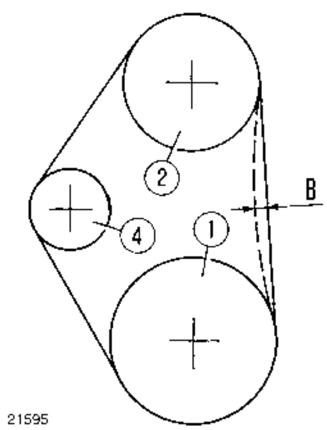
Water pump drive belt (models F 100, F 110 and F 120 w/air conditioner version and model F 130).

Check, periodically and using tool **296118**, that to a belt depression of 10 mm (.40 in) corresponds a load (applied at B) greater than 27 N (2.8 kg – 6.2 lb); if less, slacken the alternator nut (3) and move the alternator until obtaining, under the same conditions, an applied load at B of 36 to 46 N (3.7 to 4.7 kg – 8.1 to 10.3 lb); finally, tighten alternator nut.

Note – This check should always be carried out at engine temperatures comprised between 20° and 40°C (68° to 104°F).

Attention – When replacing belts, install the new ones so that under a load (applied at B) of 75 to 90 N (7.6 to 9.2 kg – 16.7 to 20.2 lb) belts will depress 10 mm (.40 in). Let engine run one hour, then check belt tension (10 mm depression under a load of 60 to 75 N = 6.1 to 7.6 kg = 13.4 to 16.7 lb, applied at B).



Water pump drive belt tension scheme for models F 100, F 110, F 120 w/ air conditioner version and F 130.

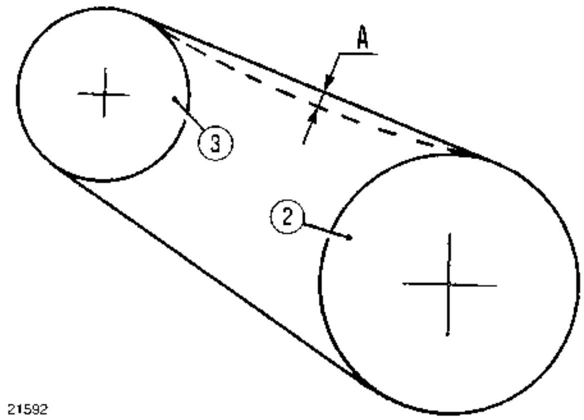
B. Load application point for water pump drive belt tension adjustment – 1. Crankshaft pulley – 2. Fan pulley – 4. Belt stretcher.

Alternator drive belt (models F 100, F 110, F 120 w/ air conditioner version and model F 130).

Check periodically and using tool **296118** that to a belt depression of 10 mm (.40 in) corresponds a load (applied at A) greater than 36 N (3.7 kg – 8.1 lb); if less, slacken alternator nut (3) and move alternator until obtaining, under the same conditions, an applied load at A of 49 to 59 N (5 to 6 kg – 11 to 13.2 lb); finally, tighten alternator nut.

Note – This check should always be carried out at engine temperatures comprised between 20° and 40°C (68° to 104°F).

Attention – When replacing belts, install the new ones so that under a load, applied at A, of 100 to 120 N (10.2 to 12.2 kg – 22.4 to 26.8 kg) belts will depress 10 mm (.40 in). Let engine run one hour, then check belt tension (10 mm depression under a load of 80 to 100 N = 8.2 to 10.2 kg = 18 to 22.4 lb, applied at A).



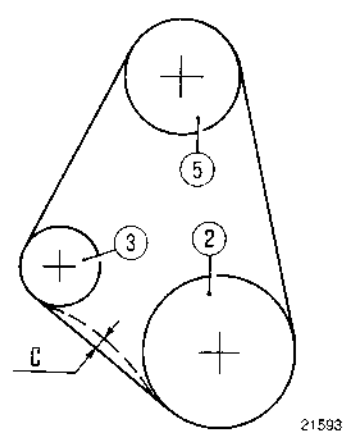
Alternator drive belt tension scheme for models F 100, F110 F 120 w/ air conditioner version and F 130.

A. Load application point for alternator drive belt tension adjustment – 2. Fan pulley – 3. Alternator pulley.

COMPRESSOR DRIVE BELT
Tension adjustment (Op. 50 200 10).

Check, periodically and using tool **296118** that to a belt depression of 10 mm (.40 in) corresponds a load, applied at C, greater than 36 N (3.7 kg – 8.1 lb); if less, slacken the alternator nut (3) and move alternator until obtaining, under the same conditions, an applied load at C of 49 to 59 N (5 to 6 kg – 11 to 13.2 lb); finally, tighten alternator nut.

Note – This check should always be carried out at engine temperatures comprised between 20° and 40°C (68° to 104°F).



Compressor drive belt tension scheme.

C. Application point for compressor drive belt tension adjustment – 2. Fan belt – 3. Alternator belt – 5. Compressor belt.

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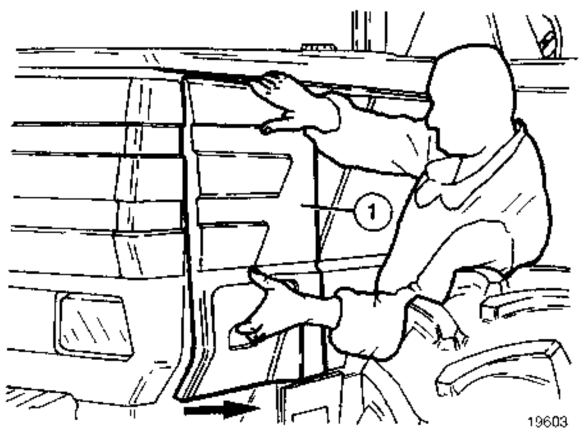
Attention – When replacing belts, install the new ones so that, under a load, applied at C, page 10–72) of 100 to 120 N (10.2 to 12.2 kg – 22.2 to 26.9 lb) belts will depress 10 mm (.40 in). Let engine run one hour, then check belt tension (10 mm = .40 in depression under a load of 80 to 100 N = 8.2 to 10.2 kg = 18 to 22.2 lb, applied at A).

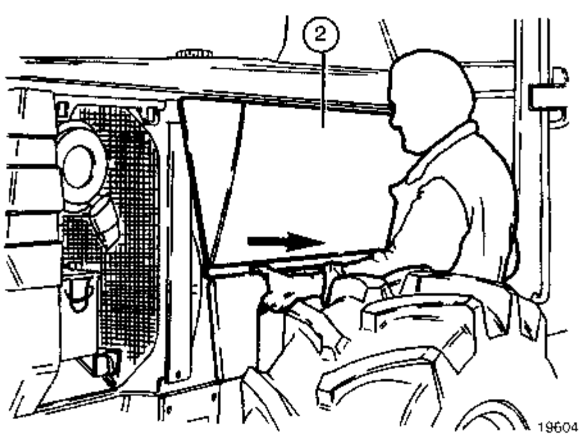
ENGINE CRANKSHAFT FRONT–END OIL SEAL
Replacement (Op. 10 102 70)

Proceed as follows:

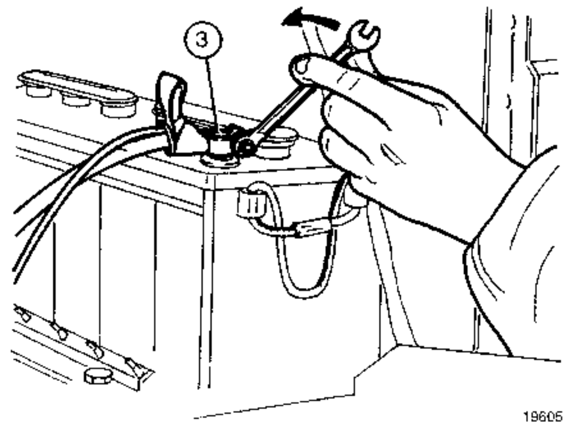
DANGER

Lift and handle all heavy components using a suitable lift.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.

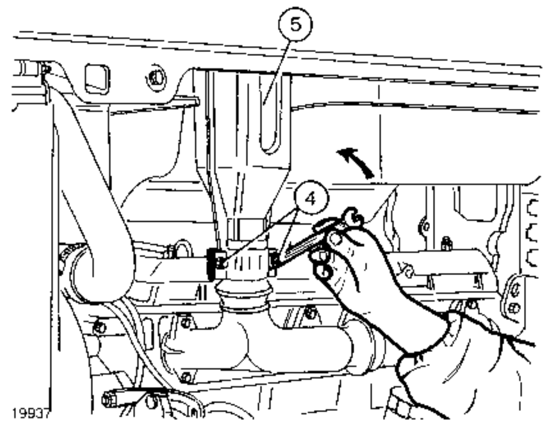




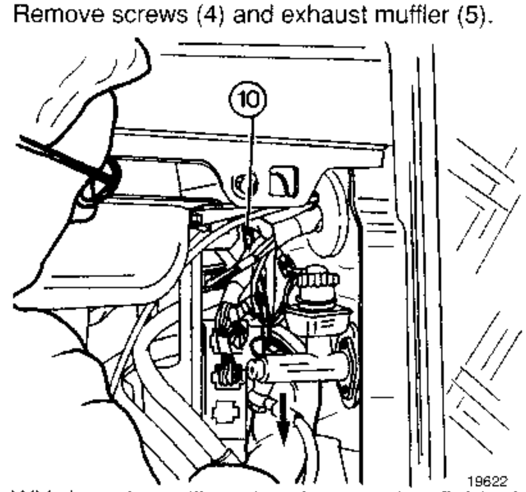
1. Remove panels (1 and 2) from both sides of hood.



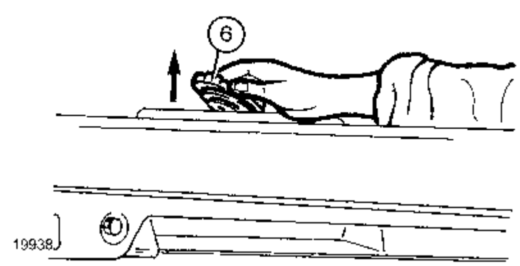
2. Disconnect battery positive cable (3) and insulate it.



3. Remove screws (4) and exhaust muffler (5).



4. Withdraw, by pulling, the glass washer fluid tubelet (10).



5. Remove cap (6) from secondary fuel tank.

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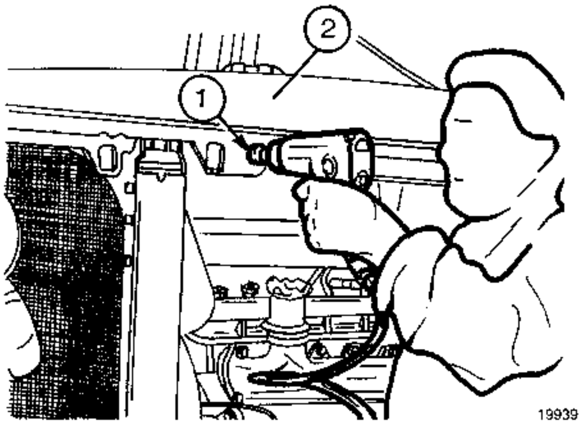
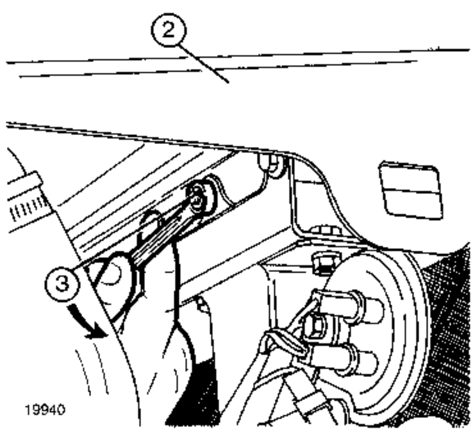
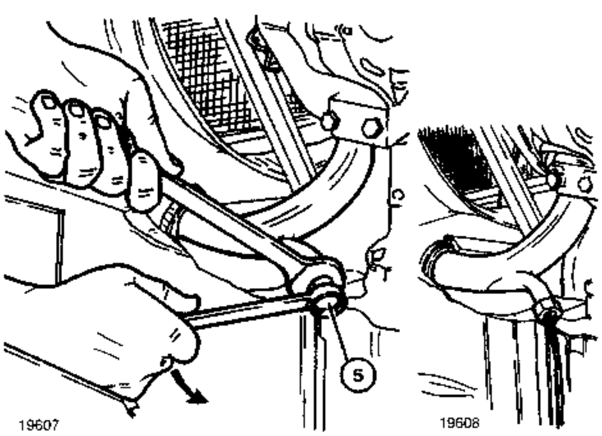


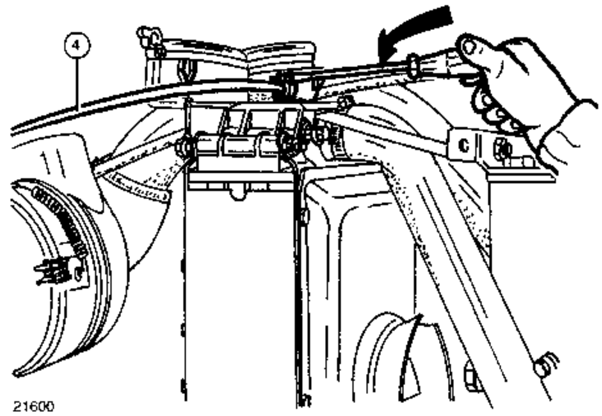
6. Loosen hood top (2) attachment screws (1), on both sides.



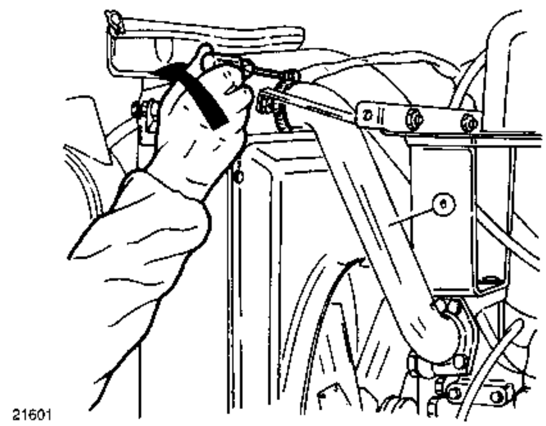
7. Loosen front end screws (3) and remove hood top (2).



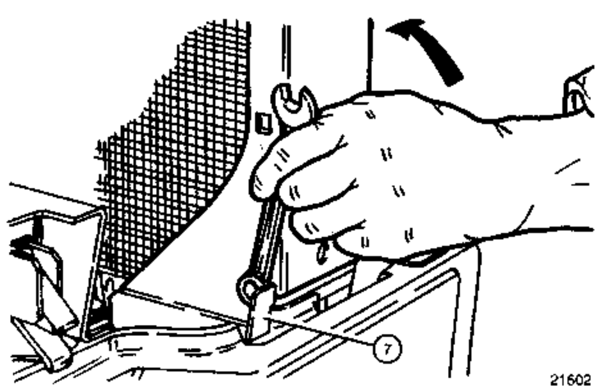
8. Remove plug (5) from drain line and empty the engine cooling plant.



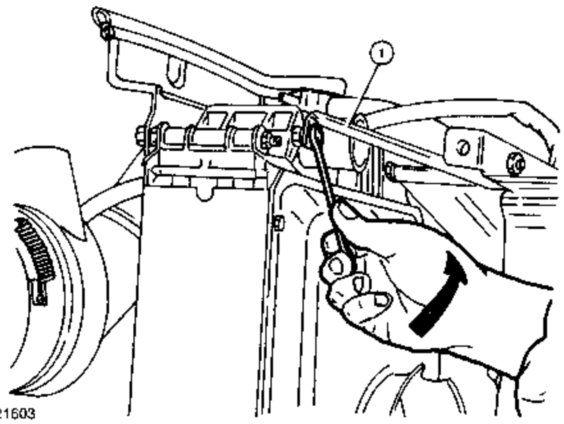
9. Disconnect line (4) connecting radiator and expansion tank.



10. Loosen band clamps and withdraw the upper hose (6) and lower one from respective radiator connections.

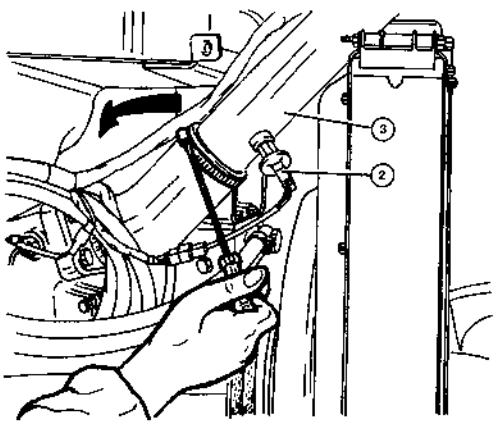


11. Loosen attachment screws and remove the vibration shield (7) (on both sides).



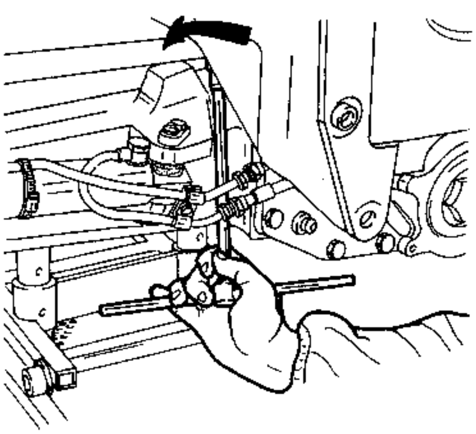
21603

12. Remove radiator attachment bracket (1), on both sides of engine.



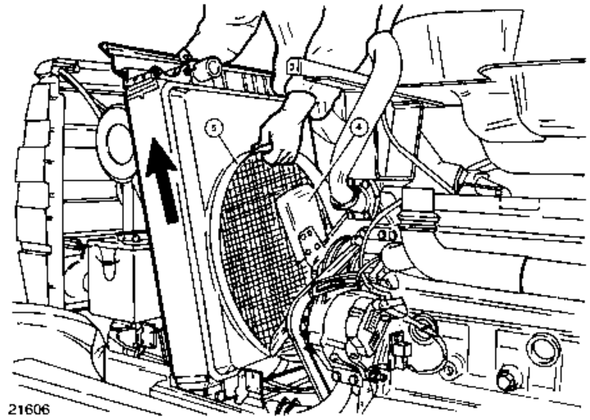
21604

13. Remove the clogged air cleaner connection (2) and secondary tank fuel level one, move cable harness to the outside of radiator, loosen the front and rear band clamps and remove duct (3) connecting air cleaner to engine.



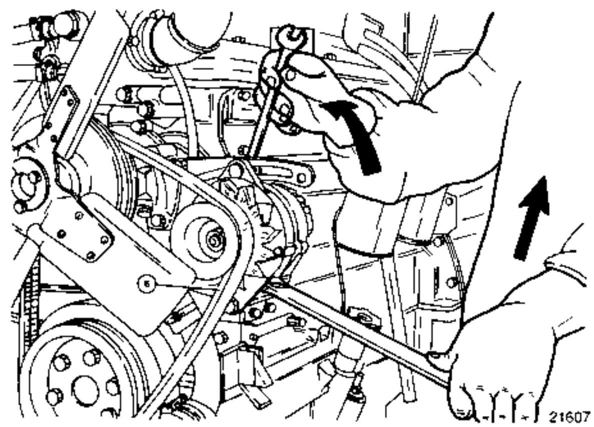
21605

14. Loosen the screw securing radiator to front axle mounting bracket (on both sides).



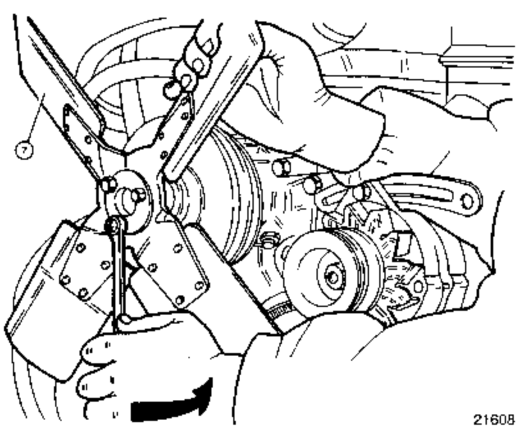
21606

15. Move radiator forward to free fan (4) from conveyor (5), then remove radiator.



21607

16. Slacken the alternator nut, move alternator unit out and remove the alternator and water pump drive belts (6).



21608

17. Loosen attachment screws and remove fan (7) together with its spacer.

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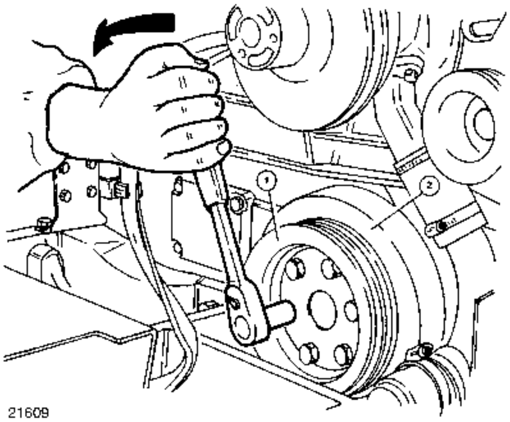
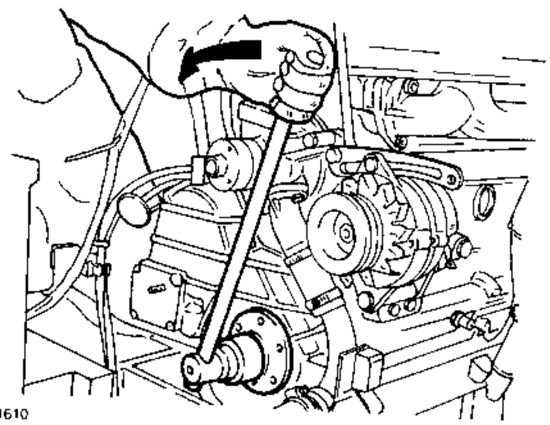


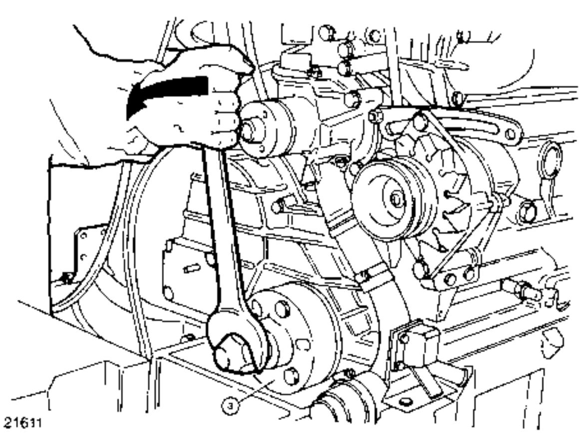
21609

18. Loosen attaching screws and remove the alternator–water pump drive pulley (1) together with the damper flywheel (2).



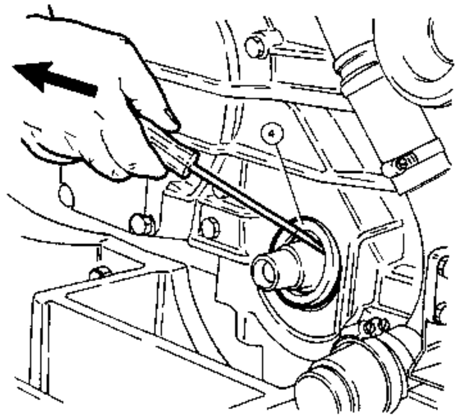
21610

19. Straighten off the safety plate, then loosen the nut securing the drive hub to engine crankshaft.



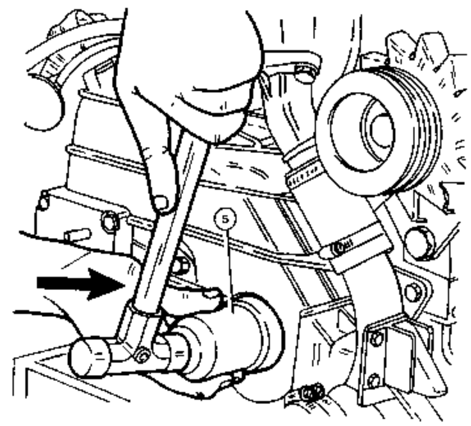
21611

20. Install and secure with threee screws, puller **291504** (3) and then remove hub from crankshaft.



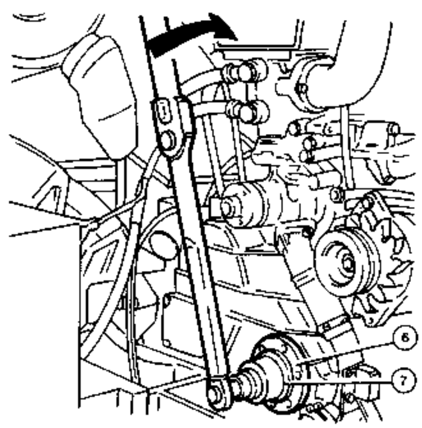
21612

21. Using a screwdriver, remove oil seal (4) from seat.



21613

22. Press–fit the new seal in place using installer tool **293329** (5).



21614

23. Install hub (6) on crankshaft, tighten nut (7) to prescribed torque (see data on page 10–27) and lock it by bending the safety tab.

24. At re–assembly:

a. proceed reversing the disassembly sequence of operations, starting from no. 18 back to no. 1;

b. torque tighten to values specified on page 10–27.

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VALVE TAPPET CLEARANCE
Check–adjustment (Op. 10 106 12)

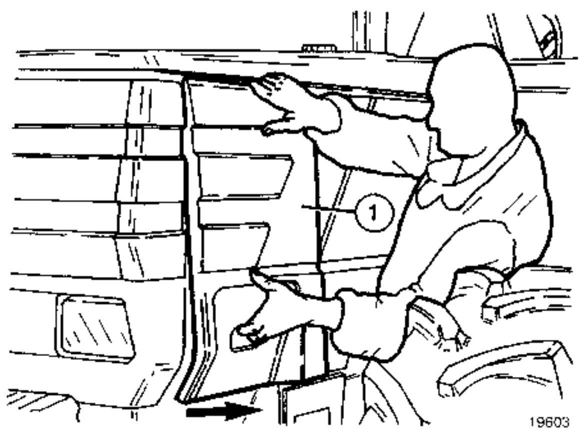
Proceed as follows:

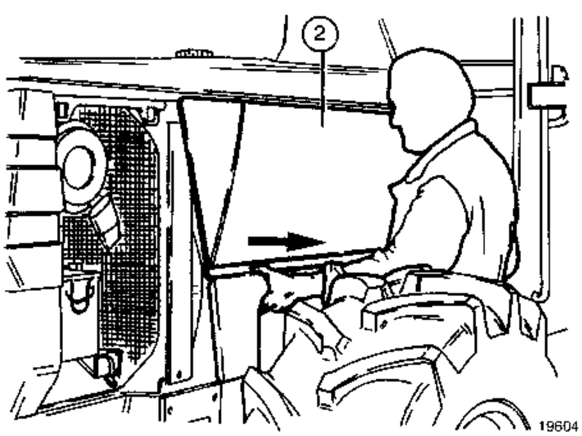
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

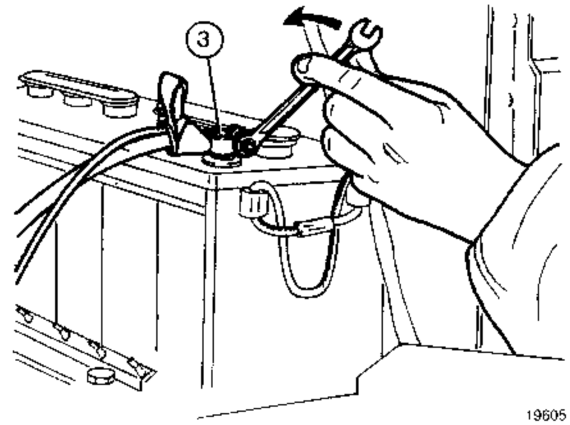
CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

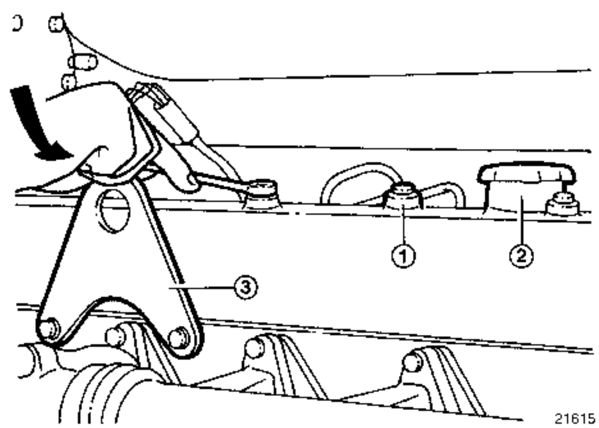




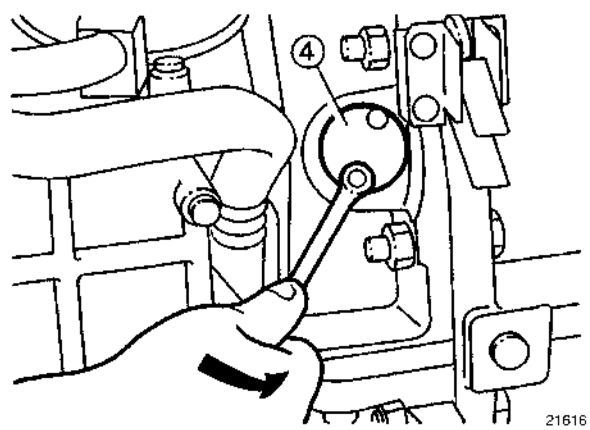
1. Remove panels (1 and 2) from both sides of hood.



2. Disconnect battery positive cable (3) and insulate it.



3. Loosen tappet cover screws (1), cap (2), flange (3) and remove cover.



4. Remove the flywheel inspection lid (4) and retrieve gasket.

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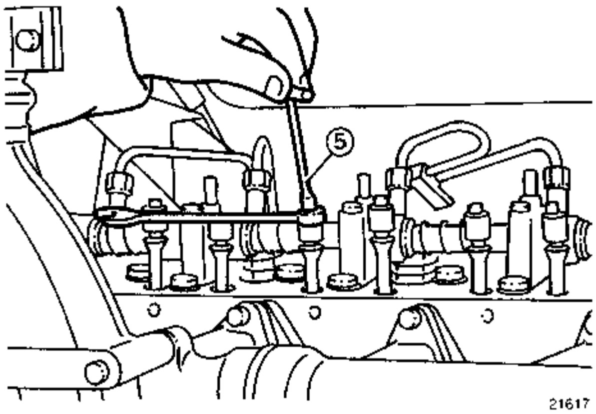

5. Adjust the valves of any one cylinder using special wrench **291883** (5), when its symmetrical cylinder balances. Symmetrical cylinders are: 1–6, 2–5 and 3–4.

Note – 0.30 ± 0.05 mm (.012 ± .002 in) clearance on cold engine.

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6. After adjusting the valve settings, re–assemble loose parts:

   a. proceed reversing the disassembly sequence of operations, starting from no. 4 back to no. 1;

   b. torque tighten to values specified on page 10–27.

INJECTORS
Removal–Installation (Op. 10 218 31)

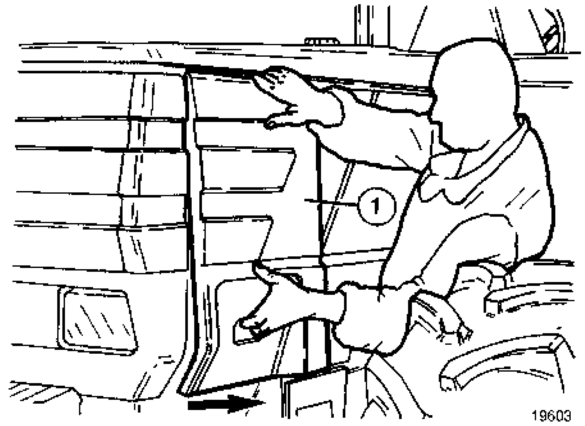
Proceed as follows:

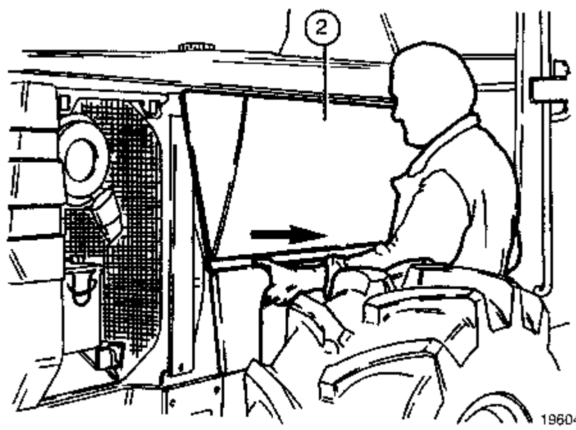
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

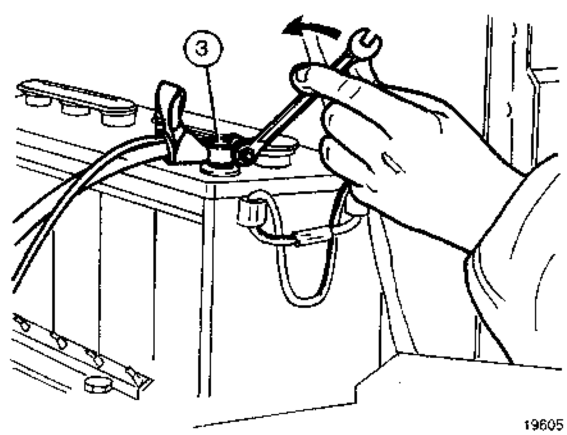
CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.



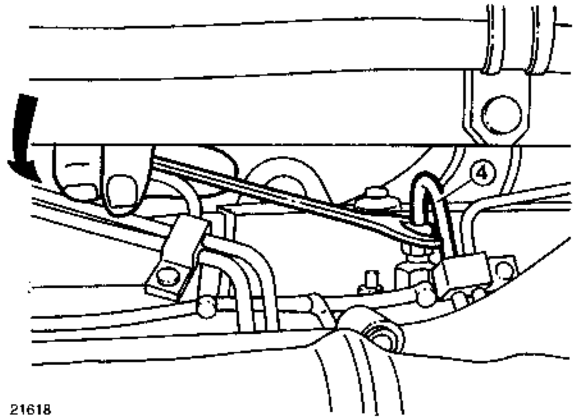


1. Remove panels (1 and 2) from both sides of hood.



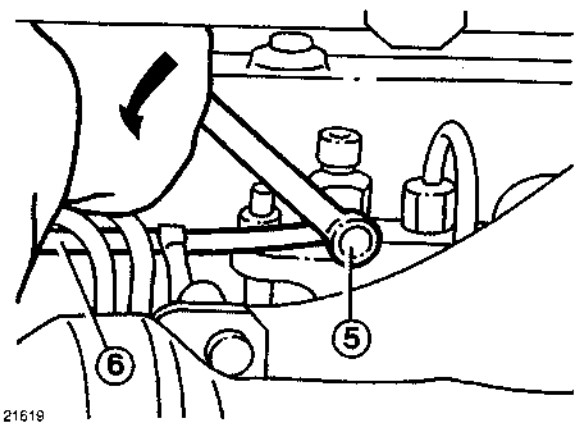
2. Disconnect battery positive cable (3) and insulate it.

Print No. 603.54.276.01 – 12 – 1992



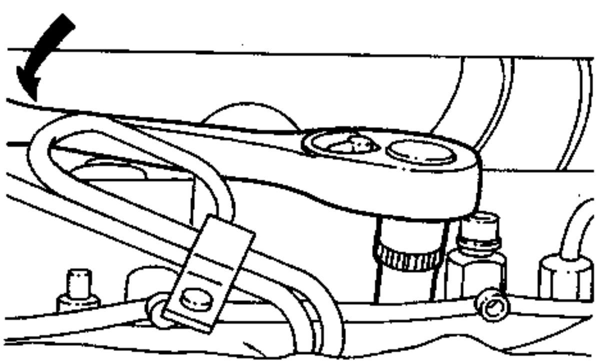
21618

3. Loosen the injector pressure line connection (4).



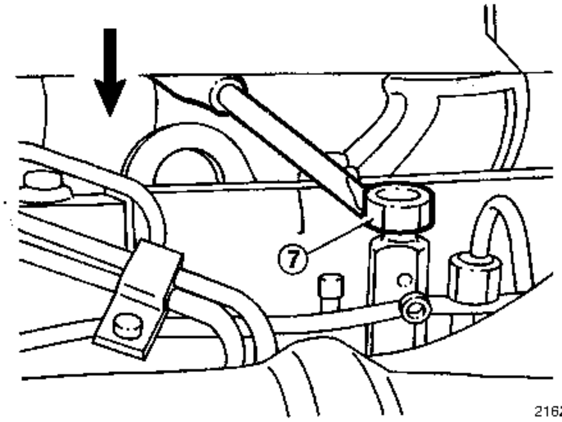
21619

4. Loosen connection (5) to free injector from excess fuel recovery line (6).



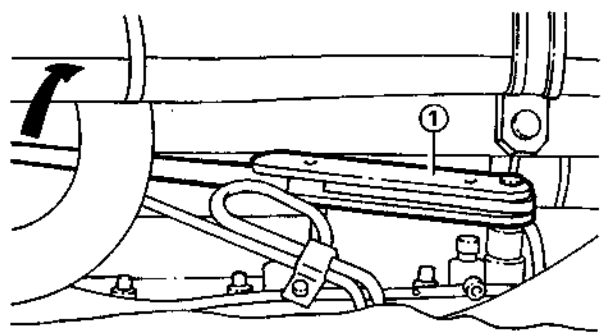
21620

5. Loosen the injector bracket attaching screws and remove bracket.



21621

6. To ease removal, temporarily screw a nut on the injector (7) and then pull the latter out by lever action with the aid of a suitable tool.
7. To re–install injectors, proceed as follows:
8. Introduce injector in its seat and install securing bracket.
9. Screw on the bracket nuts by hand until contacting bracket.



21622

10. Using a torque wrench (1), tighten nuts at prescribed value (see page 10–27), in two subsequent stages: 1st stage tighten nuts at 10 Nm (1 kgm or 7.23 ft.lb); 2nd stage tighten nuts at 25 Nm (2.6 kgm or 18.8 ft.lb).
11. Tighten the injector excess fuel recovery line connection.
12. Tighten the injector pressure line connetion.
13. Connect battery and install side panels.

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C.A.V. INJECTION PUMP
Removal–Installation, timing check and air bleeding (Op. 10 248 14)

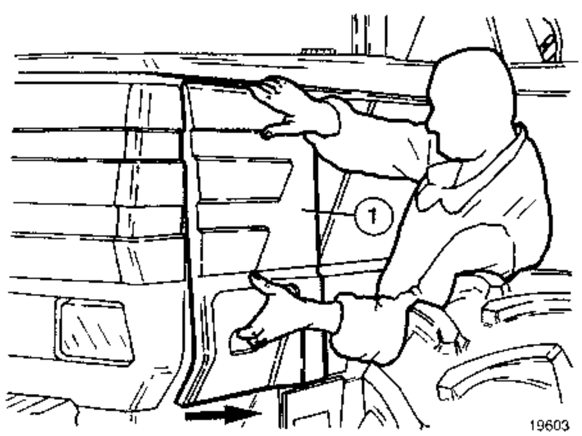
Proceed as follows:

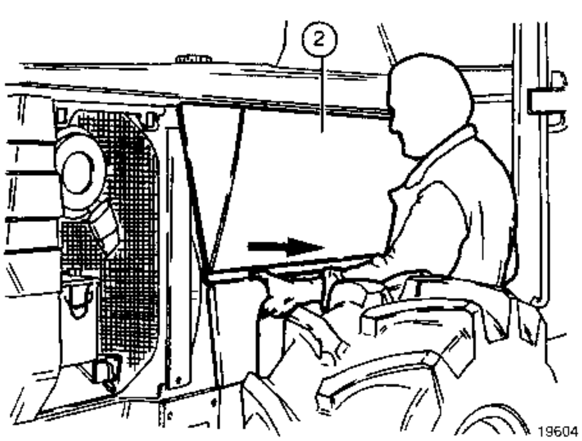
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

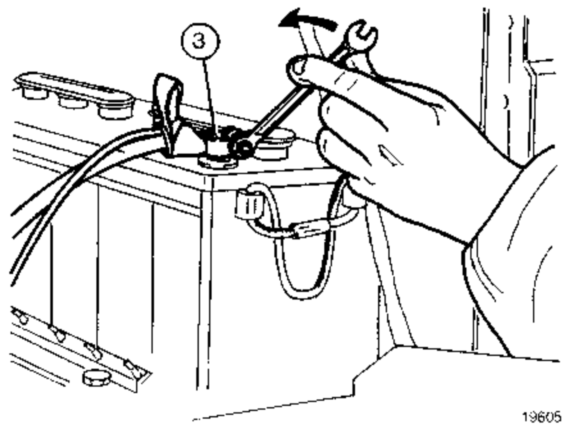
CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

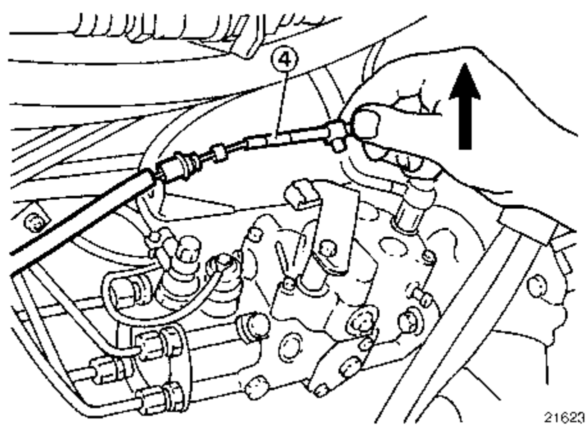




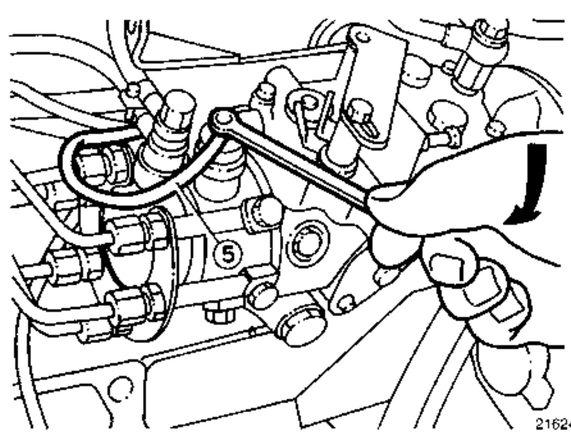
1. Remove panels (1 and 2) from both sides of hood.



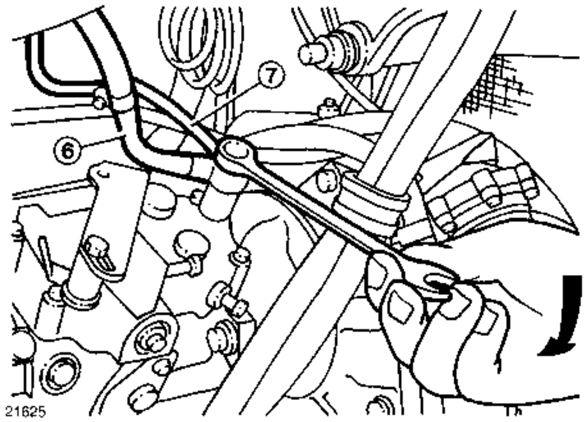
2. Disconnect battery positive cable (3) and insulate it.



3. Disconnect throttle control rod (4).

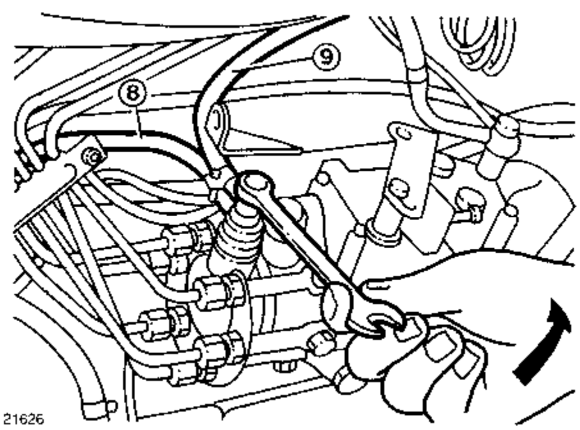


4. Disconnect engine shut–off solenoid control cable (5).



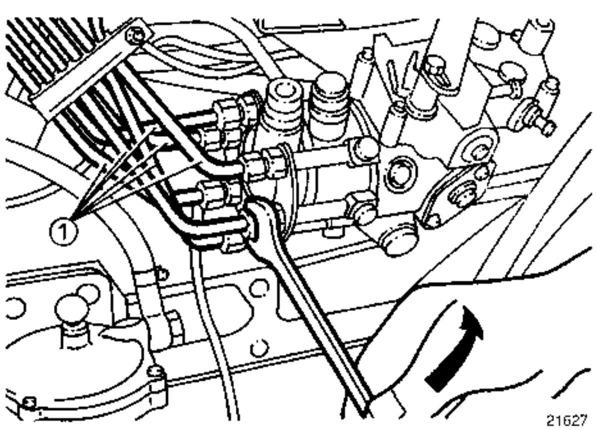
21625

5. Remove the fuel return line (6) together with injector excess fuel recovery line (7).



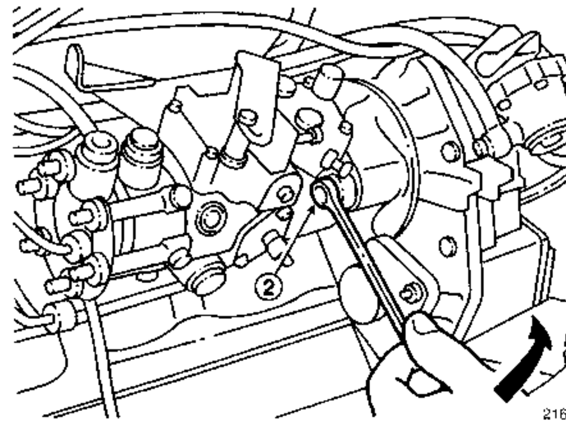
21626

6. Remove fuel injection pump feed line (8) and thermostart feed line (9).



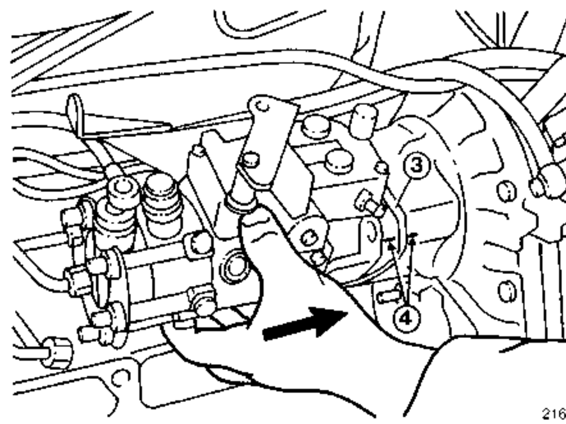
21627

7. Remove hi–pressure lines (1) from pump and injectors.



21628

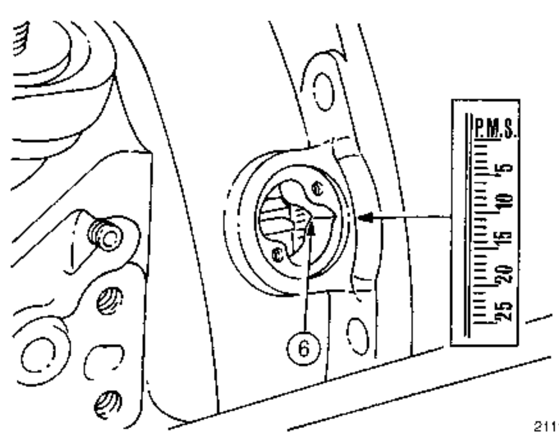
8. Loosen attaching screws and withdraw pump.



21629

9. At pump re–installation, complete with gasket (3), proceed to align reference marks (4) and tighten attaching screws to torque specifications of page 10–27.
10. To install loose parts:
    a. proceed reversing the removal sequence of operations, starting from no. 7 back to no. 2;
    b. torque tighten to values specified on page 10–27.

Lacking the reference marks, or should doubts arise as to their exactness, time the pump on the engine as follows:



21111

11. Turn flywheel to T.D.C. with valves on first cylinder closed.

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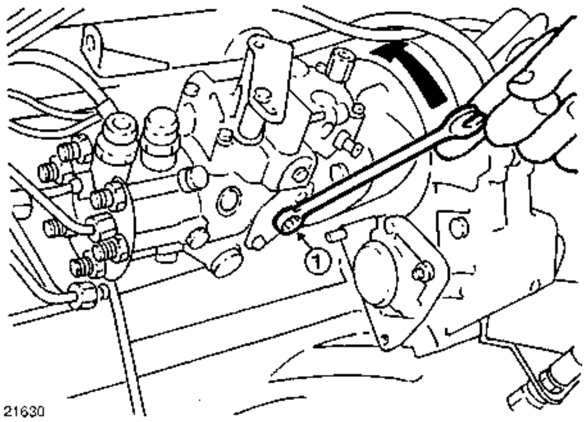
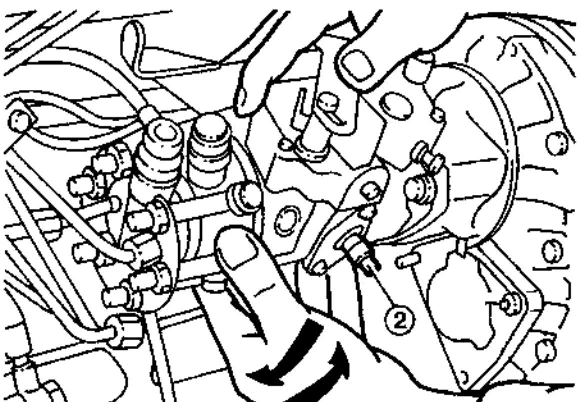


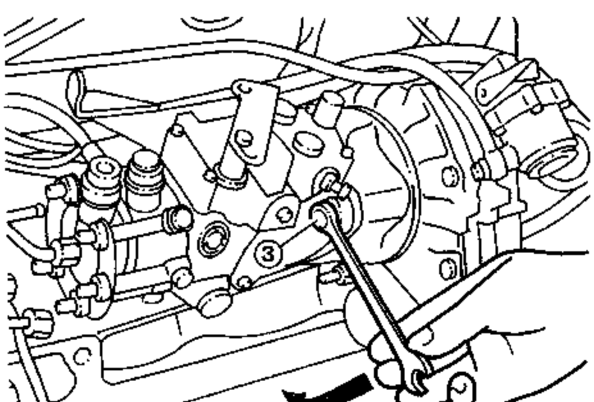
21630

12. With injection pump positioned and slack attaching screws, loosen plug (1) on pump lid.



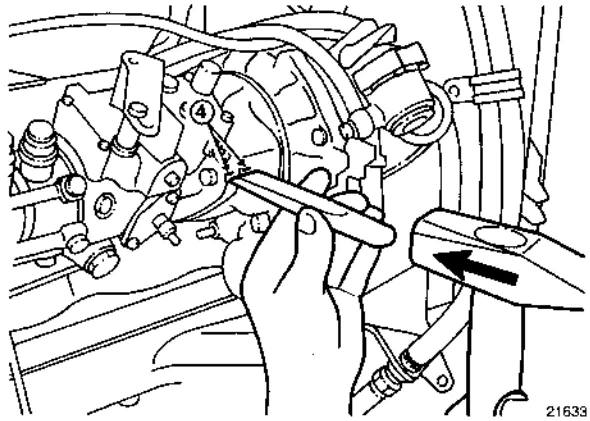
21631

13. Screw the timing pin **292411** (2) on lid and rotate pump until the inside length of pin engages the notch on pump shaft (i.e., when the pin enters the pump).



21632

14. Lock pump in position by torque tightening screws (3) to specified value (see page 10–27).

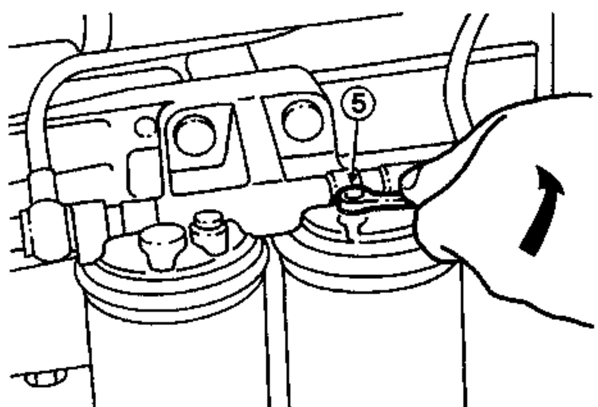


21633

15. Punch the reference marks (4) using an appropriate tool.

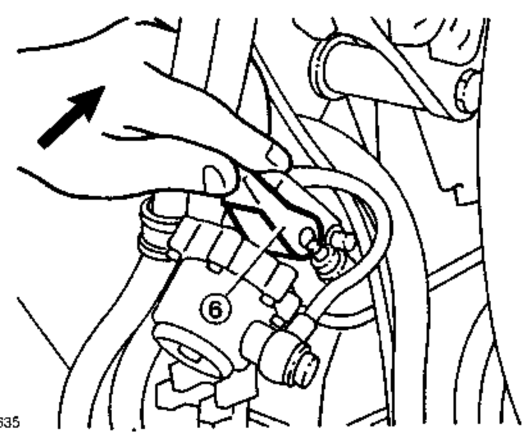
16. Remove pin **292411** (2) and fit plug (1).

17. Proceed to assembly as per point **10** on page 10–81.



21634

18. Loosen plug on first filter.



21635

19. Prime transfer pump lever until fuel flows out of the orifice on the filter without ai bubbles, then tighten plug (5).

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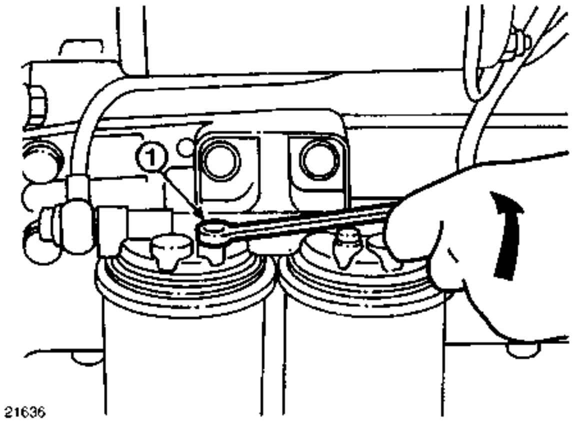
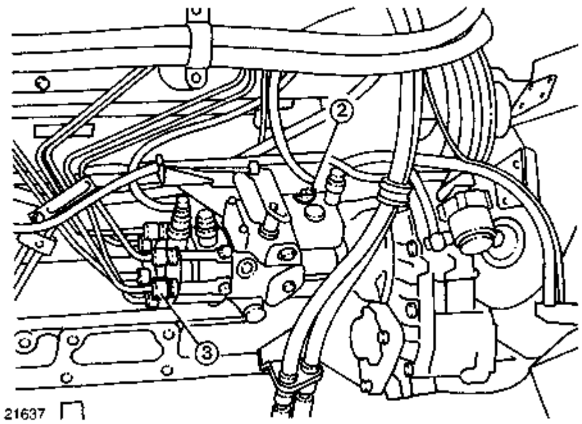

21636

20. Loosen plug (1) on second filter, repeat operation no. 19, tighten plug.


21637

21. Loosen the pump bleed screw (2) two turns and also loosen connection (3), prime through lever (6, page 10–82) until outflowing fuel is free from air bubbles.

22. Tighten connection (3), start the engine and, after making sure there are no more air bubbles in the fuel, tighten screw (2).

23. Install side panels.

Note – Air bleeding can be done, indifferently, by acting on the fuel transfer pump or directly through the starting motor.

BOSCH INJECTION PUMP
Removal–Installation, timing check and air bleeding (Op. 10 246 14).

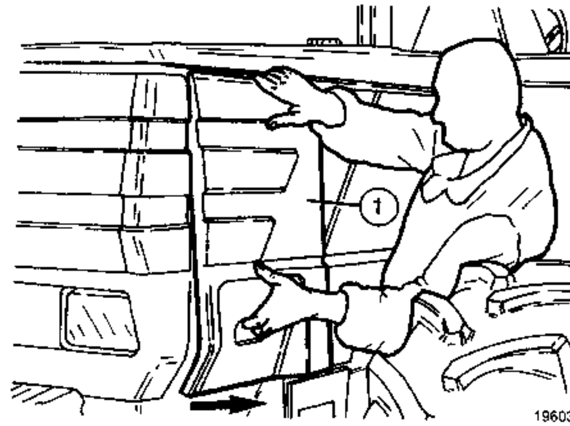
Proceed as follows:

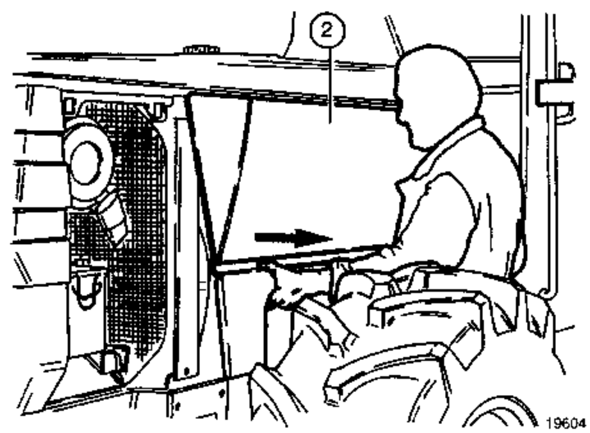
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

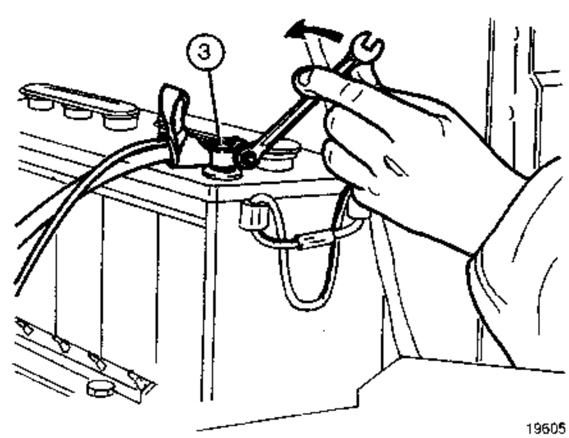
CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.


19603

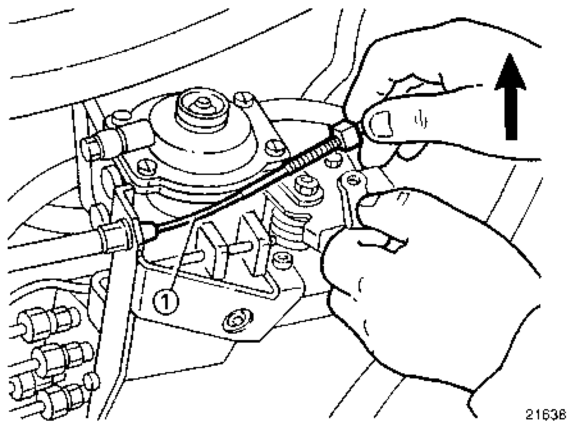

19604

1. Remove panels (1 and 2) from both sides of hood.

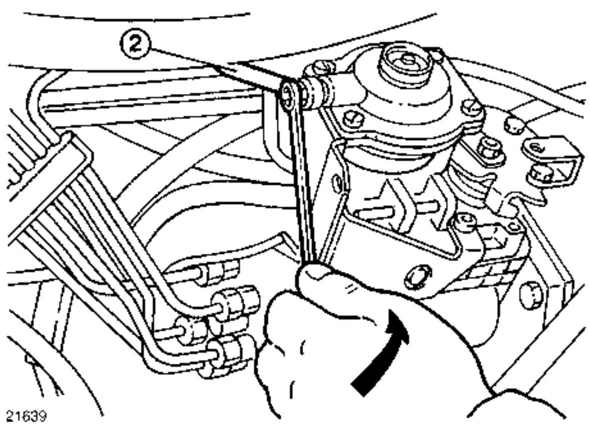

19605

2. Disconnect battery positive cable (3) and insulate it.

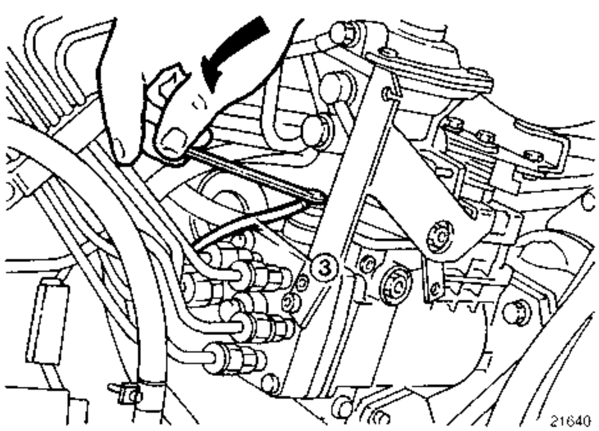
*Print No. **603.54.276.01** – 12 – 1992*



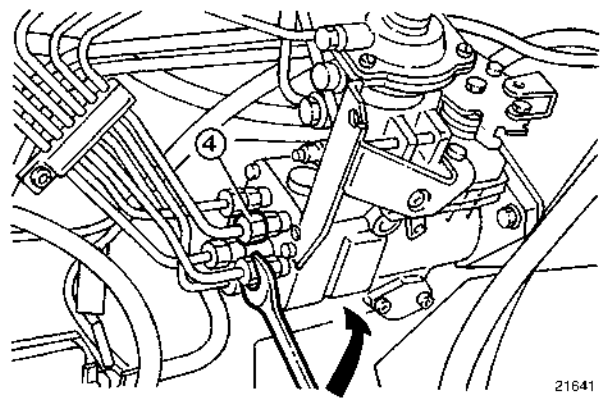
3. Disconnect throttle control rod.



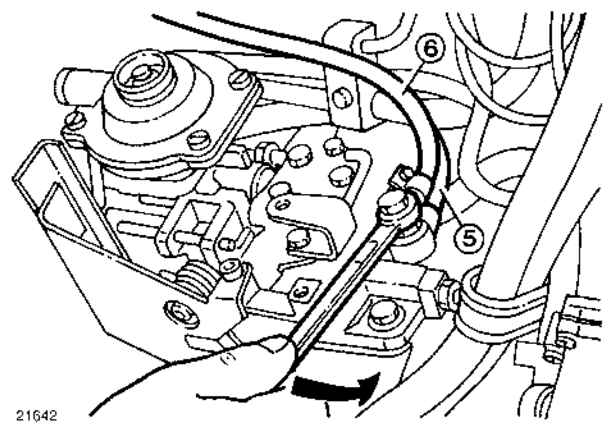
4. Remove connection pipe (2) to turbocharger.



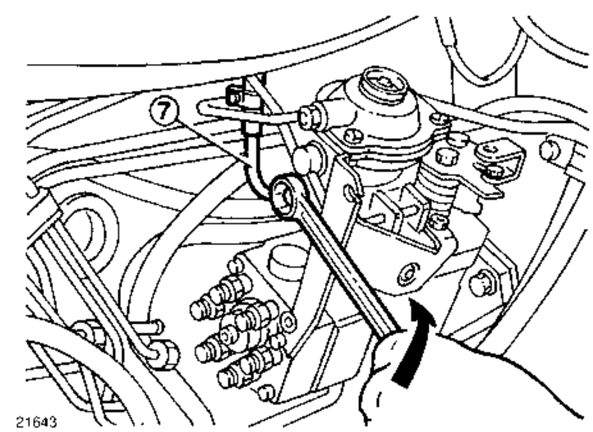
5. Disconnect engine shut–off solenoid control cable (3).



6. Loosen hi–pressure line connections (4), from pump and injectors.



7. Disconnect the pump and thermostarter feed lines (5 and 6, respectively).



8. Disconnect the fuel return line (7) together with the excess fuel recovery pipe.

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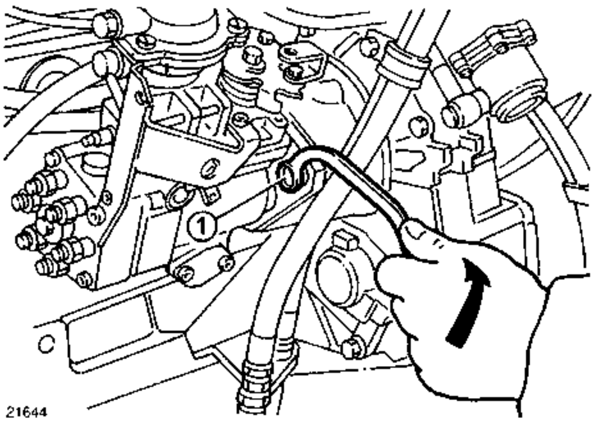
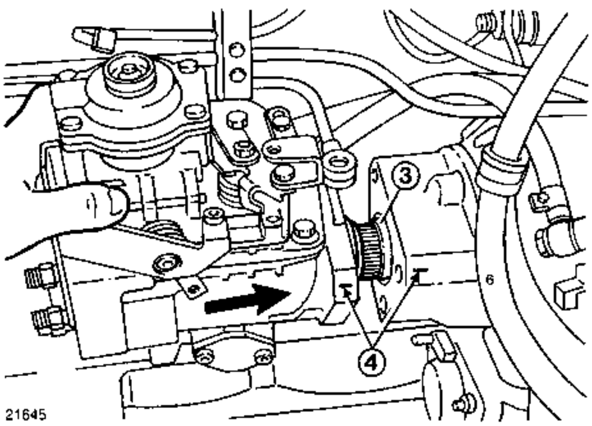


21644

9. Loosen attaching screws (1) and remove injection pump.



21645

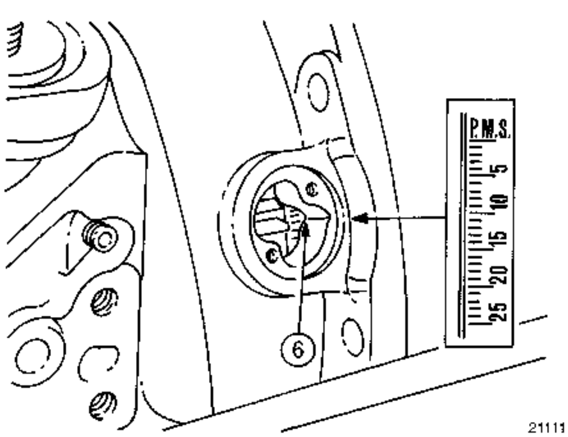
10. Re–install the pump and its gasket (3), make sure to align reference marks (4), tighten screws to torque specifications of page 10–27.

11. To install loose parts:

a. proceed reversing the previous sequence of operations, starting from no. 7 back to no.2;

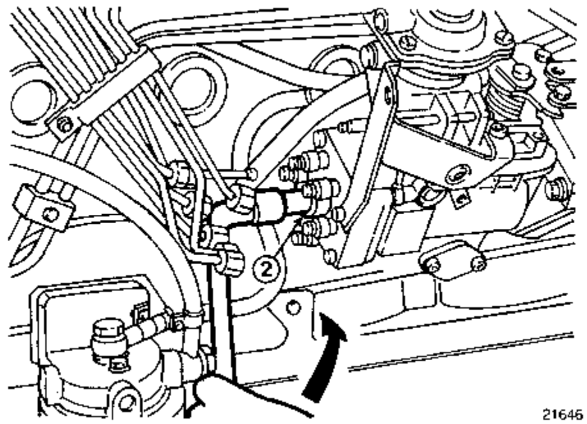
b. torque tighten to values specified on page 10–27.

Lacking the reference marks (4), or should doubts arise as to their exactness, time the injection pump on engine as follows:



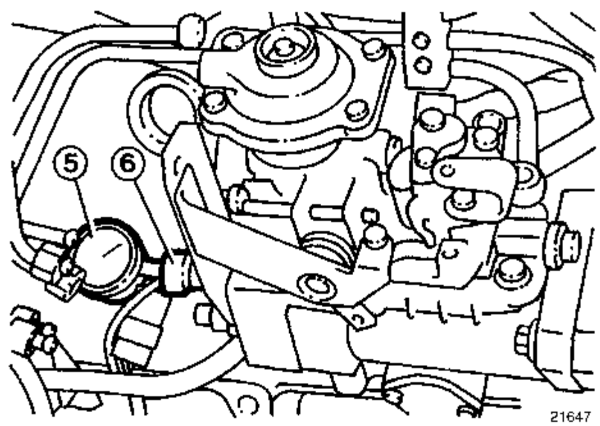
21111

12. Turn flywheel to T.D.C. with valves of first cylinder closed, turn flywheel counterclockwise (looking from fan side) until the index and the 8° notch coincide.



21646

13. With pump installed, loosen and remove plug (2) from pump.



21647

14. Install dial gauge **291754** (5) and associated tool **291755** (6), and pre–load the rod about 2.5 mm (.10 in).

15. Further and slowly turn back the flywheel until pumping element is at B.D.C. on commencement of delivery (evidenced by the gauge dial index which will stop going down).

16. Set dial gauge at zero and slowly turn the flywheel clockwise (looking from fan side) until the index lines up with the 8° notch.

17. Verify on dial gauge if pumping element stroke is 1mm (.040 in); if not, slacken the pump screws.

18. Rotate pump counterclockwise if stroke is less than specified above, clocwise if more, until obtaining the prescribed length of stroke.

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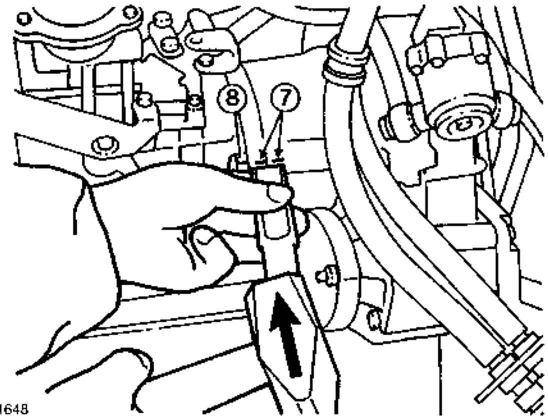
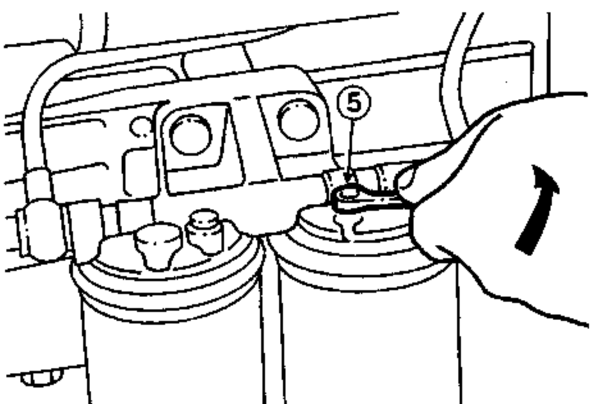


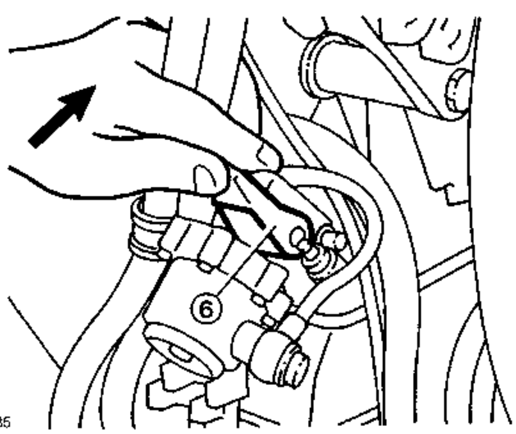
21648

19. Tighten screws (8) to torque specifications (see page 10–27) and make reference marks (7).
20. Remove comparator dial gauge **291754** and associated too; **291755** and re–ft plug (2, page 10–85), torque tightening it at 8 to 10 Nm (0.8 to 1 kgm or 5.8 to 7.2 ft.lb).
21. Proceed as per point 11, page 10–85.



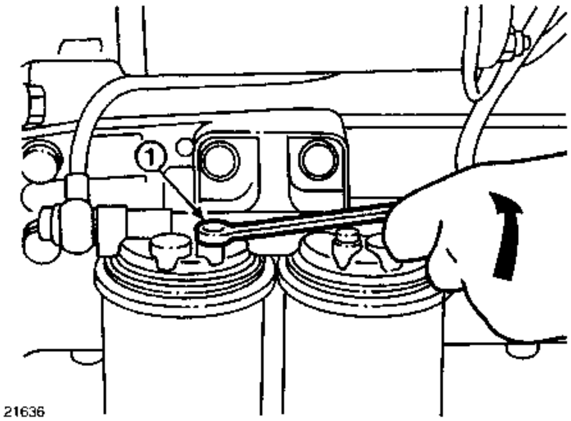
21634

22. Loosen plug (5) on first filter.



21635

23. Prime through transfer pump lever (6) until fuel flows out of filter hole free from air bubbles, then tighten plug (5).



21636

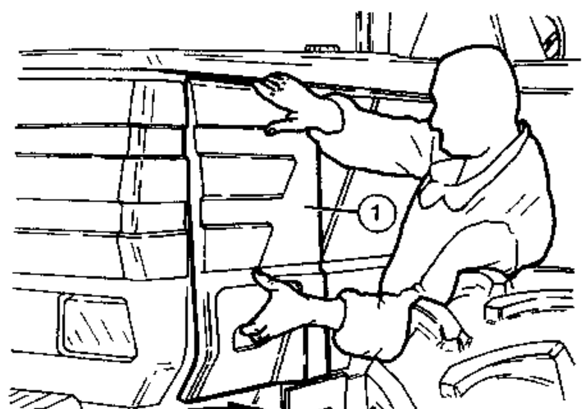
24. Loosen plug (1) on second filter and repeat operation no. 23, tighten plug back and pump a few more times.
25. Install side panels.

COOLING FLUID THERMOSTAT
Replacement (Op. 10 402 30)

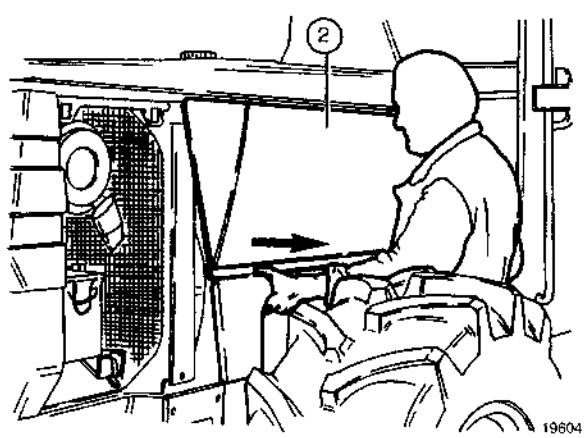
Proceed as follows:

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.



19603



19604

1. Remove panels (1 and 2) from both sides of hood.

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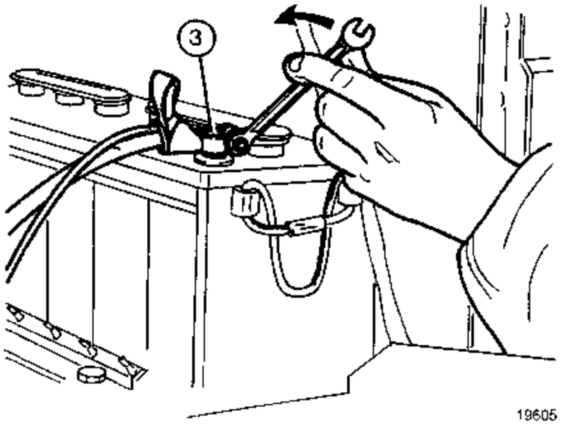
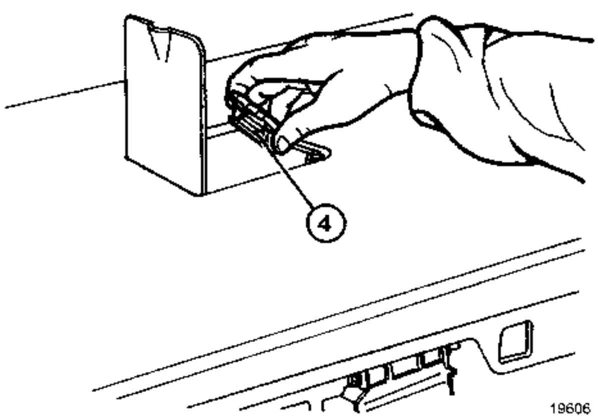
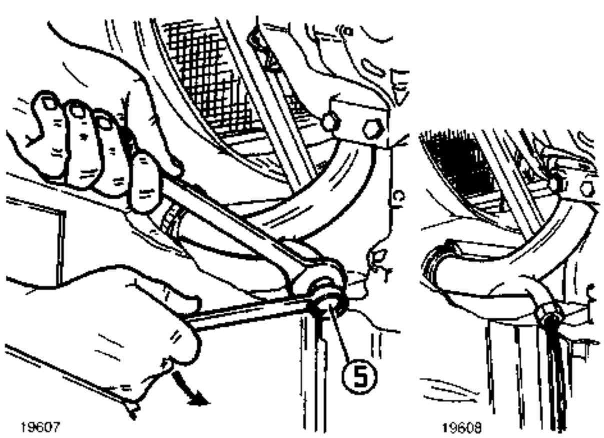


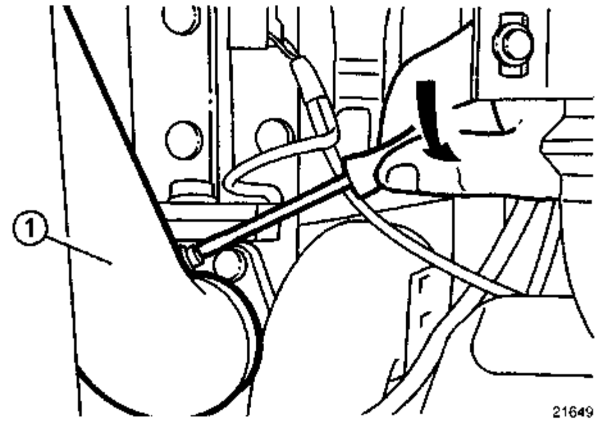
2. Disconnect battery positive cable (3) and insulate it.



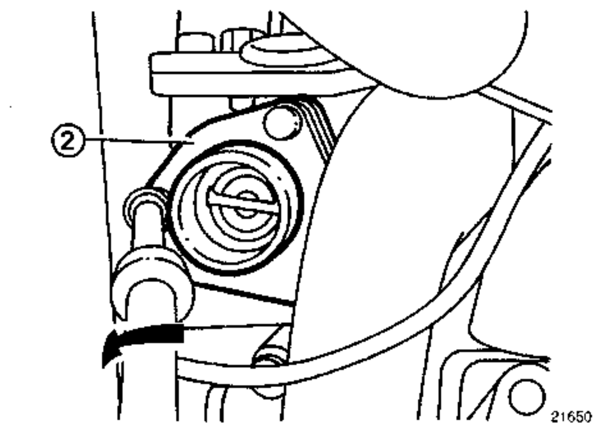
3. Remove cooling plant radiator plug (4).



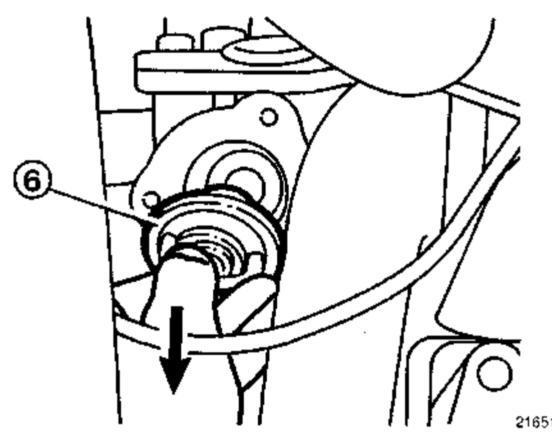
4. Remove plug (5) from drain line and empty the engine cooling plant.



5. Slacken band clamp (1) and withdraw hose (1) from thermostat



6. Remove attaching screws and thermostat mounting flange (2) and associated gasket.



7. Withdraw thermostat (6).

8. To assemble loose parts:

a. proceed reversing the previous sequence of operations, starting from no. 7 back to no. 1.

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RADIATOR
Removal–Installation (Op. 10 406 10)

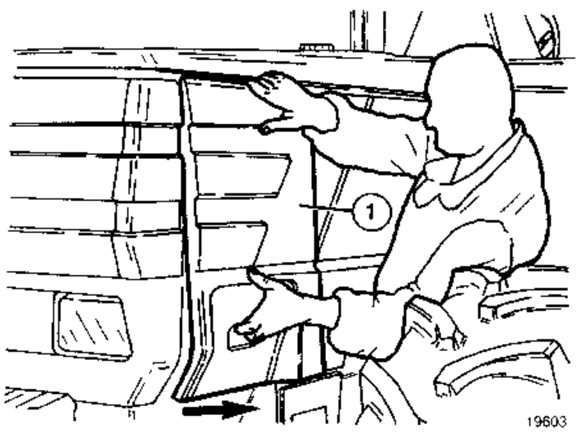
DANGER

Lift and handle all heavy components using a suitable lift.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.

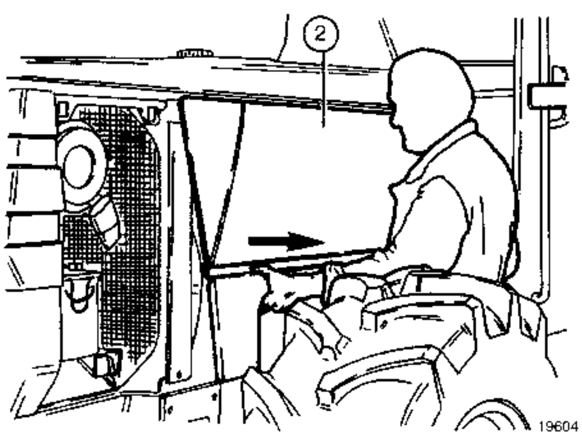
CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

Proceed as follows:

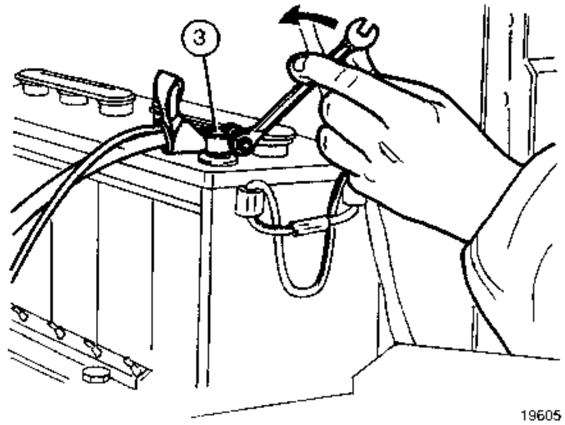


19603



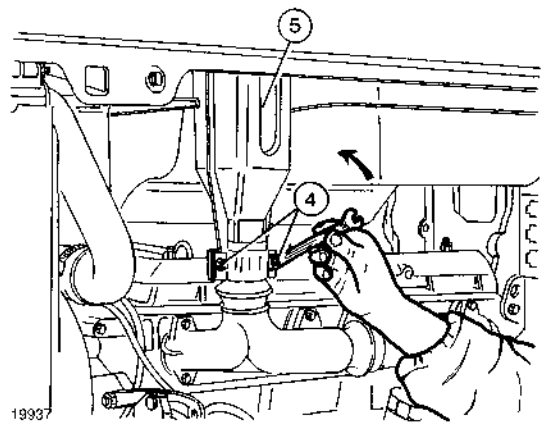
19604

1. Remove panels (1 and 2) from both sides of hood.



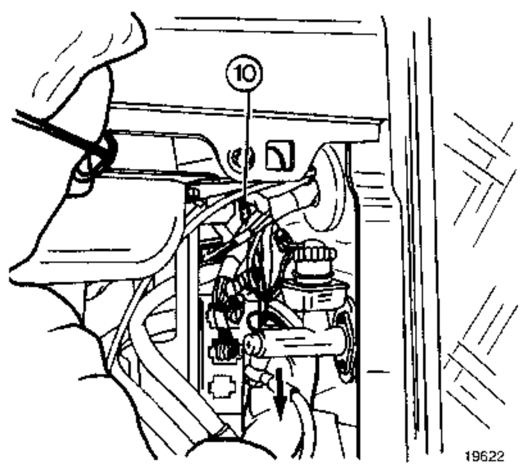
19605

2. Disconnect battery positive cable (3) and insulate it.



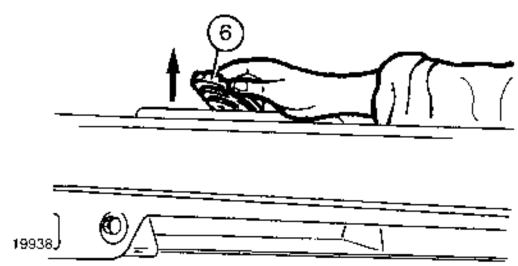
19937

3. Loosen screws (4) and remove exhaust muffler (5).



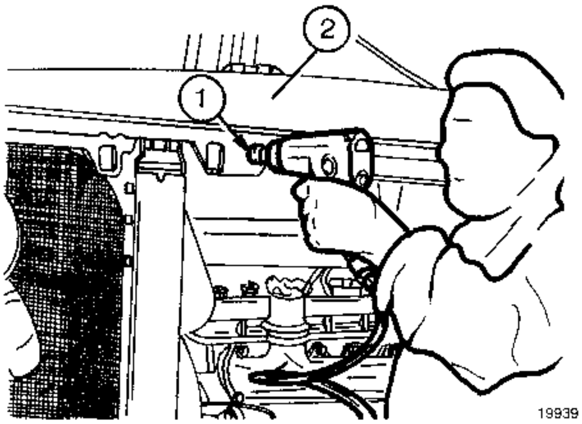
19622

4. Remove, by pulling, the glass washer tubelet (10).

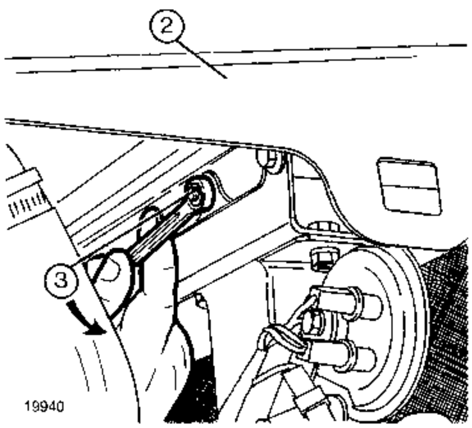


19938

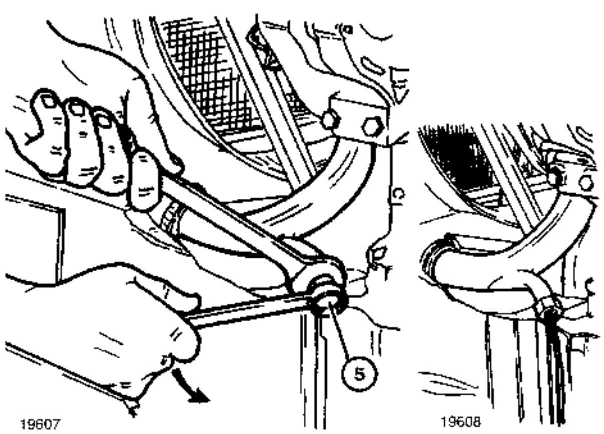
5. Remove cap (6) from secondary fuel tank.



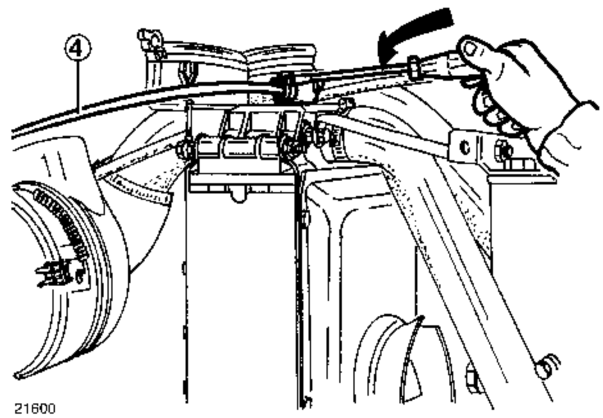
6. Loosen hood top (2) attachment screws (1), on both sides.



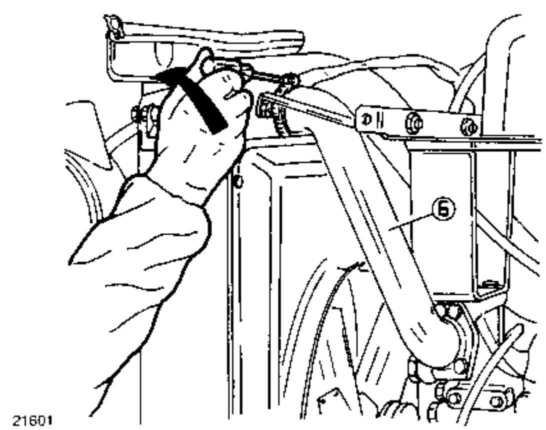
7. Loosen front screws (3) and remove hood top (2).



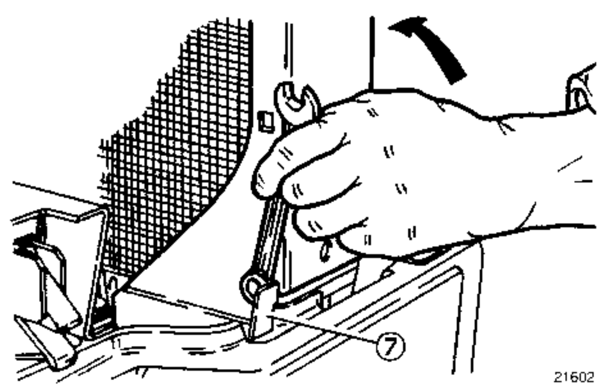
8. Remove plug (5) from drain line and empty engine cooling plant.



9. Remove line (4) connecting radiator to expansion tank.



10. Loosen band clamps and withdraw upper hose (6) and lower one from respective radiator connections.



11. Loosen attaching screws and remove vibration shield (7) on both sides.

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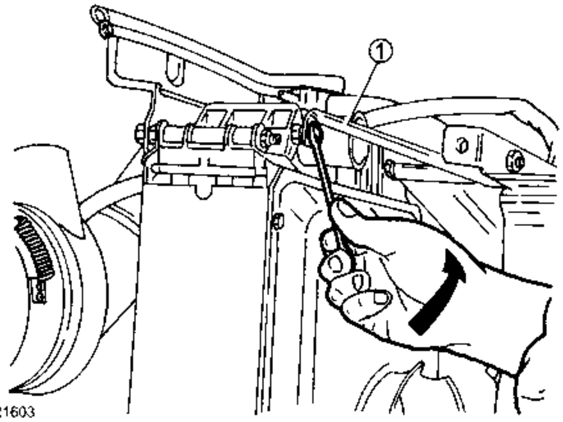
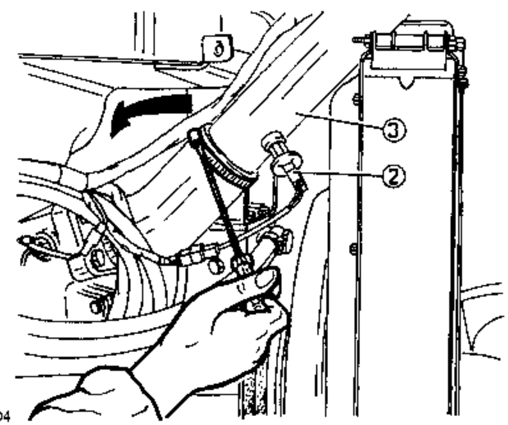


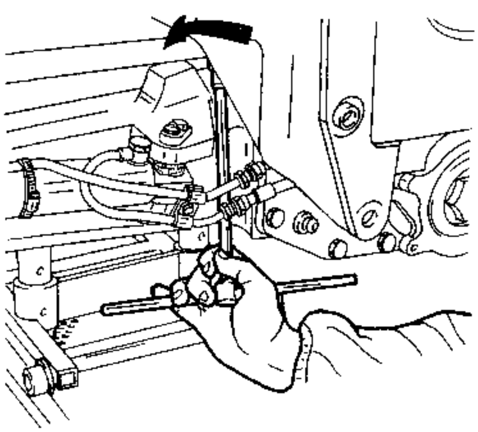
21603

12. Remove radiator attachment bracket (1), on both sides of engine.

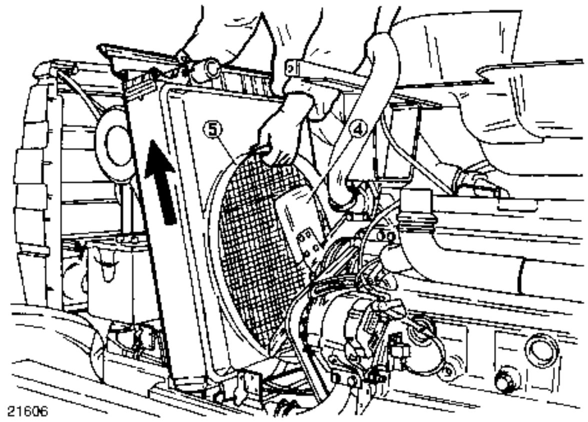


21604

13. Remove the clogged air cleaner connection (2) and secondary tank fuel level one, move cable harness to the outside of radiator, loosen the front and rear band clamps and remove duct (3) connecting air cleaner to engine.


21605

14. Loosen the screw securing radiator to front axle mounting bracket (on both sides).



21606

15. Move radiator forward to free fan (4) from conveyor (5), then remove radiator.

16. To install loose parts:
  a. proceed reversing the previous sequence of operations, starting from no. 15 back to no. 1;
  b. torque tighten to values specified on page 10–27.

COMPRESSION TEST
W/engine installed (Op. 10 001 30).
In case of poor engine performance, check, in addition to the fuel injection system, the compression at each cylinder.

⚠ DANGER ⚠

Never use matches, lighters or torches as lighting source on the machine because of the presence of inflammable fluids.

Use test instrument **291309/1** as follows:
- remove injectors;
- install the tool **293862** in place of the injector corresponding to the cylinder being tested, fitting the copper seal washer;
- hold injection pump on "stop" conditions and test by dragging engine through the starter.

On a perfectly efficient engine, the compression value measured at a temperature of about 40°C (104°F) of the oil in the sump, at the atmospheric pressure corresponding to sea level (760 mm of mercury) and at a speed of 200 to 280 rpm, measures 25.5 to 27.5 bar (26 to 28 kg/cm^2 – 370 to 399 psi).Max permissible compression spread among cylinders: 3 bar (3 kg/cm^2 – 43.5 psi).
It must also be taken into account that pressure decreases about 1% for every 100 meters (328 ft.) of altitude above sea level.
Compression faults may depend on abnormal conditions to be found in the following components: valves and their seats, pistons and their rings, cylinder liners, cylinder head gasket.

Note – Test results must not be considered of absolute value, as its main scope is to verify uniformity of compression in the cylinders and, indicatively, to assess wear conditions of components determining the tightness of the combustion chambers.

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*Print No. **603.54.276.01** – 12 – 1992*

LUK 13"/13" CLUTCH (F100–F110–F120)

Type	single, dry–plate with torsion springs
Control	hydrostatically operated, pedal control
Release mechanism	diaphragm spring
Clutch plate friction material	cerametallic buttons
Clutch plate total thickness under a load of 8800 N – 897 kg or 2280 lb)	9.6 to 10.4 mm (.38 to .41 in)
Spline backlash on gearbox drive shaft	0.076 to 0.136 mm (.003 to .005 in)
Clearance fit of throw–out collar	0.060 to 0.136 mm (.002 to .005 in)
Clutch pedal mounting adjustment	see page 18–10

LUK 14"/14" CLUTCH (F130)

Type	single, dry–plate with torsion springs
Control	hydrostatically operated, pedal control
Release mechanism	diaphragm spring
Clutch plate friction material	cerametallic buttons
Clutch plate total thickness under a load of 8800 N – 897 kg or 2280 lb	10.1 to 10.9 mm (.40 to .43 in)
Spline backlash on gearbox drive shaft	0.076 to 0.136 mm (.003 to .005 in)
Clearance fit of throw–out collar	0.060 to 0.136 mm (.002 to .005 in)
Clutch pedal mounting adjustment	see page 18–10

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TORQUE DATA

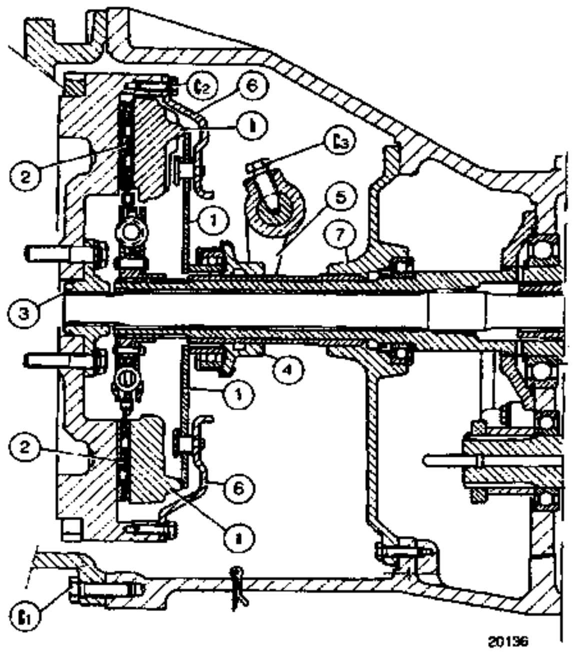
DESCRIPTION	Thread size	Torque		
		Nm	kgm	ft.lb
Capscrews and nuts, clutch case to engine (C_1)	M 12 x 1.25	88	9	65
Capscrews, clutch to engine flywheel (C_2)	M 8 x 1.25	23	2.4	17.5
Screws, shift forks (C_3)	M 16 x 1.5	157	16	116

SERVICE TOOLS

ATTENTION – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code **(X)**.
Besides, to work safely and achieve the best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjonction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

List of the special tools necessary to perform service operations covered by this section of the Manual:

	292320	Workshop stand, tractor disassembly
X	**293974**	Spigot, clutch centering (on tractor)
	292888	Pilot pins, transmission housing/engine alignment



Longitudinal sectional view of LUK 13" and 14" clutches

a. LUK 13" clutch – b. LUK 14" clutch – C_1. Capscrew, clutch case to engine – C_2. Capscrew, clutch to engine flywheel – C_3. Lockscrew, clutch release levers – 1. Diaphragm spring – 2. Master clutch plate – 3. Splined hub, PTO oil clutch shaft control – 4. Throw–out collar and thrust bearing – 5. Throw–out collar (4) shift fork – 6. Clutch cover – 7. Fixed collar cover.

ENGINE CLUTCH TROUBLE–SHOOTING CHART

Fault	Diagnosis	Correction
Clutch slips	**1.** Lack of clearance (G, page 18–12) between rod and hydraulic pump piston.	Replace pump.
	2. Disk (2) and/or pressure plate and flywheel wear.	Replace disk and the clutch, if necessary, and grind the flywheel.
	3. Weak or unserviceable diaphragm spring (1).	Replace clutch.
	4. Oil or grease on clutch disk (2) facings.	Replace disk, eliminate the cause for the presence of lubricants inside the clutch compartment and thoroughly clean friction surfaces.

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ENGINE CLUTCH TROUBLE–SHOOTING CHART

(cont.)

Fault	Diagnosis	Correction
Clutch grabs or chatters	**1.** Tight external control linkage.	Check linkage pivot points and lubricate.
	2. Bent or warped clutch disk (2, page 18–2).	Replace disk.
	3. Disk (2) hub tight on clutch shaft.	Remove clutch and check meshing: if necessary, replace defective parts.
	4. Disk (2) with damaged torsion damper springs or loose at hub (loose rivets).	Replace disk.
	5. Oil or grease on clutch disk (2) facings.	Replace disk, eliminate the cause of the presence of lubricants inside the clutch compartment and thoroughly clean disk facings.
	6. Diaphragm spring (1) with broken elements.	Replace clutch.
Clutch fails to disconnect and drags	**1.** Bent or warped clutch disk (2).	Replace disk.
	2. Seizure of external controls.	Check, replace defective parts and lubricate.
	3. Inefficient hydraulic pump and/or lower cylinder.	Overhaul or replace hydraulic pump and/or cylinder.
	4. Disk (2) hub tight on clutch shaft.	Free disk and, if necessary, replace disk or clutch shaft.
	5. Controls out of adjustment.	Adjust controls (see page 18–11).
	6. Presence of air inside the clutch hydraulic control system.	Bleed hydraulic system (see page 18–13) and, if necessary, replace pump and/or lower cylinder seals.
	7. Diaphragm spring (1) with broken elements and/or damaged throw–out bearing.	Replace clutch and/or throw–out bearing.
Clutch noise at engagement or disengagement	**1.** Bent or warped clutch disk.	Replace disk.
	2. Clutch disk (2) with defective torsion damper springs.	Replace disk.
	3. Excessive backlash on clutch shaft and disk (2) hub meshing splines.	Replace disk and, if necessary, the clutch shaft.
Clutch noise at disengagement	**1.** Worn throw–out bearing.	Replace bearing
Clutch control pedal hardness	**1.** Broken or disconnected clutch return spring.	Replace or hook–up the return spring.
	2. Seized pump plunger.	Overhaul or replace hydraulic pump.
	3. Tight external control linkage.	Check linkage points and lubricate.
	4. Hard pedal.	Check linkage and lubricate.

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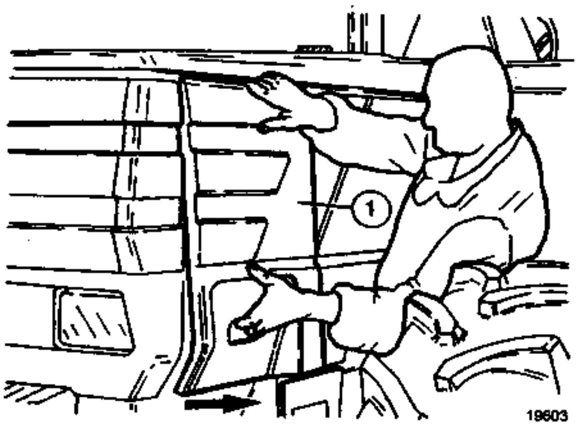
LUK CLUTCH
Removal–Installation (Op. 18 110 10)

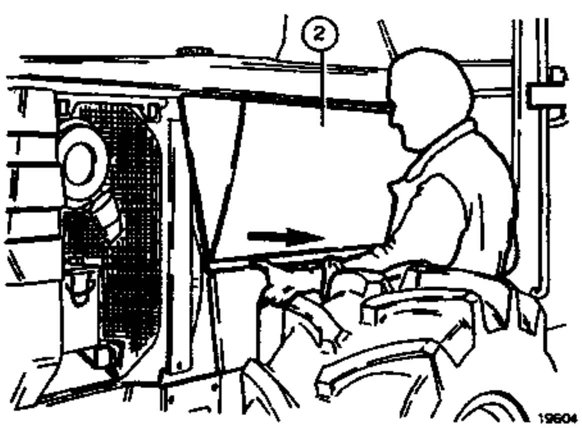
To gain access to the clutch, separate the engine with attached front axle or live axle from the transmission.

DANGER

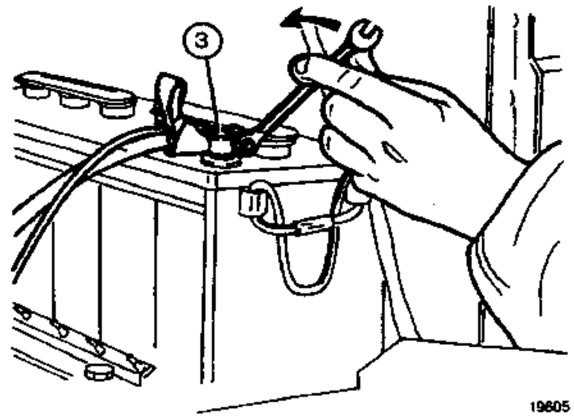
Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.

Proceed as follows:

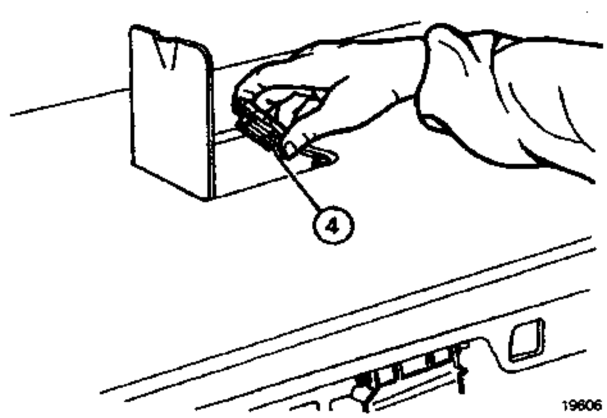




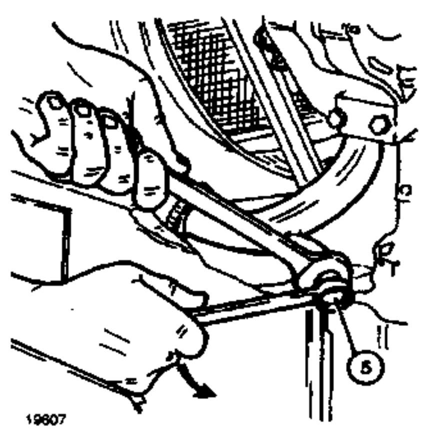
1. Remove panels (1 and 2) on both sides.



2. Disconnect the battery positive cable (3) and insulate properly.



3. Remove the engine cooling radiator filler plug (4).



4. Remove the radiator cooler drain pipe plug (5).

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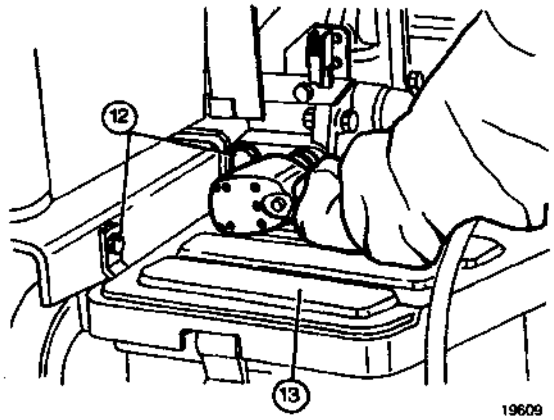
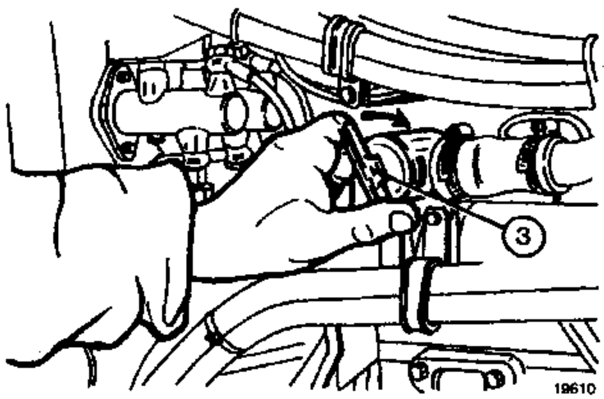
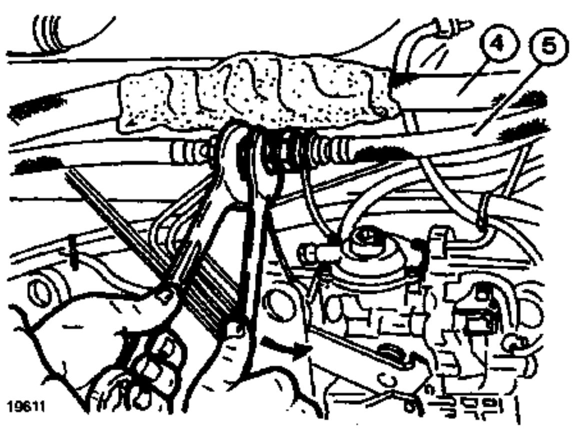


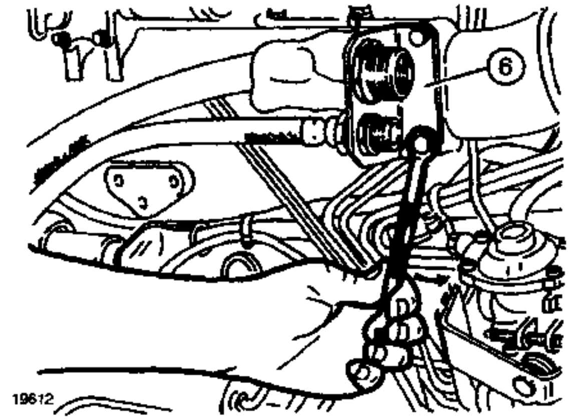
5. Remove the retaining screws (12) and tractor tool box (13).



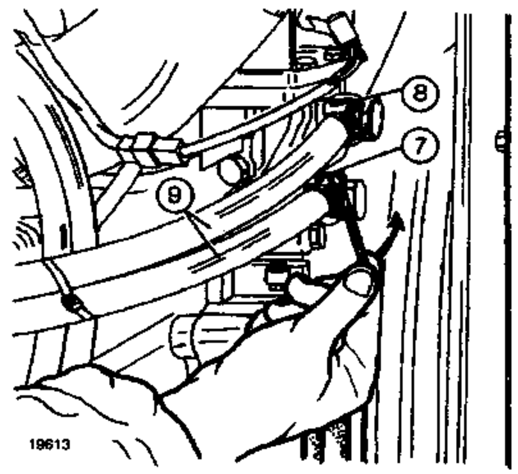
6. Shut off the cock (3) on the line connecting main and auxiliary tanks.



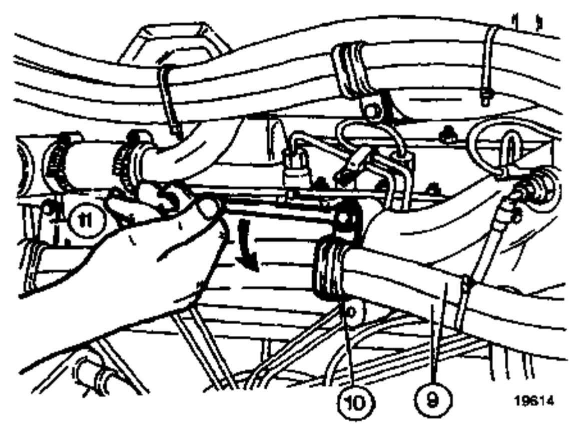
7. If the cabin is air–conditioned, remove both refriger-ant lines (4 and 5).



8. Remove retaining screws and supporting bracket (6) of the previously disconnected lines (4 and 5).



9. Unscrew clamps (7 and 8) securing the heater–to–engine connecting lines (9).



10. Remove the retaining screws of the supporting clamps (10 and 11) and subsequently the lines (9) from the engine.

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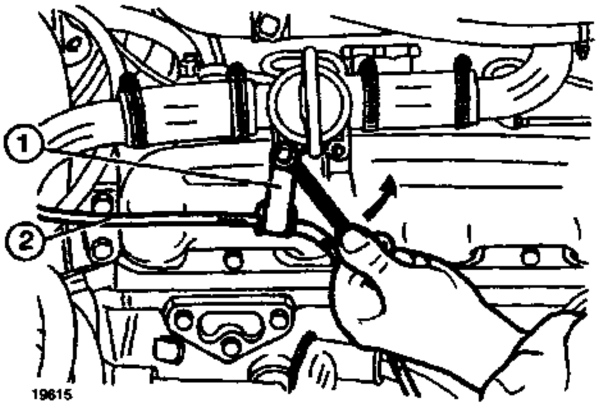
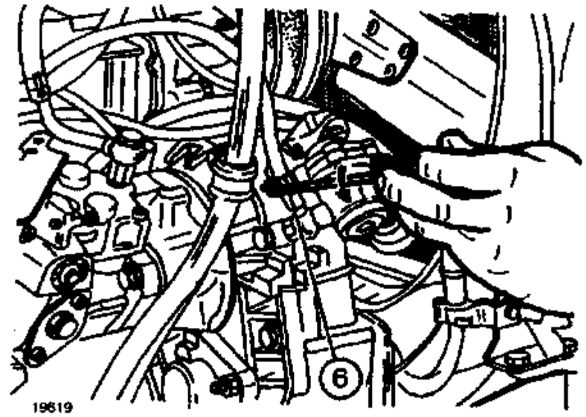
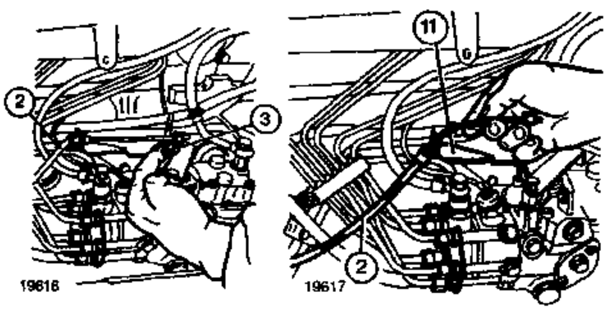


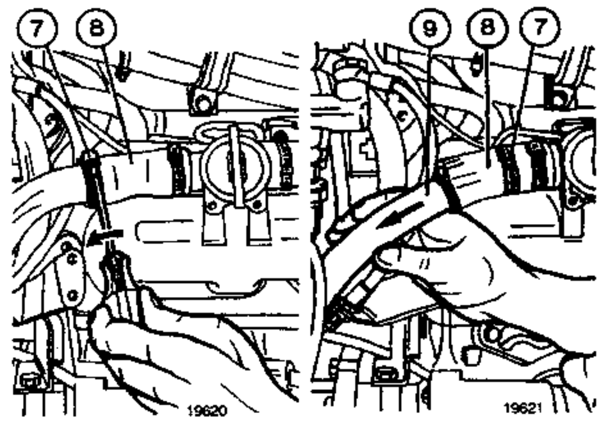
11. Slacken the engine accelerator cable supporting clamp (1) screw.



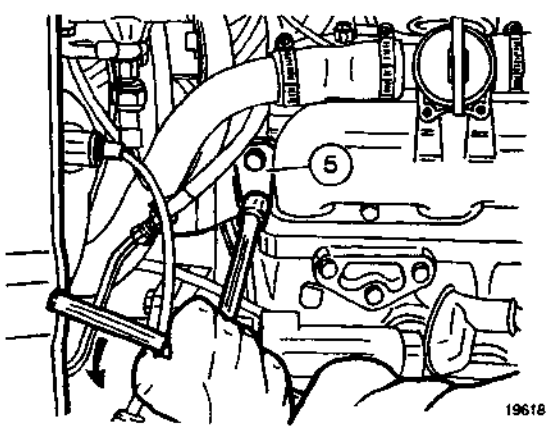
14. Loosen the feed line securing band clamp (6) and withdraw the former from its connection.



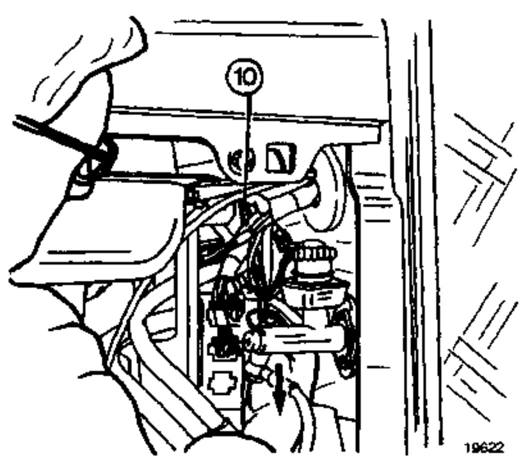
12. Snap off the stop spring (3), free the terminal section of cable (2) and finally withdraw the latter from the bracket (11).



15. Drain out approx. 2 liters or 1/2 gallon of fuel by removing plug (6, page 21–14), loosen band clamp (7) securing hose (8) and finally withdraw the latter from pipe (9).



13. Unscrew the fastenings of the brake oil lines supporting bracket (5) and remove the latter from the engine.



16. Pull out the windscreen washer fluid tubelet (10).

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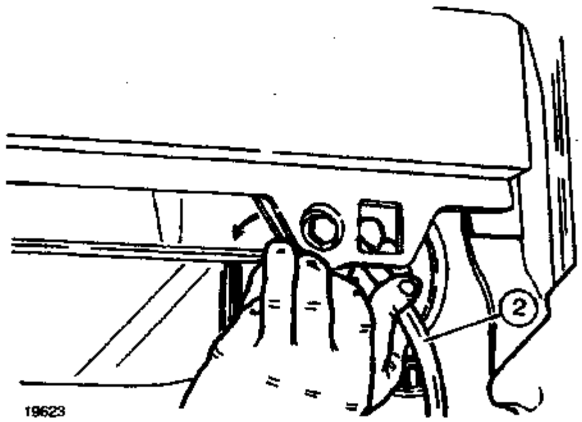
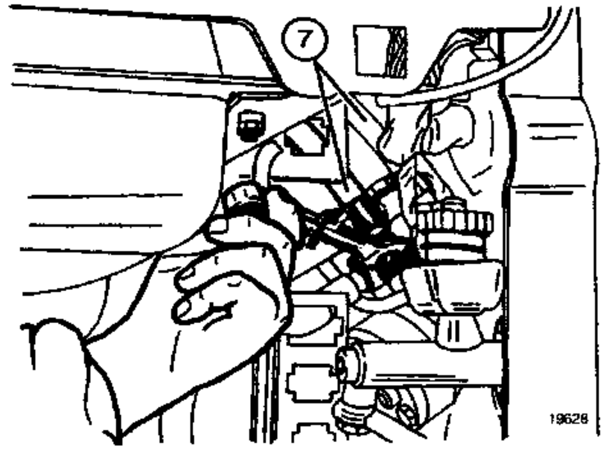
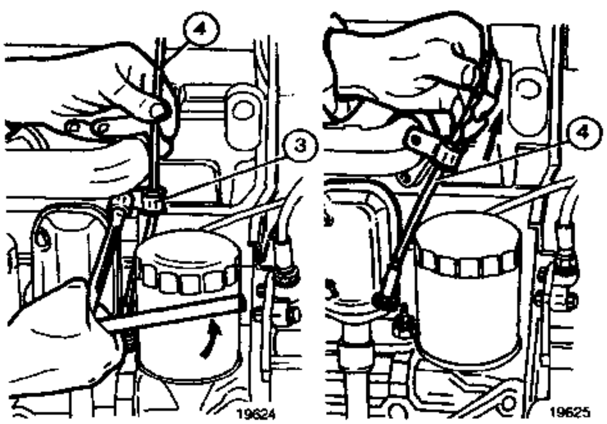


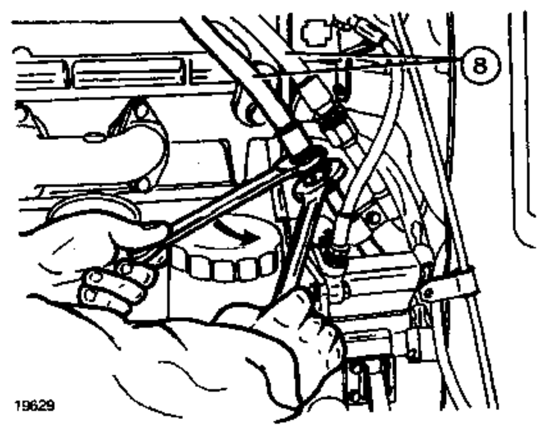
17. Loosen the breather line (2) clamp.



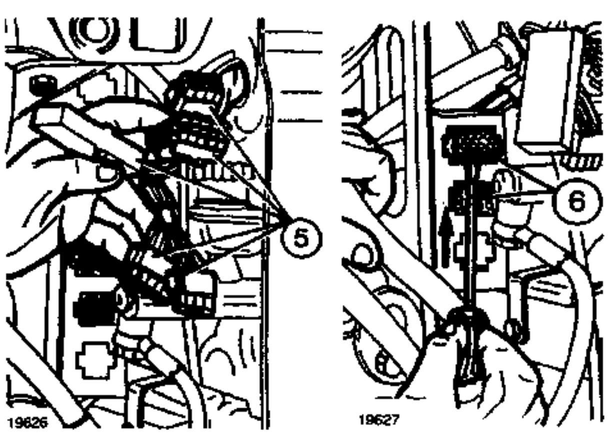
20. Unscrew the connections of the power steering cylinders oil lines (7) and remove them.



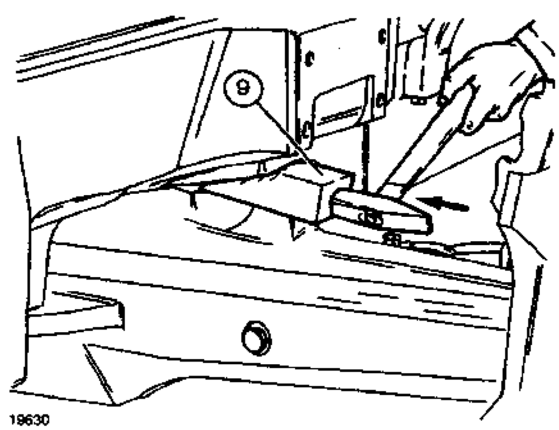
18. Back off the retaining clamp (3) screw and the tractor meter gauge (4) cable connection, then remove the instrument from the engine.



21. Unscrew the connections of the power steering hydrostatic unit oil lines (8) and remove them.



19. Disconnect electric leads (5 and 6).



22. Block the engine with respect to front axle or live front axle by installing two wood supporting blocks (9), one on each side , as shown in the figure.

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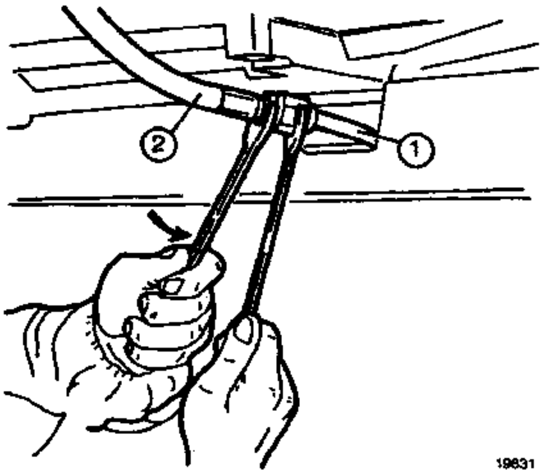
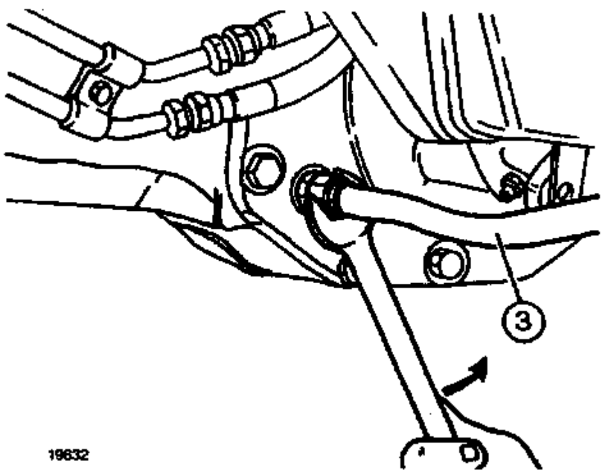
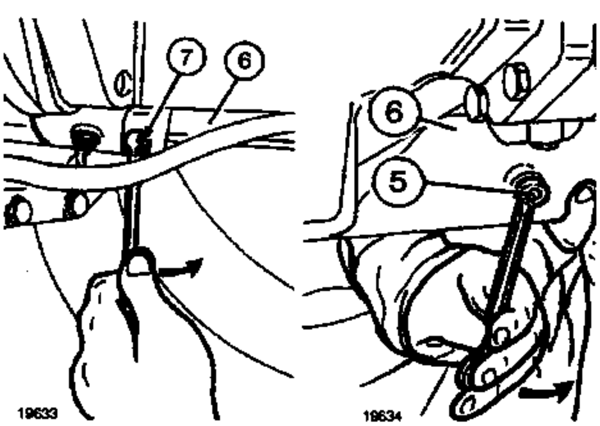


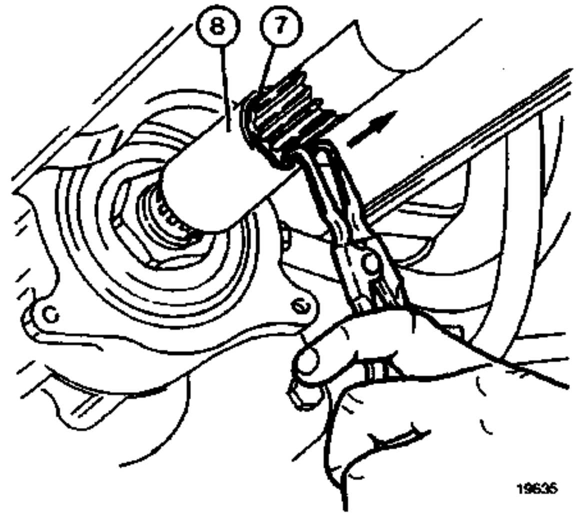
23. Disconnect hose (2) from pipe (1) leading to the live front axle differential lock.



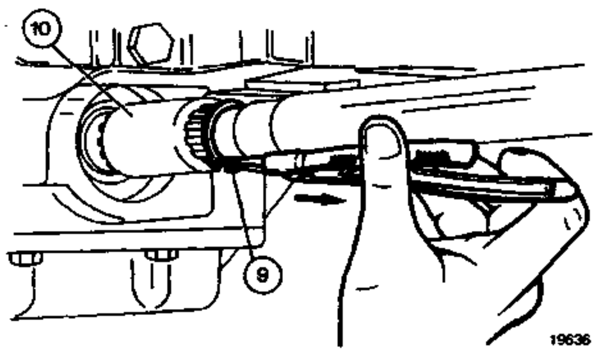
24. Remove hose (3) from live front axle.



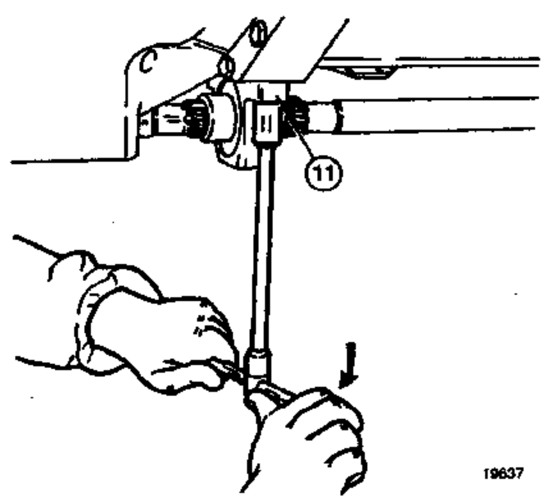
25. Unscrew the fastenings, front (4), central (5) and rear screws securing the live front axle transmission and drive shafts guard (6).



26. Snap the retaining ring (7) open and move back sleeve (8) to free it from the front axle splined connection.



27. Snap the retaining ring (9) open and move sleeve (10) forward to free it from the drive box splined connection.



28. Back off the capscrews of the front axle transmission drive shafts mounting bracket (11).

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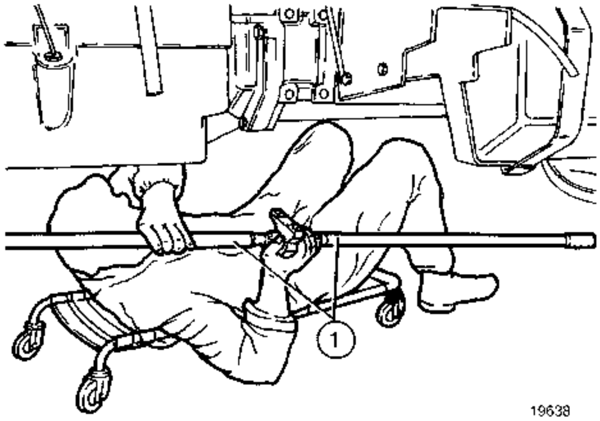
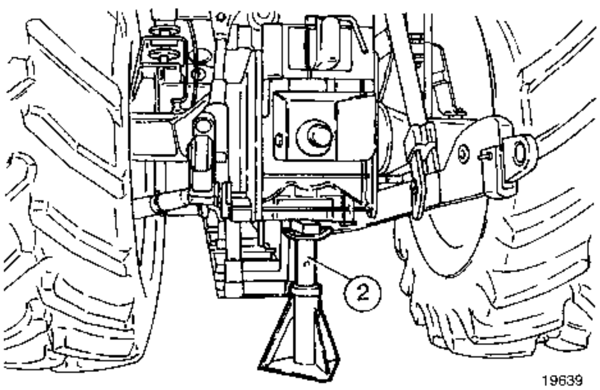
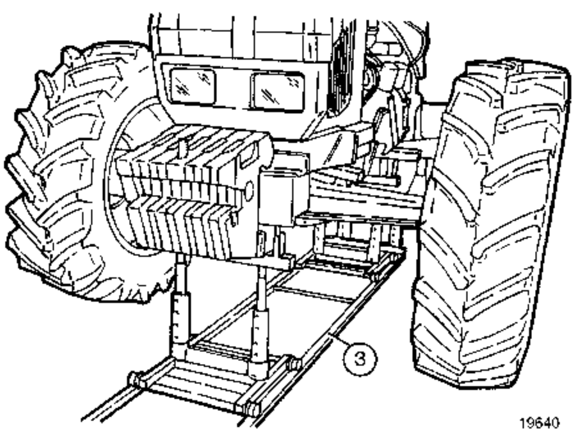


29. Retrieve shafts (1) and respective supports.

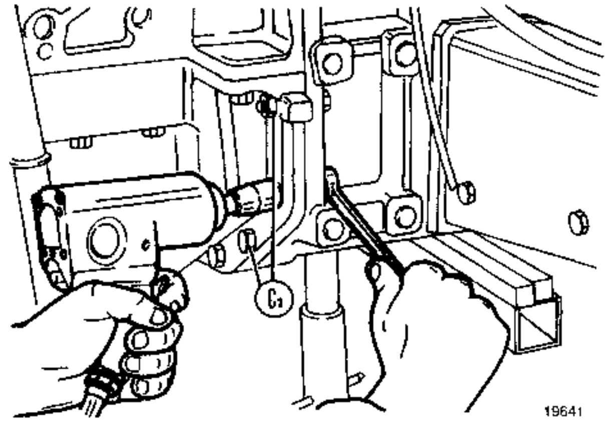
Note – Operations 23 to 29 apply in case of 4WD tractors only.



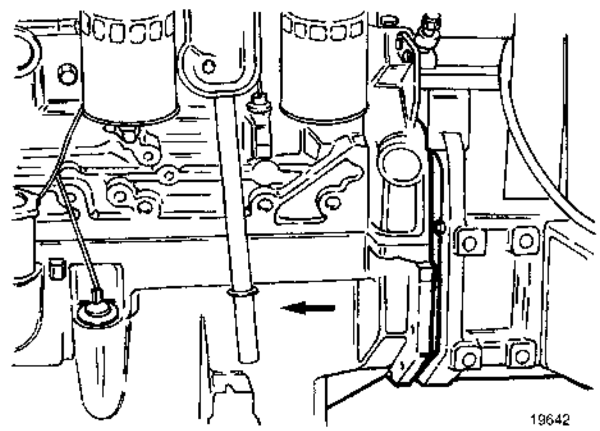
30. Support the rear end of the tractor through a stationary stand (2) positioned underneath the rear transmission case.



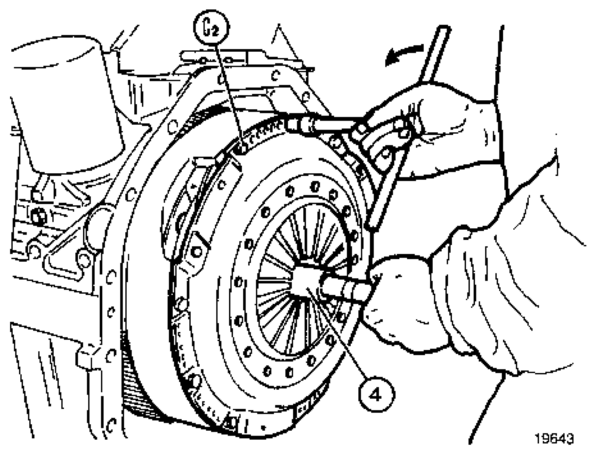
31. Place the tool **292320** (3) under the tractor positioning the stationary support underneath the clutch case and the two mobile parts under the tractor weights and engine oil sump, respectively.



32. Block rear wheels by pulling the hand brake or through wedge blocks suitably installed and then unscrew capscrews (C_1).



33. Split the tractor by separating engine and clutch case, move the former forward making sure that there no parts still connected or any undue resistance.



34. Unscrew the clutch to engine flywheel fastening capscrews (C_2) and remove the clutch with the aid of the centralizer spigot tool no. **293974** (4).

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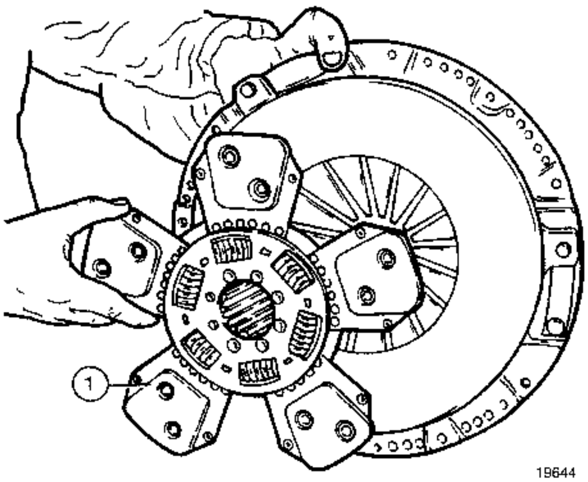

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35. Check the clutch disk (1) for wear and replace it if rivets are near to or flush with the cerametallic button friction surface.

36. When installing the clutch pay attention to the following:

a. proceed by reversing the removal sequence of operations starting from no. 35 back to no. 1;

b. torque tighten fastenings to specifications data of page 18– 2;

c. apply grease (**grassofiat TUTELA G9**) on the clutch disk splined drive;

d. use special tool **293794** (4, page 18–9) to join clutch and flywheel correctly;

e. screw on two centering dowels **292888** to ease installation, paying attention to avoid interferences;

f. before re–joining cases, brackets and covers make sure to thoroughly clean and degrease mating surfaces, then apply a round strip of sealing compound, about 2mm (.08) dia., following the scheme indicated in the figure of page 18–14.

CLUTCH HYDROSTATIC CONTROL
Pump removal–installation (Op. 18 104 15 – 18 104 30)

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

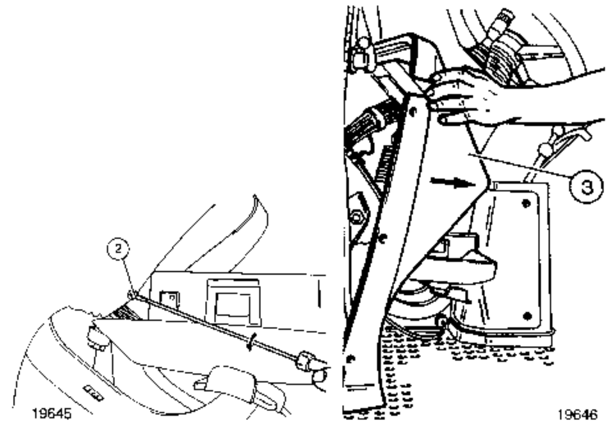
CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

Proceed as follows:

1. Remove body panels (1 and 2, page 18–4) on both sides.

2. Disconnect the battery positive cable (3, page 18–4) and insulate properly.



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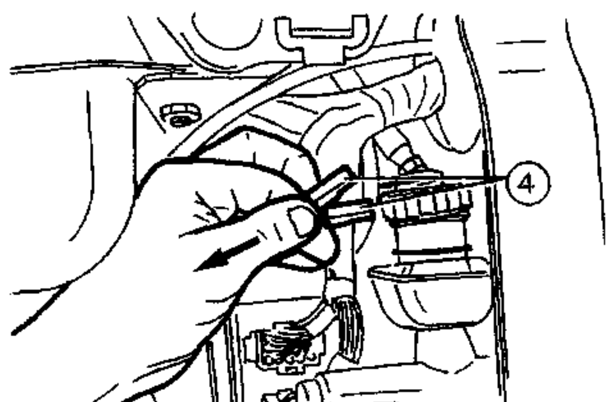
3. Remove the three side screws, the rear one (2) and finally the LH side protection (3).



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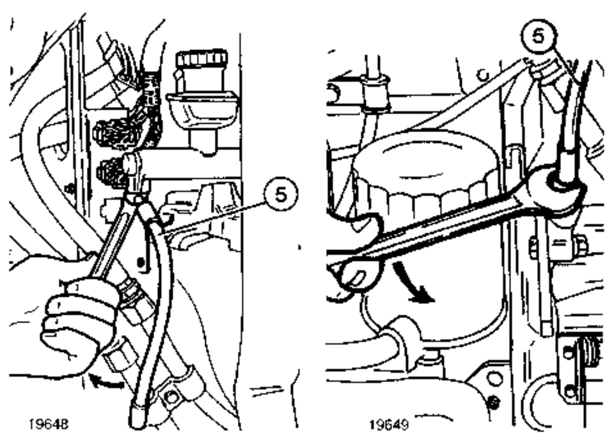
4. Disconnect the clutch hydrostatic control reservoir oil level gauge electric connections (4).



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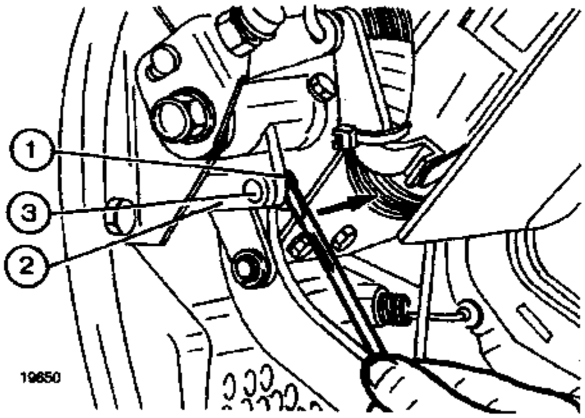
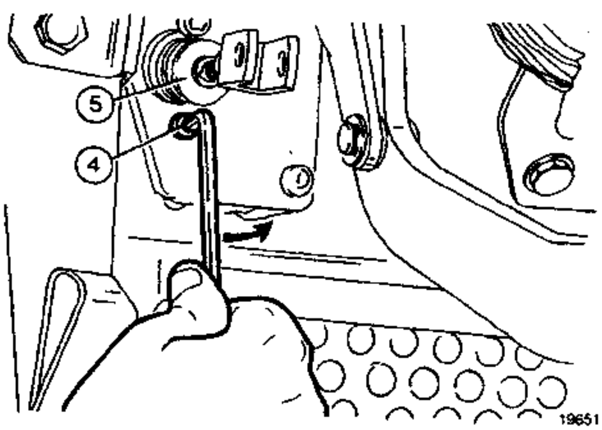
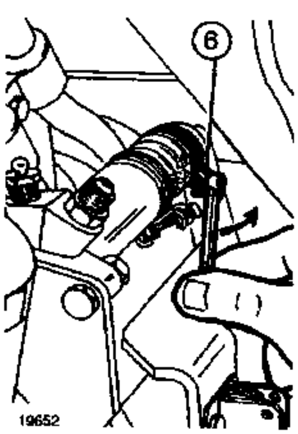
5. Unscrew the oil delivery line (5) between pump and lower cylinder.

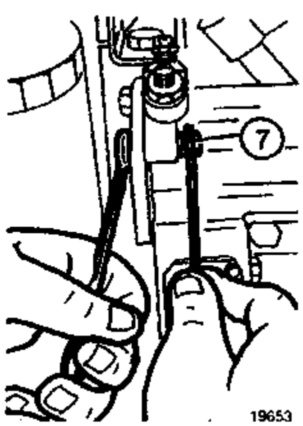


6. Remove the spring stops (1) and withdraw the pin (3) from fork (2).

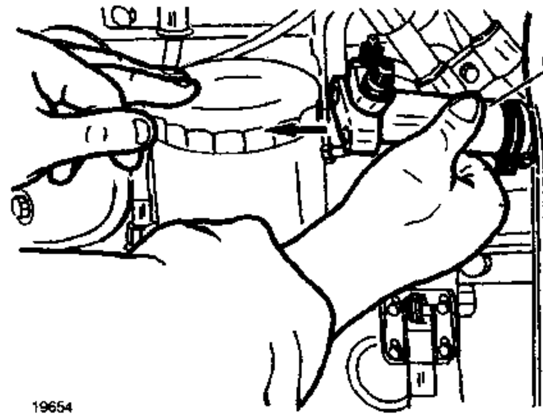


7. Unscrew the fastenings (4) and retrieve the hydraulic pump (5) from engine side.





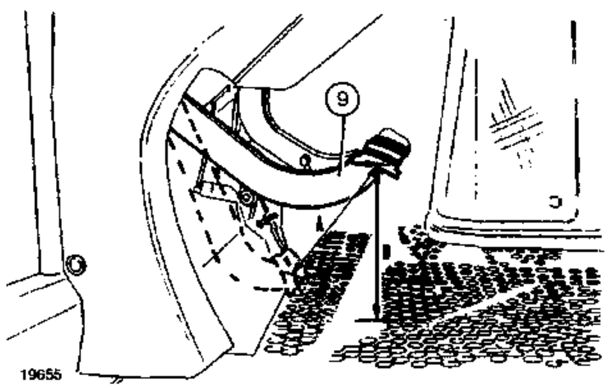
8. Slacken the band clamp (6) and retrieve it from the lever, remove screws (7).



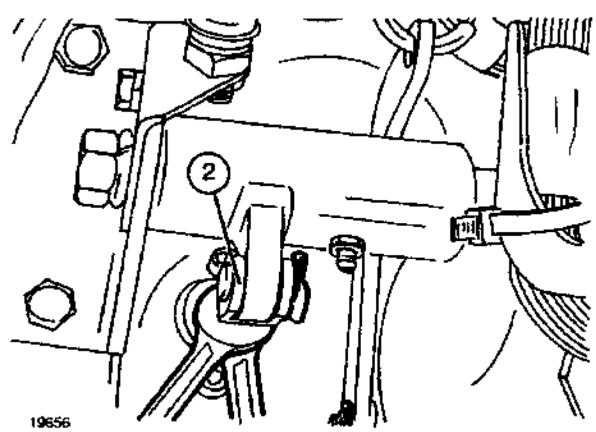
9. Retrieve the hydraulic cylinder (8).
10. Install the clutch control assembly by reversing the removal sequence of operations and, in addition, adjust the pedal position as follows:

Height clutch pedal adjustment.

11. Adjust distance (D, page 12) prior to refitting the pump.



12. With clutch pedal (9) connected to fork (2) check that height (H) from center of pedal to the top surface of the mat is approx. 190 mm or 7–1/2 in.



13. If correction is needed, slacken the jam nut and turn the screw clockwise on the fork (2) until obtaining the desired height (H), then check that the free travel (A) of pedal (9) is 170 mm (6.69 in).

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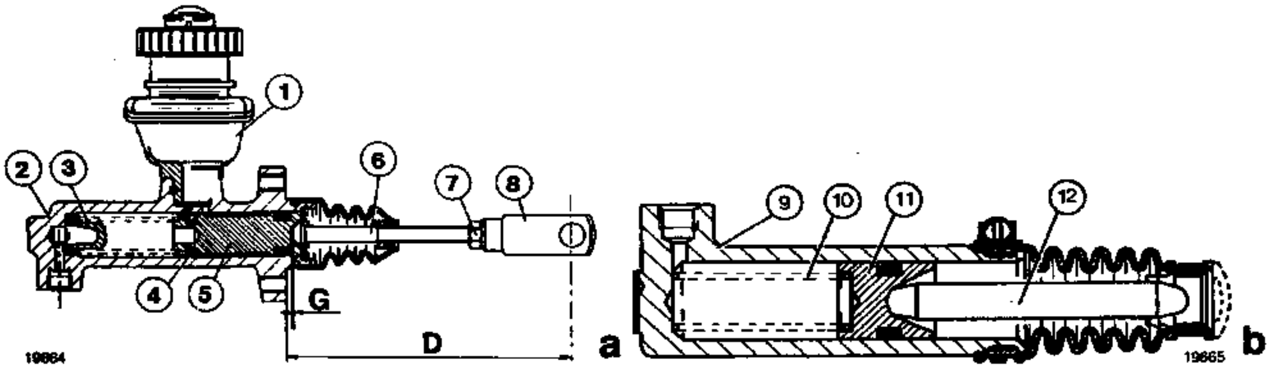


Clutch hydrostatic control assembly

a. Operating pump – b. Lower cylinder – G = .1 to 1.4 mm (.004 to .055 in). Pin (6) clearance with clutch pedal at rest – D = 137.5 to 138 mm (5.41 to 5.43 in). Distance measured from center of fork (8) to the mounting flange on pump body – 1. Reservoir – 2. Pump body – 3. Spring – 4. Seal – 5. Plunger – 6. Pin – 7. Jam nut – 8. Fork – 9. Clutch control cylinder – 10. Spring – 11. Plunger – 12. Pin.

HYDROSTATIC CLUTCH CONTROL
Disassembly–Assembly (Op. 18 104 18 – 18 104 33)

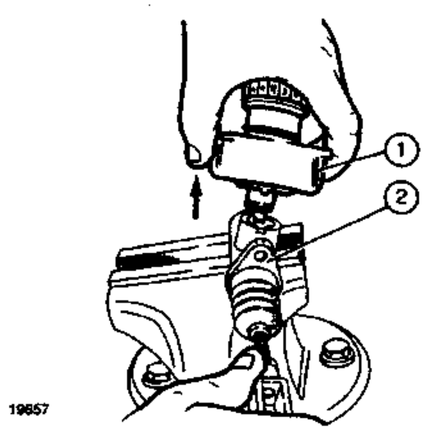
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

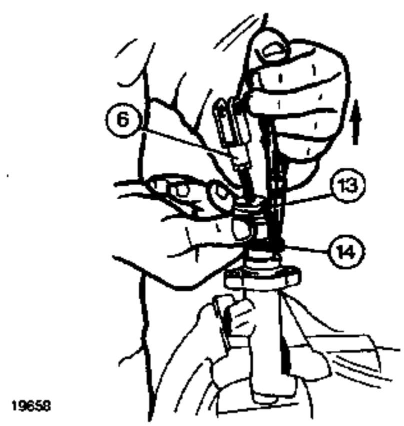
CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

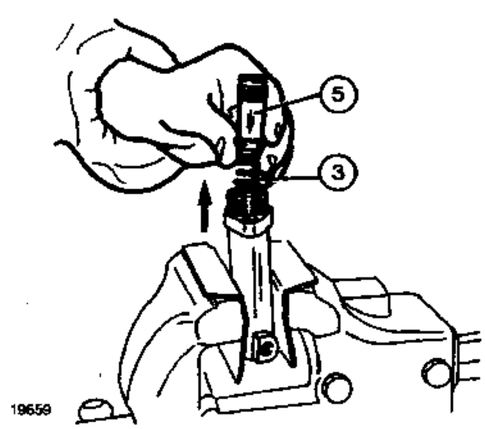
Proceed as follows:



1. Hold the pump in a workbench vise and withdraw the reservoir (1) from pump body (2).



2. Move out hose (13), disengage the retaining ring (14) and remove the complete rod (6).



3. Retrieve plunger (5) and its spring (3).

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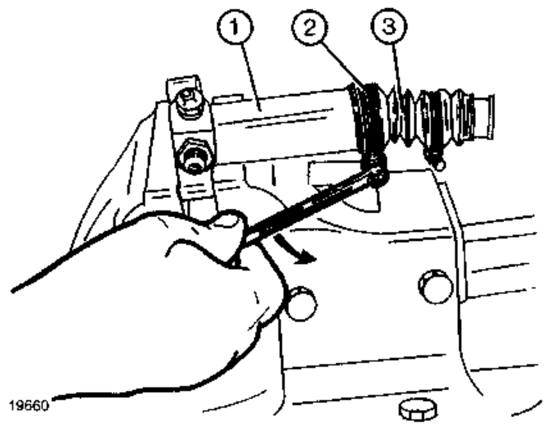
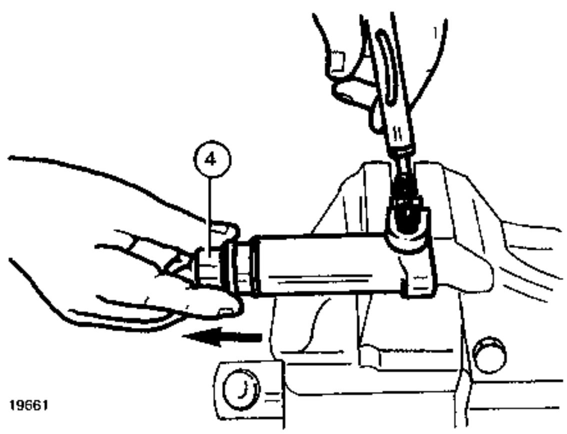


4. Hold the lower hydraulic cylinder (1) in a workbench vise, slacken the band clamp (2) and remove hose (3).



5. Use compressed air to extract the plunger (4) and spring.
6. At re–assembly of the hydraulic pump and clutch control lower hydraulic cylinder pay attention to the following:

   a. proceed by reversing the sequence of operations starting from no. 5 back to no. 1;

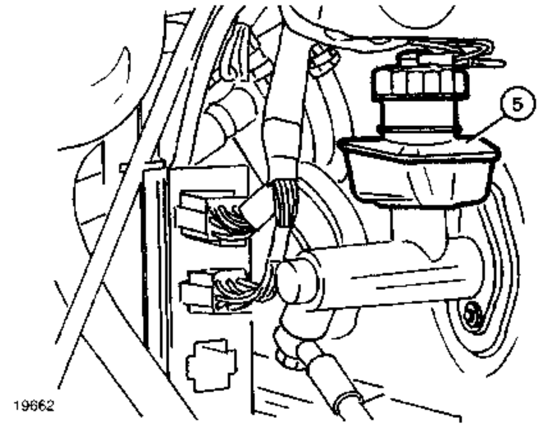
   b. inspect seals and replace them if necessary;

   c. check sliding surfaces of pistons and seats.

HYDROSTATIC CLUTCH CONTROL
Air bleeding of the clutch control hydraulic system (Op. 18 104 05).

Air bleeding is necessary after any intervention on the hydraulic system.
Proceed as follows:

1. Accurately clean external surfaces in correspondence of the bleeding screw (6) and oil reservoir (5) cover.



2. Make sure that the reservoir (5) is filled to level before and after air bleeding.

Note – Previously drained oil must be thoroughly filtered before re–use.

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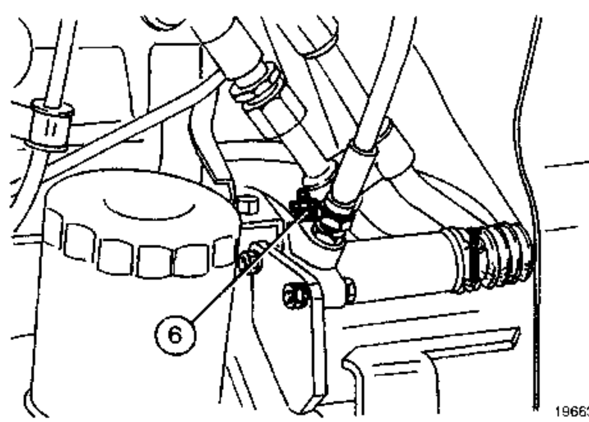
3. Depress the clutch pedal **slowly and over its full travel run**, so to pressurize the system.



4. Hold the pedal depressed , loosen the bleed screw (6) half a turn and then let oil and air bubbles flow out.
5. Turn the screw (6) back on and repeat these operations until the oil flows out clean and free from air bubbles.
6. Operate the pedal again to pressurize the system; this condition exists when pedal operation is normal again.
7. Once the operation is completed top up the oil level in the reservoir (5).

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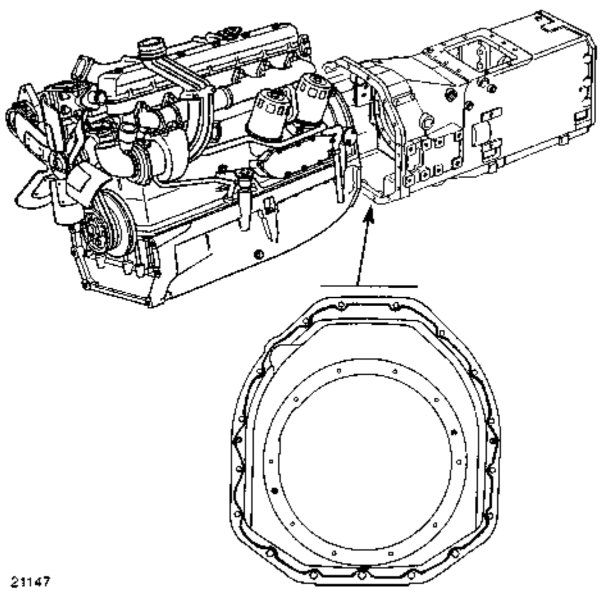
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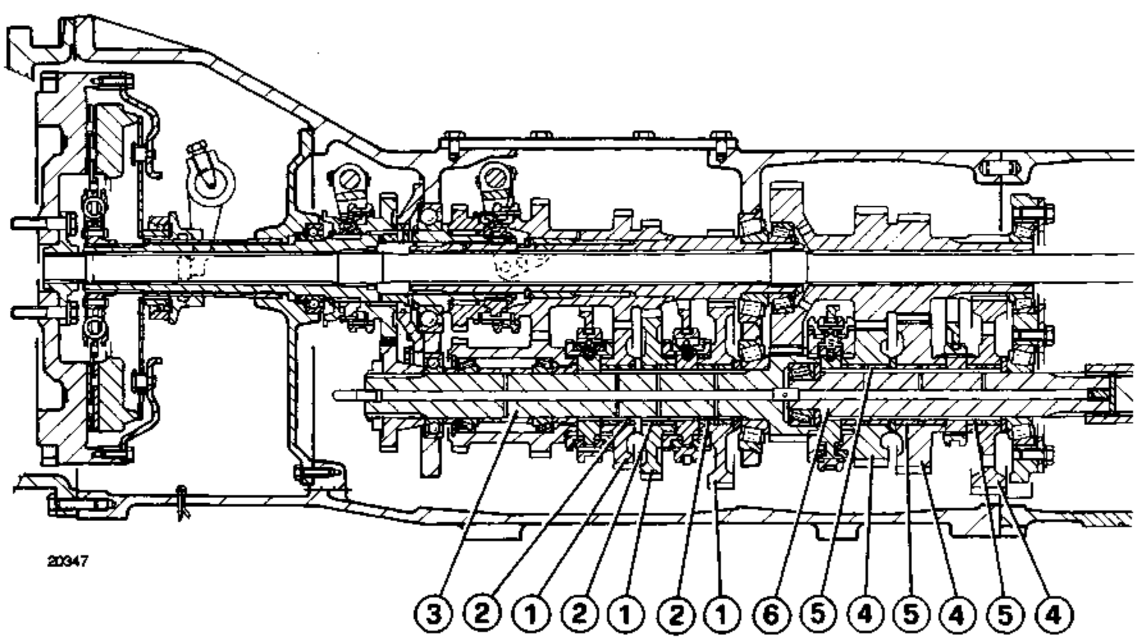
Sealing compound application scheme for engine and clutch–transmission case mating surfaces

Information on suitable types of sealing compounds are given on page 00–9.

SYNCHRO–RANGE TRANSMISSION

Transmission	4–speed w/ constant–mesh, fully synchronized gears
Gear type	helical–tooth
Range gears	cascade scheme, 4 forward plus 4 reverse ranges for a total of 16 forward and 16 reverse speeds
– gear type	helical–tooth
– reduction ratios:	
low range	(24 x 15) : (46 x 55) = 1 : 7.03
medium range	(24 x 26) : (46 x 40) = 1 : 2.95
normal range	(24 x 29) : (46 x 37) = 1 : 2.45
high range	1
Transmission and range shift controls	separate, w/ two hand levers located on the RH side of the operator.
Lubrication	forced–feed, w/ gear–type pump (the same of power steering)
I.D. of transmission driven gears (1)	60.060 to 60.090 mm (2.3645 to 2.3657 in)
O.D. of respective bushings (2)	59.981 to 60.000 mm (2.3614 to 2.3622 in)
Radial clearance of gears and bushings	0.060 to 0.109 mm (.0024 to .0043 in)
Dia. of transmission driven shaft (3)	49.375 to 49.391 mm (1.9439 to 1.9445 in)
I.D. of bushings (2)	49.400 to 49.430 mm (1.9449 to 1.9445 in)
Radial clearance of shaft in bushings	0.009 to 0.055 mm (.0003 to .0022 in)
I.D. of range driven gears (4)	60.060 to 60.090 (2.3645 to 2.3657 in)
O.D. of respective bushings (5)	59.981 to 60.000 (2.3614 to 2.3622 in)
Radial clearance of gears and bushings	0.060 to 0.109 mm (.0024 to .0043 in)
Dia. of range driven shaft (6)	49.375 to 49.391 mm (1.9439 to 1.9445 in)
I.D. of bushings (5)	49.400 to 49.430 mm (1.9449 to 1.9460 in)
Radial clearance of shaft in bushings	0.009 to 0.055 mm (.0003 to .0022 in)

(follows)



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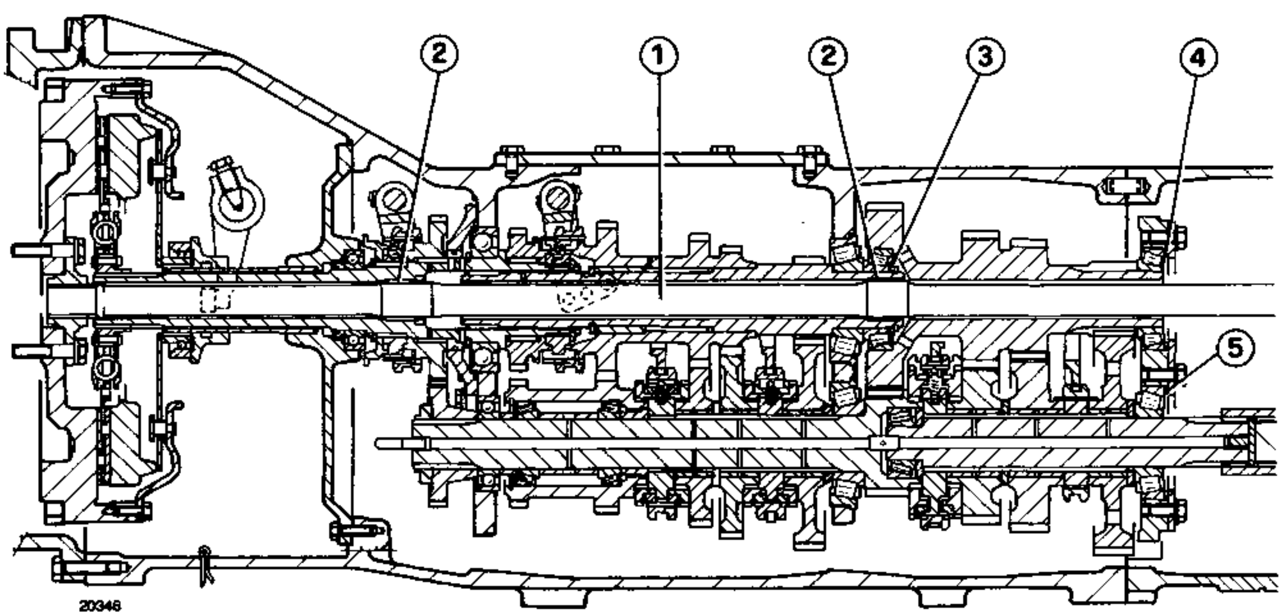
SYNCHRO–RANGE TRANSMISSION

(cont.)

Dia. of power take–off drive shaft (1), at bushing location	31.950 to 31.975 mm (1.2579 to 1.2588 in)
I.D. of force–fitted bushings (2)	31.990 to 32.085 (°) mm (1.2594 to 1.2632 in)
Radial clearance of shaft in bushings	0.015 to 0.135 mm (.0006 to .0053 in)
Thickness of transmission drive shaft (3) rear bearing thrust washer	2.950 to 3.000 mm (.1161 to .1181 in)
Adjustment of range–gear drive shaft bearings	see page 21–35
Thickness of range–gear drive shaft (4) bearing shims	1.70 – 1.80 – 1.90 – 2.00 – 2.05 2.10 – 2.15 – 2.20 – 2.25 – 2.30 – 2.35 2.40 – 2.45 – 2.50 – 2.55 – 2.60 2.65– 2.70 – 2.75 – 2.80 – 2.85 – 2.90 2.95 – 3.00 – 3.10 – 3.20 – 3.30 mm (.067 – .070 – .074 – .078 – .080 – .082 .084 – .086 – .088 – .090 – .092 – .094 –.096 – .098 – .100 – .102 – .104 – .106 – .108 – .110 – .112 – .114 – .116 .118 – .122 – .126 – .130 in)
Adjustment of range–gear driven shaft bearings	see page 21–35
Thickness of range–gear driven shaft (5) bearing shims	1.70 – 1.80 – 1.90 – 2.00 – 2.05 2.10– 2.15 – 2.20 – 2.25 – 2.30 – 2.35 2.40 – 2.45 – 2.50 – 2.55 – 2.60 2.65– 2.70 – 2.75 – 2.80 – 2.85 – 2.90 2.95 – 3.00 – 3.10 – 3.20 – 3.30 mm (.067 – .070 – .074 – .078 – .080 – .082 .084 – .086 – .088 – .090 – .092 – .094 –.096 – .098 – .100 – .102 – .104 – .106 – .108 – .110 – .112 – .114 – .116 .118 – .122 – .126 – .130 in)
Pressure–relief valve spring (1, page 21–10):	
– free length	127 mm (5.0 in)
– length under load of 278 to 304 N (28.4 to 31 kg = 72.1 to 78.7 lb)	102.5 mm (4.03 in)
Working pressure	16 bar (16.3 kg/cm^2) = (232 psi)
Lubrication pressure–relief valve (2, page 21–10):	
– free length	35.5 mm (1.40 in)
– length under load of 37 to 41 N (3.8 to 4.2 kg = 9.6 to 10.7 lb)	25.5 mm (1.0 in)
Lubrication pressure	6.5 to 7 bar (6.6 to 7.1 kg/cm^2) = (94.2 to 101.5 psi)

(°) Final dimension without reaming.



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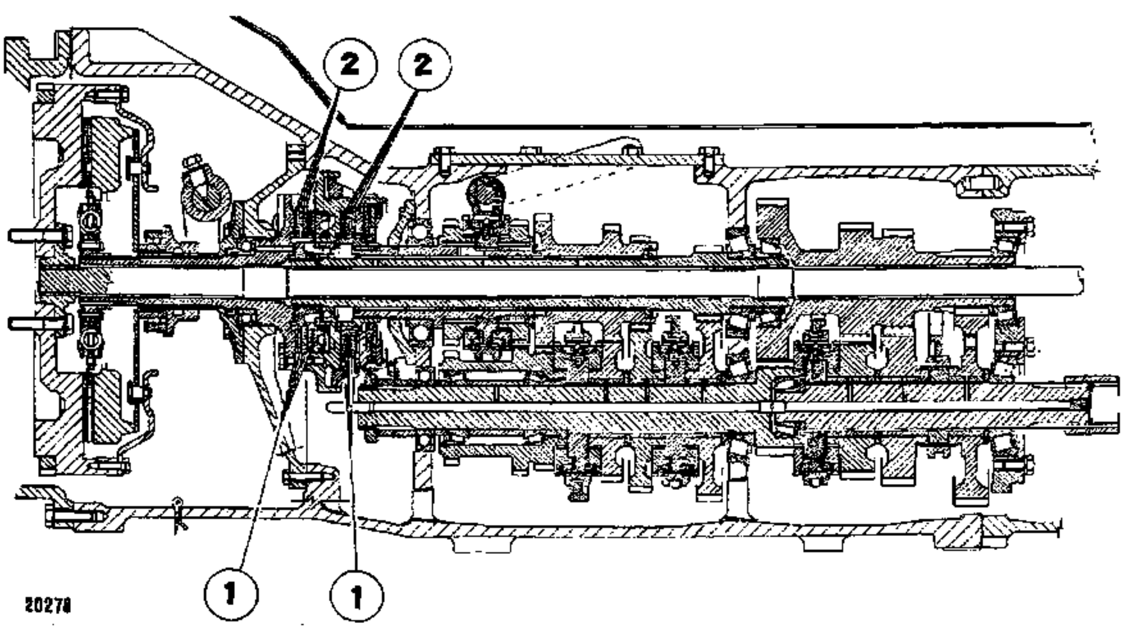
SYNCHRO–RANGE TRANSMISSION (40 km/hr version)

Transmission	5–speed, w/ constant–mesh, fully synchronized gears
Gear type	helical–tooth
Range gears	cascade scheme, four forward and four reverse ranges for a total of 20 forward and 16 reverse gears
For data not appearing here, refer to the previous chart: SYNCHRO–RANGE TRANSMISSION	

HI–LO SHIFT TRANSMISSION

Refer to specifications and data reported in the previous chart "SYNCHRO–RANGE TRANSMISSION" and to the following supplementary information:	
HI–LO unit	The operator can choose between two speeds (HI, higher or LO, lower) for the same gear
Controls	through the transmission shift lever
Quantity of HI–LO clutch driven disks (1) (each clutch)	5
Thickness of driven disks	1.7 mm (.07 in)
Material of driven disks	synthetized
Quantity of HI–LO clutch driving disks (2) (each clutch)	4
Thickness of driving disks	1.5 to 1.7 mm (.06 to .07 in)
Material of driving disks	steel
Thickness of clutch disk pack (new disks)	14.80 to 14.95 mm (.583 to .588 in)
Wear limit for clutch pack	–
Front clutch return springs:	
– free length	41 mm (1.61 in)
– length under load of 124 to 134 N (12.7 to 13.7 kg = 32.2 to 34.8 lb)	24.5 mm (.96 in)
Forward gear clearance adjustment shim (G, page 21–47)	5.00 – 5.15 – 5.30 mm (.19 – .20 – .21 in)



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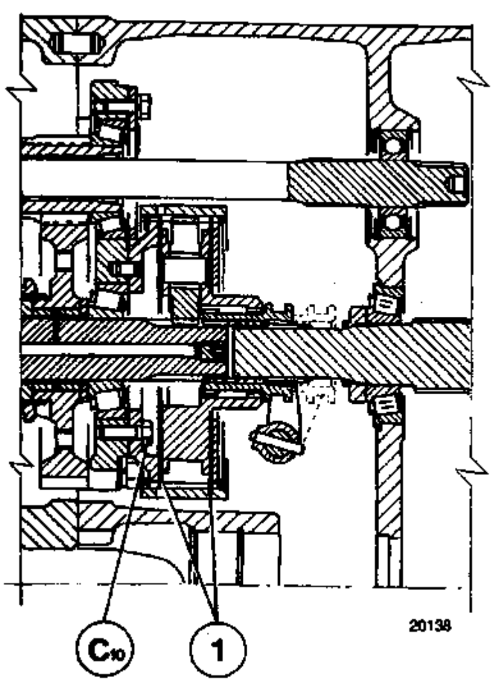
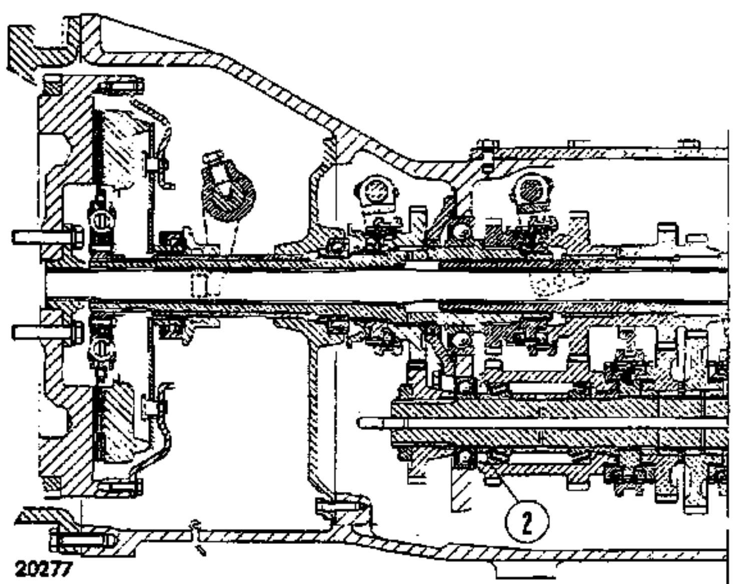
SUPPLEMENTARY CREEPER SPEED TRANSMISSION

Type	planetary, spur–gear
Reduction ratio	20 : (20 + 100) = 1.6
Controls	own hand lever located on the LH side of the operator
Thickness of driven gear and creeper housing thrust washers (1)	1.465 to 1.535 mm (.0576 to .0604 in)

REVERSER

Type	mechanical, spur–gear: supplied with
Engagement	synchronizer as standard
Reduction ratio	(43x37x39) : (37x39x44) = 1 : 1.02
Controls	own lever located on the RH side of the operator
Thickness of driven gear bearing adjustment shims (2)	2.50 – 2.60 – 2.65 – 2.70 – 2.75 2.80– 2.85 – 2.90 – 2.95 – 3.00 – 3.05 3.10 – 3.15 mm (.098 – .102 – .104 – .106 – .108 .110– .112 – .114 – .116 – .118 –.120 –.122 – .124 in)
Adjustment of driven gear bearings	See page 21–34





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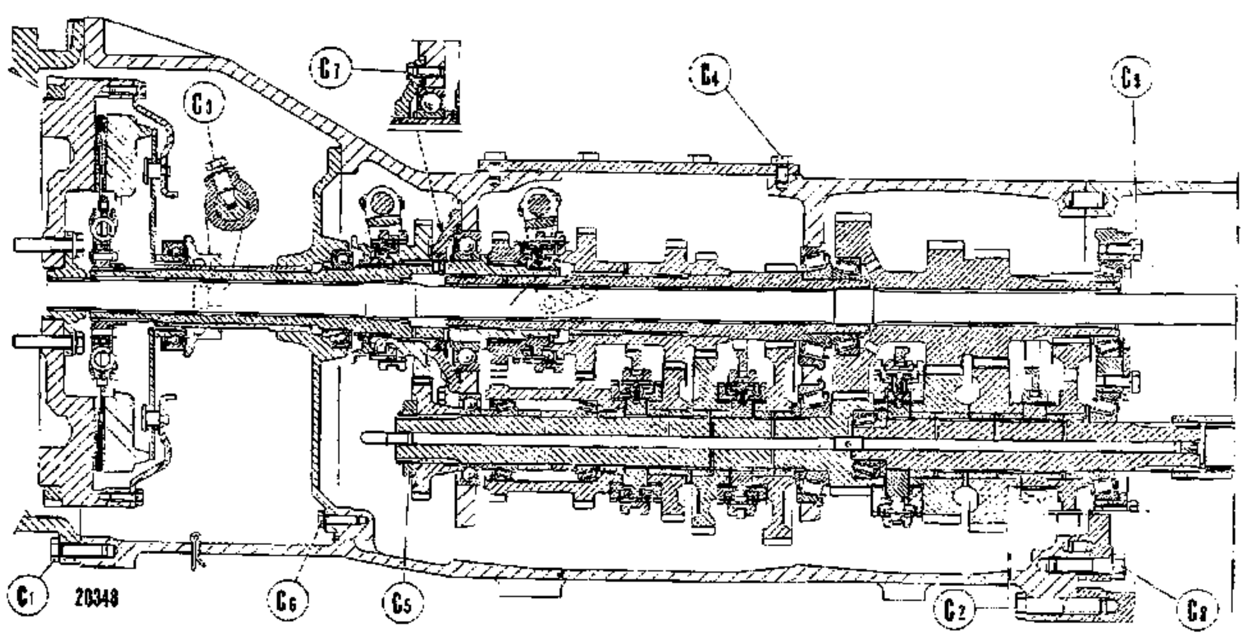
TORQUE DATA

DESCRIPTION	Thread size	Torque		
		Nm	kgm	ft.lb
Screws and nuts, clutch–transmission housing to engine (C_1)	M12 x 1.25	88	9	65
Capscrews, clutch–transmission housing to rear axle housing (C_2)	M14 x 1.5	176	18	130
Setscrew, clutch engagement shift fork (C_3)	M16 x 1.5	157	16	116
Capscrews, transmission housing cover (C_4)	M10 x 1.25	49	5	36
Nut, transmission driven shaft (C_5)	M45 x 1.5	490	50	362
Nut, clutch compartment front cover (C_6)	M8 x 1.25	23	2.4	17
Capscrews, transmission drive shaft support cover (C_7)	M8 x 1.25	23	2.4	17
Capscrews, range rear bearing quill plate (C_8)	M14 x 1.5	142	14.5	105
Capscrews, range rear bearing retainer plate (C_9)	M10 x 1.25	49	5	36
Capscrews, creeper stationary disk plate (C_{10}, page 21–4) ...	M10 x 1.25	54	5.5	40
Capscrews, synchro–range transmission shift lever support (C_{11}, page 21–9)	M10 x 1.25	49	5	36
Fitting, delivery, to shift lever support (C_{12}, page 21–10)	M22 x 1.5	83	8.5	61
Plug, lube pressure max. setting (C_{13}, page 21–10)	M18 x 1.5	49	5	36
Screw, electric control valve pin (C_{14}, page 21–10)	–	47 to 54	4.8 to 5.5	35 to 40
Screw, electric control valve (C_{15}, page 21–10)	–	5.4 to 8.1	.55 to .83	4 to 6



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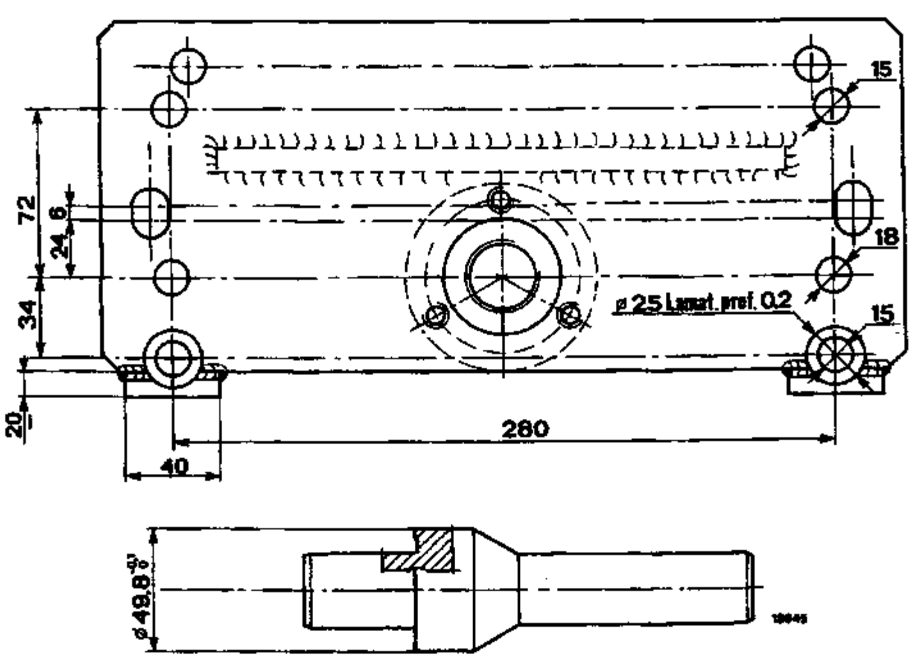
SERVICE TOOLS

ATTENTION – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code **(X)**.
Besides, to work safely and achieve the best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjonction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

List of the special tools necessary to perform service operations covered by this section of the Manual:

	290090	Shop floor overhauling stand.
	292320	Stand, tractor splitting.
	291517	Hook, transmission lifting.
	293971	Front bracket, transmission overhauling (w/**290090**).
	293972	Rear bracket, transmission overhauling (w/**290090**).
	293343/2	Wrench, driven shaft nut.
X	**293805/2**	Compression tool, drive shaft bearing removal (w/**50062**)
X	**293805/2**	Compression tool, drive and driven shafts retainer.
X	**293808/1**	Wrench, driven shaft retainer.
	292313	Adapter, reverse gear idle shaft removal.
	292176	Gauge, range drive and driven shaft end play(w/**50018** and **50013**).
	292888	Centralizing pilot dowels, engine to transmission case.
	291051	Puller, range drive shaft gear and bearing.
	291584	Centralizing pilot dowels, transmission to rear axle housing.
X	**293869**	Driver, driven shaft bearing.
X	**293992**	Driver, PTO shaft bushing installation on upper shaft (w/**293800**).
X	**293993**	Driver, PTO shaft seal installation on reverser drive shaft(w/**293800**).
	293800	Grip.
	294000	Puller, PTO shaft bushings on upper shaft.
	50060	Installer, range drive shaft bearing (w/**50013**).
	50061	Installer, range driven shaft bearing (w/**50018**).
	50062	Spacer (w/**293805/1**).
	291215	Hook, creeper lever spring.
	292870	Pressure gauge test kit, (HI–LO circuit).
X	**293992**	Driver, PTO shaft seal installation on HI–LO clutch shaft (w/**293800**).
	50064	Centralizing tool, rear clutch disk hub (HI–LO).
	50068	Tool, spring cup (HI–LO).



Modifications required by tool 293805/1 for removing the bearingn from the transmission drive shaft and for supporting the latter and the driven shaft (mark tool with no. 293805/2). Metric dimensions.

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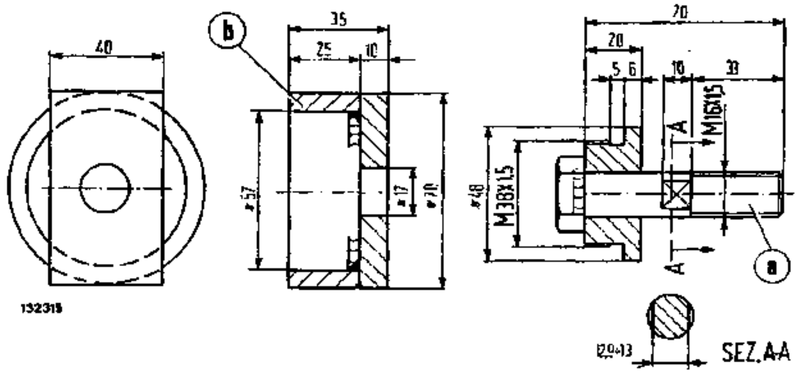
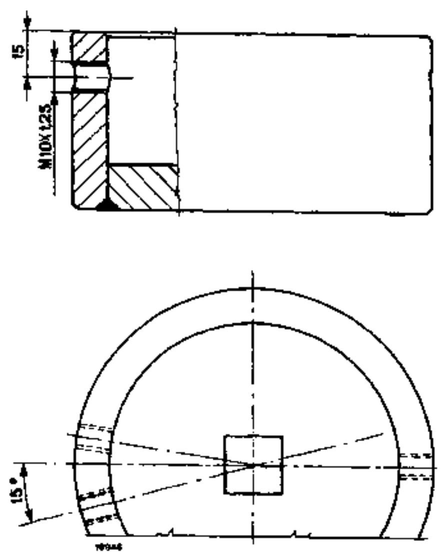
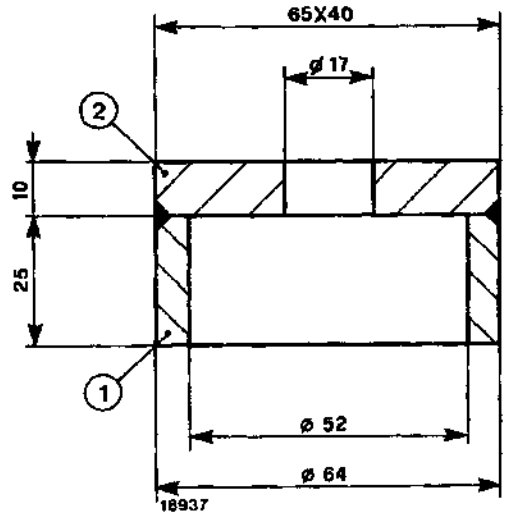


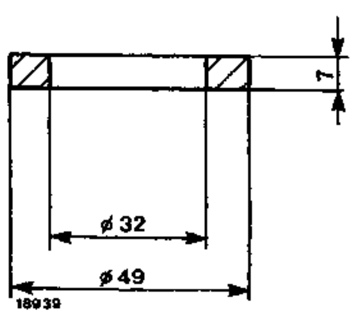
Working drawing of special installation tool for the range drive shaft roller taper bearing (stamp 50013 on tool – Metric dimensions). (Self–made)
Material specification: C40 – Utilize part (a) only.



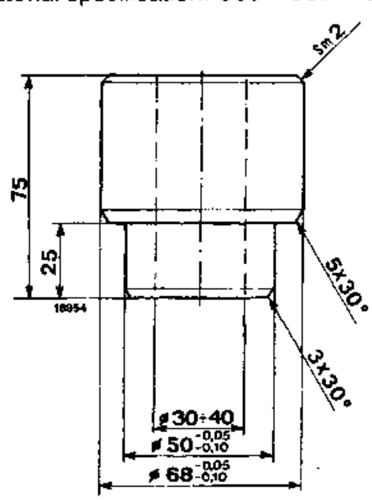
Modifications required by tool no.293808/1 to make it fit to lock transmission driven shaft.
(Self–made)



Working drawing of special installation tool for the range drive shaft bearing (stamp 50060 on tool – Metric dimensions).
Material specification: C30 – Self–made.



Working drawing of special tool for removing the drive shaft bearings (stamp 50062 on tool – Metric dimensions).
Material specification: Fe42C – Self–made.



Working drawing of special centralizing tool for HI–LO rear clutch disks (stamp 50064 on tool – Metric dimensions).
Material specification: C30 – Self–made.

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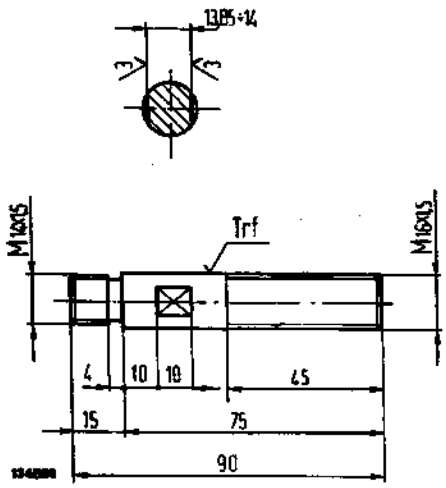
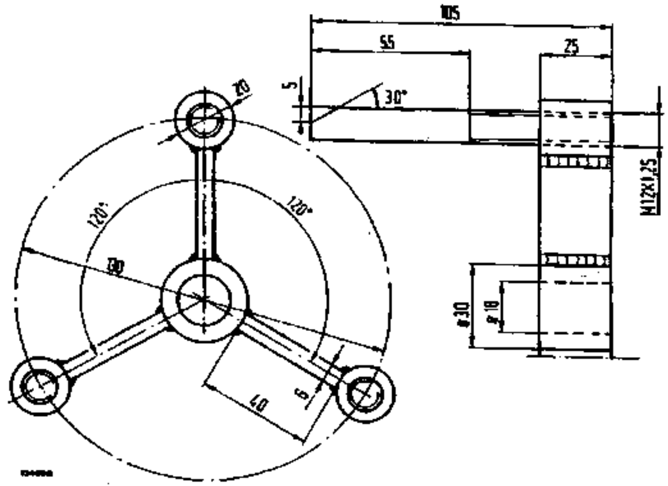
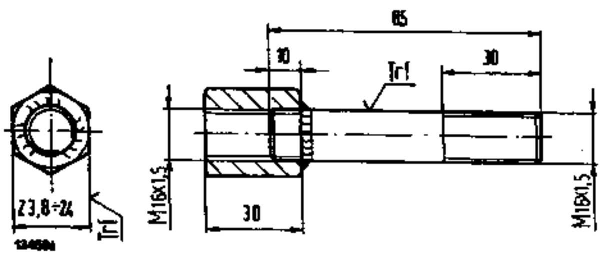
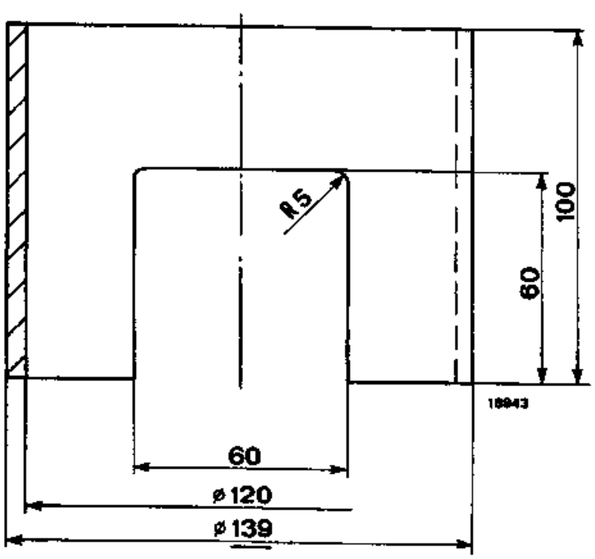


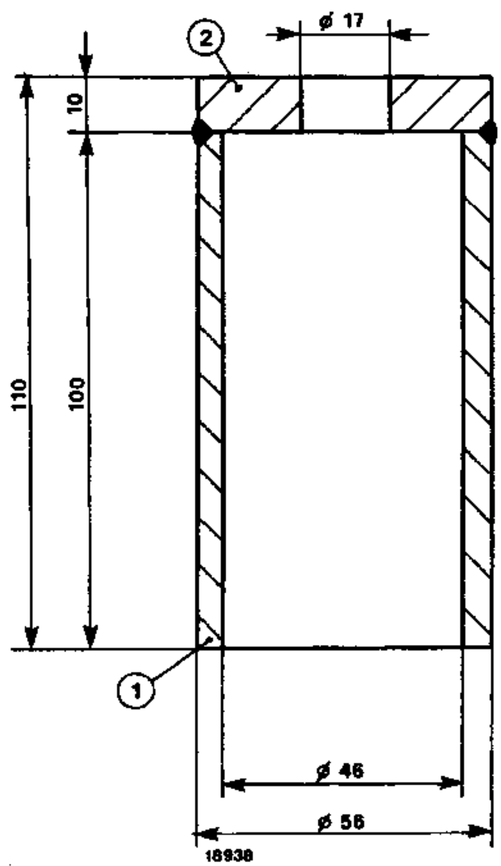




Working drawing of special adjustment tool for the range gear drive and driven shaft bearings (stamp 50018 on tool – Metric dimensions).
Material specification: Aq42 – (Self–made).



Working drawing of special splitter tool for removing the HI–LO spring cup (stamp 50068 on tool – Metric dimensions).
Material specification: C30 – (Self–made).



Working drawing of special installation tool for the range geardriven shaft bearing (stamp 50061 on tool – Metric dimensions).
Material specification: C30 – (Self–made).

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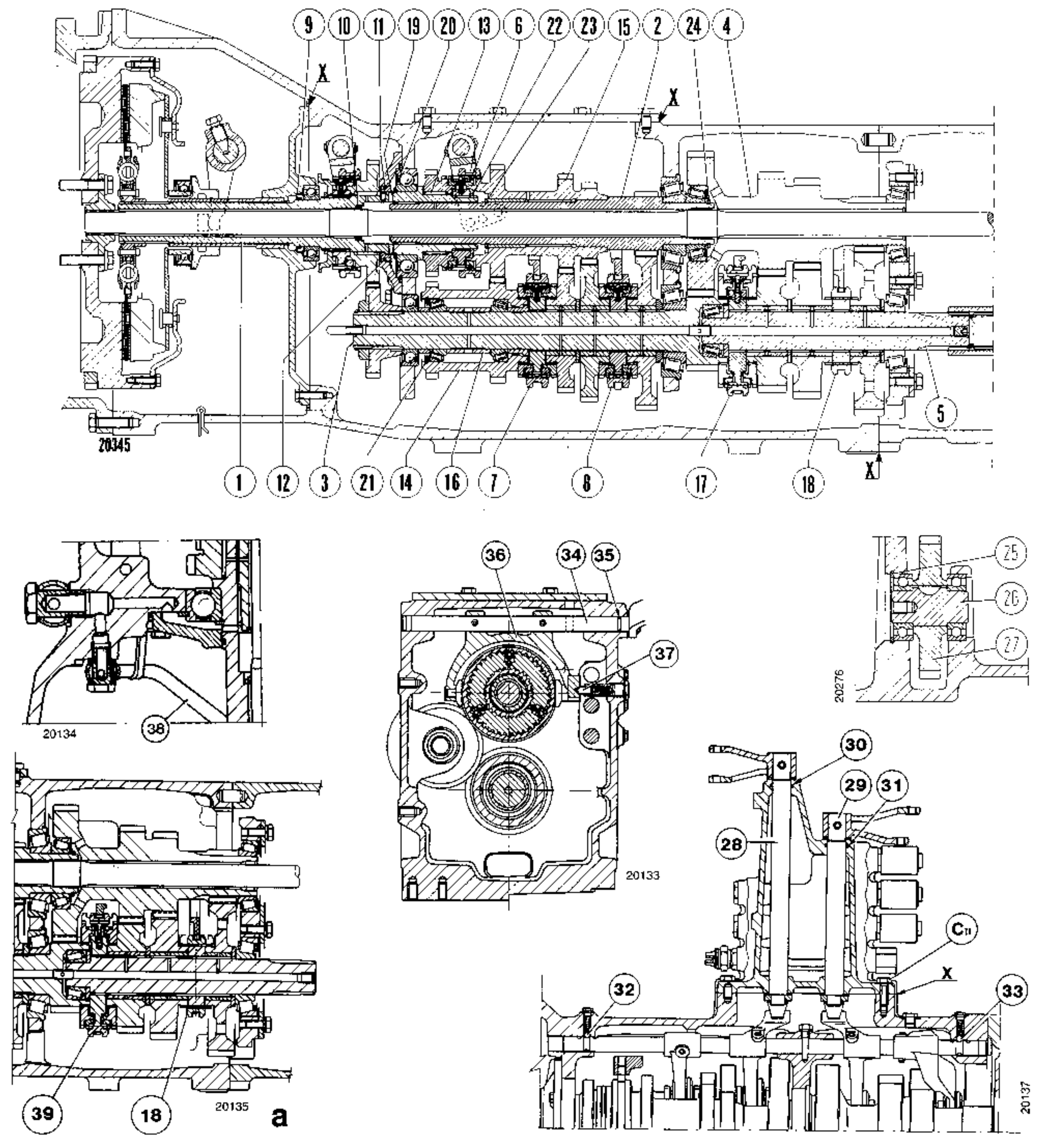

Longitudinal and cross–sectional views of the transmission and range gear unit.

a. Details of the range gear unit with synchronized high and medium–high speeds – C_{11}. Screw, transmission and range shift control lever support – **1**1. Reverser drive shaft – 2. Transmission drive shaft – 3. Transmission driven shaft – 4. Range gear drive shaft – 5. Range gear driven shaft – 6. Reverser engagement synchromesh – 7. 3rd and 4th gear synchromesh – 8. 1st and 2nd gear synchromesh – 9 and 10. Oil seals – 11. O–ring seals – 12 and 13. Needle bearings. – 14. Reverser driven gear – 15. Transmission drive gear – 16. Spacer – 17. High and medium–high speed shift collar – 18. Low and medium–low speed shift collar – 19,20,21,22,23,24 and 25. Snap rings – 26. Reverse gear axle – 27. Reverser idler gear – 28. Transmission control transfer lever – 29. Range control transfer lever – 30 and 31. O–ring seals – 32 and 33. Detent balls and springs – 34. Reverser internal control lever – 35. O–ring seal – 36. Reverser shifter fork – 37. Fork (36) detent pawl – 38. Transmission driven shaft lube oil line – 39. High and medium–high speed gear synchromesh.

Note – At assembly, apply sealing compound on surfaces **X** following directions given on page 00–9.

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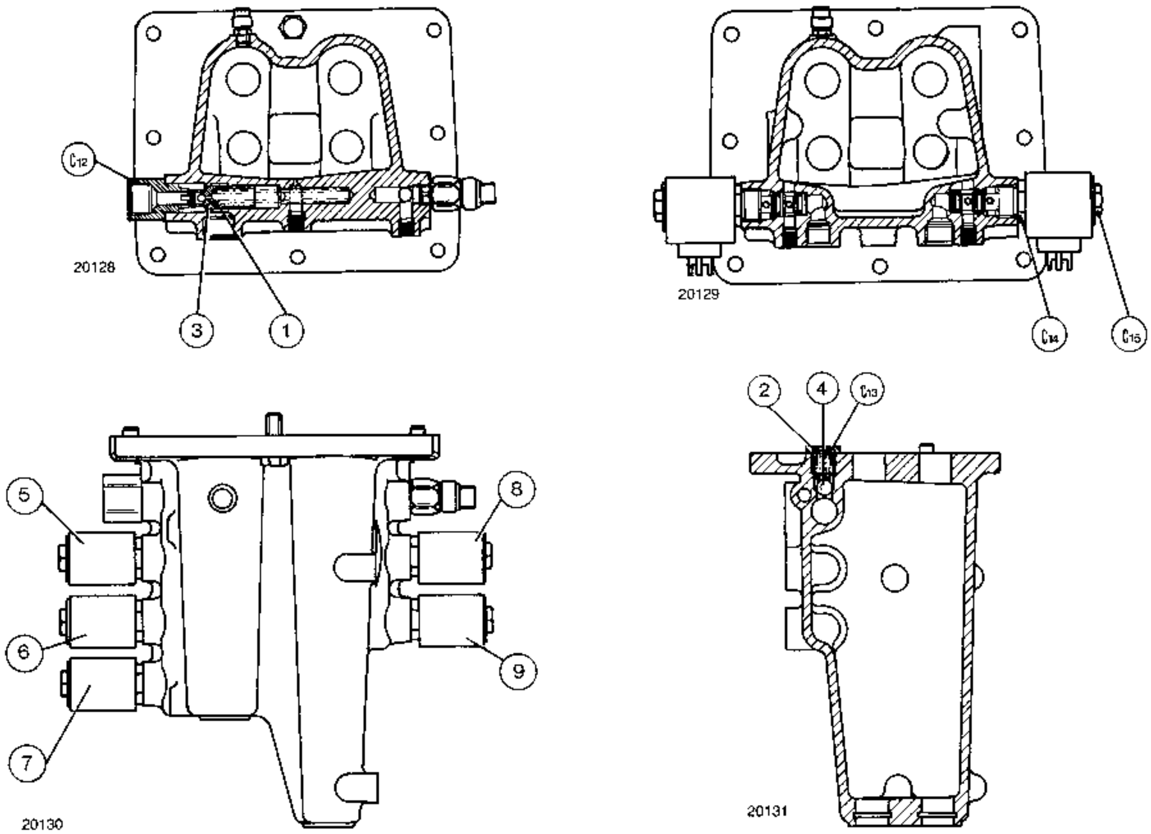
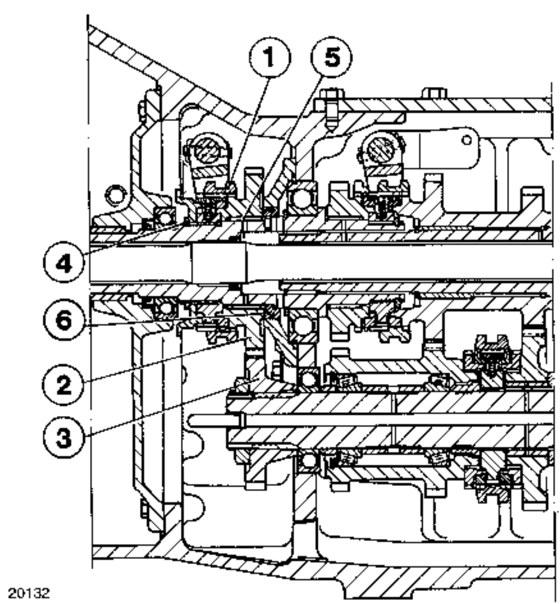


Sectional views through the transmission and range control lever support and the electric control valves layout.

C_{12}. Delivery fitting – C_{13}. Lube pressure max. setting plug – C_{14}. Electric control valve mounting screw – C_{15}. Electric valve screw – 1. Max. working pressure relief valve spring – 2. Lube oil max. pressure relief valve spring – 3. Max. working pressure relief valve (16 bar – 16.3 kg/cm^2 – 232 psi) – 4. Lube oil max. working pressure relief valve (6.5 to 7 bar – 6.6 to 7.1 kg/cm^2 – 94 to 101 psi) – 5. Electric valve, differential lock control – 6. Electric valve, PTO control – 7. Electric valve, PTO brake control – 8. Electric valve, 4WD engagement control – 9. Electric valve, HI–LO engagement.



Sectional view of 5–speed transmission (40 km/h).

1. 5th–gear synchromesh – 2. 5th–speed drive gear – 3. 5th–speed driven gear – 4. Snap ring – 5. Needle bearing – 6. Separation ring.

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SYNCHRO–RANGE TRANSMISSION TROUBLE–SHOOTING CHART

Fault	Diagnosis	Correction
Noisy transmission with range gears in neutral and speed gears engaged.	1. Driving and driven shaft bearings out of adjustment.	Remove clutch–transmission case and adjust bearings correctly (see page 21–35).
	2. Damaged or defective component part.	Remove case, overhaul the transmission and replace damaged parts.
	3. Seizure of component parts caused by poor lubrication.	Overhaul transmission and top up oil level.
Excessive noise with tractor stationary, engine idling and transmission in neutral.	1. Damaged clutch damper torsion springs.	Replace clutch disk.
Self–disengagement of speed and range gears and reverser.	1. Outside control linkage out of adjustment.	Adjust correctly.
	2. Damaged shifter rod springs.	Replace springs.
	3. Damaged synchronizer teeth.	Remove clutch–transmission case and replace the synchronizer involved.
	4. Insufficient engagement stroke.	Eliminate causes and restore full stroke.
Hard shifting of speed and range gears and reverser.	1. Outside control linkage out of adjustment.	Adjust correctly.
	2. Hardening and/or seizure of outside control linkage.	Check pivot points and lubricate.
	3. Engine clutch dragging.	See page 18–3.
	4. Damaged synchronizer.	Remove clutch–transmission case and replace the synchronizer involved.
	5. Difficult sliding of inside controls: rods, forks and sleeves.	Overhaul the controls.

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HI–LO UNIT TROUBLE–SHOOTING CHART

Fault	Diagnosis	Correction
Front clutch fails to engage: the high–range speeds in the 30 km/hour version or low–range speeds in the 40 km/hour one are ineffective.	1. Low transmission oil level.	Top up oil level.
	2. Clogged oil filter.	Replace oil filter.
	3. Inefficient hydraulic pump.	Overhaul or replace pump.
	4. Engagement control out of adjustment.	Adjust to obtain correct contact of lever with control switch.
	5. Inefficient control switch.	Replace switch.
	6. No power reaching the solenoid: interrupted, damaged connections or defective remote control switch.	Restore electrical connections or replace defective parts.
	7. Safety switch for HI–LO engagement with reverse gears engaged is ineffective.	Adjust correctly or replace switch.
	8. Control electro–valve (9, page 21–10) stuck on discharge position.	Overhaul or replace electro–valve.
	9. Fluid leakage past oil seals and consequent pressure drop: O–Rings on fluid lines and control pistons, oil seals.	Replace oil seals found defective.
Engagement delayed because of front clutch slippage.	1. Worn front clutch disks.	Replace disks.
	2. Pressure drop.	See point 9 above.
Front clutch will not disengage.	1. Engagement control out of adjustment.	Adjust to obtain correct contact of lever with control switch.
	2. Inefficient control switch.	Replace switch.
	3. No power reaching the solenoid: interrupted, damaged connections or defective remote control switch.	Restore electricel connections or replace defective parts.
	4. Control electro–valve (9, page 21–10) stuck on delivery.	Overhaul or replace electro–valve.
Rear clutch fails to engage: low–range speeds in the 30 km/hour version or high–range speeds in the 40 km/hour one are ineffective.	1. Engagement control out of adjustment.	Adjust to obtain correct contact of lever with control switch.
	2. Inefficient control switch.	Replace switch.
	3. Control electro–valve (9, page 21–10) stuck on delivery.	Overhaul or replace electro–valve.
Engagement delayed because of rear clutch slippage.	1. Control electro–valve (9, page 21–10) stuck on delivery.	Overhaul or replace electro–valve.
	2. Worn rear clutch disks.	Replace disks.
	3. Weak cup springs.	Overhaul clutch.
Rear clutch will not disengage.	1. See point 1 of front clutch failure to engage.	
	2. See point 2 of front clutch failure to engage.	
	3. See point 3 of front clutch failure to engage.	
	4. See point 4 of front clutch failure to engage.	
	5. See point 5 of front clutch failure to engage.	
	6. See point 6 of front clutch failure to engage.	
	7. See point 8 of front clutch failure to engage.	
	8. See point 9 of front clutch failure to engage.	

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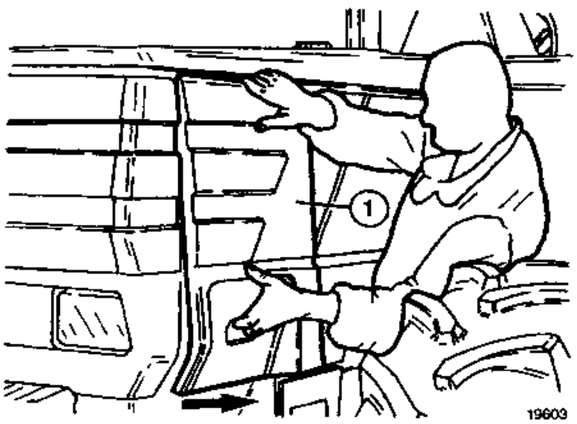
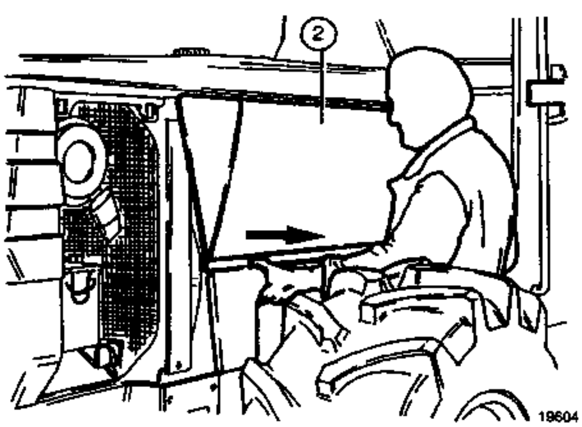
CLUTCH–TRANSMISSION CASE

DANGER

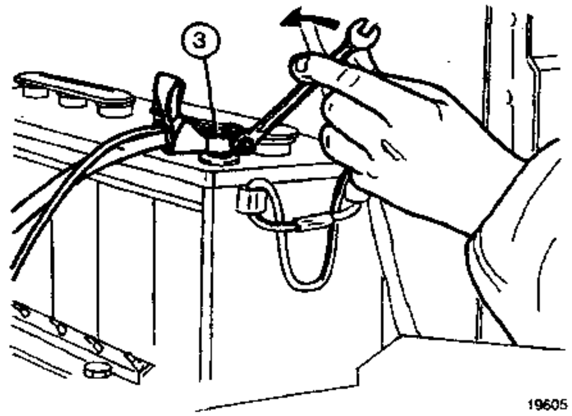
Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.

To separate the clutch–transmission case proceed as follows:

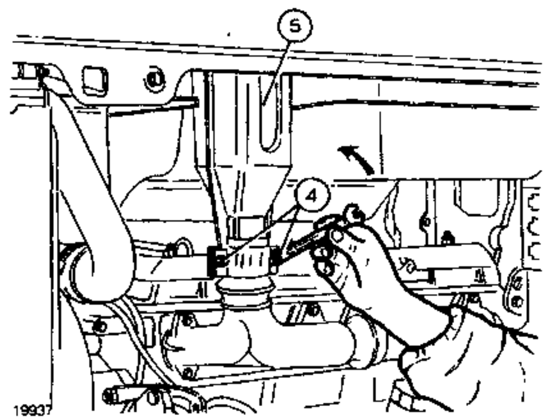




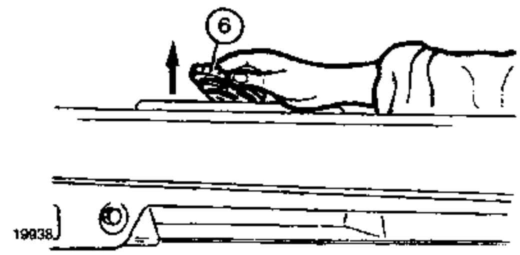
1. Remove panels (1 and 2) from both sides.



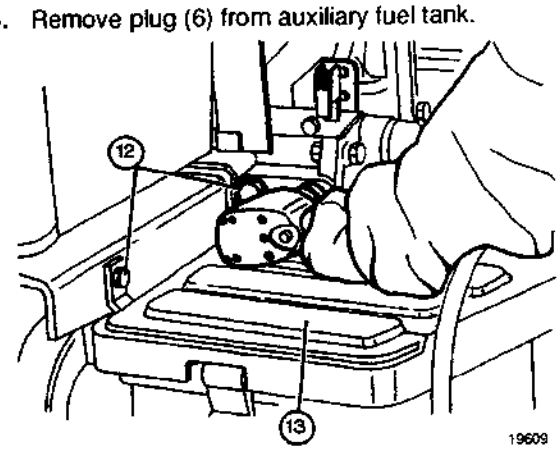
2. Disconnect the positive battery cable (3) and insulate properly.



3. Remove screws (4) and exhaust muffler (5).



4. Remove plug (6) from auxiliary fuel tank.



5. Remove screws (12) and tool box (13).

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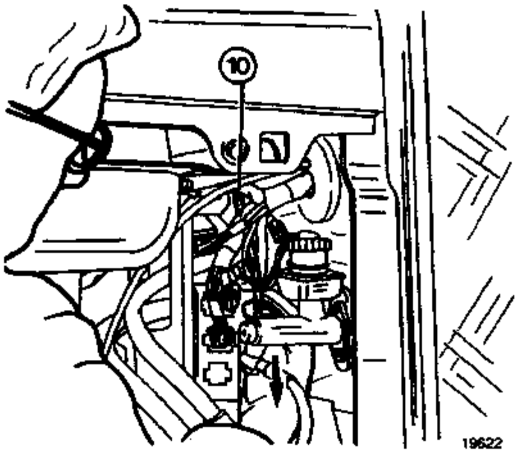
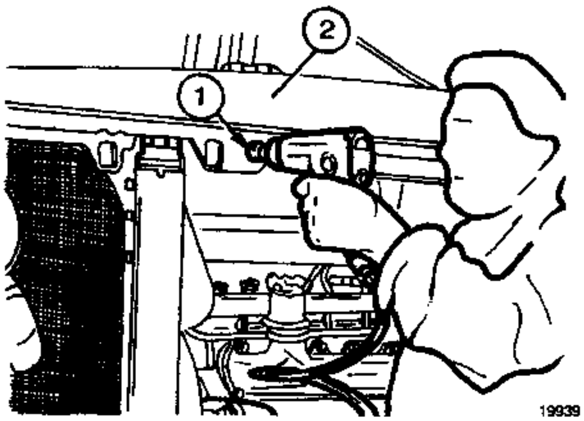
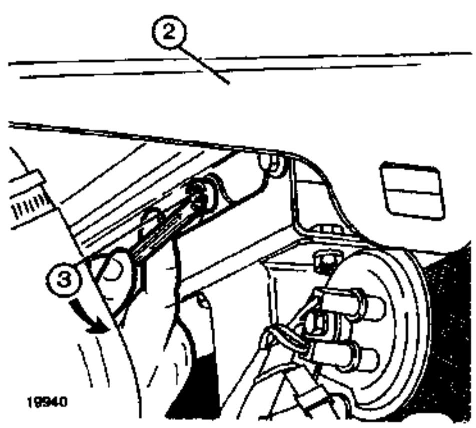


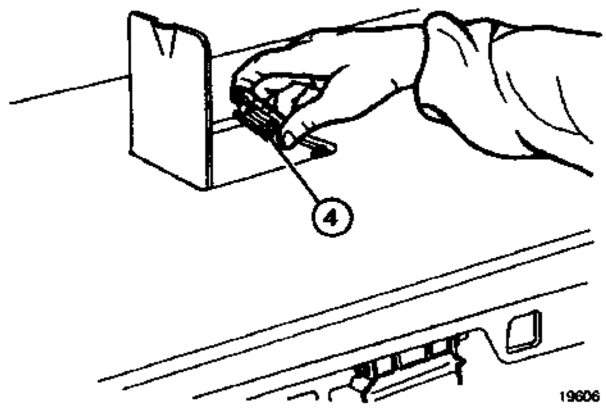
6. Pull out the windscreen washer tubelet (10).



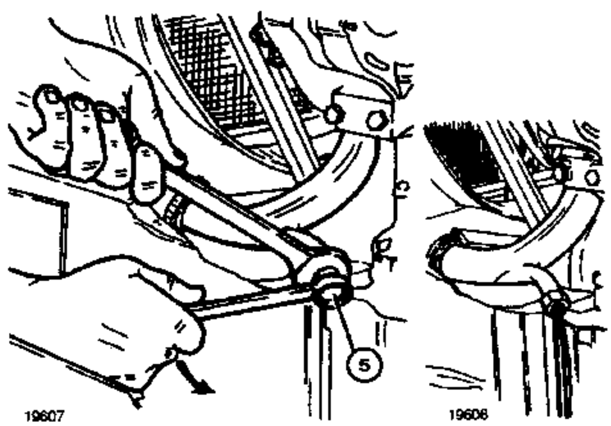
7. Remove the upper hood panel (2) screws (1) on both sides.



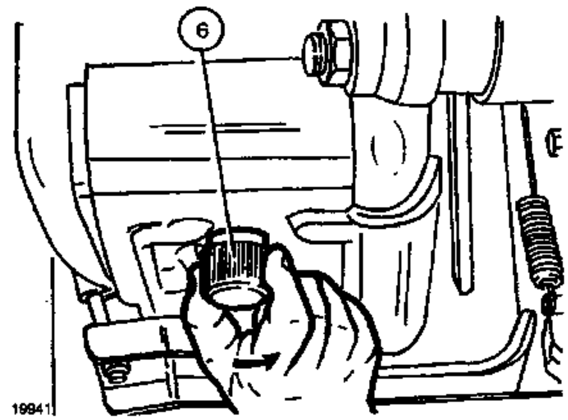
8. Remove front screws (3) and panel (2).



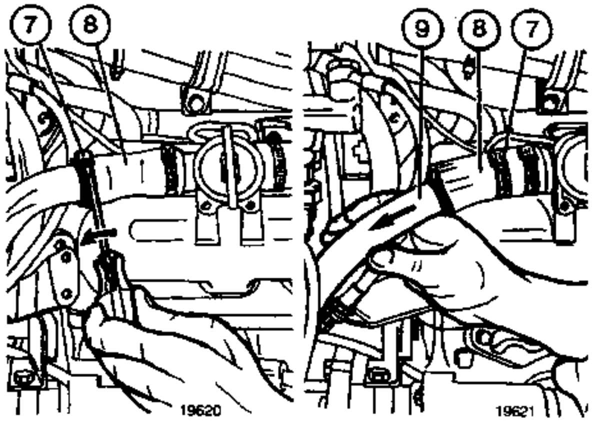
9. Remove engine cooling radiator plug (4).



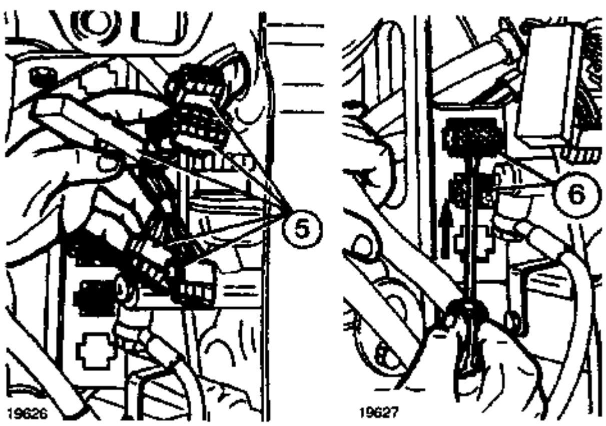
10. Unscrew plug (5) from drain pipe and empty the engine cooling system.



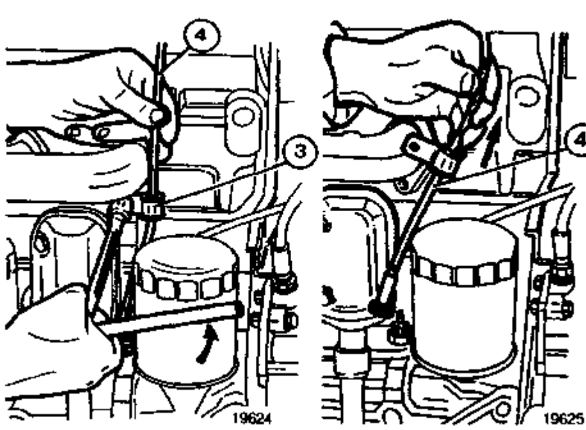
11. Unscrew plug (6) and drain main fuel tank.



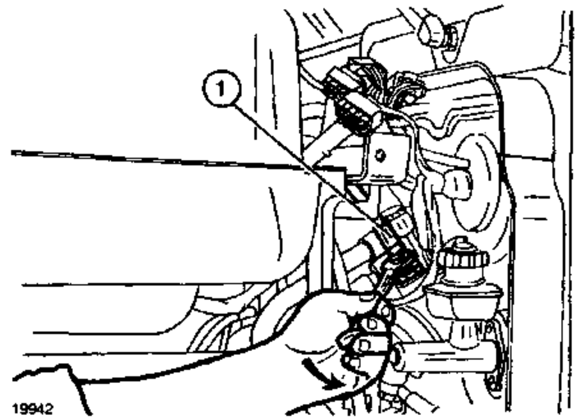
12. Loosen clamp (7) and disconnect hose (8) from line (9).



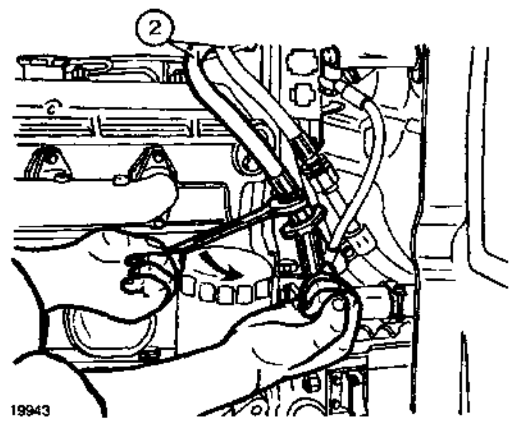
13. Disconnect electric leads (5 and 6) and withdraw them from auxiliary tank support.



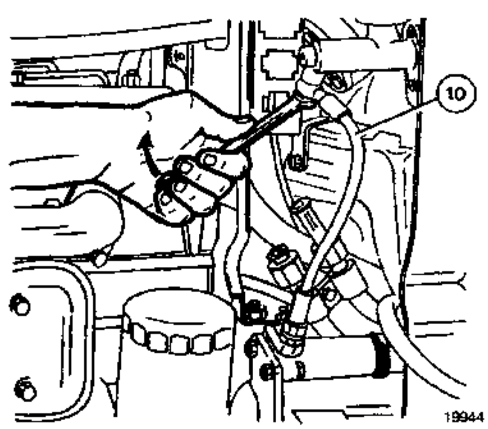
14. Slacken clamp screw (6) and cable connection of hourmeter (4), then remove the latter from engine.



15. Unscrew hydraulic ram line (1) connections.



16. Unscrew and remove power steering line (2) connections .



17. Disconnect the master clutch flex line (10) and close the two holes with plastic plugs.

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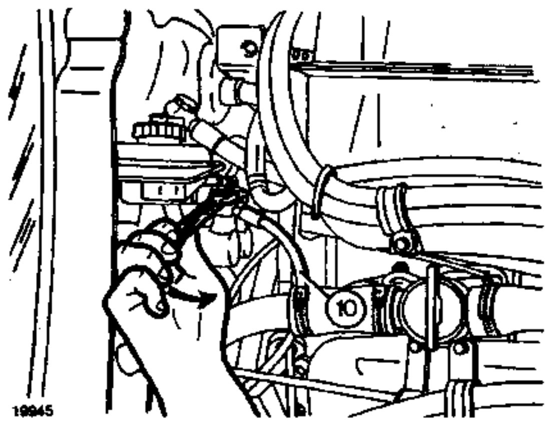
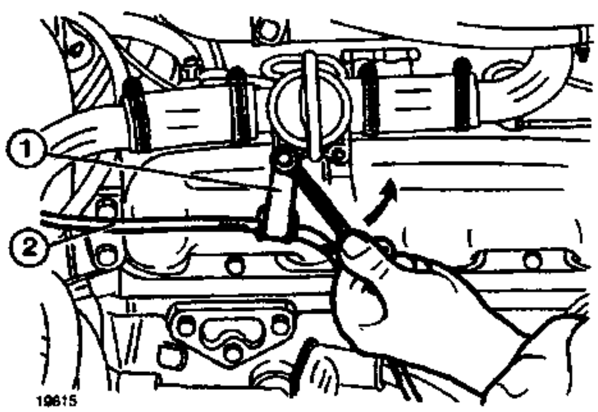
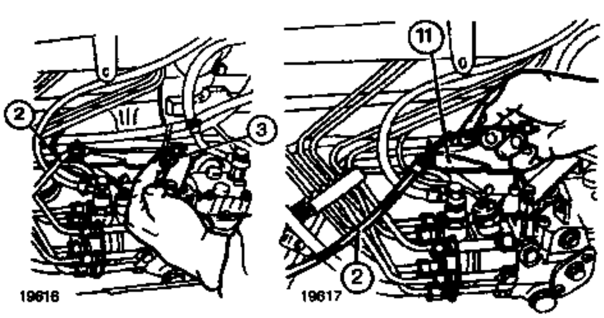


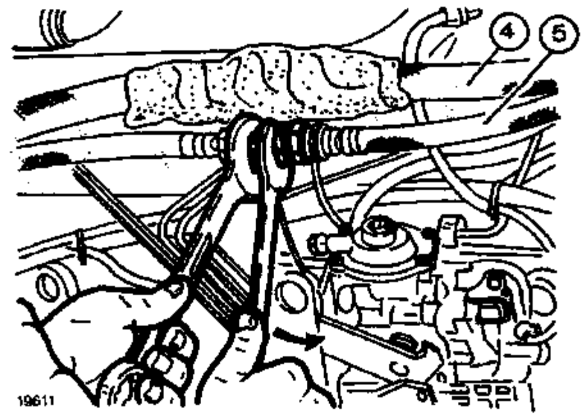
18. Disconnect brake lines (10).



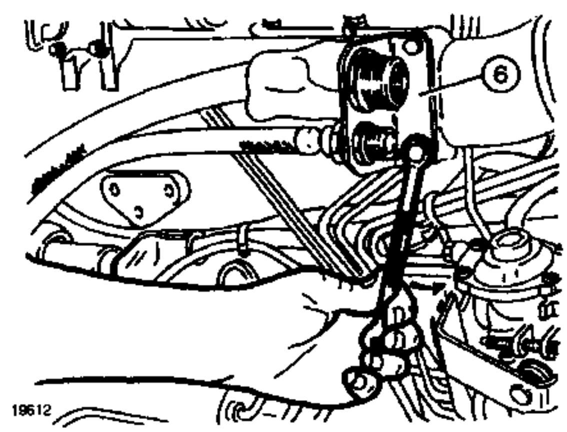
19. Slacken the accelerator cable (2) supporting clamp (1) screw.



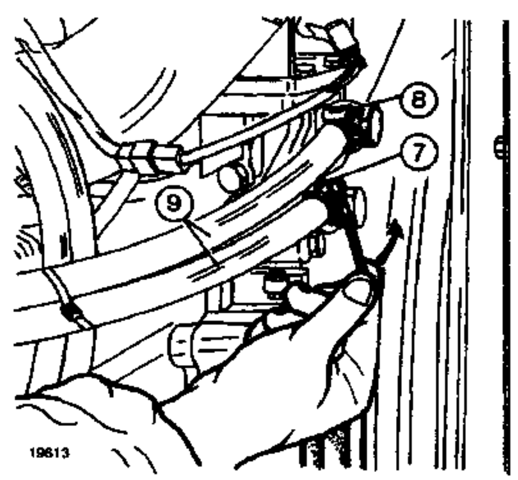
20. Disconnect spring clip (3), free the end of cable (2) and remove it from bracket (11).



21. If installed, disconnect and separate refrigerant lines (4 and 5) from air conditioning system.



22. Remove screws and bracket (6) of lines (4 and 5).



23. Unscrew clamps (7 and 8) securing lines (9) connecting heater to engine.

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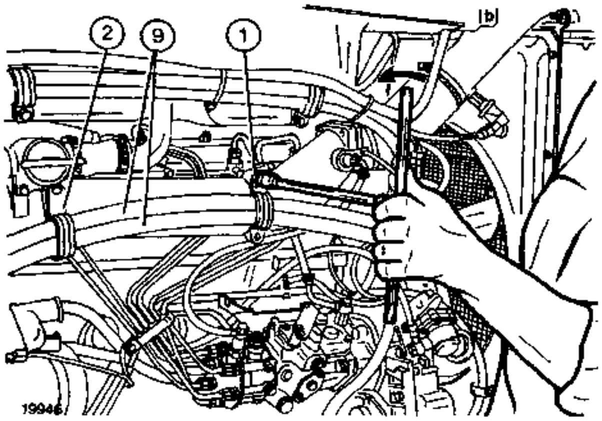
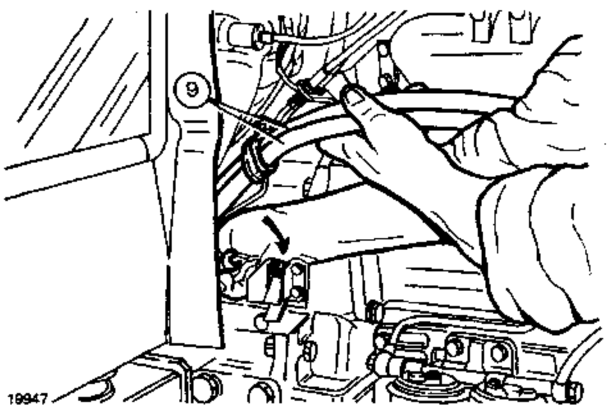
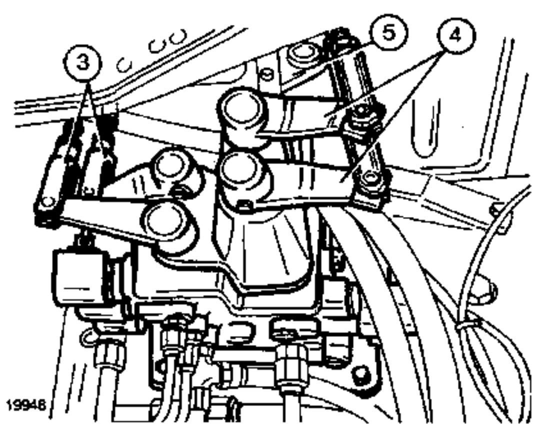


24. Unscrew straps (1 and 2) of heater lines (9).

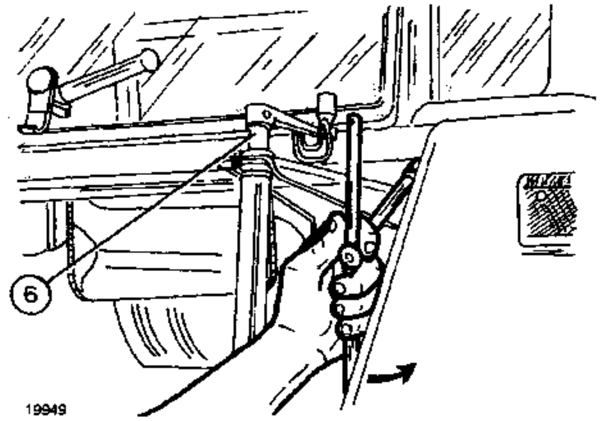


25. Unscrew the strap of lines (9) located on the inside of the platform.

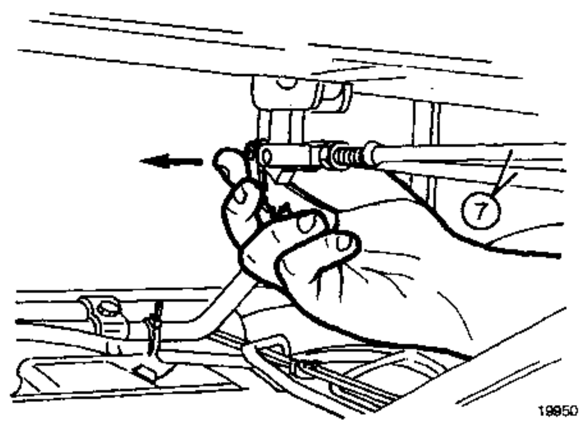


26. Remove spring clips and subsequently the transmission (4), range gears (3) and reverser control levers.

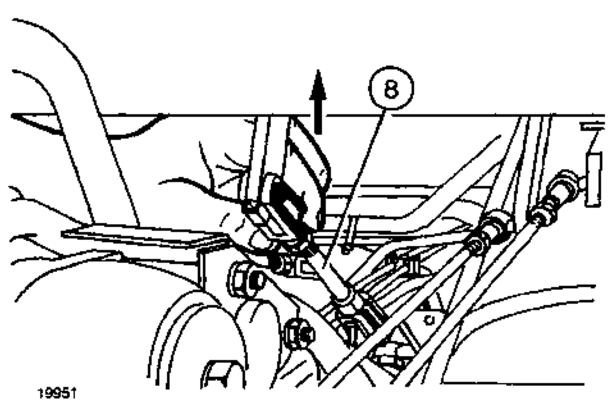
Note – If the 40 km/h transmission is installed remember to remove the 5th gear control lever located right above it.



27. Remove attaching screws and adjustment lever (6) of the lift right arm together with bracket.



28. Remove spring clips and auxiliary valve control levers (7).



29. Remove spring clips and the synchronized ground–speed PTO control lever (8).

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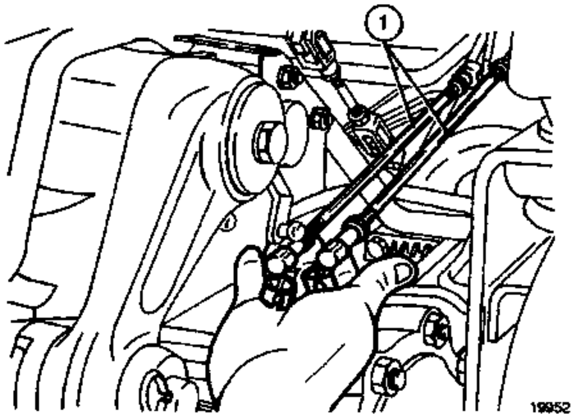
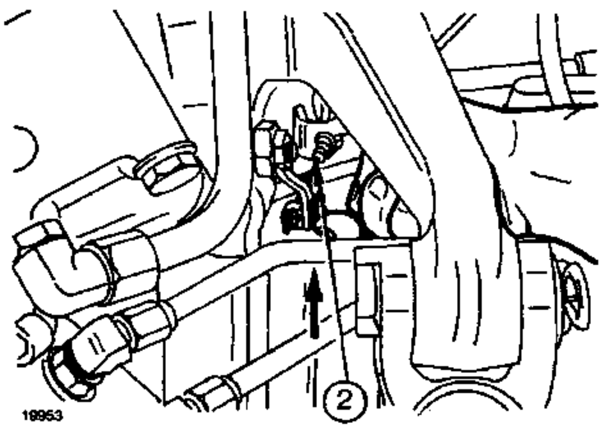
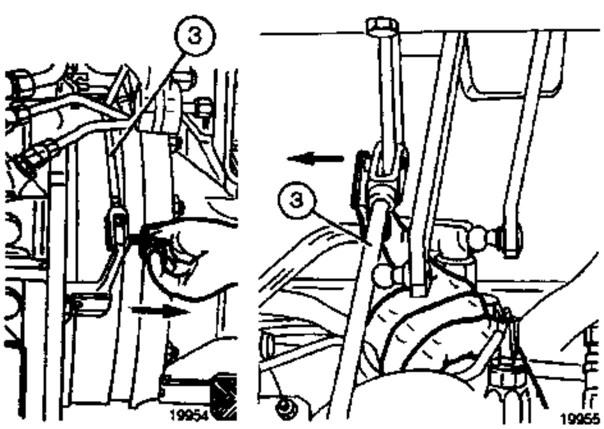


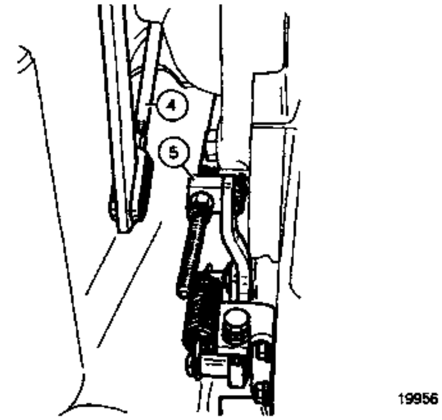
30. Remove spring clips and hydraulic lift control levers (1).



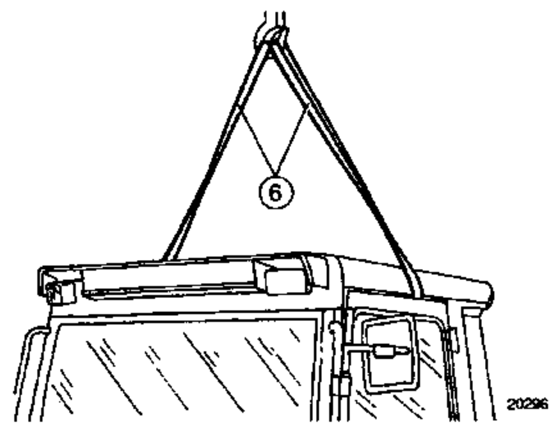
31. Withdraw spring clips and disconnect the Lift–O–Matic control cable (2).



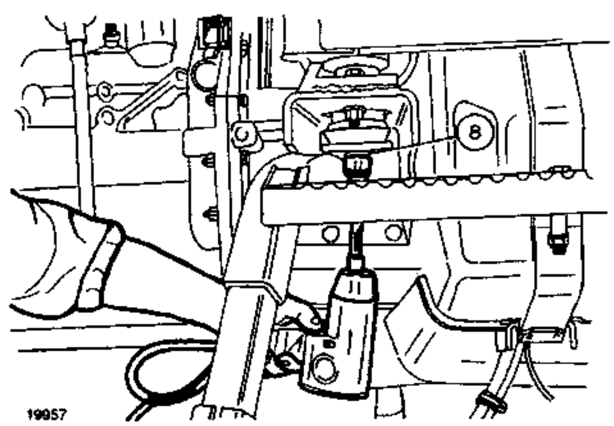
32. Remove front and rear spring clips then retrieve the PTO speed selection control lever (3).



33. Withdraw spring clips and remove the hand brake lever (4) and creeper transmission control lever (5).



34. Sling up the cab with a nylon rope (6), as shown in the figure, about 4 meter (13 ft) long, hook it to a suitable hoist and put it under slight tension; cab doors should be at near closed position.



35. Remove the front mounting screw (8) of cabin (on both sides).

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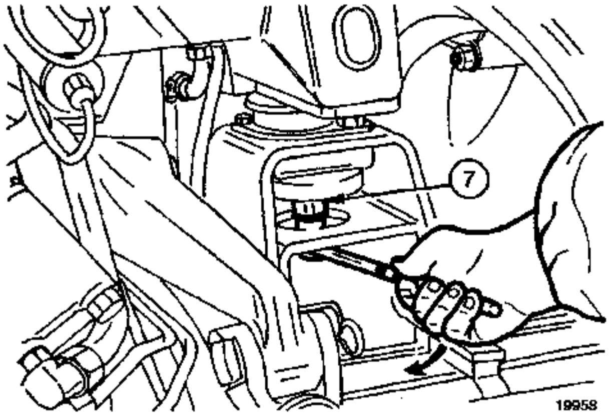
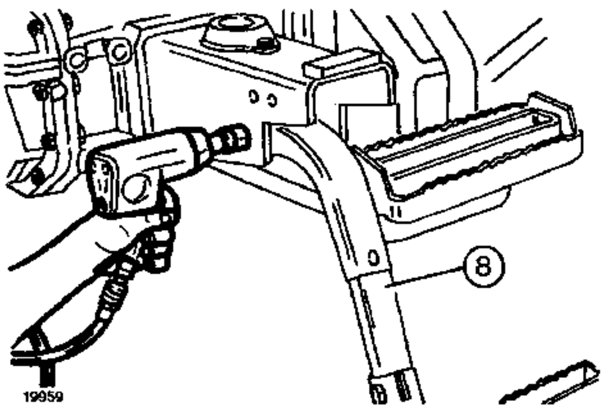
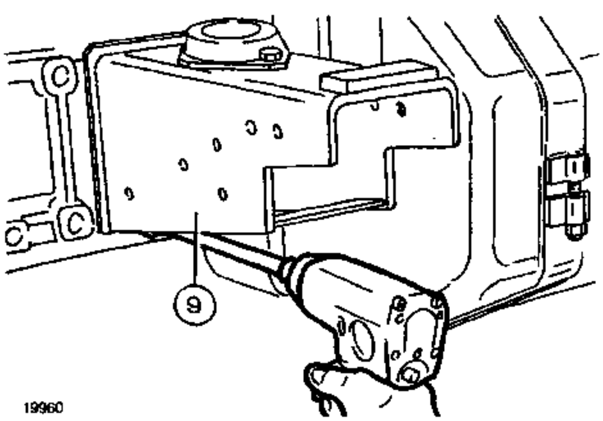


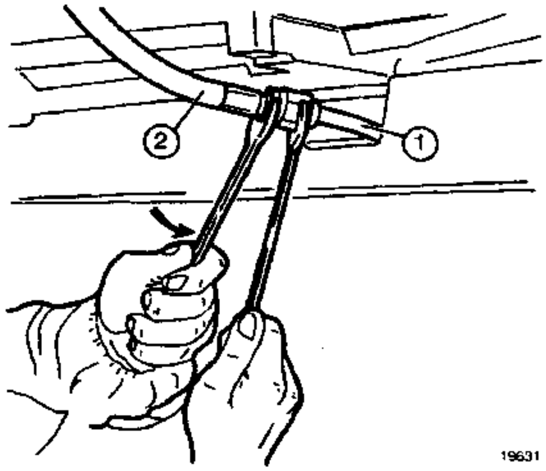
36. Remove the rear mounting screw (7) on both sides, lift the cab and remove it.



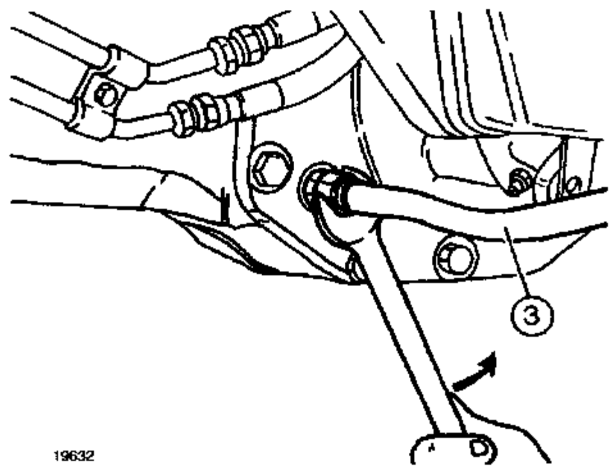
37. Remove screws and step ladder (8), on both sides.



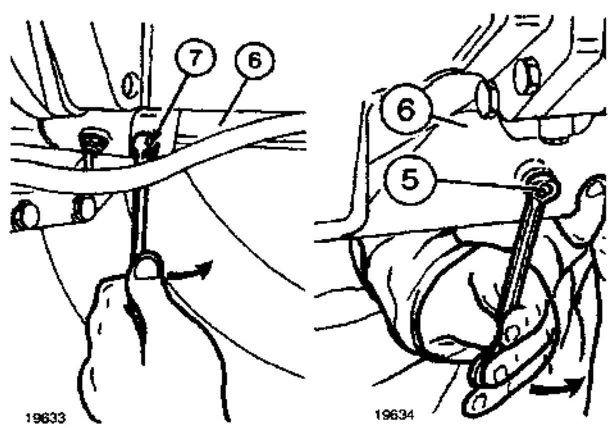
38. Remove capscrews and mounting bracket (9), then split and remove cabin (on both sides).



39. Disconnect hose (2) from pipe (1) of front drive differential lock.



40. Remove hose (3) from front drive axle bridge.



41. Remove the front screws (4), middle (5) and rear one securing the front drive axle shaft guard.

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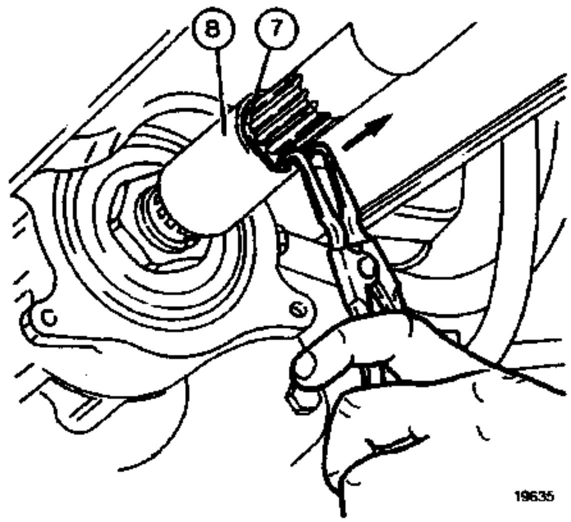
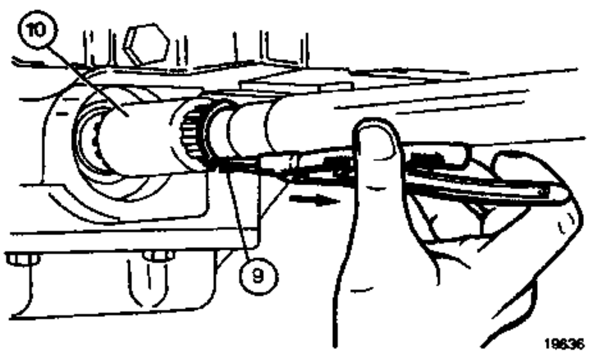
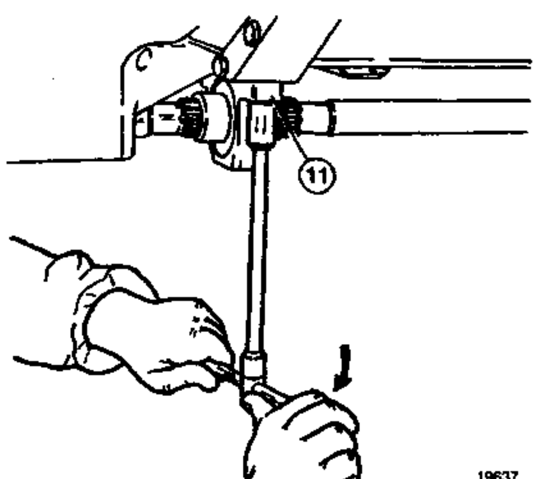


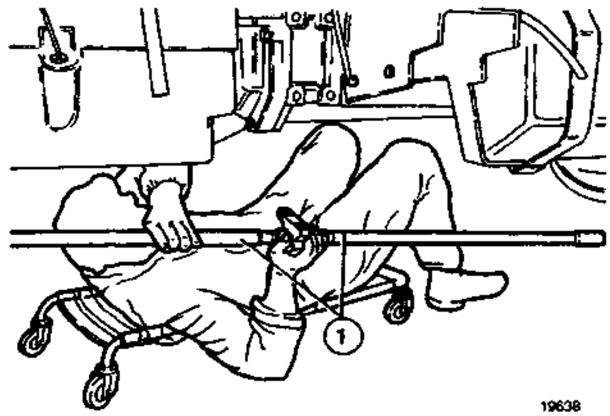
42. Remove snap ring (7) and move sleeve coupling (8) back until free from front axle splined connection.



43. Remove snap ring (9) and move sleeve coupling (10) forward until free from the drive transfer box splined connection.

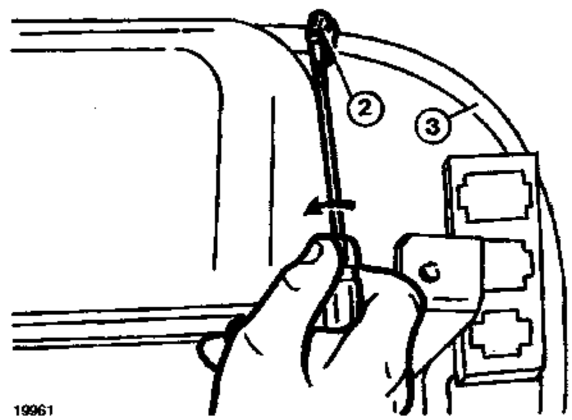


44. Remove capscrews securing the front axle drive unit and transmission shaft carrier (11).

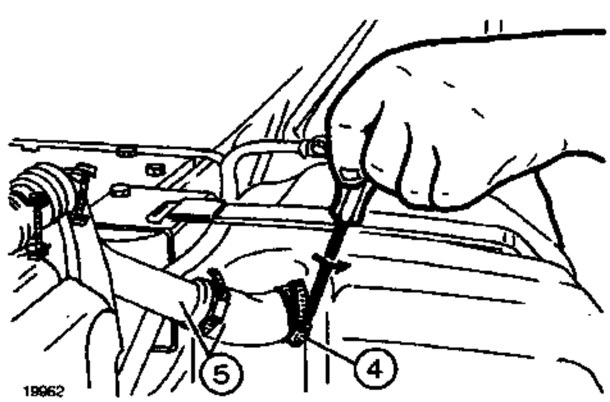


45. Retrieve shafts (1) and carrier.

Note – Operations no. 39 to 45 are specific to 4WD tractors only.



46. Unscrew clamp (2) and remove breather line (3) between main and auxiliary fuel tanks.



47. Remove clamp (4) and connecting line (5) between main and auxiliary fuel tanks.

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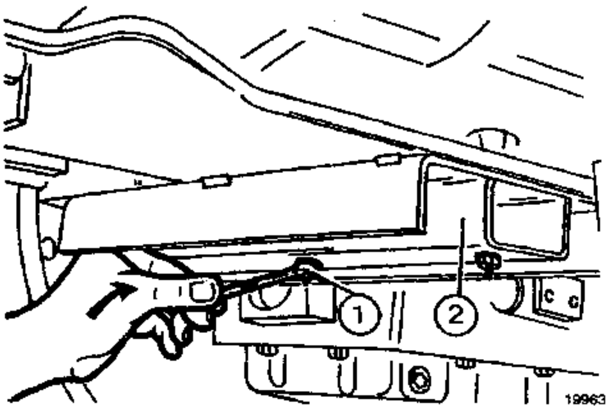
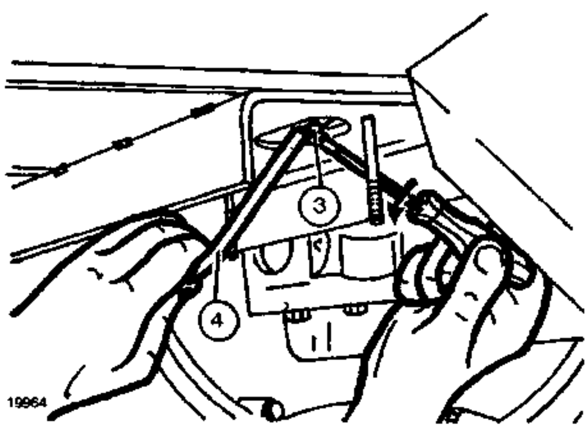
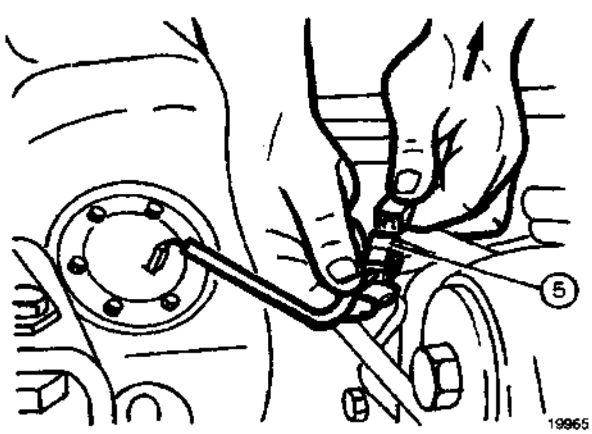


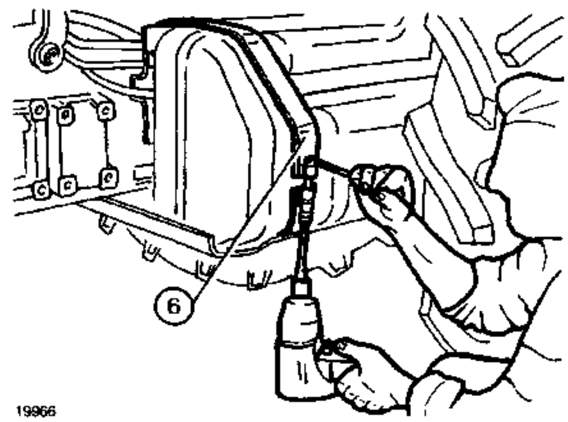
48. Remove attaching screws (1) and guard (2).



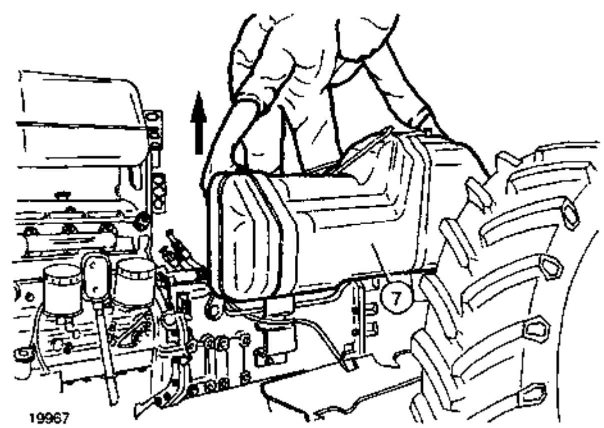
49. Remove clamp (3) and disconnect the fuel feed pump suction line (4).



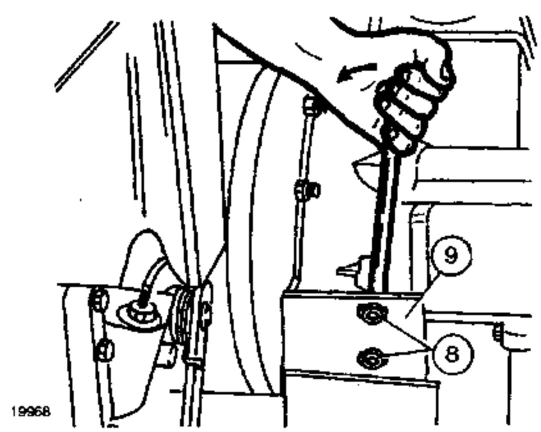
50. Remove the fuel level gauge connection (5).



51. Remove screw and main fuel tank front strap (6); also remove rear one.



52. Separate, by pulling upwards, the main fuel tank (7).



53. Remove the two screws (8) securing the main fuel tank mounting bracket (9).

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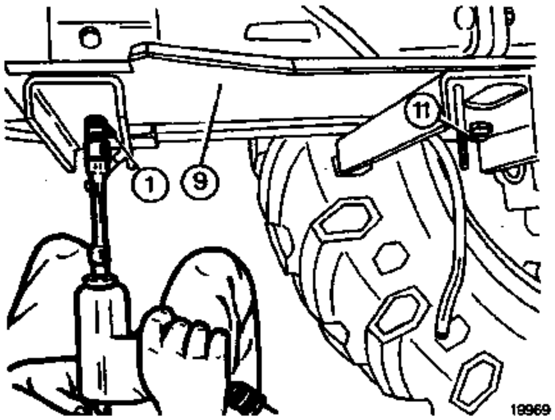
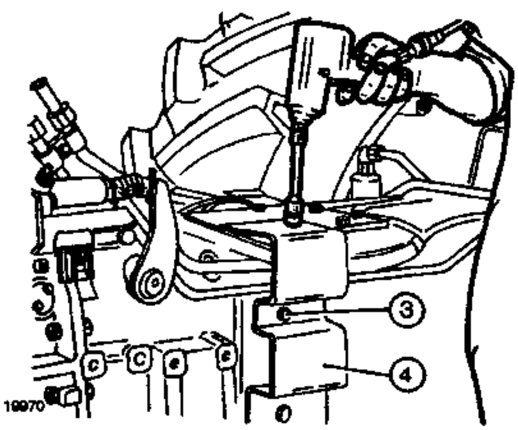
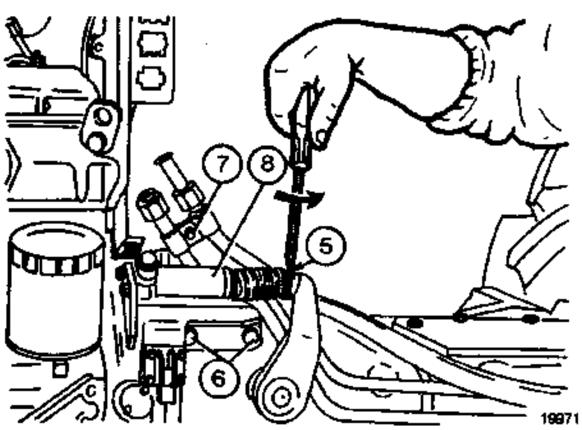


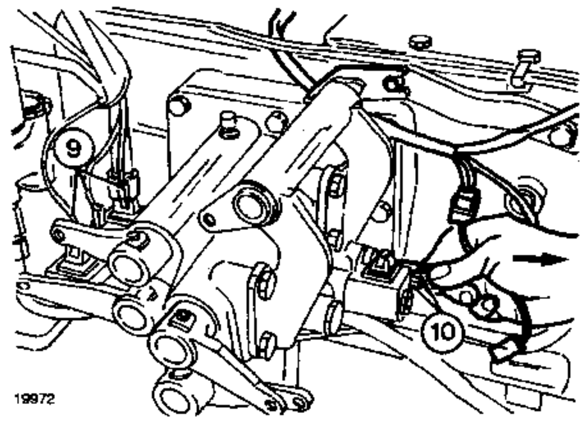
54. Remove front (1) and middle (11) screws, then the main fuel tank mounting bracket (9).



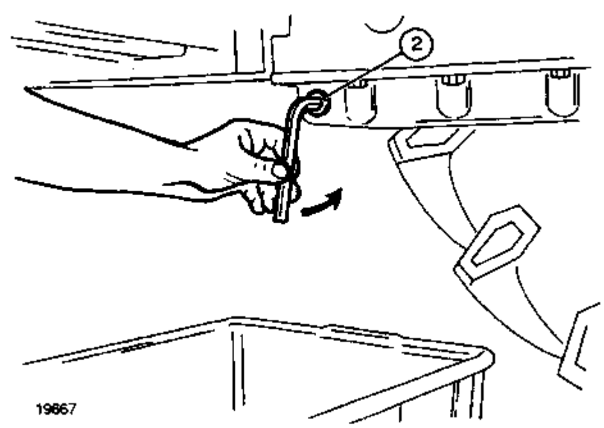
55. Remove screws (3) securing the main fuel tank front strap bracket (4).



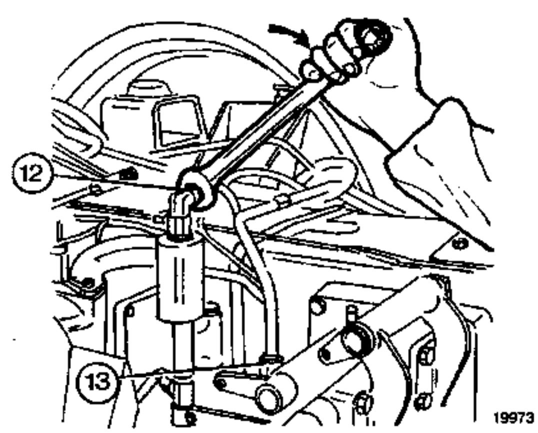
56. Unscrew clamp (5), screws (6 and 7) then remove the clutch lower hydraulic cylinder (8).



57. Disconnect electric leads (9) and (10) from respective valves.



58. Remove plug (2) and drain the rear transmission oil (remember that refill q.ty is 60 liters – $11^3/_4$ Imp or 15.8 Usa Gall).



59. Disconnect and remove power steering pressure and return oil lines (12 and 13).

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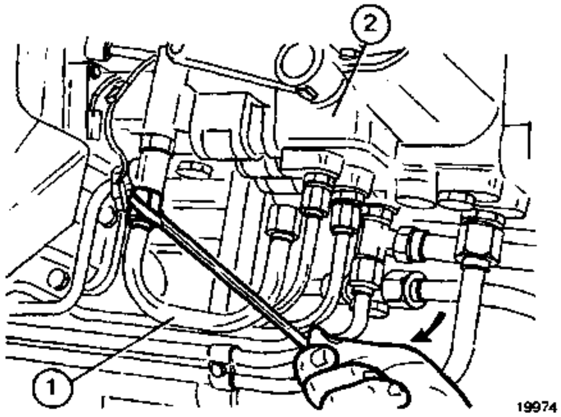
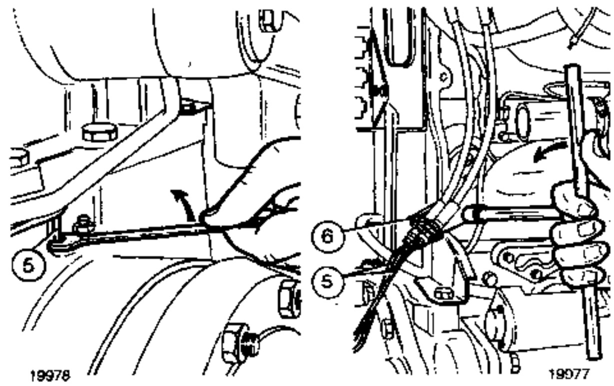
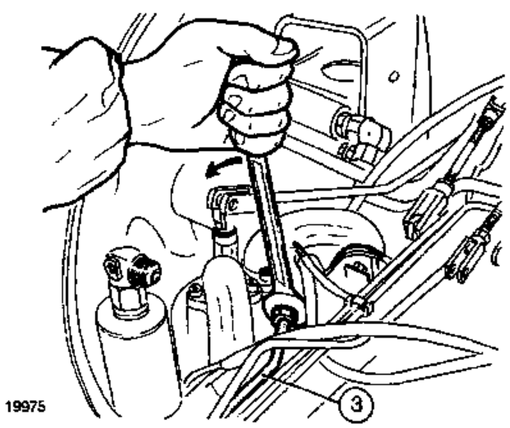


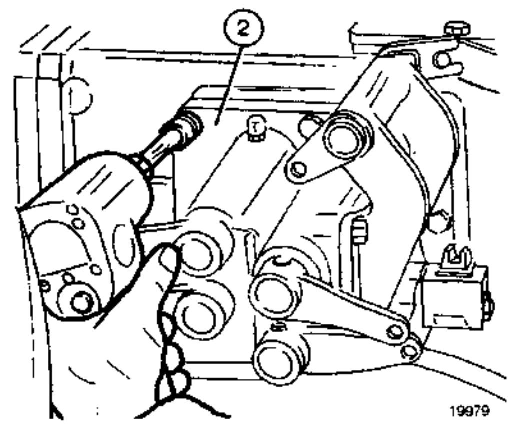
60. Disconnect line (1) from both fittings and remove it; also disconnect all fluid lines from the electric control valve and transmission–range shift rod support (2).



63. Unscrew the connection securing brake line (5) to transmission housing (on both sides), remove screws and strap (6) with lines (5).

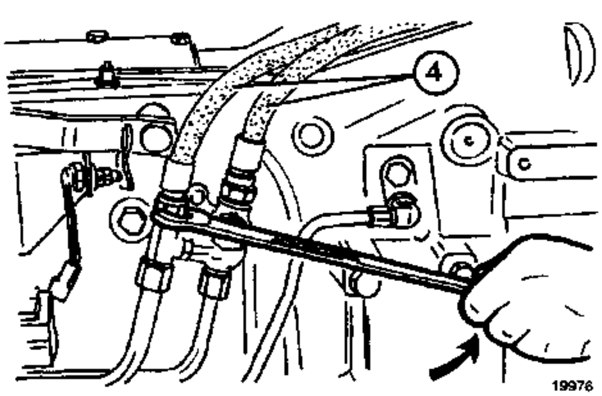


61. Unscrew front and rear fittings from lube oil line (3) and remove it.

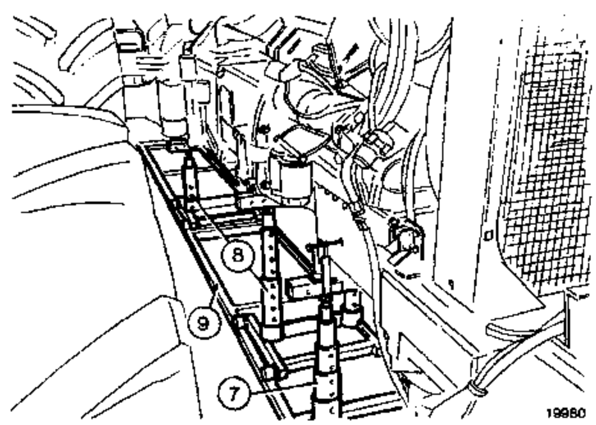


64. Remove screws and support (2).

65. Place a stationary stand under front weights, if any.



62. Free connecting lines (4) to heat exchanger by unscrewing respective fittings.



66. Position the stand tool no. **292320** (9) with its fixed support (7) under the engine oil pan and the mobile supports (8) one underneath the clutch case and the other under the flexion bar carrier, respectively.

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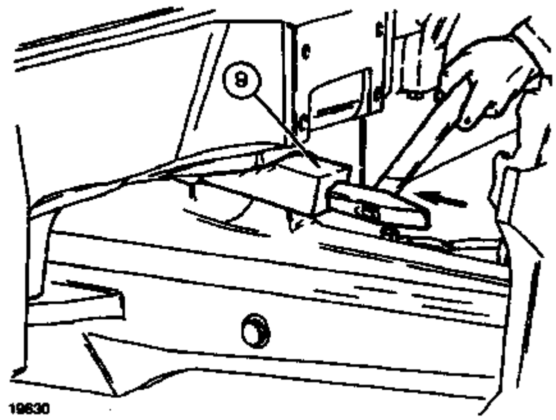
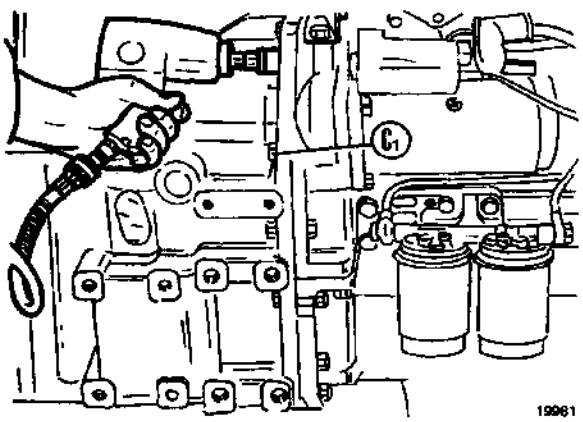
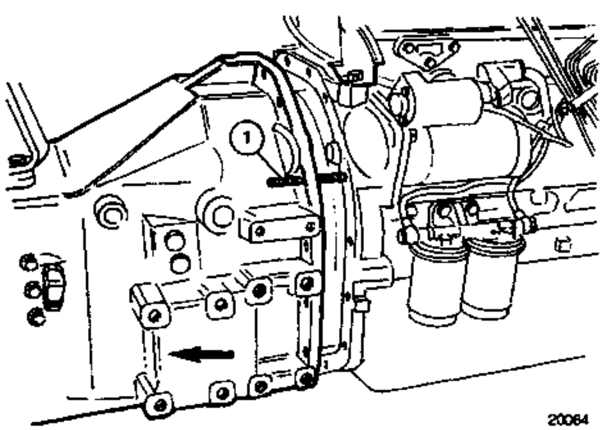


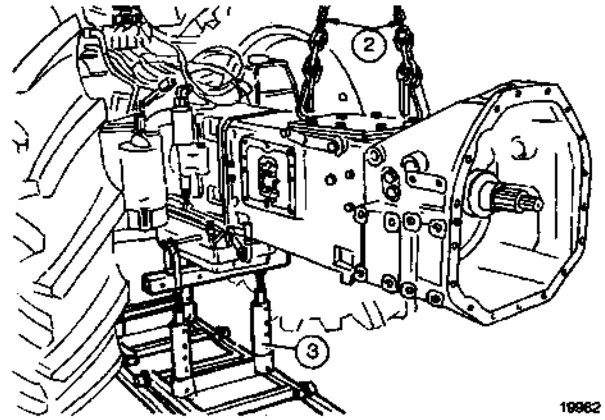
67. Safety block the engine with respect to front axle or power bridge by inserting wedge blocks (9) in between (one on each side), as shown in the figure.



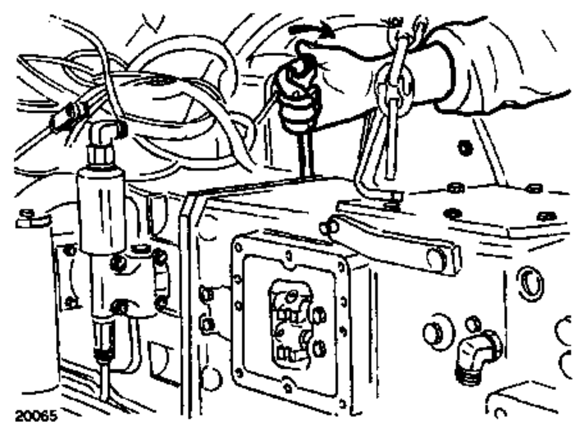
68. Remove clutch–transmission case to engine block capscrews (C_1).



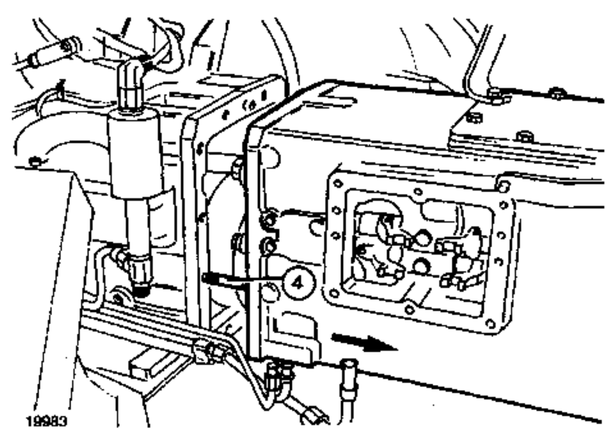
69. Fit centralizing dowels tool no. **292888** (1), one on each side, then separate the clutch–transmission case from engine by pushing the former back.



70. Sling–up the clutch–transmission case to a hoist using the specific chain tool no. **291517** (2) and put it under tension, then place the mobile stand (3) of the shop floor stand **292320** underneath the transmission case.



71. Remove the clutch–transmission to rear transmission case attaching capscrews.



72. Fit the centralizing dowels tool no. **291584** (4), one on each side, and remove the clutch–transmission case.

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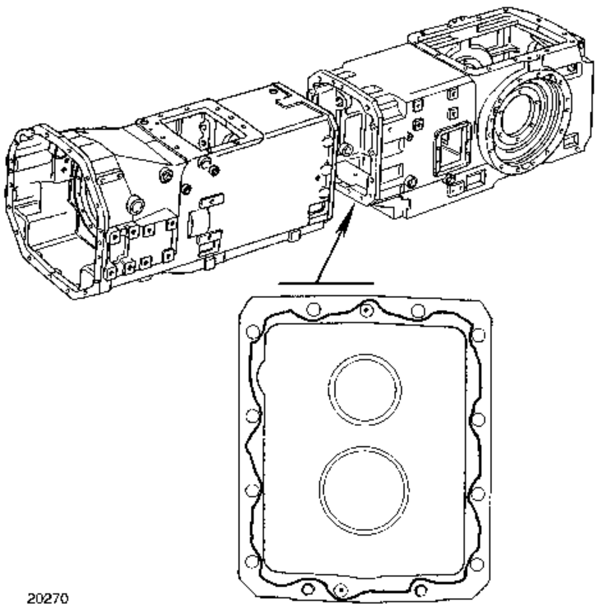


20270

Application scheme for sealing compound coating of mating surfaces at reassembly of clutch–transmission and rear transmission housings

Information on suitable types of sealing compounds are given on page 00–9.

CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

73. When re–joining the clutch–transmission and rear axle cases and the engine, consider the following directions:
a. proceed by reversing the separation sequence of operations from no. 72 back to no. 1;
b. prior to reassembly of housings, supports and covers make sure to thoroughly clean and degrease mating surfaces, then apply a string (about 2 mm or .08 in diameter) of a suitable sealing compound following the application scheme shown in the figure above;
c. also, make sure to tighten fastenings to torque specifications reported on page 21–5;
d. adjust speed, range and reverser transmission controls by shifting hand levers, and respective rods, in neutral, act on forks to adjust rod lengths and tighten jam nuts; finally, check that all shifting and engagements can be done correctly.

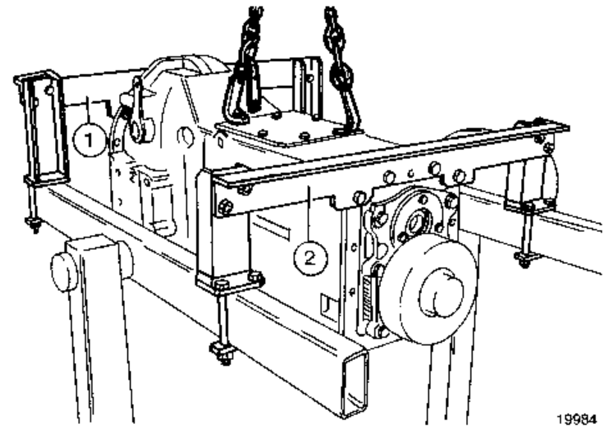
CLUTCH–TRANSMISSION CASE

Disassembly–Assembly of synchro–range transmission (Op. 21 114 85 – 21 140 36 – 21 140 50 – 21 140 52).

CAUTION

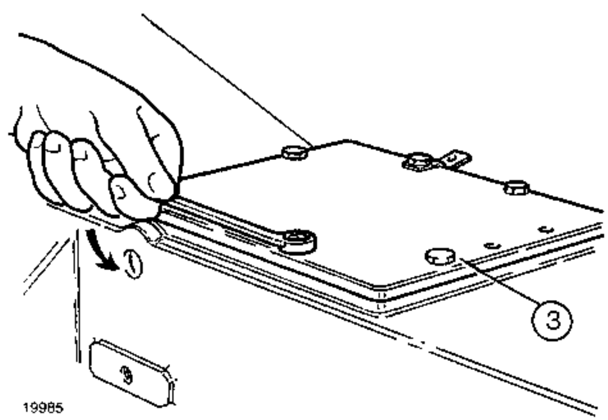
Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

Separate and disassemble transmission and range unit component parts as follows:



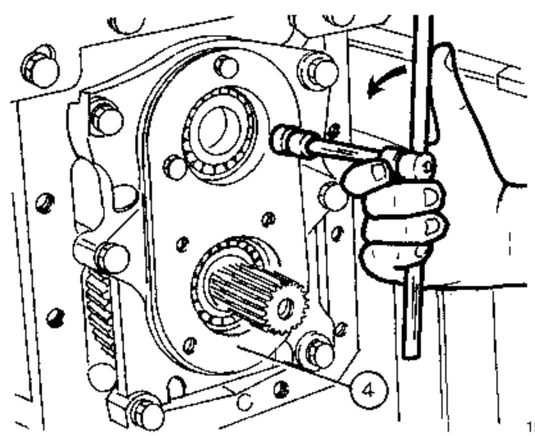
19984

1. Install clutch–transmission case on rotary stand tool no.**290090** securing it through the stand special brackets, tool n. **293971** (1, front) and **293972** (2, rear).



19985

2. Remove capscrews and top cover plate (3).



19986

3. Remove capscrews and cover (4) and retrieve bearing shims, range drive and driven shafts.

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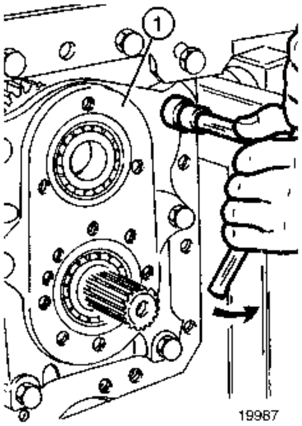
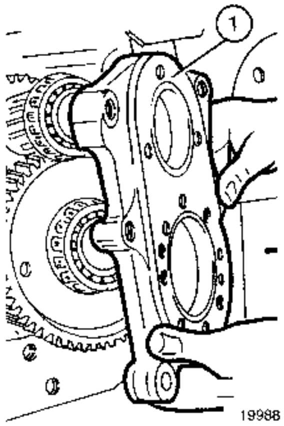
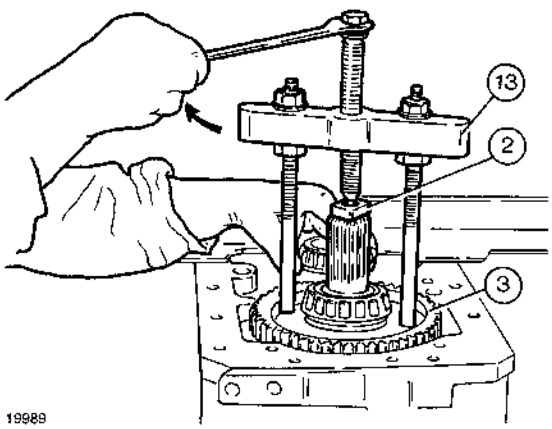
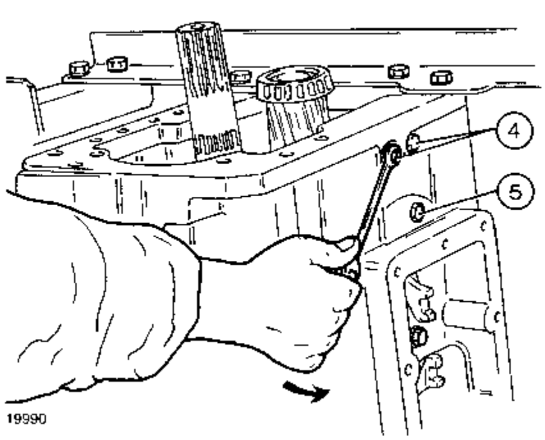




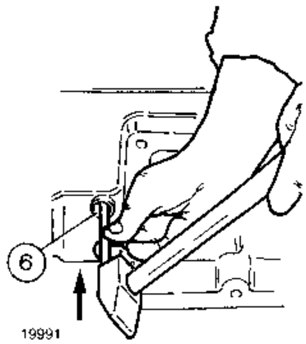
4. Remove capscrews and range drive and driven shaft rear bearing quill (1).

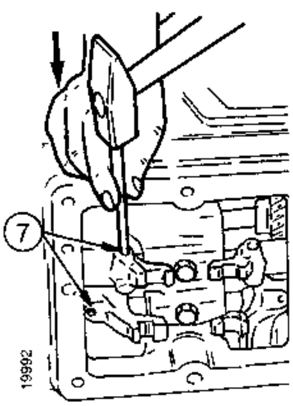


5. Using puller tool no. **291051** (13) and a suitable thrust block (2) pull out gear (3) together with respective bearings or bushing; pay attention to keep the drive shaft bearing detached.

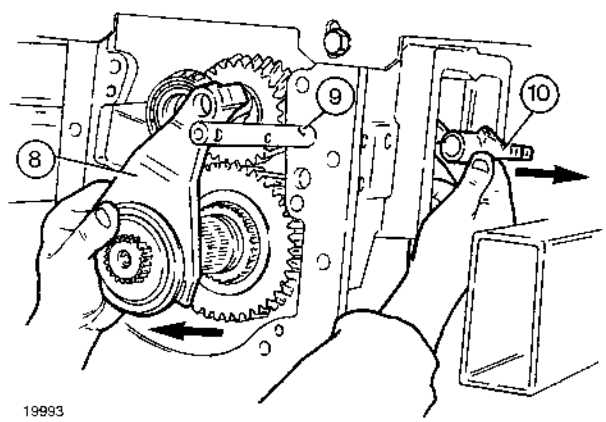


6. Unscrew caps (4) and retrieve detent balls and springs. Remove cap (5).

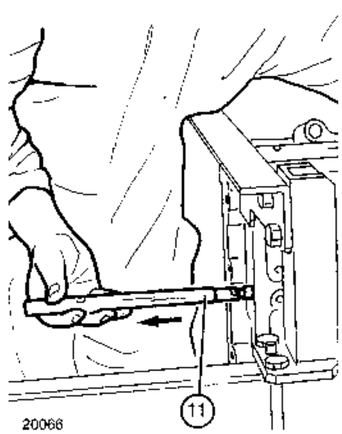


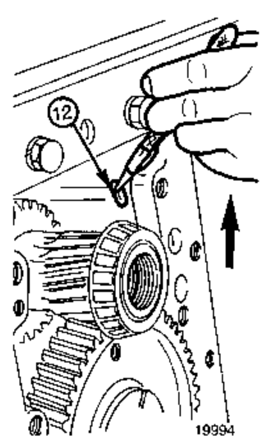


7. Take out spring pins (6) securing the low range shifter fork as well as spring pins (7) from the range shift dogs.



8. Remove shifter fork (8) together with engagement sleeve , slide off shifter shaft (9) and retrieve dog (10).





9. Slide out shifter shaft (11), retrieve dog (12) and shifter shaft (11 and 9) safety pawl.

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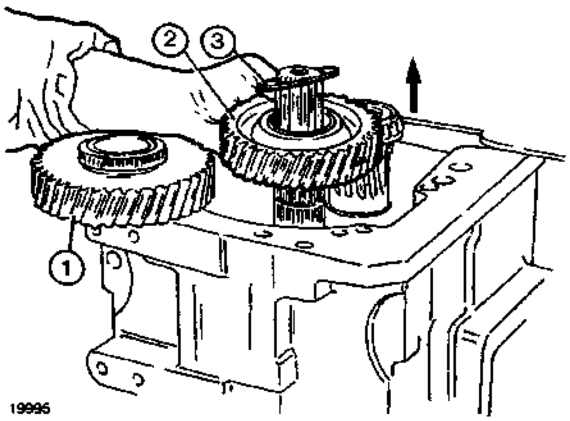
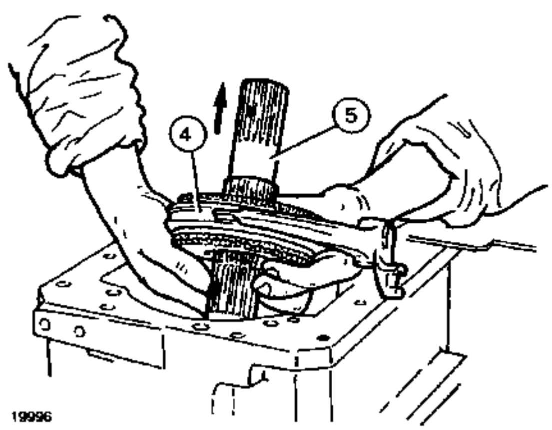
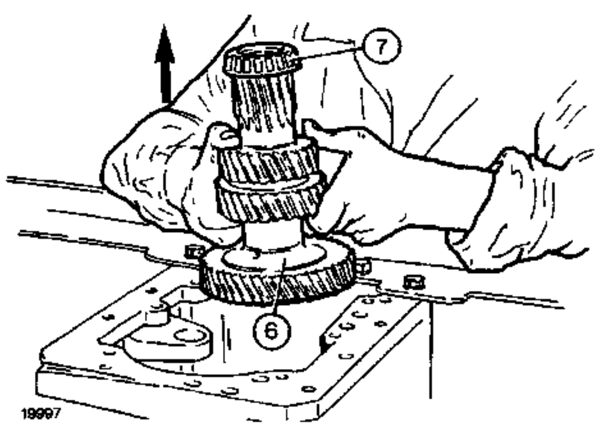


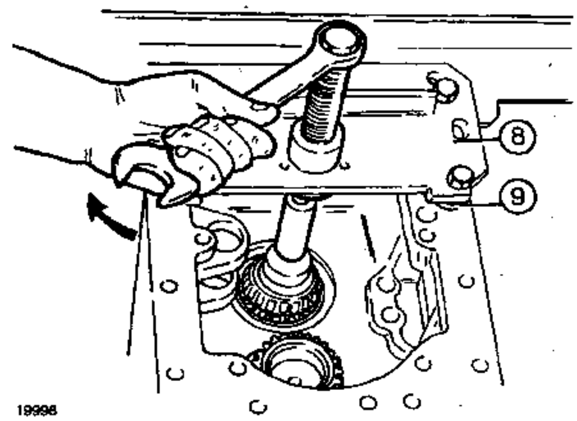
10. Slide off medium–low range gears (1) and medium–high range ones (2) together with inside bushings and thrust rings (3).



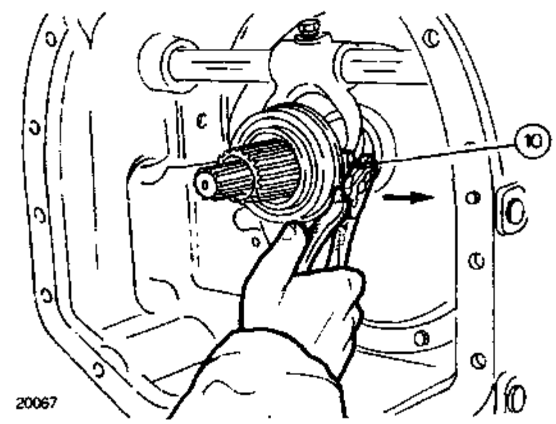
11. Remove synchronizer (4) (if equipped) or the shift collar together with shifter fork and driven shaft (5).



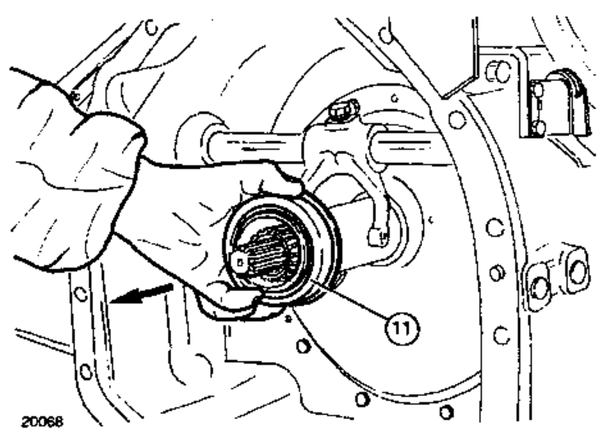
12. Remove range drive shaft (6).



13. Install special tool **293805/1** (8) (see page 21–6) using two rigid spacers (9) (20 mm – .8 in thickness) to support the transmission drive shaft.



14. Withdraw spring (10) securing the bearing (from both sides).



15. Retrieve the clutch engagement bearing (11).

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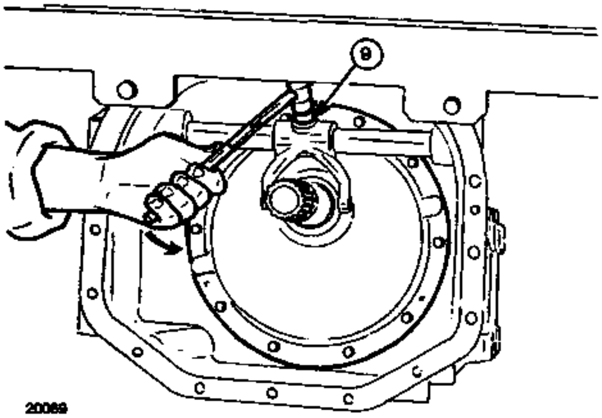
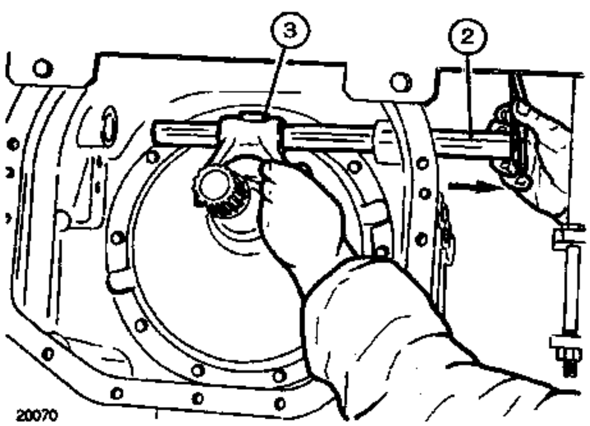
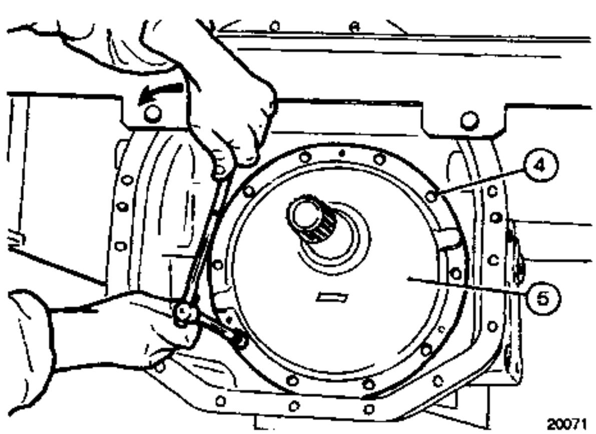


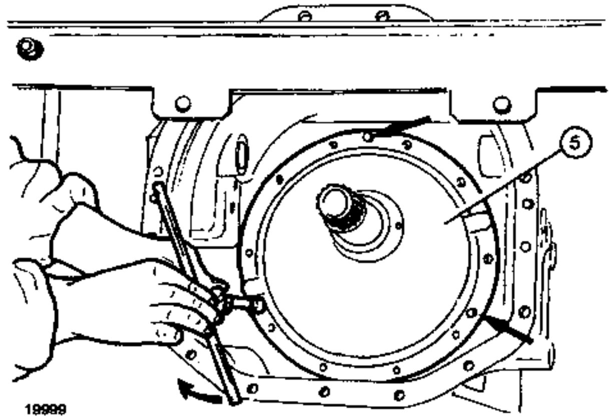
16. Remove screw (9) securing shifter fork to its lever.



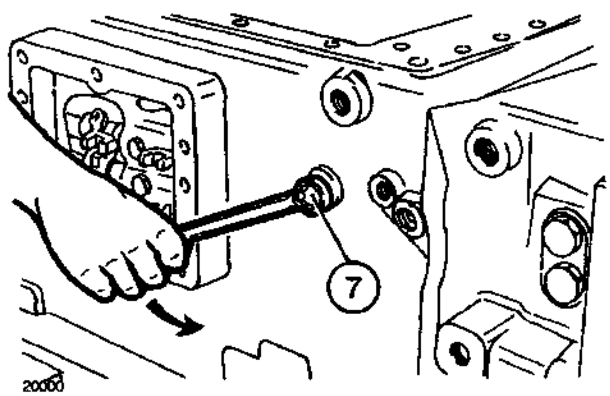
17. Slide control lever (2) out and retrieve shifter fork (3).



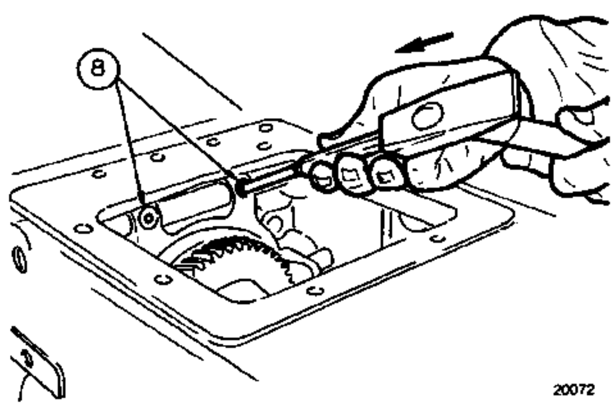
18. Remove all cover (5) attaching capscrews (4).



19. Screw back three of the capscrews (4) inside threaded holes (6) which will allow separation and removal of cover (5) from the transmission housing.



20. Unscrew cap (7) and retrieve detent spring and pawl.



21. Pull out spring pins (8) just enough to free the reverser control lever.

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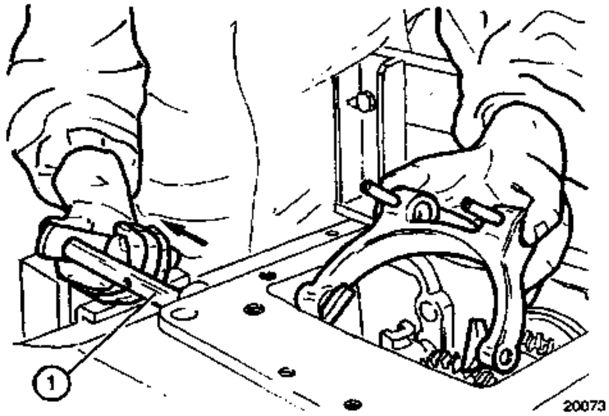
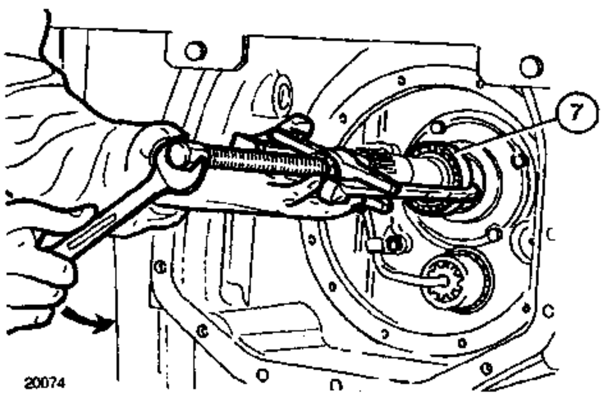
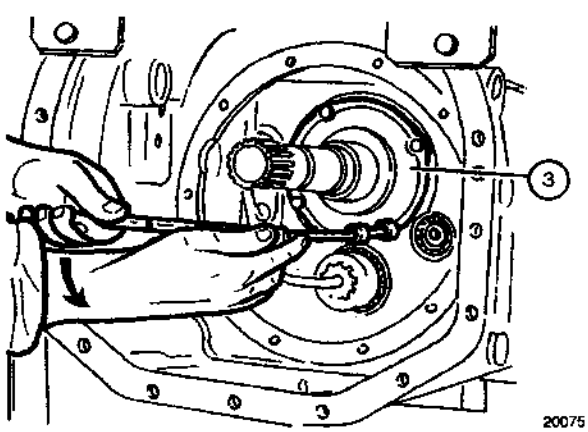


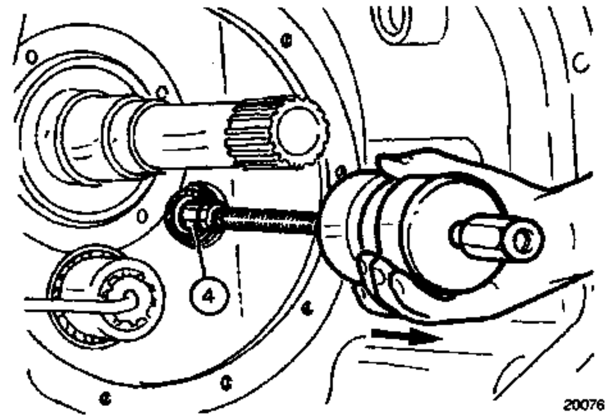
22. Slide out shifter shaft (1) and retrieve shifter fork.



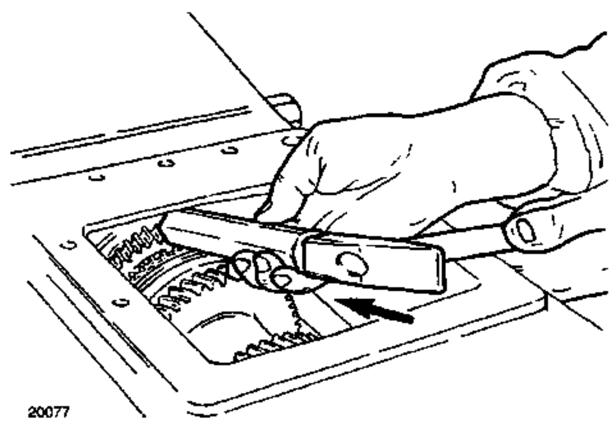
23. Remove bearing (7) from the reverser drive shaft using a universal puller.



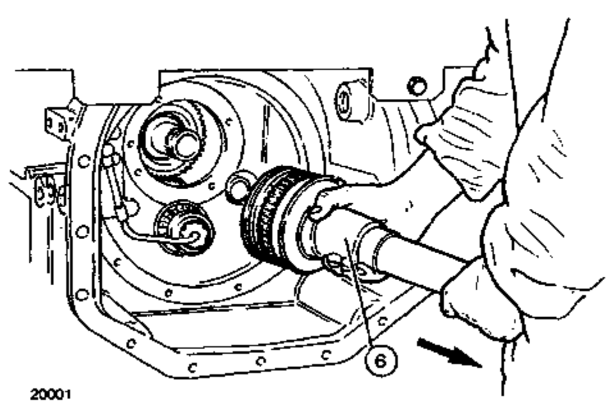
24. Remove attaching capscrews and cover (3).



25. Remove the retaining snap ring and using special adapter tool no. **292313** (5) and slide–hammer type driver **292927** extract the reverse gear axle leaving the former in place.



26. Striking on the rear of the reverse drive gear using a brass driver punch and hammer



27. Withdraw the drive shaft (6) complete with reverse gear and synchronizer from front end.

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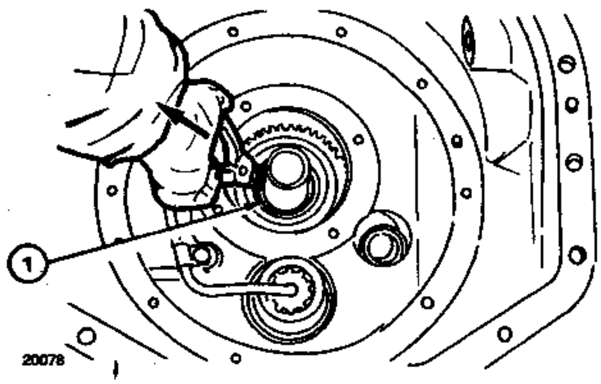
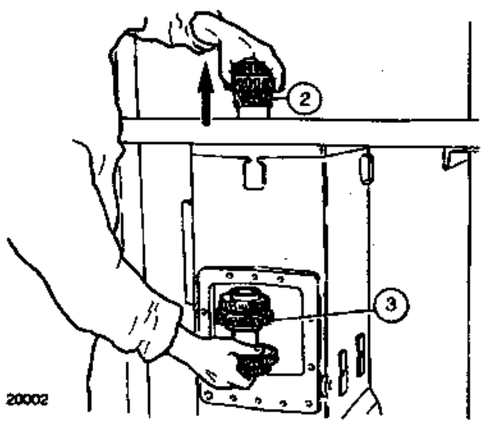
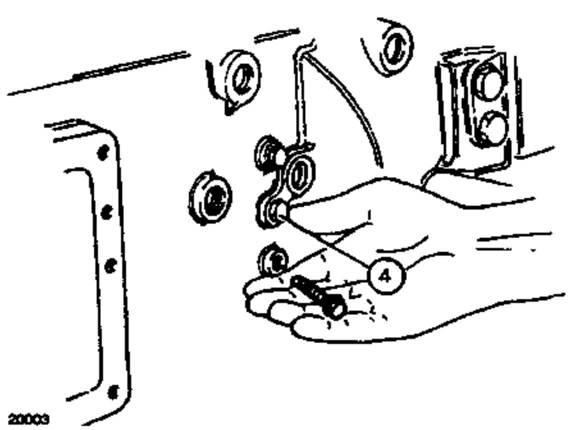


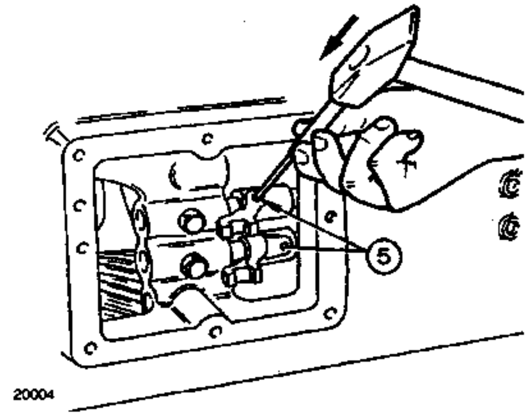
28. Remove snap ring (1) from transmission drive shaft.



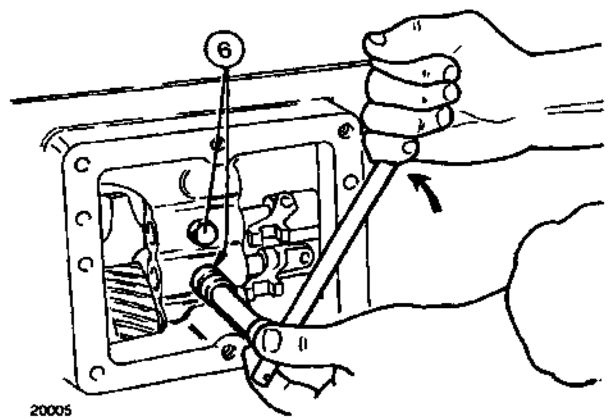
29. Remove special tool **293805/1** from rear end of case leaving it in upright position, remove drive shaft (2) and retrieve the reverse idler gear and its bearing.



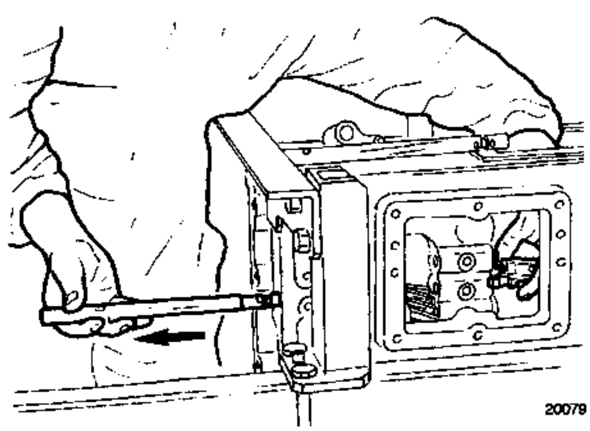
30. Unscrew caps (4) and retrieve detent springs and balls.



31. Pull out spring pins (5) as well as the inside one on shifter fork in order to free the transmission gear shift rods.



32. Unscrew the stop caps (6).



33. Withdraw the gear shift rods from rear end and retrieve shifter forks and pawl.

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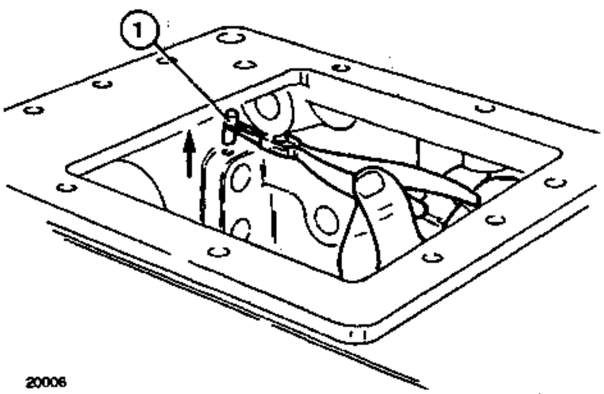
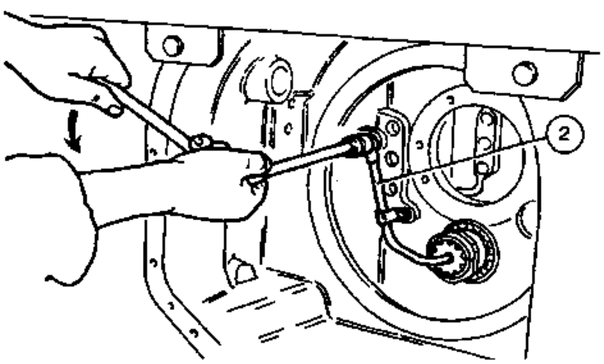


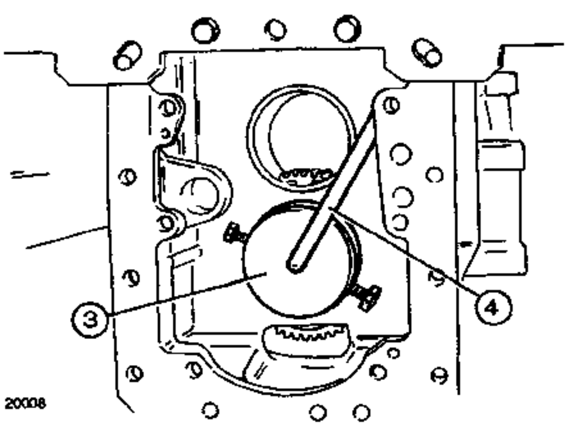
20006

34. Retrieve safety pawl (1).



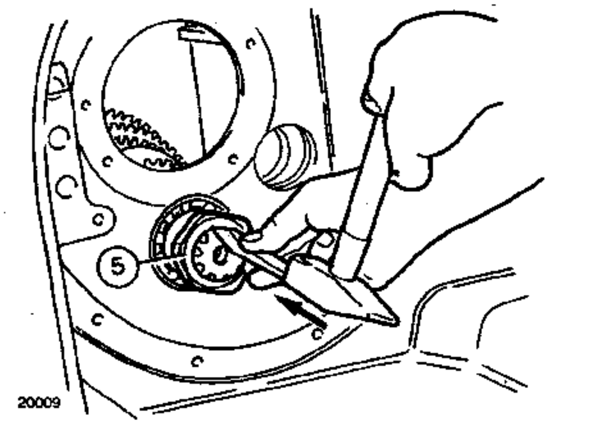
20007

35. Unscrew connection, remove attaching screw and take away the driven shaft lube line (2).



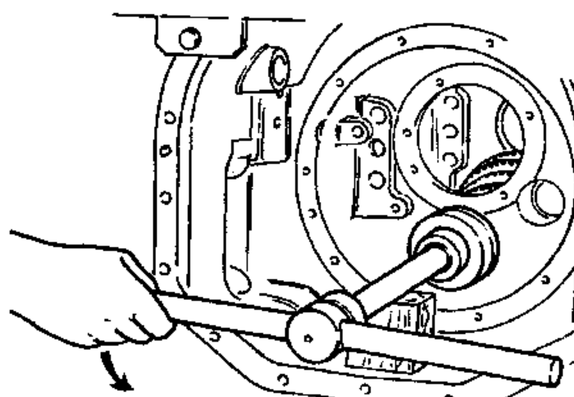
20008

36. Install retaining tool no. **293808/1** (3) on the transmission driven shaft and insert a wrench (4) to hold the shaft.



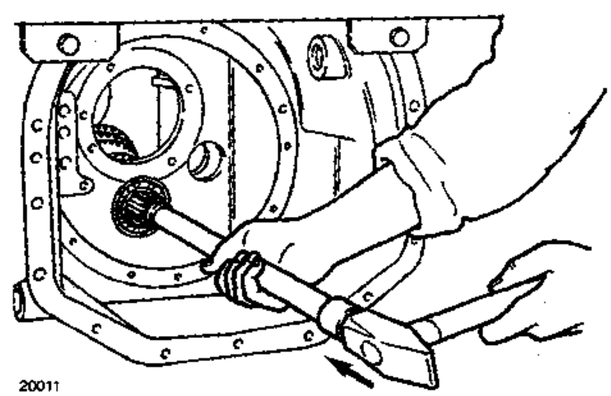
20009

37. Straighten tab on transmission driven shaft lock nut (5).



20010

38. Unscrew lock nut and retrieve bushing.



20011

39. Free the shaft from bearing applying an aluminium punch on its front end and striking on the latter with a hammer.

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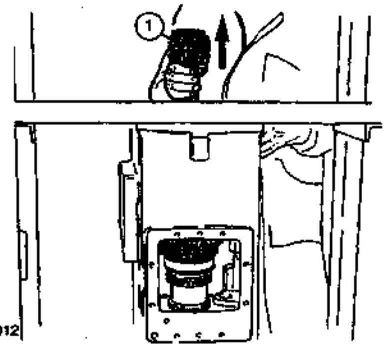
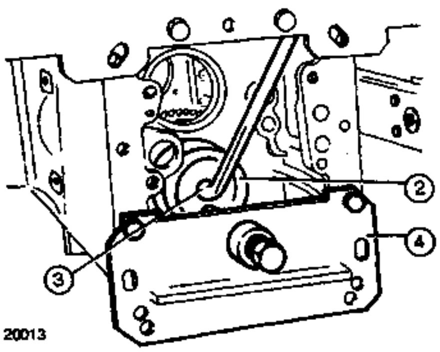


20012

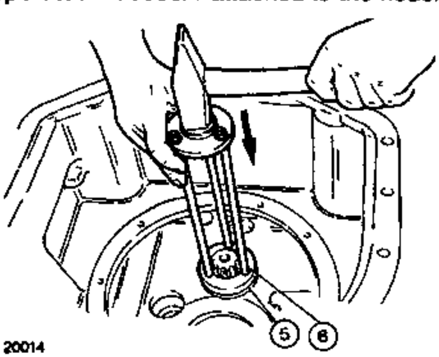
40. Position the clutch–transmission case upright, withdraw driven shaft (1) and retrieve gear cluster.

41. At re–assembly of the transmission and reduction units in their respective housings consider the following directions and information:
a. proceed by reversing the disassembly sequence of operations starting from no. 40 back to no. 1
b. see figures on pages 21–9 and 21–10 for correct placement of component parts;
c. make sure the housing is thoroughly clean, particularly the inside compartments;
d. prior to re–fitting housings, supports and covers make sure to thorougly clean and degrease mating surfaces, then apply a bead (about 2 mm or .08 in diameter) of a suitable sealing compound following the application scheme of page 21–33;
e. tighten fastenings to torque specifications reported on page 21–5;
f. perform operations which are further indicated and adjustments reported on pages 21–34 and 21–35.



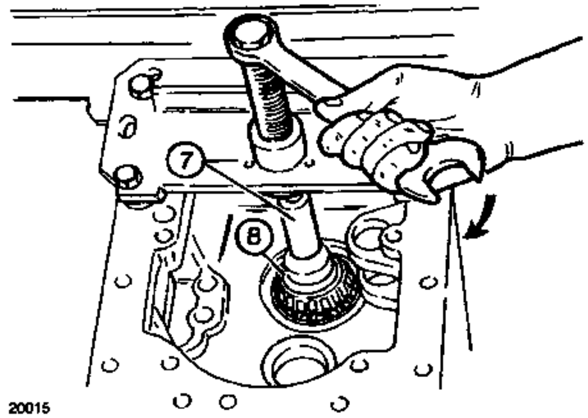
20013

42. Install retaining tool no.**293808/1** (2) on transmission drive shaft, inserting a wrench (3) to block it, and support tool **293805/1** attached to the housing.



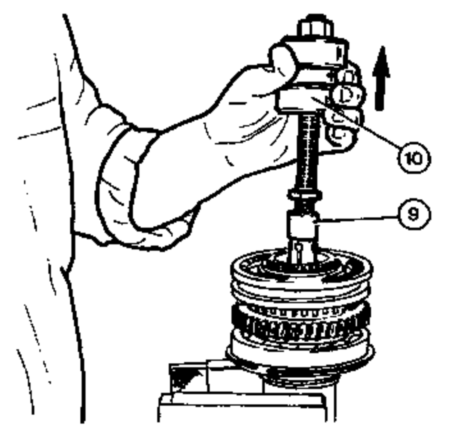
20014

43. Force–fit front bearing (5) onto the transmission driven shaft using special tool no. **293869** (6).



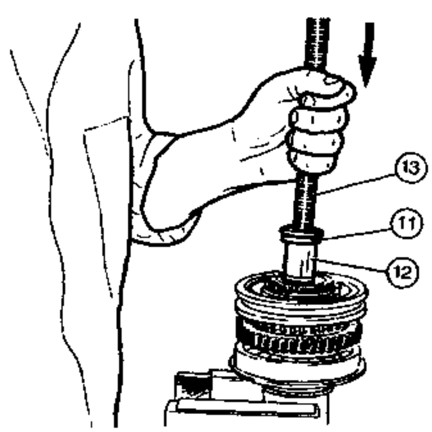
20015

44. Remove snap ring and thrust washer and then the transmission drive shaft bearings using special tools no. **2938051** (7) and **50062** (8) (see page 21–7). To refit bearings, pre–heat them and use a brass punch to bed them properly.



20080

45. Remove the PTO shaft oil seal (11) using pullers tool no. **294000** (9) and a slide–hammer type puller (10).



20081

46. Force fit oil seal (11) using special tool no. **293993** (12) with grip **293800** (13).

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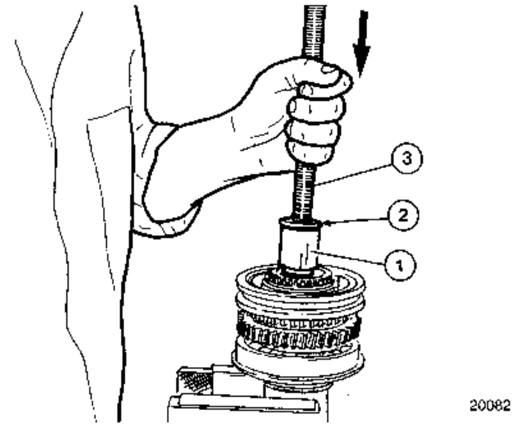
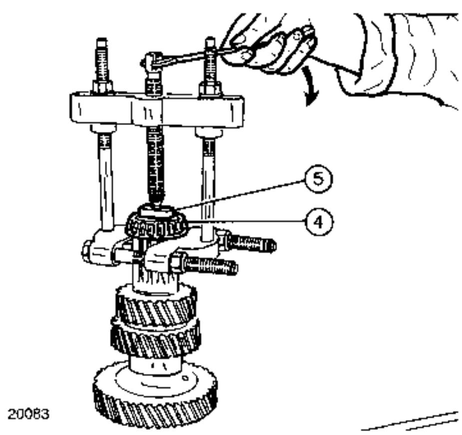
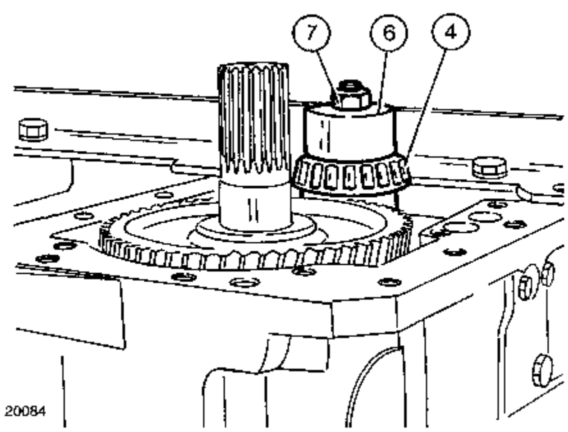


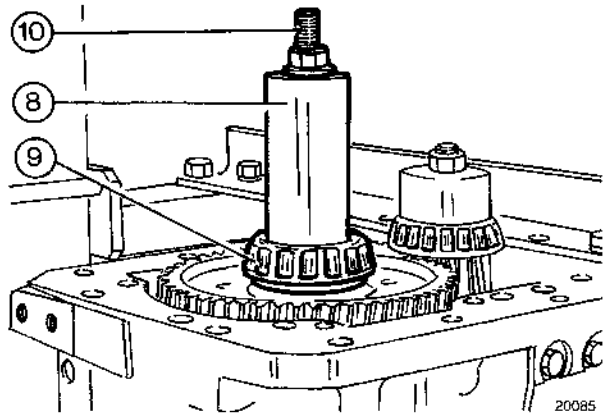
47. Pull out bushing (1) referring to operation no. 44. Force–fit bushing (1) using the tool no.**293932** (2) and grips **293800** (3).



48. Remove bearing (4) from range drive shaft using two adequate pullers and a thrust block (5).

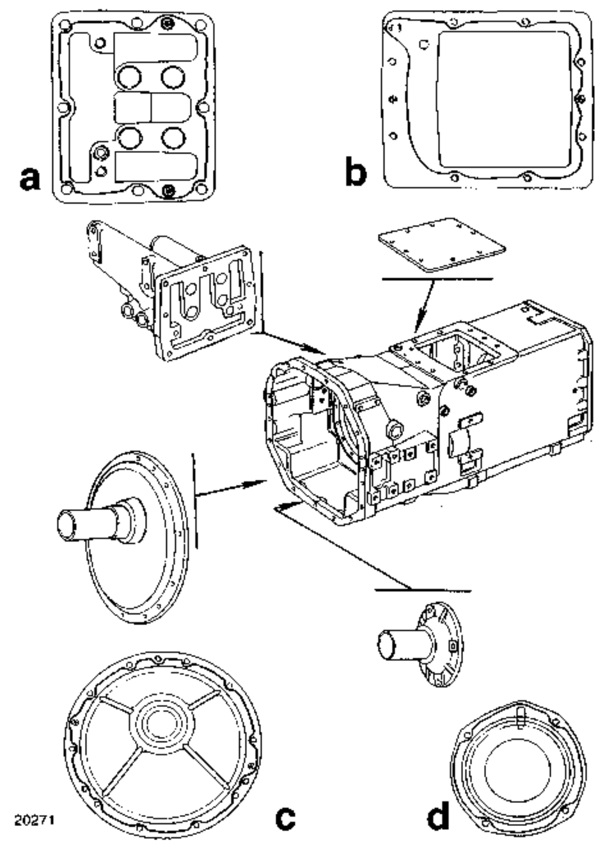


49. Heat and force–fit bearing (4) onto the drive shaft using tool **50060** (6) illustrated on page 21–7 and keeping it in contact, during the cooling process, using the tool **50013** (7) (see page 21–7).



50. Heat and force–fit bearing (9) onto the driven shaft using tool **50061** (8), illustrated on page 21–7 and keeping it in contact, during the cooling process, using tool no. **50018** (10) (see page 21–7).

Note – Remove tools **50060** (6) and **50061** (8) only after bearings have completely cooled off.



Application scheme of sealing compound at installation of gearshift console (a), top cover (b) and front cover (c) to clutch–transmission case and of cover plate (d) on cover (c) (HI – LO version only).

Information on suitable types of sealing compounds are given on page 00–9.

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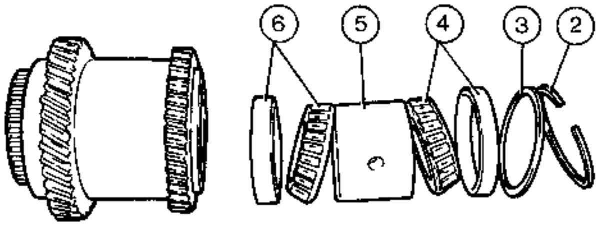
CLUTCH – TRANSMISSION CASE
Adjusting the reverser gear bearings

CAUTION

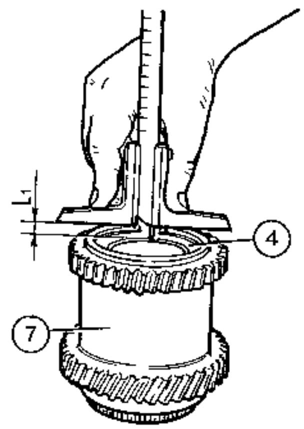
Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

Proceed as follows:



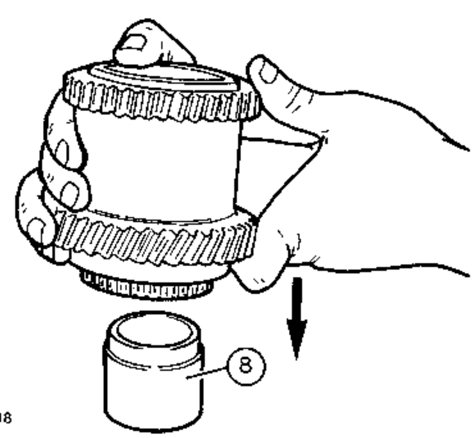
20016

51. Remove snap ring (2) and take away shim (3), front bearing (4), spacer (5) and rear bearing (6).



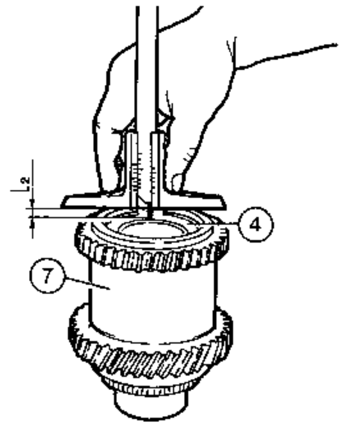
20017

52. Re–assemble component parts with the exception of shim make sure pack is flush and measure distance L_1 between top of gear (7) and bearing outer race (4).



20018

53. Place bearing (7) on a suitable bushing so to bring the inside pack flush with upper side; check that the snap ring is also under same conditions.



20019

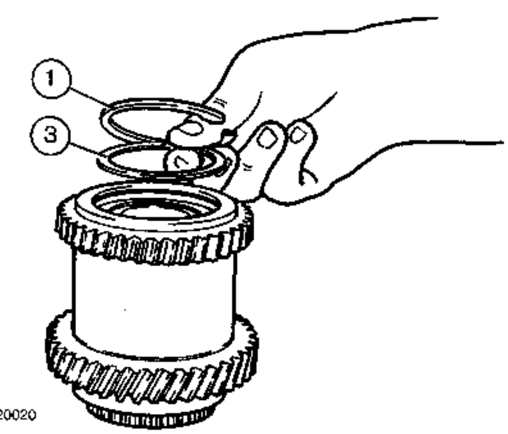
54. Measure distance (L_2) between the top of gear (7) and outer reace of bearing (4).Required shim (3) thickness is given by:

$$\mathbf{S = L_1 - L_2 - 0.05\ mm\ (.002\ in)}$$

where:
S = shim (3).
$\mathbf{L_1}$ and $\mathbf{L_2}$ = reading on gear.
0.05 mm = to be subtracted to compensate for increased bearing pre–load consequent to tightening of transmission driven shaft.
If necessary, round off (–) value **S** within 0.05 mm (.002 in).

Example:
Reading L_1 = 10.25 mm (.403 in)
Reading L_2 = 7.33 mm (.288 in).
Shim thickness:
S = 10.25 – 7.33 – 0.05 = 2.87 mm.
Shim thickness to be fitted is 2.85 mm (.112 in).

Note – Shim thickness range values for the reverser driven gear are listed on page 21–4.



20020

55. Remove snap ring (2), fit shim (3) the thickness of which was found previously and block the pack by re–fitting the snap ring (2).

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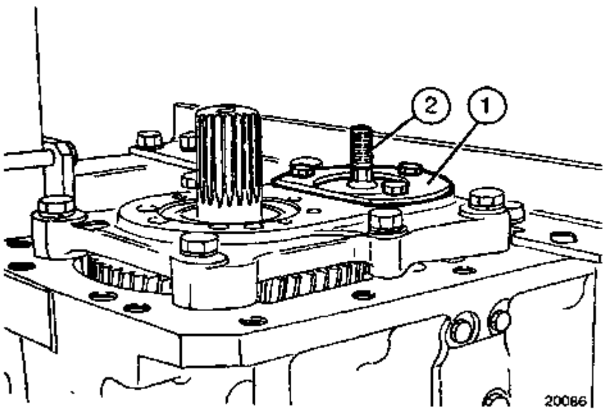
CLUTCH – TRANSMISSION CASE
Adjusting the range drive and driven shaft roller bearings.

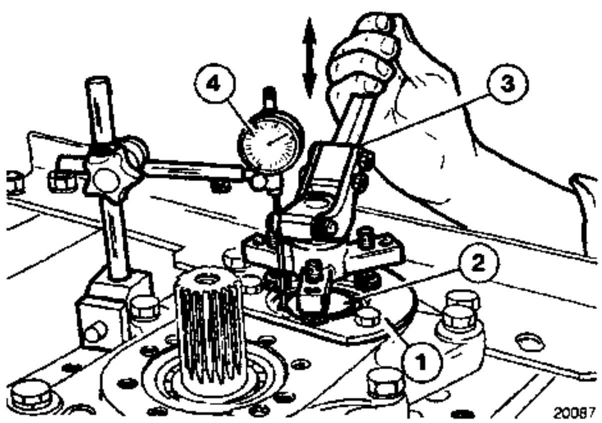
CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

Proceed as follows:



56. Fit cover (1) without shim and screw tool no. **50013** (2) onto the drive shaft (see page 21–7).



57. Srew the adapter tool no. **292176** (3) onto the tool no. **50013** (2). Position the comparator dial gauge (4) with the feeler tip contacting the bearing cone .
Turn shafts manually to bed the bearing rollers, set dial at zero and make sure that pack bottom is seated tight.
Actuate hand lever of tool **292176** (3) to bring the pack flush against cover (1) and read the measure of stroke (L) on the comparator dial.
Required shim thickness is given by:

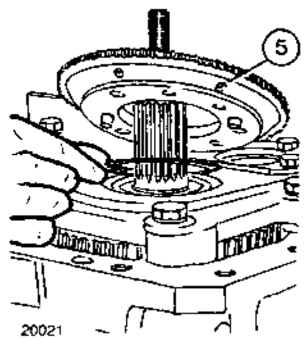
S = L– (0.04 to 0.10 mm or .001 to .004 in)

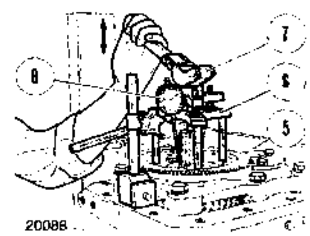
where:

S = Shim.
L = Stroke reading.
.04 to .10 mm = drive shaft bearing play.

Note – Shim thickness range values for range drive shaft bearing are listed on page 21–2.

58. Remove tools (2 and 3), cover (1), fit the shim found previously, re–fit cover (1) and tools (2 and 3), check that play is within specifications (0.04 to 0.10 mm or .001 to .004 in). Proceeding as per operation no. 57. Remove tools (2 and 3).





59. Fit disk (5) together with a trial shim (Sp). Unplug the opening. Install tool no. **50018** (6) (see page 21–8), tool no. **292176** (7) and comparator (8); make sure that the tip of the latter is positioned on the bearing cone.
Turn shafts manually to bed the bearing rollers, set dial gauge at zero and make sure that pack bottom is seated tight.
Actuate hand lever of tool **292176** (7) to bring the pack flush against the disk (5) and read the measure of stroke (H) on the comparator dial.
Required shim thickness is given by:

S_1 = H + Sp – (0.04 to 0.10 mm or .001 to .004 in)

where:

S_1 = Shim.
Sp = Trial shim.
H = Stroke reading.
0.04 to 0.10 mm = driven shaft bearing play.

Note – Shim thickness range values for the range driven shaft bearings are listed on page 21–2.

60. Remove tools (6 and 7), cover (5), replace test shim (Sp) with adjustment shim (S_1), refit cover (5) and tools (6 and 7); check, by proceeding as per point no. 59, that play is within specifications (0.04 to 0.10 mm or .001 to .004 in).
Finally, remove tools (6 and 7) ad re–plug the driven shaft lube port.

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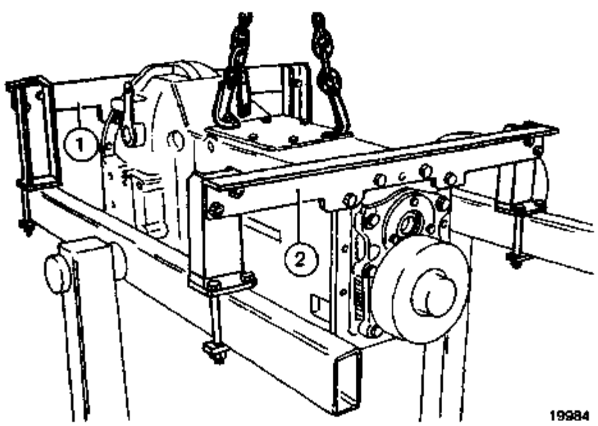
CLUTCH – TRANSMISSION CASE
Disassembly–Assembly of 5th speed gears
(Op. 21 140 14).

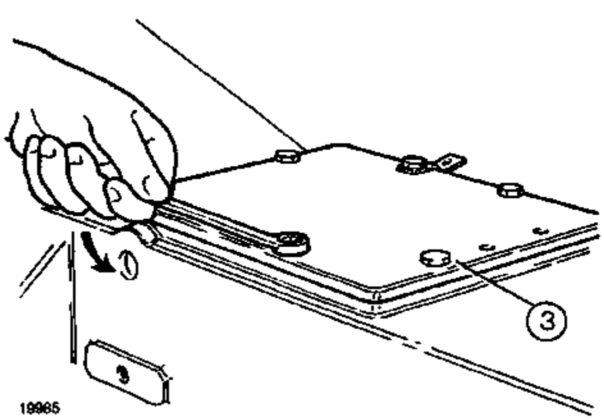
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

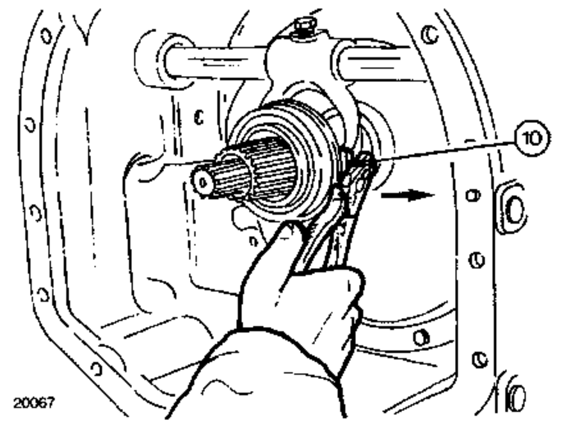
Prior to any intervention involving the 5th speed gears it is necessary to separate the clutch–transmission case from tractor following directions on pages 21–13 through page 21–25.
Proceed then as follows:



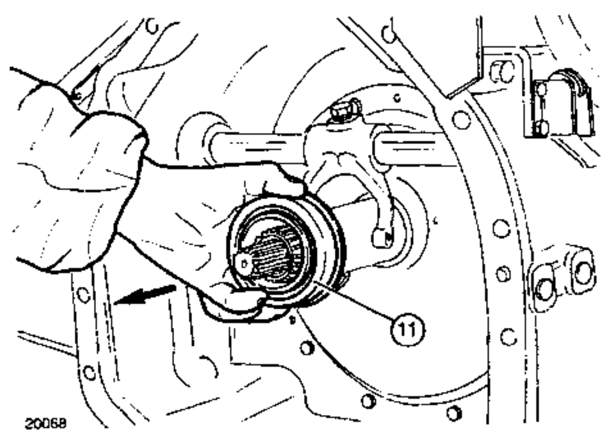
1. Install clutch–transmission case on rotary stand tool no. **290090** securing it through the stand special brackets tool no.**293971** (1, front) and **293972** (2, rear).



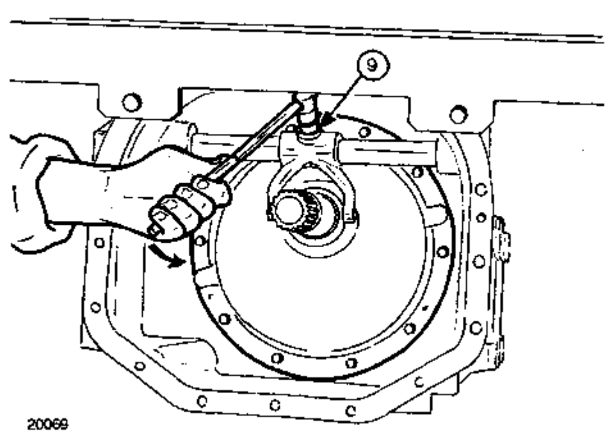
2. Remove attaching screws and top cover (3).



3. Remove bearing spring clips (10) (on both sides).



4. Pull out clutch throw–out bearing (11).



5. Remove fork to lever attaching screw (9).

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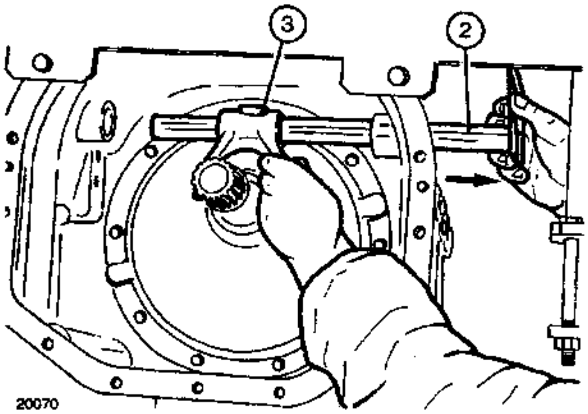
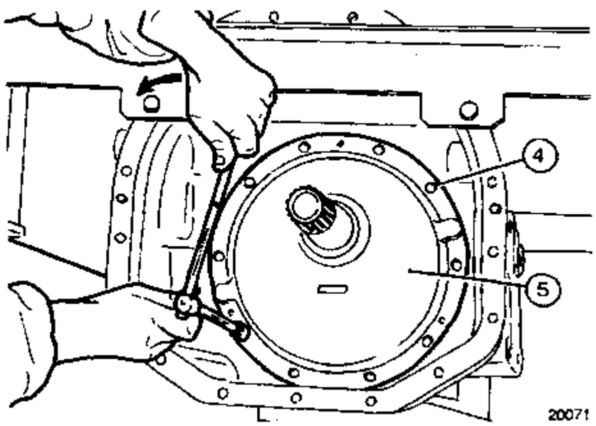
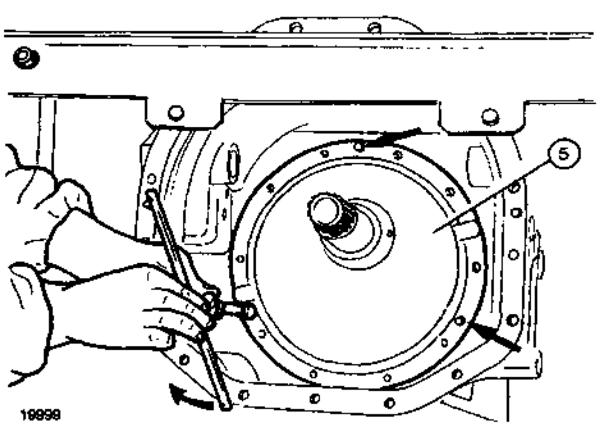


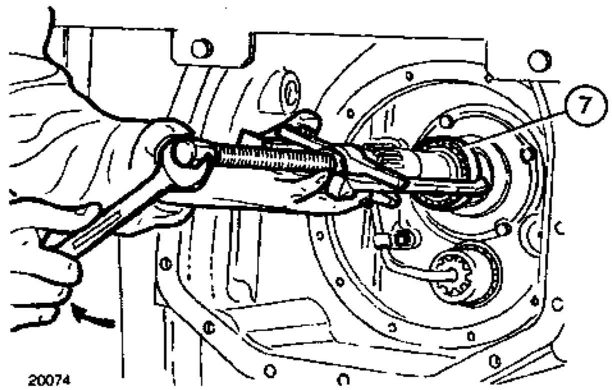
6. Withdraw control lever (2) and retrieve fork (3).



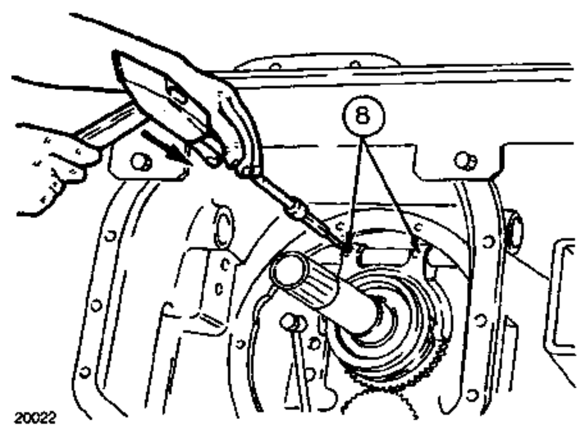
7. Remove all cover (5) attaching capscrews (4).



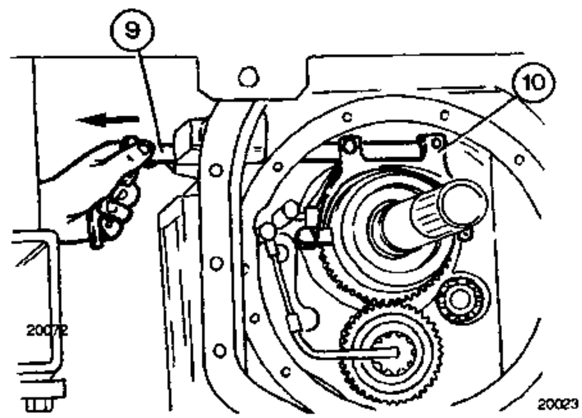
8. Screw back three of the capscrews (4) inside threaded holes (6) which will allow separation and removal of cover (5) from clutch–transmission case.



9. Use a universal puller to separate bearing (7) from reverser drive shaft.



10. Pull out the fork spring pins (8).



11. Withdraw control lever (9) and retrieve fork (10).

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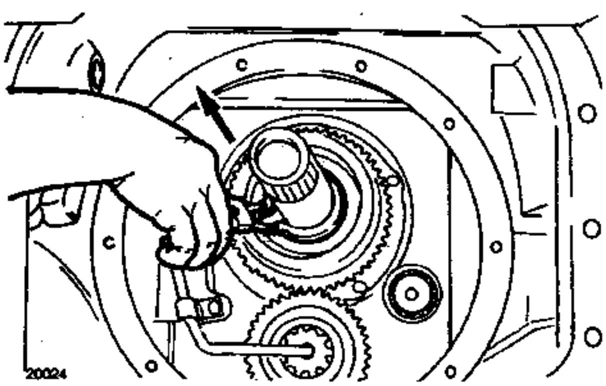
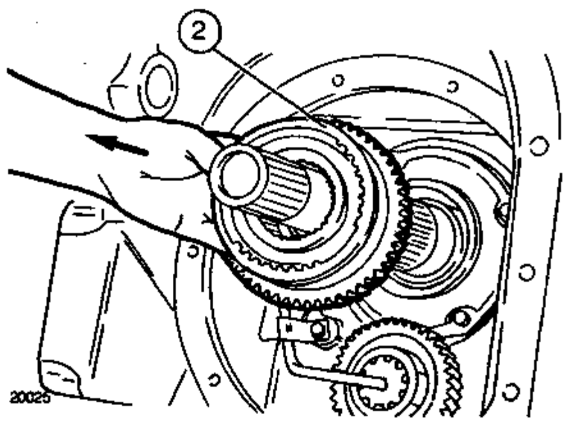
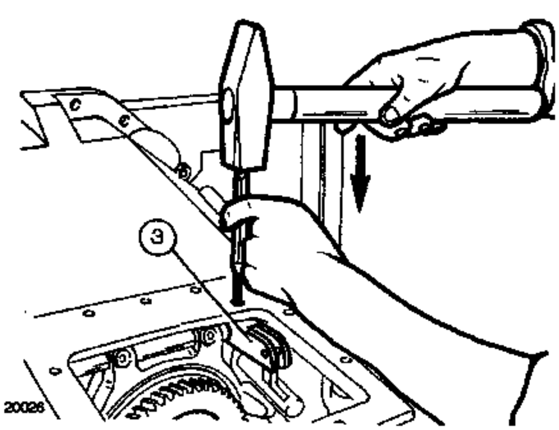


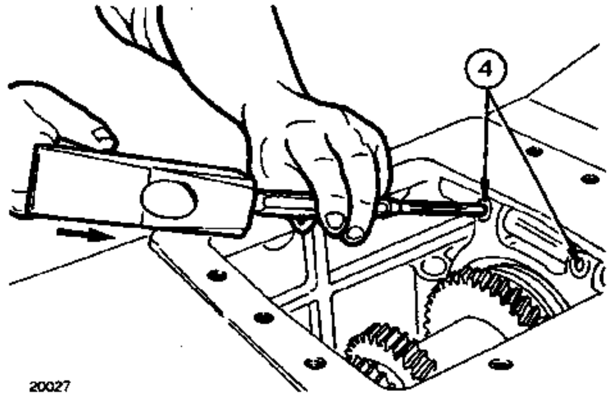
12. Remove snap ring (1).



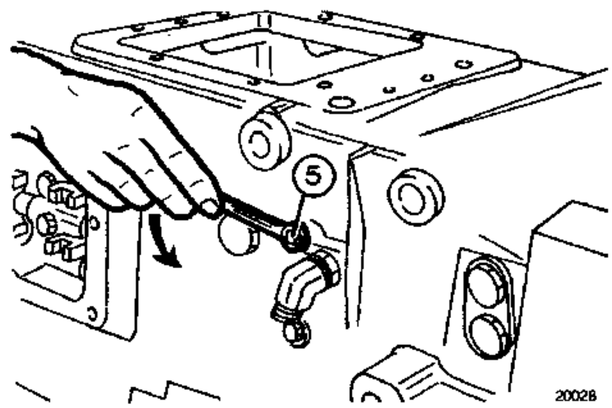
13. Retrieve synchronizer assembly (2), 5th speed drive gear and thrust washer with oil seal.



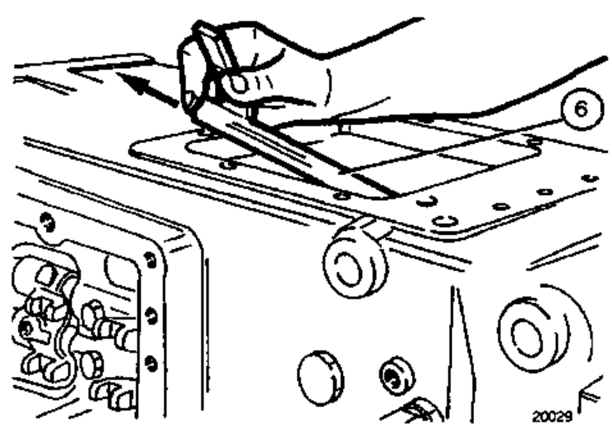
14. Pull out the spring pin securing the 5th speed gear safety lever (5).



15. Remove spring pins (4), withdraw the control lever and retrieve fork and safety lever (3).



16. Remove screw (5) and retrieve detent ball and spring.



17. Withdraw safety rod (6) of the 5th speed gear.

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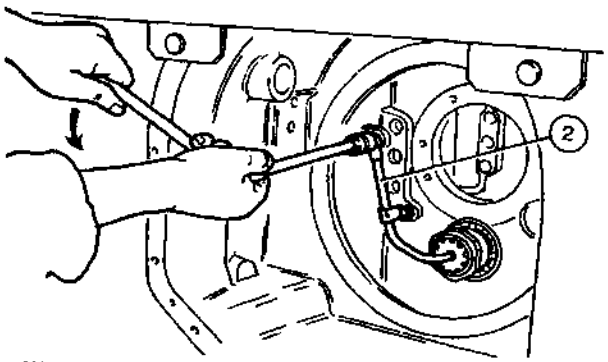
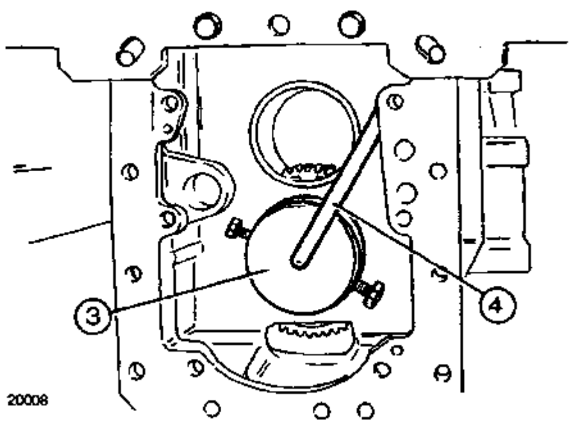


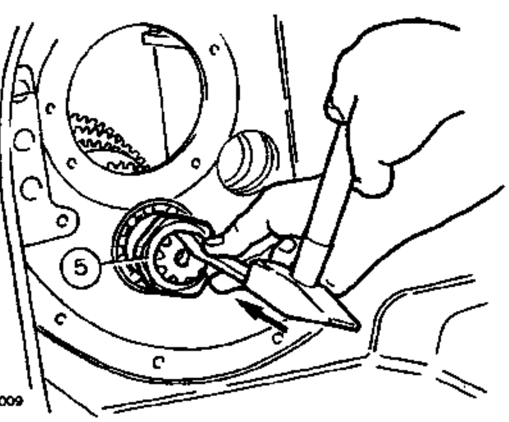
20007

18. Unscrew connection and securing screw, then remove the driven shaft lube line (2).



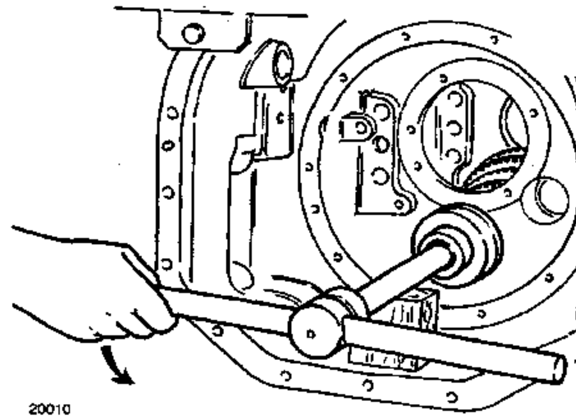
20008

19. Install retaining tool no. **293808/1** (3) on the transmission driven shaft and insert a wrench (4) to block the shaft.



20009

20. Straighten tab on transmission driven shaft lock nut (5).



20010

21. Unscrew the driven shaft lock nut and retrieve the 5th speed gear.

Note – In case of complete disassembly of the transmission and range unit, add operations 10, 11, 12, 13, 14, 15, 16 and 17 of this section to the disassembly–assembly operations on pages 21– 25 through 21–33.

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22. At re–assembly of the 5th speed gear unit consider the following directions :

a. proceed by reversing the disassembly sequence of operations starting from no.21 back to no. 1;

b. see illustations on pages 21–9 and 21–10 for correct placement and orientation of component parts;

c. make sure the housing is thoroughly clean, particularly the inside compartments;

d. prior to installation of the 5th gear unit, thoroughly clean and degrease mating surfaces , then apply a bead (about 2 mm or .08 in diameter) of a suitable sealing compound following the application scheme reported on page 21–33;

e. tighten fastenings to torque specifications of page 21–5.

TRANSMISSION WITH HI–LO SHIFT UNIT
Removal–Installation (Op. 21 168 70 – 21 168 80 – 21 168 84 – 21 168 85)

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

Prior to any intervention on the HI–LO unit it is necessary to separate the clutch–transmission case according to directions given on pages 21–13 through 21–25.
Proceed then as follows:

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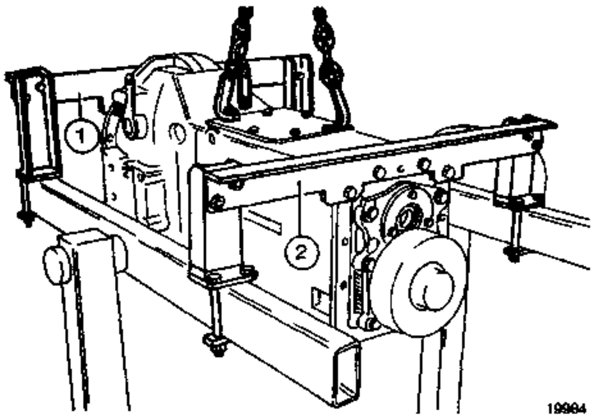
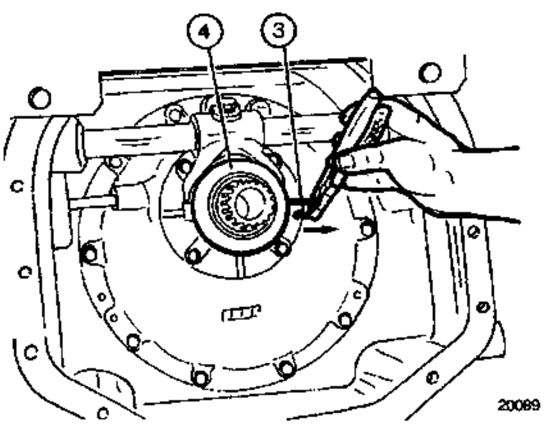
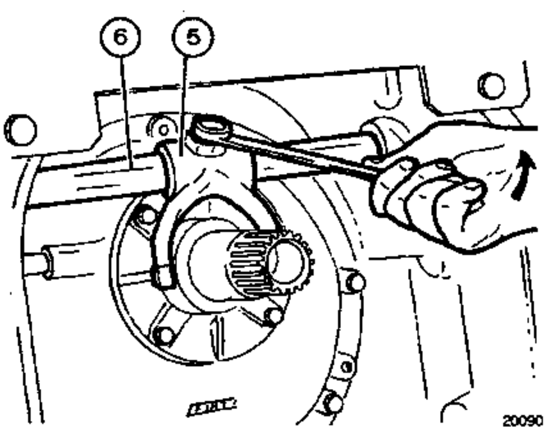


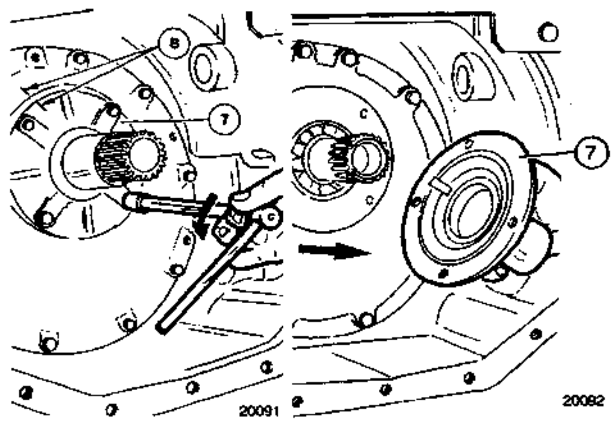
1. Install the clutch–transmission housing on rotary stand tool no **290090** securing it trough the stand special brackets tool no. **293971** (1, front) and **293972** (2, rear).



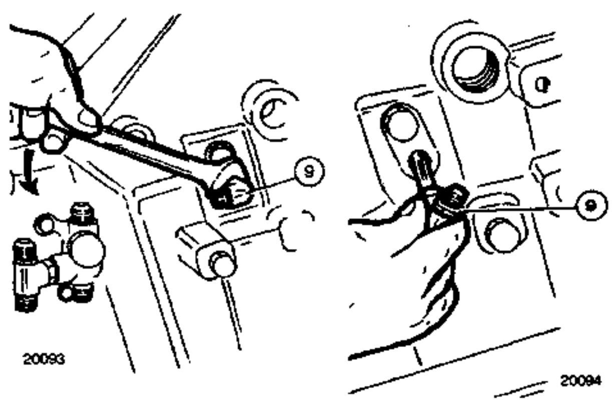
2. Remove attaching spring clips (3) (on both sides) as well as bearing (4).



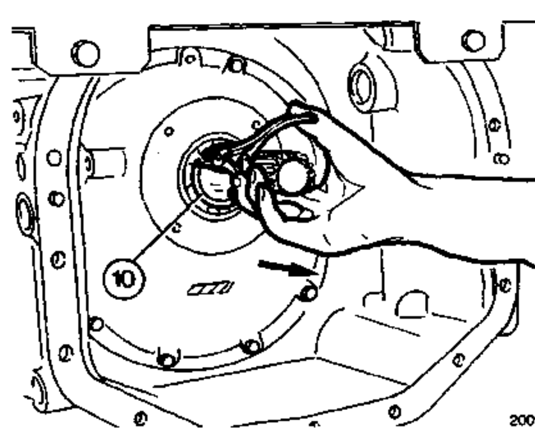
3. Remove fork (5) attaching screw, slide off the control lever (6) and retrieve the fork.



4. Make two reference marks (8) on lid (7) as well as on the cover, remove attaching capscrews and lid.



5. Unscrew the HI–LO pressure line (9) and take it out of the clutch–transmission case.



6. Remove the bearring retaining snap ring (10).

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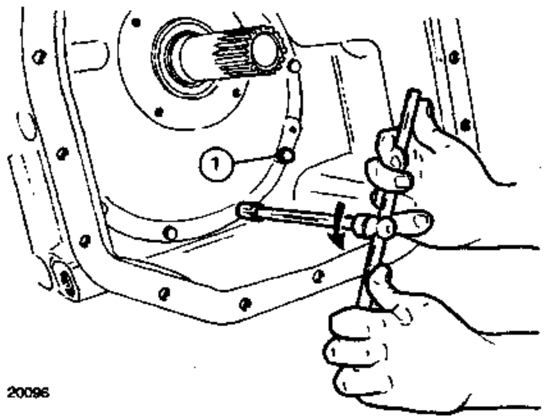
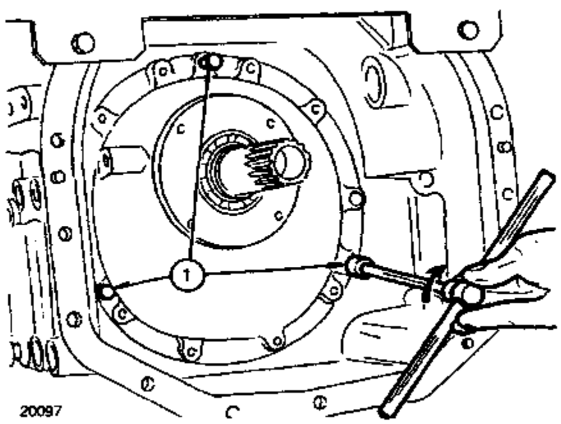
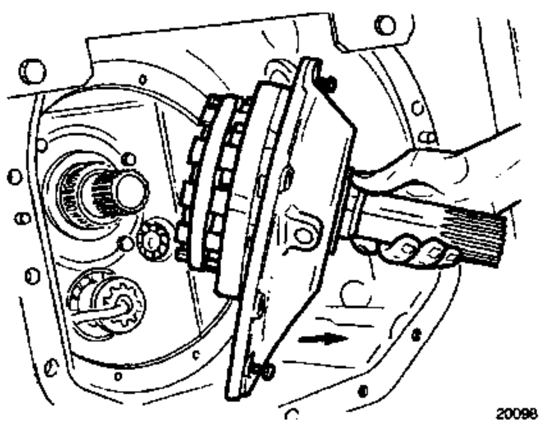


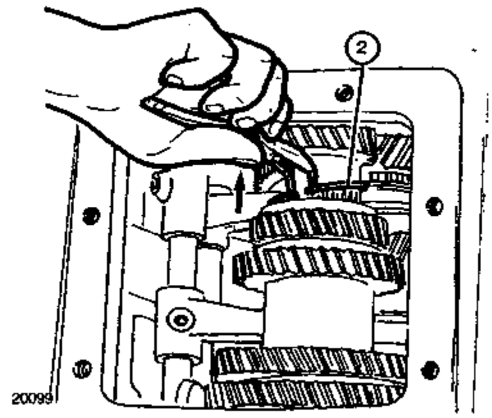
7. Remove all cover capscrews (1).



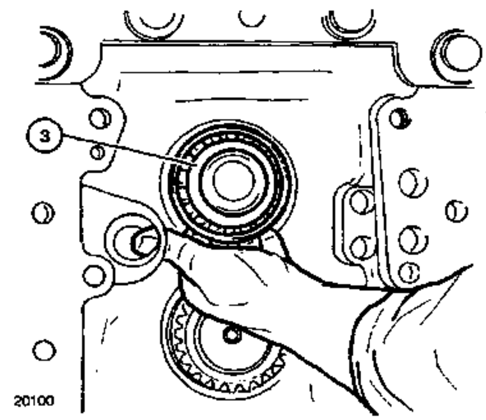
8. Screw back three screws (1) inside threaded holes which will allow the separation and removal of cover from clutch–transmission case.



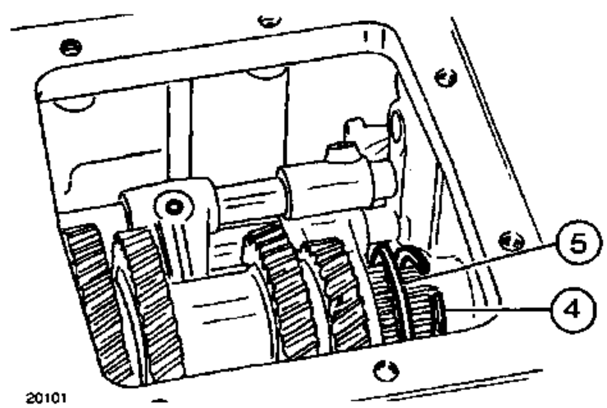
9. Retrieve cover as well as the Hi–Lo assembly.



10. Perform operations 2 through 12 (pages 21–25 through 21–27) and remove snap ring (2).



11. Withdraw drive shaft (3) from rear end.



12. While withdrawing shaft (3) retrieve as well the drive gear, retaining ring (4) and half–rings (5).

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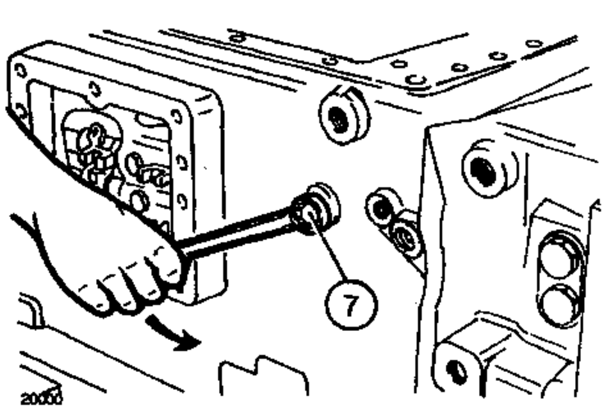
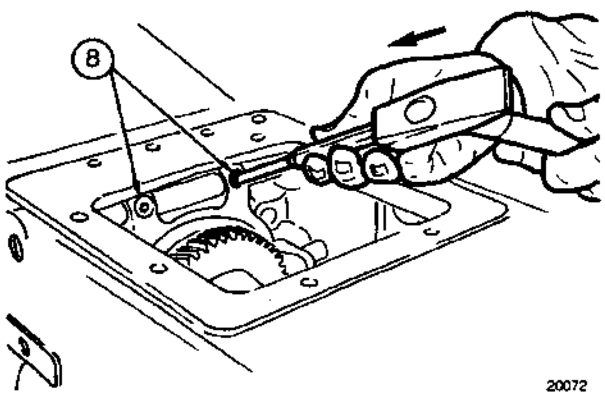
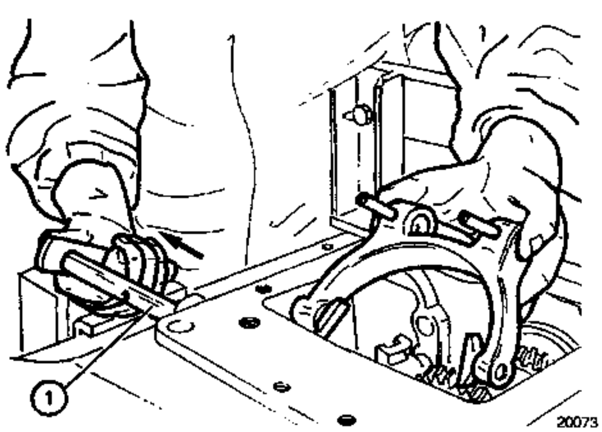


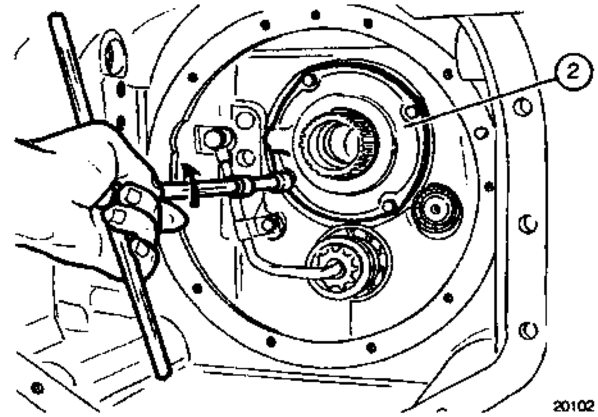
13. Unscrew cap (7) and retrieve detent spring and pawl.



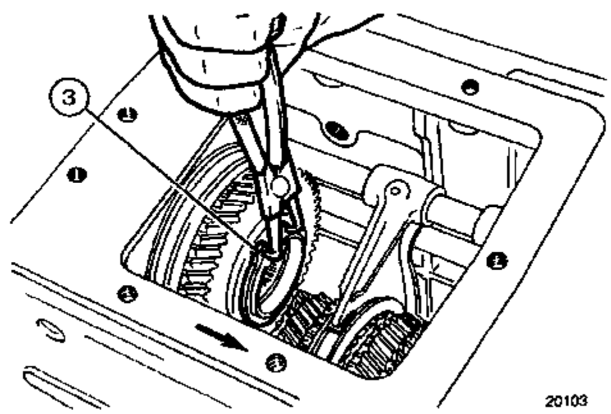
14. Pull spring pins (8) out sufficiently to free the reverser control lever.



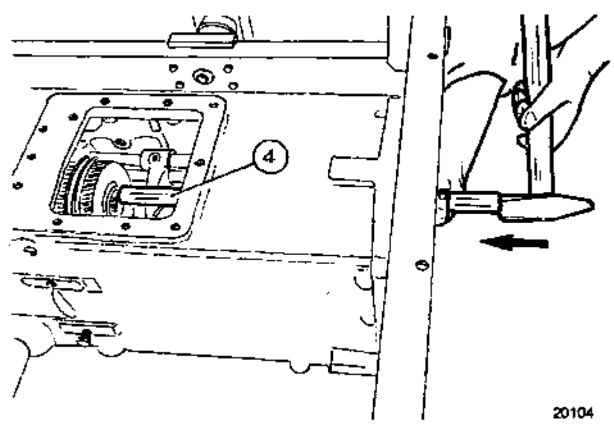
15. Retrieve shifter rod (1) as well as the fork.



16. Remove attaching capscrews and cover (2).



17. Remove snap ring (3) and retrieve thrust washer.



18. Force out the reverser drive shaft using a suitable aluminium punch (4) and hammer.

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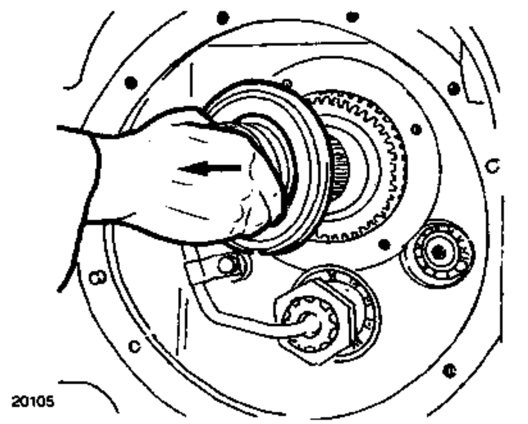
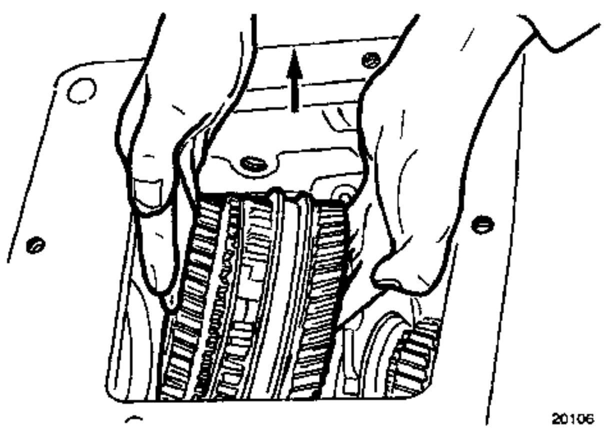
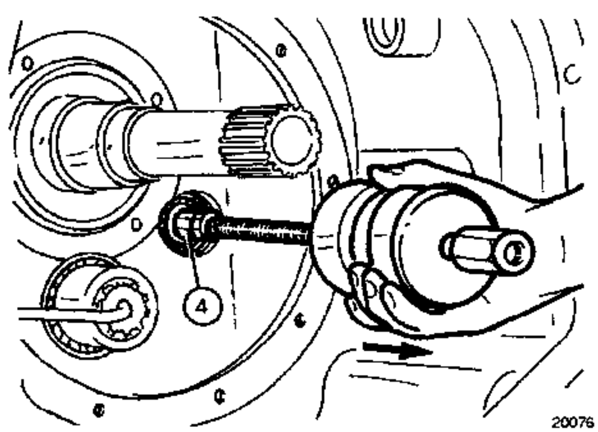


19. Withdraw the range drive shaft from front end.



20. Retrieve the reverser gear and synchronizer assy.



21. Remove the retaining snap ring first then the reverse gear axle using adapter tool no **292313** (5) and slide–hammer type puller **292927**; leave gear inside.

22. To complete the transmission disassembly, perform operations 30 through 40 (pages 21–30 through 21–32).

CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

23. Re–assemble the synchro–range transmission and re–join the clutch–transmission case to engine block and rear–axle case in accordance with the following directions:

a. proceed by reversing the disassembly and removal sequence of operations, respectively, starting from no.22 back to no. 1;

b. see illustrations on pages 21–47 for correct placement and orientation of component parts;

c. make sure the housing is thoroughly clean, inside compartments in particular;

d. prior to re–joining housing, support and cover mating surfaces, make sure to clean and degrease the same thoroughly and to apply a bead of sealing compound about 2 mm (.08 in) thick following the schemes shown on pages 21–25 and 21–33;

e. torque tighten fastenings to specifications of page 21–5;

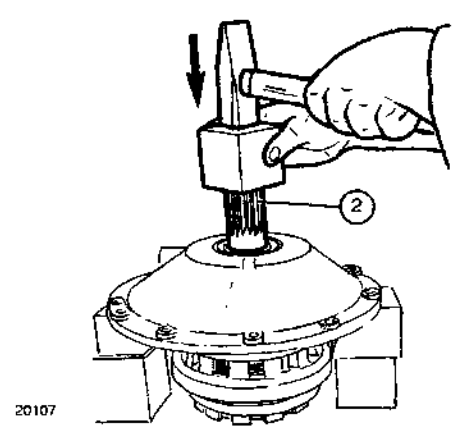
f. check, using caliper gauge and feelers, end play (G, page 21–47) against specifications of 0 to 0.15 mm (0 to .006 in).

TRANSMISSION WITH HI–LO UNIT
Disassembly–Assembly (Op. 21 168 72 – 21 168 74)

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

Prior to any intervention on the HI–LO it is necessary to separate and remove unit from clutch–transmission case conforming to directions given from page 21–39 to page 21–43.
Proceed as follows:



1. Pull drive shaft (2) using suitable wooden blocks.

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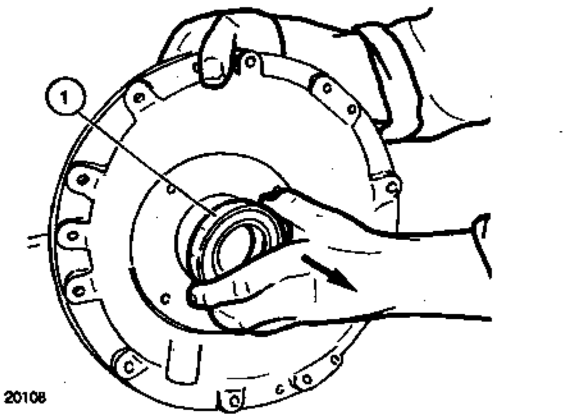
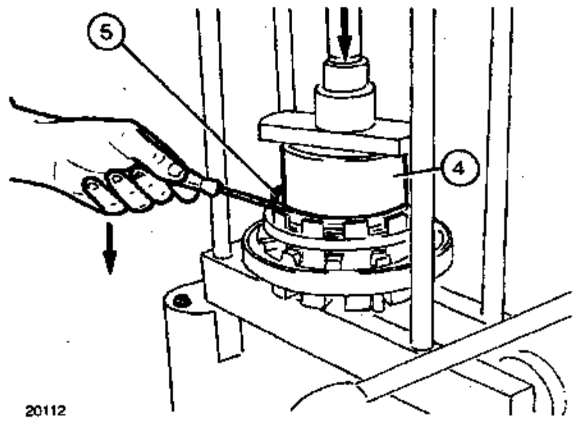
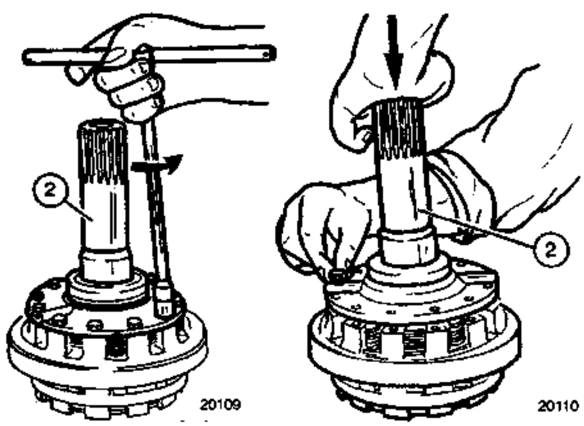


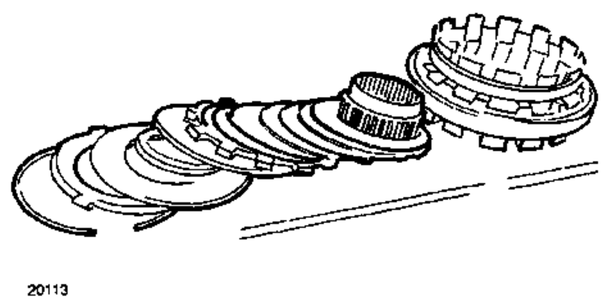
2. Remove bearing (1) from housing.



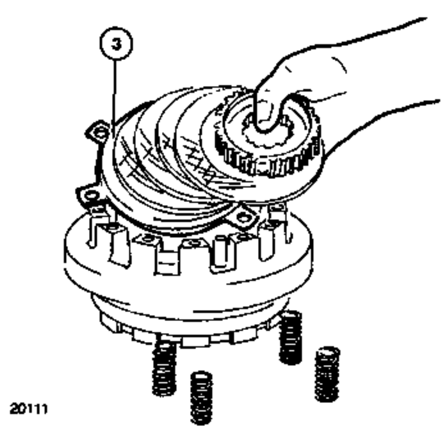
5. Using a hydraulic press and tool no. **50068** (4) (see page 21– 8), remove snap ring (5).



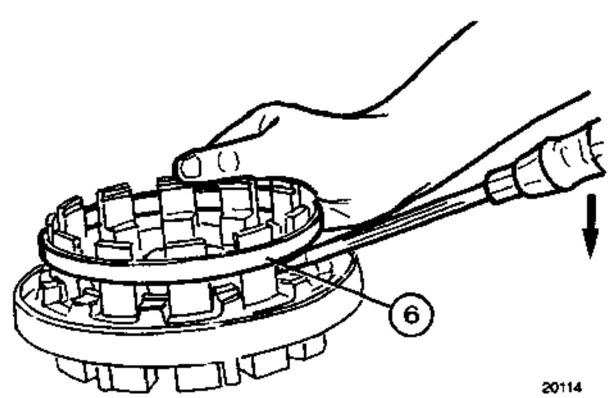
3. Back off shaft (2) retaining screws, press down on the shaft in order to release pressure on springs then remove the last two fastening screws.



6. Retrieve the rear clutch pack, cupped spring and inside gear.



4. Retrieve springs, front clutch pack complete with the last spring carrier ring (3) and lastly the inside gear.



7. Using a screwdriver remove outer ring (6).

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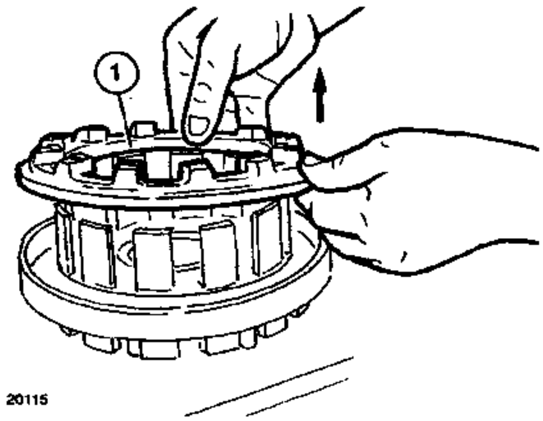
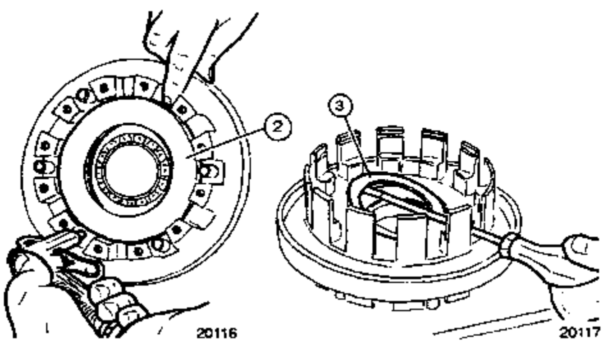


8. Withdraw the rear clutch piston (1).



9. Using compressed air, force the front clutch actuating piston (2) outward and, finally, retrieve washer (3).

CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

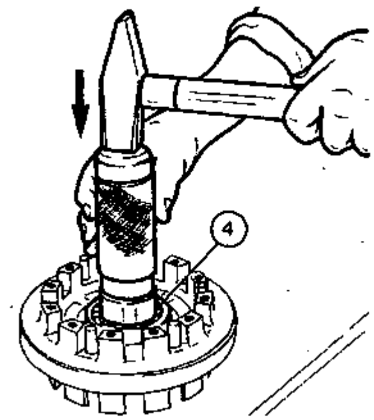
10. Re–assemble the HI–LO unit in accordance with the following directions:

 a. proceed by reversing the disassembly sequence of operations starting from no. 9 back to no. 1;

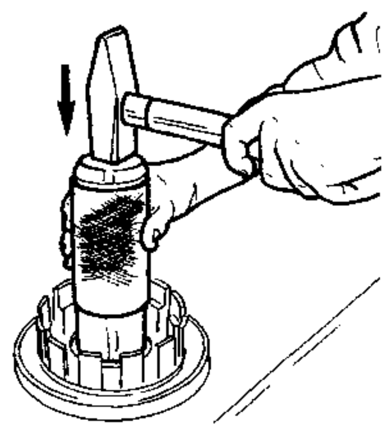
 b. see illustrations on page 21–47 for correct placement and orientation of component parts;

 c. tighten fastenings to torque specifications reported on page 21–5.

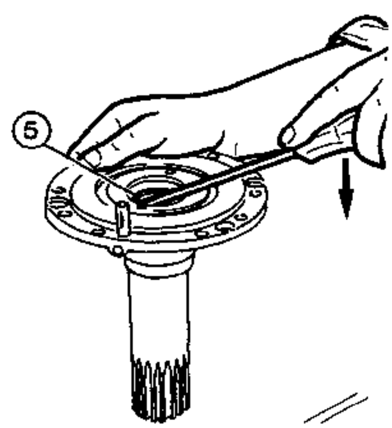
 d. consider operations that follow:



11. Remove bearing (4) from clutch using a suitable driver tool.



12. Heat bearing (4) prior to its force–fitting in place; use a suitable driver to bed it properly in its seat.



13. Remove oil seal (5) from PTO shaft.

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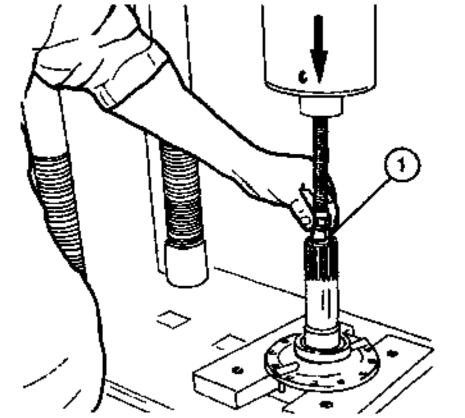
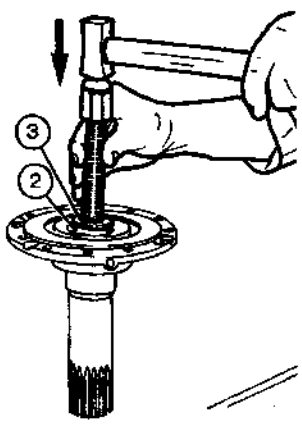


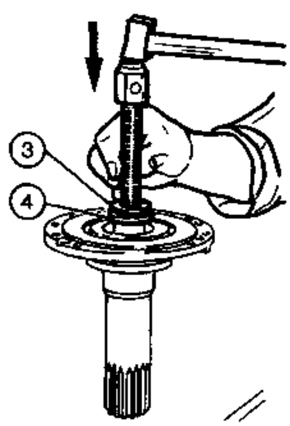
20121

14. Pull PTO shaft bushing out using a hydraulic press and tool no. **294000** (1).



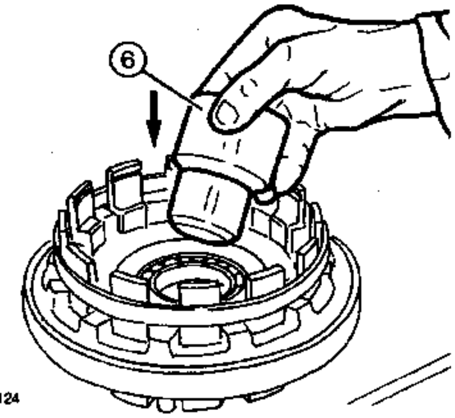
20122

15. Force–fit bushing (2) using tool no. **293992** (3) and associated grip tool no. **293800**.



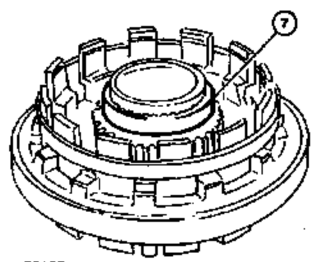
20123

16. Force–fit oil seal (4) using tool no. **293992** (3) and associated grip tool no. **293800**.

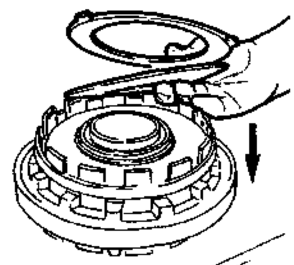


20124

17. Place tool no. **50064** (6) (see page 7) onto the clutch pack bearing.

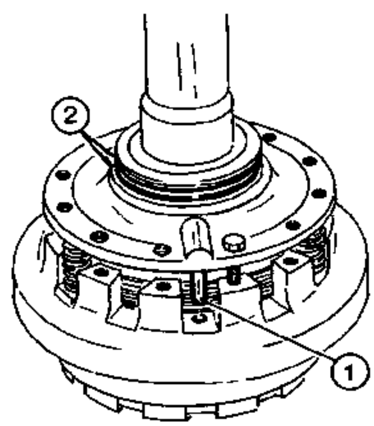


20125



2012

18. Introduce the inside gear (7) and position the rear clutch pack complete with cupped spring. (See illustration on page 21–47).



20127

19. Install the HI–LO drive shaft checking that line (8) is in correspondence with its hole. Fit oil seals (9).

HI–LO CONTROL ELECTRO–VALVE
Replacement (Op. 21 168 68).

Proceed in the same way following description on page 31–14 given for the PTO brake control electro–valve.

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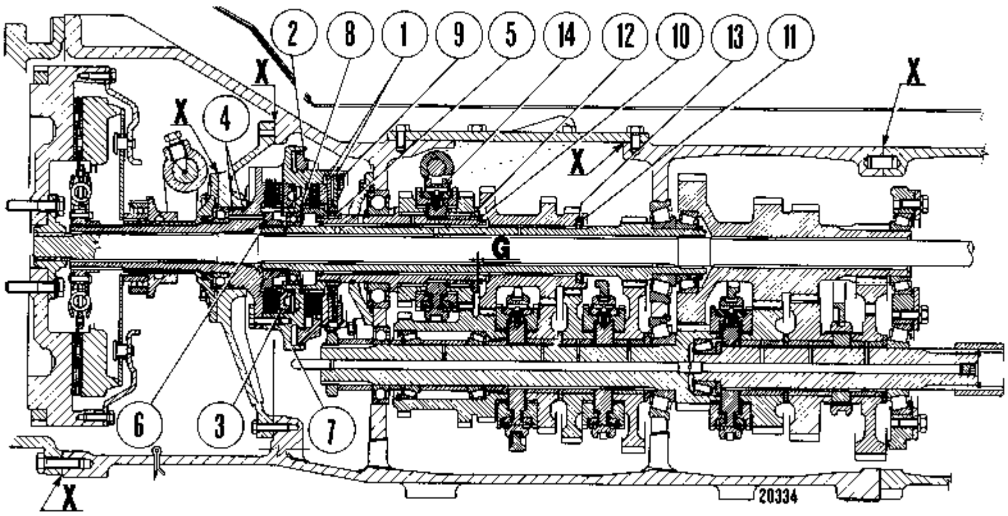
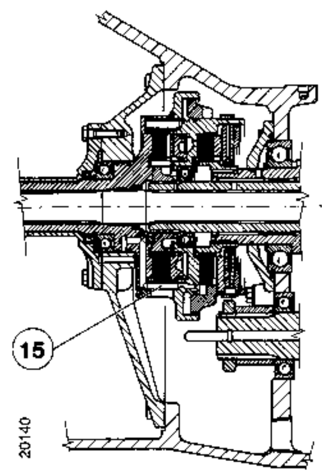
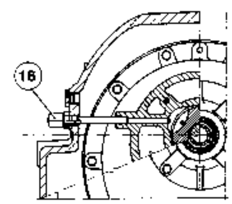






Longitudinal and cross–section views of transmission with HI–LO shift unit

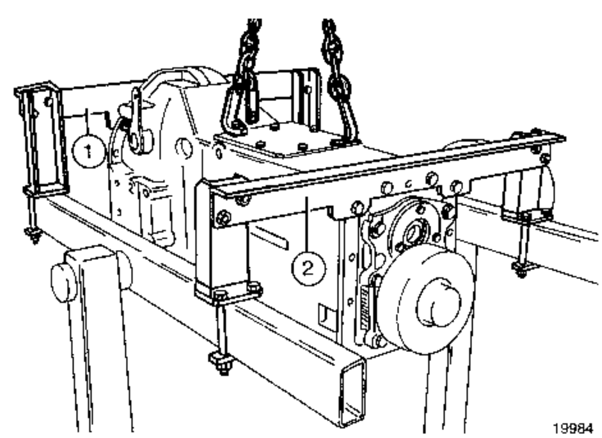
G.= 0 to 0.15 mm (0 to .006 in). Clearance between snap ring and forward speed gear – 1. Cupped springs – 2. Rear clutch disengagement piston – 3.Front clutch engagement piston – 4. Oil seals – 5. Rear inside gear – 6. Front inside gear – 7. Clutch housing – 8. Thrust washer – 9, 10 and 11. Snap rings – 12. Thrust ring – 13. Half–rings – 14. Reverser control synchronizer – 15. Clutch oil pressure line – 16. Connection and clutch pressure oil inlet line.
Note – At assembly coat mating surfaces **X** with sealing compound according to directions reported on page 00–9.

CREEPER SPEED UNIT
Disassembly–Assembly of creeper speed gear unit (Op. 21 160 50)

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

1. Interventions on creeper unit require the previous removal of the clutch–transmission case according to directions reported from page 21–13 to page 21–25. Proceed then as follows:



2. Install and secure the clutch–transmission case on rotary stand **290090** using front and rear brackets **293971**(1) and **293972**(2), respectively.

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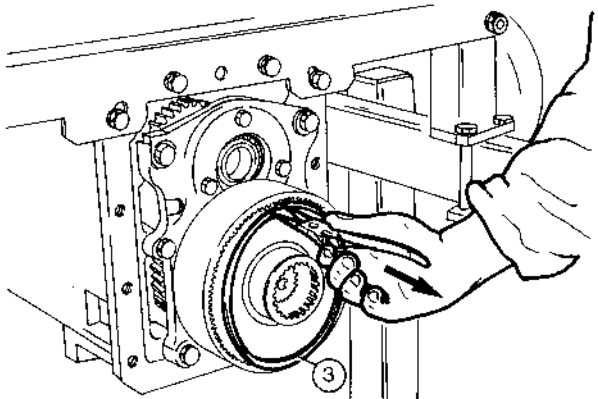
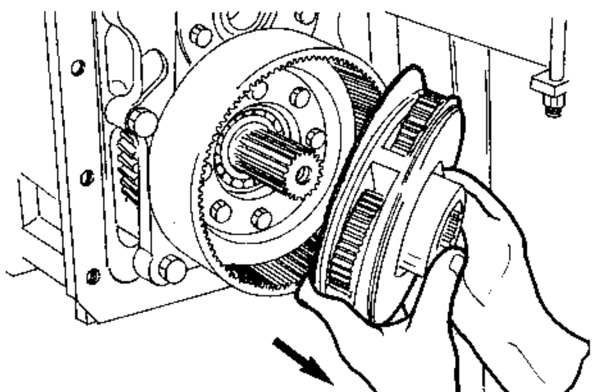


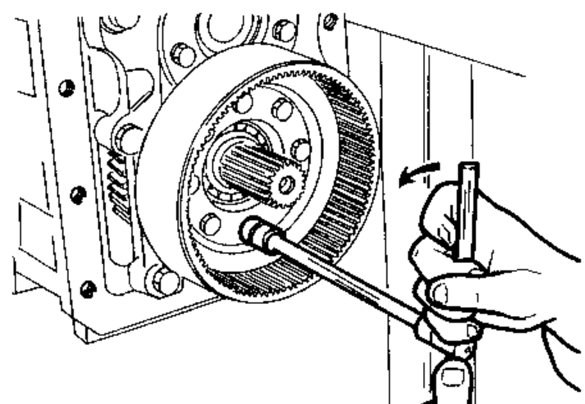
20030

3. Remove snap ring (3).



20031

4. Retrieve planetary gears and friction disks.



20032

5. Remove fastening capscrews and creeper unit.

CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

6. Re–assemble the creeper speed gear unit in accordance with the following directions:

a. proceed by reversing the disassembly sequence of operations starting from no. 5 back to no. **1**;

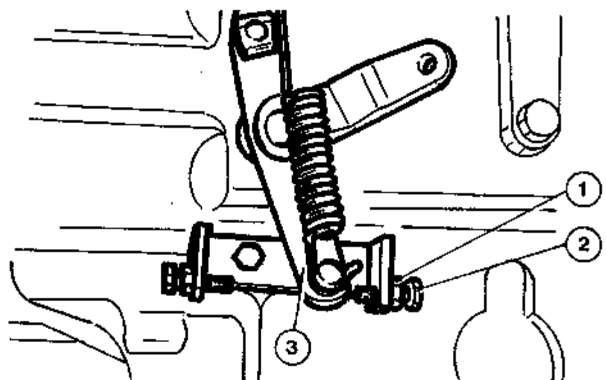
b. see illustrations on page 21–4 for correct placement and orientation of component parts;

c. tighten fastenings to torque specifications reported on page 21–5;

d. after re–joining the clutch–transmission and rear axle cases, but prior to installation of the main fuel tank, proceed to the following adjustment:

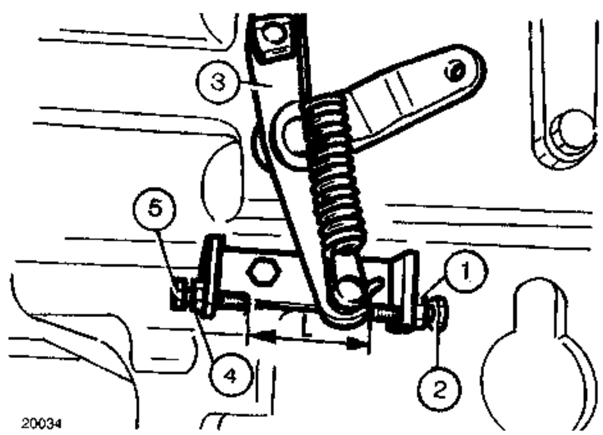
TRANSMISSION CREEPER SPEED UNIT
Adjusting the control lever travel.

7. Clutch–transmission case must be re–joined to rear axle transmission housing prior to this adjustment, but without installing the main fuel tank.
Proceed as follows:



20033

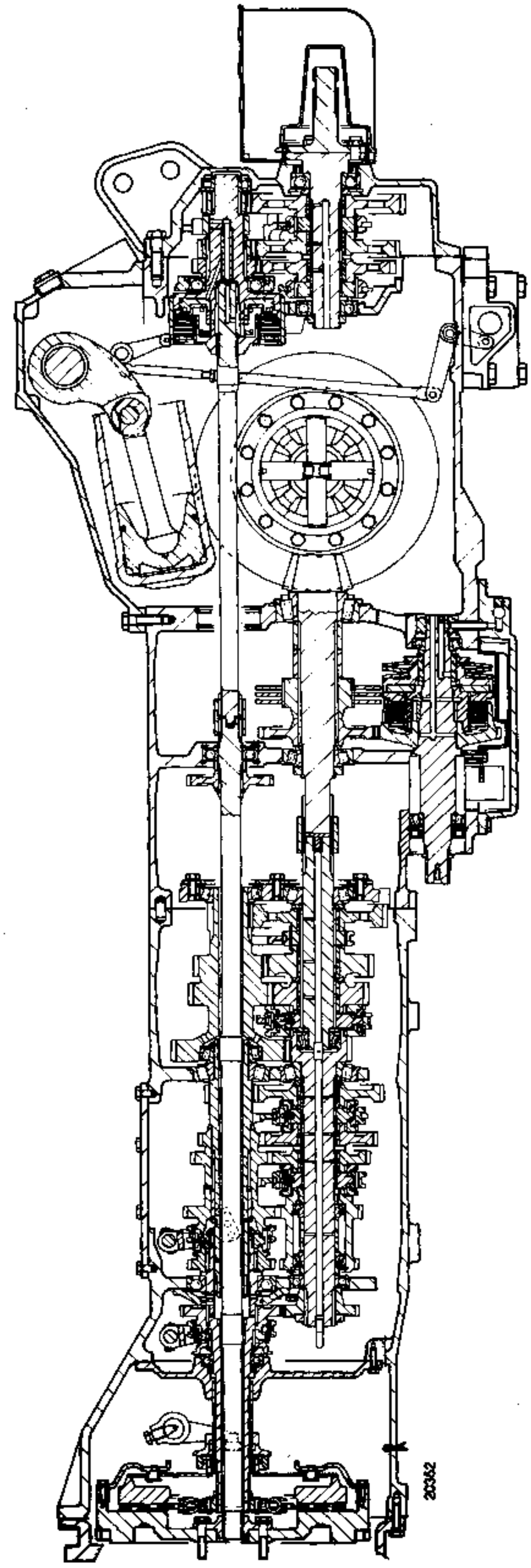
8. Slacken jam nut (1) and back screw (2) off almost completely.
Move control lever (3) back to stop.



20034

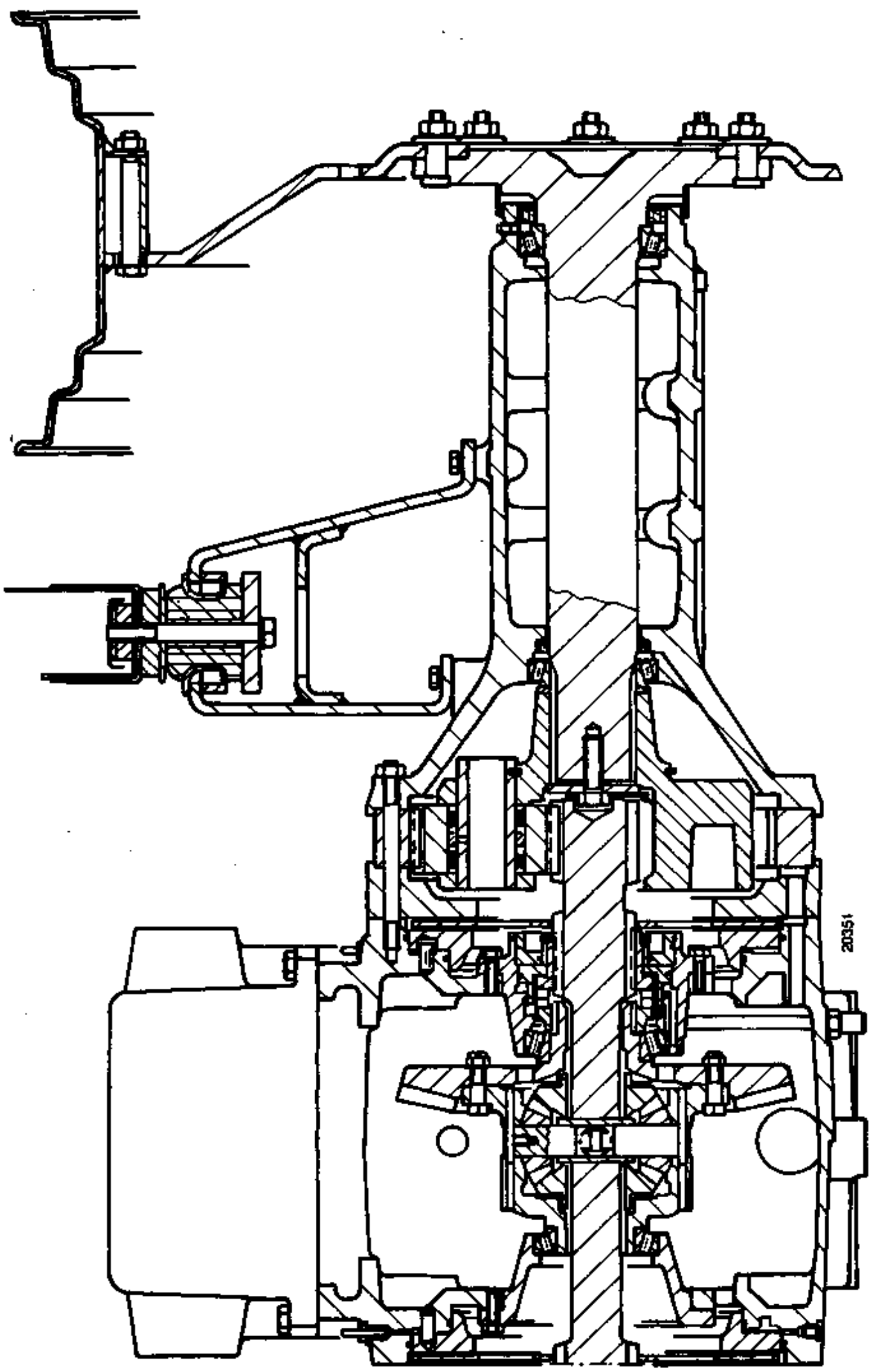
9. Turn screw (2) back on until in contact with lever (3), screw further on about one and a half turn and finally lock it with the jam nut (1).
Slacken jam nut (4) and turn the screw (5) to establish a distance (L) = 57 mm (2–1/4 in) between lever and screw, then re–tighten jam nut (4).

Print No. ***603.54.276.01*** *– 12 – 1992*



Longitudinal sectional view of power train

Print No. 603.54.276.00 – 01 – 1992



Cross–sectional view through differential and final drives

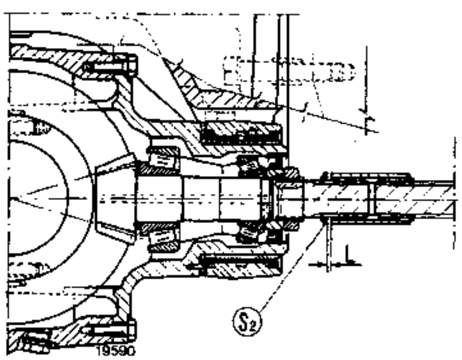
Print No. 603.54.276.00 – 01 – 1992

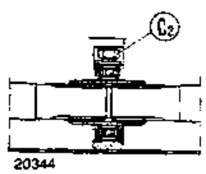
MECHANICAL ENGAGEMENT

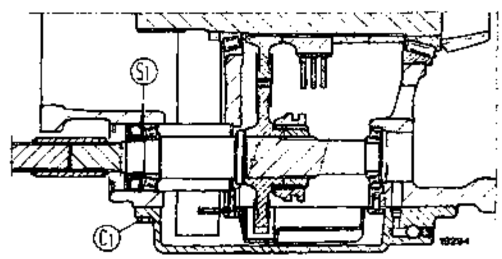
Reduction ratio	51/55 = 1:1.08
Shaft bearings shim thickness range (S_1)	2.20–2.30–2.40–2.50–2.55–2.60–2.65–2.70–2.75–2.80–2.85 2.90–2.95–3.00–3.05–3.10–3.15 3.20–3.25–3.30–3.35–3.40–3.45 3.50–3.60–3.70–3.80 mm (.086–.090–.094–.098–.100–.102 .104–.106–.108–.110–.112–.114–.116–.118.120–.122–.124–.126–.128–.130.132–.134–.136–.138–.142–.146–.149 in)
Engagement pad width	7.910 to 8.000 mm (.3114 to .3150 in)
Seat width in engagement sleeve coupling	8.280 to 8.370 mm (.3260 to .3295 in)
Drive unit relay lever detent spring data:	
– free length	42 mm – (1.65 in)
– length under load 94 to 104 N (9.6 to 10.6 kg) (24 to 27 lb):	30 mm – (1.18 in)

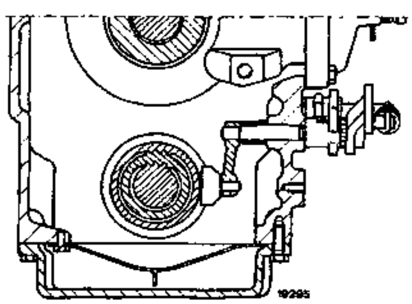
PROPELLER SHAFT

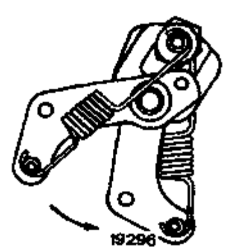
Front coupling position adjustment shim thickness range (S_2)	1–1.2–1.5–1.8–2–2.2–2.5–3–3.3 3.7–4–4.3 mm (.039–.047–.059–.070–.078–.086–.098–.118–.129–.145 .157–.169 in)
Front coupling end play (L)	1.2 to 1.7 mm (.047 to .067 in)











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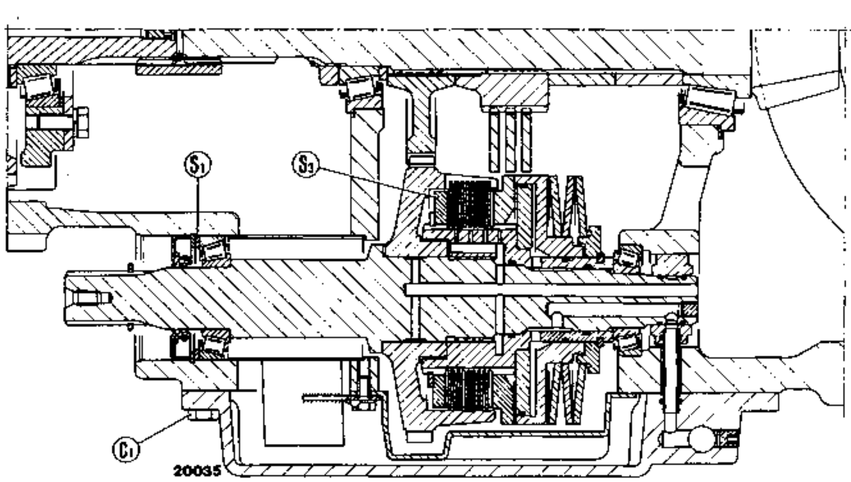
ELECTRO–HYDRAULIC ENGAGEMENT

Reduction ratio	51/55=1:1.08
Shaft bearings shim thickness range (S_1)	2.20–2.30–2.40–2.50–2.55–2.60 2.65–2.70–2.75–2.80–2.85–2.90 2.95–3.00–3.05–3.10–3.15–3.20 3.25–3.30–3.35–3.40–3.45–3.50 3.60–3.70–3.80 mm (.086–.090–.094–.098–.100–.102 .104–.106–.108–.110–.112–.114– .116–.118–.120–.122–.124–.126 .128–.130–.132–.134–.136–.138 .142–.146–.149 in)
Clutch thrust plate thickness range (S_3)	7.1–7.3–7.5–7.7–7.9–8.1–8.3 8.5–8.7–8.9–9.1–9.3–9.5–9.7 9.9–10.1 mm (.28–.29–.295–.30–.31–.32–.325 .33–.34–.35–.36–.37–.375–.38 .39–.40 in)
Number of clutch pack driven discs	9
Number of clutch drive discs	8
Thickness of clutch driven discs	1.65 to 1.75 mm (.065 to .069 in)
Thickness of clutch drive discs	1.45 to 1.55 mm (.057 to .061 in)
Free height of cup spring (one)	9.85 to 10.10 mm (.388 to .398 in)
Spring height under load of 19320 N (1970 kg) (5004 lb)	7.70 to 12.25 mm (.303 to .482 in)

TORQUE DATA

DESCRIPTION	Thread size	Torque		
		Nm	kgm	ft.lb
Capscrew, drive box (C_1)	M10 x 1.25	49	5	36
Capscrew, propeller shaft central support (C_2, page 23–1)	M12 x 1.5	88	9	65



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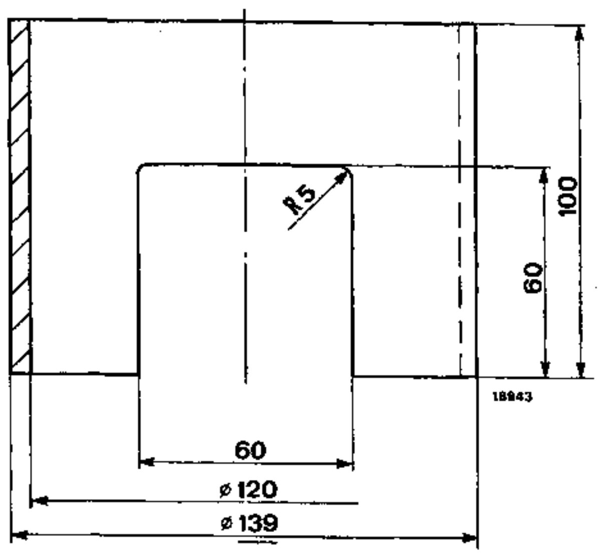
SERVICE TOOLS

ATTENTION – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code **(X)**.
Besides, to work safely and achieve the best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjonction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

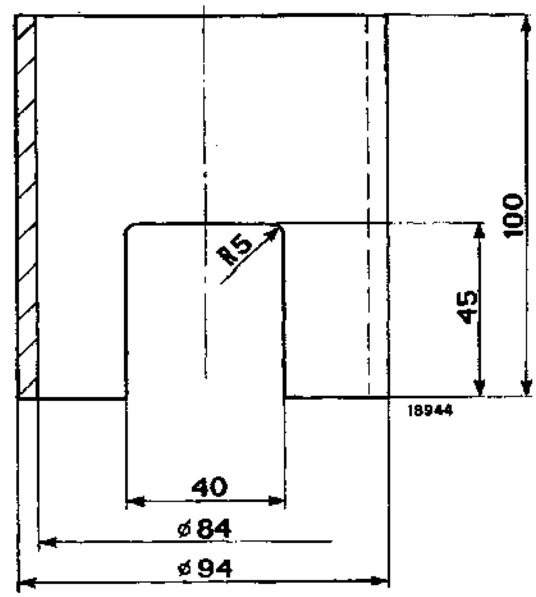


Self–made tool for the removal of the electro–hydraulic drive reaction disk.
(Mark with code no. 50068 – Metric dimensions)

Note – Material: F42 steel.

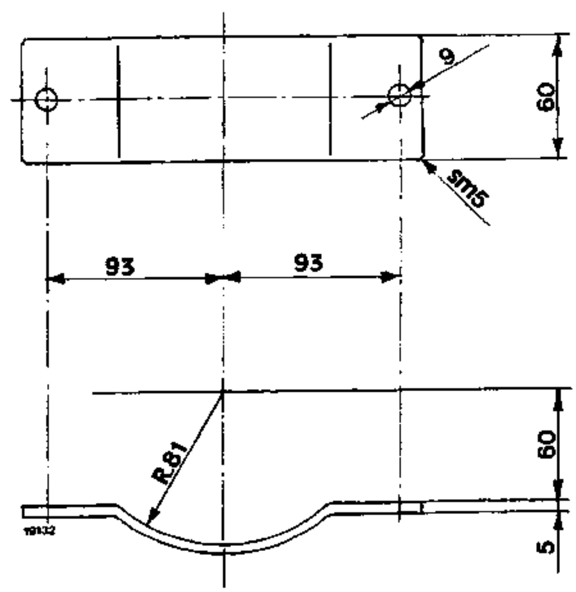
Note – This is the same tool shown on page 21–8 and used for the removal of the transmission HI–LO shift unit spring plate.

	293996	Adapter (M8x1.25) for extraction of the drive box shaft (with **292927**).
X	**293995**	Bracket, drive box shaft end play check.



Self–made tool for the removal of th electro–hydraulic drive rear cup.
(Mark with code no. 50067 – Metric dimensions)

Note - Material: F42 steel.



Self–made bracket for the disassembly of the electro–hydraulic drive clutch unit.
(Mark with code no. 50069 – Metric dimensions).

Note - Material: F42 steel.

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ELECTRO–HYDRAULIC DRIVE TROUBLE–SHOOTING CHART

Fault	Diagnosis	Correction
4WD fails to engage.	1. Inefficient drive engagement control switch.	Replace switch.
	2. No power is reaching the solenoid: interrupted, damaged connections or defective remote control switch.	Restore electrical connections and replace defective parts.
	3. Drive control electro–valve (8, page 21–10) stuck on discharge position.	Overhaul or replace electro–valve.
	4. Worn clutch disks.	Replace disks.
	5. Weak cup springs.	Overhaul clutch.
4WD will not disengage.	1. Low transmission oil level.	Top up oil level.
	2. Clogged oil filter.	Replace oil filter.
	3. Inefficient hydraulic pump.	Overhaul or replace pump.
	4. Inefficient drive engagement control switch.	Replace switch.
	5. No power is reaching the electro–valve: interrupted, damaged connections or defective remote control switch.	Restore electrical connections and replace defective parts.
	6. Drive control electro–valve stuck on delivery.	Overhaul or replace electro–valve.
	7. Fluid leakage past oil seals and consequent pressure drop: hub, piston , delivery connection seals or drive take–off shaft o–rings.	Replace oil seals found defective.
With electro–hydraulically controlled 4WD disengaged the same will not engage when pressing on brake pedals.	1. Inefficient pressure gauge on brake pump.	Replace pressure gauge.

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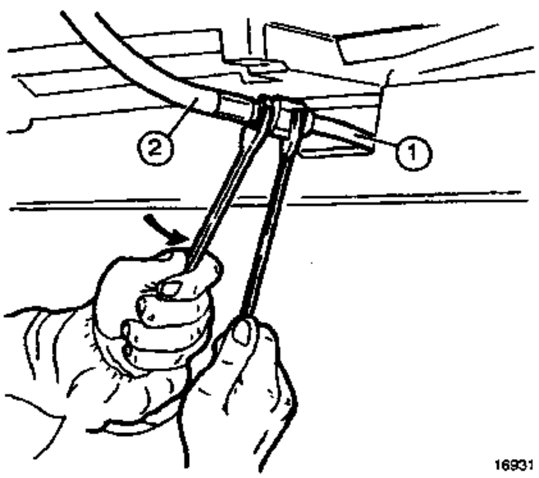
PROPELLER SHAFT GUARD
Removal–Installation (Op. 23 101 20)

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

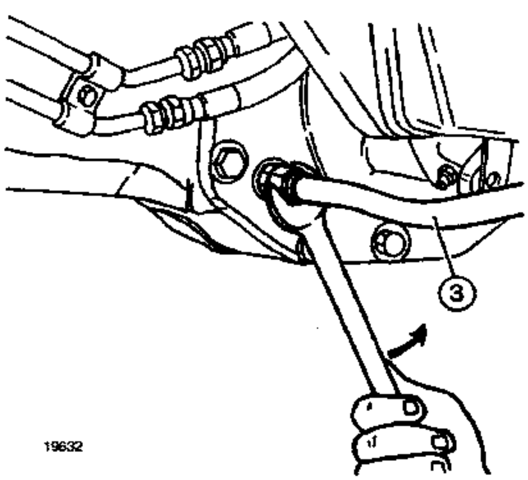
Proceed as follows:

1. Disconnect battery cables.



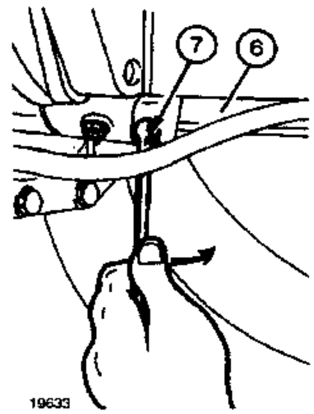
16931

2. Disconnect the flexible line (2) from the front axle differential lock control pipe (1).

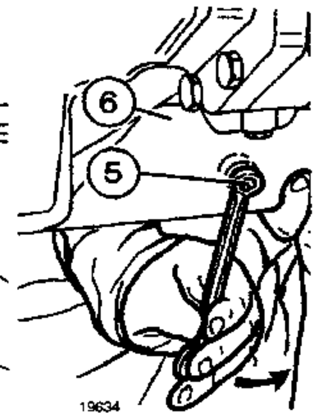


19632

3. Disconnect flexible line (3) from front axle.



19633



19634

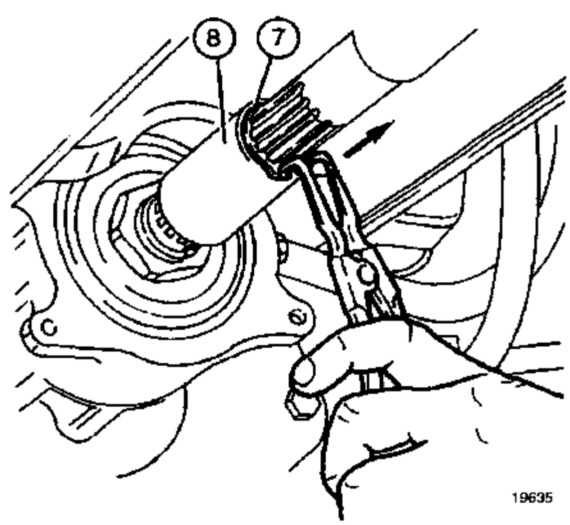
4. First remove the shafts guard fastening screws, front (4), central (5), rear ones (6) and finally the guard itself.
5. When reinstalling the shafts guard just reverse the removal sequence.

PROPELLER SHAFT AND SUPPORT
Disassembly–Assembly (Op. 23 101 26)

With propeller shaft removed, proceed as follows:

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.



19635

1. Remove retaining ring (7) and back off the coupling sleeve (8) to free it from the front axle spline.

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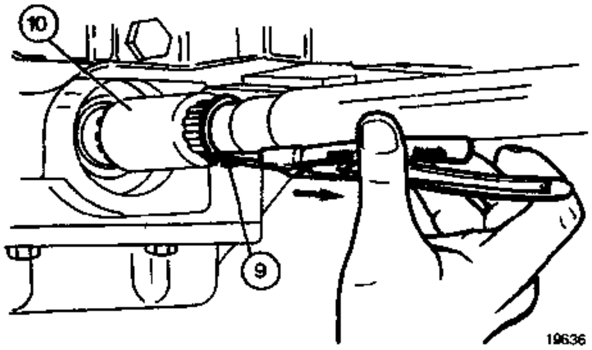
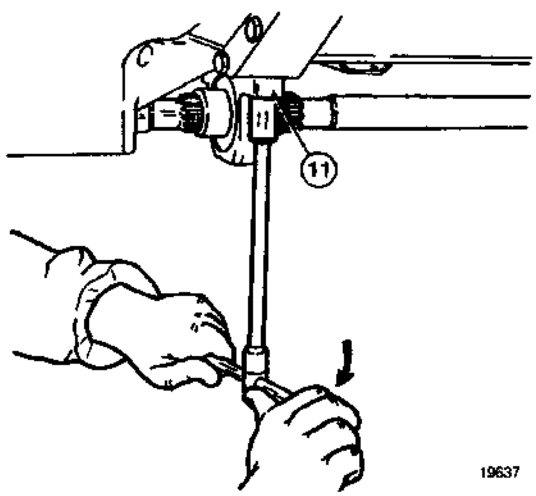
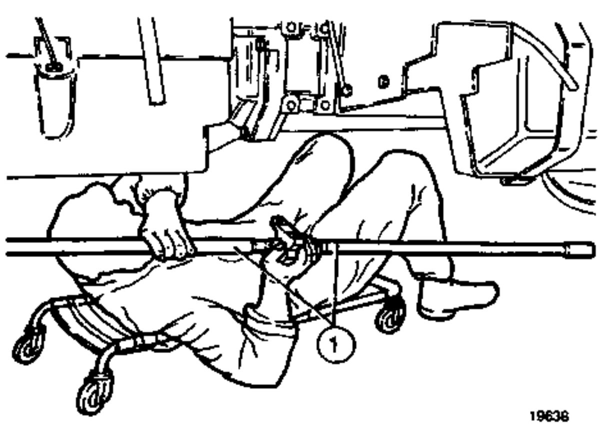


2. Remove retaining ring (9) and move sleeve (10) forward to free it from the splined coupling.



3. Remove screws (11) securing the shafts support to the front axle.



4. Retrieve shafts (1) and their support.
5. When reassembling the propeller shaft just reverse this sequence of operations.

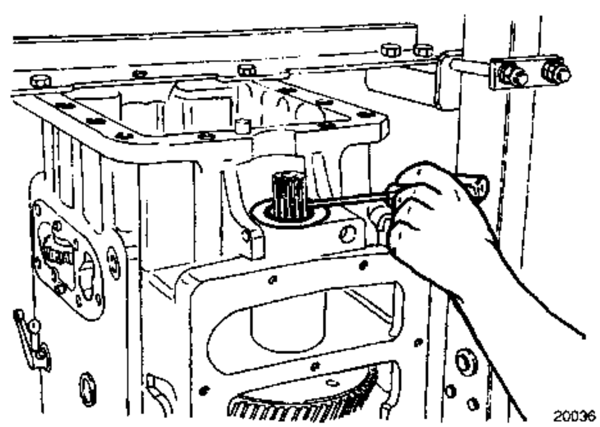
DRIVE SHAFT OIL SEAL
Oil seal replacement with propeller shaft removed (Op.23 101 32–23 202 44)

The shaft oil seal (on both versions, mechanical and electrohydraulic engagement) can be replaced either with transmission housing on bench or directly on the tractor.
Proceed as follows:

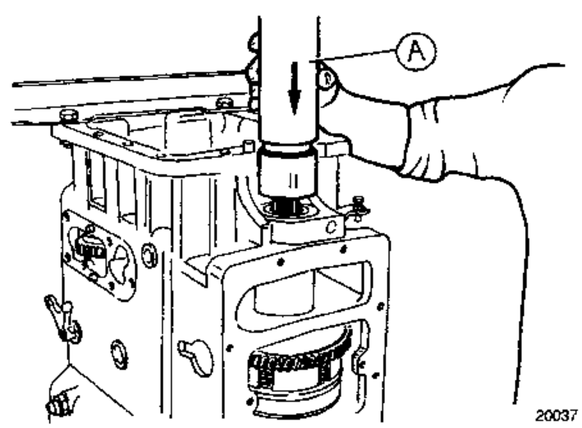
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

1. (On the tractor, with transmission housing installed). Disconnect battery cables, drain oil from the transmission and rear axle cases and remove the propeller shaft.



2. Using a screwdriver or a drift punch remove the dust shield and damaged seal.



3. Fit the new seal using the abutting tool No. **293475** (A) to position it squarely and correctly in its seat.
4. Last, fit a new dust shield.

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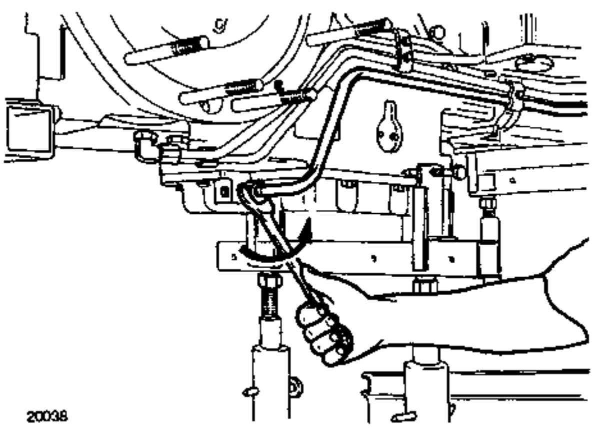
ELECTROHYDRAULIC–ENGAGEMENT DRIVE BOX
Disassembly – Assembly (Op.23 202 46)

Disassemly and assembly operations of the electro–drive controlled drive box unit can be performed either with the transmission housing on bench or installed on the tractor.
Proceed as follows:

CAUTION

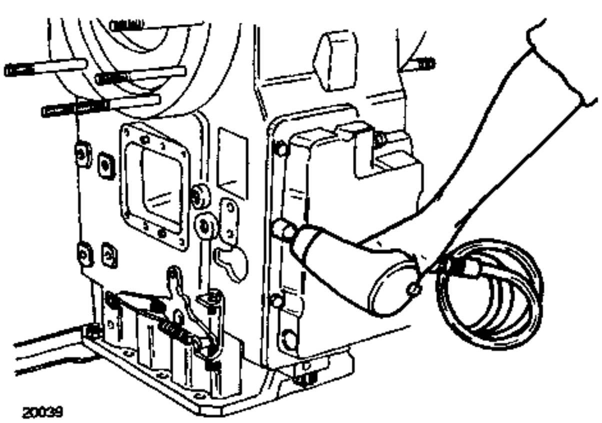
Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

1. On the tractor, with transmission housing installed: disconnect battery cables, drain oil from transmission and rear axle cases and remove the propeller shaft.



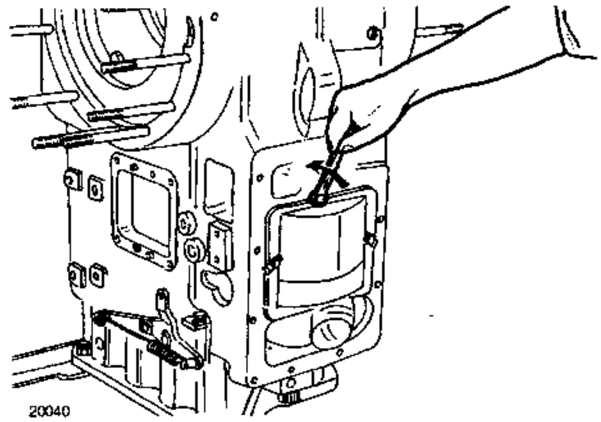
20038

2. Disconnect the inlet pipe from the drive unit bottom cover.



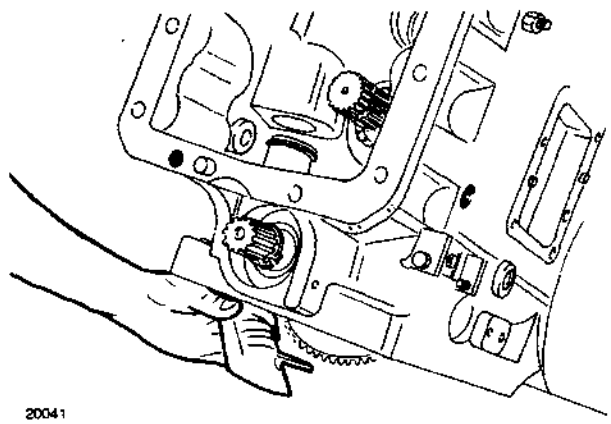
20039

3. Remove bottom cover.



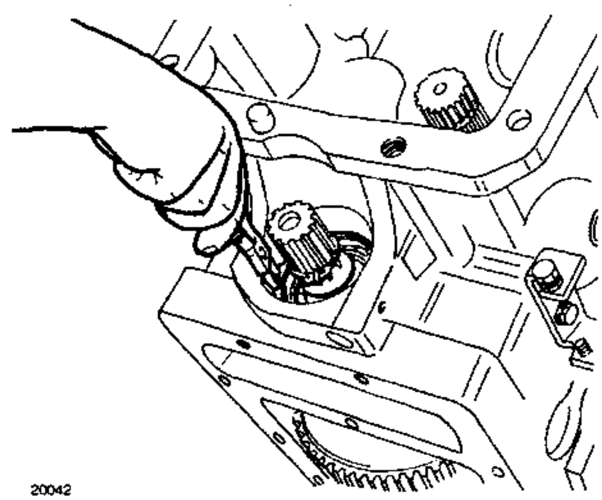
20040

4. Remove inside protection.



20041

5. Remove the oil inlet pipe.



20042

6. Remove the dust shield, the oil seal and the shaft bearings retaining ring.

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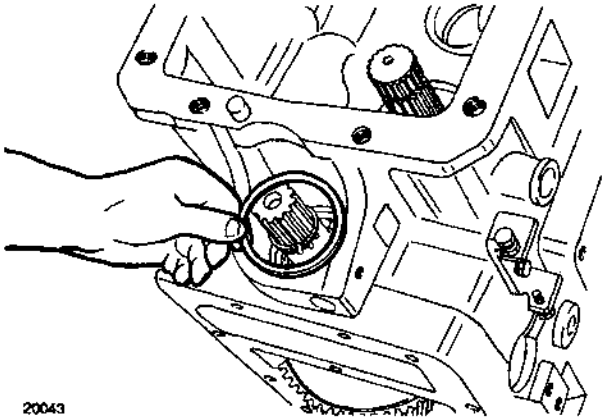
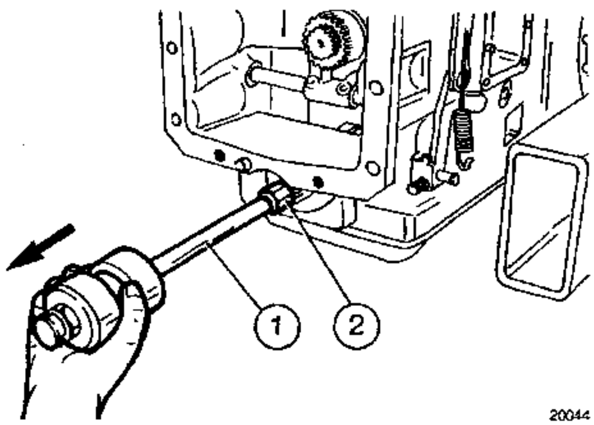
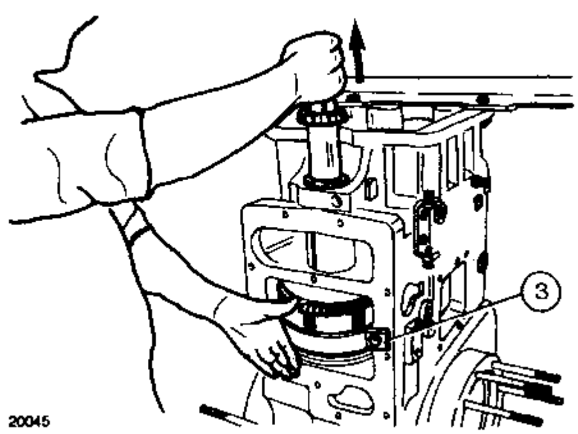


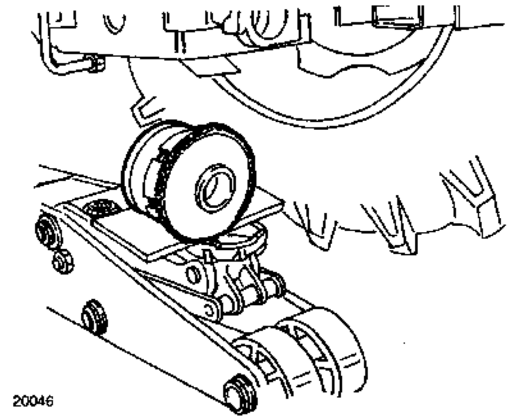
7. Retrieve the shaft bearing shim.
8. Make in the workshop the bracket tool no. **50069** following indications given in the working drawing on page 23–3.
9. Install bracket **50069** on the transmission housing to secure the front–wheel drive engagement clutch.



10. Using the remover/installer tool no. **292927** (1) fitted with adaptor tool no. **293996** (2) partially withdraw the shaft.

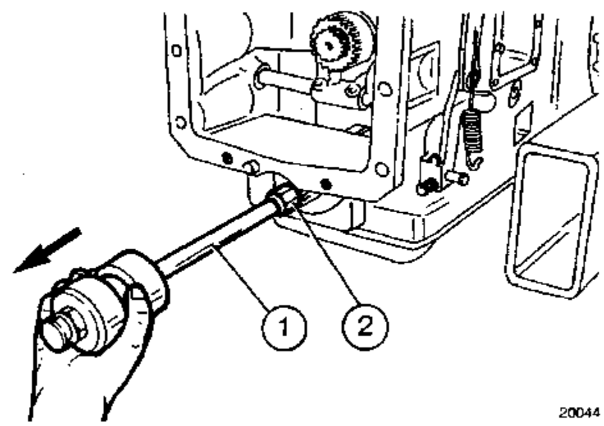


11. Subsequently remove the shaft by hand , making sure that the clutch is retained by bracket **50069** (3).

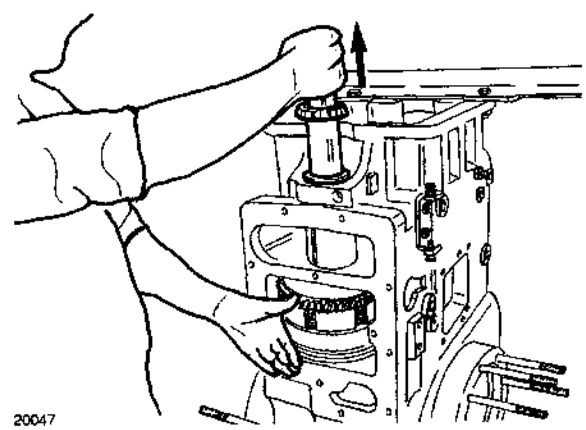


12. Remove bracket **50069** and retrieve the complete clutch unit.

Note – Bracket **50069** is necessary to remove the electrohydraulic engagement drive unit directly from the tractor with transmission case installed. With the latter removed and installed on bench proceed in alternative as per following indications:



13. Using again the tool no. **292927** (1) fitted with adapter **293996** (2) partially withdraw the shaft.



14. Place housing upright then remove the shaft by one hand holding, with the other, the front–wheel drive engagement clutch.

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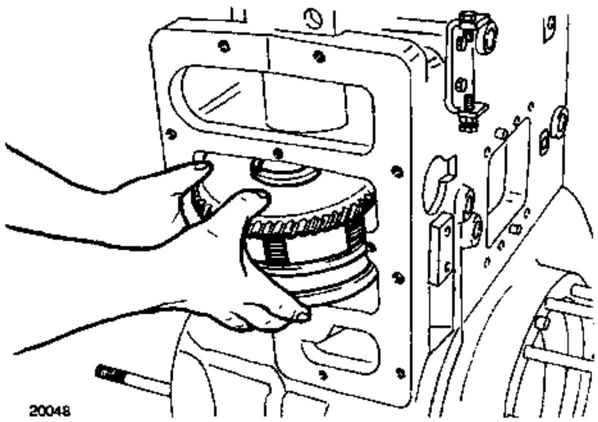
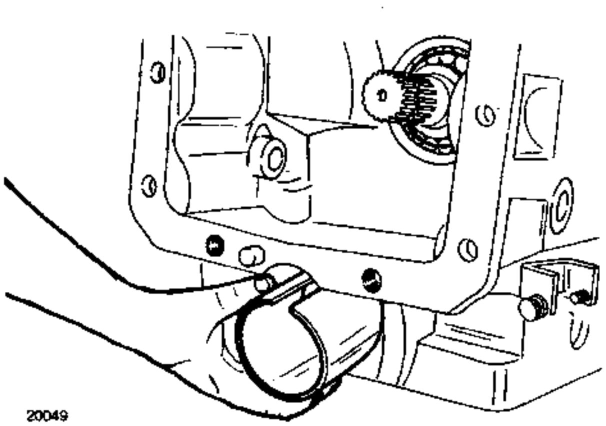


20048

15. Remove the complete front–wheel drive engagement clutch.



20049

16. Remove the drive unit shaft protection.

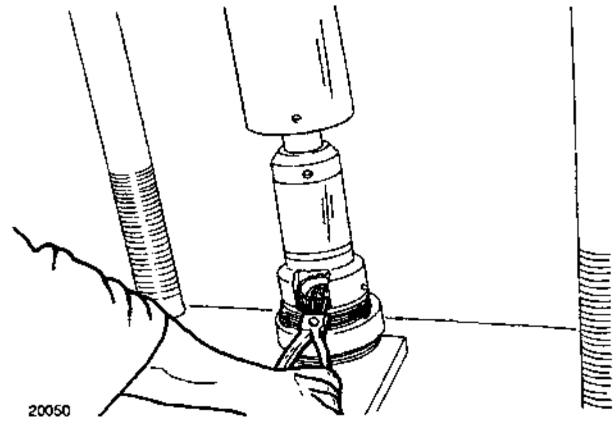
17. Overhaul the hydraulic clutch unit on bench; proceed as follows:

18. Make in the workshop both tools no. **50067** and **50068** following indications given in the working drawing son page 23–3.

Note – Tool **50068** can be used to remove both the electrohydraulic drive thrust plate and the HI–LO springs plate.

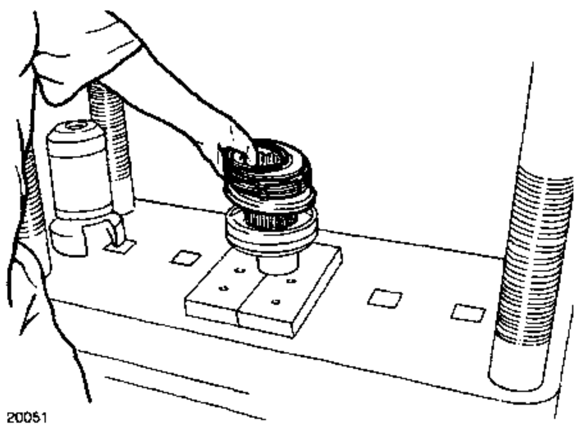
19. Place the clutch on the table of an hydraulic press with clutch discs upward.

20. Fit to the clutch the tool **50068** previously constructedin the workshop.



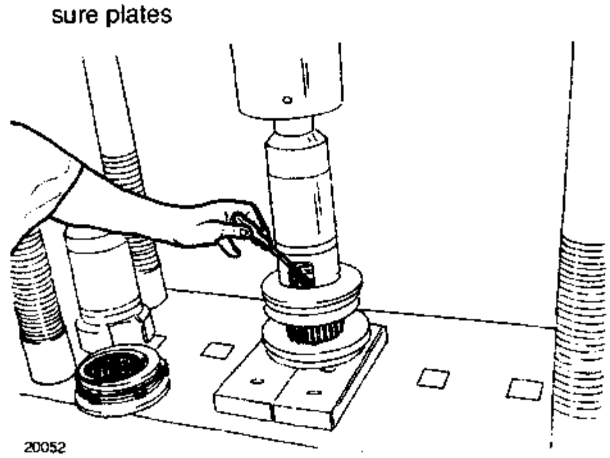
20050

21. Activate the hydraulic press to overcome the clutch springs reaction, then remove the discs retaining ring.



20051

22. Release the hydraulic press and retrieve clutch discs complete with retaining ring, thrust and pressure plates



20052

23. Place the clutch with springs upwards,fit the tool no. **50067**,activate the hydraulic press to overcome springs reaction and remove the springs retainer half–rings.

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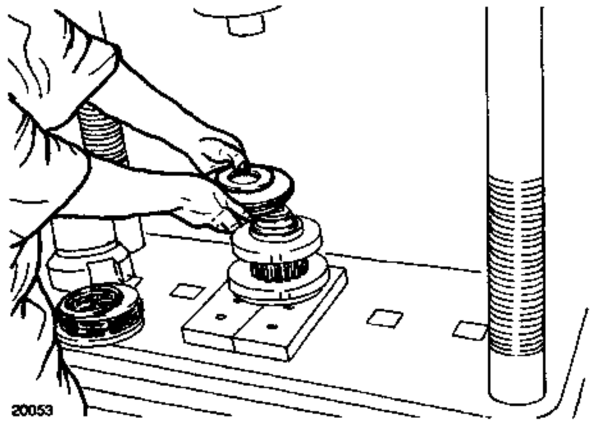
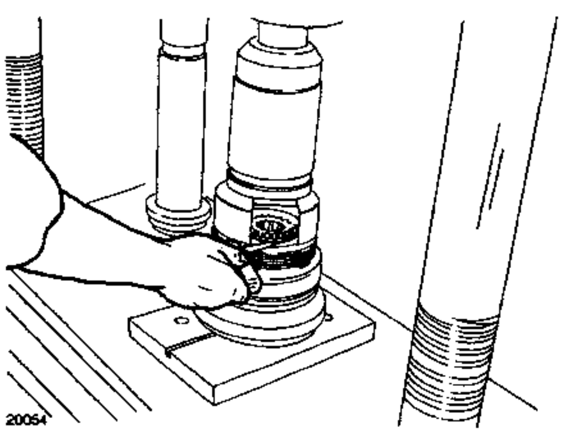


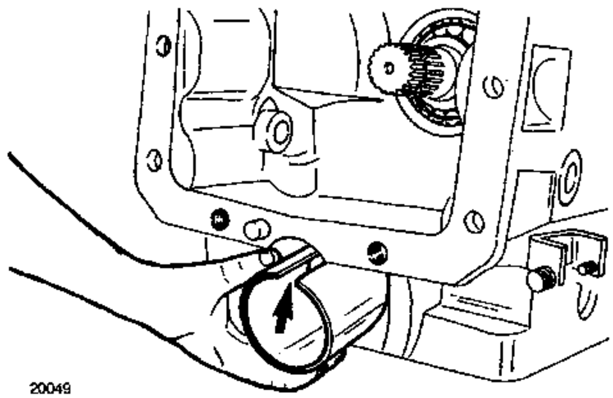
20053

24. Release hydraulic press and retrieve springs complete with thrust plate.
25. Check O–rings wear and replace them if necessary.
26. Reassemble the clutch reversing the assembly sequence of operations.
27. Place the completely assembled clutch on the table of an hydraulic press with clutch discs upwards.
28. Fit to clutch the tool no. **50068** previously constructed in the workshop.



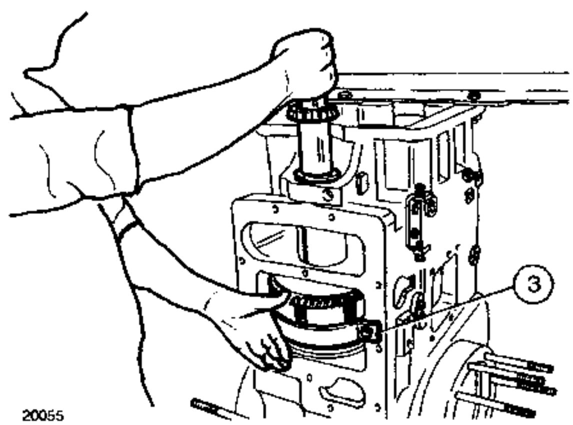
20054

29. Activate the hydraulic press in order to overcome springs pressure, then, with a feeler gauge, measure the gap between retaining ring and thrust plate. Correct reading is 1 to 1.2 mm,(.039 to .047 in), if not replace the clutch thrust plate (S_3, page 23–2).
Once fitted the new replacement part, activate the hydraulic press again and verify the existance of the specified gap of 1 to 1.2 mm (.039 to .047 in) between retaining ring and thrust plate.



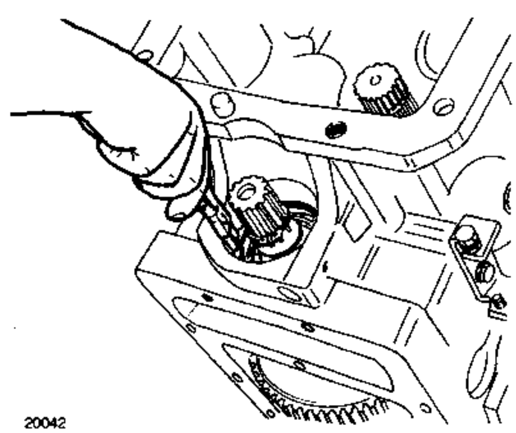
20049

30. Install the drive shaft protection pipe making sure that the cut is turned upwards.



20055

31. Install clutch unit on transmission housing and in the case the latter is installed on the tractor, secure the clutch using bracket tool no. **50069** (3) and fit the drive shaft.
32. Remove bracket **50069**, then fit in its seat the drive unit front bearing outer race keeping in contact with the bearing rollers.



20042

33. Fit the bearing retaining ring.

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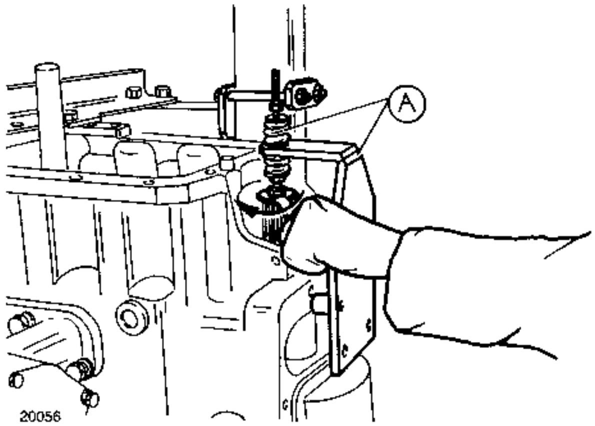
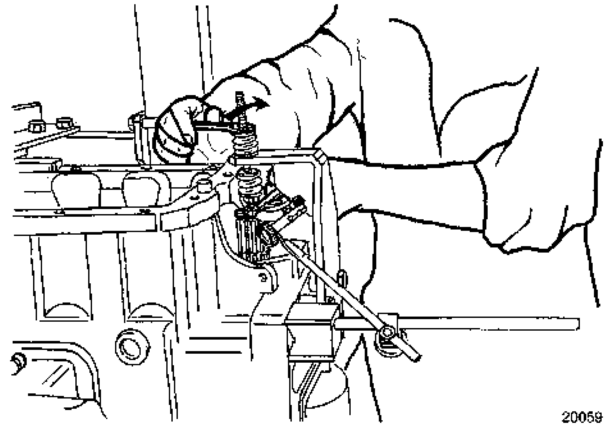


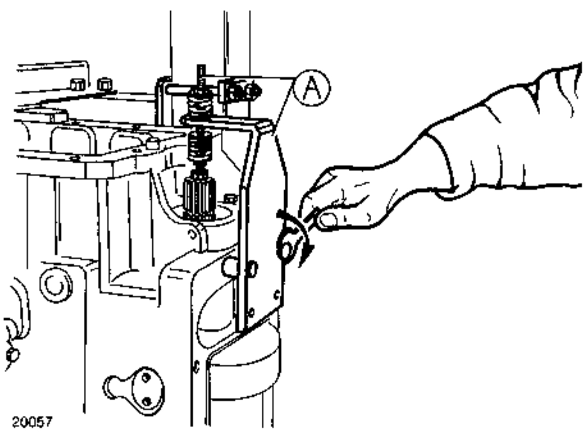
20056

34. Fix the screw of tool **293995** (A) onto the shaft.



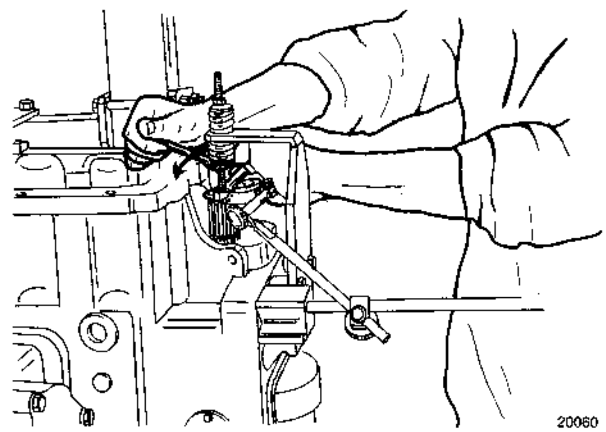
20057

35. Fit tool **293995** (A) to transmission case (if necessary,unscrew the nuts on the tool stud for alignment with transmission case holes).



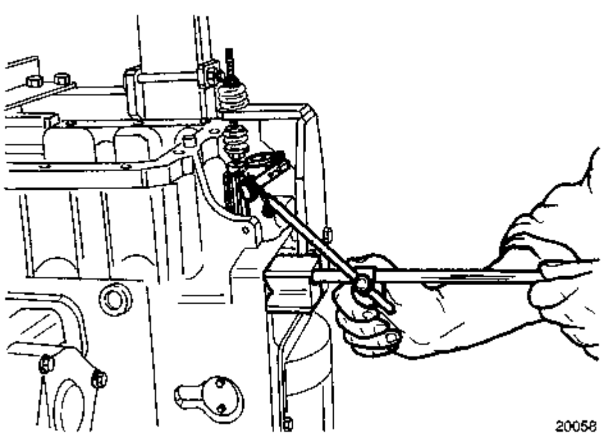
20058

36. Place a comparator dial gauge with magnetic base on transmission housing (not on tool) and position the dial tip on the top of the shaft.



20059

37. With the lower nut fully unscrewed, screw up the upper nut of tool **293995** to bring to abutment the cup placed under the upper spring, further give it one and a half turn and, in these conditions, reset the comparator dial gauge to zero.



20060

38. Fully unscrew the tool **293995** upper nut and manually turn the lower one to bring to abutment the cup placed under the lower spring, then give it a further one and a half turn.

39. Take the comparator reading of the end displacement (L) of shaft. The shim thickness (S_1, page 23–2) to be fitted between retaining ring and race will be given by:

$$S_1 = L - 0.05 \text{ mm } (.002 \text{ in})$$

where:

L = comparator reading of shaft end displacement.
0.05 mm = minus factor necessary to avoid pre–loading the bearings.
Round off this reading by defect within 0.05 mm (.002 in)

40. Remove tool **293995** from transmission case.

41. Remove the shaft bearings retaining ring.

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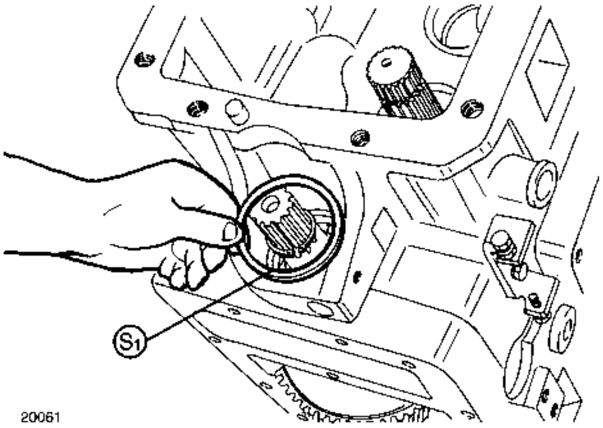
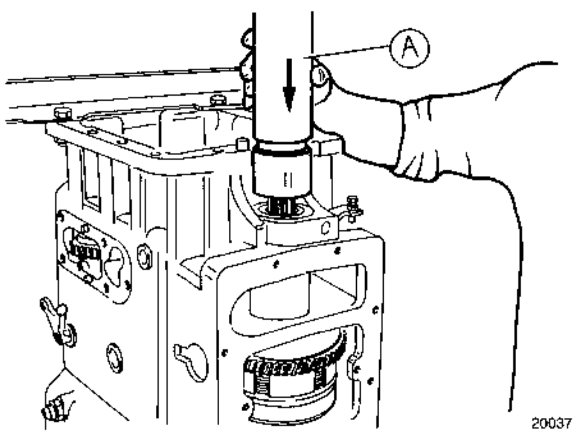


20061

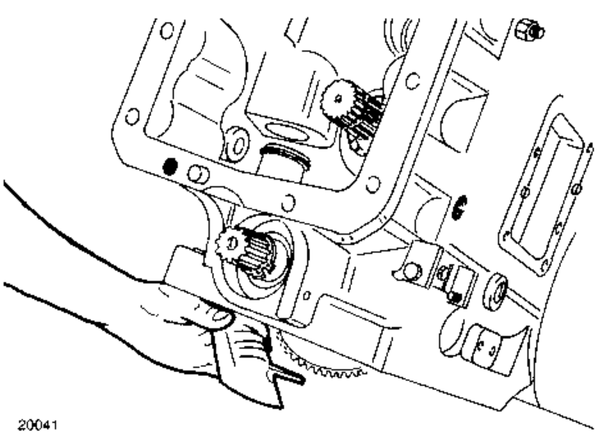
42. Fit the shim thickness found before.

43. Fit the shaft bearings retaining ring.



20037

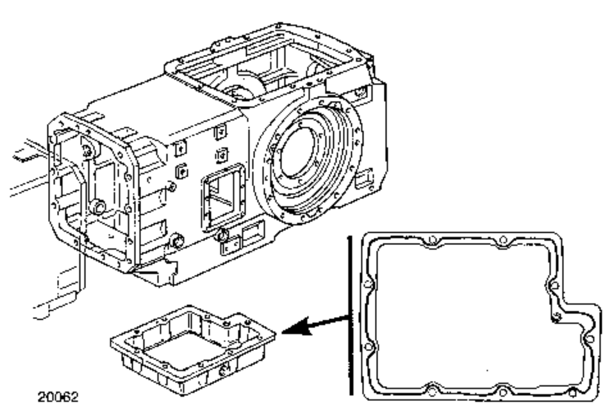
44. Fit the oil seal using the remover\installer tool no. **293475** (A) to ensure correct installation in its seat and, last, fit the dust shield.



20041

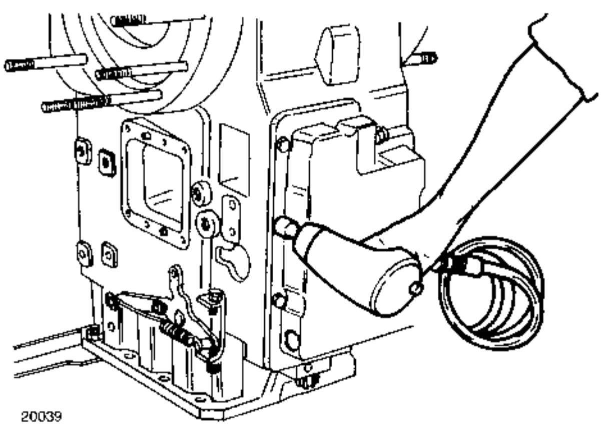
45. Fit the oil intake pipe.

46. Fit the drive inner protection.



20062

47. Accurately clean and degrease mating surfaces of both transmission housing and drive unit bottom cover and then apply one of the sealing compounds indicated on page 00–9 , following the scheme illustrated.



20039

48. Install the drive unit case bottom cover and connect the oil intake pipe.

MECHANICAL–ENGAGEMENT DRIVE BOX
Disassembly – Assembly (Op. 23 101 36)

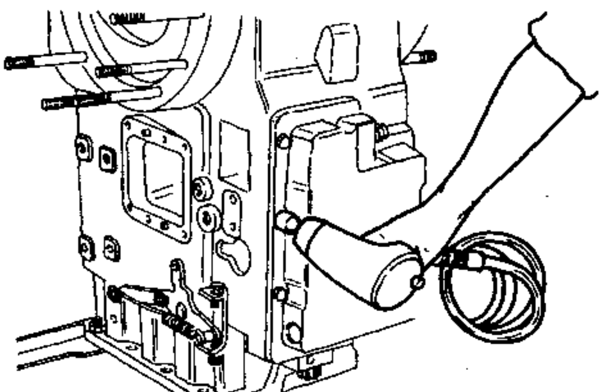
Disassembly and assembly operations can be performed either with the transmission housing on bench or directly on the tractor.

Proceed as follows:

CAUTION

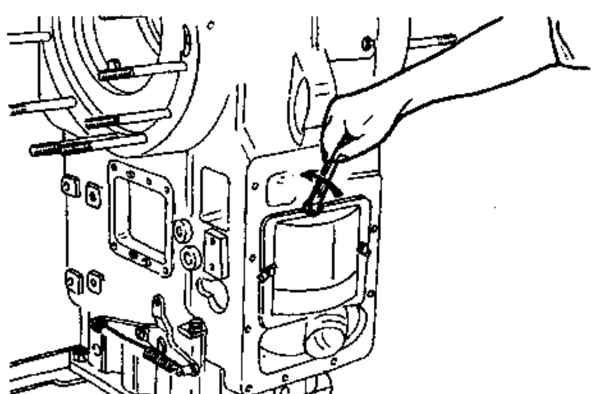
Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

1. (On the tractor, with transmission housing installed): disconnect battery cables, drain oil from transmission and rear axle cases and remove the drive shaft.



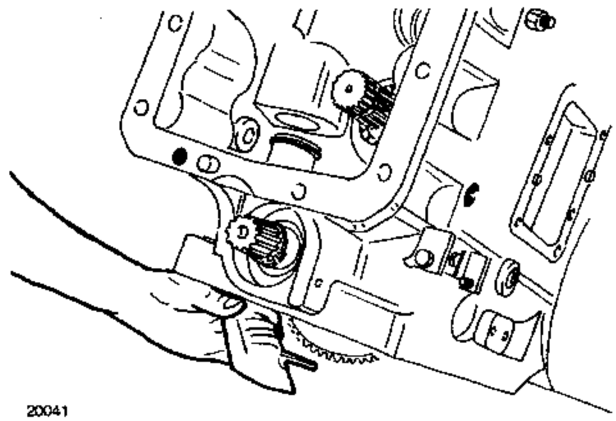
20039

2. Remove the drive box bottom cover.



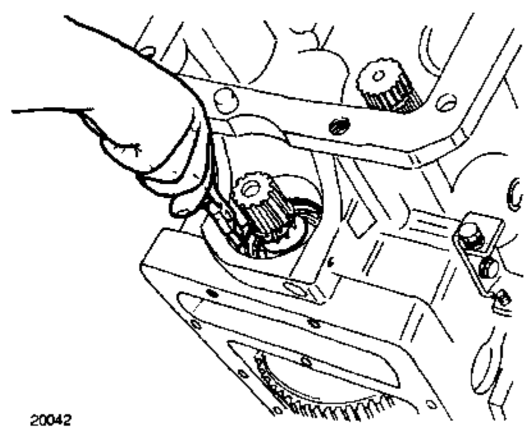
20040

3. Remove the guard and withdraw the fixed coupling sleeve retaining ring from inside the transmission case.



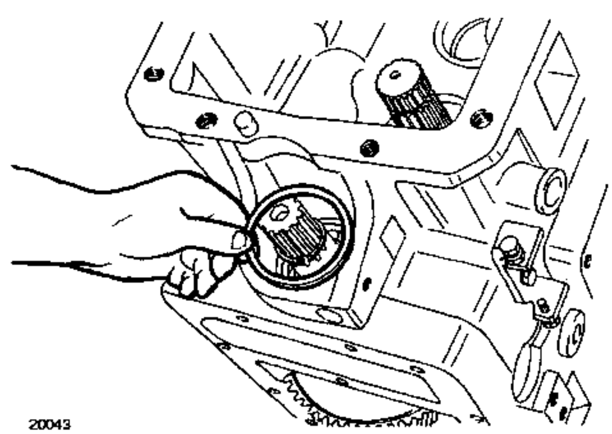
20041

4. Disconnect the oil intake pipe.



20042

5. Remove the dust shield, the oil seal and the drive shaft bearings retaining ring.



20043

6. Retrieve the drive shaft bearings adjustment shim.

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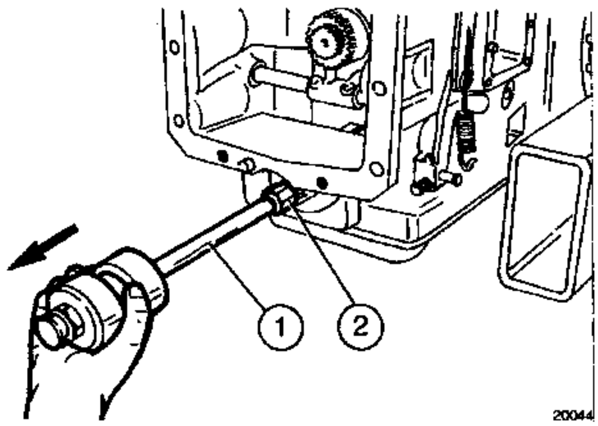
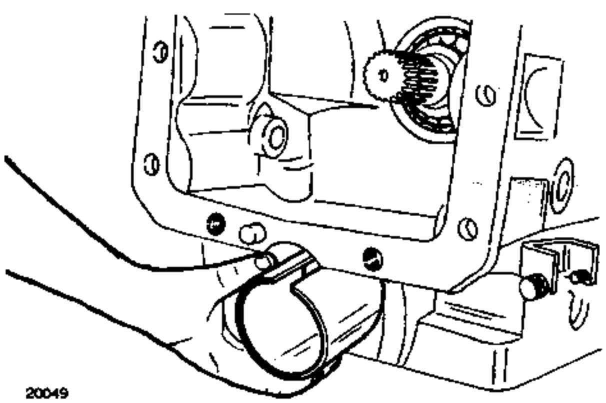
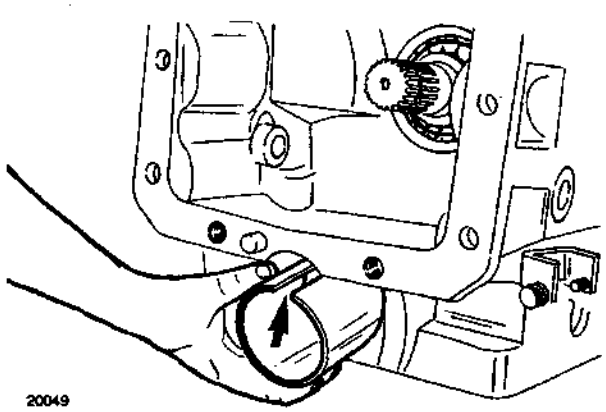


7. Using the remover/installer tool no. **292927** (1) with adapter tool no. **293996** remove the drive unit shaft retrieving at the same time, from inside the case, driven gear, sleeves fixed sleeve and retaining ring.



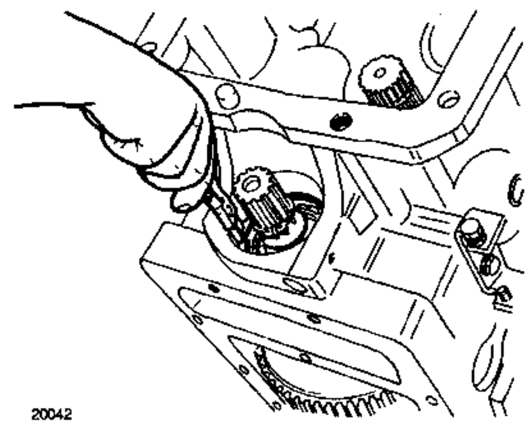
8. Remove the shaft protection.



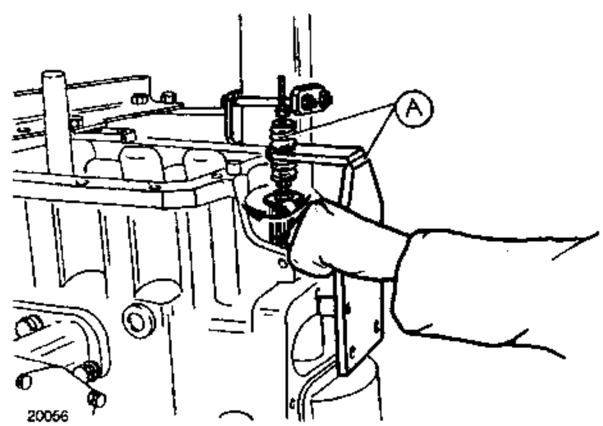
9. When refitting the protection make sure that cut is turned upwards.

10. Install the shaft and fit from inside the case the driven gear, sleeve coupling, fixed sleeve and its retaining ring.

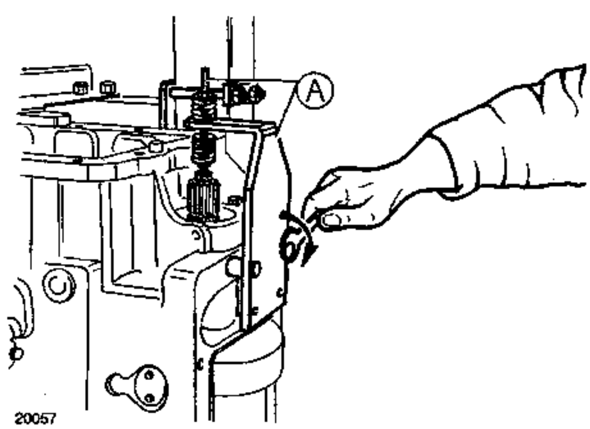
11. Fit in its seat the front bearing outer race positioning it against rollers.



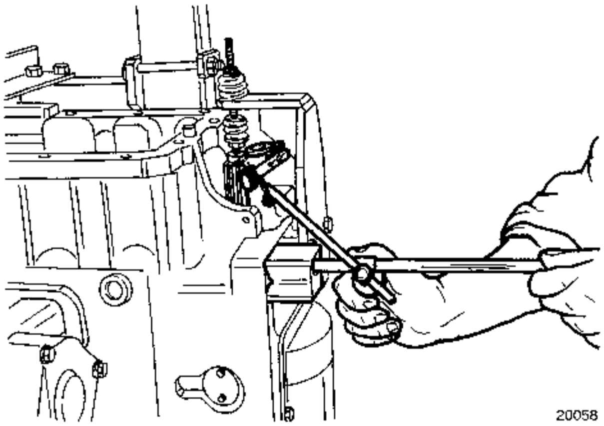
12. Fit the shaft bearings retaining ring.



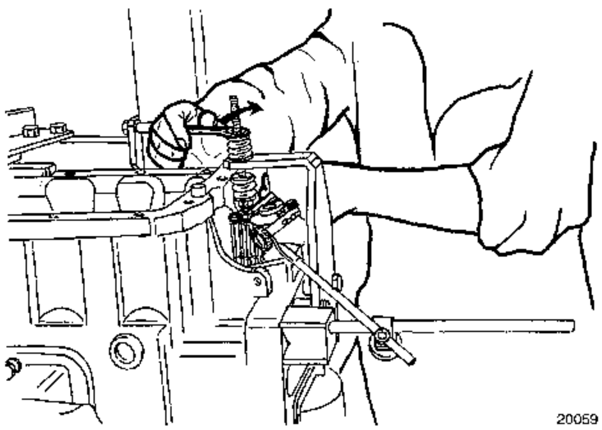
13. Fix the screw of tool **293995** (A) on to the shaft.



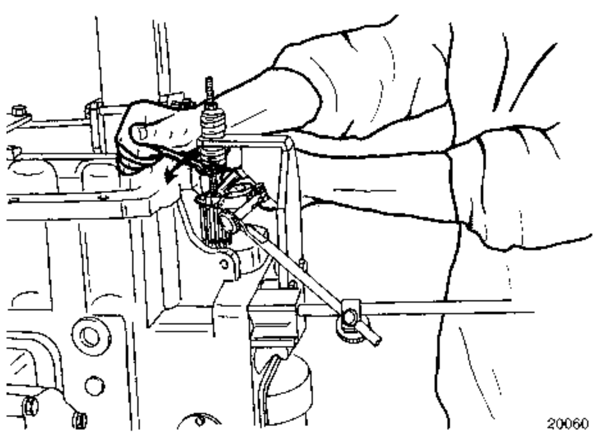
14. Fit tool **293995** (A) to transmission case (if necessary,unscrew the nuts on the tool stud for alignment with transmission case holes).


20058

15. Place a comparator dial gauge with magnetic base on transmission housing(not on tool) and position the dial tip on the top of the shaft.


20059

16. With the lower nut fully unscrewed, screw up the upper nut of tool **293995** until abutting against the cup under the upper spring, further give it one and a half turn and, under these conditions, reset the comparator dial gauge to zero.


20060

17. Fully unscrew the tool **293995** upper nut and turn the lower one manually to abut against the cup placed under the lower spring, then further give it one and a half turn.

18. Take the comparator reading of the end displacement (L) of shaft. The shim thickness (S_1, page 23–1) to be fitted between retaining ring and race will be given by:

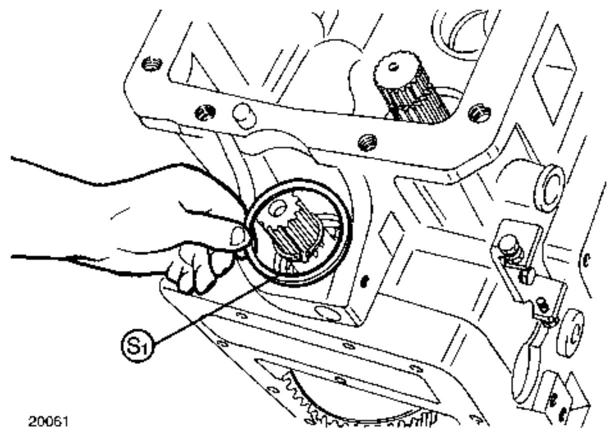
$$S_1 = L - 0.05 \text{ mm } (.002 \text{ in})$$

where:

L = comparator reading of shaft end displacement.
0.05 mm = Minus dimension necessary to avoid pre–loading the bearings.
Round off this reading by defect within 0.05 mm (.002 in)

19. Remove tool **293995** from transmission case.

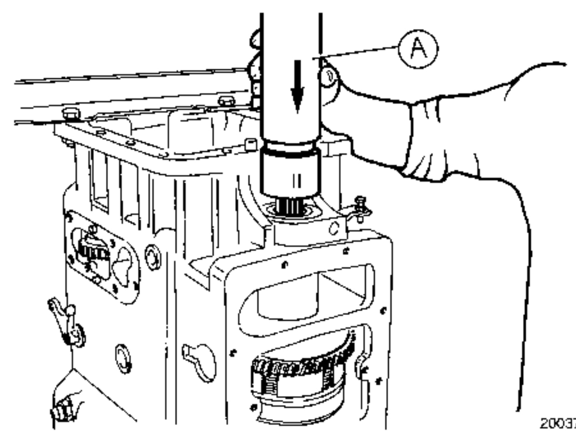
20. Remove the shaft bearings retaining ring.



20061

21. Fit the shim (S_1) thickness found before.

22. Fit the shaft bearings retaining ring.



20037

23. Fit the oil seal using the remover\installer tool no. **293475** (A) to ensure correct installation in its seat and, last, fit the dust shield.

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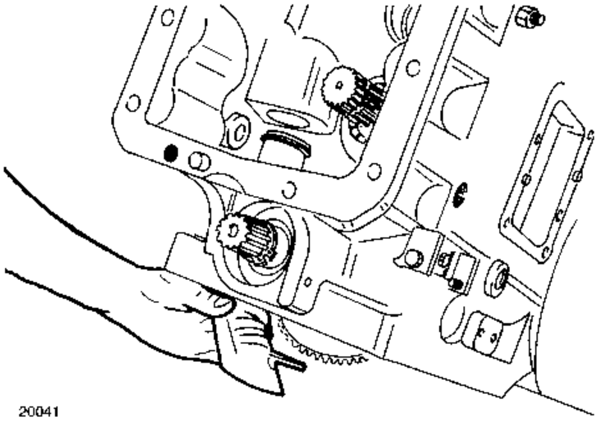
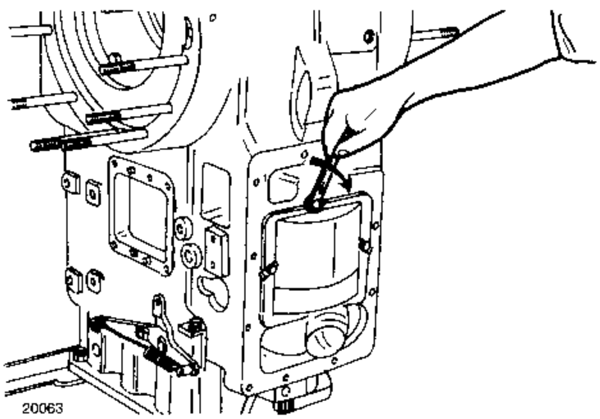


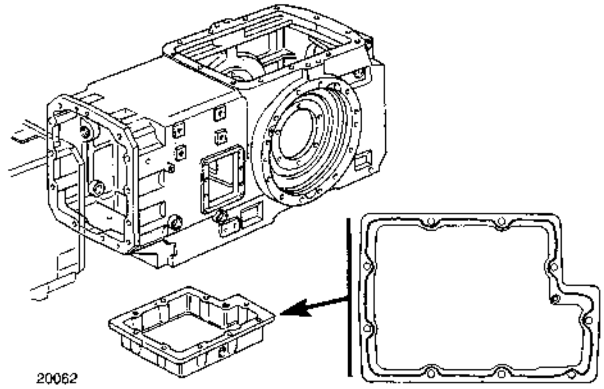
20041

24. Fit the oil intake pipe.



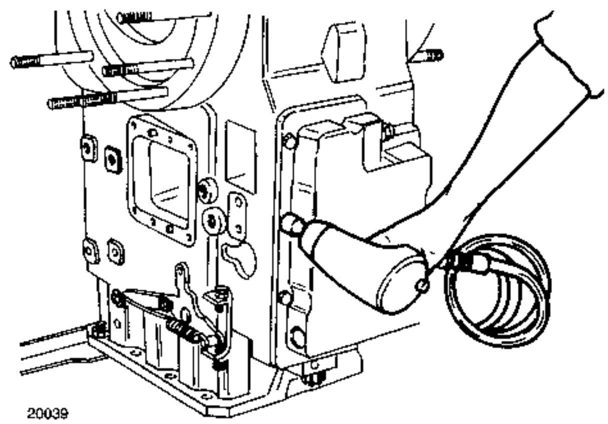
20063

25. Fit the drive box inner protection.



20062

26. Accurately clean and degrease mating surface of both trasmission housing and drive box bottom cover and then apply one of the sealing compounds indicated on page 00–9 following the scheme shown above in the figure.



20039

27. Install the drive box bottom cover.

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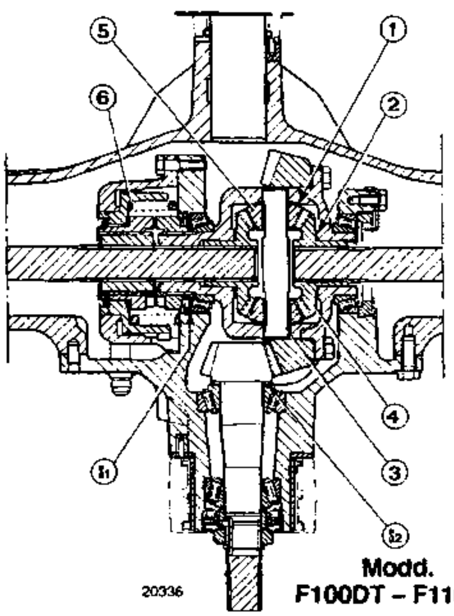
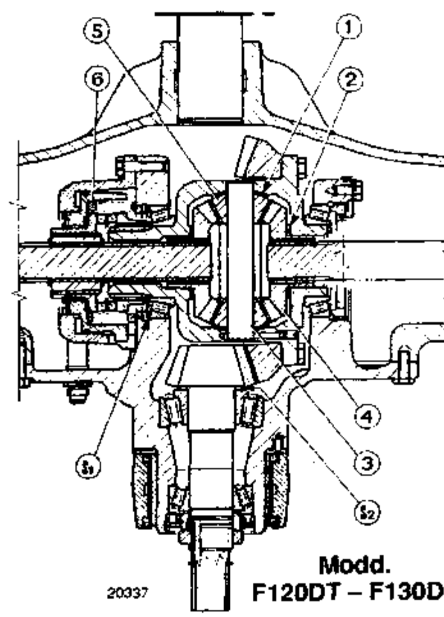
LIVE FRONT AXLE

	F100DT – F110DT	F120DT – F130DT
Type	steering, full floating, centre pivoting	
Bevel gear and differential drive		
Bevel gear speed reduction ratio	10/34 = 1:3.4	
Bevel gear tooth backlash	0.18 to 0.23 mm (.007 to .009 in)	
Bevel pinion position adjustment shims thickness range (S_2)	2.5–2.6–2.7–2.8–2.9–3.0–3.1–3.2–3.3–3.4–3.5–3.6–3.7 mm (.098–.102–.106–.110–.114–.118–.122–.126–.130–.134–.138–.142–.146 in)	2.3–2.4–2.5–2.6–2.7–2.8–2.9–3.0–3.1–3.2–3.3–3.4–3.5 mm (.090–.094–.098–.102–.106–.110–.114–.118–.122–.126–.130–.134–.138 in)
Bevel ring gear bearings adjustment shims thickness range (S_1)	0.9–1–1.1–1.2–1.3–1.4–1.5–1.6–1.7–1.8–1.9–2 mm (.035–.039–.040–.0402–.0406–.0410 .0414–.0418–.0422–.0426–.0430–.0434 in)	
Differential gear and pinion tooth backlash	0.15 mm (.006 in)	0.18 mm (.007 in)
Differential side gear thrust washers (1) thickness	1.470 to 1.530 mm (.058 to .060 in)	
Differential pinion thrust washers (2) thickness	1.4–1.5–1.6– 1.7–1.8 mm (.055–.059–.063–.065–.071in)	
Differential pinions pin (3) dia.	23.939 to 23.960 mm (.9425 to .9433 in)	24.939 to 24.960 mm (.9818 to .9827 in)
Pin bore dia. in differential pinions (5)	24.040 to 24.061 mm (.9464 to .9473 in)	25.040 to 25.061 mm (.9858 to .9866 in)
Clearance fit of differential side gears	0.080 to 0.122 mm (.0031 to .0048 in)	0.080 to 0.122 mm (.0031 to .0048 in)
Differential side gears spigot (4) dia.	43.961 to 44.000 mm (1.7307 to 1.7323 in)	50.954 to 51.000 mm (2.0060 to 2.0079 in)
Spigot seat dia. in differential housing	44.080 to 44.119 mm (1.7354 to 1.8053 in)	51,100 to 51,146 mm (2.0118 to 2.0136 in)
Clearance fit of differential side gears	0.080 to 0.158 mm (.0031 to .0062 in)	0.100 to 0.192 mm (.0039 to .0076 in)
Differential lock spring (6)		
Free length of spring (6)	87 mm (3.4 in) approx.	
Length under load, 1888 to 2035 N=192.5 to 207.5 kg (489 to 527 lb)	48 mm (1.9 in) approx.	

(follows)



Modd. F100DT – F110DT



Modd. F120DT – F130DT

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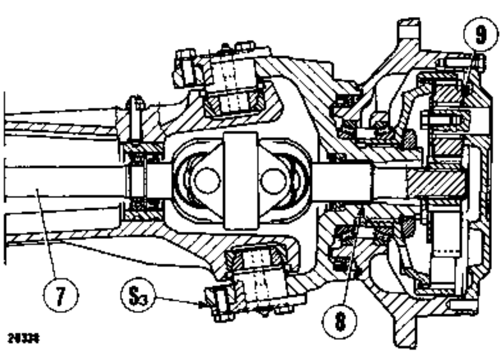
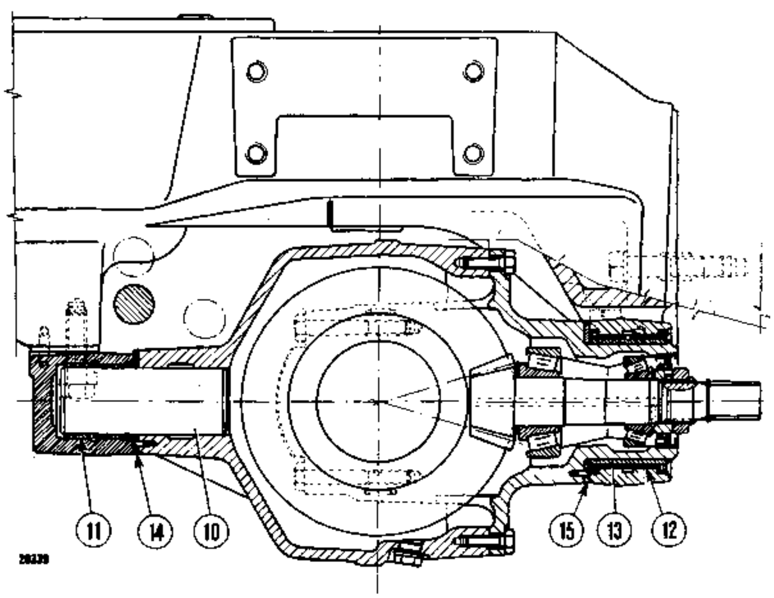
LIVE FRONT AXLE

(cont.)

Axle shafts and steering joints	F100DT – F110DT	F120DT – F130DT
Outer axle shafts (7) dia. in correspondence of journal bearing bushes (8)	41.975 to 42.000 mm (1.6515 to 1.6535 in)	44.975 to 45.000 mm (1.7697 to 1.7716 in)
Forced–fit bushing (8) I.D.	42.100 to 42.175 mm (1) (1.6575 to 1.6604 in)	45.100 to 45.175 mm (1) (1.7756 to 1.7785 in)
Axle shaft and bushing running clearance	0.100 to 0.200 mm (.0039 to .0078 in)	0.100 to 0.200 mm (.0039 to .0078 in)
Journal bearing bushing seat interference fit	0.064 to 0.129 mm (.0025 to .0051 in)	0.064 to 0.129 mm (.0025 to .0051 in)
Kingpin bearing adjustment shims (S_3)	0.10–0.15–0.20–0.25–0.30 mm (.004–.006–.008–.010–.012 in)	
Epicyclic side final drives		
Speed reduction ratio	16:(16+68) = 1:5.25	
Driven gear thrust rings (9) thickness	0.77 to 0.83mm (.030 to .0326 in)	
Front axle pivot mount		
Axle housing and support end play	0.3 to 1.1 mm (.01 to .04 in)	
Max. permissible wear	2 mm (.08 in)	
Axle housing front pivot pin (10) dia.	52.652 to 52.671 mm (2.0729 to 2.0736 in)	62.720 to 62.740 mm (2.4693 to 2.4700 in)
Forced fit bushing (11) I.D.	52.720 to 52.790 mm (1) (2.0755 to 2.0783 in)	62.800 to 62.884 mm (1) (2.4724 to 2.4757 in)
Pivot pin (10) and bushing clearance fit	0.049 to 0.138 mm (.0019 to 0054 in)	0.060 to 0.164 mm (.00236 to . 00645 in)
Outer dia. of rear bushing (12) fitted in the bevel gear pinion support	99.020 to 99.086 mm (3.8984 to 3.9010 in)	115.527 to 115.585 mm (4.5483 to 4.5506 in)
Inside dia. of rear bushing (13) fitted in the front axle pivot mount support	99.146 to 99.221(1) mm (3.9033 to 3.9063 in)	115.636 to 115.71(1) mm (4.5526 to 4.5555 in)
Clearance fit between bushings	0.060 to 0.201 mm (.0024 to .0079 in)	0.051 to 0.184 mm (.0021 to .0072 in)
Axle support thrust washers, front (14) and rear (15), thickness	4.95 to 5.00 mm (.195 to .197 in)	

(1) Final dimension, without grinding





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TORQUE DATA

DESCRIPTION	Thread size	Torque		
		Nm	kgm	ft.lb
Front axle				
Lock ring, bevel pinion shaft (C_1, pages 4 and 5):				
– F100DT – F110DT	M35 x 1.5	see pages 25–20 and 25–21		
– F120DT – F130DT	M40 x 1.5			
Screw, differential case to axle housing (C_2)	M12 x 1.25	113	11.5	83
Screw, ring gear to differential case (C_3)	M12 x 1.25	113	11.5	83
Screw, steering knuckle kingpins (C_4):				
– F100DT – F110DT	M10 x 1.25	see page 25–12		
– F120DT – F130DT	M14 x 1.5			
Lock ring, wheel hub bearing (C_6):				
– F100DT – F110DT	M75 x 2	see page 25–11		
– F120DT – F130DT	M90 x 2			
Screw, final drive case (C_7)	M12 x 1.25	113	11.5	83
Nut, wheel rim bolt	M16 x 1.5	245	25	180
Screw, front and rear pivot mount supports	M18 x 1.5	392	40	289
Screw, differential case caps (C_9):				
– F100DT – F110DT	M12 x 1.5	113	11	83
– F120DT – F130DT	M14 x 1.5	176	18	130
Screw, front axle support to engine (C_{10}):				
– F100DT – F110DT	M18 x 1.5	314	32	230
– F120DT – F130DT	M18 x 1.5	353	36	260

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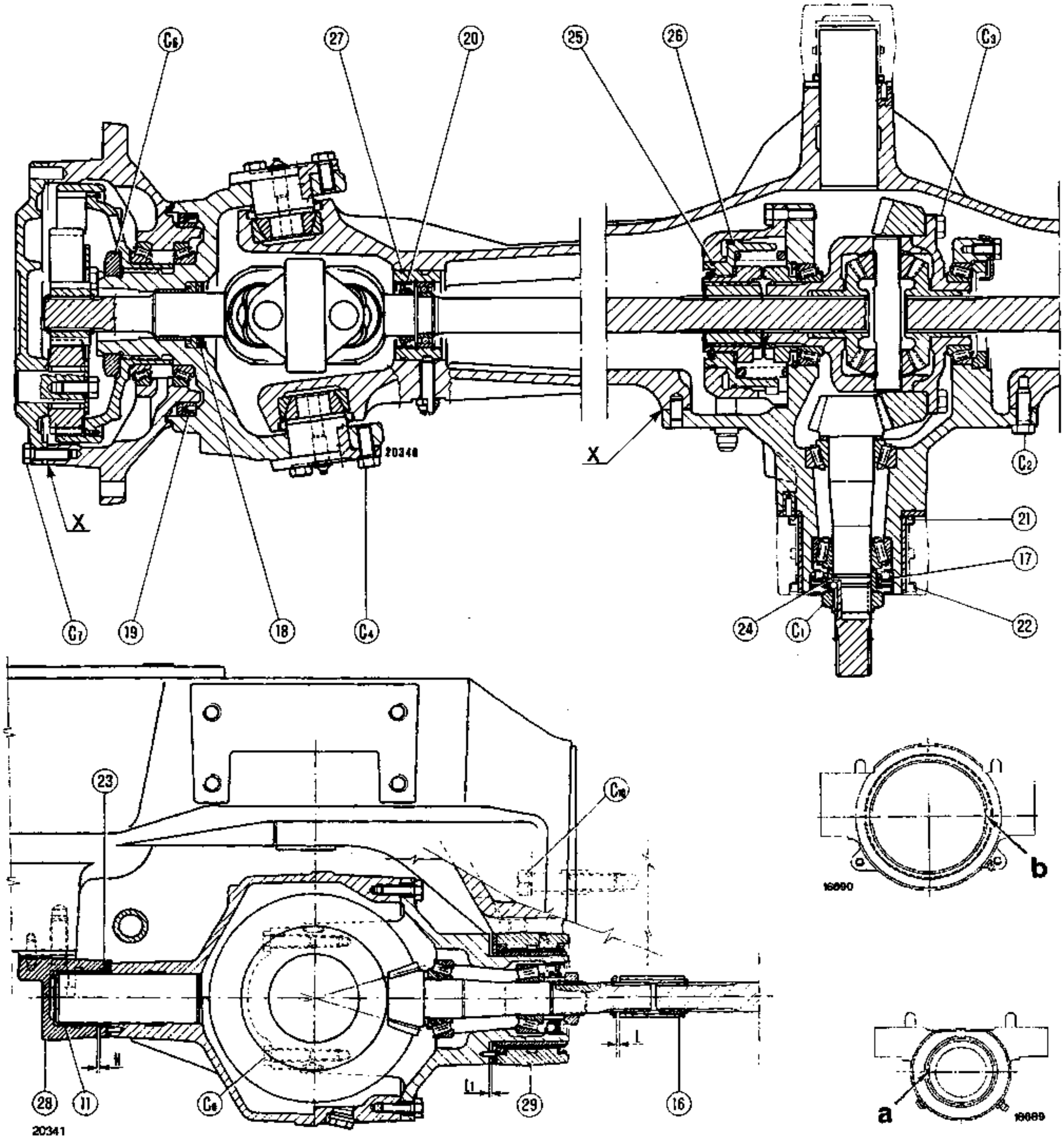

Cross–sectional views of front axle assembly and pivot mounting (F100DT – F110DT)

Note – At assembly, thoroughly clean and degrease the mating surfaces (X) and apply one of the following sealing compounds: RTV SILMATE, RHODORSIL CAF1 or LOCTITE PLASTIC GASKET

a and b. Correct installation of bushings inside the axle pivot front (detail a) and rear (detail b) supports(arrows show correct positioning of jonction cut on bushings). $C_1, C_2, C_3, C_4, C_6, C_7, C_9, C_{10}$. See chart on page 25–3. H = 1mm (.039 in).Bushing (11) recession after force fitting – L = 1.2 to 1.7 mm (.047 to .067 in). End play of bushing (16) – L_1 = 0.3 to 1.1 mm (.012 to .043 in). End play of the pivot mounting between front axle casing and its support – 17,18,19,20,21,22. Seals – 23,24,25,26,27. O–rings – 28,29. Front axle mounting supports, front and rear.

Advice – When lubricating the pivot mount supports (28,29), a better distribution of grease is achieved by lifting the tractor front end, until front wheels are clear off the ground, using an hydraulic jack placed under the ballast carrier after making sure that the hand brake lever is pulled and rear wheels are properly wedged. Inject grease while rocking the front axle by hand.

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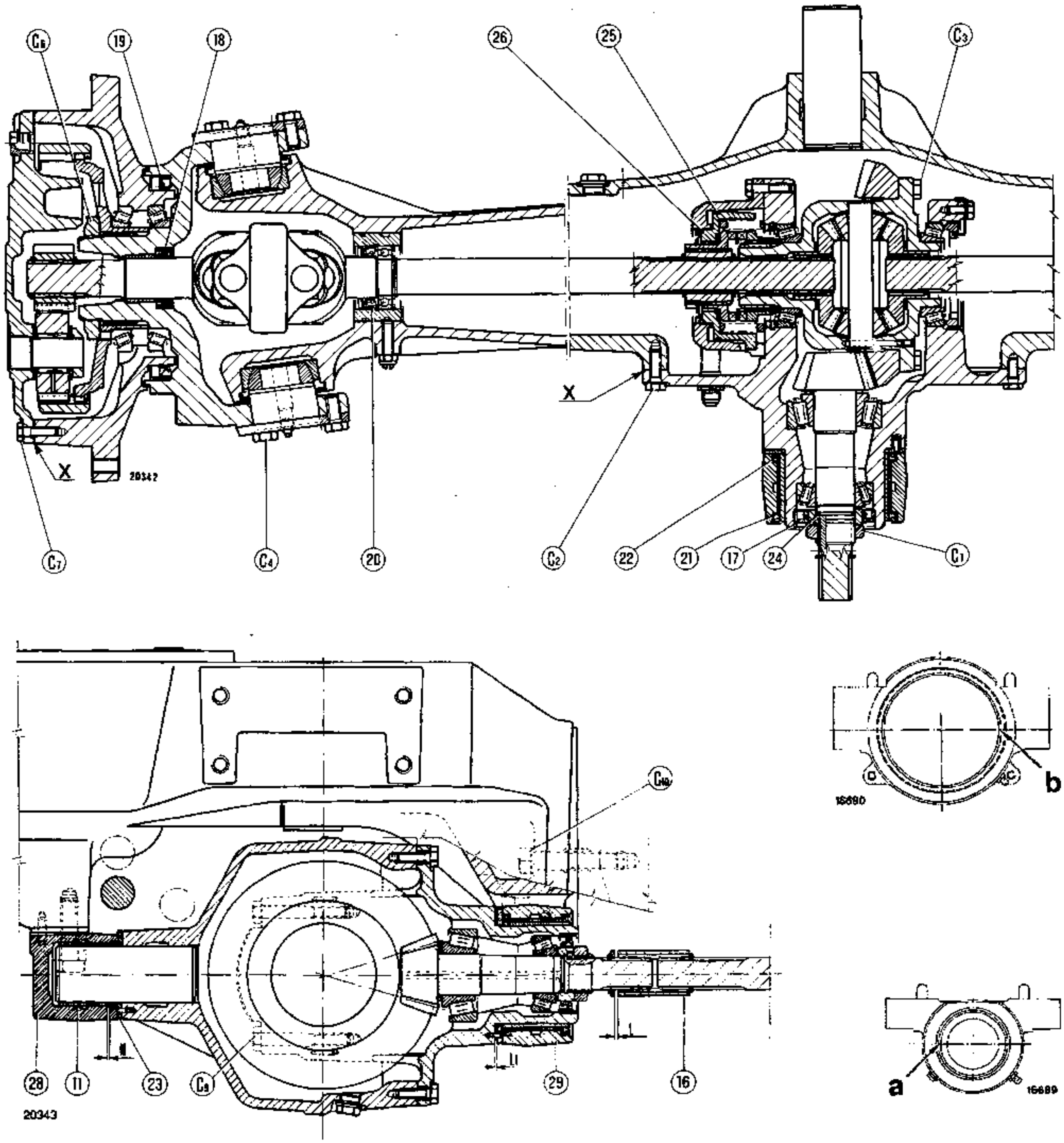

Cross–sectional views of front axle assembly and pivot mounting (F120DT – F130DT)

Note – At assembly, thoroughly clean and degrease the mating surfaces (X) and apply one of the following sealing compounds: RTV SILMATE, RHODORSIL CAF1 or LOCTITE PLASTIC GASKET

a and b. Correct installation of bushings inside the axle pivot front (detail a) and rear (detail b) supports(arrows show correct positioning of jonction cut on bushings). C_1,C_2,C_3,C_4,C_6,C_7,C_9,C_{10}. See chart on page 25–3. H = 1mm (.039 in).Bushing (11) recession after force fitting – L = 1.2 to 1.7 mm (.047 to .067 in). End play of bushing (16) – L_1 = 0.3 to 1.1 mm (.012 to .043 in). End play of the pivot mounting between front axle casing and its support – 17,18,19,20,21,22. Seals – 23,24,25,26,27. O–rings – 28,29. Front axle mounting supports, front and rear.

Advice – When lubricating the pivot mount supports (28,29), a better distribution of grease is achieved by lifting the tractor front end, until front wheels are clear off the ground, using an hydraulic jack placed under the ballast carrier after making sure that the hand brake lever is pulled and rear wheels are properly wedged. Inject grease while rocking the front axle by hand.

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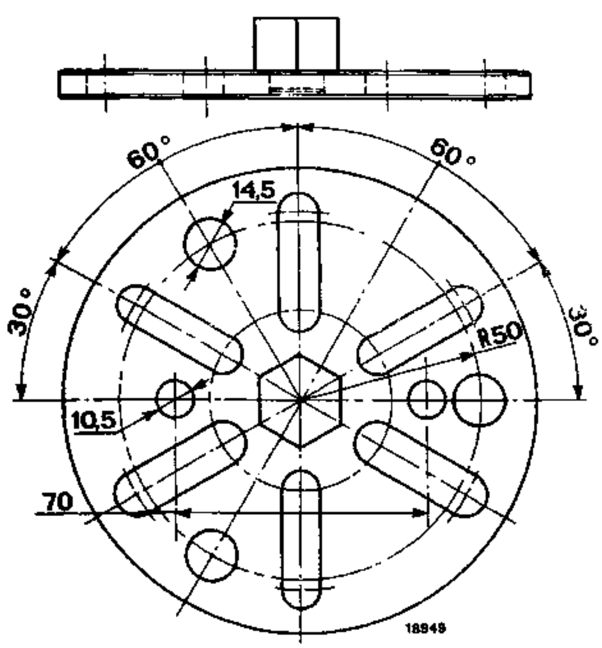
SERVICE TOOLS

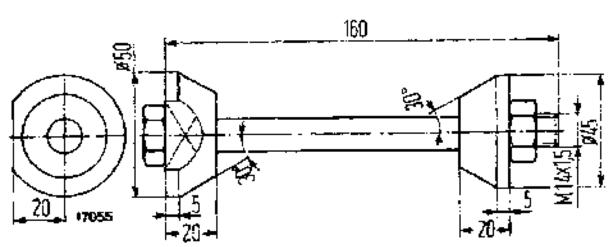
ATTENTION – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code **(X)**.
Besides, to work safely and achieve the best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjonction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

List of the tools necessary to perform the various operations involved in this Section:

	293460	Stand, axle service.
	291157	Hook, removal–installation front differential.
	293743	Support, overhauling bevel pinion carrier.
X	**293878**	Pin wrench, ring nut, bevel drive pinion (models F100DT and F110DT).
X	**293879**	Pin wrench, ring nut, bevel drive pinion (models F120DT and F130DT).
X	**293876**	Retainer wrench, bevel drive pinion (models F100DT and F110DT).
X	**293877**	Retainer wrench, bevel drive pinion,(models F120DT and F130DT).
	293400/1	Universal gauge, bevel drive pinion adjustment.
X	**293665**	Pin wrench, ring nut, front differential bearing adjustment (models F100DT and F110DT).
X	**293798**	Pin wrench, ring nut, front differential bearing adjustment (models F120DT and F130DT).
X	**293880**	Pin wrench, ring nut, front axle wheel hub bearing installation (models F100DT and F110DT).
X	**293881**	Pin wrench, ring nut, front axle wheel hub bearing installation (models F120DT and F130DT).
X	**293882**	Retainer set, front axle wheel hub bearing removal.
	292888	Pins (M12x1.25), side final drive covers.
	293812	Pins (M16x1.25), wheel removal/installation.
X	**293857/1**	Puller, front axle mounting pivot shaft.
X	**292161**	Puller, front axle pivot bearing outer race.
X	**292220/4**	Fixture, front axle bearing rolling torque checks.
	293889	Guide, installation, front axle shafts on steering knuckles (models F100DT and F110DT).
	293888	Guide, installation, front axle shafts on steering knuckles (models F120DT and F130DT).
	292870	Universal pressure gauge set, front axle differential lock oil.



Modifications required on tool 292220 for front axle steering knuckle rolling torque check (modified tool takes new number 292220/4)



Shop–fabricated, self–made tool, for bevel drive pinion adjustment

Metric dimensions – Stamp tool no. 50048.
Note – Material specification: C40 steel.

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LIVE FRONT AXLE DIFFERENTIAL LOCK TROUBLE–SHOOTING CHART

Fault	Diagnosis	Correction
Differential lock fails to engage.	1. Low transmission oil level.	Top up oil level.
	2. Clogged oil filter.	Replace oil filter.
	3. Inefficient hydraulic pump.	Overhaul or replace pump.
	4. Inefficient differential lock control switch.	Replace switch.
	5. No power is reaching the electro–valve: interrupted, damaged connections or defective remote control switch.	Restore electrical connections and replace defective parts.
	6. Differential lock control electro–valve (5, page 21–10) stuck on discharge position.	Overhaul or replace electro–valve.
	7. Fluid leakage through oil seals with consequent pressure drop: cylinder piston or feed line oil seals.	Replace oil seals found defective.
Differential lock will not disengage.	1. Differential lock control electro–valve (5) stuck on delivery.	Overhaul or replace electrovalve.
	2. Broken differential lock disconnecting spring.	Replace spring.
	3. No power is reaching the electro–valve: interrupted, damaged connections or defective remote control switch.	Restore electrical connections and replace defective parts.
With differential lock engaged and push–button control on position 3, the differential lock will not disengage when the LIFT–O–MATIC device is activated to raise the hydraulic lift arms.	1. Inefficient differential lock control switch (connected to the LIFT–O–MATIC device).	Replace switch.
With differential lock engaged, the same will not disengage upon pressing on the brake pedals.	1. Inefficient differential lock control switch (connected to the brake pump).	Replace switch.

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LIVE FRONT AXLE ASSEMBLY
Removal–Installation (Op. 25 100 30)

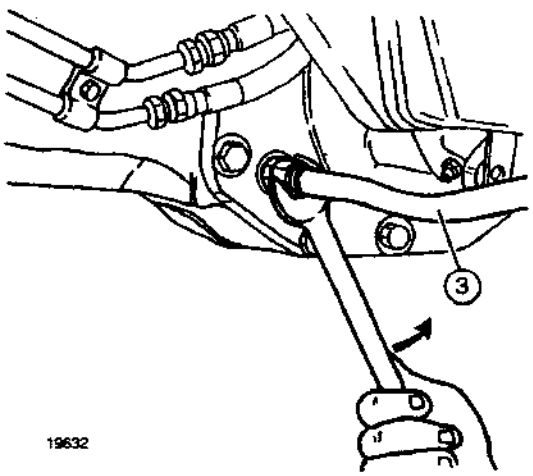
DANGER

Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.

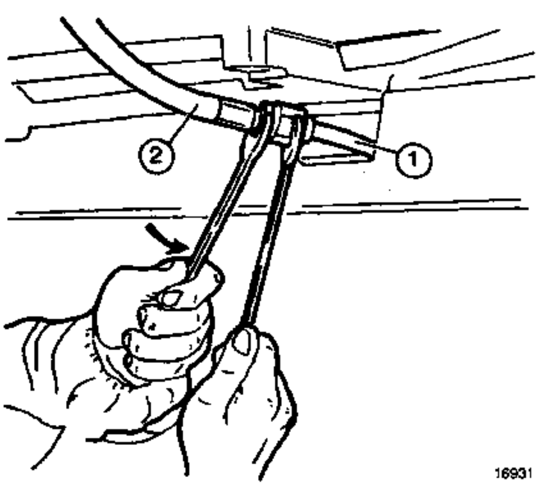
Proceed as follows:

Note – The front–axle assembly can be removed from tractor either by previously removing the front–wheel drive propeller shaft or with the latter installed. For the removal of the propeller shaft please revert to specific information on page 23–5 and 23–6.

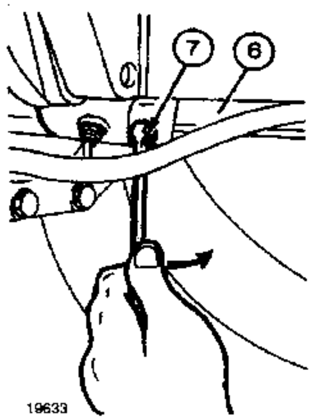
1. Disconnect battery cables and fit suitable wedge blocks under the rear wheel.

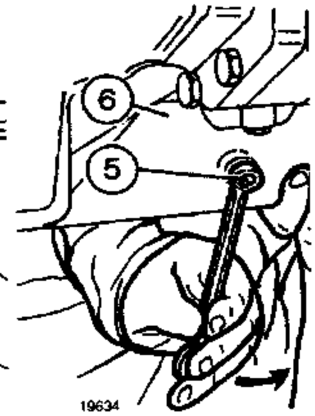


2. Disconnect the differential lock pipe (3) connection from the front–axle bevel gear and pinion housing.

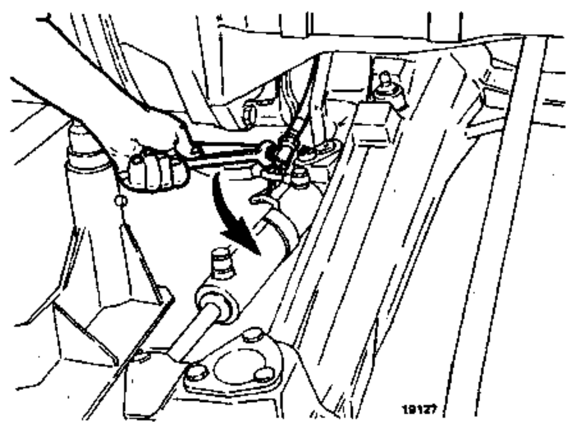


3. Disconnect the front axle differential lock hose (2) from pipe (1).

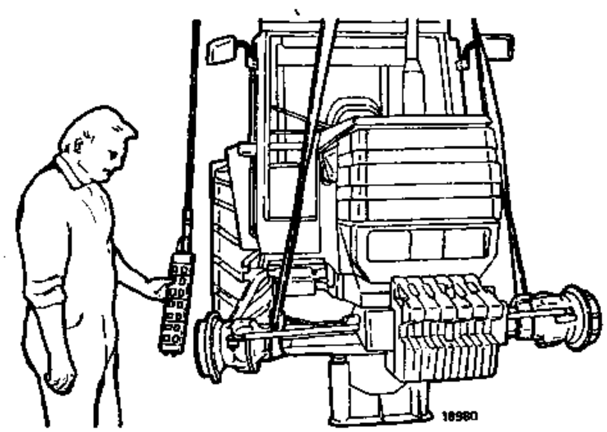




4. Remove the propeller shaft guard after unscrewing the front (7) central and rear (6) fastenings.
5. Back up the sleeve coupling to disconnect propeller shaft from front axle.
6. Lift the tractor front end with an hydraulic jack.
7. Arrange a shop stand under the engine oil sump placing a wood strip in between.
8. Remove front wheels.



9. Remove the two connections from pipes of the hydraulic steering cylinders.



10. Sling up the front axle properly.

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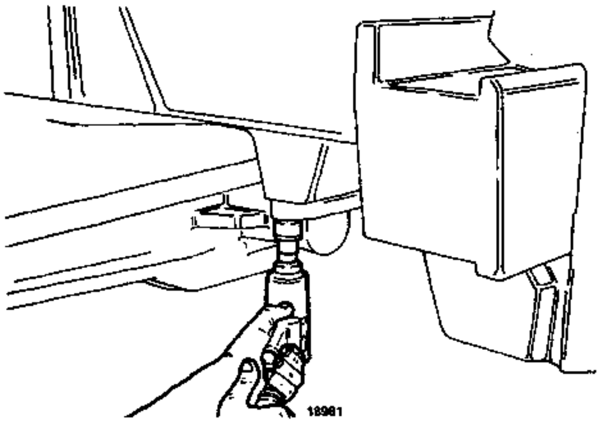
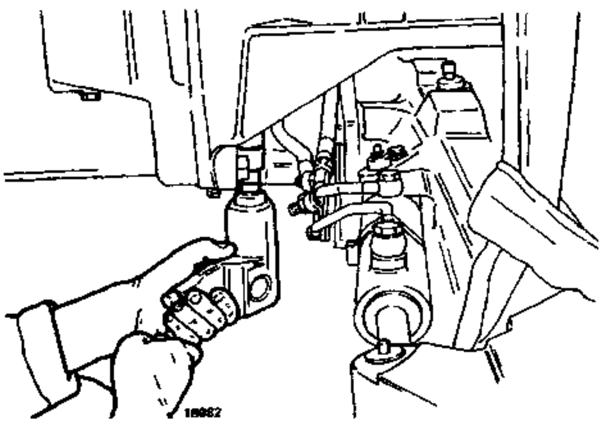


11. Remove the front support screws.



12. Remove the rear support screws and retrieve the front axle.
13. Re–join front axle and engine in accordance with following directions:

    a. proceed by reversing the splitting sequence of operations starting from no. 12 back to no. 1;

    b. tighten fastenings to torque specifications of page 25–3.

FRONT EPICYCLIC–GEAR FINAL DRIVE
Disassembly – Assembly (Op. 25 108 30)

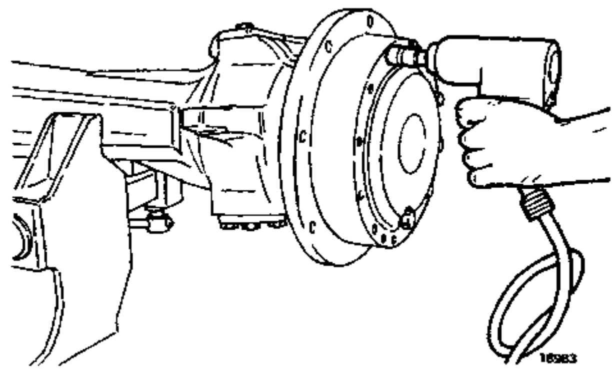
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

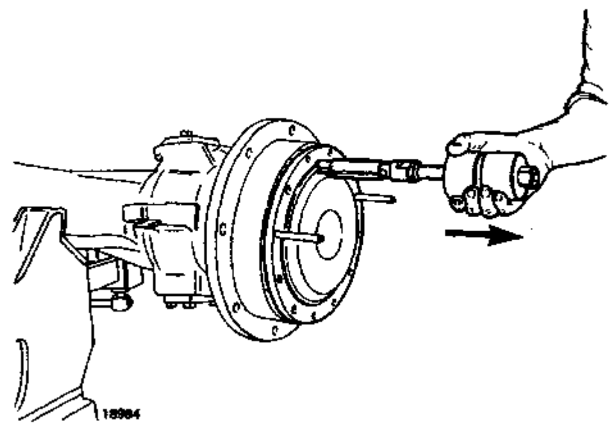
Disassembly and assembly operations of the front epicyclic–gear side final drive can be carried out with the front axle removed from tractor and installed on the disassembly stand tool no. **293460** as well as on the tractor with front–axle installed.

To install the front axle on the stand tool no. **293460** proceed by removing the hydraulic steering cylinders first following information given on page 41–2.

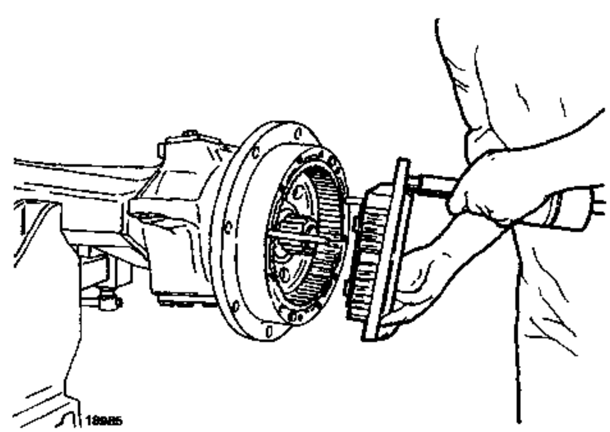
1. Drain oil from final drives.



2. Remove the housing screws and fit two alignment pins tool no. **292868**.



3. Screw into the oil drain plug hole a slide–hammer type extractor and split the housing from mating surface.



4. Remove the epicyclic–gear side final drive case complete with driven gears.

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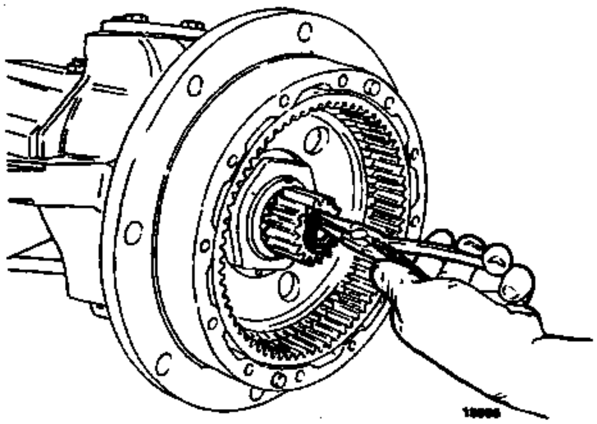
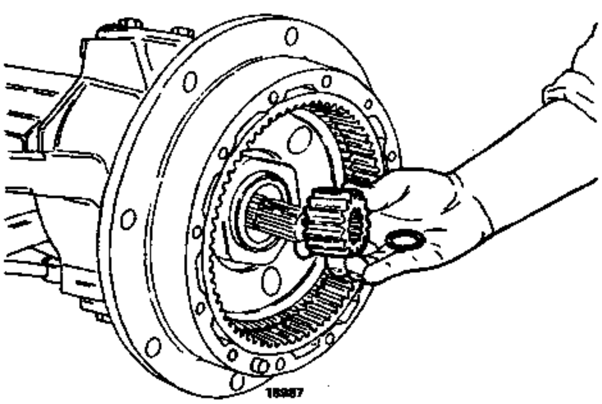
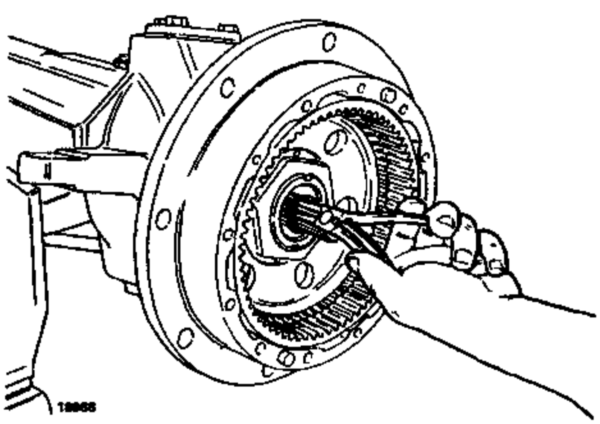


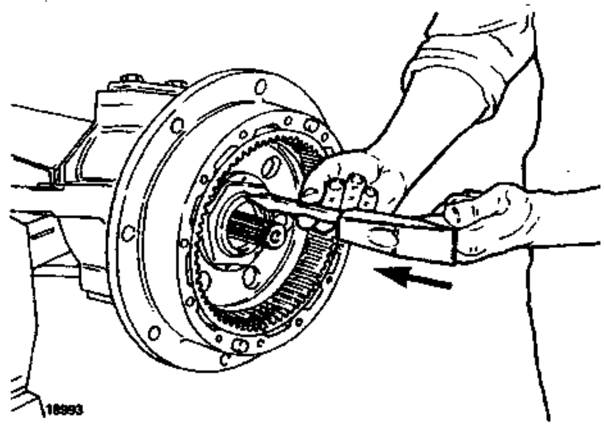
5. Remove the epicyclic sun gear front retaining ring.



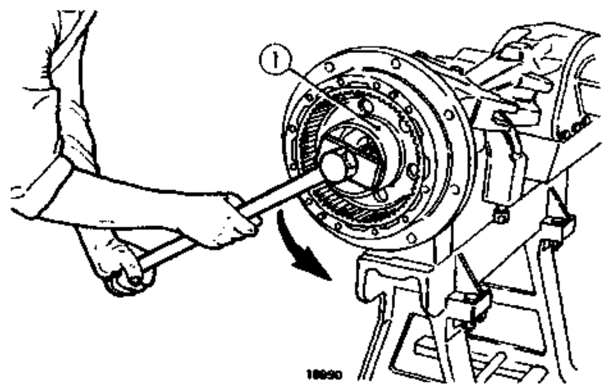
6. Pull off the sun gear.



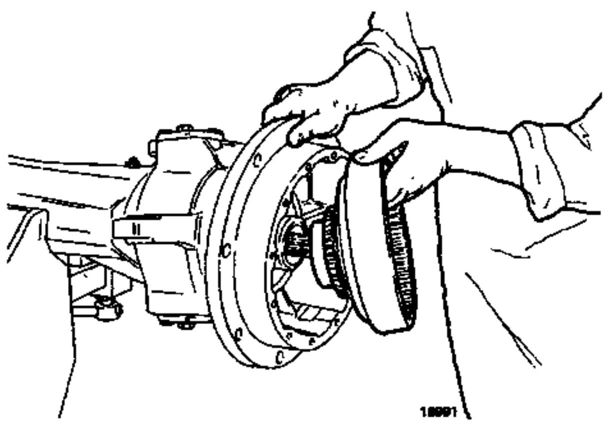
7. Remove the rear retaining ring.



8. Remove the wheel hub bearing lock ring safety lock.



9. Remove the lock ring using special wrench tool no. **293880** (1) on F100DT and F110DT or no. **293881** (1) on F120DT and F130DT.



10. Remove the epicyclic stationary ring gear.
11. Assemble the front epicyclic–gear front side final drive by reversing the disassembly sequence of operations.
12. Install the stationary ring gear and the wheel hub bearing lock ring.

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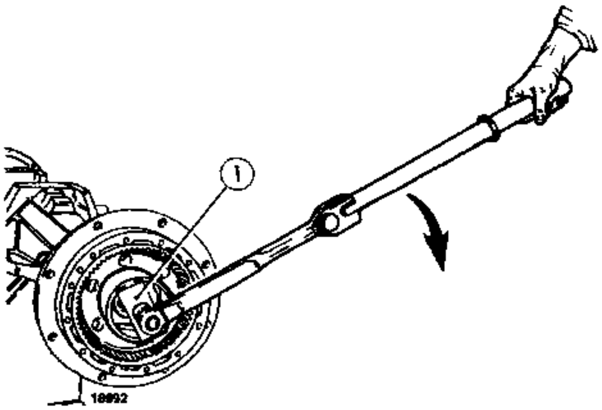
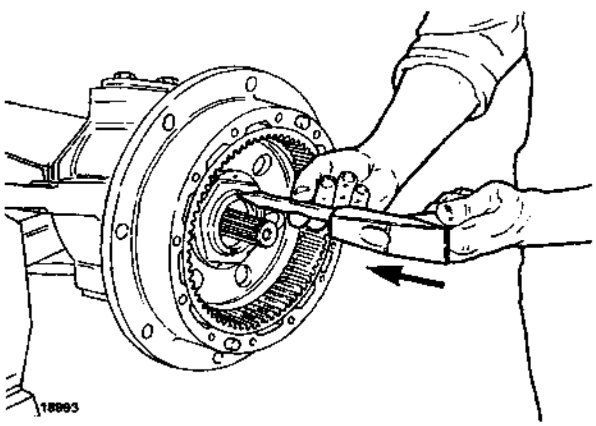


13. Gradually screw on the ring gear using a torque wrench and adapter tool no. **293880** (1) on F100DT and F110DT or **293881** (1) on F120DT and F130DT up to a torque value of 392 Nm – 40 kgm (289 ft.lb) (F100DT and F110DT) or up to a torque value of 490 Nm – 50 kgm (360 ft.lb) (F120DT and F130DT), and keep on turning the wheel hub by hand in order to achieve correct seating of bearings.



14. Fold in the safety washer tab and check by hand that hub spins without play or binding.

15. Install the drive pinion complete with retaining rings and the side final drive case complete with driven gear.

16. Prior to installation of the of the epicyclic final drive case, mating surfaces must be thoroughly cleaned and degreased, then apply a 2 mm (.08 in) diameter bead of a suitable sealing compound following the application scheme shown on page 25–23.

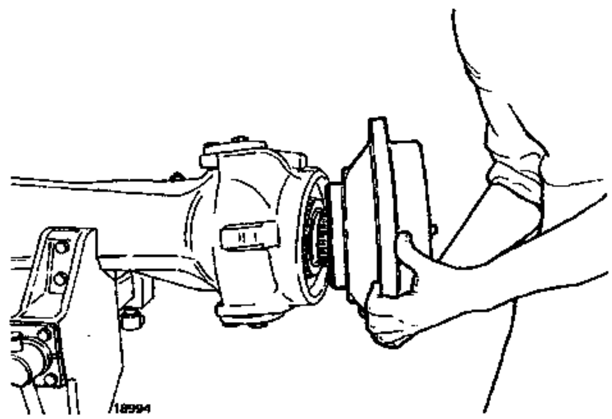
17. Tighten fastenings to torque specifications of page 25–3.

WHEEL HUB AND STEERING KNUCKLE
Disassembly – Assembly (Op. 25 108 38)

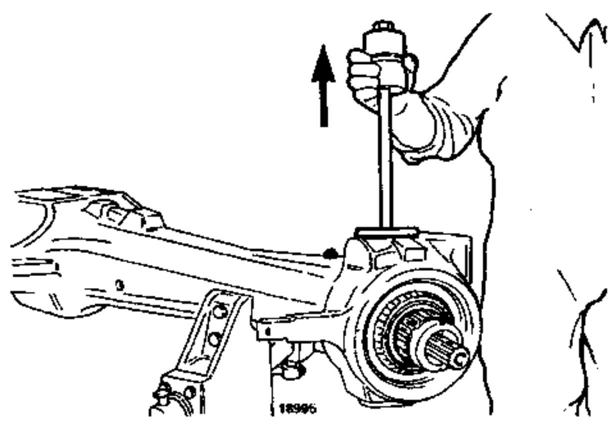
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

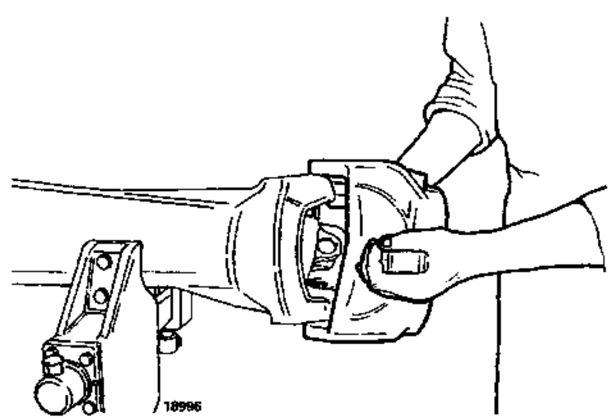
Wheel hubs can be disassembled only after removal of the front epicyclic–gear side final drive as indicated on pages 25–9 and 25–10 by proceeding as follows:



1. Remove the wheel hub.
2. Remove the steering tie–rod (see page 25–13).



3. Remove the kingpin grease nipple, the assembly screws, fit a slide–hammer type puller in the grease nipple hole and finally remove the kingpins.



4. Remove the complete steering knuckle and housing assembly being careful not to damage the inner seal.

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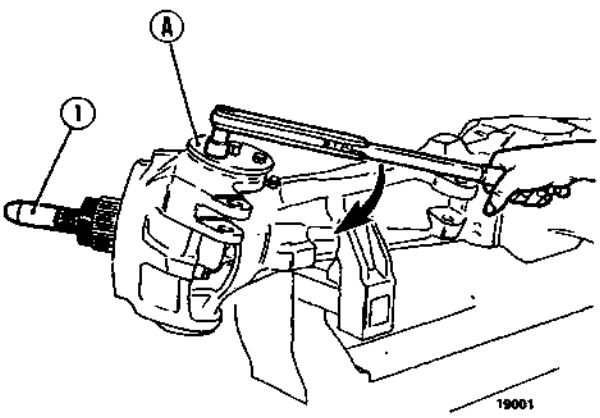
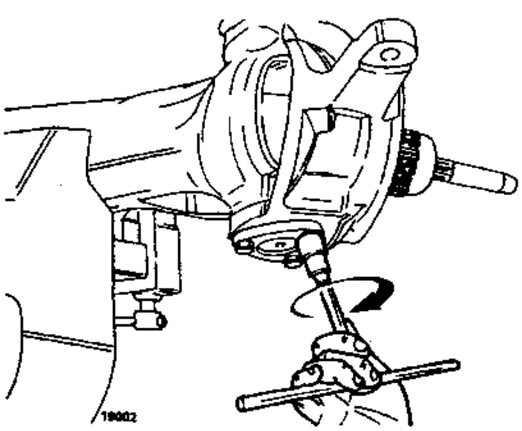
5. Install the wheel hub and steering knuckle by reversing the disassembly sequence of operations and adjusting the kingpin bearings pre–load as per following directions.



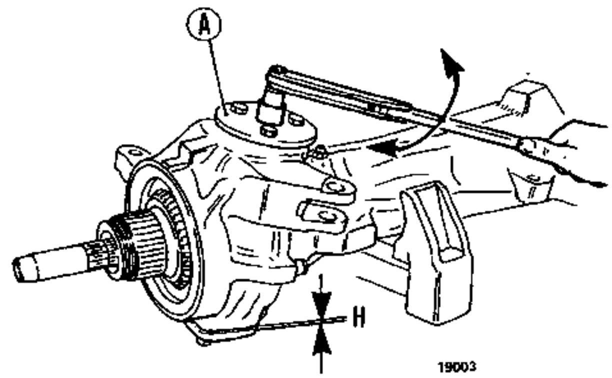
6. Lubricate the bearing outer races with grease (**grassofiat TUTELA G9**) and install top cover, without shims but complete with adapter tool no. **292220/4** (A). Torque–tighten the screws at 113 Nm (11.5 kgm – 83 ft.lb) on F100DT and F110DT or 176 Nm (18 kgm – 130 ft.lb) on F120DT and F 130DT.

Note – Fitting the alignment spigots tool no. **293889** (1) on F100DT and F110DT or **293888** (1) on F120DT and F130DT into the half–shaft will make the steering knuckle installation easier.



7. Install bottom cover without shims, secured by the three retaining screws previously lubricated with engine oil.

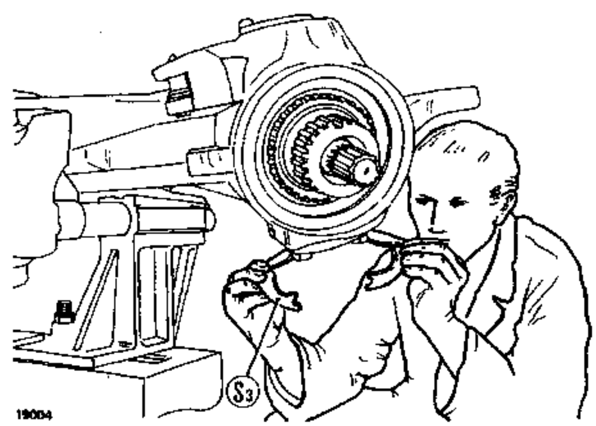
8. Tighten the three bottom cover screws progressively in a staggered sequence and at the same time rock the housing by hand to drain any excess of grease remaining inside.



9. Using a torque wrench and adapter tool no. **292229/4** check that the applied torque necessary to make the carrier swing freely is included between 15 and 25 Nm (1.5 to 2.5 kgm – 11 to 18 ft.lb), break–away torque excluded.

10. Using a feeler gauge, measure the clearance (H) created between bottom cover and housing at three points corresponding to the retaining screws.

11. Make the arithmetic average of the three readings. The shim pack (S_3) thickness to be fitted under the cover is given by:
S_3= H – 0.20 mm (.008 in) on F100DT and F110DT
or
S_3= H – 0.40 mm (.015 in) on F120DT and F 130DT.
If necessary, round off the value in excess within 0.05 mm (.002 in).



12. Slacken the bottom cover screws as needed to insert shim pack (S_3), then torque tighten the same screws at 113 Nm (11.5 kgm–83 ft.lb) on F100DT and F110DT or 176 Nm (18 kgm–130 ft.lb) on F120DT and F130DT.

13. Check that torque needed to swing the carrier, after some initial rocking movements to settle the assembly, is included between 118 and 147 Nm (12 to 15 kgm – 87 to 108 ft.lb) on F100DT and F110DT or 225 and 275 Nm (23 to 28 kgm – 166 to 202 ft.lb) on F120DT and F130DT, break–away torque excluded.

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14. Increase or decrease the shim pack thickness according to the resulting torque value, if respectively higher or lower than specified.

15. Fit nipples on the top and bottom covers and complete the grease packing.

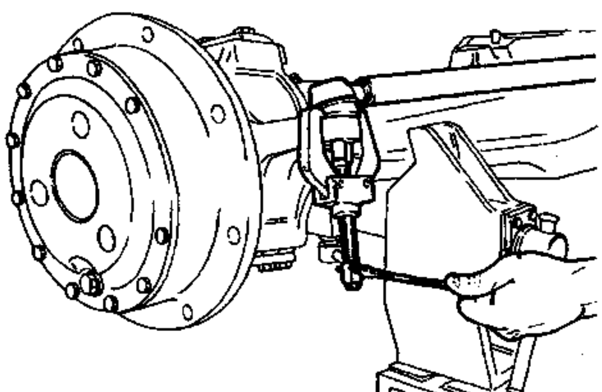
FRONT AXLE BEVEL GEAR DRIVE AND DIFFERENTIAL HOUSING
Removal – Installation (Op. 25 102 15)

CAUTION

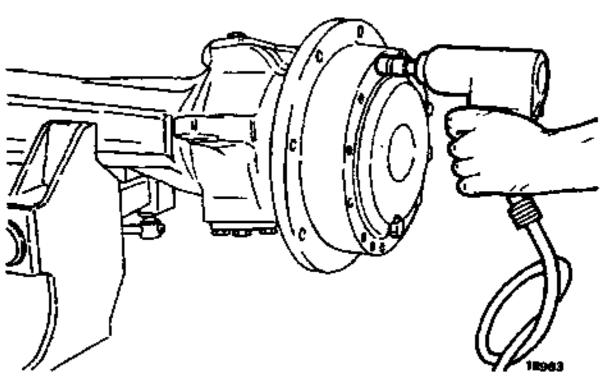
Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

Place the front axle on workshop stand tool no. **293460** then proceed as follows:

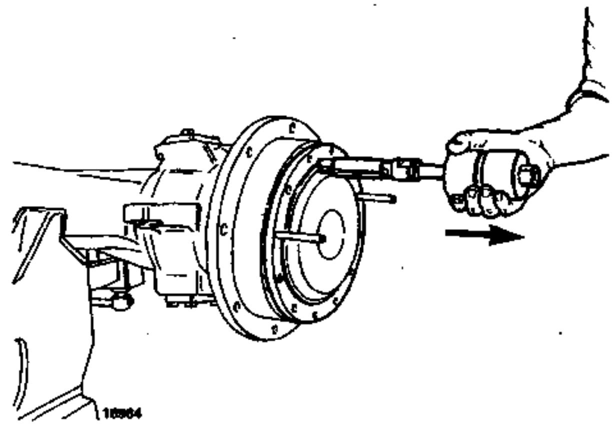
1. Drain oil from final drive and front axle housings.


19011

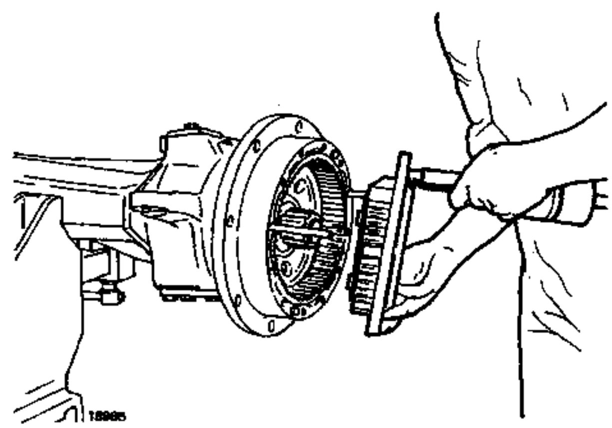
2. Remove the steering tie–rod pin nuts then, using a puller, withdraw the pins from their seats in the steering knuckle carriers and finally retrieve the tie–rod.


18963

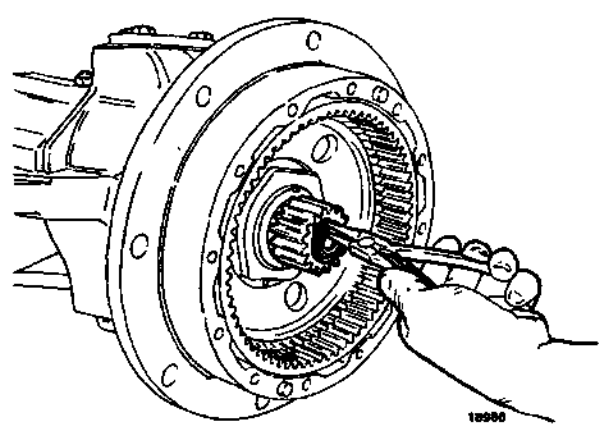
3. Remove the epicyclic–gear side final drive housing screws andfit two alignment pins tool no. **292888**.


18964

4. Screw into the oil drain plug hole a slide hammer–type extractor and split the housing from mating surface.


18965

5. Remove the epicyclic–gear side final drive case complete with driven gears.


18966

6. Remove the epicyclic sun gear front retaining ring.

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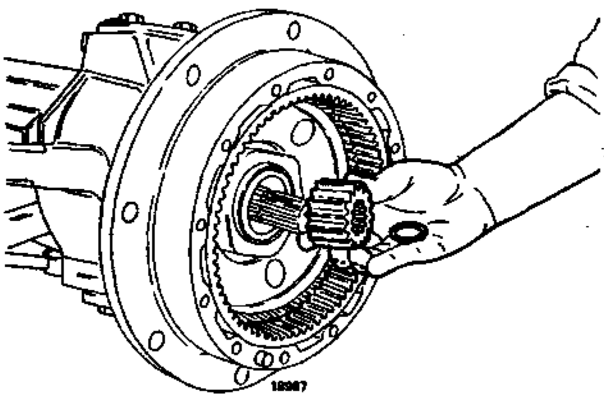
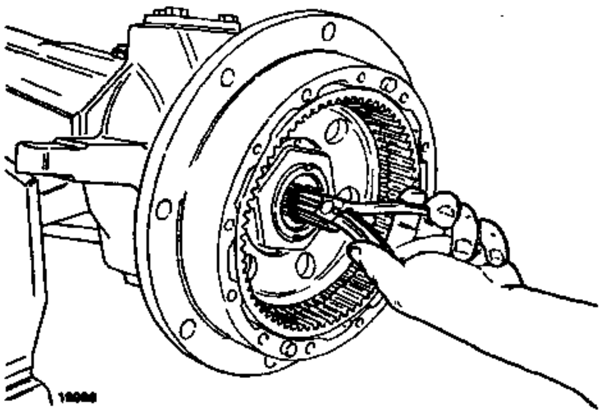
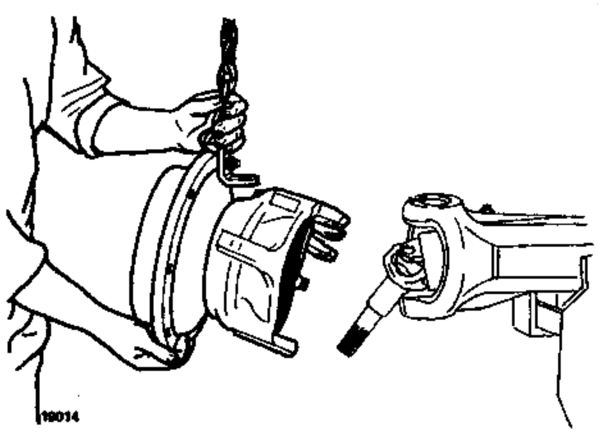


7. Pull off the sun gear.

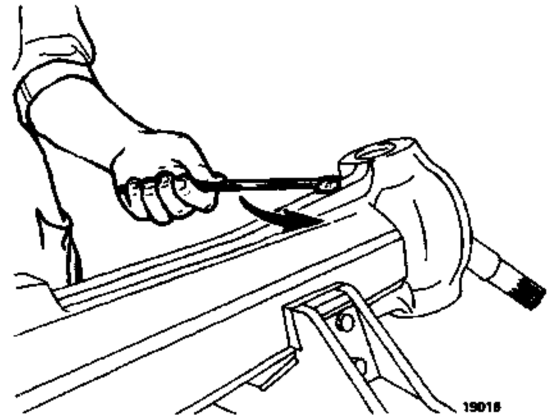


8. Remove the rear retaining ring.

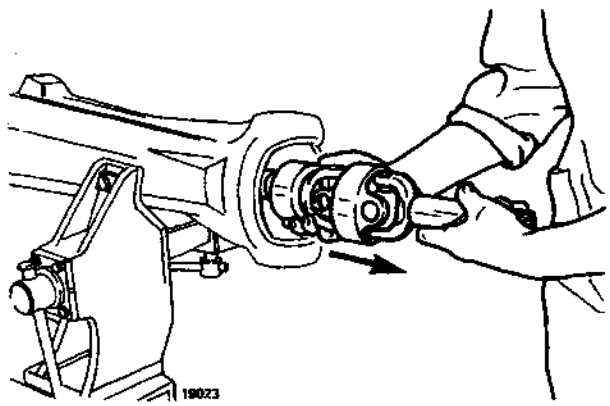
9. Connect the wheel hub complete with steering knuckle carrier to a hoist then remove the kingpins following the information on page 25–11.



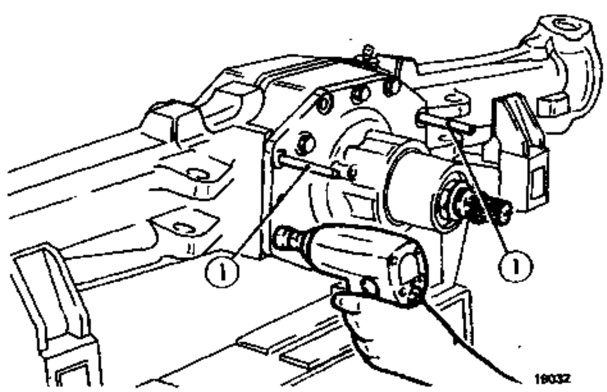
10. Remove the wheel hub complete with steering knuckle carrier being careful not to damage the inner oil seal.



11. Remove the half–shaft retaining screw.



12. Retrieve the half–shaft complete with coupling and bearing housing sleeve.



13. Remove the bevel gear and differential assembly retaining screws and replace them provisionally with two alignment pins (1). Remove the remaining screws making sure that the bevel gear and differential carrier is fully supported by the two pins (1).

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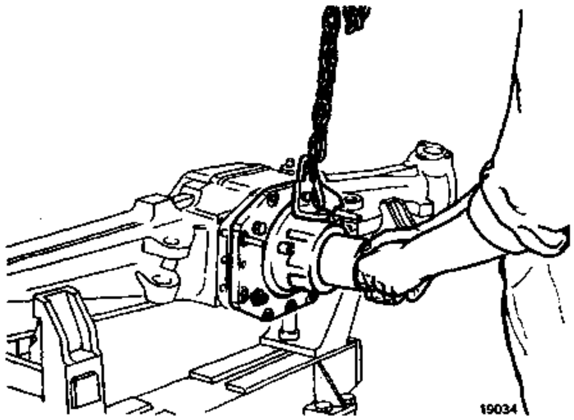
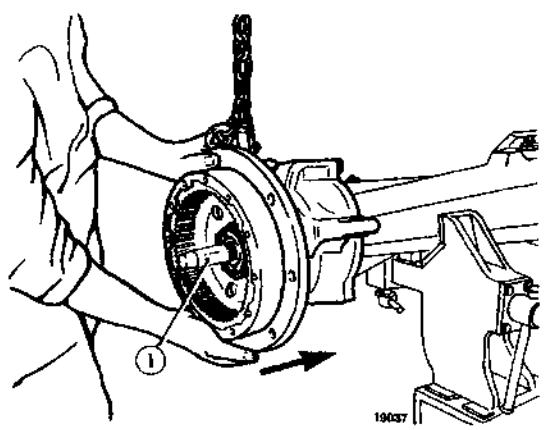


14. Connect the bevel gear and differential carrier to a hoist and remove it from the front axle.

15. Subsequently, at installation, proceed by reversing the removal sequence of operations taking good notice of the additional remarks and directions that follow:



16. Fitting the alignment spigots tool no. **293889** (1) on F100DT and F110DT or **293888** (1) on F120DT and F130DT on the half–shaft will make the installation of the wheel hub and steering knuckle on carrier easier.

17. Adjust the steering kingpin bearing pre–load following directions on page 25–12, operations 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15.

18. Install the final drive epicyclic sun gear complete with retaining rings.

19. Install the final drive case complete with driven gears.

20. Install the steering tie–rod.

21. Fill up the final drives and front axle with prescribed quantities of oil.

22. Prior to re–joining housing, support and cover mating surfaces, make sure to clean and degrease the same thoroughly and to apply a bead of sealing compound about 2 mm (.08 in) thick following the schemes shown on page 25–23.

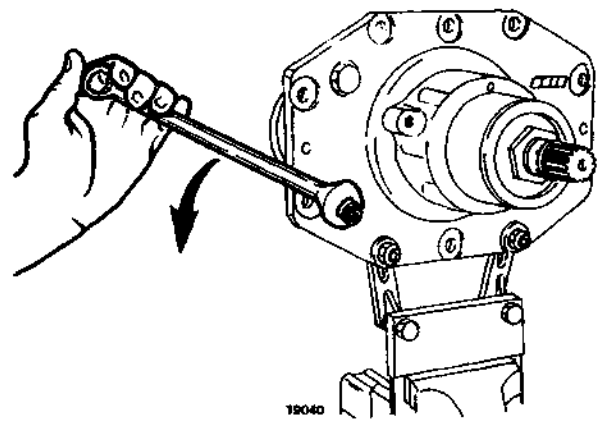
23. Torque tighten fastenings to specifications of page 25–3.

FRONT DIFFERENTIAL LOCK CLUTCH
Overhauling (Op. 25 104 34)

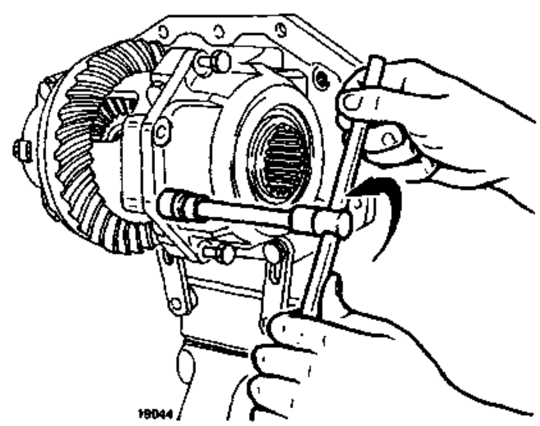
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts..
Wear safety equipment such as goggles, gloves and special shoes.

Place the bevel gear and differential assembly on stand **293743** and proceed as follows:



1. Remove the oil delivery line connection .



2. Remove the differential lock bell cover upper and lower screws and replace them provisionally with two screws (2) at least 70 mm (2–3/4 in) long. Gradually slacken the remaining four screws to allow gradual unloading of the differential lock release spring.

Note – The minimum length of the two provisional screws as above specified is necessary because the normal outer bell fastening screws are not long enough to allow the spring to fully return to free length.

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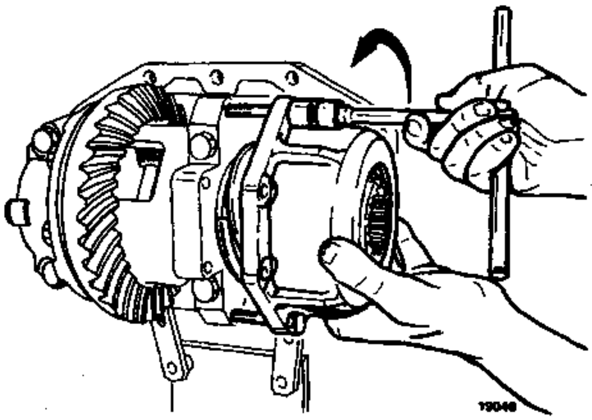
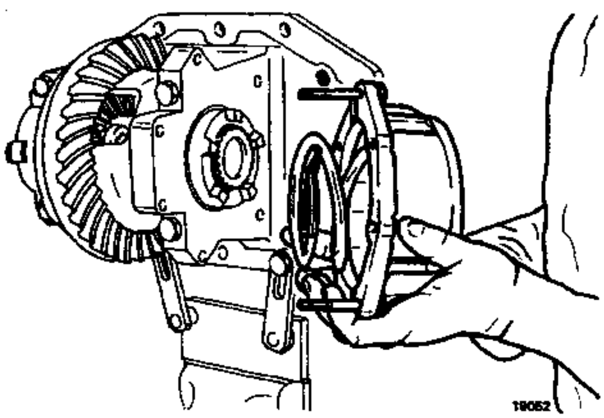
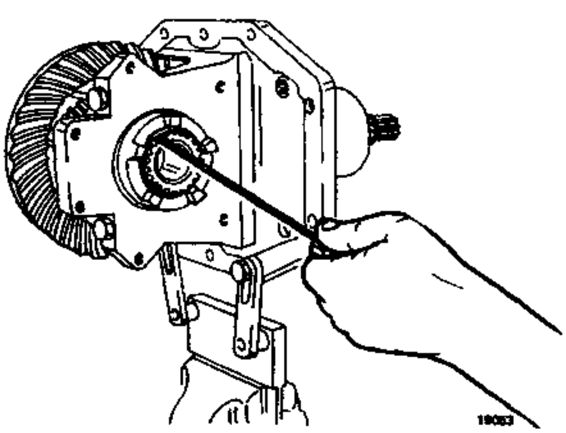


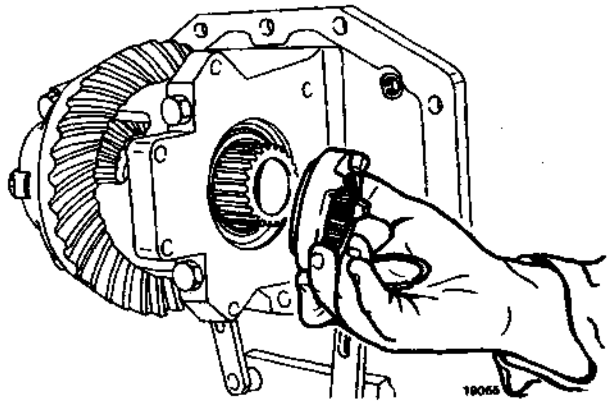
3. Last, unscrew the two 70 mm (2–3/4 in) long provisional screws.



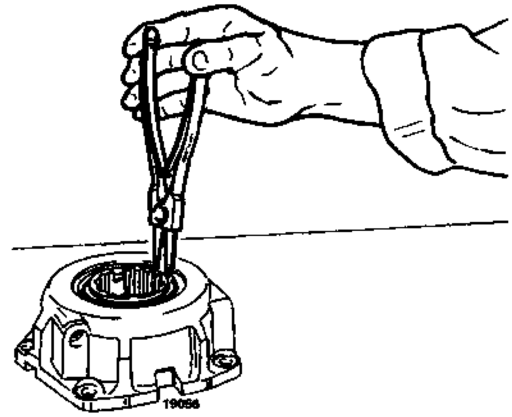
4. Remove the clutch bell housing complete with differential lock release spring and piston.



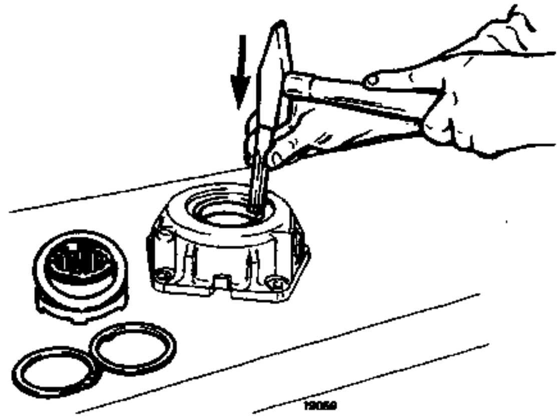
5. Remove the differential lock sleeve coupling securing wire.



6. Release the differential lock coupling.



7. Remove the differential lock piston retaining ring and retrieve the coupling together with the two thrust washers.



8. Act **smoothly and evenly** with hammer and punch on the piston to remove it from bell housing.

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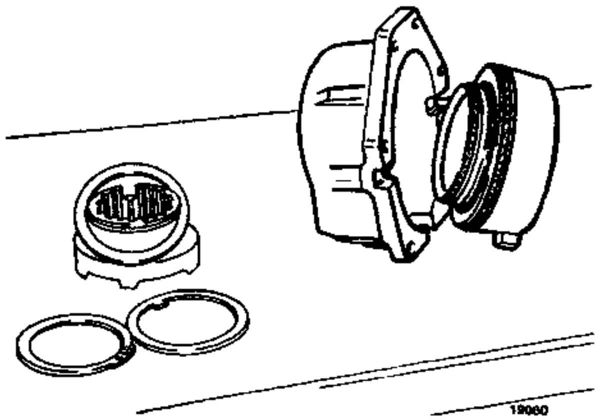
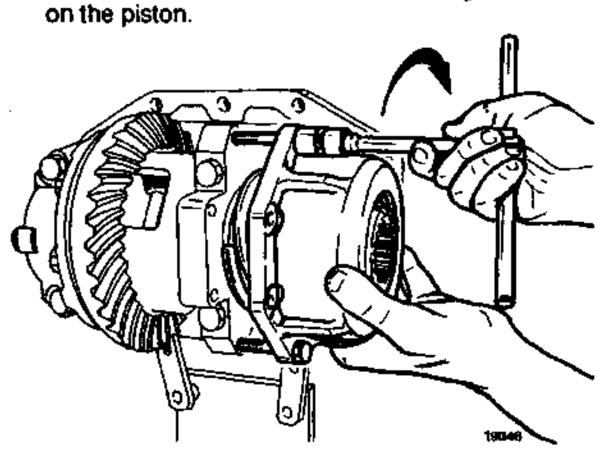
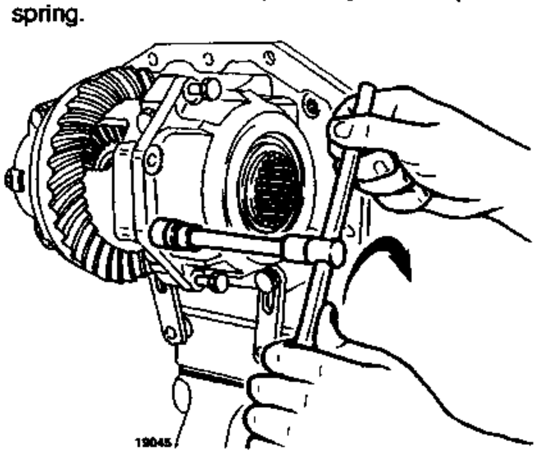


9. Remove the differential lock actuating piston.
10. Install the component parts of the differential lock clutch by reversing the removal sequence of operations and taking good notice of the additional remarks and directions that follow:
11. Check the conditions of the two O–ring seals fitted on the piston.



12. Install the clutch bell housing, complete with differential lock spring and piston, on the differential carrier, using the two provisional 70mm (2–3/4 in) screws and tightening them gradually to compress the spring.



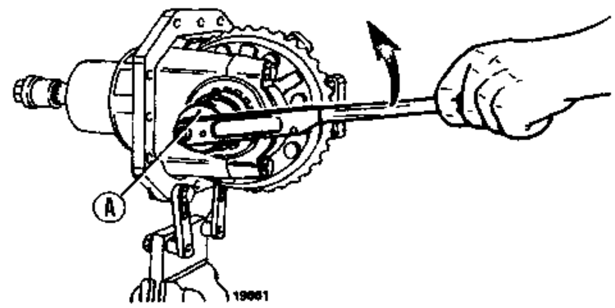
13. Fit the four original screws, remove the two provisional 70 mm ones just used to compress the spring and then complete by replacing them with the remaining original fastenings.

FRONT AXLE BEVEL GEAR AND PINION
Overhauling (Op.25 102 20)

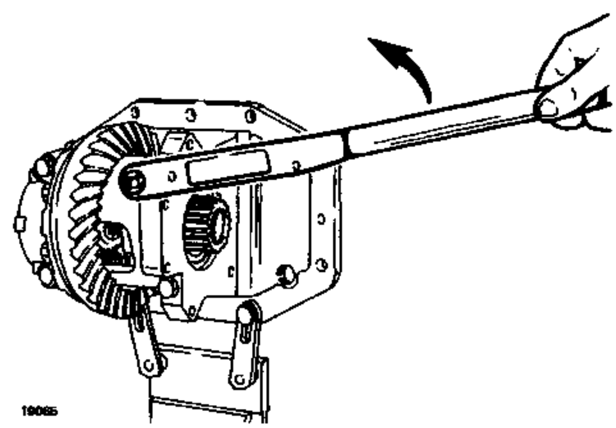
⚠ CAUTION ⚠

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

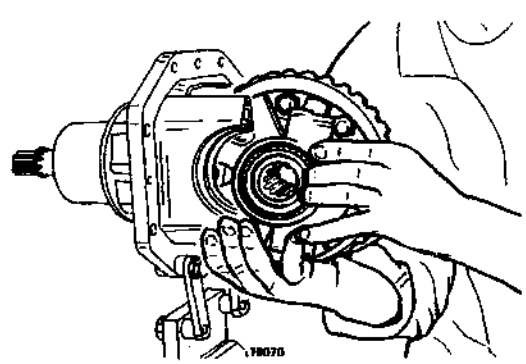
1. Remove the ring gear lock washer stop.



2. Slacken the ring gear bearing adjustment ring using the wrench tool no. **293665** (A) on F100DT–F110DT or **2293798** (A) on F120DT and F130DT.



3. Remove the bevel gear–differential carrier caps attachment screws.



4. Remove ring gear retrieving the shim packs from the opposite side of the adjustment ring.

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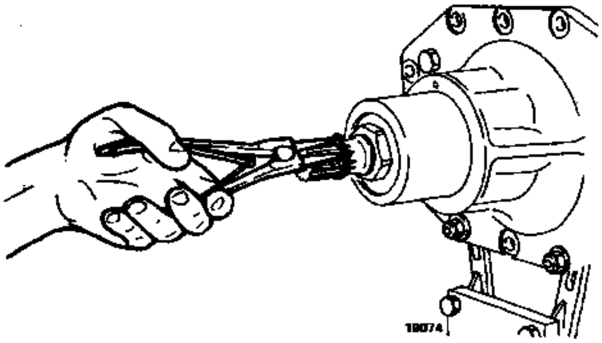
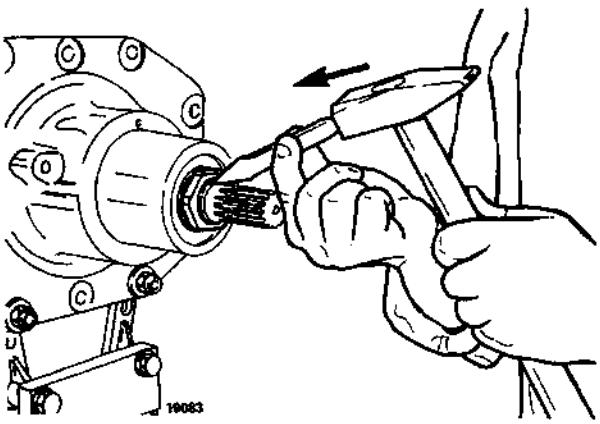
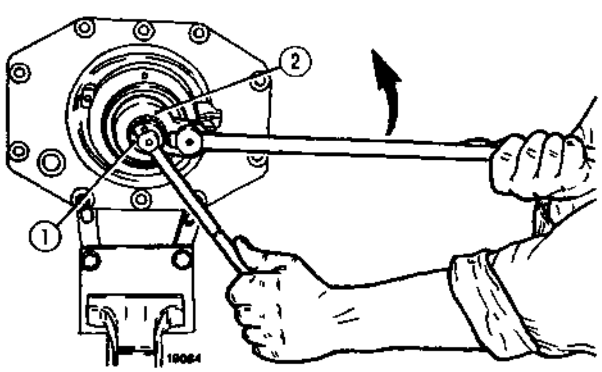


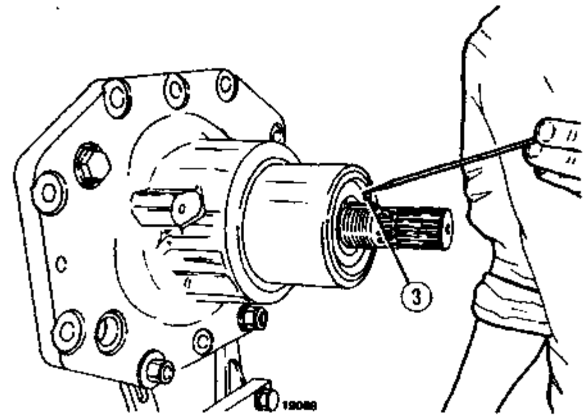
5. Remove the retaining ring fitted on bevel pinion shaft.



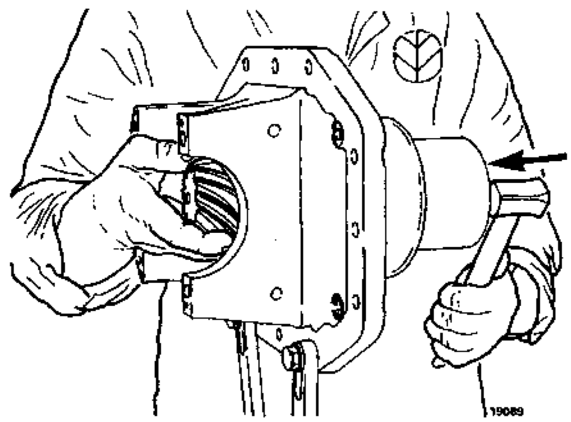
6. Flatten out the bevel pinion shaft lock ring tab.



7. Remove bevel pinion lock ring using wrench tool no. **293878** (2) and the pinion stop wrench tool no. **293876** (1) on F100DT and F110DT, or equivalent tools **293879**(2) and **293877**(1) on F120DT and F130DT.



8. Retrieve the stop ball (3).



9. Pull out the bevel pinion shaft acting with a soft hammer on its back end.
10. Remove the dust ring and oil seal then retrieve rear bearing and spacer.
11. Re–assemble the bevel drive in accordance with the following directions:

    a. proceed by reversing the disassembly sequence of operations starting from no. 10 back to no. 1;

    b. see illustrations on pages 25–4 and 25–5 for correct placement and orientation of component parts;

    c. torque tighten fastenings to specifications of page 25–3;

    d. carry on the adjustments according to instructions given on pages 25–19, 25–20, 25–21, 25–22 and 25–23.

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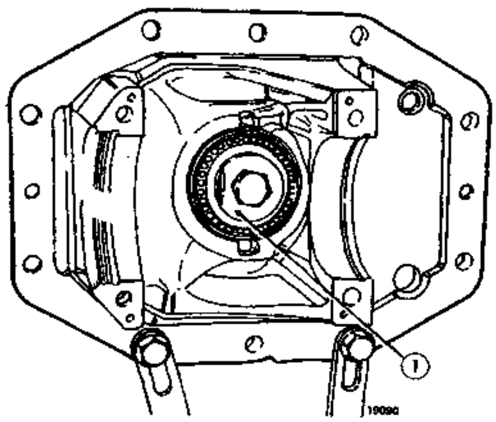
BEVEL GEAR AND PINION ADJUSTMENTS

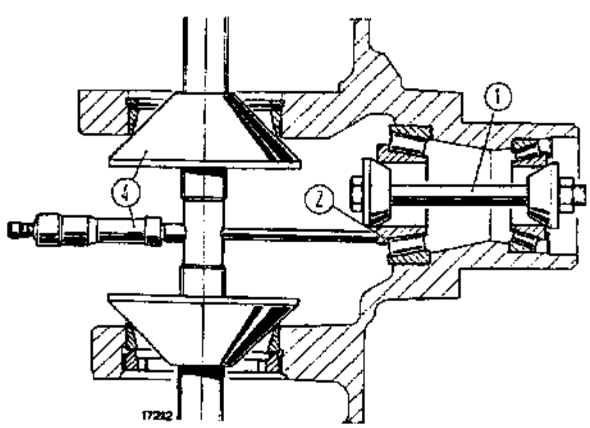
Finding the bevel pinion adjustment shim thickness (S2, page 25–1)

12. Make in the workshop the tool no. **50048** following the directions given in the working drawing on page 25–6 (the same tool applies as well to modified front axles of tractors of the 90 range from 70–90DT to 180–90DT).

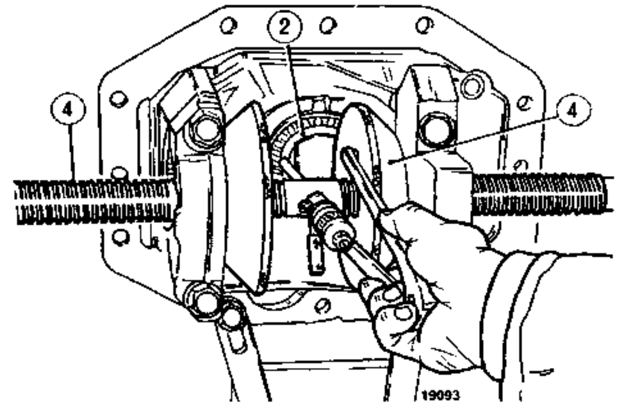


13. Install the tool **50048**(1), previously made,complete with the inner races of the bevel pinion bearings, in the bevel gear–differential carrier, the latter complete with the outer races of the same bearings.

14. Screw on the tool nut and at the same time keep un turning the tool by hand to ensure correct bedding of the bearings.



15. Install tool **293400/1**(4) in the bevel gear–differential carrier complete with the bearing outer races, ring gear bearing pre–load adjustment ring, shim pack, retaining ring and differential housing supporting caps.



16. Screw or unscrew the cones of tool **293400/1**(4) to direct the micrometer tip towards the inner race of bearing (2) and eliminate any existing end play between the tool cones (4) and outer races of the ring gear bearings.

17. Act on the micrometer to bring the tip against the inner ring of bearing (2) then take the reading of dimension (H_5).

18. Determine the nominal correct dimension (H_7) between ring gear center line and pinion back surface.

$$H_7 = H_6 \pm C$$

where:

H_6 = 115 mm (4.527 in) on F100 and F110 or 122.5 mm (4.823 in) on F120 and F130. Nominal dimension between ring gear center line and bevel pinion back surface.

C = correction factor stamped on bevel pinion and preceded by the sign + or – if different from 0, to be added or subtracted from the nominal dimension (H_6) according to the sign indication.

19. Thickness of shim (S_2, page 25–1) will be given by:

$$S_2 = H_5 - H_7$$

where:

H_5 = micrometer reading;

H_7 = corrected nominal dimension between ring gear center line and bevel pinion back surface.

Example (F100DT and F110DT):

– Micrometer reading H5 = 118 mm (4.645 in).
– Nominal dimension between ring gear center line and bevel pinion back surface H6 = 115 mm (4.527 in).
– Correction factor C = + 0.2 mm (.008 in).
– Corrected nominal value H_7 = 115 + 0.2 = 115.2 mm (4.527 + .008 in)
– Adjustment shim thickness
  S_2 = 118 – 115.2 = 2.8 mm
  (4.645 – 4.535 = .110 in).

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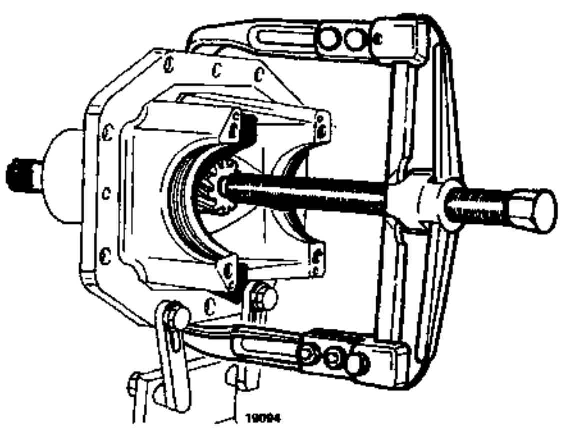
- Correction factor C = – 0.2 mm (.008 in)
- Corrected nominal value H_7 = 115 – 0.2 = 114.8 mm (4.527 – .008 = 4.519 in)
- Thickness of shim S_2 = 118 – 114.8 = 3.2 mm (4.645 – 4.519 =
- Correction factor C = 0
- Corrected nominal value H_7 = H6 =115 mm (4.527 in).
- Adjustment shim thickness S_2 = 118 – 115 = 3 mm (4.645 – 4.527 = .118 in)

BEVEL GEAR AND PINION ADJUSTMENTS

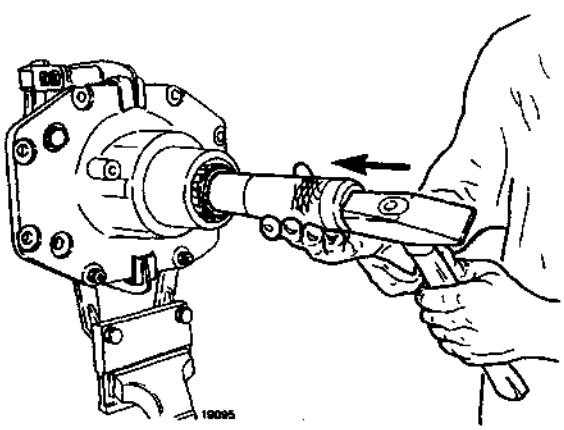
Bevel pinion shaft bearing pre–load adjustment.

20. Position the bearing outer races correctly in their respective seats.

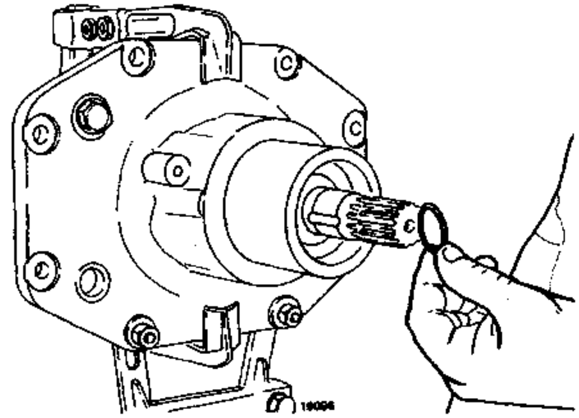
21. Install in the carrier the bevel pinion complete with the front bearing inner ring and the adjustment shim (S_2, page 25–1) found previously.



22. Attach the bevel pinion to the bevel gear–differential carrier with a universal puller.

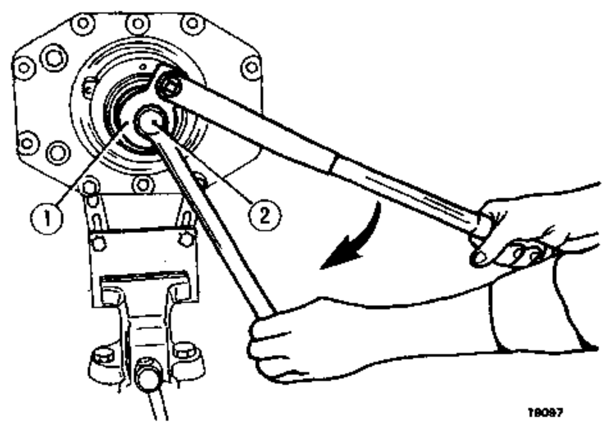


23. Fit on the bevel pinion the inner ring of the rear bearing and using,a suitable tool and hammer, drive it up to 2 to 3 mm (.08 to .12 in) from the outer race (this distance can be easily controlled by hand on the pinion).



24. Fit the O–ring on the shaft.

25. Install the spacer, after thorough lubrication of its surface, the turning–stop ball, the oil seal (17, pages 25–4 and 25–5), previously luricated in oil bath, and finally the dust shield and adjustment ring nut.



26. Fit the pinion retainer wrench tool no. **293876** (2) on F100DT and F110DT or the equivalent **293877** (2) on F120DT and F130DT.

27. Apply on the adjustment ring the wrench tool no. **293878**(1) on F100DT and F110DT or the equivalent **293879** (1) on F120DT and F130DT.

28. With the aid of a wrench applied onto the pinion retainer wrench (2) hold the bevel pinion stationary and, using a torque wrench applied exactly as shown in the figure on the ring nut wrench (1),screw in the adjustment ring up to reaching the torque value of 108 Nm (11 kgm – 79 ft.lb) while turning the bevel pinion shaft by hand.

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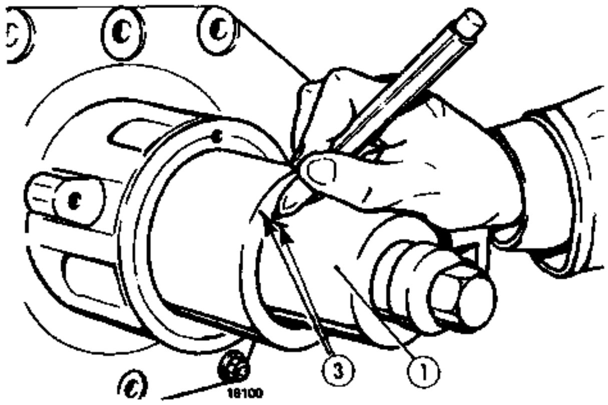
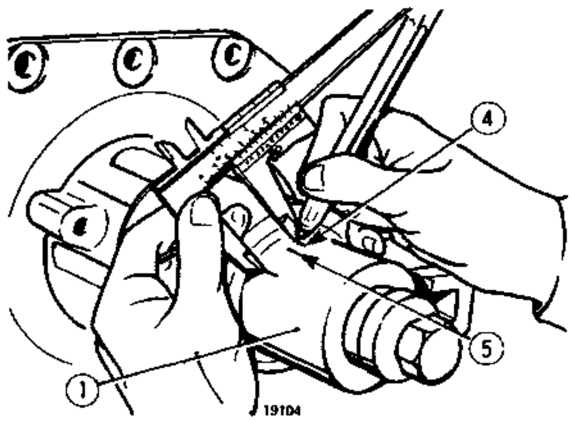
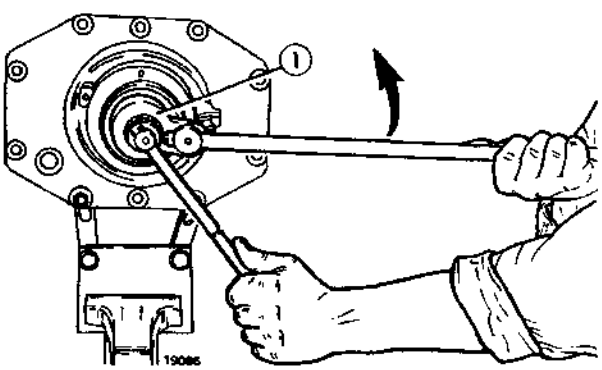


29. Trace two reference marks (3), one on the lock ring wrench (1) and the other on the bevel gear housing corresponding exactly to the sign traced on the wrench.

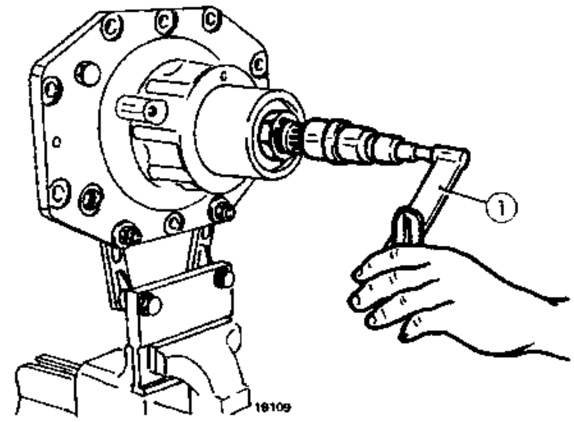


30. With the aid of a caliper trace, on the right, two new reference marks (4 and 5) on the ring nut wrench (1), respectively at a distance of 14.5 and 23 mm (.57 and .90 in) from the mark traced first.

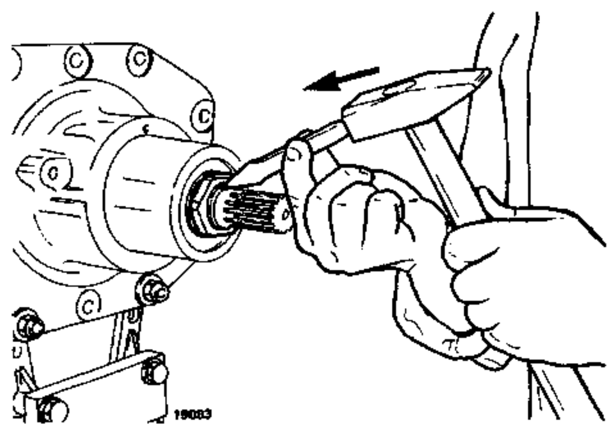


31. Holding the pinion stationary by using the specific wrench, unscrew the adjustment ring until the reference mark traced on the bevel gear and differential housing is included between the two marks (4 and 5) traced on the ring wrench (1).

Note – The two marks (4 and 5) made previously on the ring wrench correspond to a backing off of the ring of 1/16 to 1/10 of a full turn, that is to an angle of displacement of 22.5 to 36 degrees.



32. Check with torque wrench (1) tool no. **293952** applied to the ipinion retainer wrench **293876** (F100DT–F110DT) or **293877** (F120DT– F130DT) that the pinion rotating torque is less than 0.75 Nm (0.075 kgm – .54 ft.lb). If otherwise, slacken the pinion lock ring, back off the rear bearing inner race and repeat the adjustment operation from the start.



33. Accurately lock punch the ring rim, then fit the retaining ring on the pinion shaft.

BEVEL GEAR AND PINION ADJUSTMENTS

Bevel gear bearings adjustment – Checking the bevel pinion and gear tooth backlash.

Proceed as follows:

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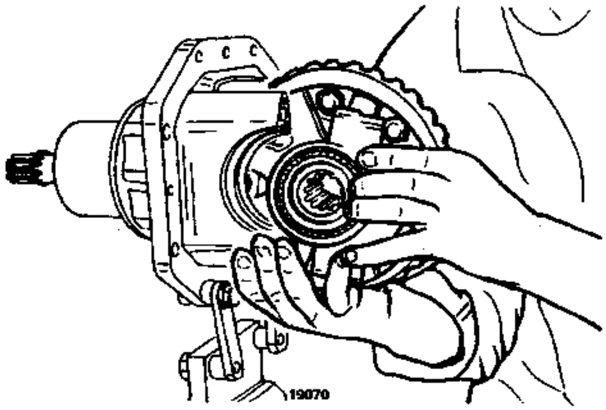
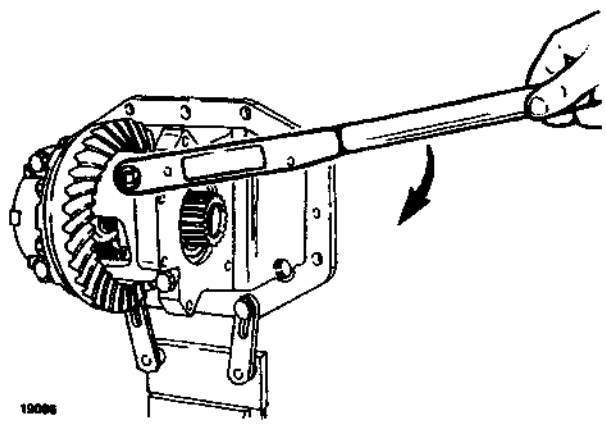
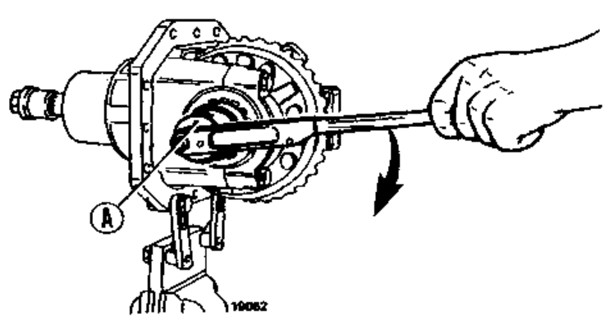


34. Install the differential assembly complete with bevel ring gear and bearings inner races on the bevel gear–differential carrier.

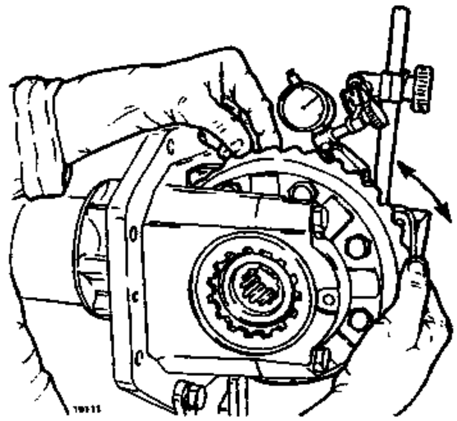


35. Introduce the bearing outer races in the bevel gear – differential carrier, fit the differential housing caps, torque– tighten the capscrews to 59 Nm (6 kgm – 43 ft.lb), slacken them and finally re–tighten at 20 Nm (2 kgm – 14 ft.lb).

36. Install the shim pack (S_1, page 25–1) removed previously during overhauling of the front axle and complete with the retaining ring.



37. Lubricate bearings thoroughly, turn the bevel ring gear while acting on the lock ring with the wrench **293665** (A) on F100DT and F110DT or the equivalent **293798** (A) on F120DT and F130DT until reaching a torque value of 29 to 49 Nm (3 to 5 kgm – 21 to 36 ft.lb) that will ensure that any end play existing among components is taken up completely.



38. Measure the bevel pinion and gear tooth backlash by placing a dial gauge comparator perpendicularly on the outside of any ring gear tooth.

39. Repeat the same measurement at two other positions 120° from each other and compare the average of the three values against specified standard value of 0.18 to 0.23 mm (.007 to .009 in), **0.20 mm (.008 in) average**.
In case the backlash found is higher than the standard value, the final shim pack (S_1, page 25–1) thickness to be fitted should be less than existing one.The thickness of the final shim pack (S_1, page 25–1) to be fitted in the bevel gear and differential carrier will be given by:

$$S_1 = Sp - \{(Gm - 0.20) \times 1.35\}$$

where:

Sp = thickness of trial shim pack fitted on the bevel gear and differential carrier;
Gm = average tooth backlash reading on bevel pinion and gear.

Should instead the backlash reading be less than the specified value, increase the thickness of the shim pack (S_1, page 25–1), the value of which is given by:

$$S_1 = Sp + \{(0.20 - Gm) \times 1.35\}$$

where

Sp = thickness of trial shim pack fitted on the bevel gear and differential carrier;
Gm = average tooth backlash reading on bevel pinion and gear.

40. Fit the calculated shim pack (S_1, page 25–1) and, with a caliper placed perpendicularly on the outside of any ring gear tooth, check that the bevel gear and pinion toooth backlash is within the specified tolerance range of 0.18 to 0.23 mm (.007 to .009 in).

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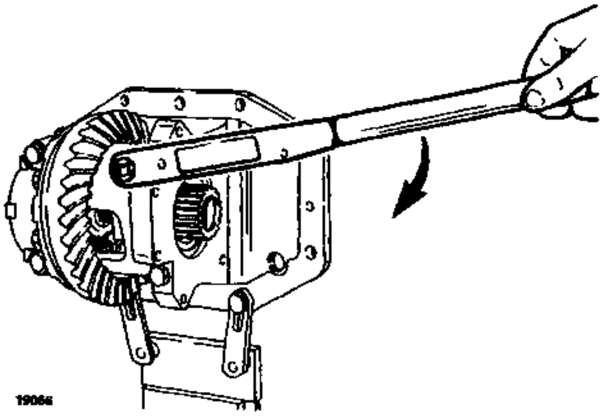
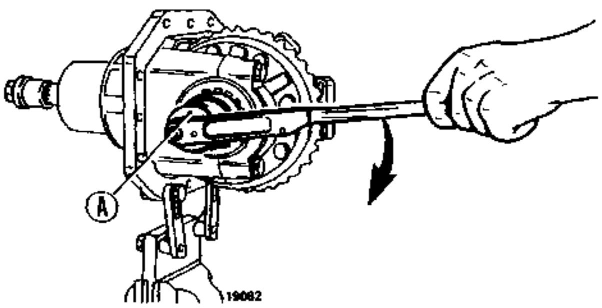
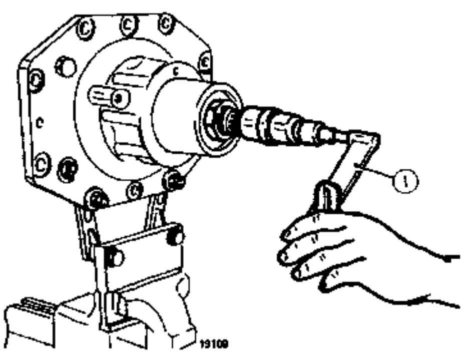


41. Torque –tighten cap screws at the value of 113 Nm (11.5 kgm – 83 ft.lb) on F100DT andF110DT or at 176 Nm (18 kgm – 130 ft.lb) on F120DT and F130DT.



42. Act on the adjustment ring nut with wrench tool no. **293665**(A) on F100DT and F110DT or the equivalent **293798**(A) on F120DT and F130 DT and



Using torque wrench (1) tool no. **293952**, check that the bearing rolling torque on bevel pinion and gear assembly, measured under the same conditions of pinion only, is:

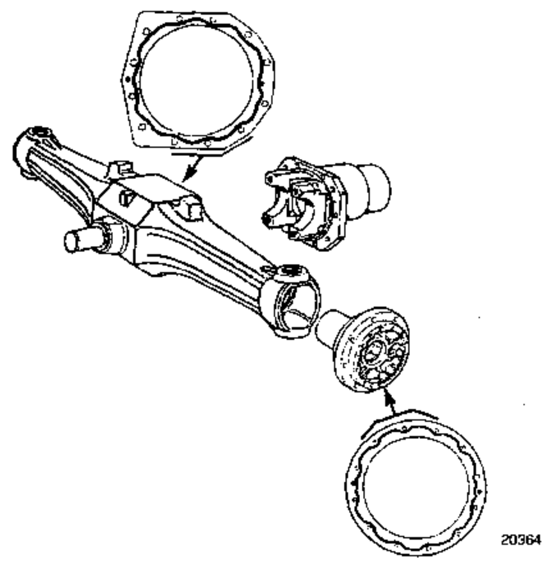
$$\mathbf{A_2 = A_1 + 0.5 \text{ to } 1 \text{ Nm}}$$
(0.05 to 0.1 kgm – .71 to 1.42 ft.lb)

where:
A_2 = bevel pinion and gear bearing rolling torque;
A_1 = pinion only bearing rolling torque as per previous reading;

0.5 to 1 Nm (0.05 to 0.1 kgm) = rolling torque for the bevel ring gear only, measured at pinion end with wrench **293876** (F100DT and F110DT) or equivalent **293877** (F120DT–F130DT) and torque wrench **293952**.

43. Fit the lock washer either screwing or unscrewing the adjustment ring until reaching the nearest tab.

44. Secure the bevel gear–differential carrier onto the front axle case after thoroughly cleaning and degreasing mating surfaces and previous application of a bead of sealing compound about 2 mm (.08 in) thick, following the scheme illustrated in the figure



Sealing compound application scheme.
Indications for the choice of suitable sealing compounds are given on pages 25–4 and 25–5.

FRONT AXLE DIFFERENTIAL
Overhauling (Op. 25 102 24)

Overhauling operations include the adjustment of differential gears and pinions tooth backlash.
Proceed as follows:

1. Wash component parts thoroughly to remove any trace of grease that might alter the backlash reading.
2. Install the two side gears in the differential housing.
3. Introduce pinions complete with respective thrust washers and pins and turn in the pin screws sufficiently to prevent the pins from coming off.
4. Place a comparator gauge on the differential housing.

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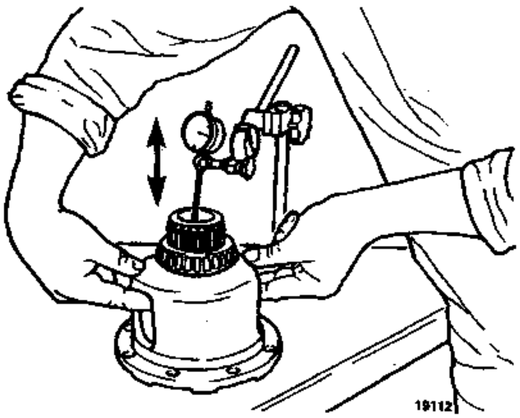
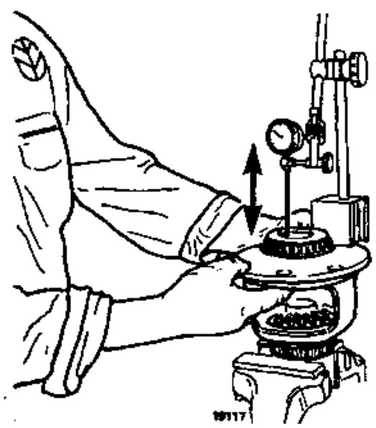


5. Bring the L.H. side gear fully in contact with the pinion and then push it against the differential housing; read on the comparator gauge dial the end play (G_s) of the L.H. side gear.



6. Repeat on the R.H. side gear and take the reading of end play (G_d).

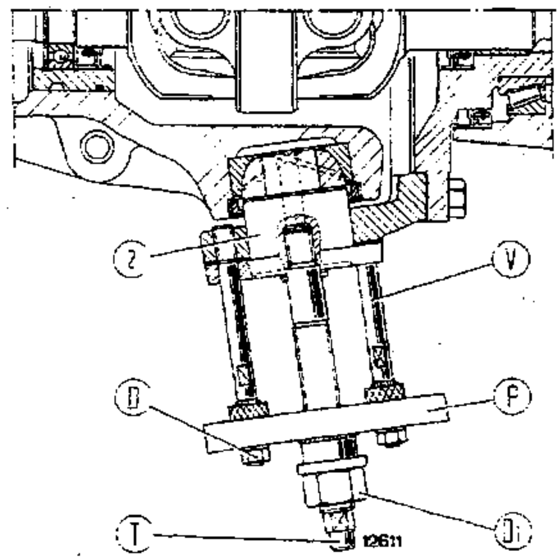
   The axial displacement specification is **0.25 mm (.010 in)** on F100DT and F110DT and **0.30 mm (.012 in)** on F120DT and F130DT.
   Consequently the shim thickness to be installed will be:
   $S_s = G_s$ – 0.25 mm (.010 in) for the L.H. side gear on F100DT and F110DT
   $S_d = G_d$ – 0.25 mm (.010 in) for the R.H. side gear on F100DT and F110DT
   $S_s = G_s$ – 0.30 mm (.012 in) for the L.H. side gear on F120DT and F130DT
   $S_d = G_d$ – 0.30 mm (.012 in) for the R.H. side gear on F120DT and F130DT.

7. Introduce the shims of the nearest thickness with respect to the correct value and, using a comparator and in accordance with the above directions, check that end play of R.H. and L.H. side gears approaches the values of 0.25 mm (.010 in) on F100DT–F110DTand of 0.30 mm (.012 in) on F120DT–F130DT).

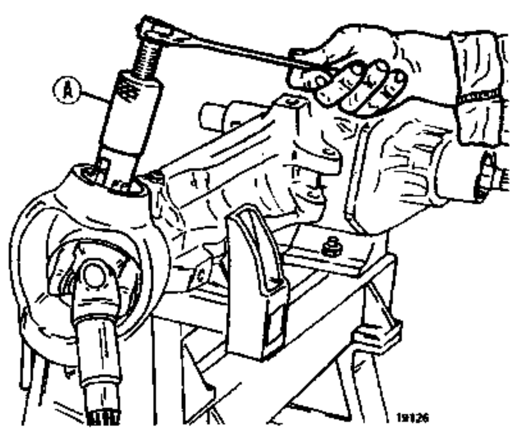
STEERING KNUCKLE KINGPINS AND BEARINGS
Replacement (Op. 25 108 46 or 25 108 47)

Should the king pins be difficult to remove proceed as follows:

1. Remove grease nipples and retaining screws.



2. Fit the screws (V) of the jig tool no. **293857/1**.
3. Fit the jig plate (P) bolted (D) to the three screws.
4. Install the tie–rod (T) and screw it completely into the grease nipple threaded hole on pin (2).
5. Screw the bolt (D1) on until the pin comes off.



6. Use extractor tool no. **292161**(A) to remove the steering knuckle bearings.
7. Refit the bearings using a suitable installer tool.

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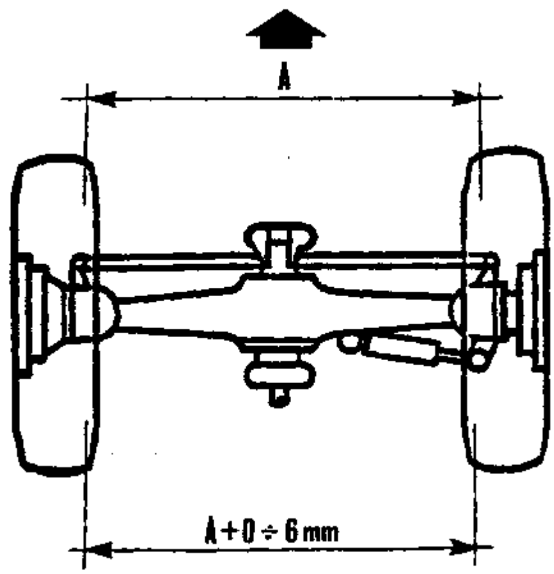

Drive–steering wheels diagram geometry check.

CHECKING THE DRIVE–STEERING WHEEL TOE–IN (Op. 44 511 80)

In straight–ahead driving position, the 4WD tractor wheels should be parallel to the tractor longitudinal axis, or (to be considered as permissible) with a slight front toe–in up to a maximum value of 6 mm (2.36 in), for tires with 24" and 28" rims, measured between rim edges.

To check the exact toe–in value on 4WD tractors, proceed as follows:

1. Inflate tires to prescribed pressure.
2. Turn steering wheel half–way, with one rung aligned with the tractor longitudinal centre line.
3. Check if wheels are parallel to the tractor longitudinal axis.
4. Measure, on the horizontal plane passing through the wheels center line, the distance (A) between **front inside edges** of rims (see figure on side).
5. Then measure, still on the horizontal plane passing through the wheels center line, the distance between the **rear inside edges** of rims, making sure that this latter measurement is equal to (A) or larger up to a maximum of 6 mm (.24 in) (see figure on side).
6. For any correction of the wheel toe–in, turn the front axle track rod adjustable end.

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BEVEL GEARS AND DIFFERENTIAL

Bevel drive ratio Bevel drive tooth backlash Differential Differential lock control	10/43 = 1 : 4.3 0.20 to 0.28 mm (.008 to .011 in) 4–pinion acting through front–meshing, hydraulically actuated gears and control panel switch.
Differential pinion bore dia., (1, page 3) Differential pinion journal dia., (2) Differential pinion running clearance	28.040 to 28.061 mm (1.1039 to 1.1047 in) 27.939 to 27.960 mm (1.1000 to 1.1008 in) 0.080 to 0.122 (.00312 to .0048 in)
Side gear hub seat in differential cage dia., (3, page 3) Side gear hub dia., (4)	65.0 mm (2.56 in) 62.8 to 63.0 mm (2.47 to 2.48 in)
Bevel drive cone point adjustment Bevel drive cone point shim thickness, (S_1, page 3)	see pages 19, 20, 21 and 22 1.40 – 1.45 – 1.50 – 1.55 – 1.60 –1.65 – 1.70 – 1.75 – 1.80 – 1.85 –1.90 – 1.95 – 2.00 – 2.05 – 2.10 –2.15 – 2.20 – 2.25 – 2.30 – 2.35 –2.40 – 2.45 – 2.50 mm (.055 – .057 – .059 – .061 – .063 – .065–.067–.069–.071–.073–.075–.077–.079–.081–.083–.085–.087–.089–.091–.093–.095–.097–.099 in)
Bevel drive pinion bearing adjustment Bevel drive pinion bearing shim thickness, (S_2)	see pages 20, 21 and 22 4.40 – 4.50 – 4.60 – 4.70 – 4.80 –4.85 – 4.90 – 4.95 – 5.00 – 5.05 –5.10 – 5.15 – 5.20 – 5.25 – 5.30 – 5.35 – 5.40 – 5.45 – 5.50 – 5.55 –5.60 – 5.65 – 5.70 – 5.75 – 5.80 –5.85 – 5.90 – 5.95 – 6.00 – 6.05 –6.10 – 6.15 – 6.20 – 6.30 – 6.40 –6.50 – 6.60 mm (.173 – .177 – .181 – .185 – .189 – .191–.193–.195–.199–.200–.202–.204–.206–.208–.210–.212–.214–.216–.218–.220–.222–.224–.226–.228–.230–.232–.234–.236–.238–.240–.242–.244–.248–.252–.256–260 in)
Ring gear bearing and tooth backlash adjustment Ring gear bearing and tooth backlash shim thickness, (S_3, page 3)	see pages 27–25, 27–26 and 27–27 0.15–0.20–0.50 (.006 – .008 – .020 in)
Differential gear and pinion tooth backlash Differential gear thrust washer thickness, (S_4, page 3) Differential gear end play (each) Differential gear end play adjustment	0.15 to 0.20 (.006 to .008 in) 2.80 – 2.85 – 2.90 – 2.95 – 3.00 –3.05 – 3.10 – 3.15 – 3.20 – 3.25 –3.30 mm (.110 – .112 – .114 – .116 – .118 – .120–.124–.126–.128–.130 in) 0.30 (.012 in) see page 27

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FINAL DRIVES

Type .... Reduction ratio	planetary, with three spur gears 14:(14 + 70) = 1:6
Thickness of planet gear thrust washers, (9, page 3) .... Thickness of planet gear roller bearing spacer (10), (models F120 and F130)	1 mm (.039 in) 10.95 to 11.00 mm (.431 to .433 in)
Adjustment of drive wheel shaft taper roller bearings	see page 34

TORQUE DATA

DESCRIPTION	Thread size	Torque		
		Nm	kgm	Ft.lb
Nut, bevel pinion shaft, (C_1, pag. 27–3)	M45x1.5	490	50	362
Nut, final drive housing, (C_2, pag. 27–3)	M14x1.5	176	18	129
Capscrew, drive wheel shaft, (C_3, pag. 27–3)	M18x1.5	88 (*)	9 (*)	65 (*)
Self–locking nut, bevel drive ring gear, (C_4, pag. 27–3)	M12x1.25	137	14	102
Capscrew, bevel drive gear and differential supports, (C_5, pag. 27–3) .	M10x1.25	54	5.5	40
Nut, steel wheel disc to wheel hub, (C_6, pag. 27–3)	M18x1.5	255	26	190
Nut, wheel disc to wheel rim, (C_7, pag. 27–3)	M16x1,5	294	30	216
Capscrew, wheel hub on dual wheel axle shaft, (C_8, pag. 27–3)	M16x1.5	294	30	216
Capscrew, RAIL disc on dual wheel axle shaft, (C_9, pag. 27–3)	M16x1.5	294	30	216
Nut, RAIL disc block, (C_{10}, pag. 27–3)	M20x2.5	245	25	181
Nut, RAIL disc to wheel hub	M18x1.5	314	32	232
Nut, weight screw to wheel disc	M16x1.5	294	30	216
Attachment screw, wheel weights	M16x1.5	211	21.5	155
Allen screw, wheel weights to cast iron disc	M16x1.5	186	19	137
Capscrew, pump and filter support (C_8, pag. 35–5)	M12x1.5	83	8.5	62

(*) Adjustment information on page 27–36.

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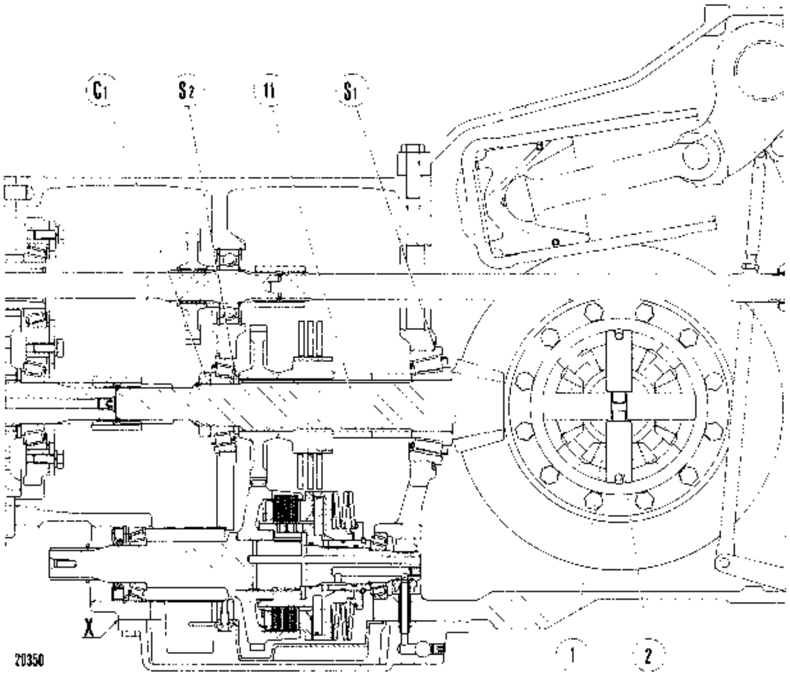

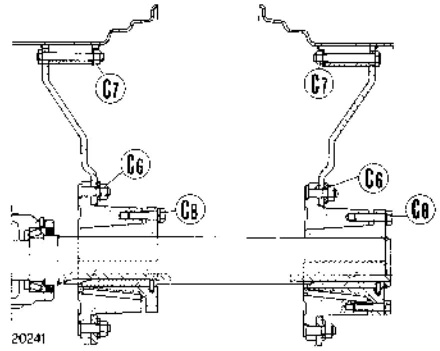

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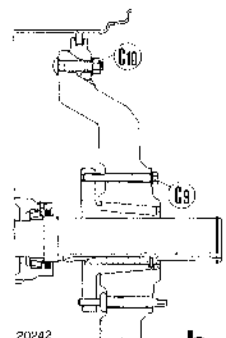

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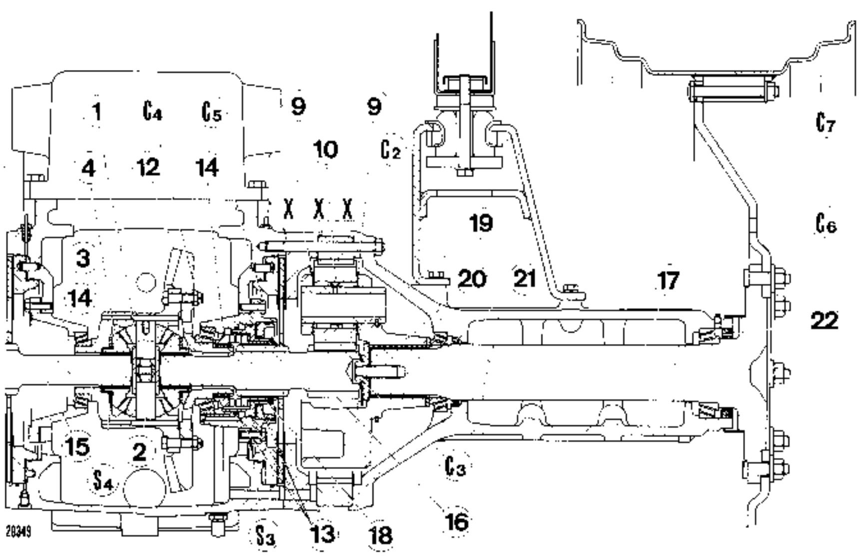

Longitudinal and cross–sectional views of the mechanical rear drive assembly.

a,b. Detail of dual–wheel version – C_1. Nut, bevel drive pinion shaft – CV_2. Nut, final drive housing – C_3. Capscrew, drive wheel shaft– C_4. Self–locking nut, bevel drive ring gear – C_5. Capscrew, bevel drive gear and differential supports– C_6. Nut, steel wheel disc – C_7. Nut, wheel disc to wheel rim – C_8. Capscrew, wheel hub to wheel shaft – C_9. Capscrew, RAIL wheel disc on wheel shaft – C_{10}. Nut, RAIL disc block – H_2. Correct dimension of distance between bevel drive ring gear axis and pinion base – S_1. Bevel drive cone point adjustment shim – S_2. Bevel drive pinion bearing adjustment shim – S_3. Bevel drive gear bearing and tooth backlash adjustment shims – S_4. Differential side gear end play adjustment shims – 1. Differential pinions – 2. Pinion shaft – 3. Differential housing – 4. Side gears – 9. Thrust rings – 10. Pinion bearing spacer – 11. Bevel drive pinion – 12. Bevel drive ring gear – 13. Oil seal – 14. Ring gear bearing quills – 15 and 16. Differential output half–shafts – 17. Wheel shaft – 18. Differential lock actuating piston – 19. Final drive planetary gears – 20. Final drive planetary gear cage – 21 and 22. Oil seals.

Note – Prior to assembly thoroughly clean and degrease mating surfaces **X** and apply one of the sealing compounds indicated on page 00–9.

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BEVEL DRIVE AND DIFFERENTIAL TROUBLE–SHOOTING CHART

Fault	Diagnosis	Correction
Noisy transmission during motion with tractor gearbox in neutral also (not originating from final drives).	**1.** Bevel pinion and/or ring gear bearings out of adjustment.	Remove rear drive unit and adjust the bevel pinion and ring gear bearings (page 27–21).
	2. Worn differential side and planetary gears or their backlash out of adjustment.	Remove rear drive unit, replace worn parts and adjust the differential gear tooth backlash (page 27–29).
	3. Excessive differential side gear and axle shaft spline backlash.	Remove rear drive unit and replace defective parts.
Noisy transmission with tractor under load and upon releasing.	**1.** Excessive bevel pinion and ring gear tooth backlash.	Remove rear drive unit, replace worn parts and adjust the bevel pinion and ring gear bearings (page 27–21).
	2. Faulty or defective inside component part.	Remove rear drive unit, replace worn parts and adjust the differential gear tooth backlash (page 27–29).
Noisy transmission accompanied by over–heating.	**1.** Insufficient bevel pinion and/or ring gear bearing clearance fit.	Remove rear drive unit and adjust the bevel pinion and ring gear bearings (page 27–21).
	2. Insufficient bevel pinion and ring gear tooth backlash.	Remove rear drive unit and adjust the ring gear bearings (page 27–25).

FINAL DRIVE TROUBLE–SHOOTING CHART

Fault	Diagnosis	Correction
Noisy final drives during motion with tractor gearbox in neutral also.	**1.** Wrong wheel axle shaft bearing adjustment.	Remove final drive case and adjust bearings (page 27–36).
	2. Faulty or defective inside component part.	Remove final drive case and replace defective parts.
	3. Excessive wheel axle shaft and final drive spline backlash.	Remove final drive case and replace defective parts.

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HYDRAULIC DIFFERENTIAL LOCK TROUBLE–SHOOTING CHART

Fault	Diagnosis	Correction
Differential lock will not engage.	**1.** Low transmission oil level.	Top up oil level.
	2. Clogged oil filter.	Replace filter.
	3. Inefficient hydraulic pump.	Overhaul or replace pump.
	4. Inefficient differential lock control switch.	Replace switch.
	5. No power is reaching the electro–valve: interrupted, faulty connections or defective remote control switch.	Restore electrical connections and/or replace defective parts.
	6. Differential lock control electro–valve ((5, page 21–10) stuck on discharge position.	Overhaul or replace electro–valve.
	7. Fluid leakage past oil seals and consequent pressure drop: cylinder piston or feed line seals.	Replace oil seals found defective.
Differential lock will not disengage.	**1.** Inefficient differential lock engagement–disengagement control switch.	Replace switch.
	2. No power is reaching the electro–valve: interrupted, faulty connections or defective remote control switch.	Restore electrical connections and/or replace defective parts.
	3. Differential lock control electro–valve (10) stuck on delivery.	Overhaul or replace electro–valve.
	4. Fluid leakage past oil seals and consequent pressure drop: cylinder piston or differential disengagement feed line seals..	Replace oil seals found defective.
With differential lock engaged and control switch on position 3, the former will not disengage when the hydraulic lift arms are raised through the LIFT–O–MATIC device.	**1.** Inefficient differential lock control switch (connected to the LIFT–O–MATIC device).	Replace switch.
With differential lock engaged the same will not disengage when pressing on brake pedals.	**1.** Inefficient differential lock control switch (connected to the brake pump).	Replace switch.

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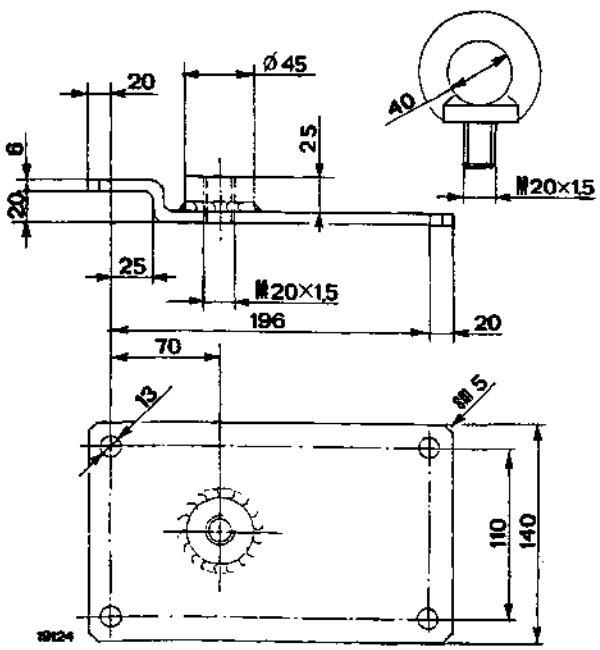
SERVICE TOOLS

ATTENTION – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code **(X)**.
Besides, to work safely and achieve the best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjonction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

List of the special tools necessary to perform service operations covered by this section of the Manual:

	290090	Shop floor overhauling stand.
	292320	Stand, tractor splitting.
	291517	Hook, transmission lifting.
	293972	Front bracket, transmission overhauling (with **290090**).
	293973	Rear bracket, transmission overhauling (with **290090**).
X	**293343/2**	Wrench, bevel pinion nut and rolling drag torque check.
	292865	Wrench, bevel pinion and ring gear rolling drag torque check.
X	**293510**	Universal tool, bevel pinion bearing adjustment.
X	**293975**	Tool, bevel pinion bearing adjustment.
X	**293977**	Spacer, (with **293510** and **293975**).
X	**293976**	Spacer, (with **293510** and **293975**).
	293400/1	Universal kit, bevel drive cone point adjustment.
	291215	Hook, creeper unit control lever spring.
	293994	Hook, ring gear and differential assembly.
	291525	Dowel guide pins, differential supports.
	292870	Pressure gauge kit, differential lock.
X	**293986**	Adjustment tool, differential side gears.
X	**293811**	Lifting hook, final drive gear assembly.
	292313	Puller adapter, oil pump drive idler gear pin.
	292400	Lifting hook, rear wheels.
	50066	Bracket, final drive removal–installation.



Self–made tool for final drive disassembly–assembly. (Etch no.50066 on completed tool – Metric dimensions).
Material specification: Fe42 steel.

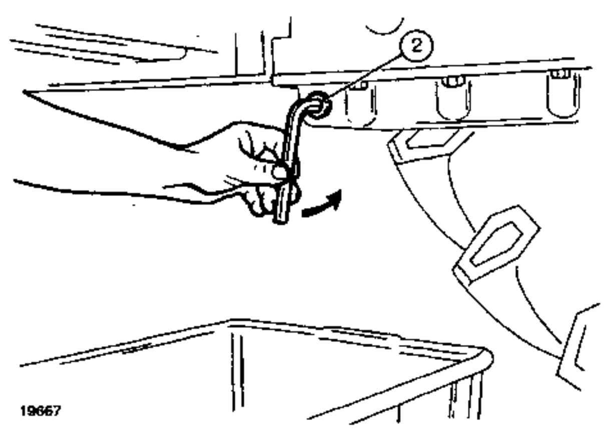
REAR DRIVE CASE
Removal–Installation (op. 27 100 10)

DANGER

Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.

To split the rear drive case from the tractor, proceed as follows.

1. Carry on operations 1 through 52 described on pages 11 through 19 of Section 21.



2. Unscrew plug (2) and drain rear drive housing oil (60 liters or 15.8 USA = 11–3/4 Imp. Gall).

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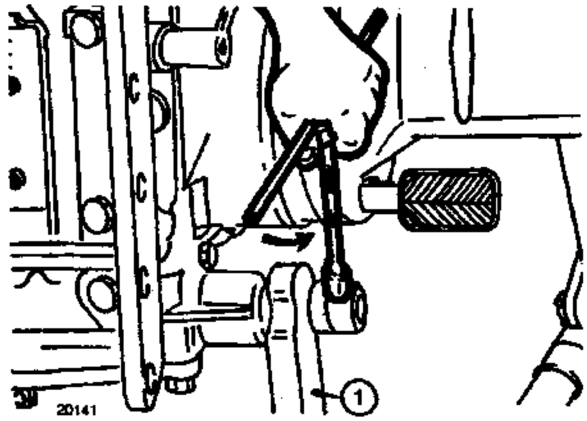
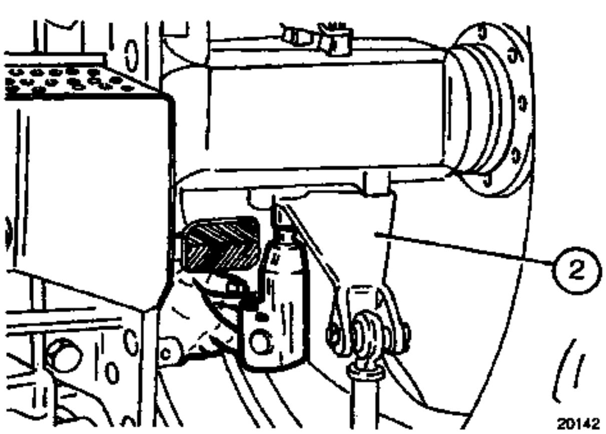
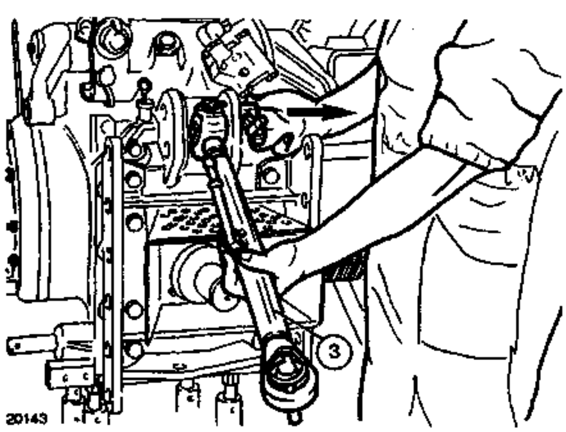


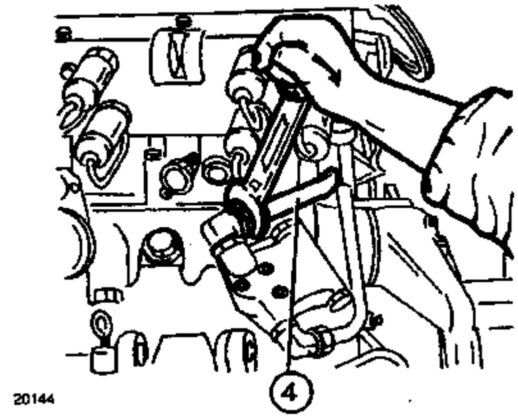
3. Disconnect lower links (1) from lift arms and flex bar (on both sides).



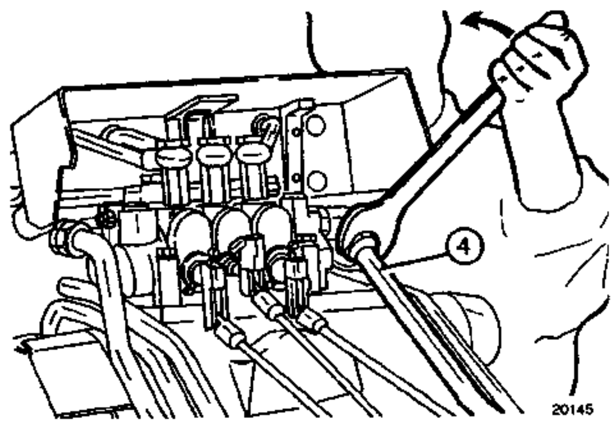
4. Remove capscrews and sway limiter mounting bracket (2) (on both sides).



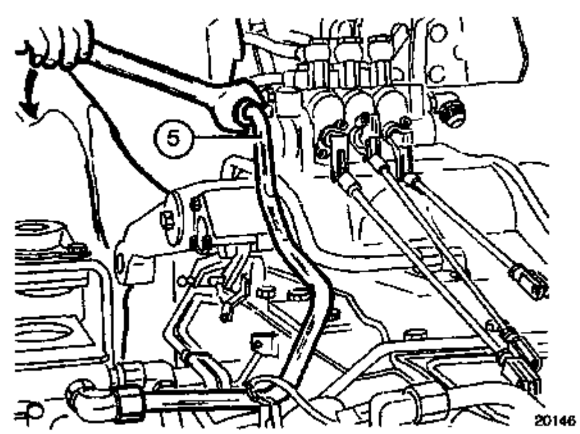
5. Remove cotter pin, pivot pin and finally the top link (3).



6. Disconnect the hydraulic lift pressure line (4).



7. Remove the hydraulic lift pressure line (4) from remote control valves.



8. Disconnect line (5) from remote control and trailer brake valves, then remove it.

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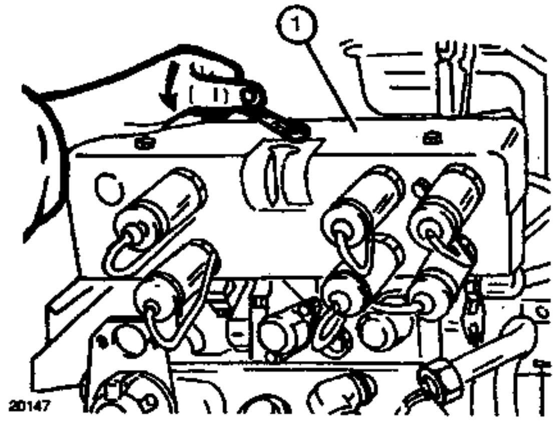
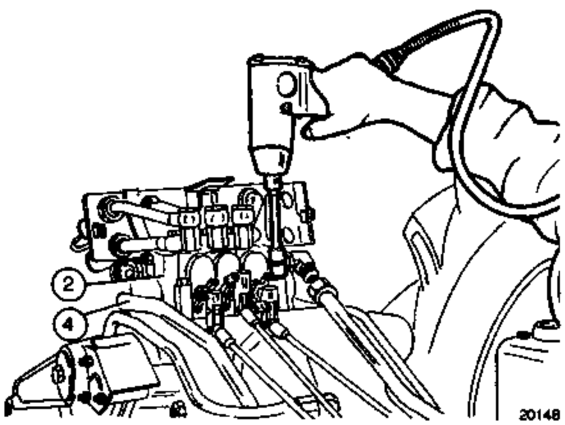
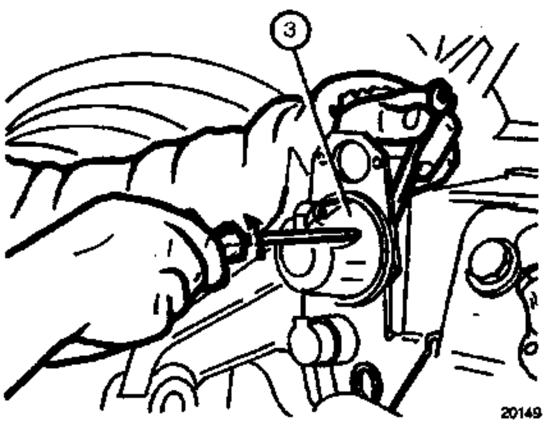


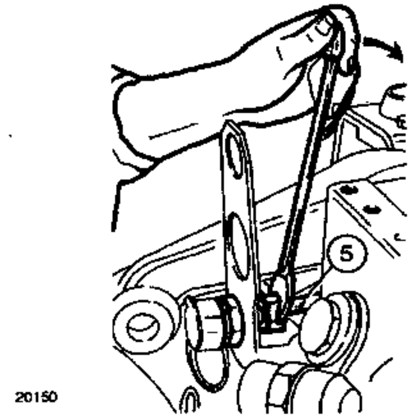
9. Remove attaching screws and remote control valve guard (1).



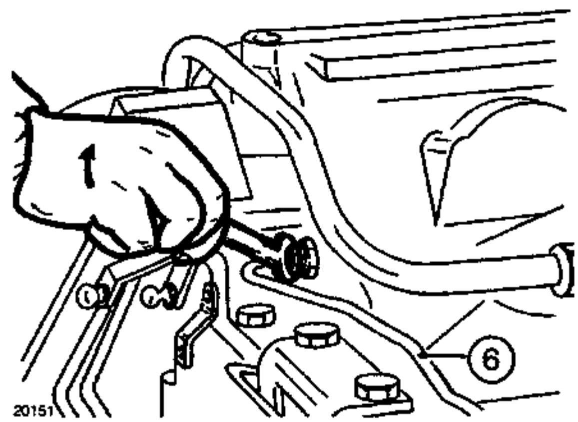
10. Remove attaching screws and remote control valve block (2); retrieve the lift pressure line (4) previously removed.



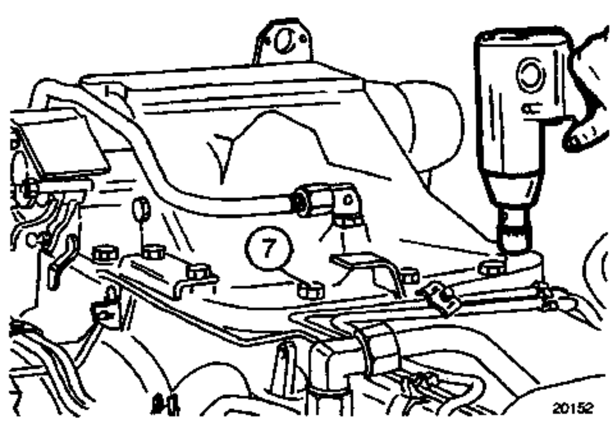
11. Remove attaching screws and socket (3).



12. Disconnect trailer brake pressure line (5).



13. Disconnect oil line (6) from hydraulic lift and filter bracket, then remove it.



14. Remove all capscrews (7) securing hydraulic lift to rear drive housing.

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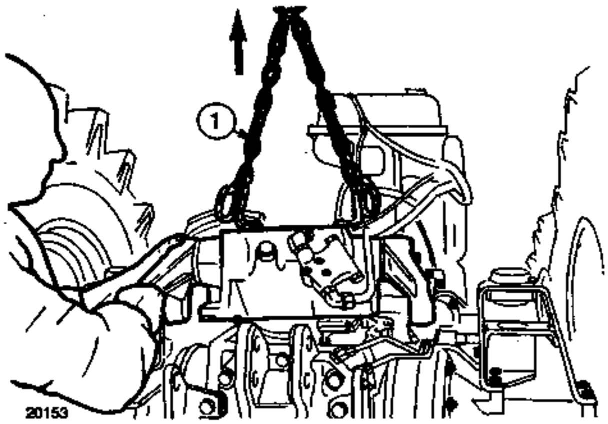
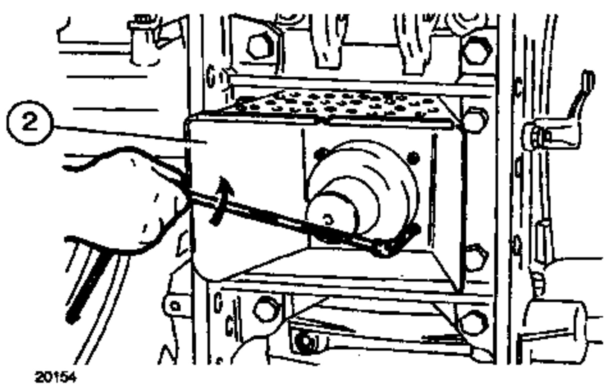
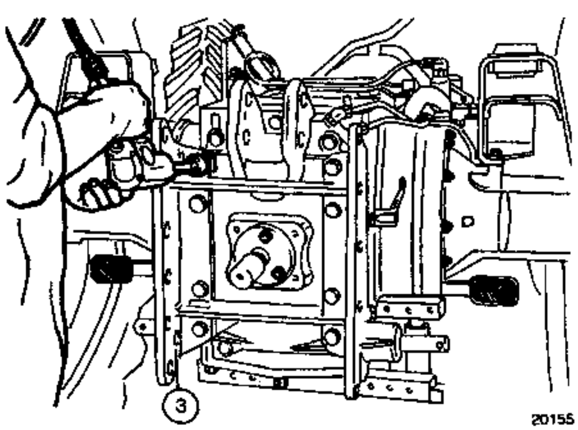


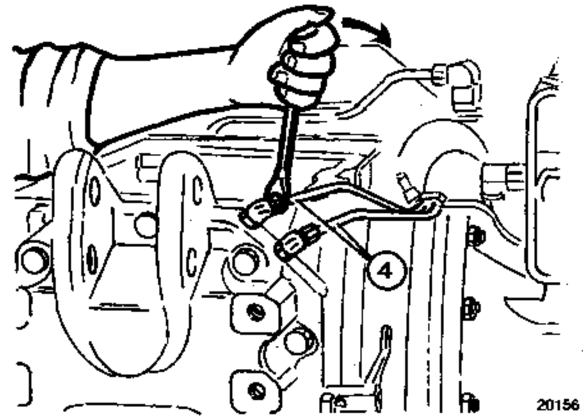
15. Using chain **291517** (1) and suitable lifting equipment separate hydraulic lift from rear drive housing and remove it.



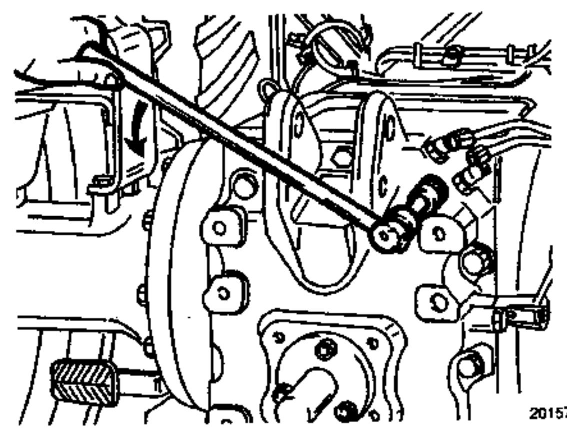
16. Remove attaching screws and PTO guard (2).



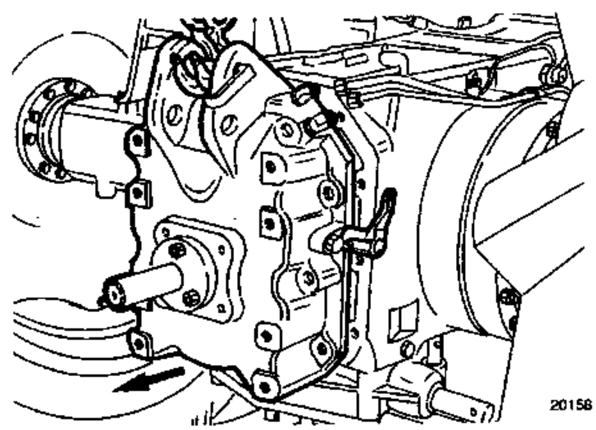
17. Remove capscrews securing towing hook mounting bracket (3).



18. Remove the PTO pressure and lube lines (4).



19. Remove the PTO mounting capscrews.



20. Attach the PTO assembly to a hook and suitable lifting equipment and remove it from tractor.

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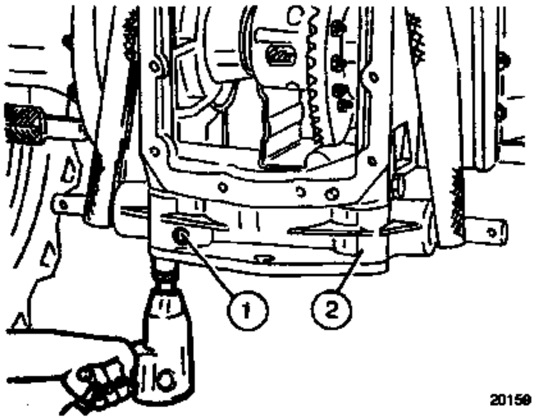
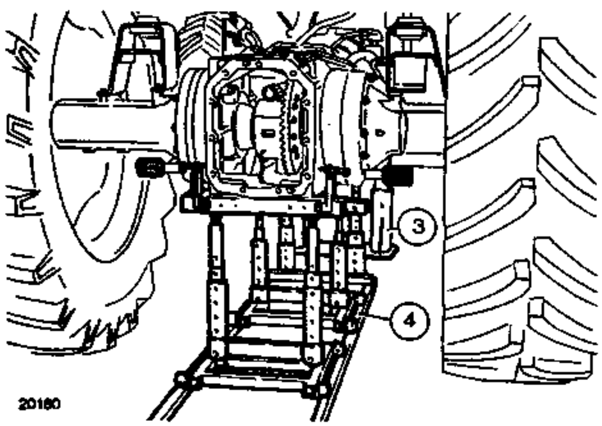
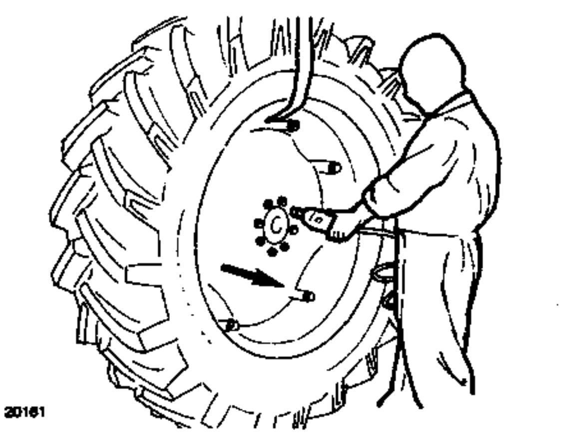


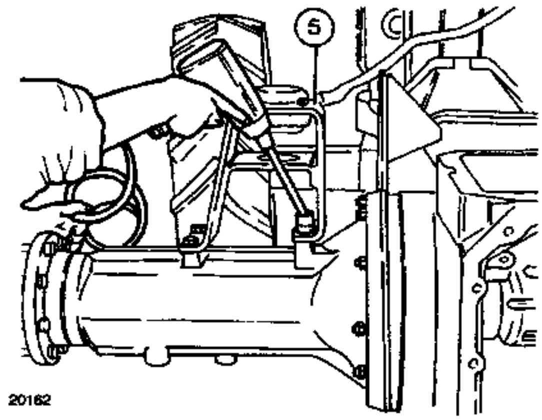
21. Remove plug (1) and drain flex bar housing (2) oil, then remove the attaching capscrews and finally the bar housing using a nylon rope and suitable lifting equipment.



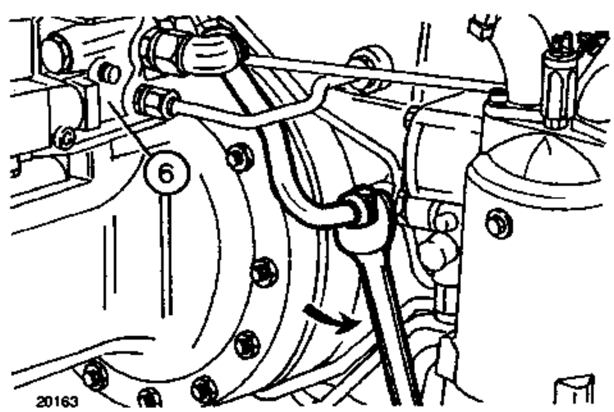
22. Support the engine with a jack stand (3) and place the special stand **292320** (4) with its stationary section under the clutch–transmission housing and the two mobile ones under the rear axle housing.



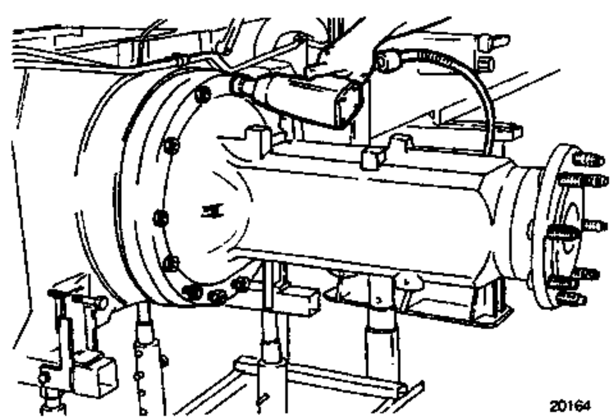
23. Remove wheel mounting screws and the wheel itself using suitable lifting equipment and a nylon rope, (on both sides).



24. Remove attaching capscrews and the cabin mounting bracket (5).



25. Disconnect and remove all oil lines from the trailer brake remote control valve (6), then remove the valve itself together with the cabin support.



26. Unscrew and remove the nuts securing the final drive housing to the rear axle one.

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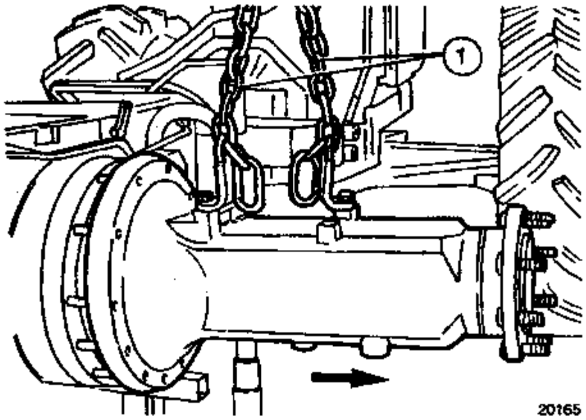
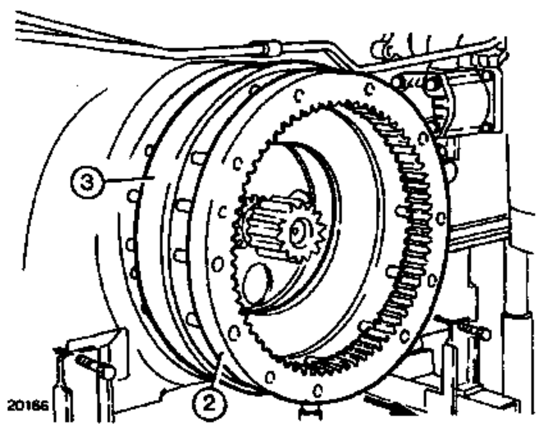
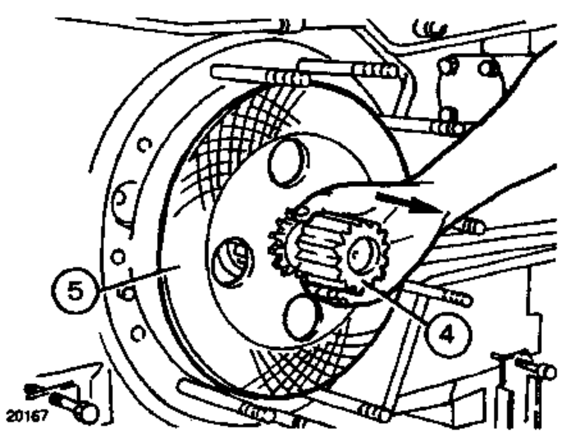


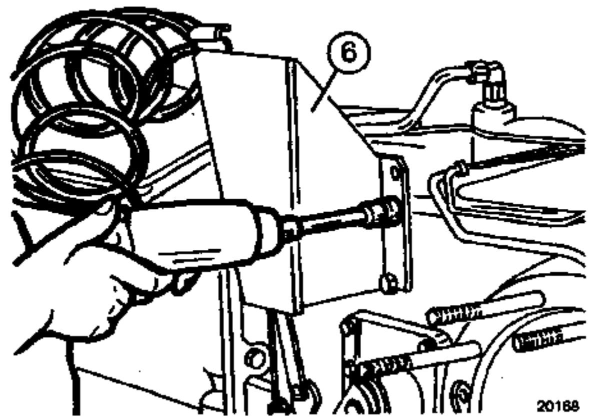
27. Using the special chain **291517** (1) and suitable lifting equipment separate and remove the final drive assembly from tractor, (on both sides).



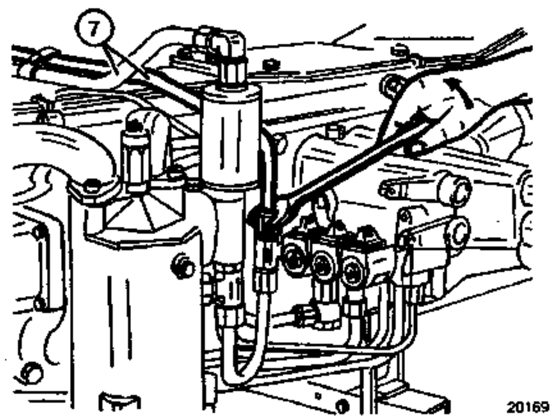
28. Retrieve the final drive outer ring gear (2) and spacer (3).



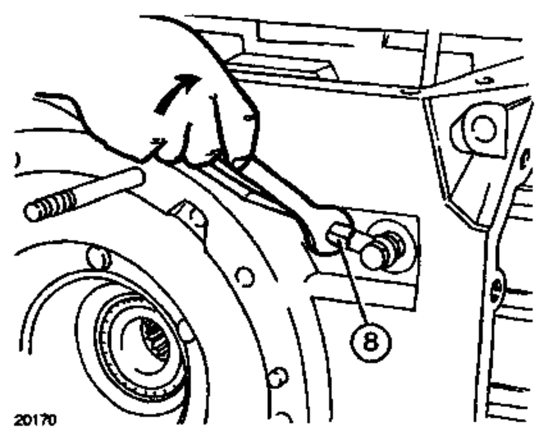
29. Withdraw the wheel shaft (4) together with brake disc (5).



30. Remove attaching screws and mounting bracket (6) of the main fuel tank.



31. Unscrew connections and remove the power steering oil lines (7).



32. Disconnect the PTO brake control oil line (8).

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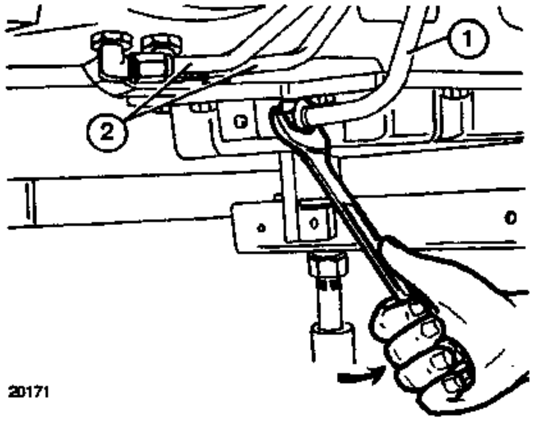
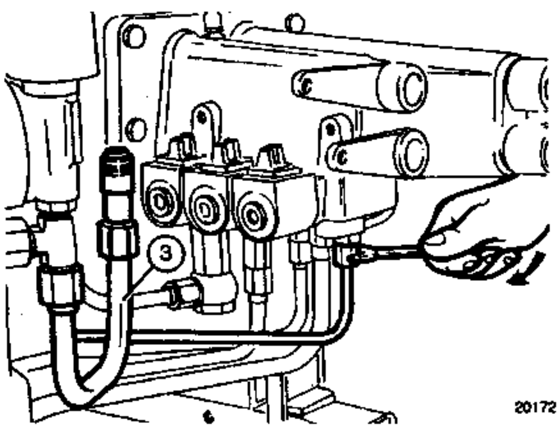
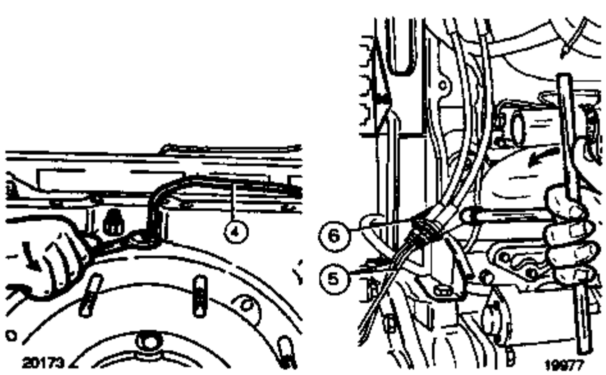


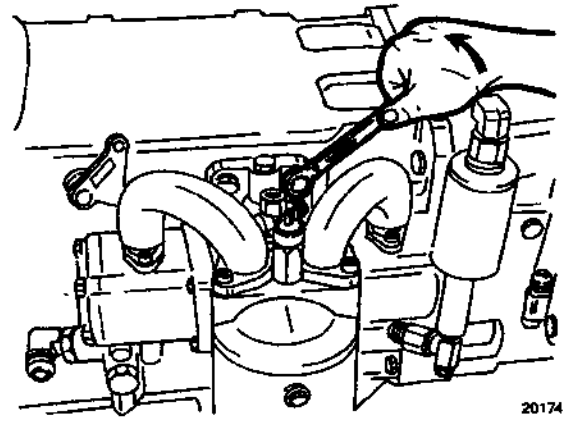
33. Remove: 4WD hydraulic engagement oil line (1) and differential lock hydraulic control oil lines (2).



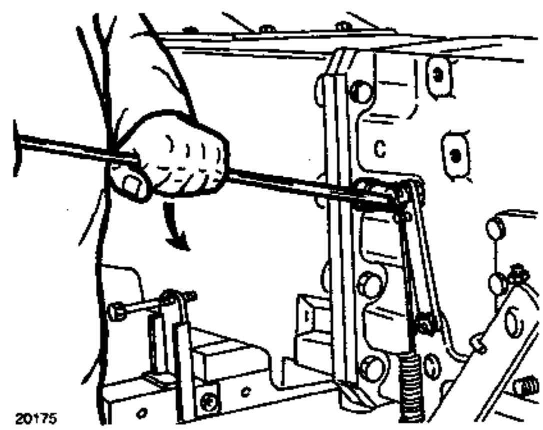
34. Disconnect and remove: PTO brake, PTO engagement , 4WD hydraulic engagement , differential lock and connecting (3) oil lines.



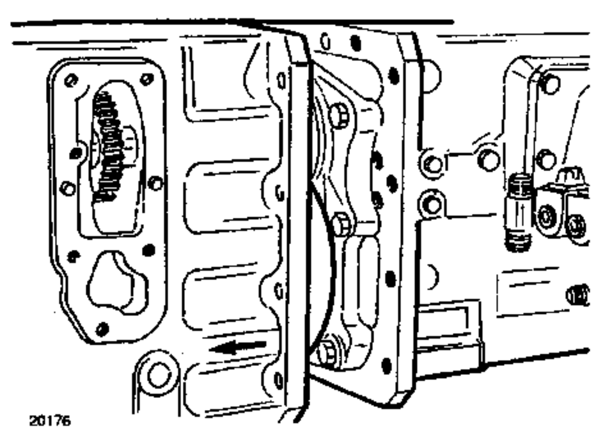
35. Unscrew connection securing brake oil line (4) to the transmission housing (on both sides), remove attaching screws and subsequently the support (6) together with oil lines (4).



36. Make sure that all oil lines are disconnected, remove attaching screws and the oil pump and filter assembly.



37. Remove the clutch–transmission and rear axle housing joining capscrews.



38. Separate rear axle from clutch–transmission.

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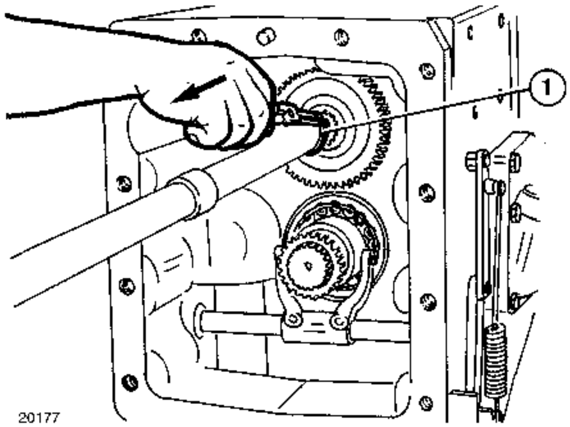
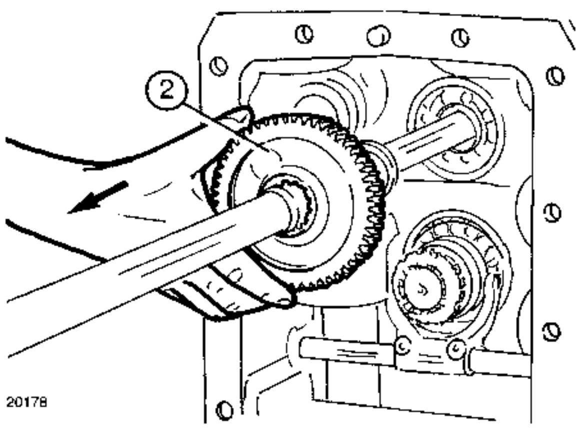


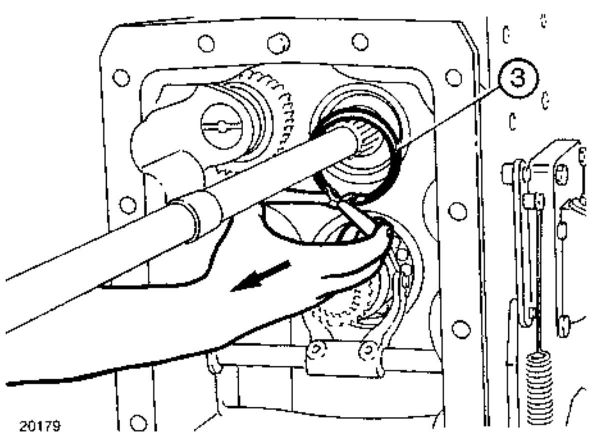
20177

39. Remove snap ring (1) securing the oil pump driving gear.



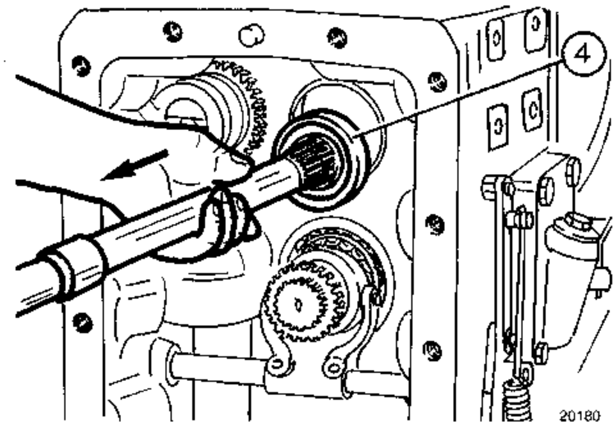
20178

40. Withdraw oil pump driving gear (2) and retrieve spacer.



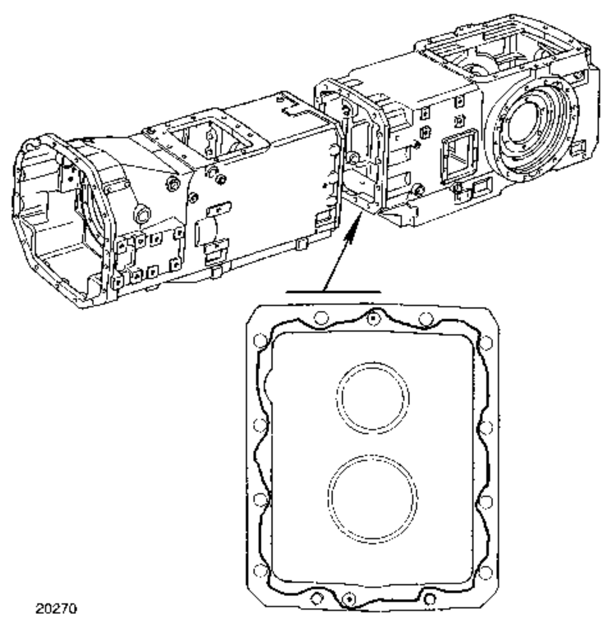
20179

41. Remove the PTO shaft bearing retaining snap ring (3).



20180

42. Withdraw PTO shaft and bearing (4).



20270

Application scheme of sealing compound to clutch–transmission and rear axle housing mating surfaces.

Sealing compound types are indicated on page 00–9.

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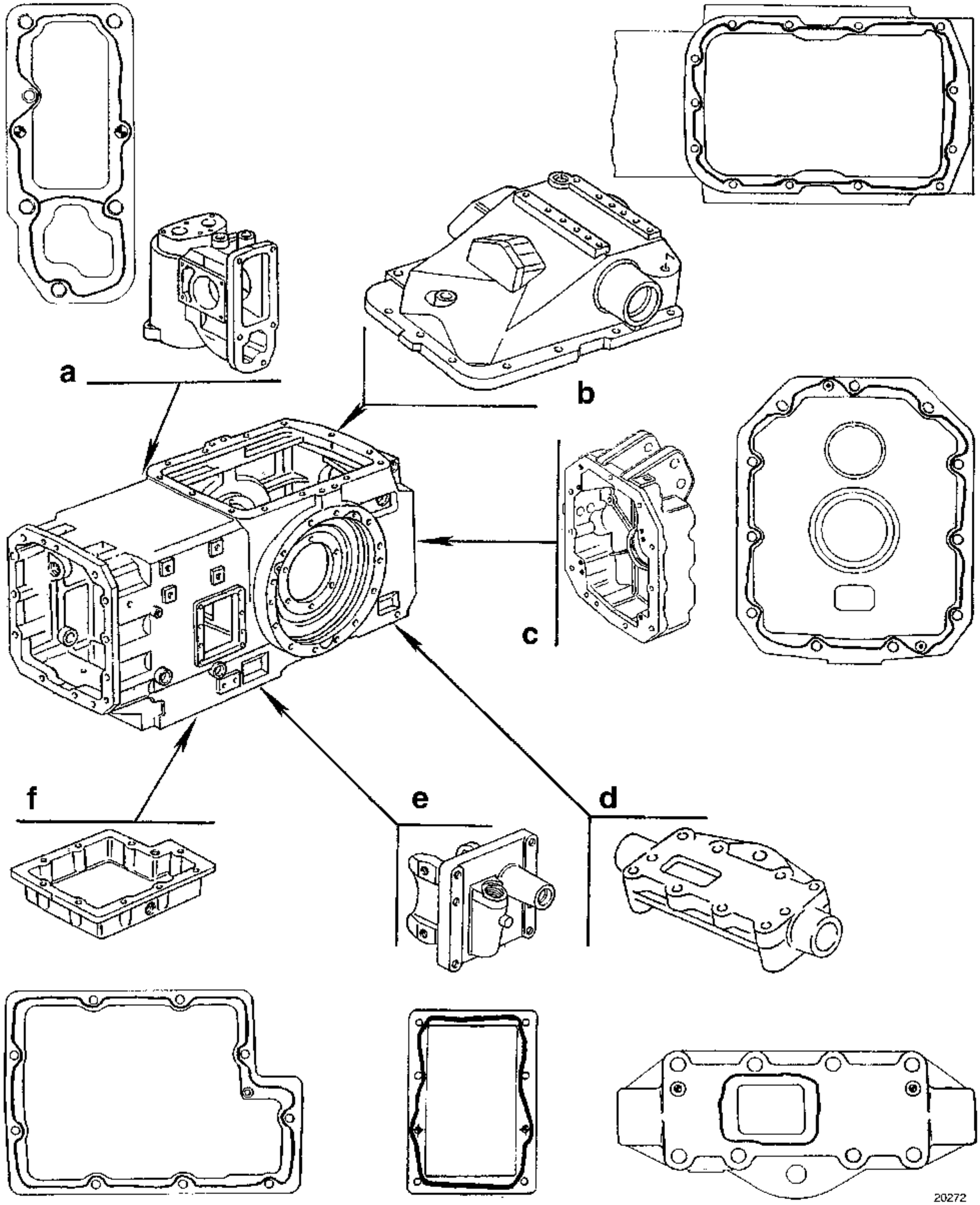

Application scheme of sealing compound to mating surfaces of: oil pumps and filter (a), hydraulic lift (b), PTO case (c), flexible bar housing (d), parking brake support (e) and rear axle housing bottom cover plate (f).

Sealing compound types are indicated on page 00–9.

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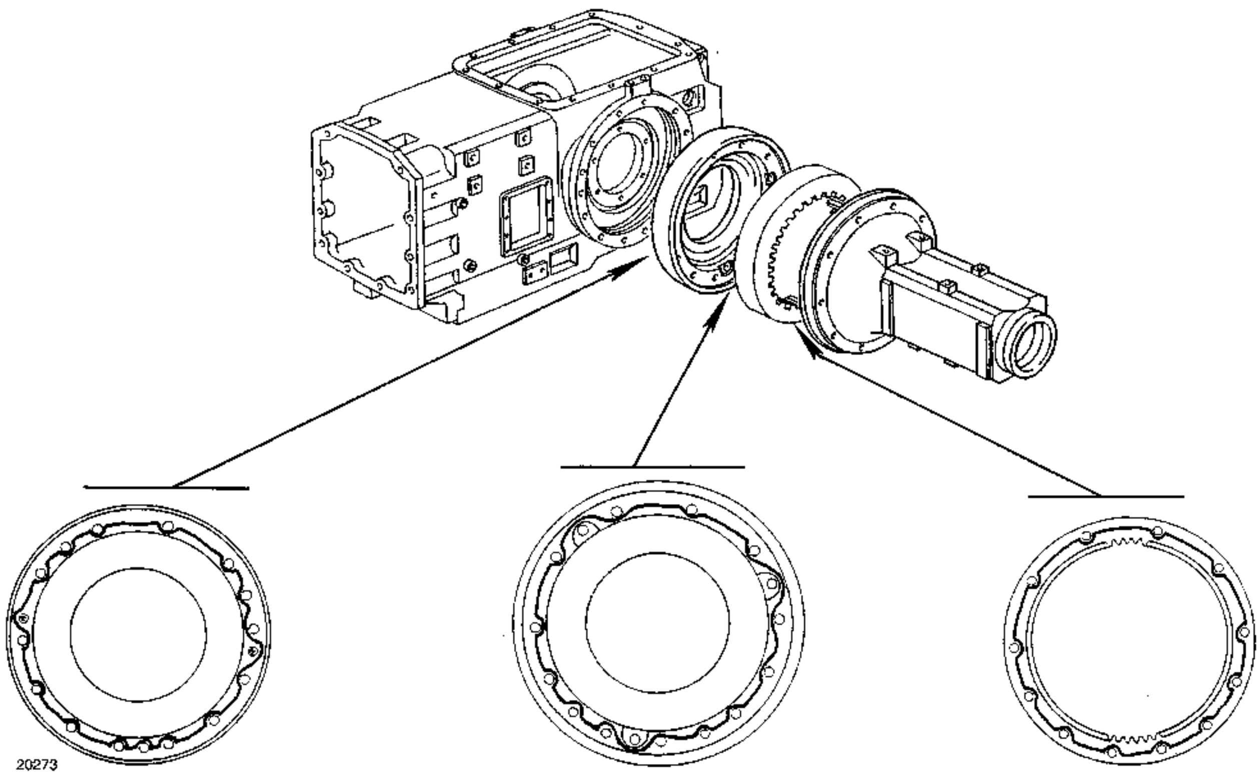


Application scheme of sealing compound to final drive and rear axle housing mating surfaces.

Sealing compound types are indicated on page 00–9.

CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

43. When re–joining the rear axle and clutch–transmission cases pay attention to the following points:

a. proceed by reversing the removal sequence of operations starting from no. 42 back to no. 1;

b. prior to installation of housings, supports and covers make sure that mating surfaces are thoroughly clean and degreased, then apply a bead of a sealing compound, approximately 2 mm (.08 in) diameter, following the application schemes shown above and on pages 27–13 and 27–14;

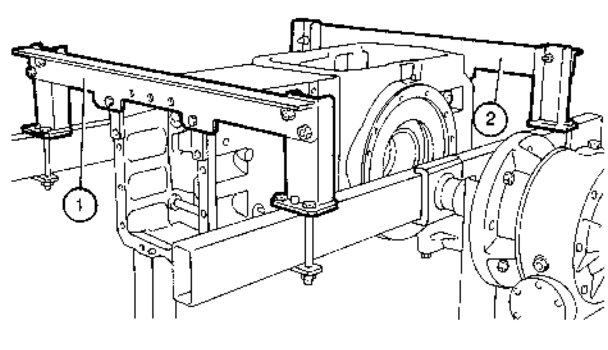
c. tighten fastenings to torque data of page 27–2.

REAR DRIVE CASE
Replacement (Op. 27 100 85)

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

To replace the rear axle housing proceed as follows:



1. Attach rear axle housing on special revolving stand **290090** using the special brackets **293972** (1, front) and **293973** (2, rear).

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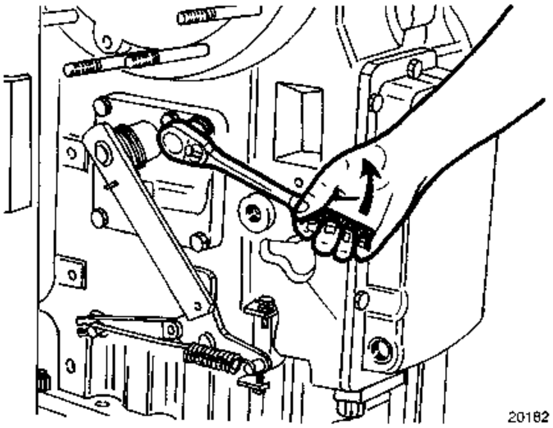
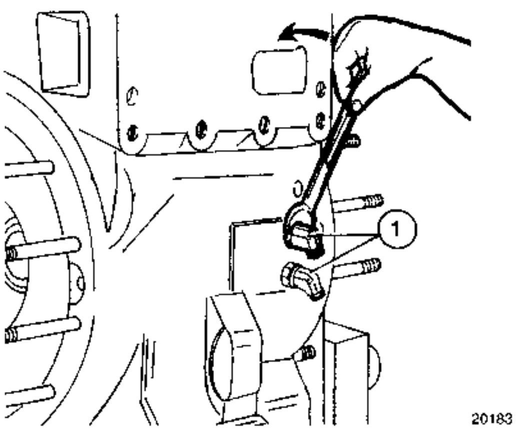
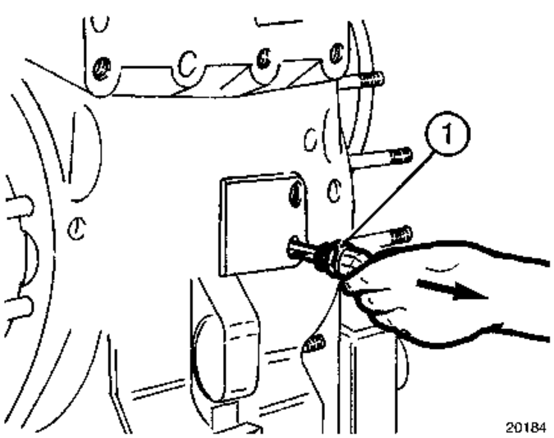


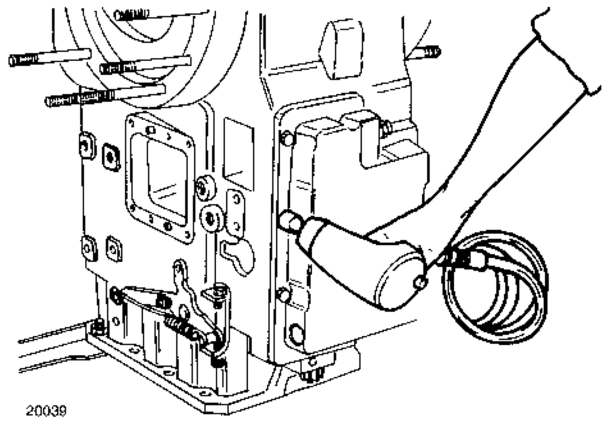
2. Remove attaching capscrews and hand brake controls.



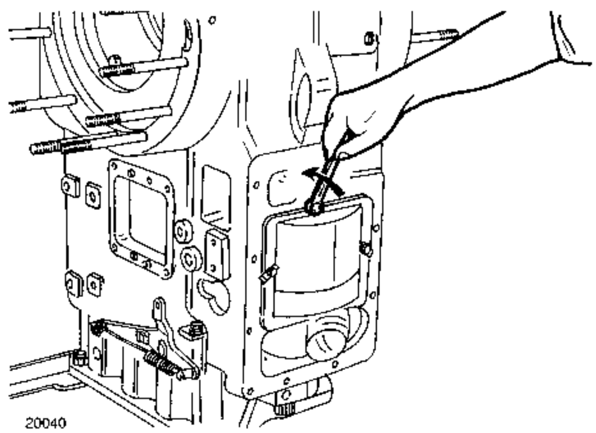
3. Disconnect differential lock oil lines (1).



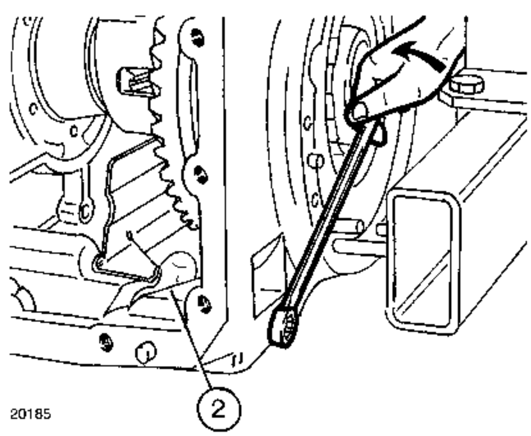
4. Withdraw the differential lock oil lines (1).



5. Remove attaching capscrews and take off the drive box bottom cover.



6. Straighten retaining latches, remove screws and pull out the transmission drive inside guard.



7. Unscrew pivot pin and pull out the flexible bar draft relay unit (2).

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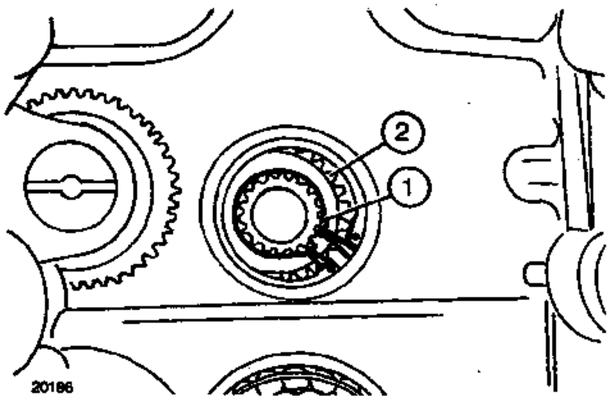
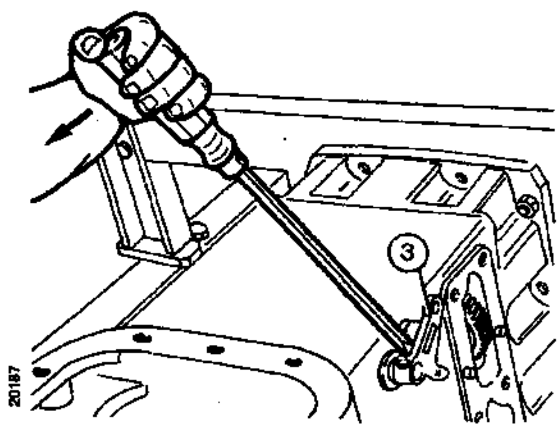
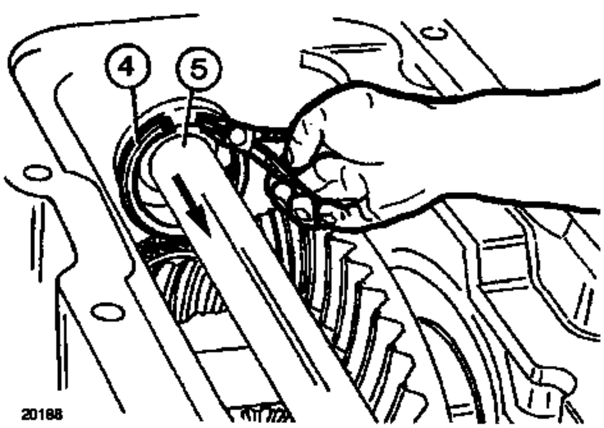


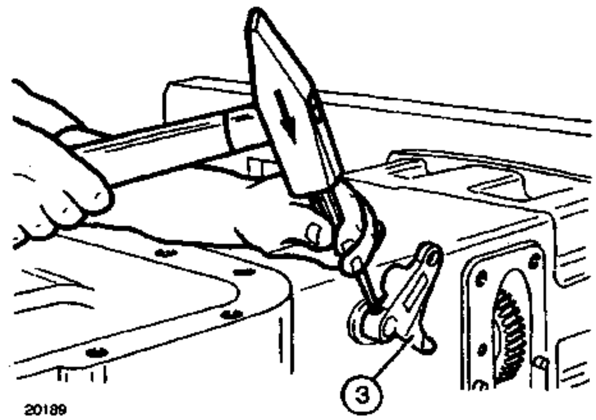
8. Remove the ground–speed PTO driving gear (2) retaining snap ring (1).



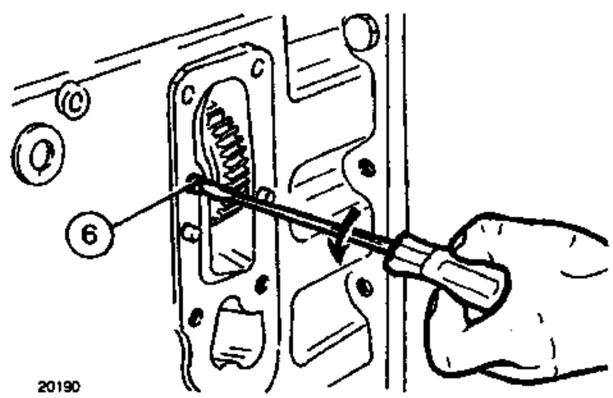
9. Using a suitable tool move lever (3) off sidewise to free the gear (3) from drive block, then remove it.



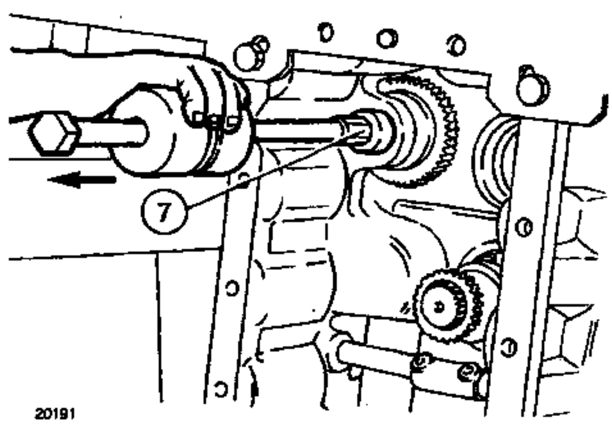
10. Disconnect snap ring (4) and remove the ground–speed PTO shaft (5) with bearing.



11. Remove spring pin and the ground–speed PTO control lever (3).



12. Back up set screw (6).



13. Using adapter **292313** (7) and slide–hammer type puller **292927** remove pin and retrieve gear, bearing and spacer.

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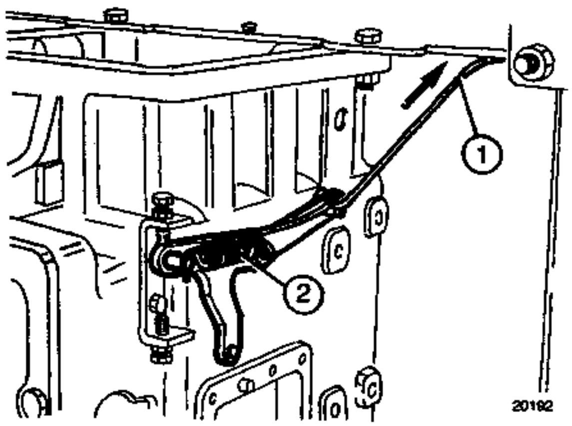
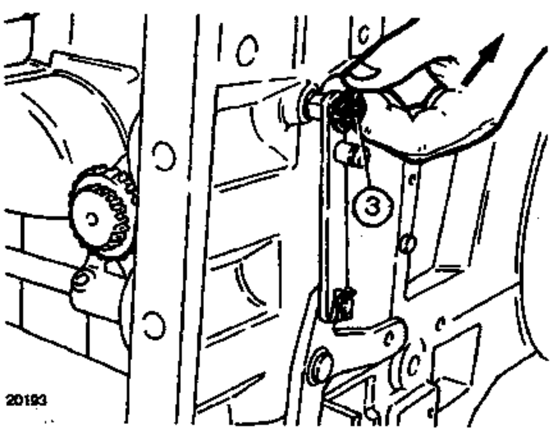
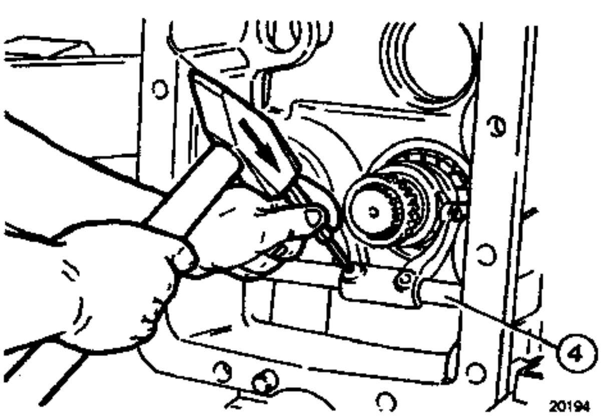


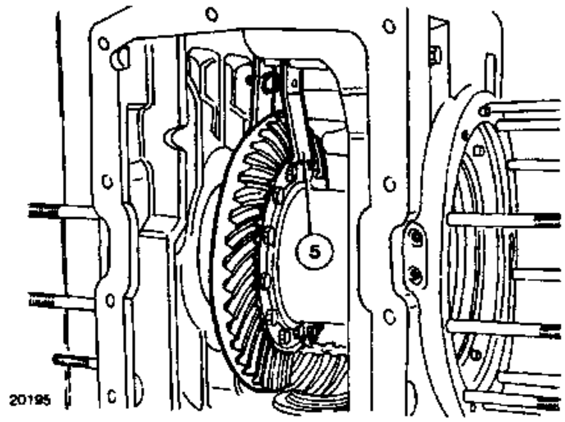
14. Use hook **291215** (1) to remove spring (2).



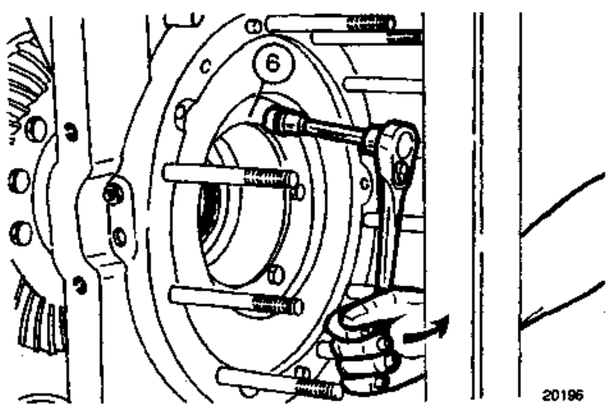
15. Remove spring clip (3).



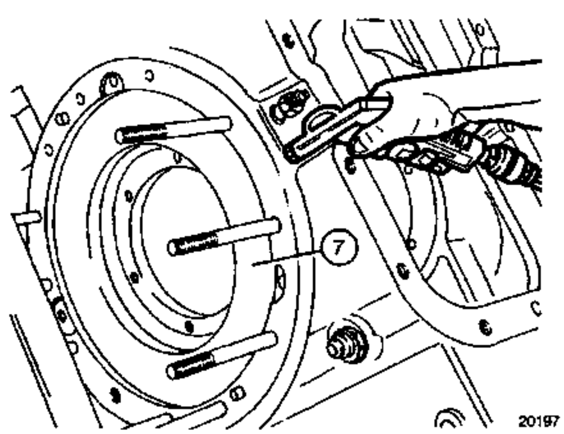
16. Remove spring pins, withdraw lever (4) and retrieve the fork.



17. Revolve stand to position rear drive housing upright, attach special tool **293994** (5) to the bevel drive ring gear and hook it to suitable lifting equipment.



18. Remove attaching capscrews and the ring gear–differential housing (6, on both sides), retrieve it and remove the inside sheet metal guard.



19. Remove the control piston (7) using compressed air and retrieve springs from both ends.

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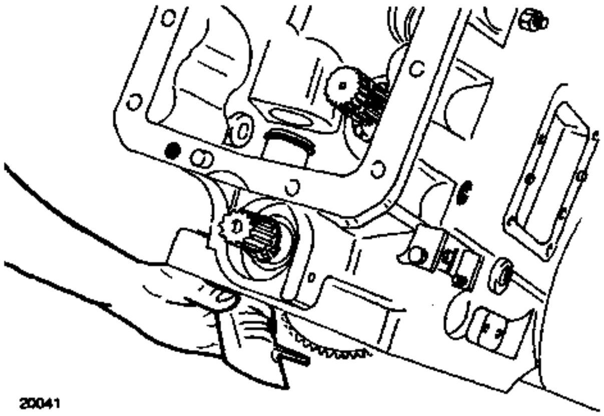
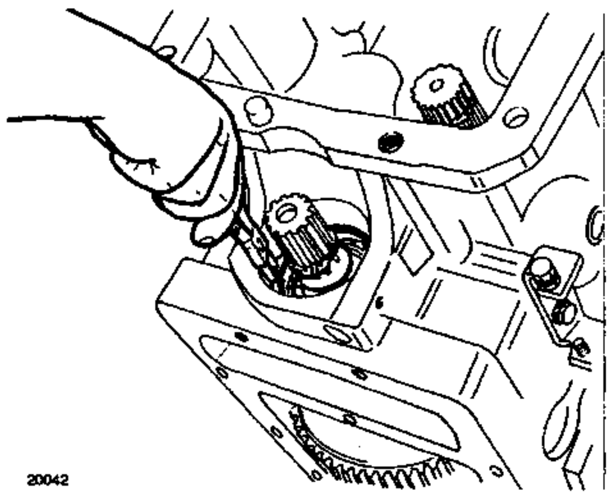


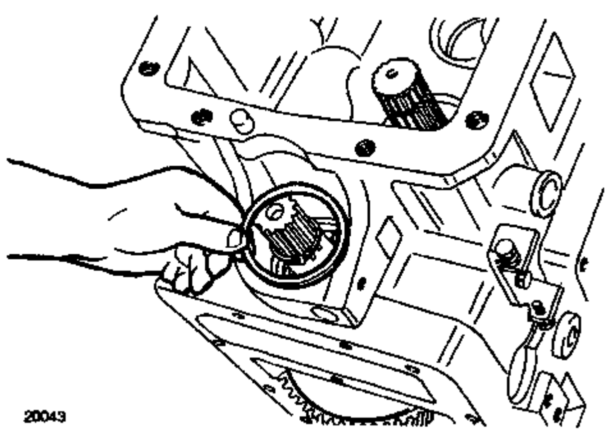
20041

20. Remove the oil suction line.



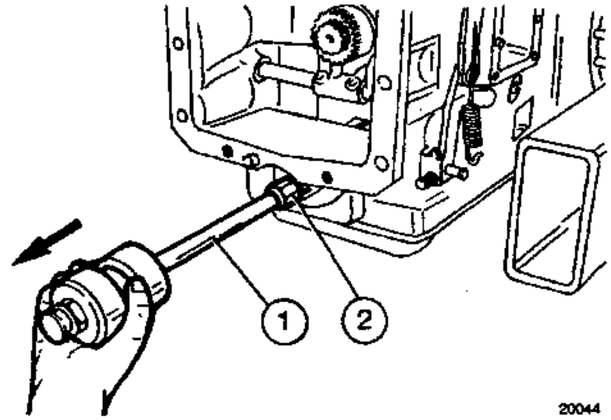
20042

21. Remove dust shield, oil seal and drive shaft bearing retaining snap ring.



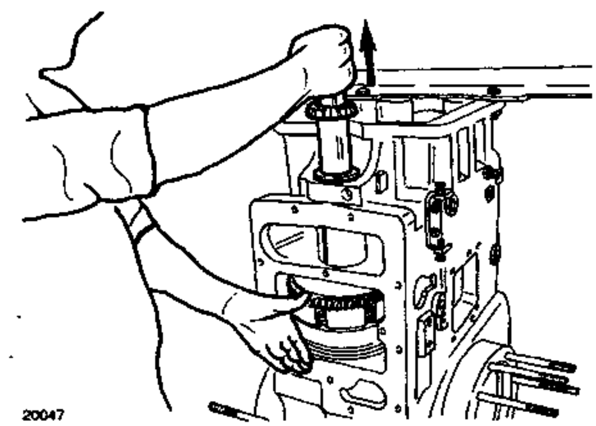
20043

22. Retrieve the shaft bearing shim.



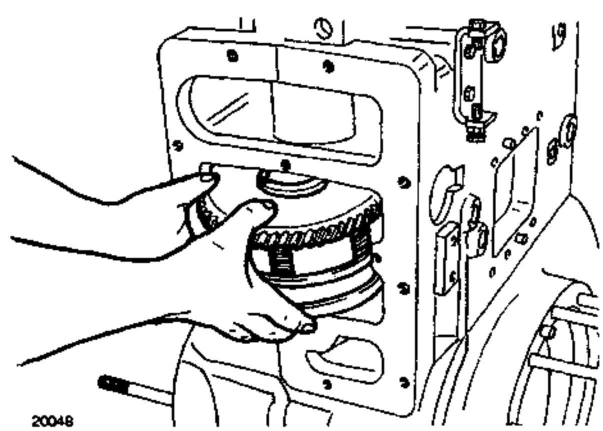
20044

23. Using slide–hammer type puller **292927** (1) with special adapter **293996** (2) pull out the drive shaft, partially.



20047

24. Manually, remove the drive shaft with one hand, holding the front–wheel drive engagement clutch with the other.



20048

25. Remove the complete front–wheel drive engagement clutch.

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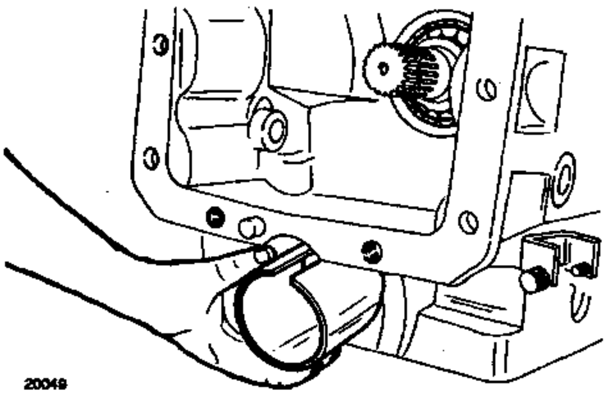
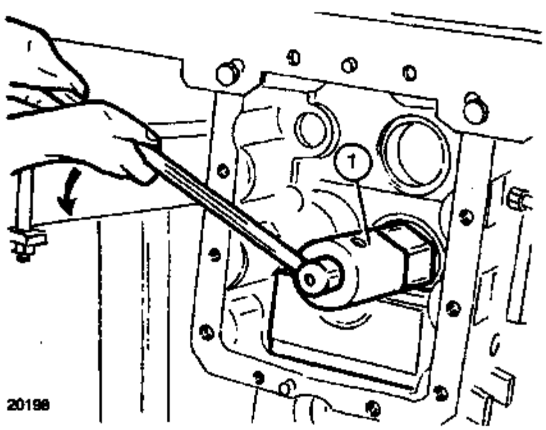
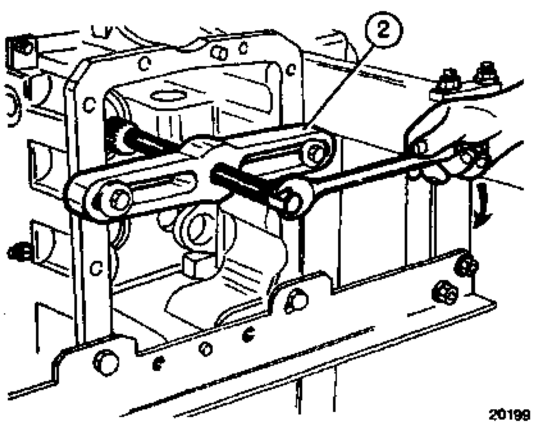


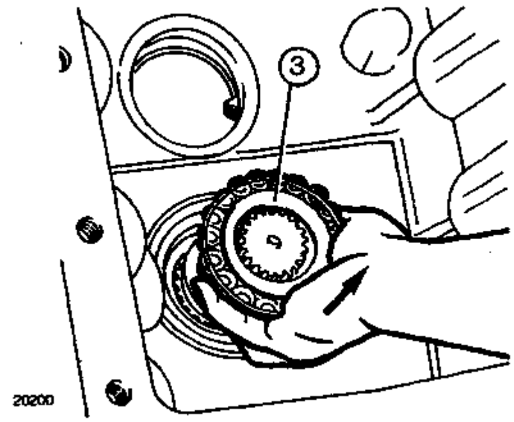
26. Remove the drive shaft guard.



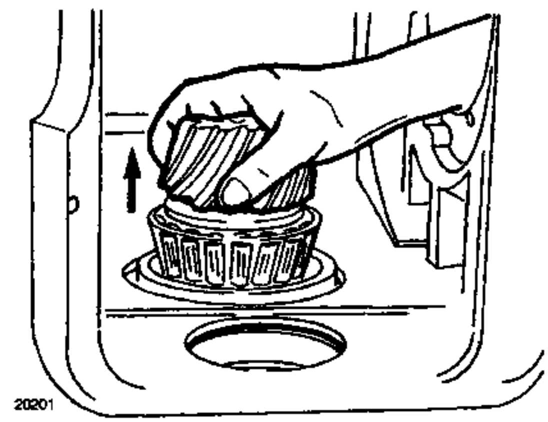
27. Remove the nut lock, hold the pinion and using special wrench **293349** (1) unscrew the nut.



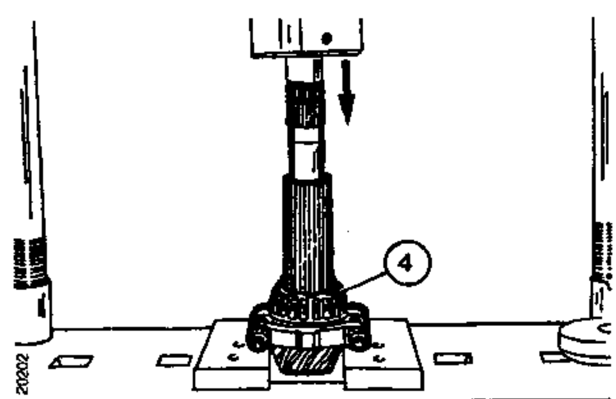
28. Partially withdraw the bevel pinion using a universal puller (2).



29. Remove universal puller and extract front bearing (3).



30. Withdraw pinion and retrieve various loose parts from inside through the hand brake compartment opening.



31. Remove bearing (4) from pinion shaft using a drive tool and hydraulic press.

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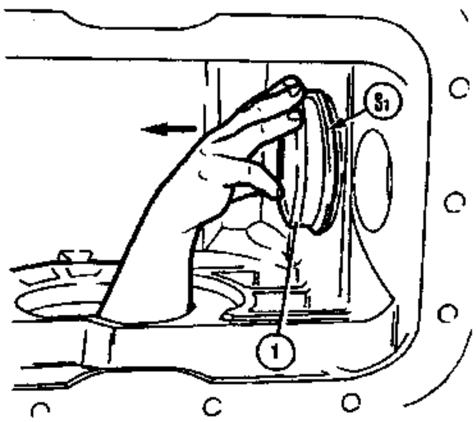


20203

32. Using a driver tool from front end remove the pinion bearing cup (1) and retrieve shim (S_1).

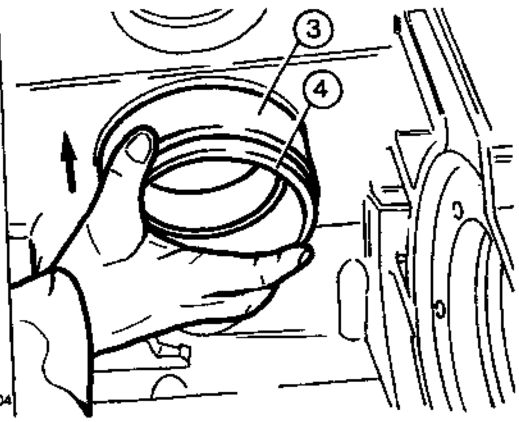
CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

33. When assembling the rear drive components inside the case pay a good attention to the following points:
a. make sure the housing is thoroughly clean, inside compartments in particular;
b. proceed by reversing the disassembly sequence of operations, starting from no. 32 back to no. 1;
c. refer to figures on page 27–3 for correct placement and orientation of component parts;
d. tighten fastenings to torque specifications of page 27–2;
e. prior to installation of housings, supports and covers make sure that mating surfaces are thoroughly cleaned and degreased, then apply a bead of a sealing compound, approximately 2 mm (.08 in) diameter, following the application schemes reported on pages 27–14 and 27–15;
f. at re–assembly of bevel drive pinion re–adjust as per instructions given on pages 27–31, 27–22 and 27–33 or, in alternative, on pages 27–23 27–24 and 27–25;
g. at re–assembly of the ring gear adjust the associated taper roller bearings and tooth backlash by performing operations starting with no. 59 on page 27–25;
h. assemble and adjust the transfer drive box bearings as instructed on pages 23–8, 23–9 and 23–10;
i. per registrare la corsa leva esterna di comando riduttore supplementare eseguire quanto descritto a pag. 21–48.

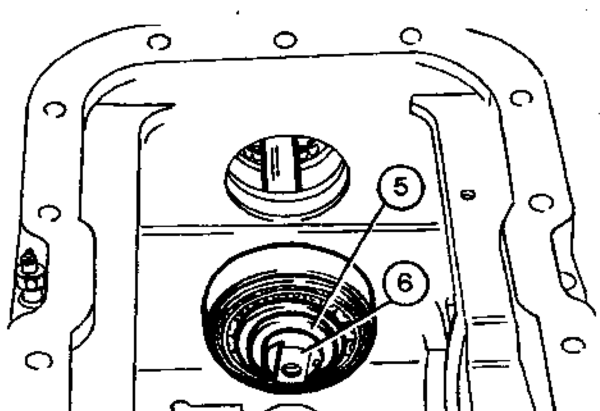
BEVEL GEAR AND PINION ADJUSTMENTS

Determining the cone point adjustment shim thickness (S_1, page 3) using universal tool 293510.



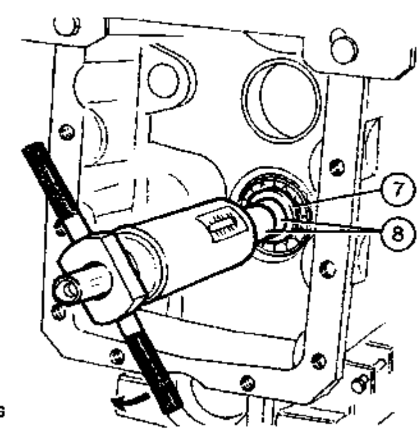
20204

34. Install tool **293976** (3) on the rear drive case with pinion rear bearing cup (4) already in place.



20205

35. Place the rear bearing with bushing **293636** (5) (of the universal tool) on the rear drive housing and introduce the end section (6) of the universal tool **293510**.



20206

36. Install the universal tool **293910** with attached bushing **293638** (7), plus spacers **293619** – **293625** (8) and front bearing.
Turn tool handle to bring index at 175 kg, simultaneously turning the tool also in order to settle bearings properly.

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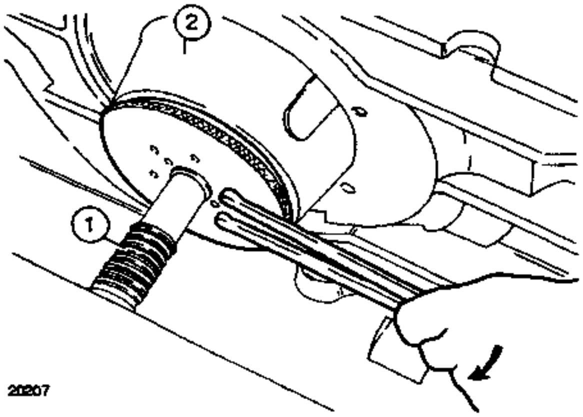
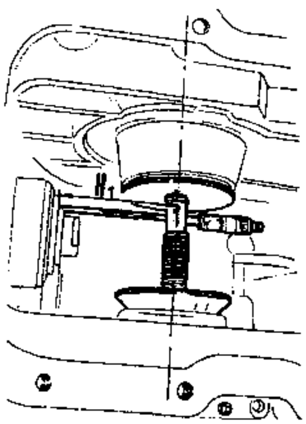


20207

37. Position the universal tool **293400/1** (1) on bevel drive ring gear bearing housings (2) with cups fitted.



20208

38. Move the tool rod to contact the bearing cup and note the dimension (H_1).

39. Determine the correct nominal dimension (H_2, page 3) between centerline of ring gear and base of bevel pinion:

$$H_2 = H_3 \pm C$$

where:

H_3 = **180 mm (7.086 in).** Nominal dimension between centerline of ring gear and base of bevel pinion.

C = Correction factor etched on pinion expressed in millimeters and preceded by the sign + or –, if different from 0, to be added to or subtracted from nominal dimension H_3 depending on the sign.

40. Thickness of shim pack (S_1) is given by:

$$S_1 = H_1 + 35 \text{ mm } (1.378 \text{ in}) - H_2$$

where:

H_1 = micrometer reading.
35mm = thickness of bushing **293976** (3, page 19).
H_2 = corrected nominal dimension between centerline of ring gear and base of bevel pinion. If necessary, round up S_1 to the next .05 mm (.002 in).

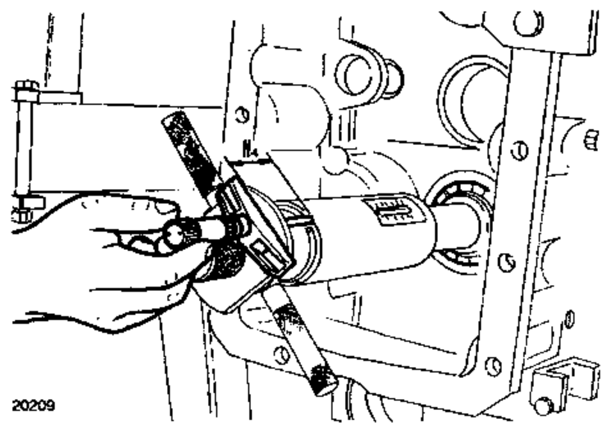
Example:
- Micrometer reading: H_1 = 146.9 mm (5.783 in).
- Thickness of bushing **293976** (3, page 19) = 35 mm (1.378 in).
- Nominal dimension between centerline of ring gear and base of bevel pinion: H_3 = 180 mm (7.086 in).
- Correction factor: C = + 0.1 mm (.004 in).
- Corrected nominal dimension: H_2 = 180 + 0.1 = 180.1 mm (7.086 + .004 = 7.090 in).
- Thickness of shim pack: S_1 = 146.9 + 35 – 180.1 = 1.8 mm (5.783 + 1.378 – 7.090 = .07 in).
- With correction factor C = – 0.1 mm (.004 in).
- Corrected nominal dimension : H_2 = 180 – 0.1 = 179.9 mm (7.086 – .004 = 7.082 in).
- Thickness of shim pack: S_1 = 146.9 + 35 – 179.9 = 2.0 mm (5.783 + 1.378 – 7.082 = .008 in).
- With correction factor = 0.
- Corrected nominal dimension:
  $H_2 = H_3$ = 180 mm (7.086 in)
- Thickness of shim pack:
- S_1 = 146.9 + 35 – 180 = 1.9 mm (5.783 + 1.378 – 7.086 = .075 in).

41. Remove the universal tool **293400/1**.

BEVEL GEAR AND PINION ADJUSTMENTS

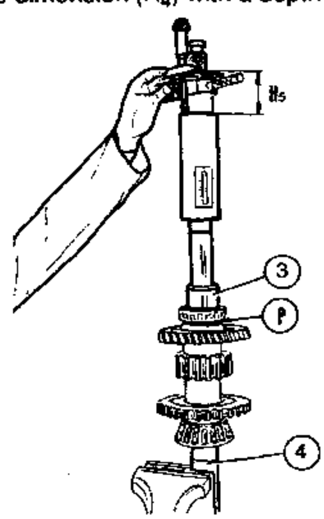
Determining the bevel pinion shaft taper roller bearing shim pack thickness (S_2, page 3) using universal tool 293510.

Proceed as follows:



20209

42. Measure dimension (H_4) with a depth gauge.



20210

43. Remove universal tool **293510** from rear drive case and tighten it in a bench vice using adapter **293617** (4).

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44. Install bushings **293636** and **293638**, spacers **293619** and **293625**, bearing cones, a provisional shim (P, page 20) to prevent interference between gear and bearing, spacer **293977** (3) and parts shown in the figure.

45. Reset the tool index at 175 kg and measure, using a depth gauge, dimension (H_5, page 20).

46. Thickness of shim pack (S_2) is given by:

$$S_2 = H_5 + P + S_1 - H_4 + 0.2 \text{ mm } (.008 \text{ in})$$

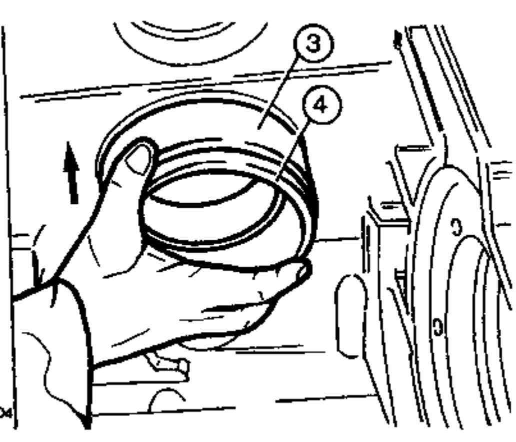
where:
P = provisional shim.
S_1 = cone point adjustment shim pack thickness, previously found in preceding paragraph.
0.2 mm (.008 in) = factor added to offset the increase of bearing preload consequent to the tightening of the bevel pinion shaft locknut.
If necessary, round up (S_2) to the next 0.05 mm (.002 in).

Example:
- Thickness of cone point adjustment shim pack, previously found in preceding paragraph: S_1 = 1.8 mm (.070 in).
- Micrometer reading: H_4 = 74.3 mm (2.925 in).
- Thickness of provisional shim: P = 2 mm (.08 in).
- Micrometer reading: H_5 = 75.80 mm (2.984 in).
- Thickness of shim pack: S_2 = 75.80 + 2 + 1.8 – 74.3 + 0.2 = 5.5 mm (2.984 + .08 + .070 – 2.925 + .008 = .217 in).

BEVEL GEAR AND PINION ADJUSTMENTS

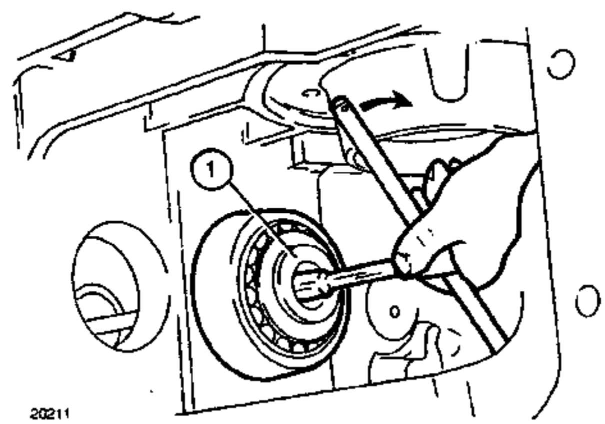
Determining the cone point adjustment shim thickness (S_1, page 3) using specific tool 293975.

Proceed as follows:



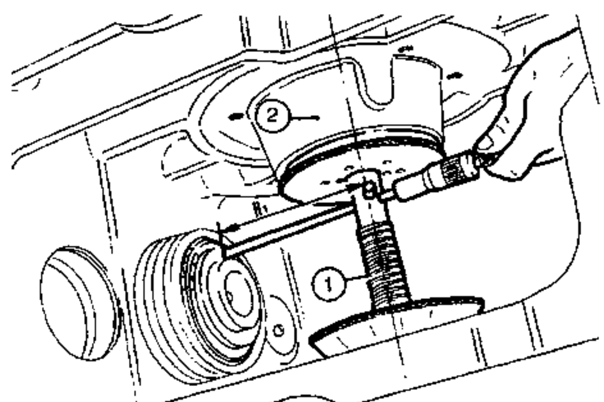
20204

47. Install tool **293976** on the rear drive case (3) with pinion rear bearing cup (4) already in place.



20211

48. Install the specific tool **293975** (1), complete with bearings, on the rear drive case, tighten the nut and simultaneously turn the bearings.



20212

49. Install universal tool **293400/1** (1) on bevel drive ring gear supports (2) with bearing cups fitted.

50. Move the tool **293400/1** spindle to contact the bearing cup and measure dimension (H_1).

51. Establish the corrected nominal dimension (H_2, page 3) between centerline of ring gear and base of bevel pinion:

$$H_2 = H_3 \pm C$$

where:
H_3 = **180 mm** (7.086 in). Nominal dimension between centerline of ring gear and base of bevel pinion
C = correction factor etched on pinion expressed in millimeter and preceded by the sign + or –, if different from 0, to be added to or subtracted from H_3 depending on the sign.

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52. Thickness of shim pack (S_1) is given by:

$$S_1 = H_1 + 35\ \text{mm}\ (1.378\ \text{in}) - H_2$$

where:
H_1 = Micrometer reading.
35 mm (1.378 in) = thickness of bushing **293976** (3, page 21).
H_2 = corrected nominal dimension between centerline of ring gear and base of bevel pinion.
If necessary, round up (S_1) to the nearest .05 mm (.002 in).

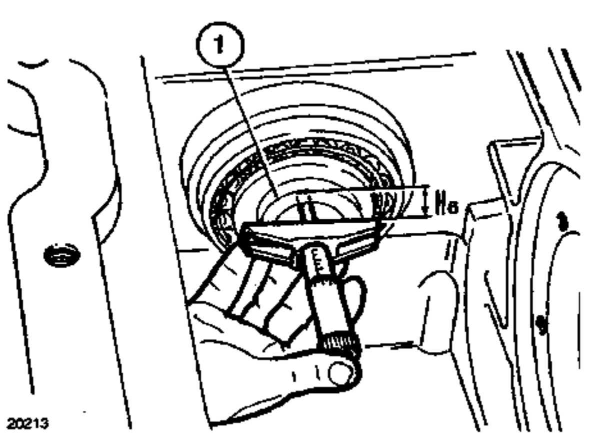
Example:
- Micrometer reading = H_1 = 146.9 mm (5.783 in).
- Thickness of bushing **293976** (3, page 19) = 35 mm (1.378 in).
- Nominal dimension between centerline of ring gear and base of bevel pinion: H_3 = 180 mm (7.086 in).
- Correction factor: C = 0.1 mm (.004 in)
- Corrected nominal dimension : H_2 = 180 + 0.1 = 180.1 mm (7.086 + .004 = 7.090 in).
- Thickness of shim pack: S_1 =146.9 + 35 – 180.1 = 1.8 mm (5.783 + 1.378 – 7.090 = .07 in).
- With correction factor C = – 0.1 mm (.004 in).
- Corrected nominal dimension: H_2 = 180 – 0.1 = 179.9 mm (7.086 – .004 = 7.082 in).
- Thickness of shim pack: S_1 = 146.9 + 35 – 179.9 = 2 mm (5.783 + 1.378 – 7.082 = .008 in).
- With correction factor = 0.
- Corrected nominal dimension : H_2 = H_3 = 180 mm (7.086 in).
- Thickness of shim pack: S_1 = 146.9 + 35 – 180 = 1.9 mm (5.783 + 1.378 – 7.086 = .075 in).

53. Remove the universal tool **293400/1**.

BEVEL GEAR AND PINION ADJUSTMENTS

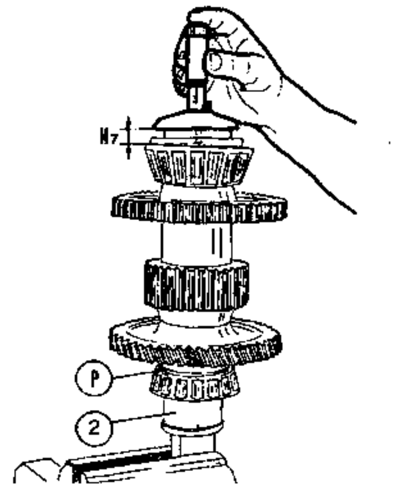
Determining the bevel pinion shaft taper roller bearing shim pack thickness (S_2, page 3) using specific tool 293975.

Proceed as follows:



54. Using a depth micrometer gauge measure dimension (H_6) between the end of tool **293975** (1) and the end of screw inside.

55. Remove tool **293975** from rear drive housing.



56. Tighten tool **293975** on a bench vice and assemble parts, including a provisional shim (P) and spacer **293977** (2).

57. Tighten the tool lock nut and then measure, using a micrometer depth gauge, the dimension (H_7) between tool end and inside screw.

58. Thickness of shim pack (S_2) is given by:

$$S_2 = H_7 + P + S_1 - H_6 + 0.2\ \text{mm}\ (.008\ \text{in})$$

where:
P = provisional shim.
S_1 = cone point adjustment shim pack thickness, previously found in preceding paragraph.
0.2 mm = factor added to offset the increase of bearing preload consequent to the tightening of the bevel pinion shaft locknut.
If necessary, round up S_1 to the nearest 0.05 mm (.002 in).

Example:
- Thickness of cone point adjustment shim pack, previously found in preceding paragraph: S_1 = 1.8 mm (.070 in).
- Micrometer reading: H_6 = 12.10 mm (.476 mm).
- Thickness of provisional shim: P = 2 mm (.08 in).
- Micrometer reading: H_7 = 13.60 mm (.535 in).
- Thickness of shim pack: S_2 = 13.60 + 2 + 1.8 – 12.1 + 0.2 = 5.5 mm (.535 + .08 + .070 – .476 + .008 = .217 in).

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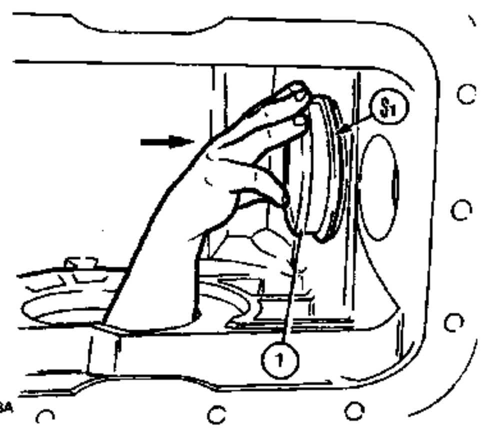
BEVEL GEAR AND PINION ADJUSTMENTS

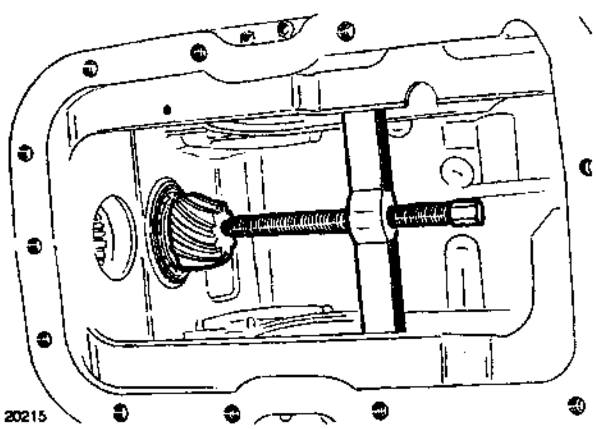
Adjusting ring gear bearings and checking bevel drive gear tooth backlash.

Proceed as follows:



20203A

59. Fit the rear bearing cup (1) and the previously established shim (S_1).



20215

60. Install bevel pinion assembly with previously established bearing adjustment shim pack (S_2, page 3); (if necessary use a suitable tool to hold the pinion in position).

Note – Refer to page 1 for available thickness range of bevel pinion cone point and bearing adjustment shims (S_1 and S_2).

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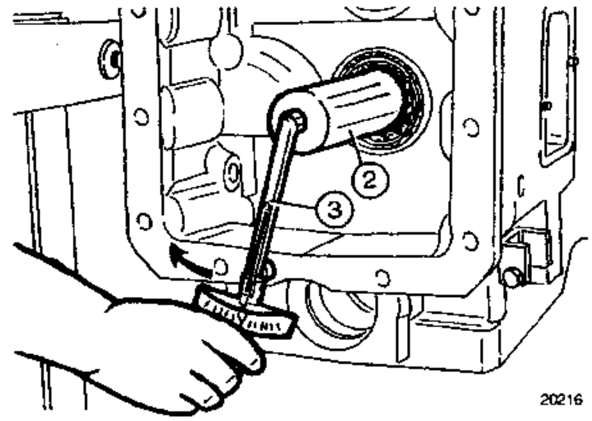
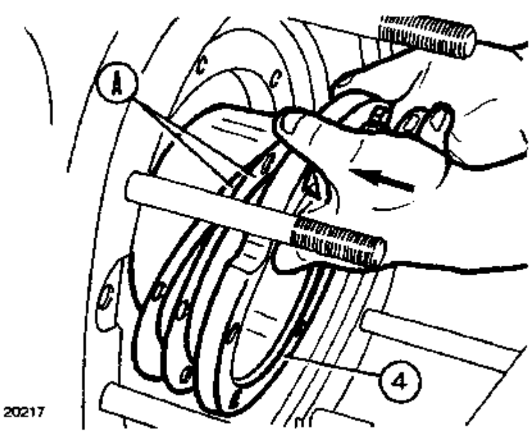
61. Thread on and torque tighten hex. nut (C_1, page 3) to specifications (490 Nm = 50 kgm = 362 ft.lb) using wrench **293343/2** and simultaneously turning the bevel pinion shaft in order to seat bearings correctly. Remove previously installed pinion holding tool, if any.



20216

62. Check the bevel pinion shaft rolling drag torque. Correct value measured at shaft end using wrench **293343/2** (2) and torque wrench **292865** (3) is 1.0 to 2.0 Nm (0.1 to 0.2 kgm or .7 to 1.4 ft.lb). Finally lock hex. nut (C_1, page 3) by caulking.

Note – Reduce bearing adjustment shim (S_2, page 3) thickness if the rolling drag torque is lower than specified value or increase it if higher.



20217

63. Install the ring gear–differential assembly in the rear drive case and fit the R.H. side bearing housing (4) with a provisional shim (A) and finally secure it with three of the capscrews torqued to 54 Nm (5.5 kgm or 40 ft.lb).

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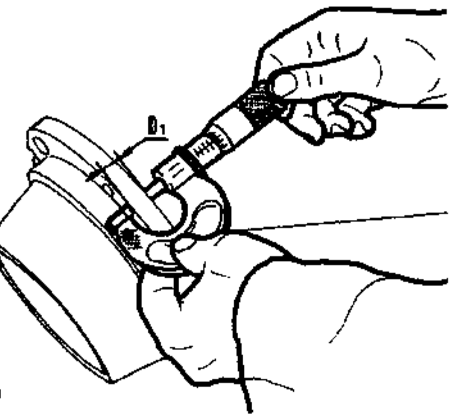
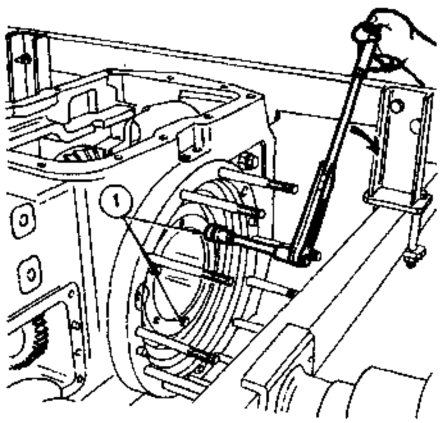


20218

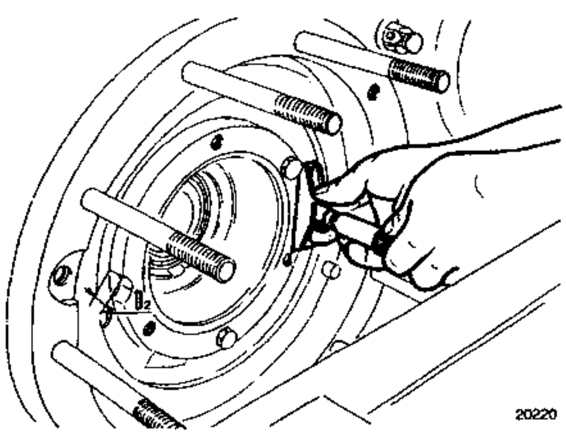
64. Measure thickness of L.H. side housing (D_1).



20219

65. Install the L.H. side bearing housing without shims and with only three of the screws (1) previously lubricated and staggered 120° from each other.

66. Tighten screws (1) progressively and in a staggered sequence, simultaneously turning the ring gear to seat bearings properly, to a torque of 6 to 9 Nm (0.6 to 0.9 kgm or 4.5 to 6.5 ft.lb).



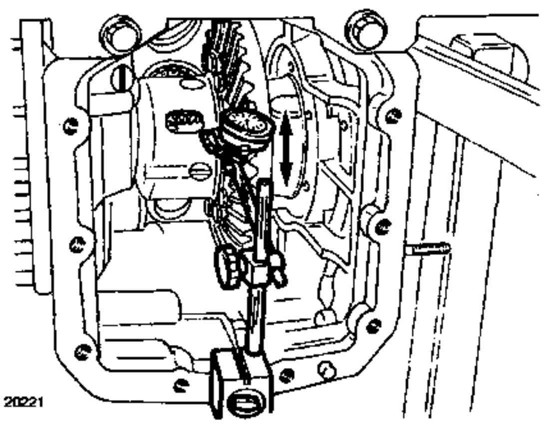
20220

67. Apply a depth gauge to the two recesses of the left quill and measure dimension (D_2); make the average of the two readings.

68. Total thickness of shims (S) to be inserted under the right and left quills is given by:

$$S = D_2 - D_1 + A + 0.3 \text{ mm } (.012 \text{ in})$$

where:
A = provisional shim = 1.5 mm (.06 in)
D_1 = thickness of L.H. side flange (mm).
D_2 = dimension in mm measured at operation no. 56.
0.3 mm (.012 in) = added factor to offset the increase of bearing preload consequent to the tightening of capscrews (1).
If necessary, round up S to nearest 0.05 mm (.002 in).



20221

69. Using a dial gauge measure tooth backlash (G) of bevel drive at three points 120° from each other; find the average of the three readings.

70. Normal backlash is 0.20 to 0.28 mm (.008 to .011 in) or 0.24 mm(.009 in) as an average.

71. To compensate any deviation, higher or lower with respect to specified value, consider that existing ratio between normal tooth backlash and equivalent ring gear endwise displacement is 1 : 1.34.
Consequently, the endwise displacement (Z) required to bring the backlash value within tolerance is:

$$Z = (G - 0.24) \times 1.34$$

Thickness of shim packs (S_d and S_s) for right and left quills are given by:

$$Sd = A \pm Z$$
$$Ss = S - Sd$$

where:
S = total shim pack thickness.
Z = ring gear endwise displacement value as previously determined.
A = provisional shim thickness of 1.5 mm (.06 in).

72. Fit the previously calculated shim packs on quills and torque attaching capscrews (1) to specifications.

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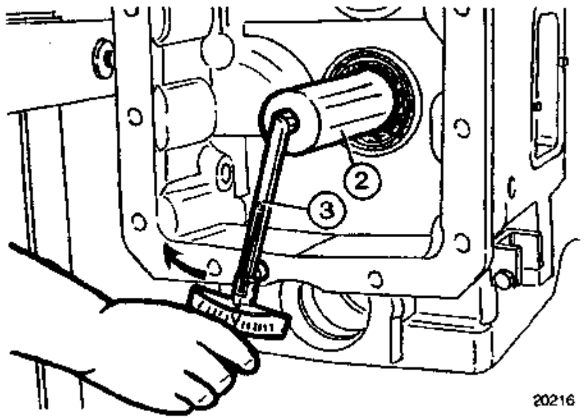


20216

73. Check rolling drag torque of the bevel gear drive measured at shaft end with wrench **293342/2** (2) and torque wrench **292865** (3) = **Rp + (1.25 to 2.0 Nm), Rp + (0.125 to 0.200 kgm or .9 to 1.4 ft.lb)**.

where:
Rp = torque value previously found for bevel pinion only (see page 27–25).

Example:

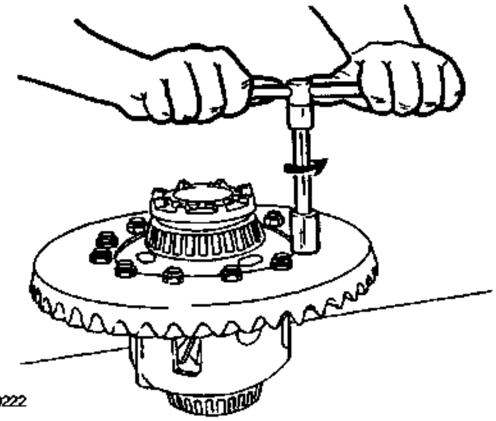
- Measurement of the L.H. side shim (D_1) = 14.00 mm (.551 in).
- Provisional shim A = 1.5 mm (.06 in).
- Measurement of distance D_2 between left quill and seat in rear drive case:
  14.15 mm (.557 in); 14.25 mm (.561 in).
  D_2, average value = (14.15 + 14.25) : 2 = 14.20 mm or (.557 + .561) : 2 = .559 in.
- Total shim thickness:
  S = 14.20 – 14.00 + 1.5 +0 .3 = 2.00 mm (.559 – .551 + .06 + .012 = .079 in).
- Tooth backlash reading : 0.13 mm (.0051 in); 0.12 mm (.0047 in); 0.14 mm (.0055 in).
  G, average value = (0.13 + 0.12 + 0.14) : 3 = 0.13 mm or (.0051 + .0047 + .0055) : 3 = .0051 in.
- Axial displacement (Z) required to bring tooth backlash value within tolerance:
  Z = (0.13 – 0.24) x 1.34 = .15 mm approx. or Z = (.0051 – .009) x 1.34 = .0052 in, approx.
- Thickness of R.H. side shim:
  S_d = 1.5 – 0.15 = 1.35 mm (.059 – .0059 = .0531 in).
- Thickness of L.H. side shim:
  S_s = 2.00 – 1.35 = 0.65 mm (.078 – .053 = .025 in).

DIFFERENTIAL WITH HYDRAULIC LOCK
Disassembly–Assembly (Op. 27 106 37)

Remove assembly from rear drive case, then proceed as follows:

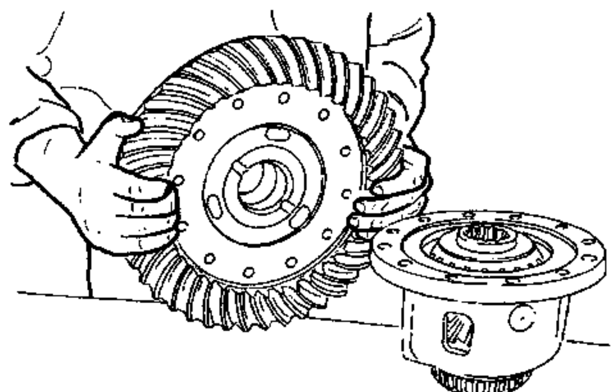
⚠ CAUTION ⚠

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.



20222

1. Remove ring gear attaching capscrews.



20223

2. Separate ring gear from differential case

20224

3. Remove the differential side gear (1).

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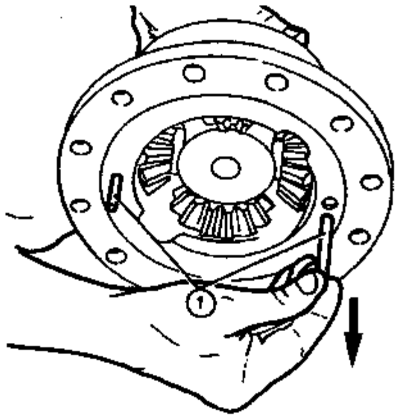
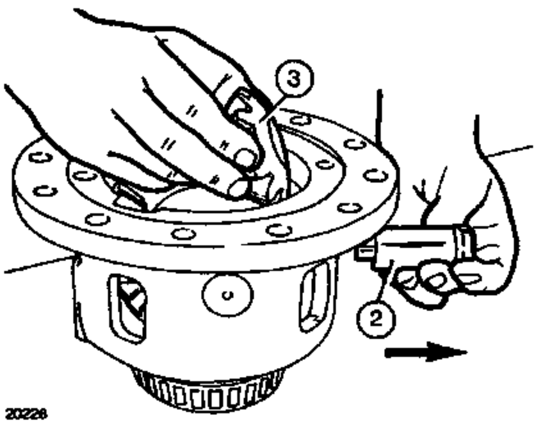


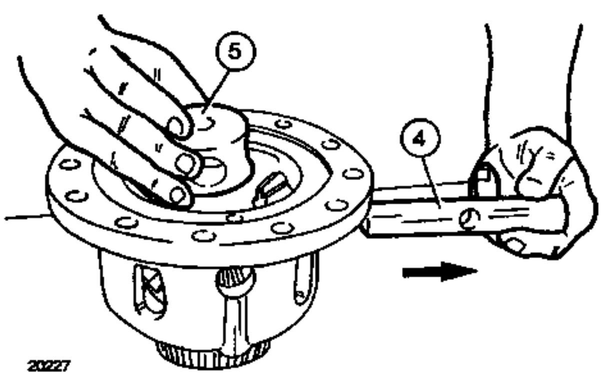
20225

4. Remove set pins (1) of differential pinion axle.



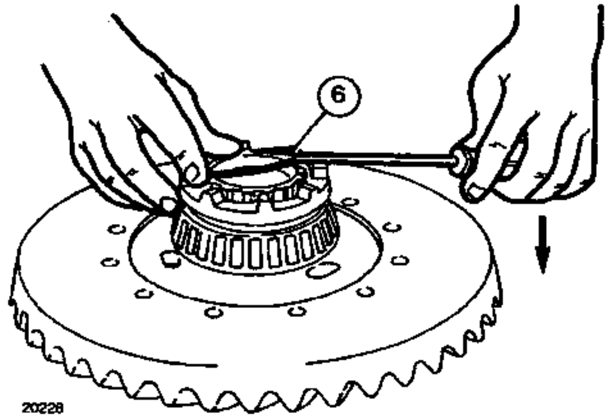
20226

5. Slide off pin (2) and retrieve differential pinion (3) (on both sides). It is advisable that mating pinion and pin be kept together when removed.



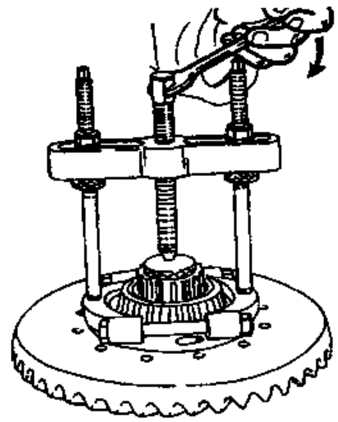
20227

6. Withdraw pin (4) then retrieve pin support (5) and pinions.



20228

7. Remove the differential lock gear retaining ring (6).



20229

8. Using suitable pullers remove bearing from ring gear.

9. Proceeding as at previous point 8, remove bearing from differential housing.

CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

10. At assembly, pay good attention to the following points:
a. proceed by reversing the disassembly sequence of operations starting from no. 9 back to no. 1;
b. see illustrations on page 27–3 for correct placement and orientation of component parts;
c. tighten fastenings to torque specifications of page 27–2;
d. take operations that follow into consideration and make the adjustment of page 27–29.

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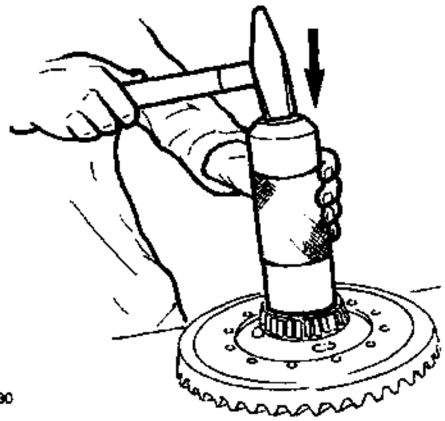
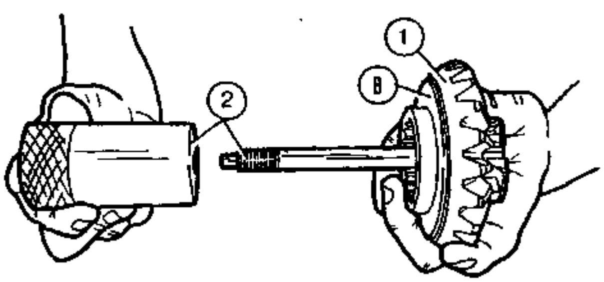


20230

11. Fit bearing on ring gear and differential housing using a suitable drive punch.

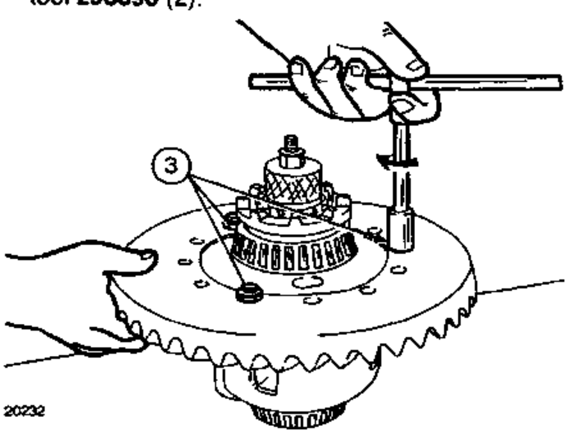
Adjusting the differential side gear end play

Note – To adjust the L.H. side gear end play proceed as per subsequent instructions referring to the R.H. side one.



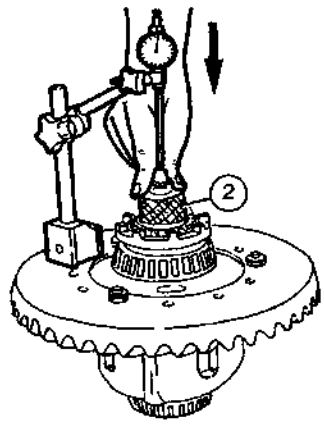
20231

12. Fit differential pinions, axles and securing pins.
13. Position side gear (1) with provisional shim (B) on tool **293896** (2).



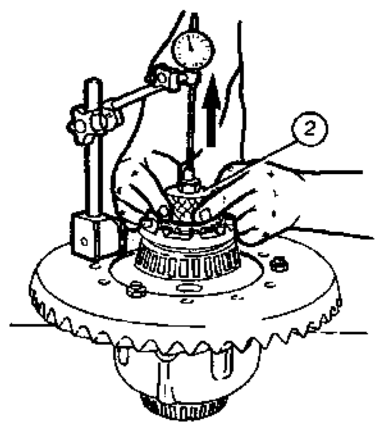
20232

14. Attach side gear with tool **293896** to differential case, place ring gear on top and secure it with three of the attaching capscrews (3).
Turn the pack to assure proper seating.



20233

15. Place a comparator dial gauge with tip in contact with the tool screw (2), press on the tool and set dial at zero.



20234

16. Pull the tool (2) upwards and measure displacement (H) on the comparator gauge.
17. Thickness of shim for the R.H. side gear is given by:

Rd = (B + H) – 0.05 – 0.30

where:
Rd = shim for right side gear.
B = provisional shim, 3.00 mm (.12 in) thickness.
H = micrometer reading of displacement.
0.05 mm (.002 in) = half of differential pinion clearance on respective pins.
0.30 mm (.012 in) = side gear end play specification.

Example:
- comparator reading of displacement H = 0.50 mm (.02 in).
- thickness of provisional shim = 0.3 mm (.012 in).
- Shim thickness for right side gear:
R_s = (3.00 + 0.50) – 0.05 – 0.30 = 3.15 mm (.124 in).

18. Once established the shim thickness required for right and left–hand side gears, re–assemble and torque tighten the ring gear capscrews at 137 Nm (14 kgm = 101 ft.lb).to specifications.

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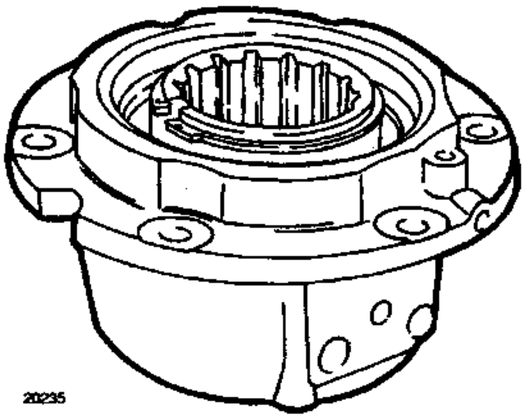
DIFFERENTIAL LOCK HYDRAULICS
Disassembly–Assembly (Op. 27 110 44)

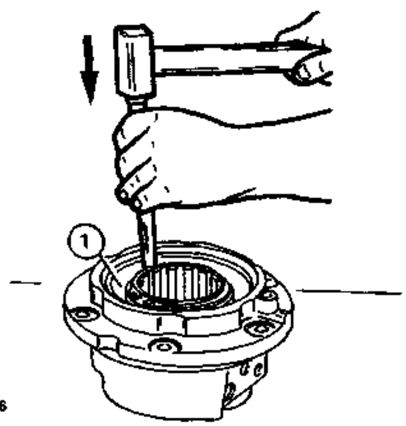
⚠ CAUTION ⚠

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.



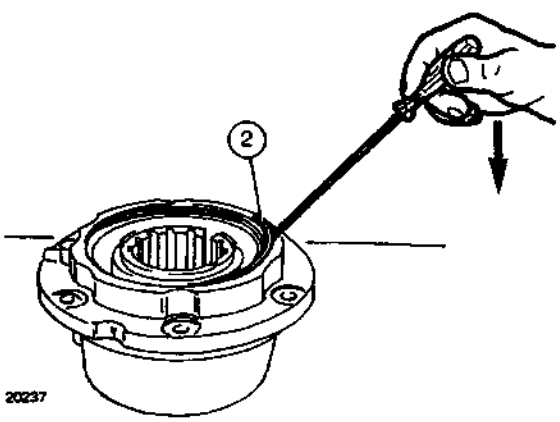
20235

1. Remove assembly from rear drive case and proceed as follows:



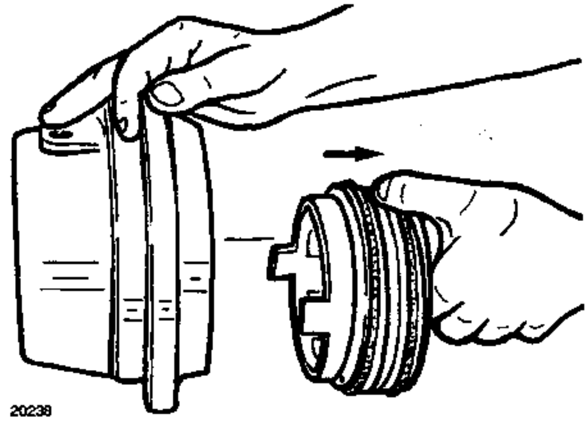
20236

2. Act on piston (1) to free the ring.



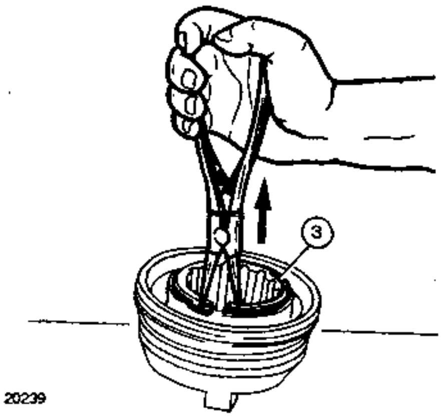
20237

3. Remove ring (2).



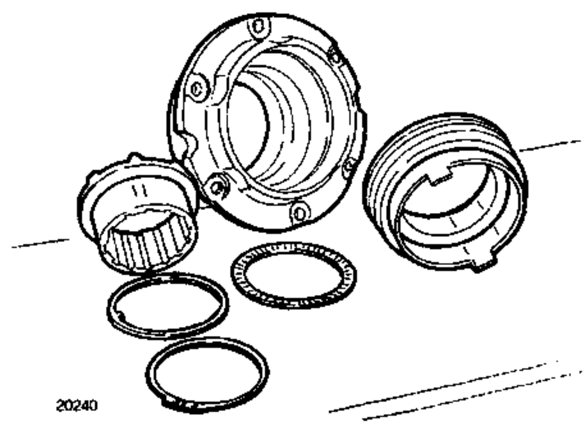
20238

4. Withdraw differential lock from support.



20239

5. Remove snap ring (3).



20240

6. Disassemble, check component parts and oil seals, replace worn and damaged parts.

7. Proceed to re–assemble the differential lock control paying attention to the following points:
a. reverse the disassembly sequence of operations starting from no. 6 back to no. 1;
b. see illustrations on page 27–3 for correct placement and orientation of component parts;
c. lubricate loose parts with oliofiat **TUTELA MULTI F**

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DIFFERENTIAL LOCK CONTROL ELECTRO–VALVE
Replacement (Op. 27 110 88)

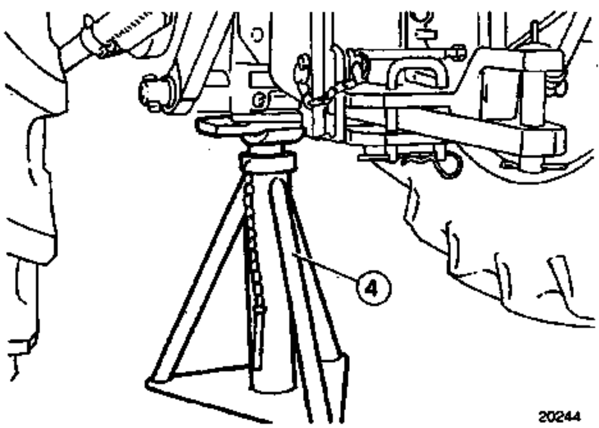
Proceed as described on page 31–14 in connection with the PTO brake engagement electro–valve.

FINAL DRIVE ASSEMBLY, RIGHT OR LEFT
Removal–Installation (Op. 27 120 10 – 27 120 20)

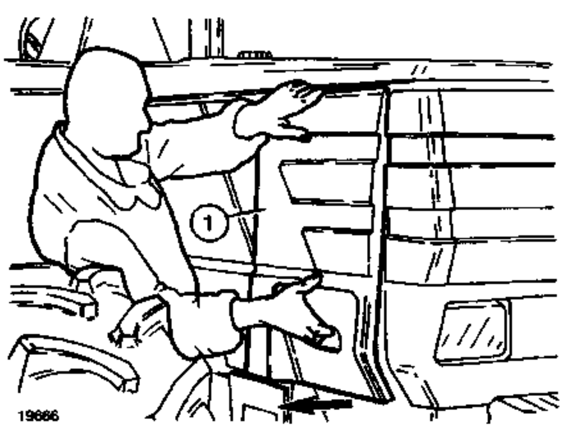
DANGER

Lift and handle all heavy components using a suitable lift.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.

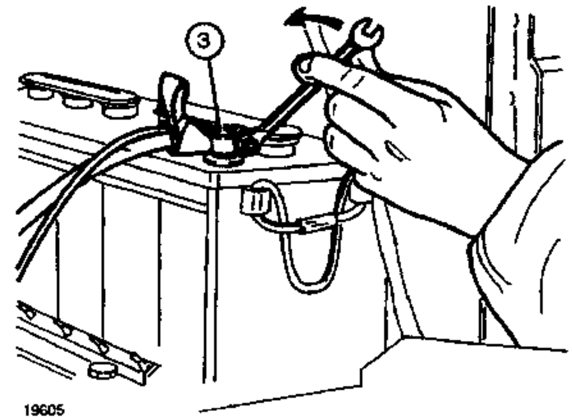
Separate and remove final drive case as follows:



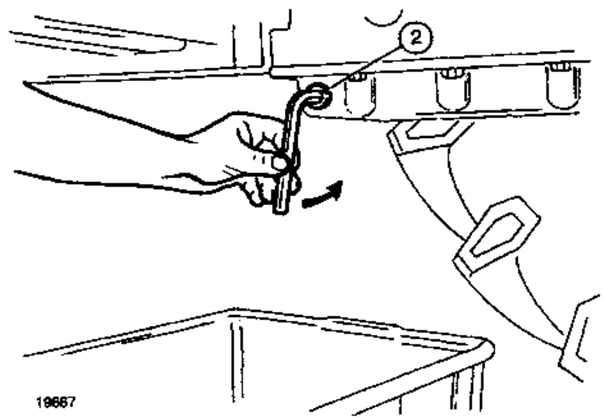
1. Place a stationary stand (4) under the rear drive case.



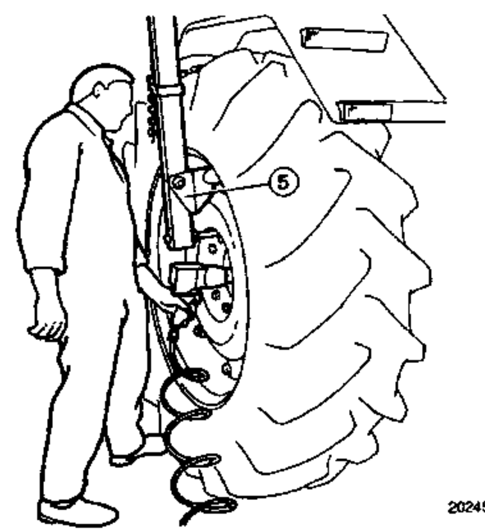
2. Remove front panel section (1) from the tractor R.H. side.



3. Disconnect positive battery cable (3) and insulate it.



4. Unscrew plug (2) and drain rear drive case oil noting the refill quantity: 60 liters (15.8 Usa or 11–3/4 Imp. Gall).



5. Attach hook **292400** (5) to the wheel, remove the attaching capscrews and finally the wheel, complete, using a hoist.

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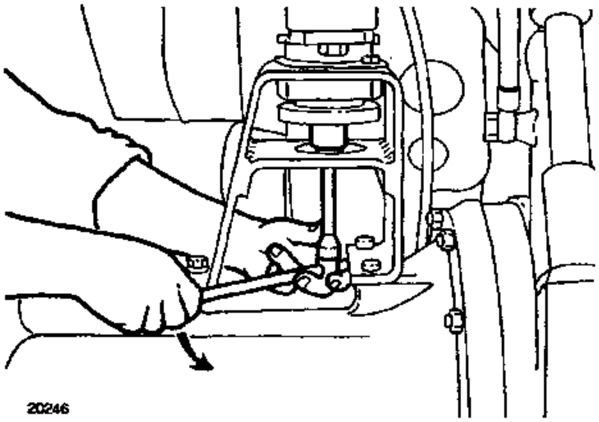
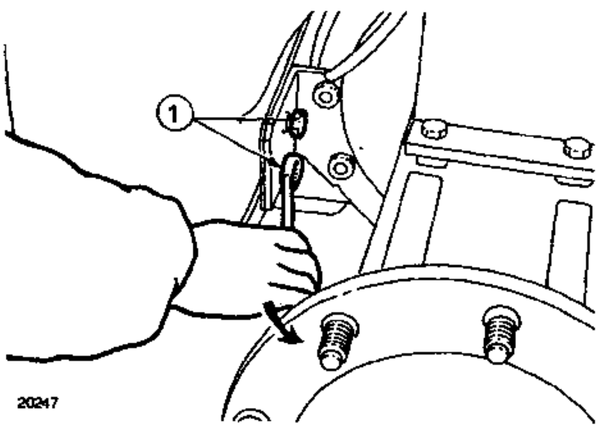
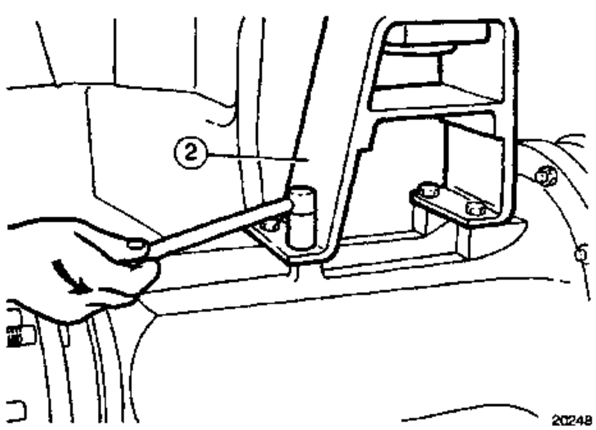


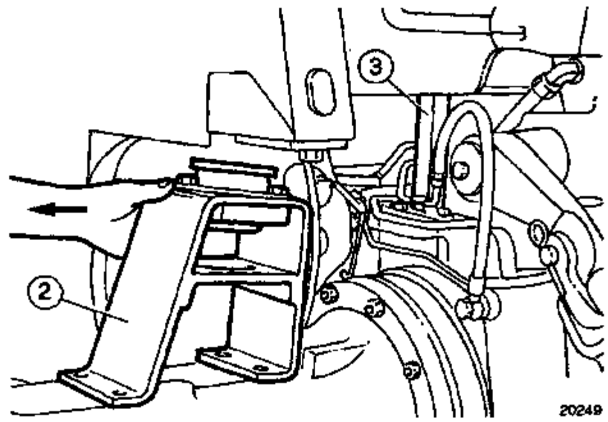
6. Loosen and remove the cabin rear mounting capscrew.



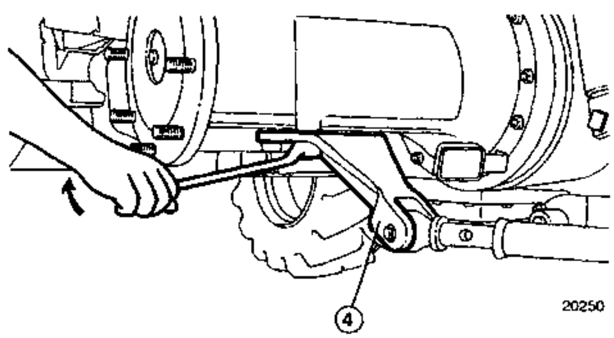
7. Remove capscrews (1) securing the main fuel tank support.



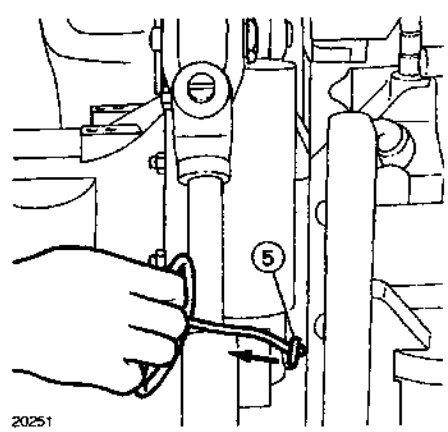
8. Remove the cabin rear mounting bracket capscrews (2).



9. Prop up slightly the cabin rear end , if necessary loosen the attaching capscrew on the opposite final drive case, fit a supporting wooden block (3) for safety, then remove the cabin mounting bracket (2).



10. Remove attaching capscrews and finally the implement hitch sway limiter rod mounting bracket (4).



11. Withdraw cotter pin (5) and remove the auxiliary ram attaching pin.

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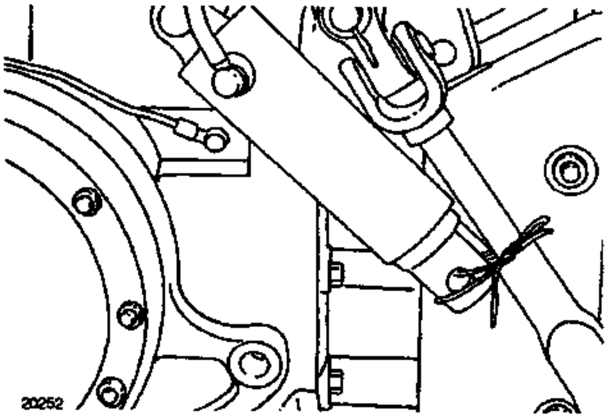
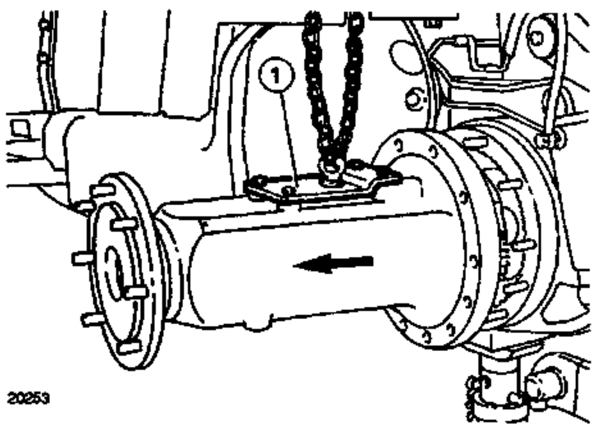
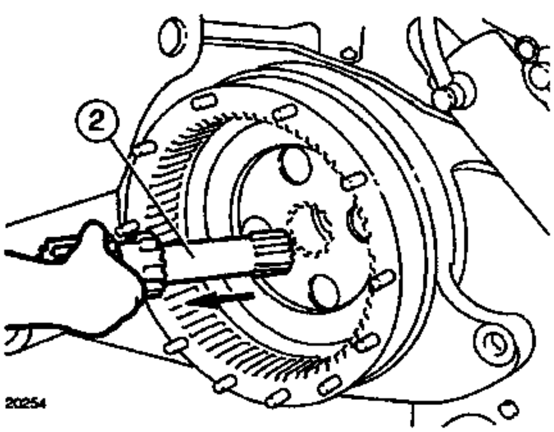


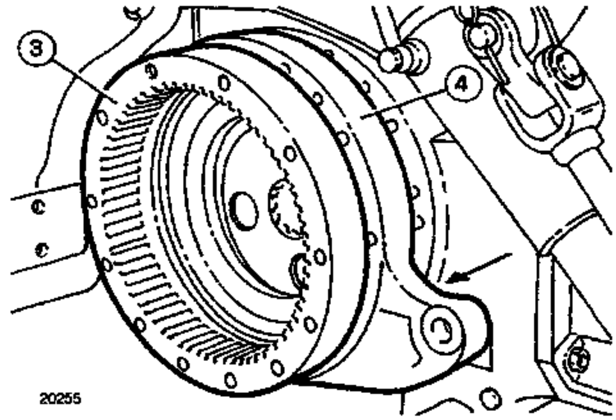
12. Secure the auxiliary ram to the lift rod with provisional means.



13. Attach tool **50066** (1) (see page 4) to the final drive case, remove the screws and separate it from the rear drive housing.



14. Retrieve the wheel shaft (2).



15. Remove the outer ring gear (3) , spacer (4) and retrieve friction disc.

CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

16. Proceed to re–join the final drive cases to the rear drive paying attention to the following points:
a. proceed by reversing the removal sequence of operations starting from no. 15 back to no. 1;
b. prior to re–assembly make sure that mating surfaces are thoroughly cleaned and degreased, then apply a bead of sealing compound, indicatively 2 mm (.08 in) diameter, following the application scheme of page 27–15;
c. tighten fastenings to torque specification data of page 27– 2.

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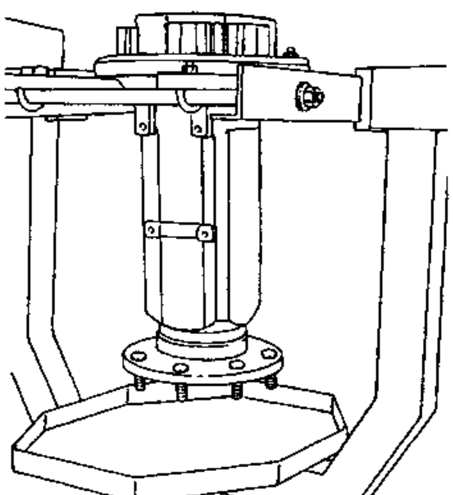
DRIVE WHEEL SHAFT
Disassembly–Asembly (Op. 27 120 34)

Separate and remove the final drive from the rear drive case, then proceed as follows:

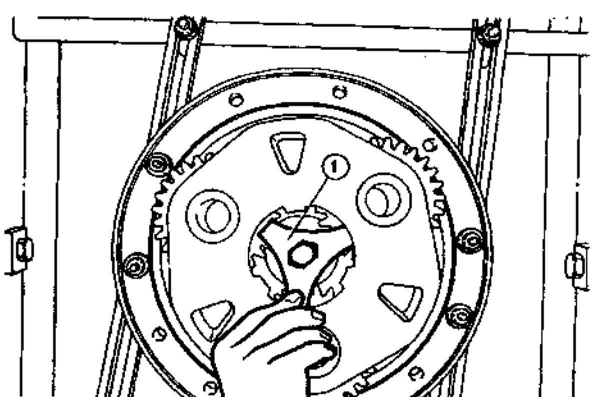
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.



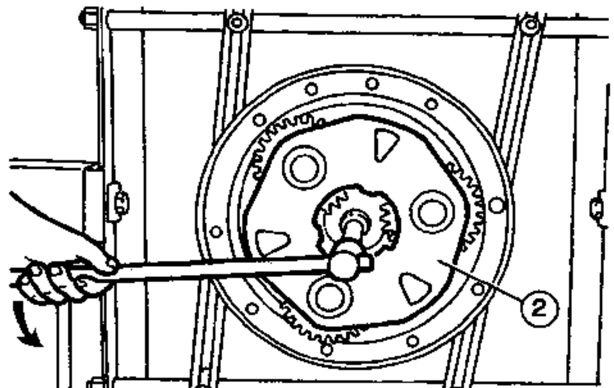
20256

1. Install final drive on revolving stand.



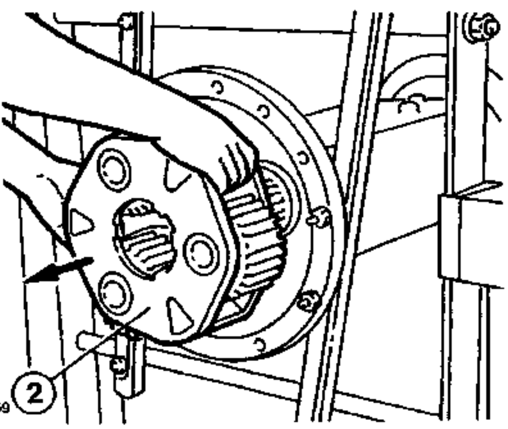
20257

2. Remove retaining plate (1), slightly rotating it if necessary.



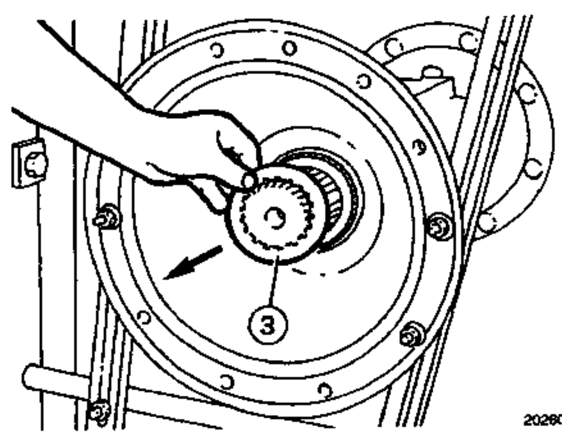
20258

3. Remove the screw securing the planet gear support (2) to wheel shaft.



20259

4. Withdraw the planet gear support (2).



20260

5. Retrieve thrust washer (3).

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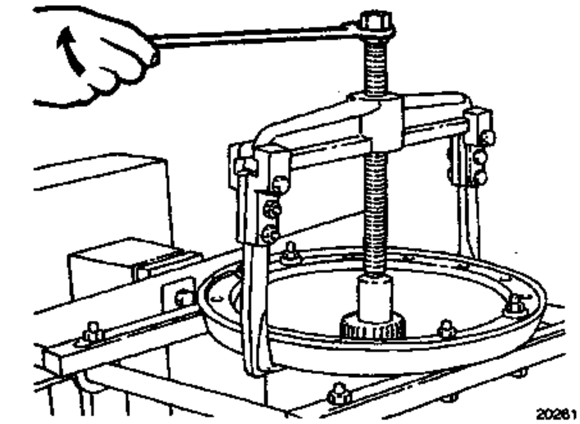
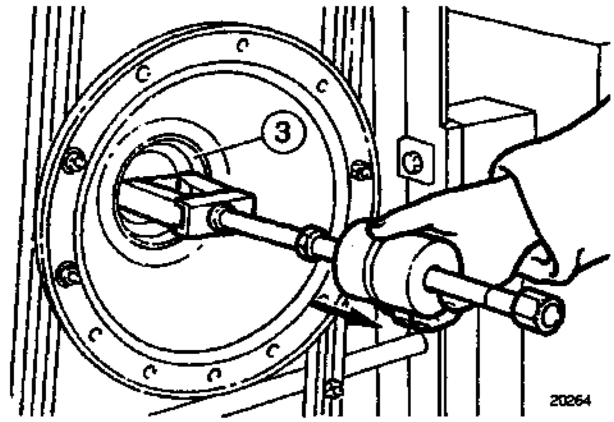
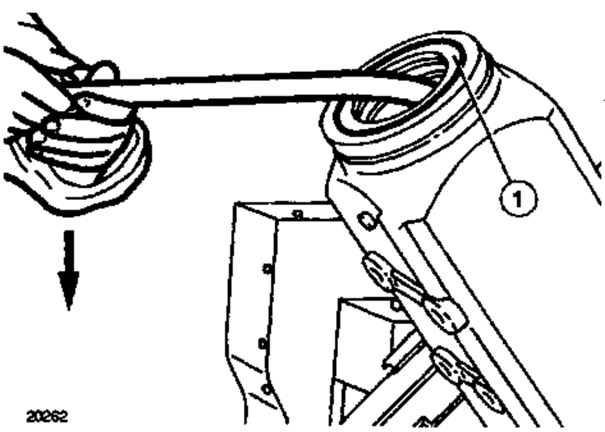


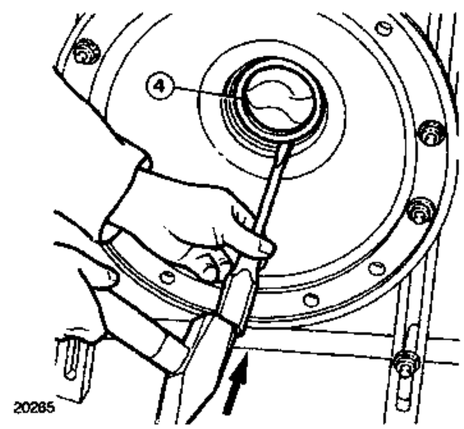
6. Using a suitable tool pull out the wheel shaft.



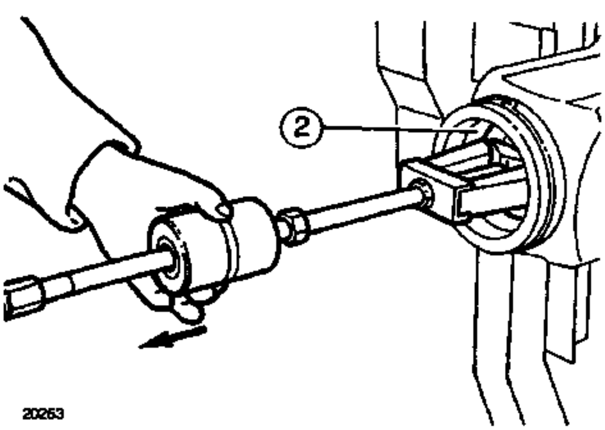
9. Using same type pullers of point 8 take out the inside bearing cup (3) also from wheel shaft.



7. Remove oil seal (1) and retrieve the shaft bearing cone, wheel end.



10. Remove oil seal (4).



8. Using expansion and slide–hammer type pullers take out the bearing cup (2).

CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

11. Proceed to re–assemble drive wheel shaft unit paying attention to the following points:
   a. proceed by reversing the disassembly sequence of operations starting from no. 10 back to no. 1;
   b. see illustrations on page 27–3 for correct placement and orientation of component parts.
12. Install the bearing outer races and oil seals using driver tools of appropriate dimensions.
13. After fitting all parts in the final drive case proceed with the adjustment of the drive wheel taper roller bearing.

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Adjusting the drive wheel taper roller bearings

14. Tighten screw (C_3, page 3) to torque specifications of 196 Nm (20 kgm or 145 ft.lb), simultaneously turning the wheel shaft in order to assure proper seating of all parts and components.

15. Slacken screw (C_3) then re–tighten it to 88 Nm (9 kgm or 65 ft.lb) still turning the wheel shaft simultaneously in order to assure proper seating of bearings.

16. Fit safety plate and lock by turning screw (3) in or out to nearest notch.

Note – Turn on or back up screw for a maximum angle of 15°.

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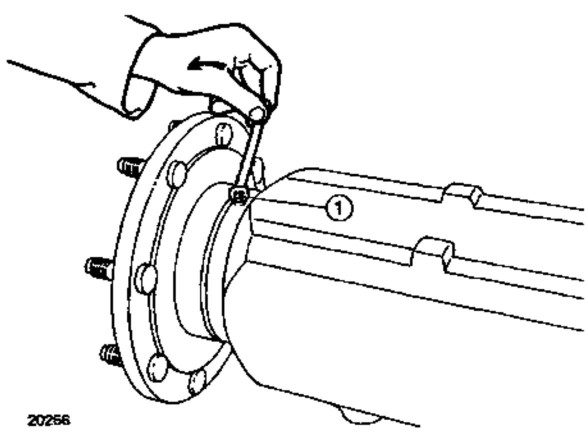
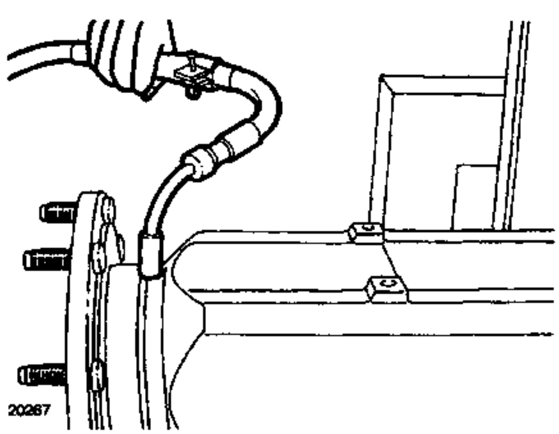
17. Manually check free shaft rotation without end play or resistance.



18. Remove plug (1) and fit a grease nipple.



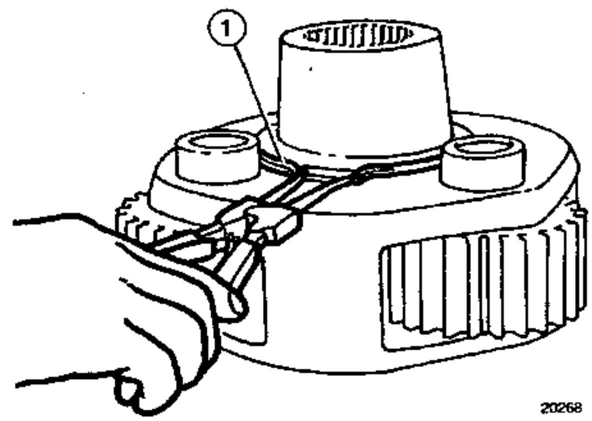
19. Fill inside recess (a few pump strokes) with **grasso-fiat G9** through the nipple, remove it and fit plug (1).

PLANETARY GEAR REDUCTION UNIT
Disassembly–Assembly (Op. 27 120 32)

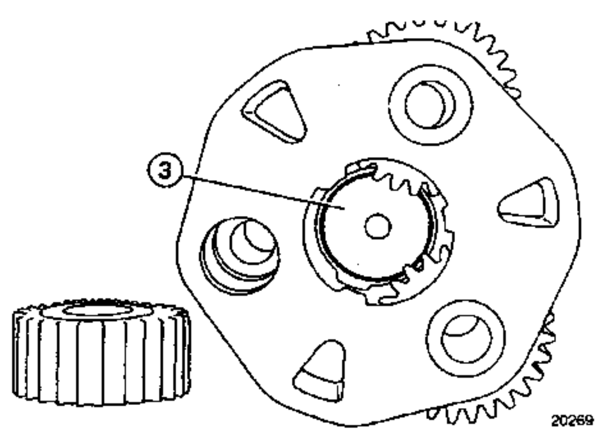
Remove unit from final drive case then proceed as follows:

⚠ CAUTION ⚠

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.



1. Remove retaining ring (2).



2. Slide out pins and retrieve gears with needle bearings, finally remove thrust washer (3).
3. Proceed to re–assemble the planet gear unit paying attention to the following points:
   a. proceed by reversing the disassembly sequence of operations no. 1 and 2.
   b. install thrust plate (3) first on the planet gear carrier plate.

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POWER TAKE–OFF

540/1000 rpm PTO	
Type	fully indipendent of tractor ground speed or: synchronized with tractor gearbox
Engagement and controls	through oil–bath, multi–disc clucth, electro–hydraulic control
Rotation (looking from tractor rear end)	clockwise
Speed selection	manual, through hand lever located at the operator's RH side
Engine speed at 540–rpm PTO rpm	1969
Engine speed at 1000–rpm PTO »	2120
PTO speed with engine running at max. power rating:	
– 540 rpm »	630
– 1000 rpm »	1085
Synchronized ground–speed PTO:	
– 540 rpm rotations/1 wheel turn	13.9
– 1000 rpm »	23.8
Splined extension shaft dia:	
– 540 rpm	$1^3/_8$" (6 spline) or $1^3/_4$" (6 spline) (optional)
– 1000 rpm	$1^3/_8$" (21 spline)
O.D., bushings, driven gear bearings (3, page 31–3)	49.910 to 49.940 mm (1.9649 to 1.9661 in)
I.D., driven gears (2)	50.060 to 50.106 mm (1.9709 to 1.9727 in)
Clearance fit, gears and bearing bushings	0.120 to 0.196 mm (.0047 to .0078 in)
Driven shaft dia. (5, page 31–3)	44.366 to 44.391 mm (1.7467 to 1.7477 in)
I.D., bushings (3)	44.400 to 44.425 mm (1.7480 to 1.7490 in)
Clearance fit, shaft and bushings	0.009 to 0.059 mm (.0003 to .0023 in)

(follows)

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POWER TAKE–OFF

(cont.)

540/750/1000 rpm power take–off	refer to previos description of 540/1000 rpm PTO plus following information
Engine speed at 750–rpm PTO rpm PTO speed with engine running at max. power rating rpm	2147 803
Splined output shaft dia.	$1^3/_8$" (6 spline)
Synchronized ground–speed PTO, rpm: revolutions/1 wheel turn	17.6
PTO engagement clutch Type	oil–bath, multi–disc, hydraulically actuated
Number of clutch discs: – driving – driven Number of clutch engagement springs	 7 6 1
Shaft turning stop brake, type	shoe–brake, hydraulically controlled acting on clutch bell
Actuating oil pump	the same of the power steering hydraulics
Oil filter, type Location	paper cartridge at pump suction

TORQUE DATA

DESCRIPTION	Thread size	Torque		
		Nm	kgm	ft.lb
Capscrews, PTO case (C_1, page 31–3)	M 16 x 1.5	211	21.5	155
Nut, PTO shaft (C_2)	M 32 x 1.5	294	30	217
Self–locking nut, PTO extension shaft (C_3)	M 12 x 1.25	137	14	101
Srews, bearing housing (C_4)	M 12 x 1.25	88	9	65
Plug, PTO braking device connection (C_5)	M 35 x 1.5	83	8.5	61
Cap, spring retainer (C_6)	M 16 x 1.5	49	5	36
Screw, electro–valve (C_7, page 31–14)	–	5.4 to 8.1	.55 to .83	4 to 6
Screw, electro–valve pin (C_8, page 31–14)	–	47 to 54	4.8 to 5.5	35 to 40

SERVICE TOOLS

ATTENTION – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code **(X)**.
Besides, to work safely and achieve the best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjonction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

List of the special tools necessary to perform service operations covered by this section of the Manual:

	292870	Universal pressure tester kit, hydraulic clutch.
X	**293997**	Replacer punch, clutch driving shaft needle bearing (with **293800**).
X	**293836**	Protection, clutch driving shaft seal.
X	**293993**	Replacer punch, clutch driving shaft seal (with **293800**).
X	**290785**	Protection, clutch drum seal installation.
	293812	Pilot pins, PTO assembly alignment.
	293800	Handle, (for **293993** and **293997**).
	293998	Replacer punch, clutch shaft cup.
	293999	Puller adapter, clutch brake plunger.
	50063	Special tool for clutch spring cup (with**292651** and **292654**) to be made in the workshop (see page 31–3).

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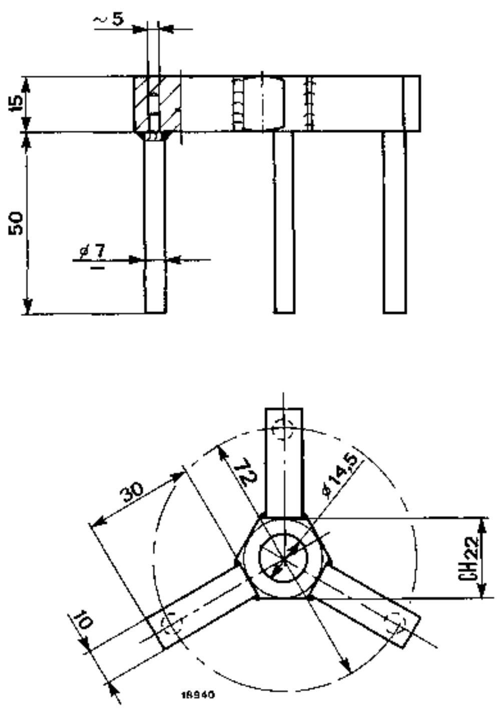
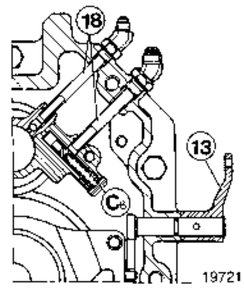
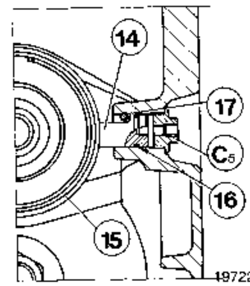
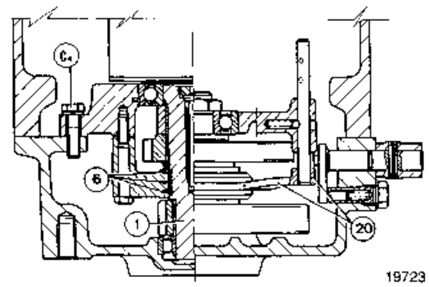
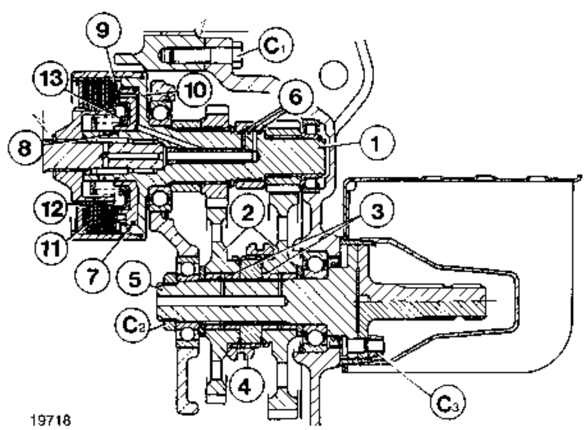


Special tool for the PTO clutch spring cup (stamp on tool the reference no. 50063)(Metric dimensions)
Material specification: Fe42C.









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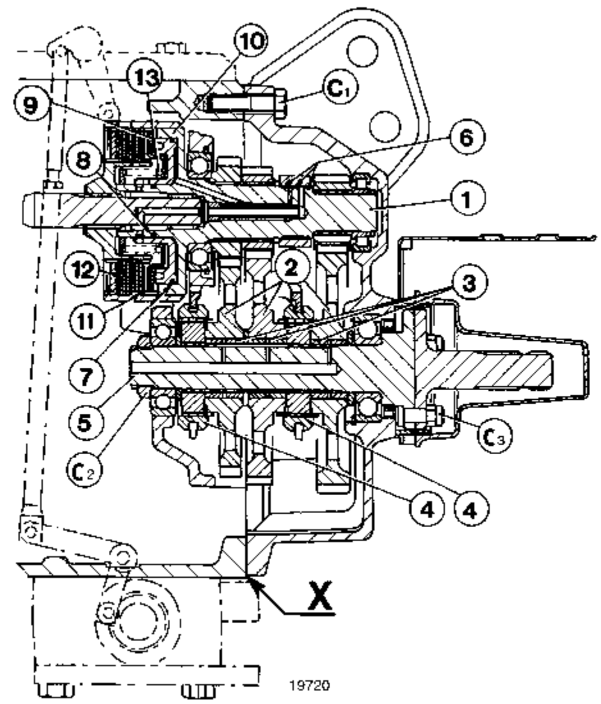

b

Sectional views of power take–off

a. Section through dual speed PTO (540–1000 rpm) – b. Section through 3–speed PTO (540–750–1000 rpm) – C_1. Capscrews, PTO case – C_2. Nut, PTO shaft – C_3. Self–locking nut, PTO splined extension shaft – C_4. Screws, bearing housing – C_5. Plug, PTO braking device connection – C_6. Cap, spring retainer – 1. Driving shaft – 2. Driven gears – 3. Driven gear bush bearings – 4. Engagement sleeves – 5. Driven shaft – 6. Permanent metal seals – 7 and 8. Oil seals – 9. Clutch engagement spring – 10. Actuating plunger – 11. Driven discs – 12. Driving discs – 13. Return spring – 14. Braking device – 15. Clutch case – 16. Oil seal – 17. Retaining split–pin – 18. Clutch control lines – 19. PTO speed selection control lever – 20. Speed selection control fork.

Note – At assembly apply sealing compound over surfaces **X** as reported on page 00–9.

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POWER TAKE–OFF TROUBLE–SHOOTING CHART

Fault	Diagnosis	Correction
Power take–off fails to operate	**1.** Low transmission oil level.	Top up oil level.
	2. Clogged oil filter.	Replace filter.
	3. Inefficient hydraulic pump.	Overhaul or replace pump.
	4. Inefficient PTO engagement switch.	Replace switch.
	5. No power is reaching electro–valve: interrupted, faulty connections or defective remote control switch.	Restore electrical connections and replace defective parts.
	6. PTO control electro–valve (6, page 21–10) stuck at discharge.	Overhaul or replace electro–valve.
	7. Fluid leakage past oil seals and consequent pressure drop: manifold or piston seals.	Replace defective seals.
Power take–off will not stop (when disengaged)	**1.** Inefficient PTO engagement switch.	Replace switch.
	2. No power is reaching electro–valve: interrupted, faulty connections or defective remote control switch.	Restore electrical connections and replace defective parts.
	3. PTO control electro–valve (6, page 21–10) stuck on delivery.	Overhaul or replace electro–valve.
PTO clutch dragging	**1.** Inefficient PTO brake engagement switch.	Replace switch.
	2. No power is reaching electro–valve: interrupted, damaged connections or defective remote control switch.	Restore electrical connections and replace defective parts.
	3. PTO brake control electro–valve (7, page 21–10) stuck on closed position.	Overhaul or replace electro–valve.
	4. Worn–out PTO brake (14, page 31–3).	Replace brake.

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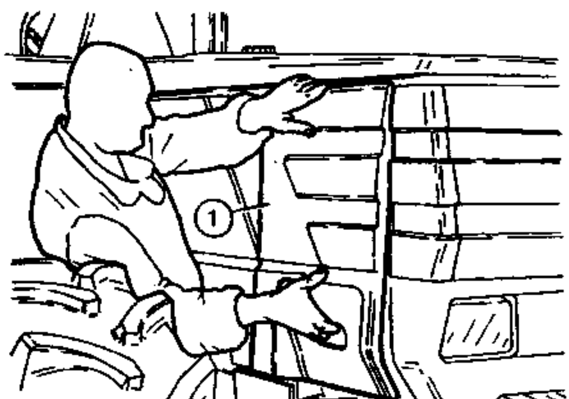
POWER TAKE–OFF
Removal–Installation (Op. 31 114 20 – 31 116 20)

⚠ CAUTION ⚠

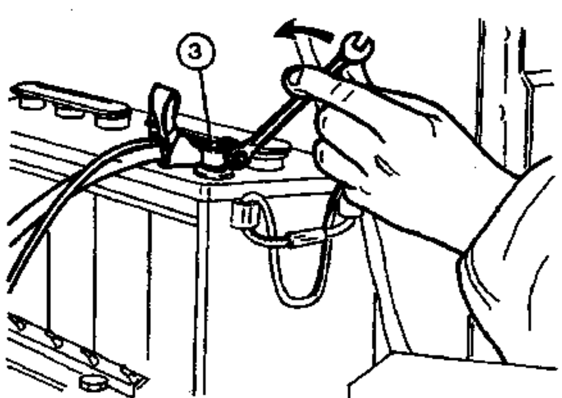
Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

The removal of the power take–off and hydraulic clutch assembly requires the following:



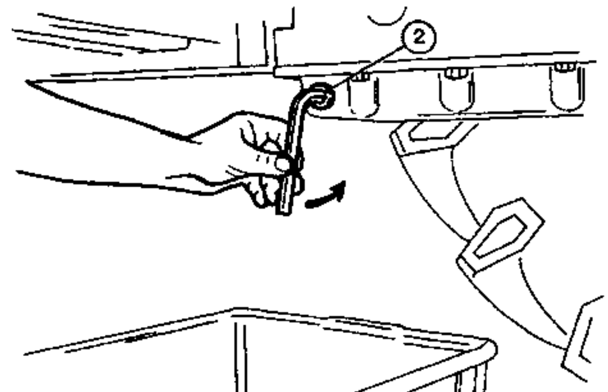
19666

1. Remove the side front panel (1) from the RH side of the tractor.



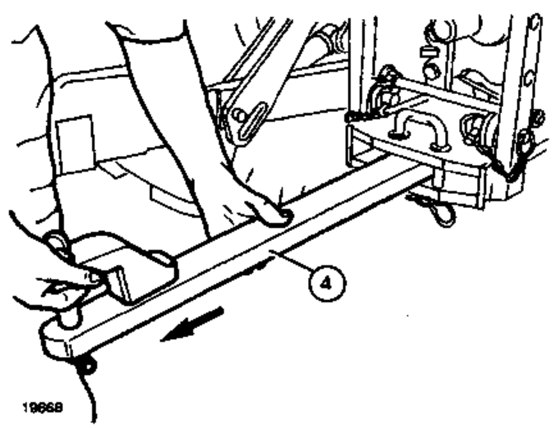
19605

2. Disconnect cable (3) from the positive pole of the battery and insulate properly.



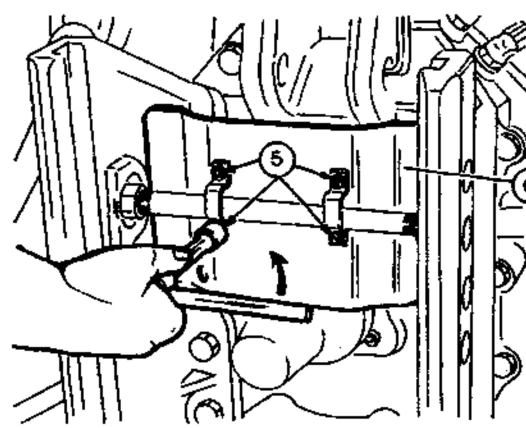
19667

3. Unscrew plug (2) and drain the rear transmission oil reservoir (remember that refill q.ty is 60 liters = 11–3/4 Imp. or 15.8 USA Gall).



19668

4. Remove stop pin and drawbar (4).



19669

5. Remove retaining screws (5) and guard (6).

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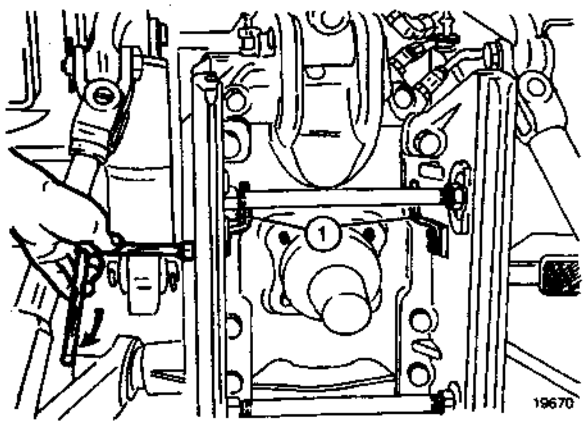
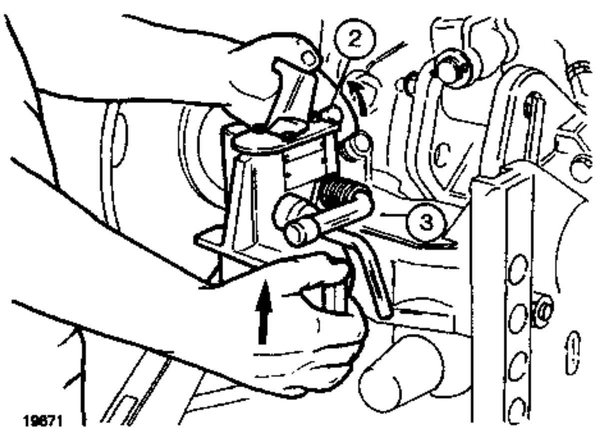
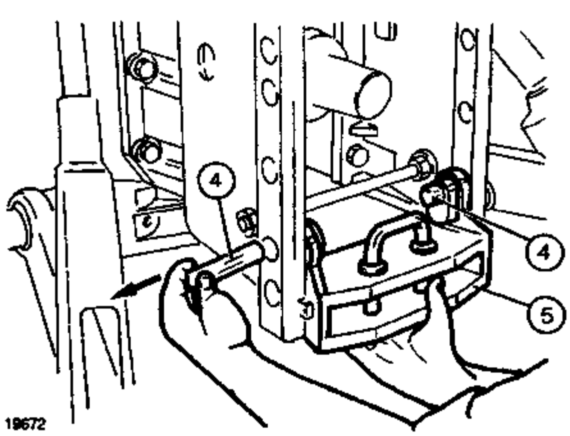


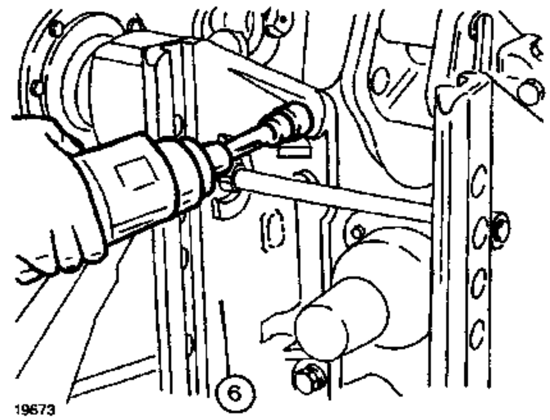
6. Remove retaining screws and the two guard stop wings (1).



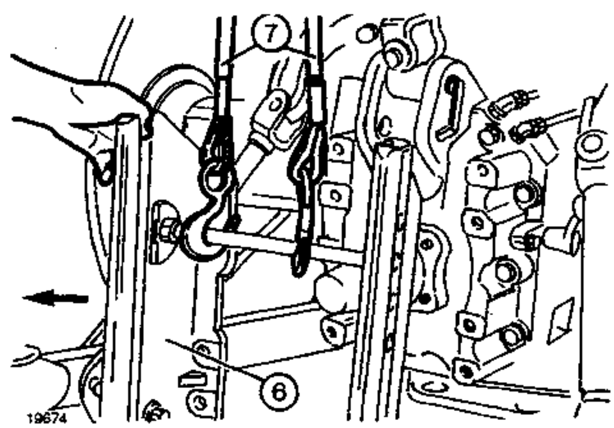
7. Shift lever (2) leftwards to stop and retrieve the tow–hook.



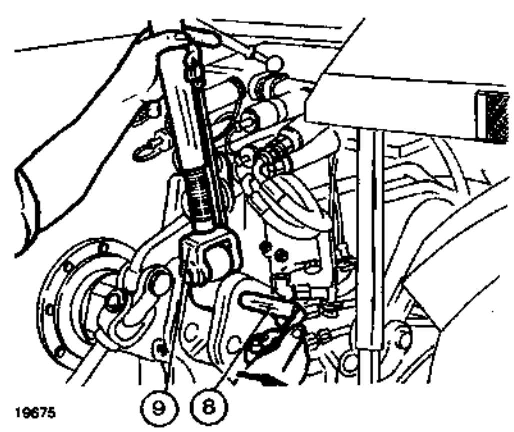
8. Withdraw the securing pins (4) and retrieve the drawbar mounting bracket (5).



9. Remove the tow–hook mounting support (6) capscrews.



10. Using a suitable hoist and hook (7) remove the tow–hook mounting support (6).



11. Withdraw the pivot pin (8) and retrieve the adjustable rod (9).

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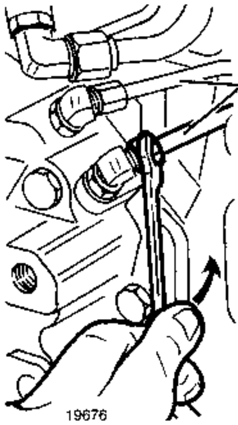
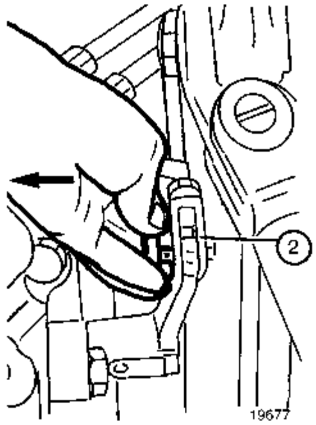
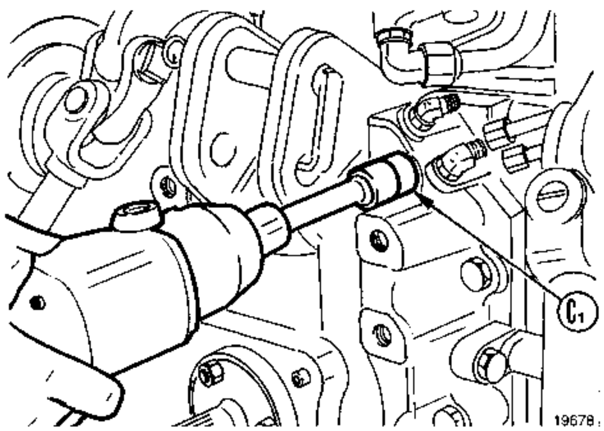


19676



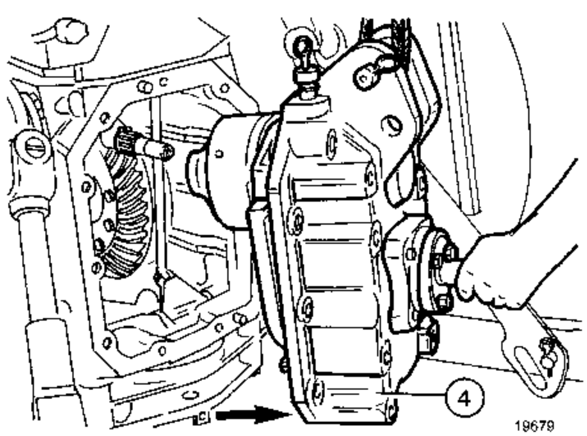
19677

12. Remove the clutch lines (1) and speed selection control lever (2).



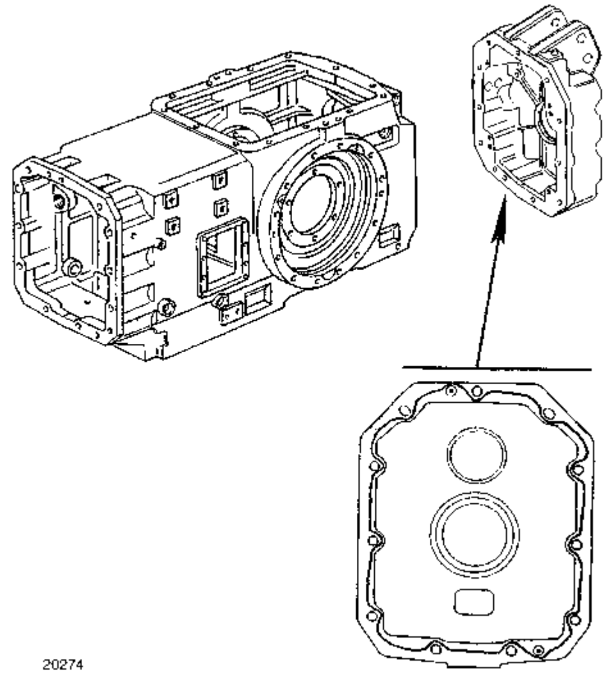
19678

13. Back off the power take–off case retaining capscrews (C_1).



19679

14. Using a suitable hoist and hook remove the power take–off case (4) from the rear transmission housing.



20274

Sealing compound application scheme at power take–off case installation on the tractor rear transmission housing.

The sealing compound types for application are indicated on page 00–9.

15. Install the PTO case on the rear drive case paying attention to the following important points:

a. proceed by reversing the removal sequence of operations starting from no. 14 back to no. 1;

b. prior to re–joining the cases, make sure the respective mating surfaces are thoroughly cleaned and degreased, then apply a bead of a sealing compound, approximately a 2 mm (.08 in) diameter, following the application scheme illustrated above;

c. tighten fastenings to torque specification data of page 31– 2.

⚠ CAUTION ⚠

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

POWER TAKE–OFF
540/750/1000 rpm power take–off – Disassembly – Assembly (Op. 31 114 46 – 31 114 47 – 31 114 48 – 31 114 60 – 31 116 46 – 31 116 47 – 31 116 48).

⚠ CAUTION ⚠

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

Proceed as follows:

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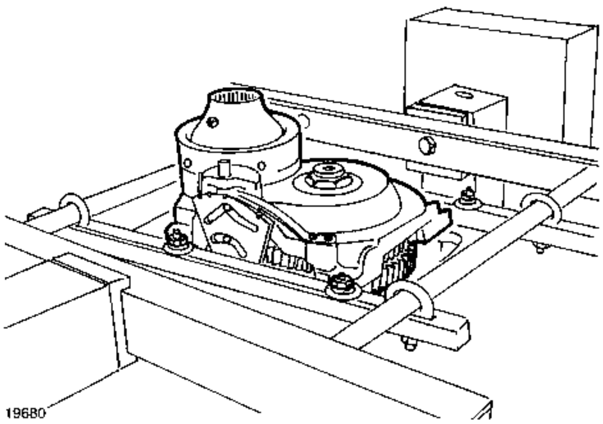
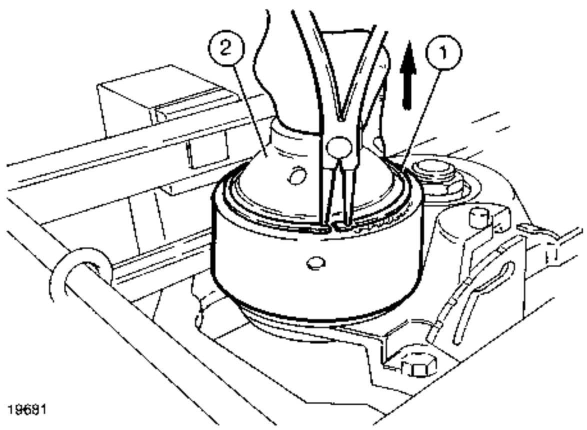
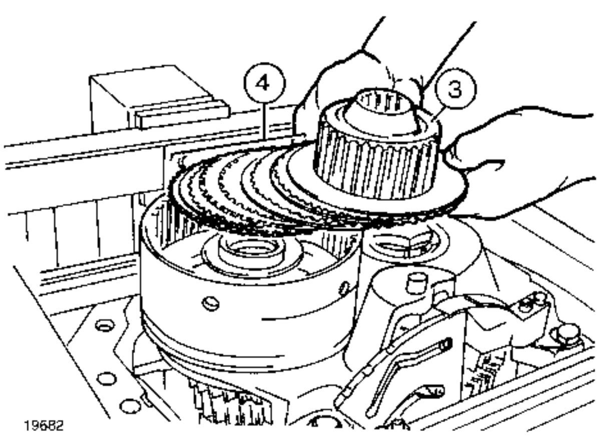


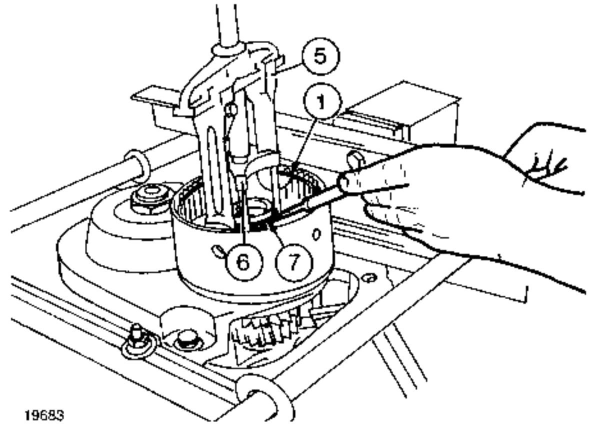
1. Place the power take–off assembly on a rotary shop stand.



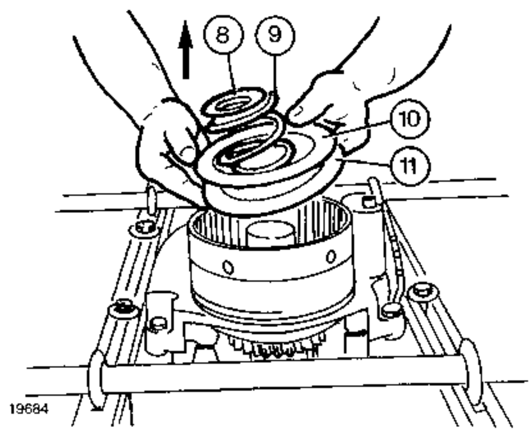
2. Remove the retaining ring (1) and retrieve the drive gear (2).



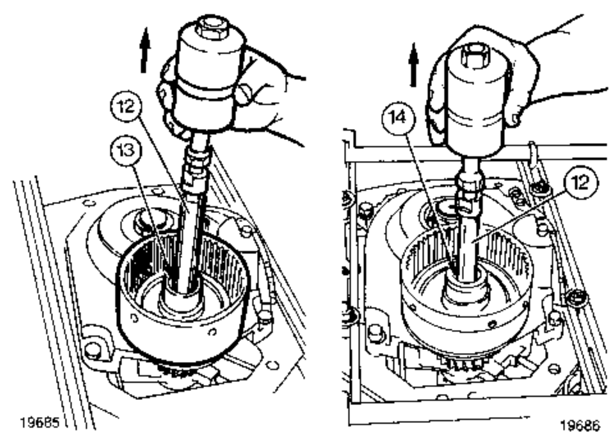
3. Retrieve the driven and drive disk pack (4) together with inside gear (3).



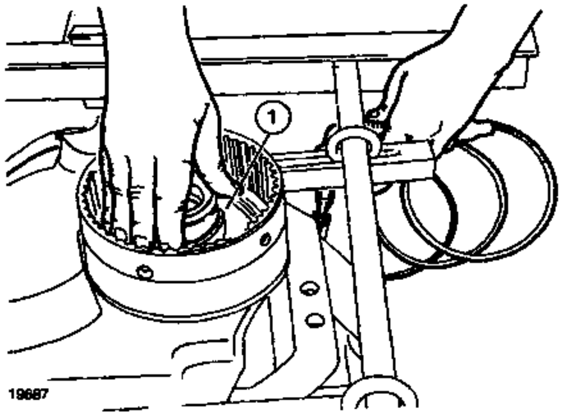
4. Refit the retaining ring (1) using a universal puller (5) and the special tool **50063** (6, see on page 31–3), screw on the first until freeing and removing the lock ring (7).



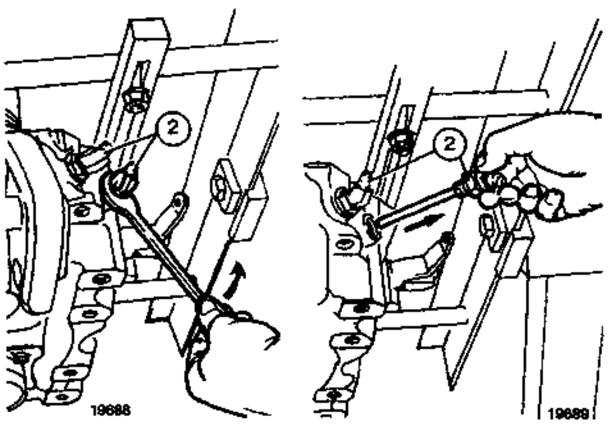
5. Remove the retaining ring (1) just fitted to carry out the previous operation and retrieve the washer (8), spring (9), lower cup (10) and dish spring (11).



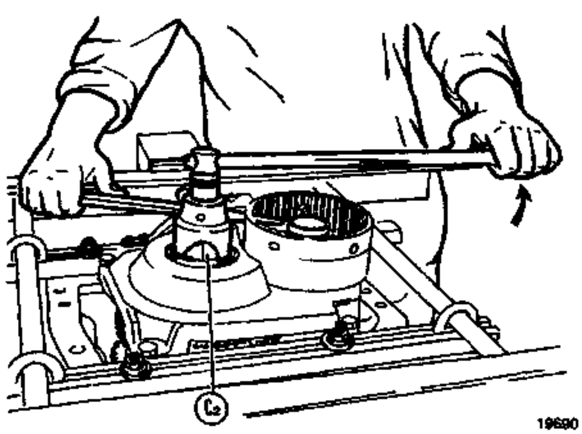
6. By means of the special tool no. **294000** (12) and the slide–hammer type extractor **292927** remove the cup (13) and inside bearing (14).



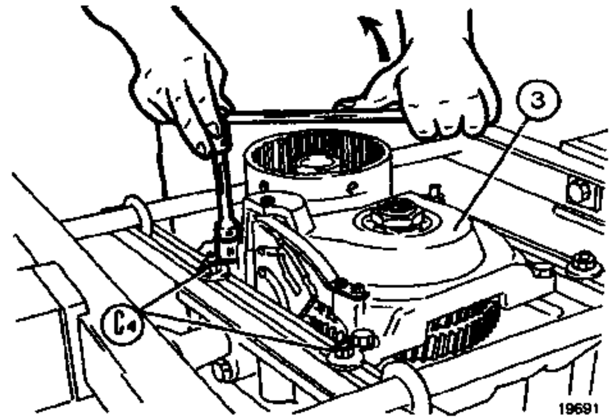
7. Use compressed air to remove the clutch control plunger (1).



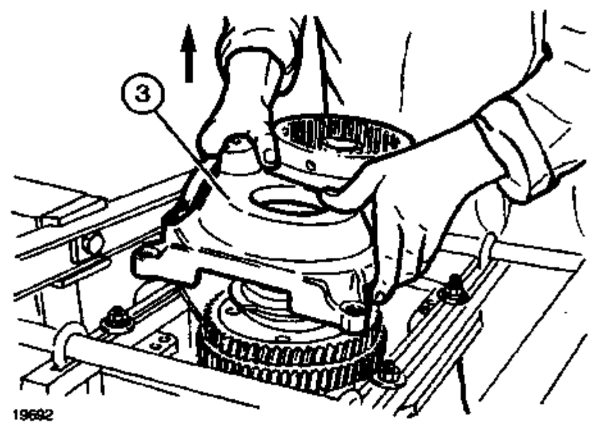
8. Unscrew the clutch actuating fluid lines (2) and remove them.



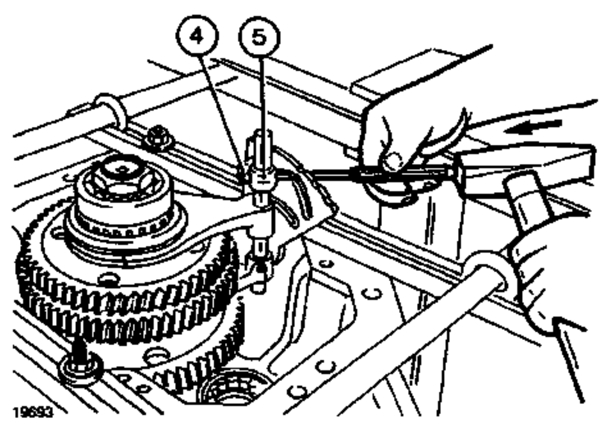
9. Unscrew the driven shaft nut (C_2).



10. Remove the driven shaft mounting plate (3) screws (C_4).



11. Remove mounting plate (3) complete with drive shaft.



12. Remov lock pin (4) securing the pawl (5) and retrieve the latter.

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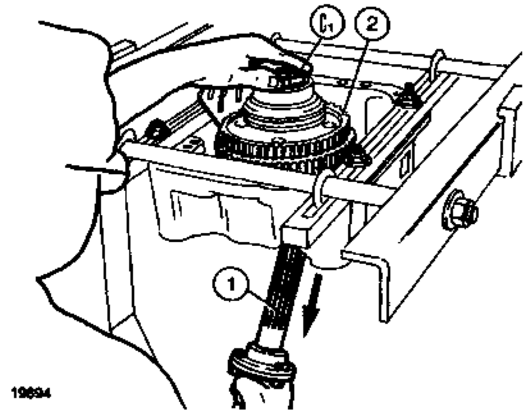
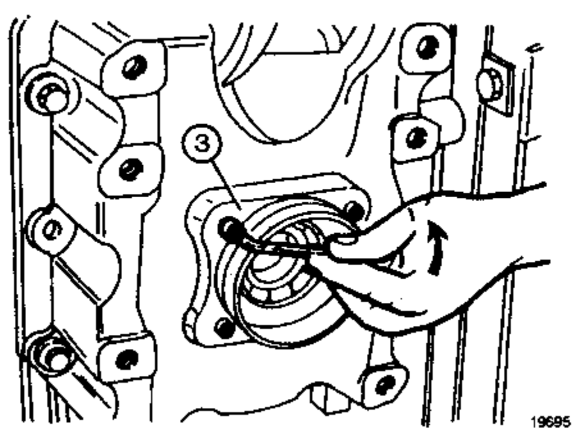
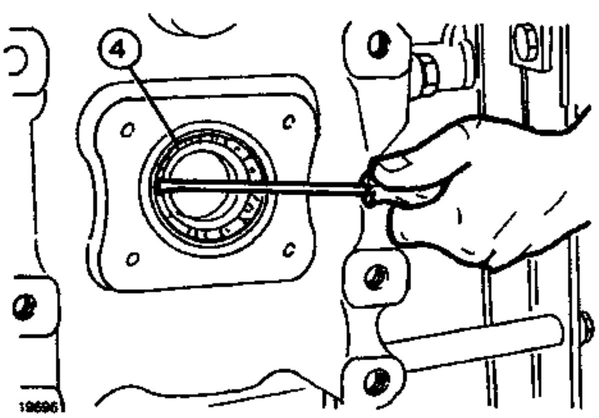


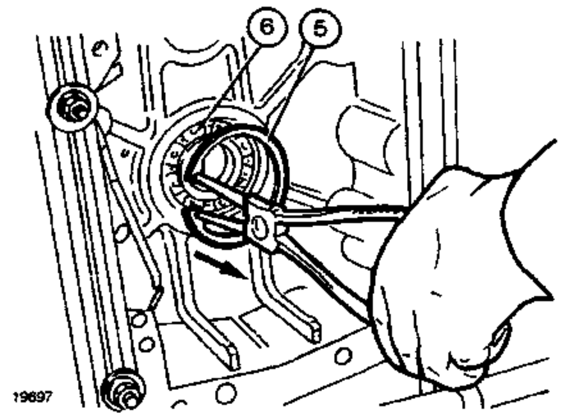
13. Unscrew the nut (C_1), withdraw the shaft (1) and remove the complet pack of driven gears (2) together with forks and rod.



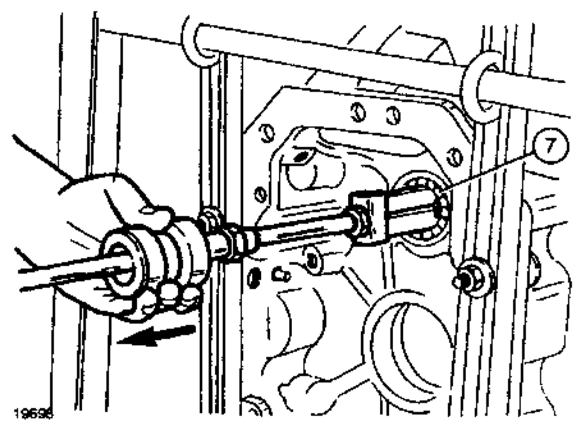
14. Remove the retaining screws and the shield (3).



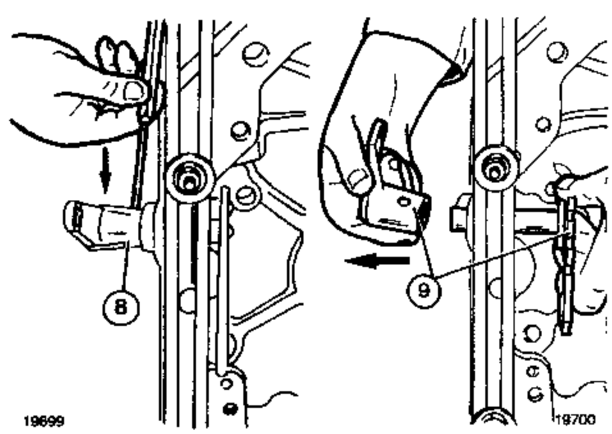
15. Remove the oil seal (4).



16. Remove the retaining ring (5) and retrieve the bearing (6).



17. Pull off the upper bearing (7) using a slide–hammer type extractor with expansion puller.



18. Withdraw the split pin (8) and remove the complete speed selection control lever (9).

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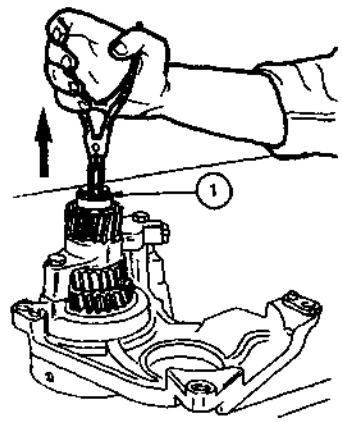
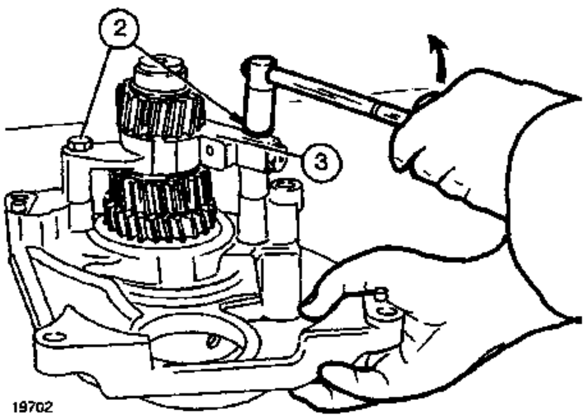


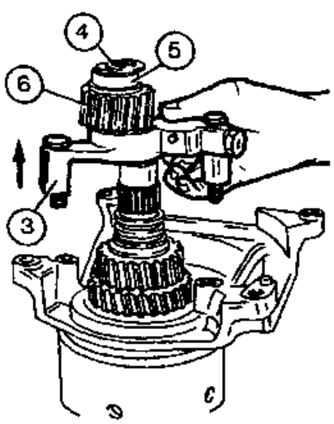
19701

19. Remove retaining ring (1).



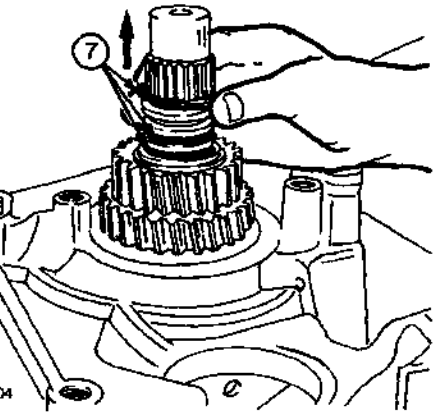
19702

20. Remove screws (2) securing the hydraulic clutch header (3).



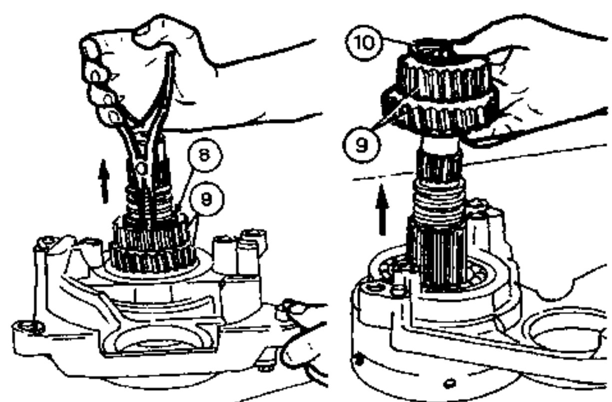
19703

21. Withdraw:thrust plate (4), bearing inner race (5), gear (6), header (3) and make sure to pay a particular attention to the sealing segments (7).



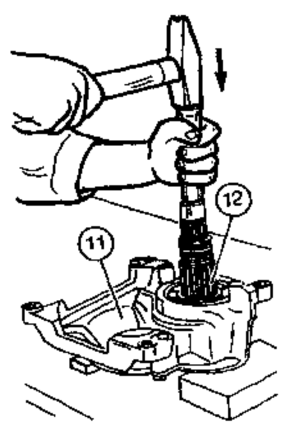
19704

22. Disengage and remove the metal seal segments (7).



19705 19706

23. Remove retaining ring (8) and withdraw gears (9) and thrust plate (10).



19707

24. Place mounting plate (11) on two wooden blocks and extract the shaft (12) by brass punch and hammer.

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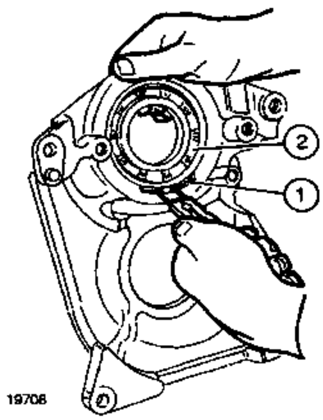
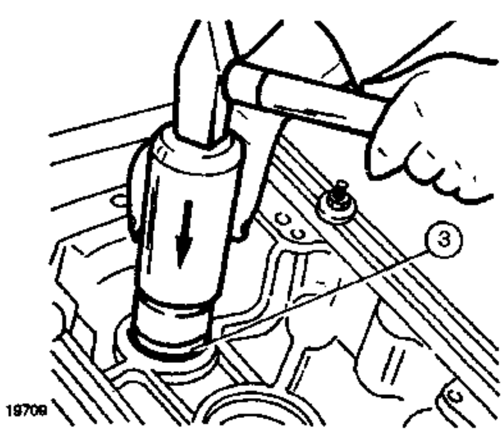


25. Open retaining ring (1) and remove bearing (2).

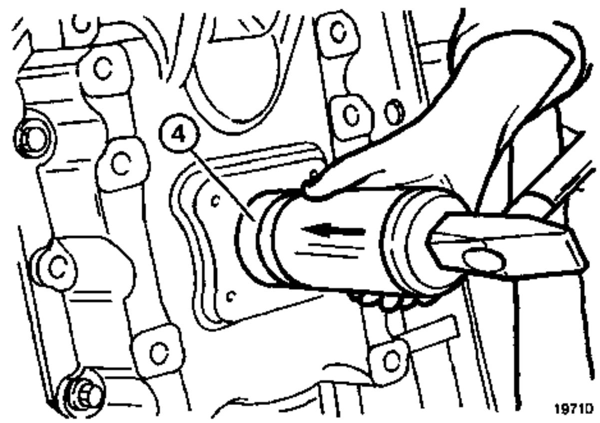
26. Assemble PTO unit paying attention to the following important points:
   a. proceed by reversing the disassembly sequence of operations starting from no. 25 back to no. 1;
   b. inspect all oil seals and gaskets and replace where necessary;
   c. tighten fastenings and hardware to torque specification data of page 31–2;
   d. see illustrations on page 31–3 for correct placement and orientation of component parts;
   e. proceed as further indicated.

CAUTION

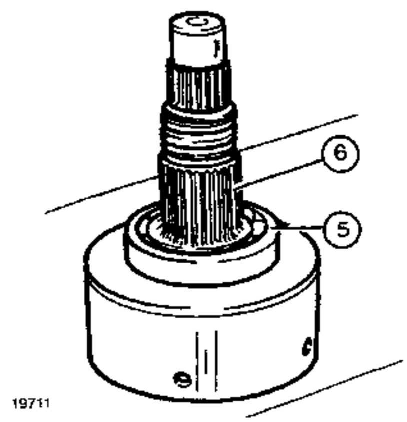
Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.



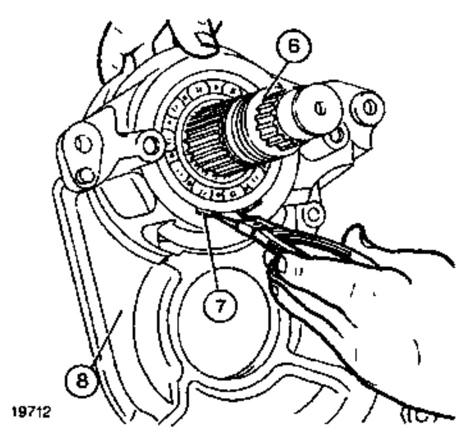
27. Drive the upper bearing (3) in place using a suitable installer tool.



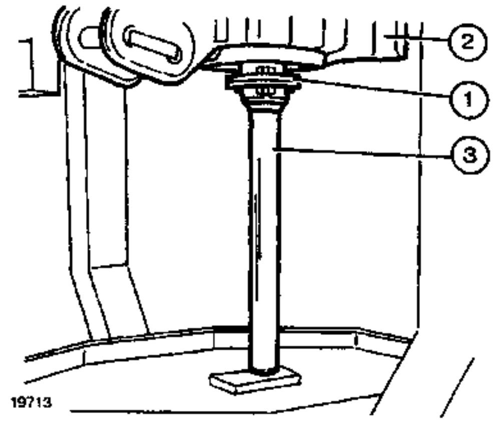
28. Proceed similarly with the oil seal (4).



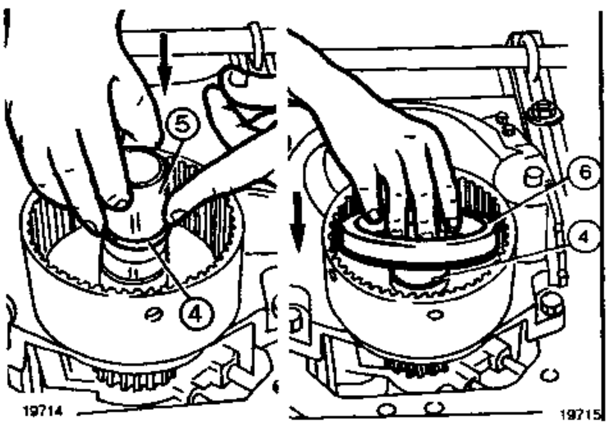
29. Install bearing (5) on power take–off drive shaft (6).



30. Position the driving shaft (6) complete with bearing on the mounting plate (8) then fit retaining ring (7).

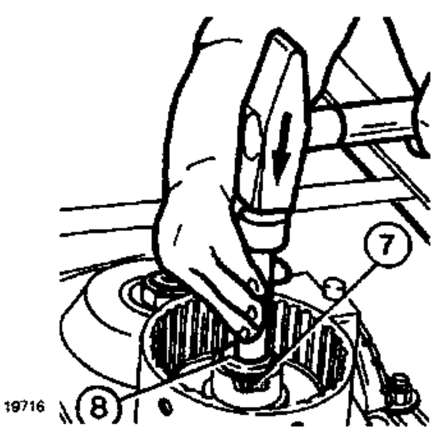


31. Introduce the driven shaft (1) in the clutch housing (2) and hold it in place through a suitable support (3) until the assembly is completed.

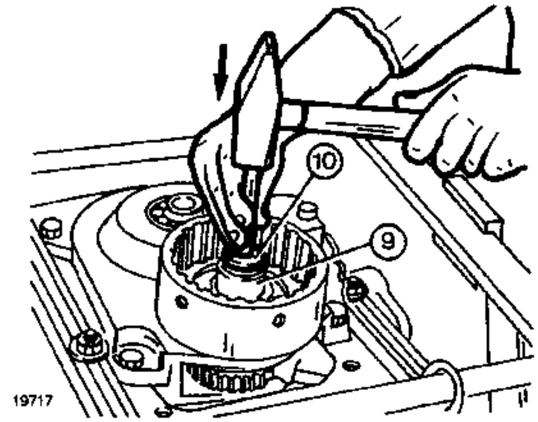


32. Fit oil seal (4) using the specific protection tool no. **290785** (5).

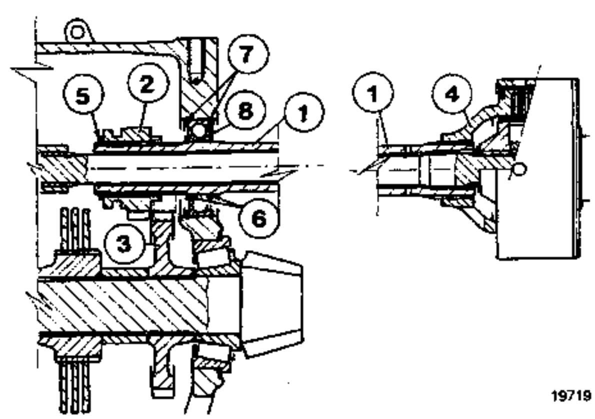
Note – Wait about15 minutesbefore installing the clutch control piston (6).



33. Drive in the bearing (7) using special tool **293997** (8) complete with handle **293800**.



34. .Position the cup (9) in place using special tool **293998** (10) complete with a hex. head, M 14 x 1.5 screw of a suitable length.



Sectional view of the ground–speed power take–off synchronized with the tractor gearbox.

1. Driving shaft – 2. Engagement sleeve – 3. Idling gear – 4. Driving shaft – 5,6 and 7. Retaining rings – 8. Driving shaft (1) bearing.

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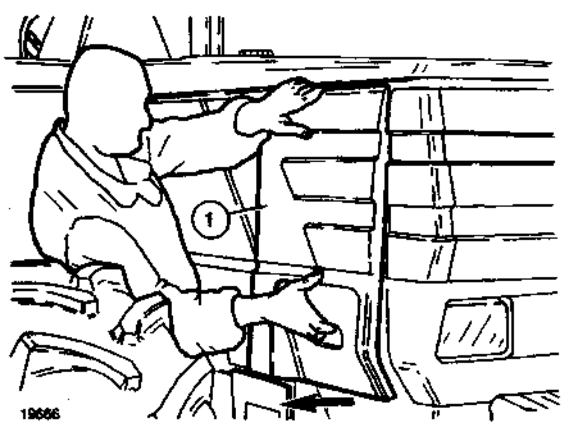
PTO BRAKE CONTROL ELECTRO–VALVE
Replacement (Op.31 104 84).

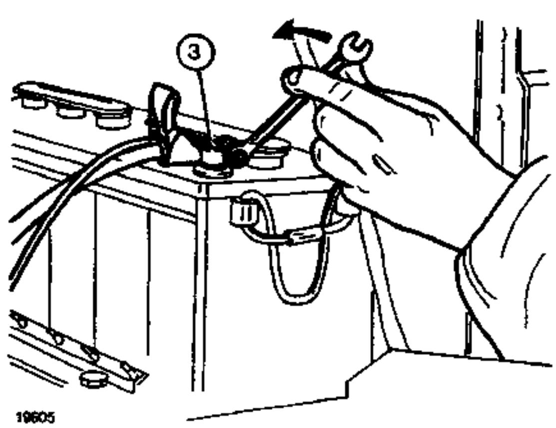
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

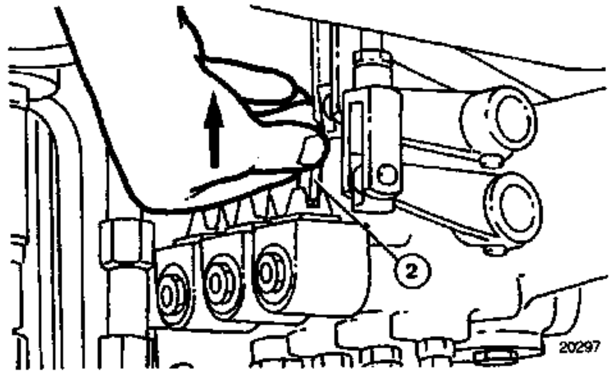
To replace the PTO brake engagement electro–valve control, proceed as follows:



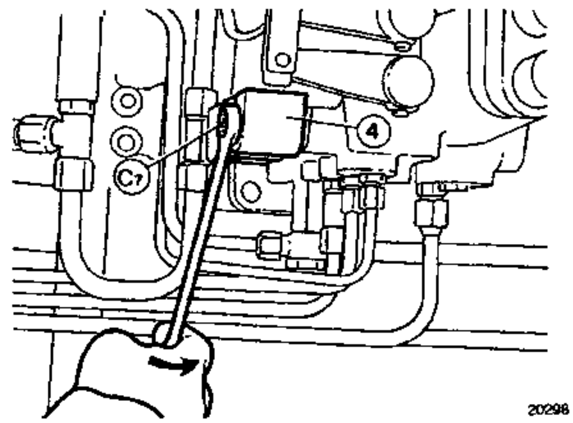
1. Remove the front R.H. side tractor hood panel (1).



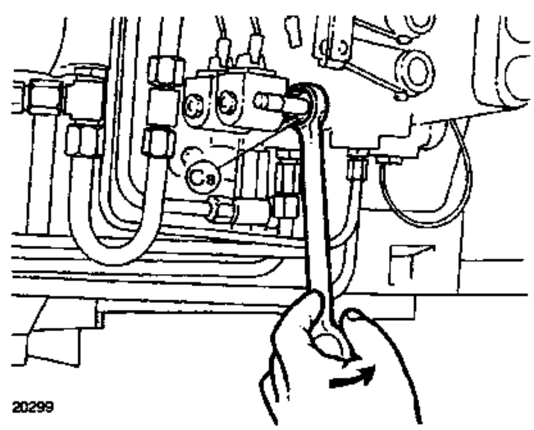
2. Disconnect battery positive cable (3) and insulate it.



3. Disconnect electric lead (2).



4. Remove retaining screw (C_7) and the electro–valve (4).



5. Unscrew pin (C_8) and withdraw it.
6. :When re–fitting the electro–valve pay attention to the following:

   a. proceed by reversing the removal sequence of operations starting from no. 5 back to no. 1;

   b. tighten fastenings to torque specification data of page 31–2.

PTO ENGAGEMENT CONTROL ELECTRO–VALVE
Replacement (Op. 27 110 88)
Proceed in the same way already dealt with in connection to the PTO brake electro–valve control.

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BRAKES

Type - service brakes - parking brake	 oil–bath disk acting on differential shafts three oil–bath disks acting on bevel pinion shaft
Controls: – service brakes – parking brake	 hydrostatic, indipendent pedals (or latched for joint operation) mechanical, through hand–control lever
Service brake disk material Parking brake disk material Parking brake lining material	sintered steel sintered or organic conglomerate
Disk thickness: - service brake Permissible wear limit - parking brake	 10 mm (.39 in) 8.6 mm (.34 in) 6 mm (.24 in)
Parking brake lining thickness: - side - intermediate	 3.1 to 3.4 mm (.12 to .13 in) 4.2 to 4.5 mm (.16 to .18 in)
Brake pedals and shaft Brake shaft journal dia. Bushing I.D. Shaft clearance fit	 24.967 to 25.000 mm (.9829 to .9842 in) 25.050 to 25.200 (⁰) mm (.9862 to 9921 in) 0.050 to 0.233 mm (.0020 to .0092 in)
Brake pedal bore I.D. Bushing O.D. Bushing interference fit	30.927 to 30.966 mm (1.2175 to 1.2191 in) 31.000 to 31.050 mm (1.2205 to 1.2224 in) 0.034 to 0.123 mm (.0013 to .0048 in)
Hydrostatic drive Hydraulic pump Working oil pressure	 2 master cylinders indipendently operated through brake pedals 17.6 bar (18 kg/sq.cm = 256 psi)
Control pedal adjustment Brake system air bleeding	see page 33 – 9 see page 33 – 10

(⁰) Dimension after force–fitting, no reaming.

TORQUE DATA

DESCRIPTION	Thread size	Torque		
		Nm	kgm	ft.lb
Stud nuts, final drives to rear axle case (C_1, page 33–2)	M 14 x 1.5	176	18	129
Capscrews, brake housing to rear axle case (C_2, page 33–2)	M 10 x 1.25	49	5	36
Guide screws, parking brake mobile lining (C_3, page 33–2)	M 14 x 1.5	24	2.5	18

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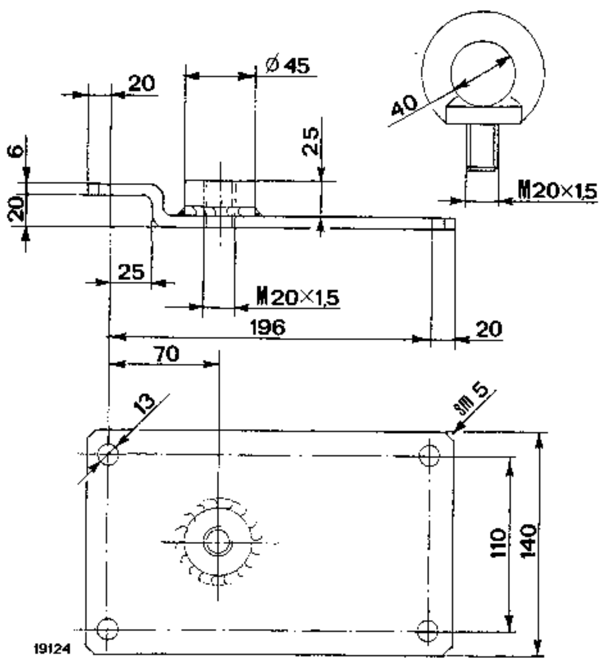


Self–made tool for final drive disassembly–assembly. (Etch no.50066 on completed tool – Metric dimensions).
Material specification: Fe42 steel.

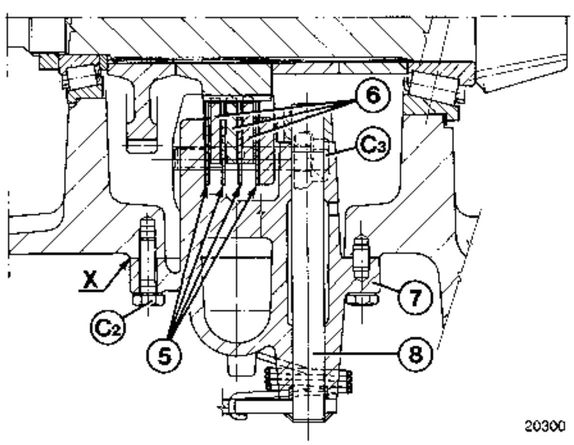
SERVICE TOOLS

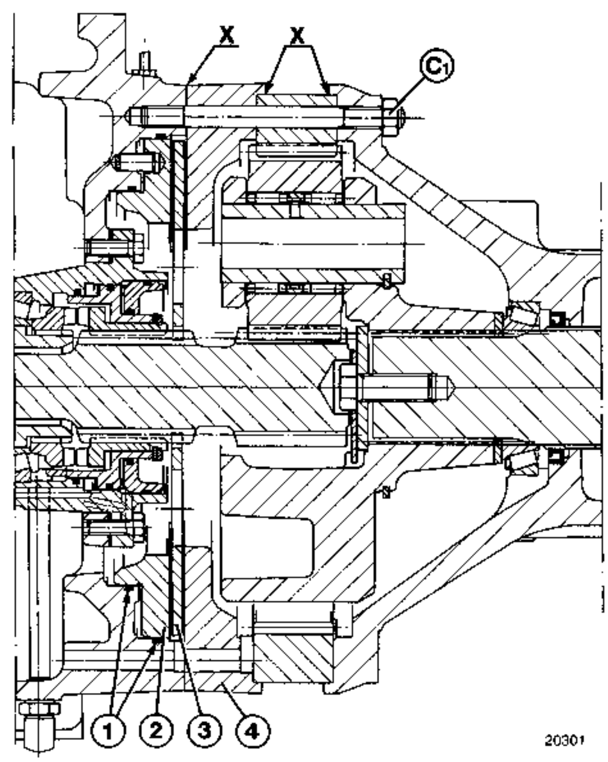
ATTENTION – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code **(X)**.
Besides, to work safely and achieve the best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjunction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

List of the special tools necessary to perform service operations covered by this section of the Manual:

50066 Stand bracket, final drive disassembly–assembly.

292400 Universal lifting hook, rear wheels.





Sectional views through the service and parking brakes

C_1. Stud nuts, final drive to rear axle case – C_2. Capscrews, brake housing to rear axle case – C_3. Guide screw, parking brake mobile lining – 1. Oil seals – 2. Brake pressure ring – 3. Brake disk – 4. Final drive housing spacer – 5. Brake linings – 6. Brake disks – 7. Brake lining housing – 8. Parking brake hand control lever.
Note – At assembly apply sealing compound to surfaces **X** according to instructions of page 00–9.

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BRAKE TROUBLE-SHOOTING CHART

Fault	Diagnosis	Correction
Pedals hard to operate.	1. Seizure of the hydraulic master cylinder involved.	Replace the brake actuating pump.
	2. Chocked or flattened hydraulic lines.	Clean or replace pressure lines.
Brakes remaining blocked as pedals are released.	1. Stuck brake pistons (3, page 33–10).	Free piston and, if necessary, replace seals.
	2. Seized master cylinders.	Replace the brake actuating pumps.
Brake noise.	1. Worn brake disk (3, page 33–2) linings.	Replace brake discs.
Excessive pedal travel.	1. Presence of air inside brake hydraulic control system.	Air bleed the brake hydraulic system.
	2. Worn brake hydraulic pumps.	Replace the brake actuating pumps.
	3. Oil leakage from pressure lines.	Remove causes of leakages.
Unbalanced braking.	1. Wrong tyre pressure.	Inflate tyres to correct pressure.
	2. Worn brake hydraulic pumps.	Replace the brake actuating pumps.
	3. Chocked or flattened pump connecting line.	Clean or replace pressure lines.
	4. Chocked or flattened brake pressure line.	Clean or replace pressure lines.
	5. Worn or damaged oil seals (4, page 33–10) on a brake piston.	Replace oil seals.
	6. Worn linings on one brake disk (3, page 33–2).	Replace disk.
Poor braking action.	1. Worn brake disks (3, page 33–2) linings.	Replace brake disks.
	2. Worn brake hydraulic pumps.	Replace the brake actuating pumps.
	3. Presence of air inside brake hydraulic control system.	Air bleed the brake hydraulic system.
	4. Oil leakage from pressure lines.	Remove causes of leakages.
	5. Worn or damaged oil seals (4, page 33–10) on brake pistons.	Replace oil seals.
Inefficient parking brake.	1. Brake controls out of adjustment.	Adjust correctly.
	2. Worn brake segments (5, page 33–2).	Replace brake segments.
Tractor remains braked upon releasing the parking brake hand control lever.	1. Hindered control lever return travel.	Remove obstructions.
	2. Seized brake disk segments (5, page 33–2).	Free and replace damaged parts.

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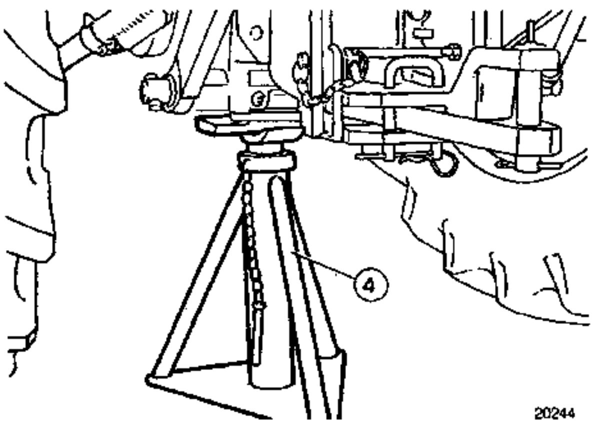
BRAKE, RIGHT OR LEFT
Removal–Installation (Op. 33 202 65)

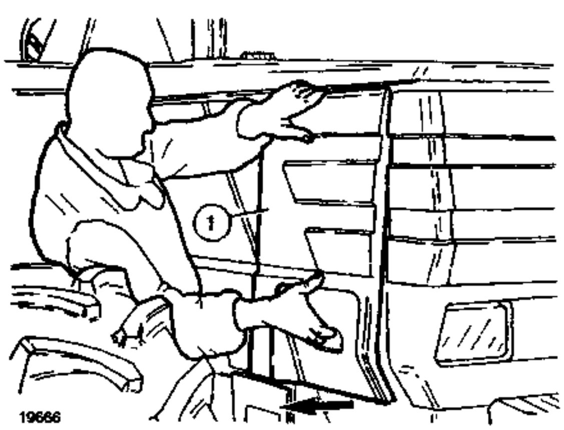
DANGER

Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.

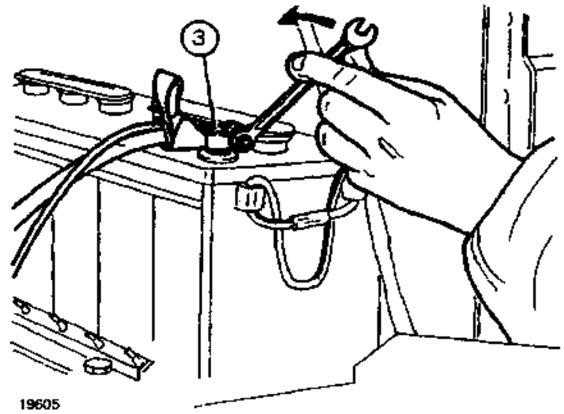
Separate and remove final drive case as follows:



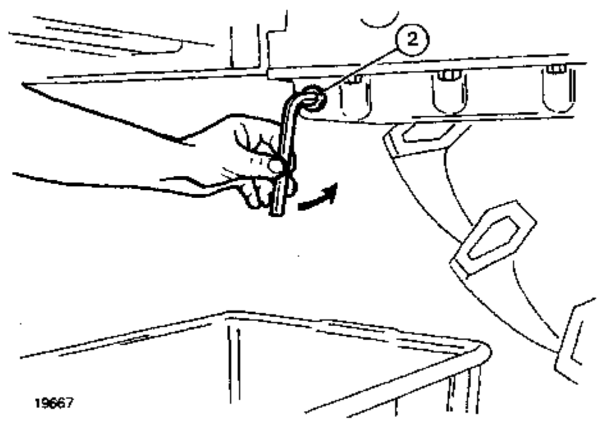
1. Place a stationary stand (4) under the rear drive case.



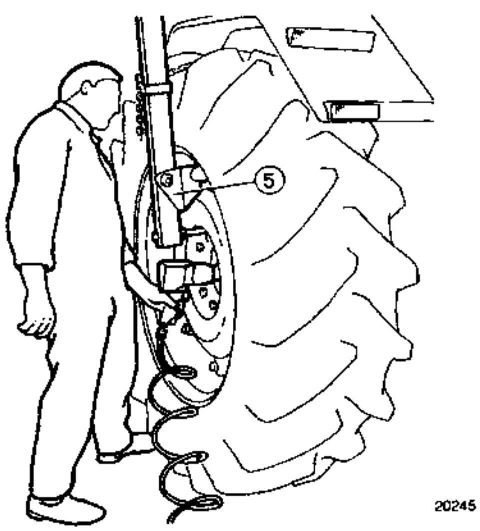
2. Remove front panel section (1) from the tractor R.H. side.



3. Disconnect battery positive cable (3) and insulate it.



4. Unscrew plug (2) and drain rear drive case oil noting the refill quantity : 60 liters (15.8 USA or 11–3/4 Imp. Gall).



5. Attach hook **292400** (5) to the wheel, remove the attaching capscrews and finally the wheel, complete, using a hoist.

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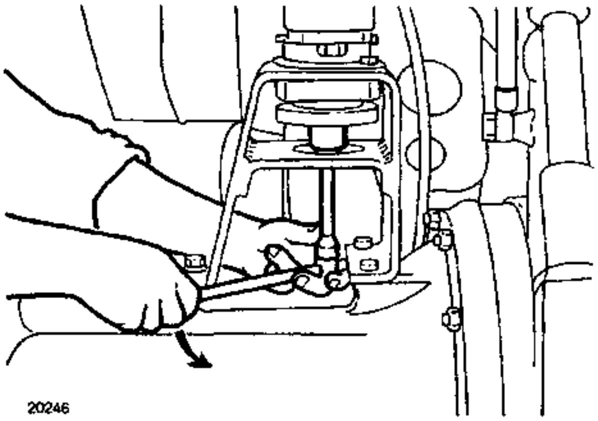
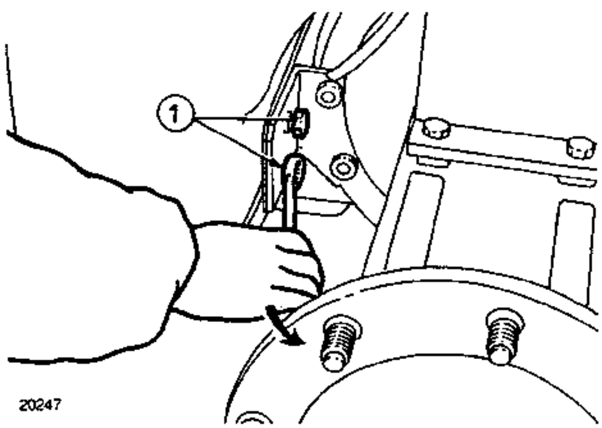
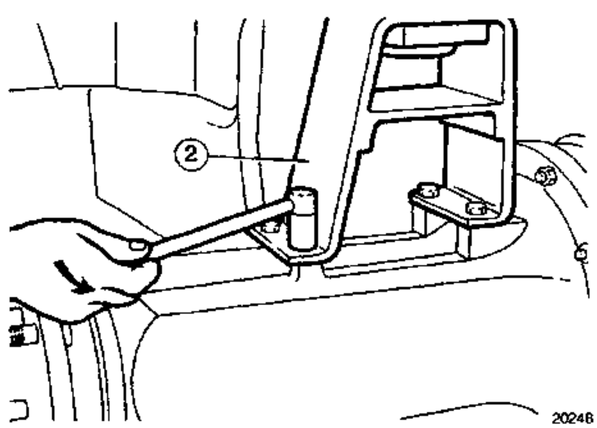


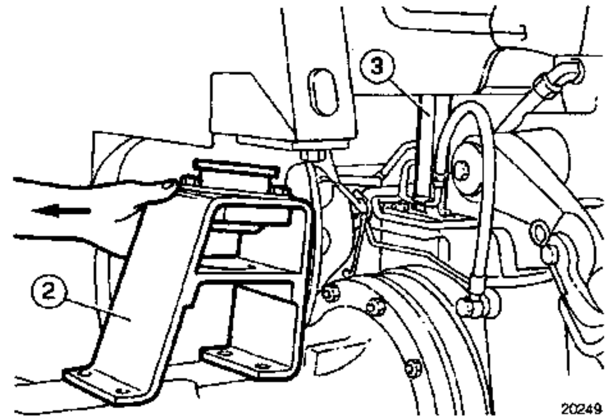
6. Loosen and remove the cabin rear mounting capscrew.



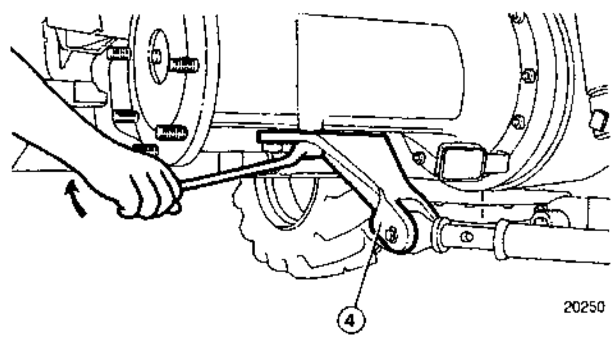
7. Remove capscrews (1) securing the main fuel tank support.



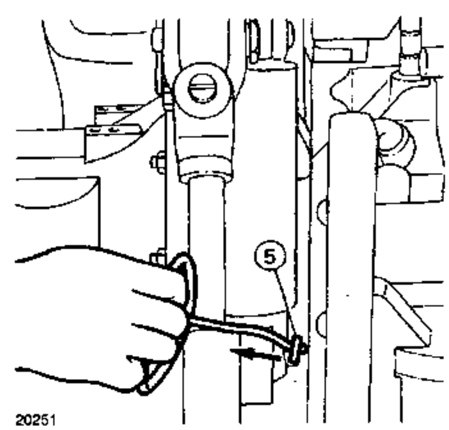
8. Remove the cabin rear mounting bracket capscrews (2).



9. Prop up slightly the cabin rear end, if necessary loosen the attaching capscrew on the opposite final drive case, fit a supporting wooden block (3) for safety, then remove the cabin mounting bracket (2).



10. Remove attaching capscrews and finally the implement hitch sway limiter rod mounting bracket (4).



11. Withdraw cotter pin (5) and remove the auxiliary ram mounting pin.

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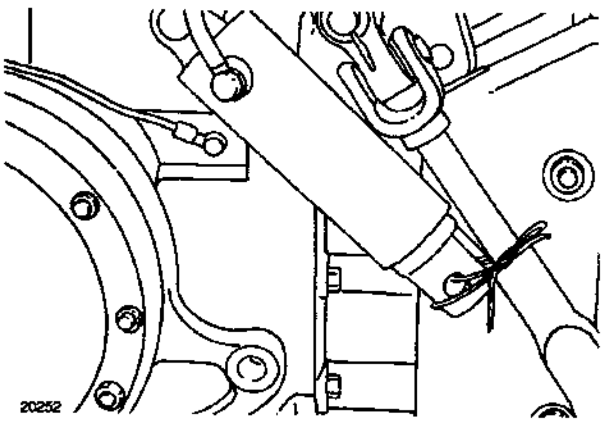
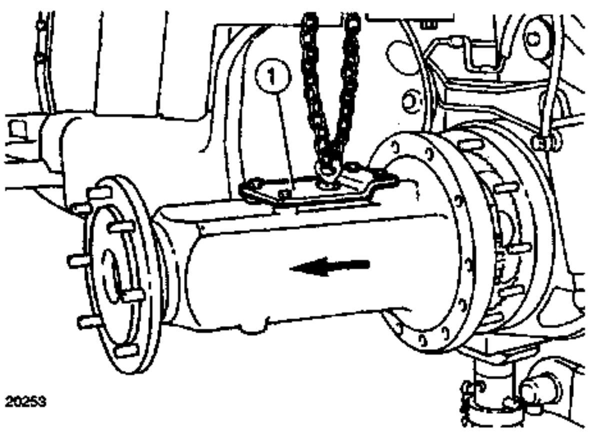
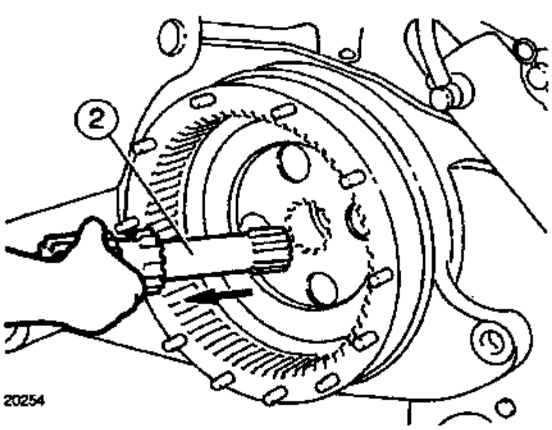


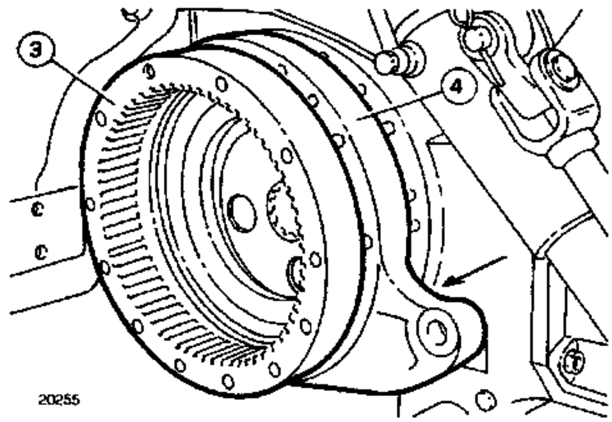
12. Tie up the auxiliary ram to lift rod with as shown in the figure.



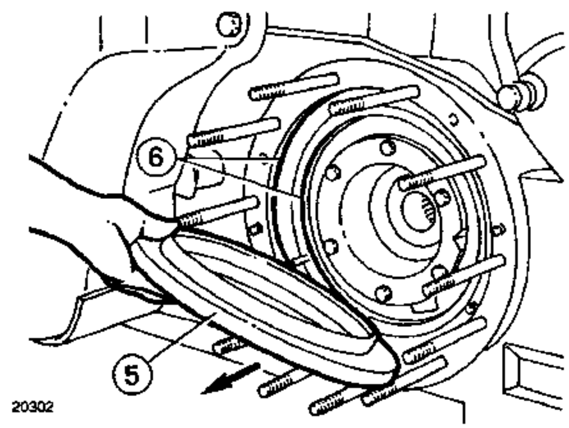
13. Attach tool **50066** (1) (see page 33–2) to the final drive case, remove the screws and separate it from the rear drive housing.



14. Retrieve the wheel shaft (2).



15. Remove the outer ring gear (3), spacer (4) and retrieve friction disc.



16. Press on relevant brake pedal and retrieve pressure ring (5).

17. Check oil seals and replace them if necessary.

CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

18. Re–join the final drive case to the rear drive housing paying attention to the following important points:

a. proceed by reversing the removal sequence of operations starting from no. 17 back to no. 1;

b. see illustrations on page 33–2 for correct placement and orientation of component parts;

c. prior to re–fitting the final drive to the rear drive housing make sure that mating surfaces are thoroughly cleaned and degreased , then apply a bead of sealing compound , approximately a 2 mm (.08 in) diameter, following the aplication scheme of page 33–7;

d. tighten fastenings and hardware to the torque specification data of page 33–1.

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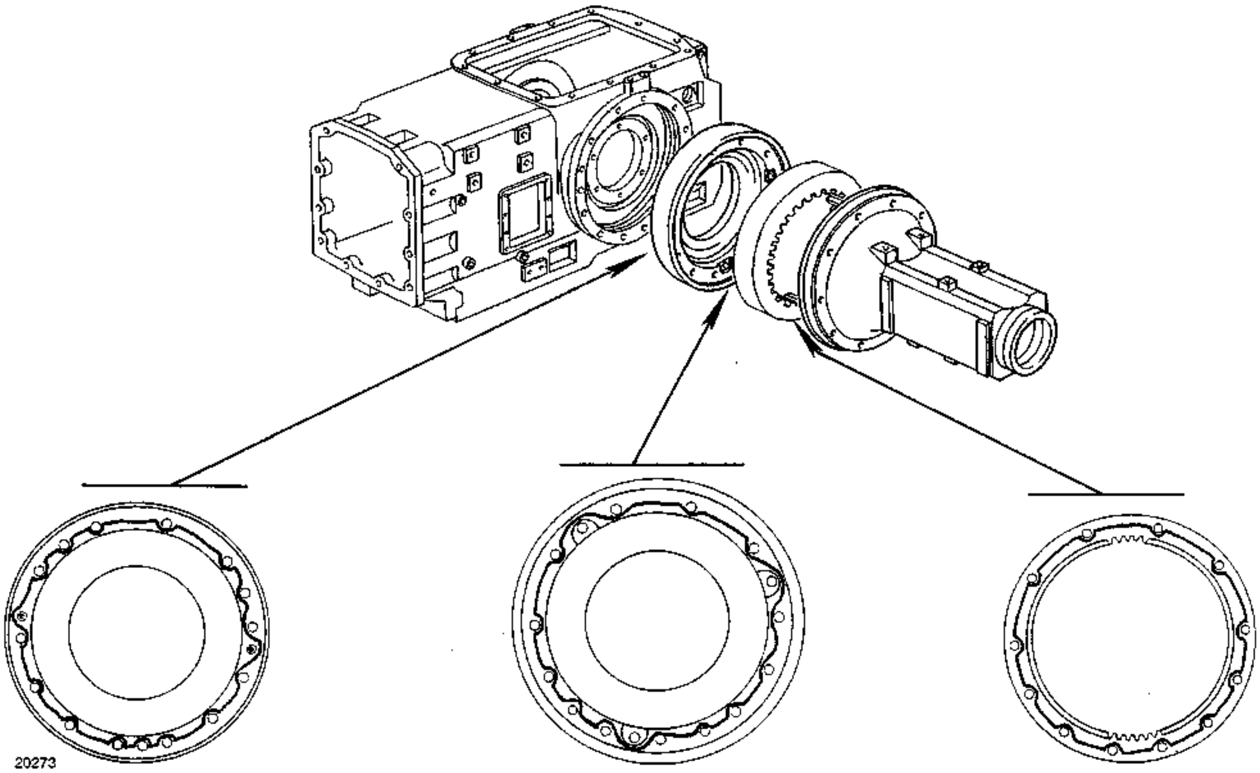


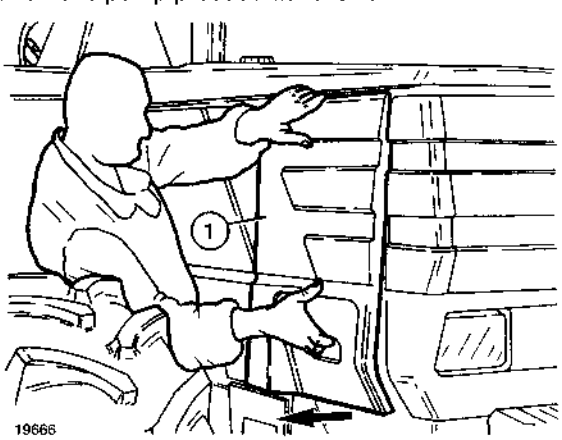
Application scheme of sealing compound to final drive and rear axle housing mating surfaces.
Sealing compound types are indicated on page 00–9.

HYDRAULIC BRAKE PUMP
Removal–Installation (Op. 33 202 46)

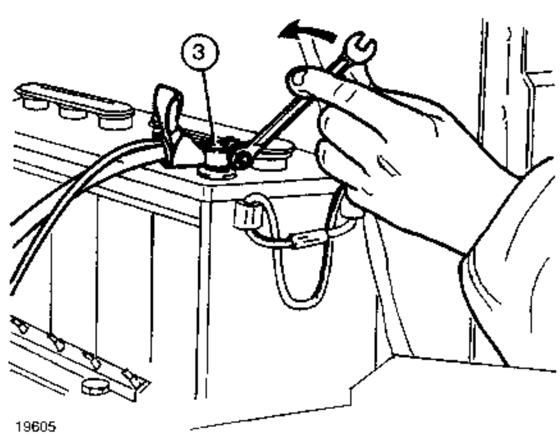
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

To remove pump proceed as follows:



1. Remove front panel section (1) from the tractor R.H. side.



2. Disconnect positive battery cable (3) and insulate it.

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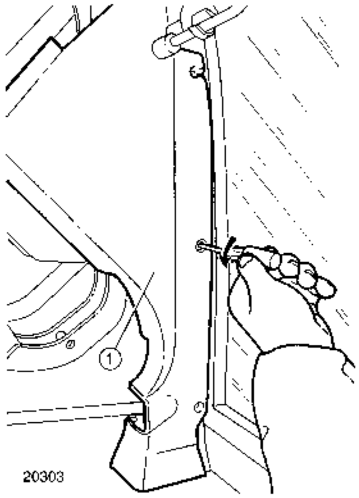
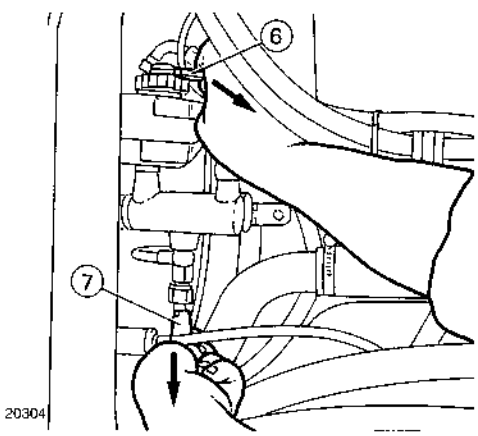
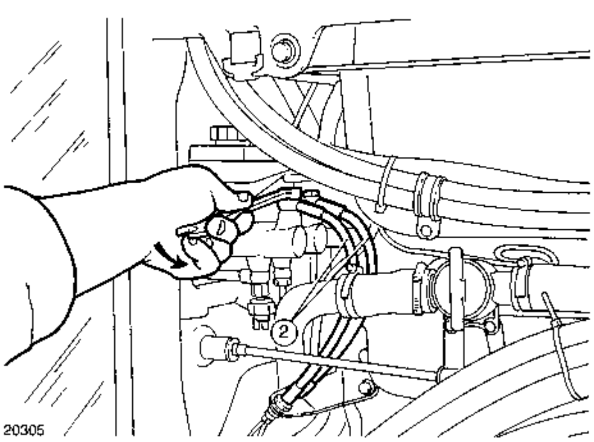


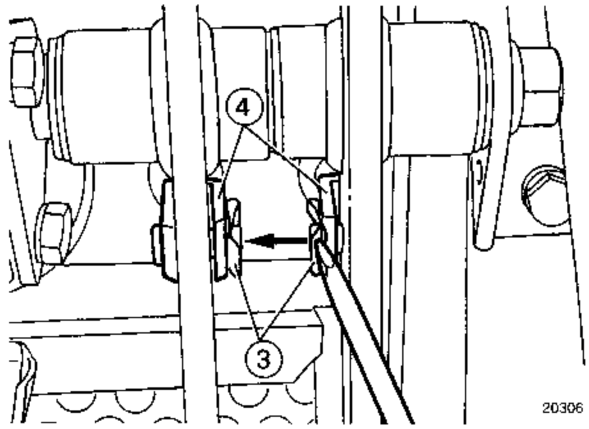
3. Remove attaching screws and R.H. side protection (1).



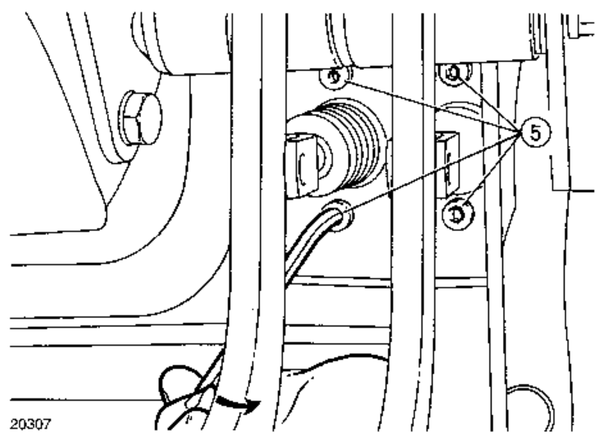
4. Detach the fuel tank cap and pressure gauge feeler electrical connections (6 and 7).



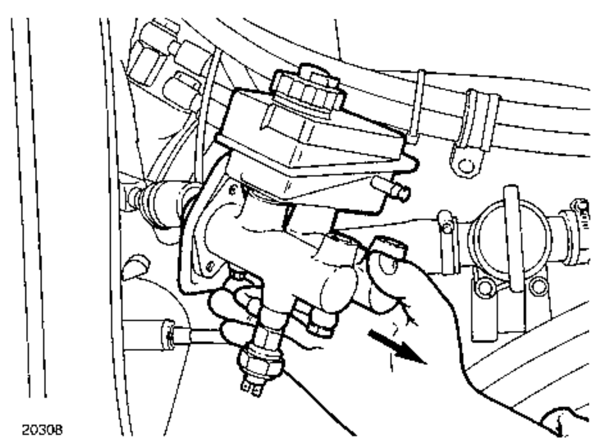
5. Disconnect and remove brake pressure lines (2).



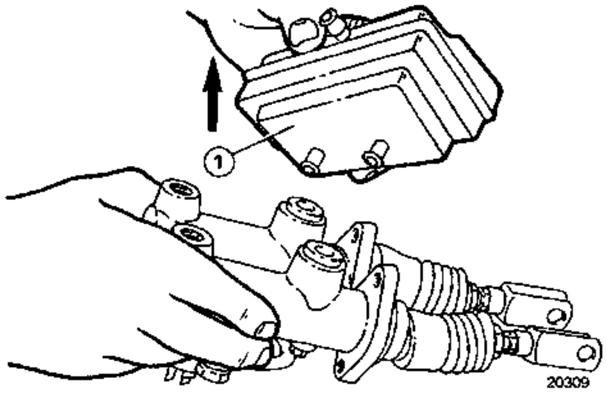
6. Remove spring clips (3), withdraw the respective pins and free the pump control levers (4).



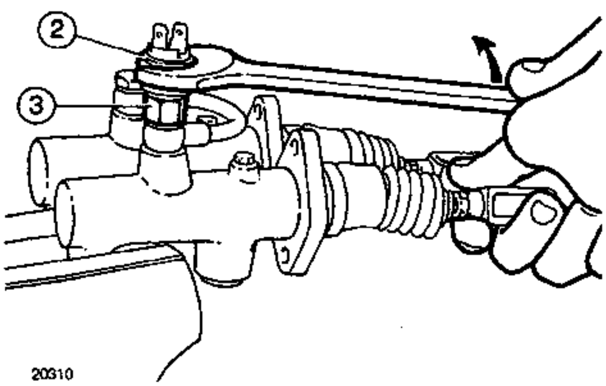
7. Remove the brake pump attaching screws (5).



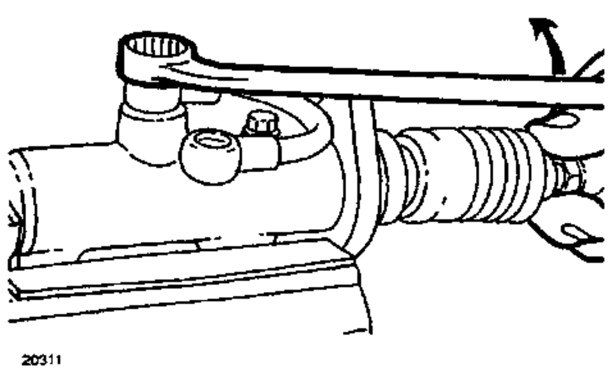
8. Retrieve brake pump assembly.



9. Separate oil reservoir (1) from brake pumps.



10. Remove pressure feeler connection (2) and unscrew nut (3) to detach pump from connecting line.



11. Remove attaching screw and connecting line from pump.

CAUTION

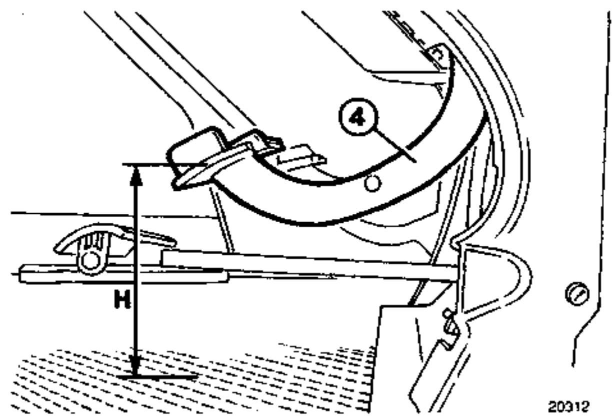
Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

12. Re–install the brake pumps paying attention to the following important points:

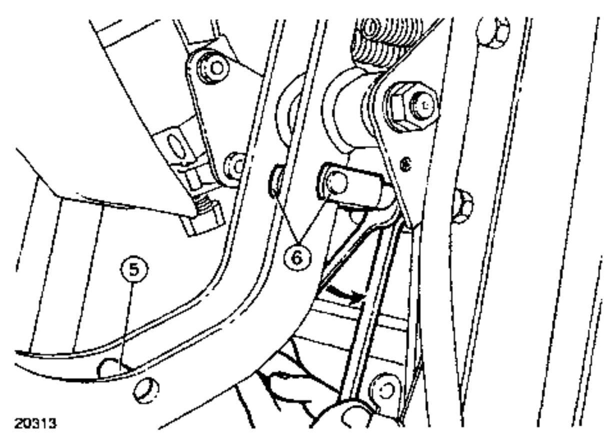
    a. proceed by reversing the removal sequence of operations paying attention to the following important points:

    b. make the following adjustment and bleed air out of system following the procedure of page 33–10.

Brake pedal adjustment.



13. With brake pedals (4) connected to respective yokes and connecting pin (5) withdrawn, measure height (H) from center of pedals to top of footboard which should read approximately 184 mm (7–1/4 in).



14. If correction is needed, slacken jam nuts and turn in or out the screw on yokes (6) until the correct height (H) is obtained. Tighten jam nuts.

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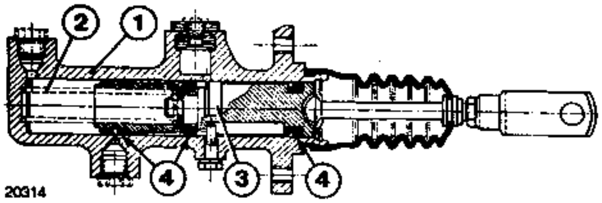
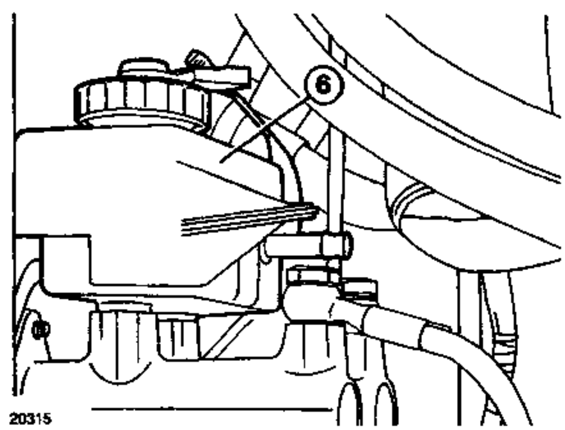


Cut–out view of brake pump.
1. Pump housing – 2. Spring – 3.Piston 4. Oil seals.

BRAKE HYDRAULIC SYSTEM
Air bleeding (Op. 33 204 04).

Air bleeding must be made any time the hydraulic system has been subject to disassembly or equivalent operations.
Proceed as follows:

1. Thoroughly clean surfaces around bleed screws (5) and oil reservoir cover (6).



2. Make sure from both sides that the oil reservoir is filled, prior and after bleeding.

Note - Clean the previously bled oil accurately through proper filtering before re–using it.

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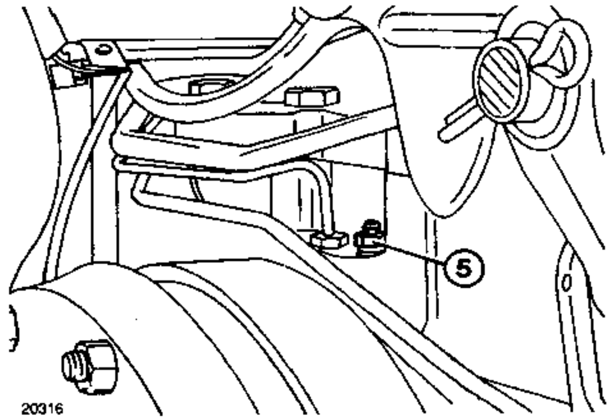
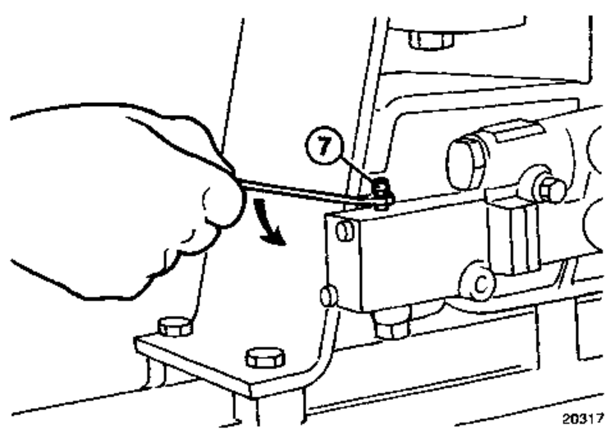
3. Press on left pedal, **slowly and over its full travel**, in order to pressurize the oil in the system.



4. With pedal fully pressed down turn out the bleed screw (5) of about half–a–turn and let oil and air bubbles out.
5. Turn the screw (5) in again and repeat above operations until oil flows out free of air.
6. Press again on left pedal to pressurize the system : this condition exists when the pedal travel becomes normal again.
7. Repeat previous operations on the right pedal also.
8. Finally, top up oil level in the reservoir (6).



9. On tractors equipped with hydraulic trailer brake valve, in addition to the previous operations bleed air through the screw (7) as done with screw (5).
10. Finally, top up oil level in the reservoir (6).

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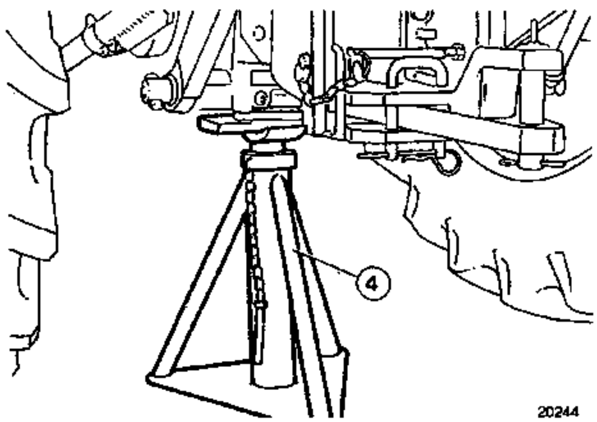
HANDBRAKE SECTOR PLATE SUPPORT
Disassembly–Assembly (Op.33 110 40)

DANGER

Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.

Proceed as follows:



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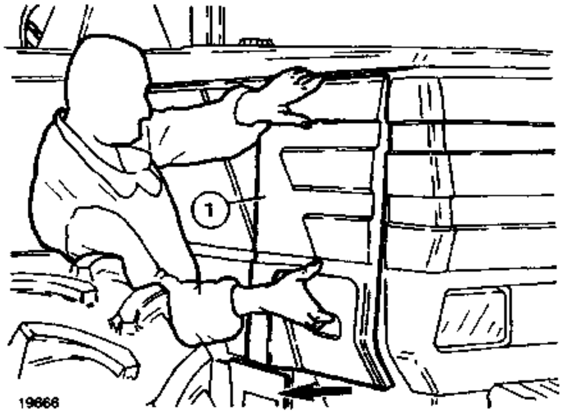
1. Place a stationary stand (4) under the rear drive case.



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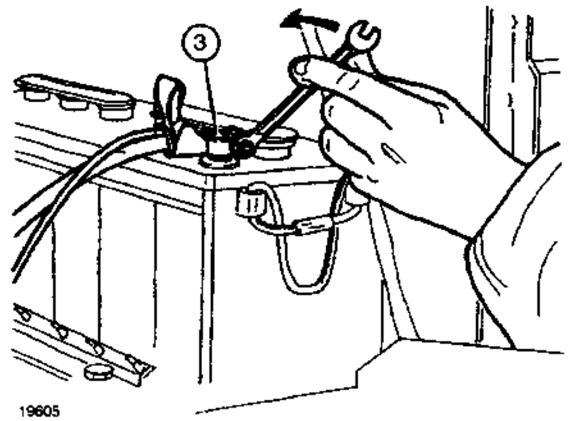
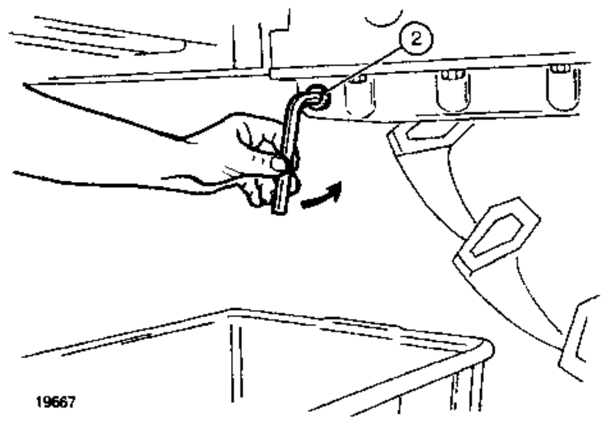
2. Remove front panel section (1) from the tractor R.H. side.



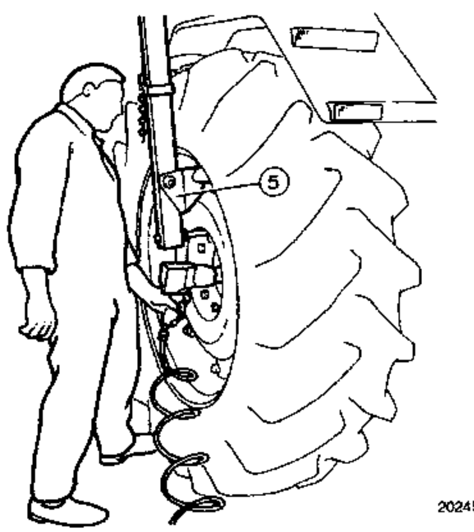
19605

3. Disconnect positive battery cable (3) and insulate it.



19667

4. Unscrew plug (2) and drain rear drive case oil noting the refill quantity: 60 liters (15.8 USA or 11–3/4 Imp. Gall).



20245

5. Attach hook **292400** (5) to the wheel, remove the attaching capscrews and finally the wheel, complete, using a hoist.

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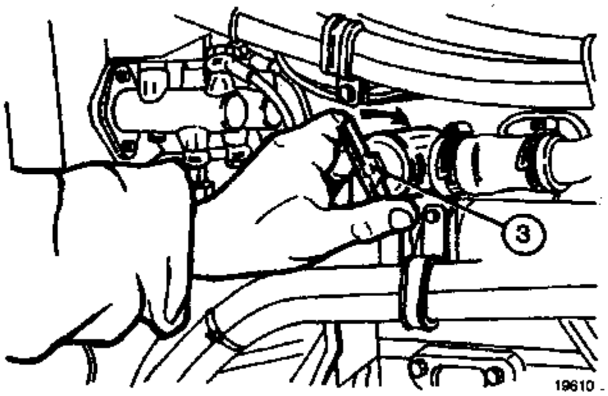
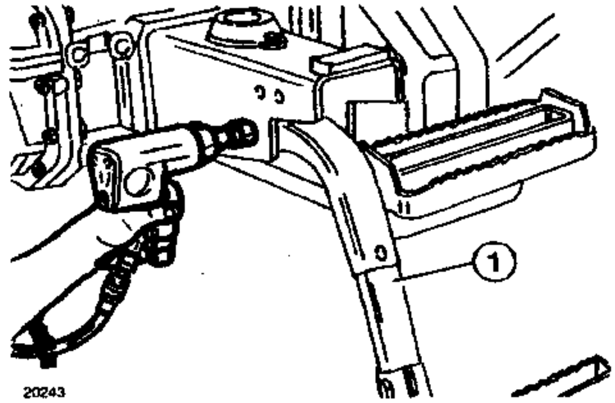
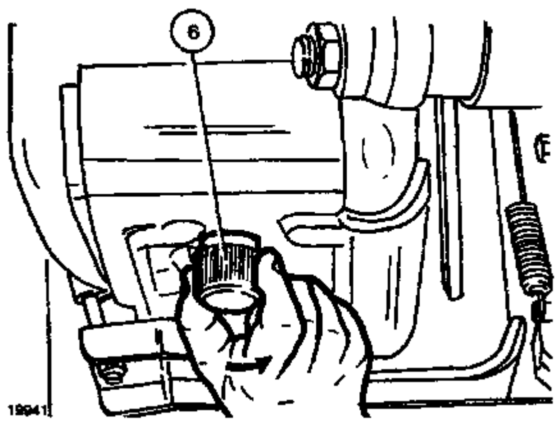


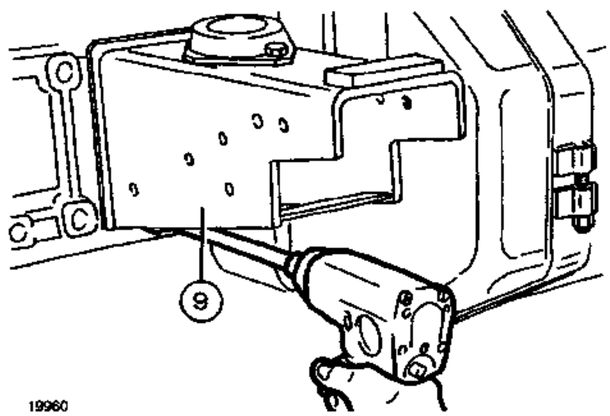
6. Shut off the fuel cock (3) between main and auxiliary tanks.



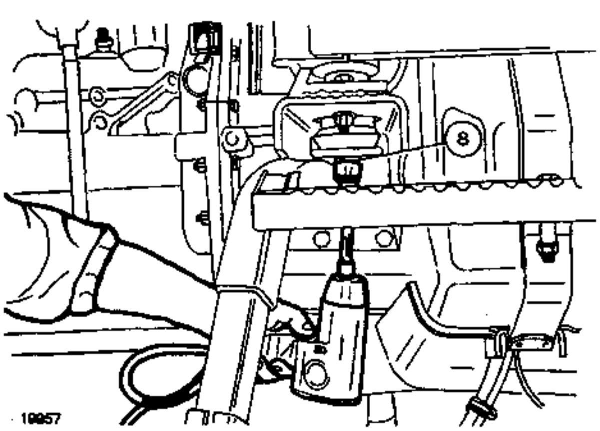
9. Remove attaching screws and step ladder (1).



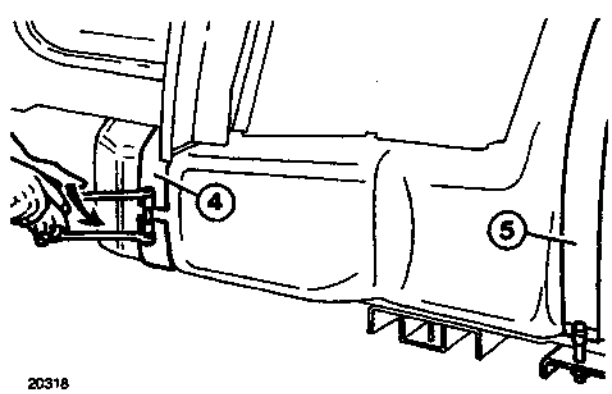
7. Unscrew plug (6) and drain fuel tank.



10. Remove attaching screws and the cab mountuing bracket (9).



8. Turn out the cabin front mounting screw (8).



11. Remove attaching screws and fuel tank clamps (4 and 5).

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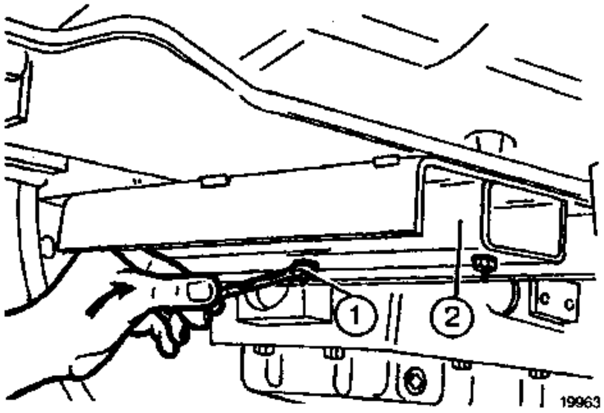
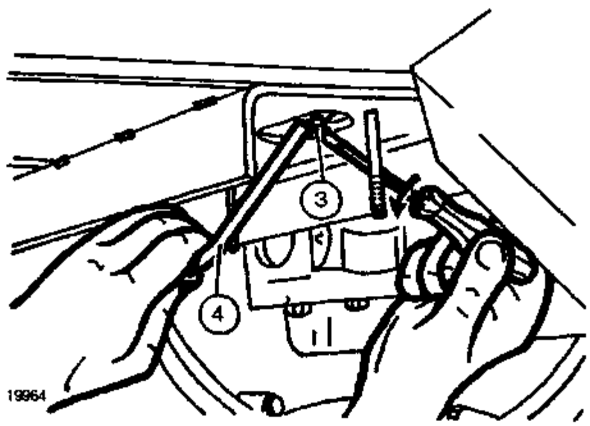
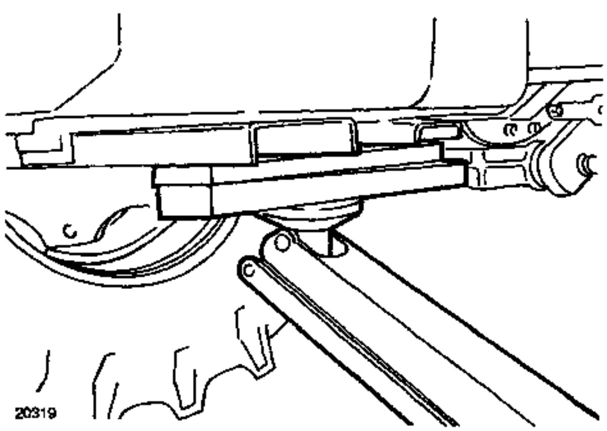


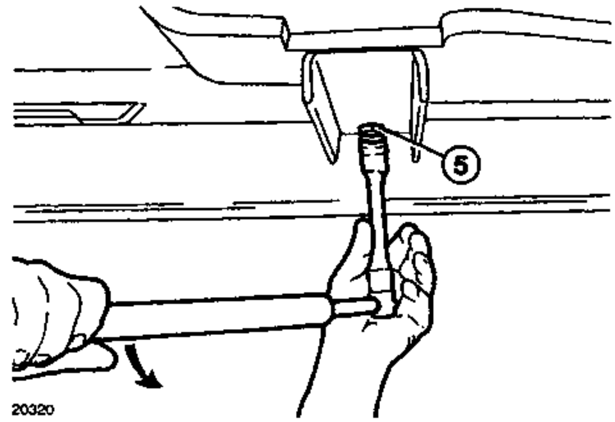
12. Remove attaching screws (1) and guard channel (2).



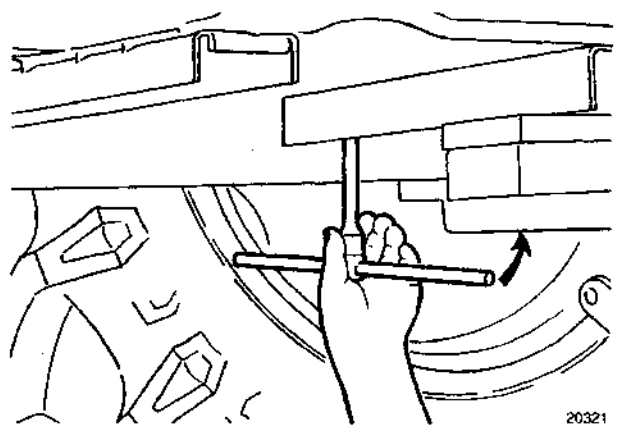
13. Remove clamp (3) and fuel pump feed line (4).



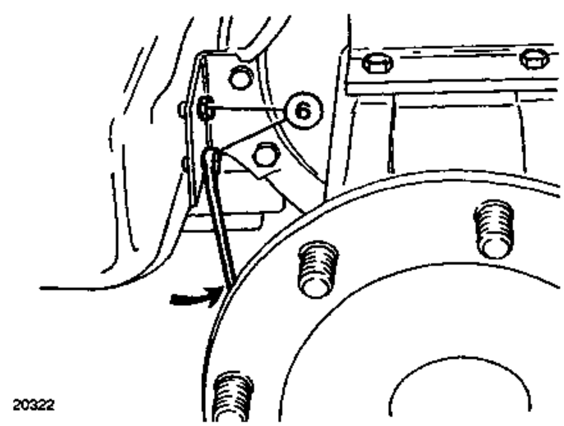
14. Place a hydraulic trolley jack under the fuel tank.



15. Remove the fuel tank front bracket screws (5).



16. Remove the fuel tank central bracket screws.



17. Remove the fuel tank rear bracket screws (6).

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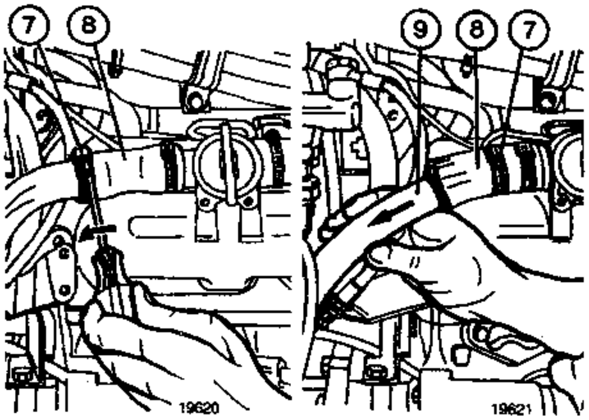
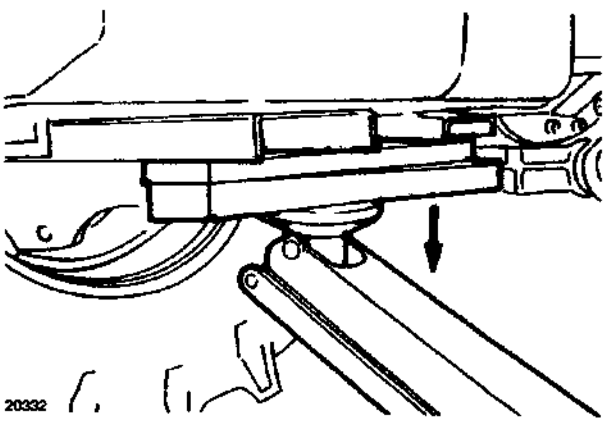
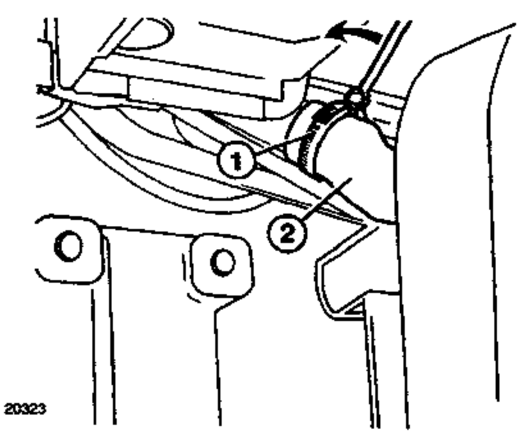


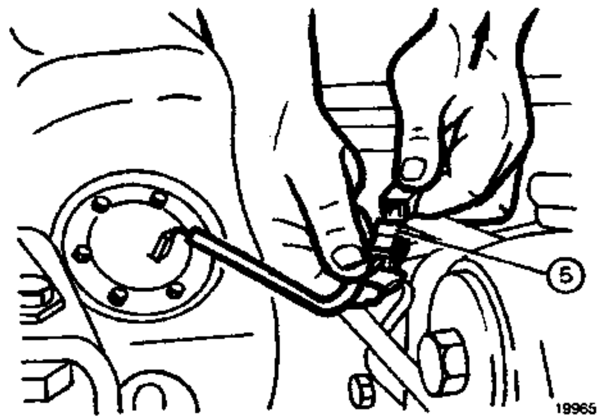
18. Loosen clamp (7) securing hose (8) and disconnect the latter from pipe (9).



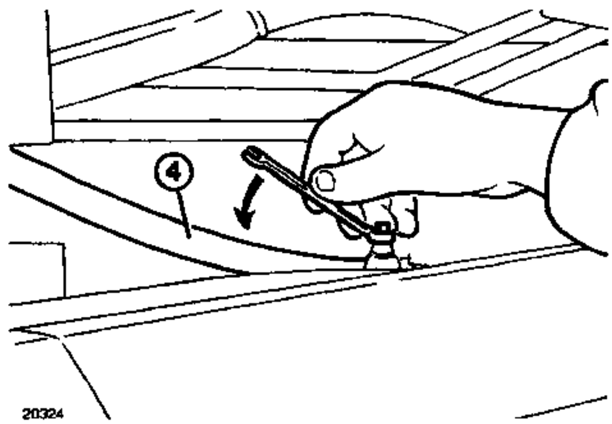
19. Let down the fuel tank slightly with the trolley jack.



20. Loosen clamp (1) and remove hose (2) from pipe.



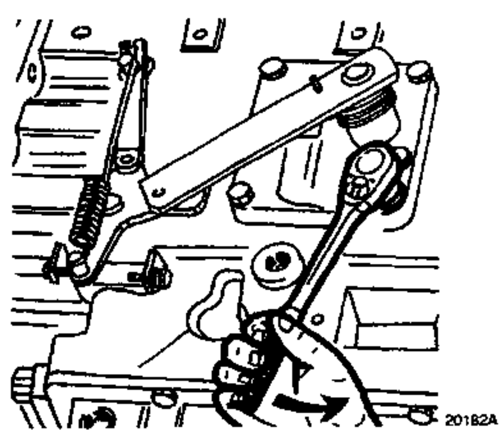
21. Detach the fuel level gauge connection (5).



22. Disconnect breather line (4) from fuel tank.

23. Lower the jack completely and retrieve fuel tank and mounting bracket.

24. Remove the handbrake lever.



25. Remove attaching screws and handbrake control unit.

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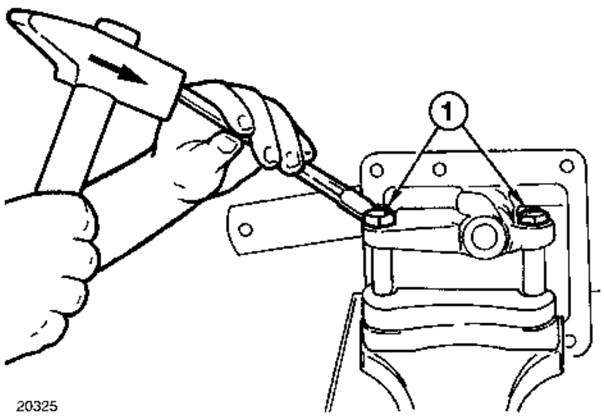
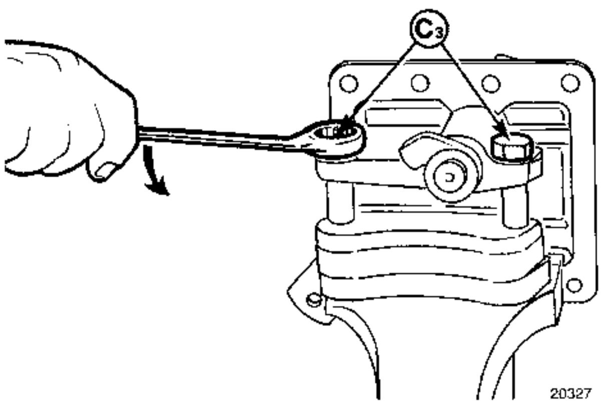
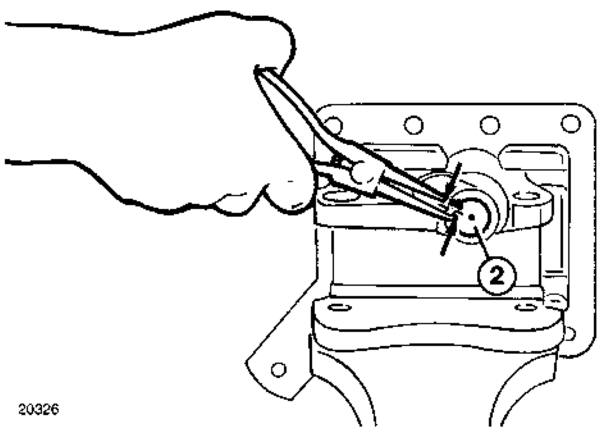


26. Straighten out safety plates (1).

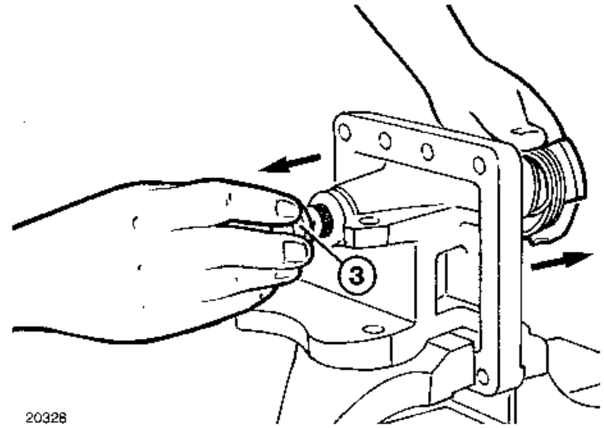


27. Remove guides (C_3) and retrieve the brake sector plates.



28. Remove snap ring (2).

Note - Arrows show marks for alignment at assembly.

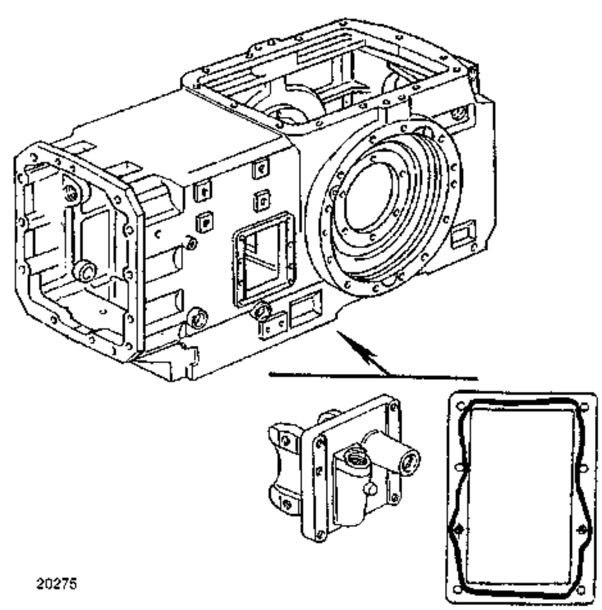


29. Withdraw control lever and retrieve inside lever (3).

CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

30. Re–assemble the parking brake paying attention to the following important points:
a. proceed by reversing the disassembly sequence of operations starting from no. 29 back to no. 1;
b. see illustrations on page 33–2 for correct placement and orientation of component parts;
c. prior to re–installing the parking brake unit in the transmission case make sure that mating surfaces are thoroughly cleaned and degreased, then apply a bead of a sealing compound, approximately 2 mm (.08 in) diameter, following the application scheme illustrated below;
d. tighten fastenings to torque specification data of page 33– 1.



Application scheme of sealing compound to hand-brake and transmission housing mating surfaces.
Jointing compound types are indicated on page 00–9.

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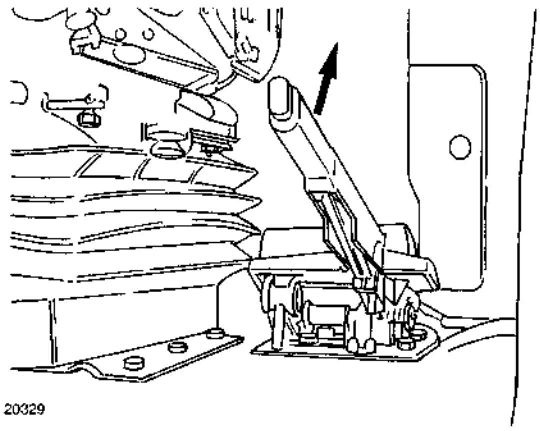
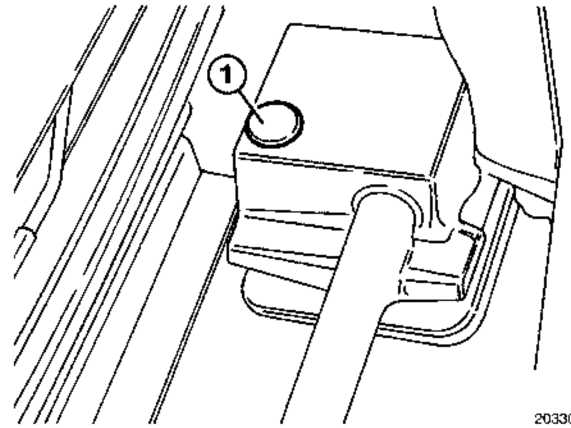
PARKING BRAKE HAND CONTROL LEVER
Travel adjustment (Op. 33 110 08)

This adjustment must be made any time the handbrake unit has been subjected to disassembly or equivalent operations and when free travel measured on the lever grip is excessive.

Proceed as follows:


20329

1. Actuate the parking brake a few times , applying a force of about 400 N (40.7 kg or 90 lb) in order to consolidate the assembly.
   Apply a force of 50 to 60 N (5.1 to 6.1 kg or 11 to 13 lb) centrally on the grip and check if control lever goes over no. 2 detents on the toothed sector.



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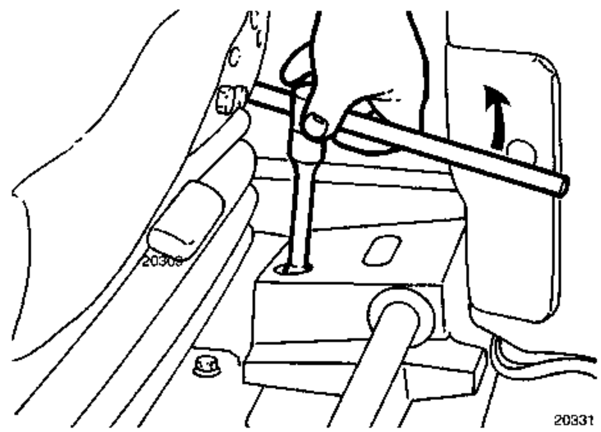
2. If not, remove plug (1).


20331

3. Turn in the nut until lever makes no. 2 steps by applying a force of 50 to 60 N (5.1 to 6.1 kg or 11 to 13 lb).
4. Refit plug (1).
5. Verify that spy lamp blinks before lever has gone over the 2 steps on the sector.

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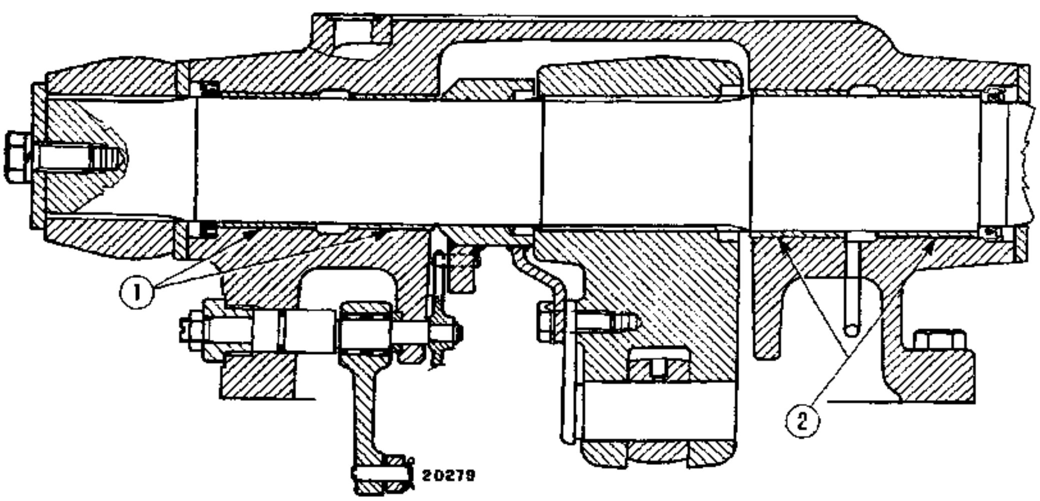
REAR HYDRAULIC LIFT

Type	separate position and draft controls plus mixed position/draft control feature
Control	through two separate, indipendent levers
Vario–speed sensitivity control	automatic, through a specific hydraulic unit located inside of the hydraulic lift
LIFT–O–MATIC	push–button operated, it allows quick lift arms raising/lowering action without any handling of control levers
Arms lowering speed adjustment	through screw–and–jam nut device located on the hydraulic control valve
Single–acting cylinder	
– bore and stroke	115 x 159 mm (4.52 x 6.25 in)
– displacement	1651 cu.cm (100.74 cu.in)
Relief valve setting	190 to 195 bar (194 to 199 kg/cm^2 – 2755 to 2827 psi)
Cylinder safety valve setting	210 to 215 bar (214 to 219 kg/cm^2 – 3104 to 3176 psi)
Plunger dia.	114.978 to 115.000 mm (4.526 to 4.527 in)
Cylinder bore dia.	115.036 to 115.071 mm (4.528 to 4.530 in)
Plunger running clearance	0.036 to 0.093 mm (.0014 to .0037 in)
Rockshaft journal dia.	
– R.H. side	59.970 to 60.000 mm (2.361 to 2.362 in)
– L.H. side	64.970 to 65.000 mm (2.557 to 2.559 in)
Bush bearings I.D., force–fitted in lift casing	
– R.H. side	60.100 to 60.184 mm (2.366 to 2.369) (1)
– L.H. side	65.100 to 65.184 mm (2.562 to 2.566 in)
Rockshaft working clearance	0.100 to 0.214 mm (.0039 to .0084 in)
Bush interference fit in lift casing seats	0.065 to 0.185 mm (.0025 to .0072 in)
Rockshaft end float with lift arms installed	0.2 to 1.4 mm (.0079 to .0551 in)

(1) Final force–fitted dimension, without reaming

(follows)



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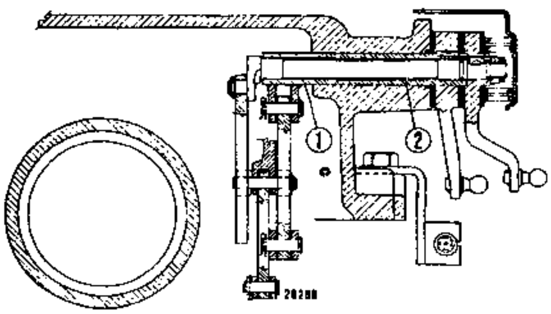
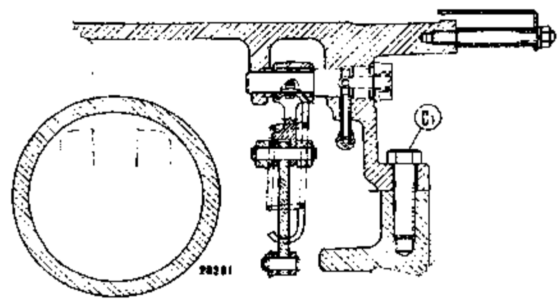
REAR HYDRAULIC LIFT

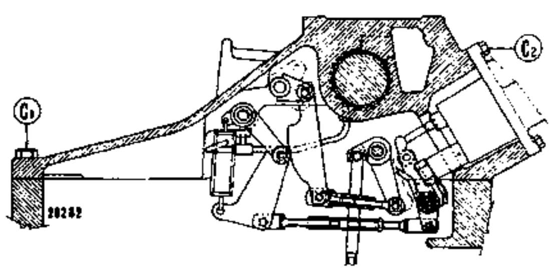
(cont.)

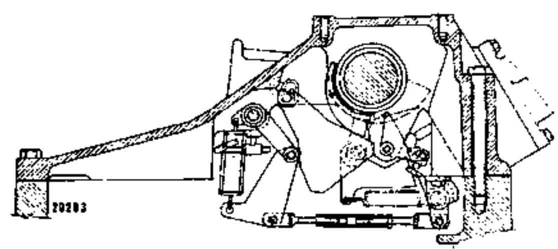
Draft relay lever hollow shaft (1), O.D.	21.967 to 22.000 mm (.8648 to .8661 in)
Shaft housing bore, I.D.	22.020 to 22.072 mm (.8669 to .8690 in)
Shaft clearance fit	0.020 to 0.105 mm (.0008 to .004 in)
Position relay lever pivot dia.	13.973 to 14.000 mm (.5501 to .5512 in)
Draft control relay lever hollow shaft, I.D.	14.016 to 14.059 mm (.5518 to .5535 in)
Clearance fit of position relay lever pivot inside draft control relay lever hollow shaft	0.016 to 0.086 mm (.0006 to .0033 in)

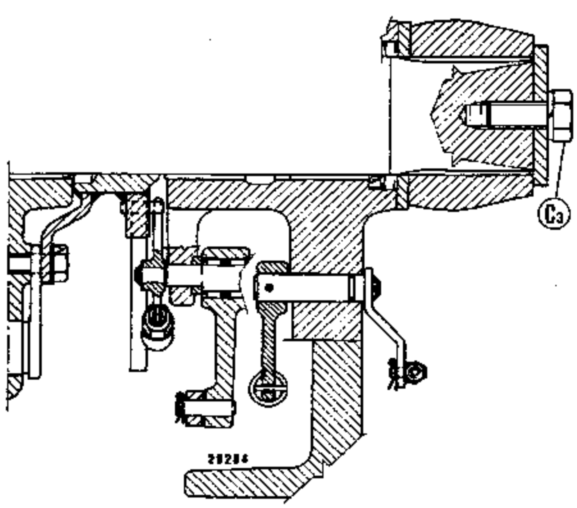
(follows)

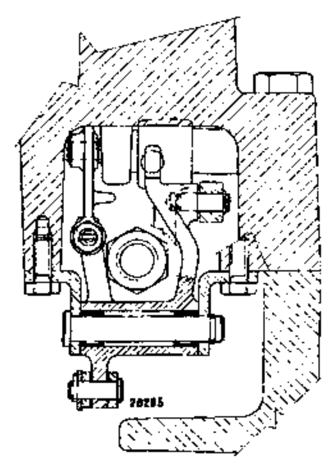












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REAR HYDRAULIC LIFT

(cont.)

Clearance, control valve spool (7, page 35–4) and seat .... Clearance, control valve in housing bore	0.008 to 0.012 mm ([1]) (.0003 to .0005 in) 0.008 to 0.014 mm ([1]) (.0003 to .0005 in)
Check valve spring (8, page 35–4) data: – free length .... – length under load of 52 to 56 N (5.28 to 5.72 kg – 11.6 to 12.6 lb) ...	 25.5 mm (1.0 in) 17.5 mm (.69 in)
Control valve spool return spring (9, page 35–4): – free length .... – length under load of 31.7 to 35 N (3.23 to 3.57 kg – 7.1 to 7.8 lb)	 50.5 mm (2.0 in) 34 mm (1.34 in)
Pilot valve spring (10, page 35–4) data: – free length .... – length under load of 103 to 114.7 N (10.5 to !!.7 kg – 23 to 26 lb)	 44 mm (1.73 in) 29 mm (1.14 in)
Lowering speed adjustment valve spring (11, page 35–4) data: – free length .... – length under load of 67 to 73 N (6.86 to 7.46 kg – 15 to 16.5 lb)	 34 mm (1.34 in) 27 mm (1.06 in)
Sensitivity valve spring (1, page 35–4) data: – free length .... – length under load of 65 to 71 N (6.6 to 7.2 kg – 14.5 to 16 lb)	 48 mm (1.89 in) 32 mm (1.26 in)
Sensitivity valve spring (2, page 35–4) data: – free length .... – length under load of 0.9 to 1 N (0.09 to 0.11 kg – .2 to .25 lb)	 21 mm (.82 in) 13 mm (.51 in)

([1]) Control valves and spools are selected prior to assembly to meet specification fit.

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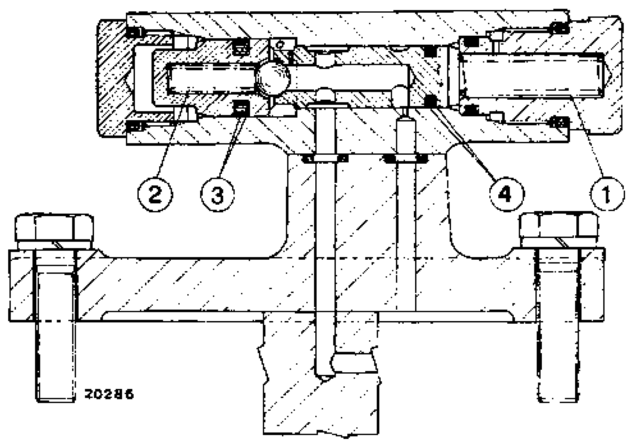
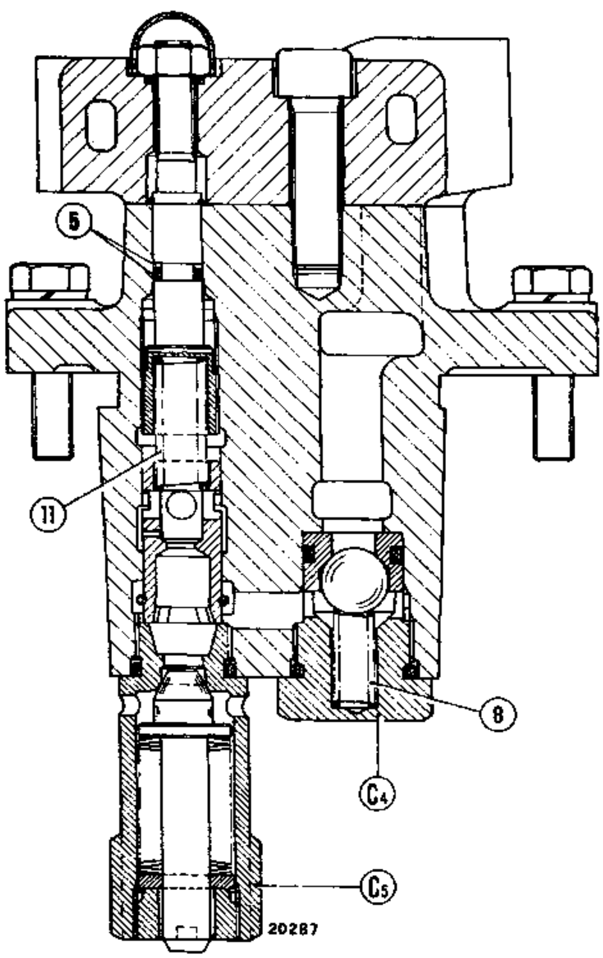
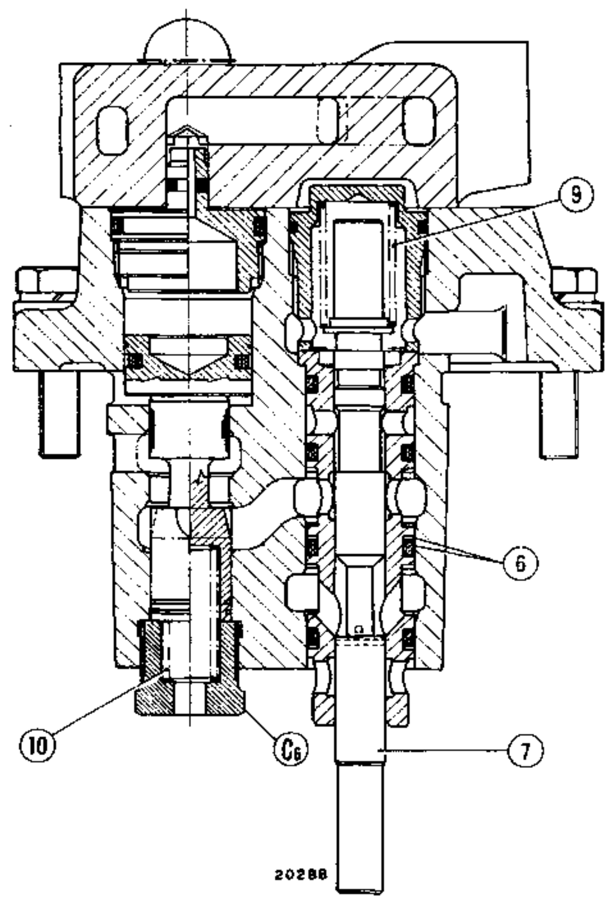
Rear hydraulic lift control valve cut–outs







NOTE – Prior to installation of seals 3,4,5 and 6 heat their respective back–up discs in oil at a temperature of about 50 °C (122 °F).
Fit seal (5) and its back–up plate using protection tool **293865/1**.
Fit seal (6) and its back–up plate using protection tool **293984**. Seals (3 and 4) and associated back–up discs can be fitted without any protection, using solely normal precautions to prevent damage.

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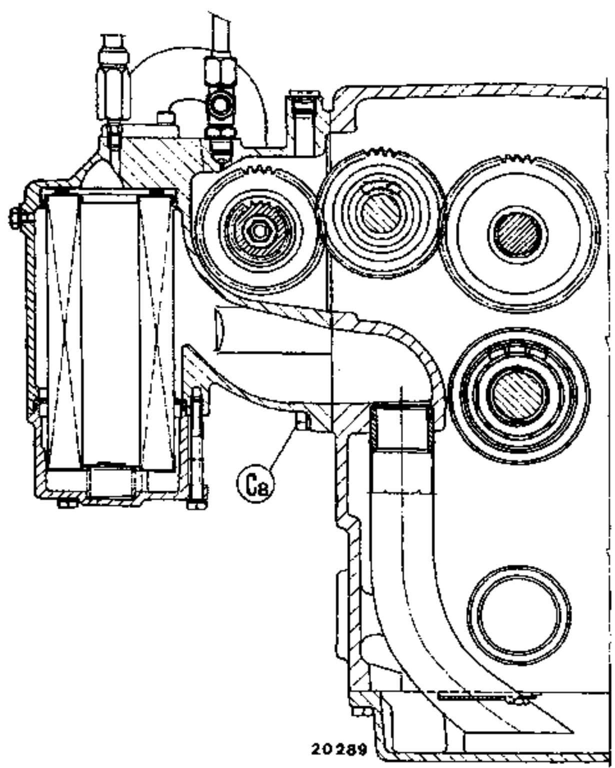
REAR LIFT HYDRAULIC PUMP

Filter	
Type	full–flow, replaceable paper cartridge
Location	pump intake, on the R.H. side of transmission case
Pump	
Type	gear type, drawing oil from trasmission case
Location	on the right–hand side of the trasmission case
Model	C42
Make	FIAT
Control	actuated by P.T.O. shaft
Rotation (from drive end)	clockwise
Engine/pump rpm ratio	1 : 1.261
Max. speed (with engine running at max. power rated speed)	2902 rpm
Rated capacity at max. speed	55.4 cu.dm/1 (l/min – 12.1 UK gal/min)
Test bench capacity at 1450 rpm and 153 bar (156 kg/cm$_2$ – 2495 psi):	
– new or reconditioned pump	25.8 cu.dm/1 (l/min – 5.67 UK gal/min)
– used pump	18 cu.dm/1 (l/min – 3.96 UK gal/min)
– test oil temperature	55 to 65 °C. (173 to 203 °F.)
– test oil viscosity	SAE 20

(follows)



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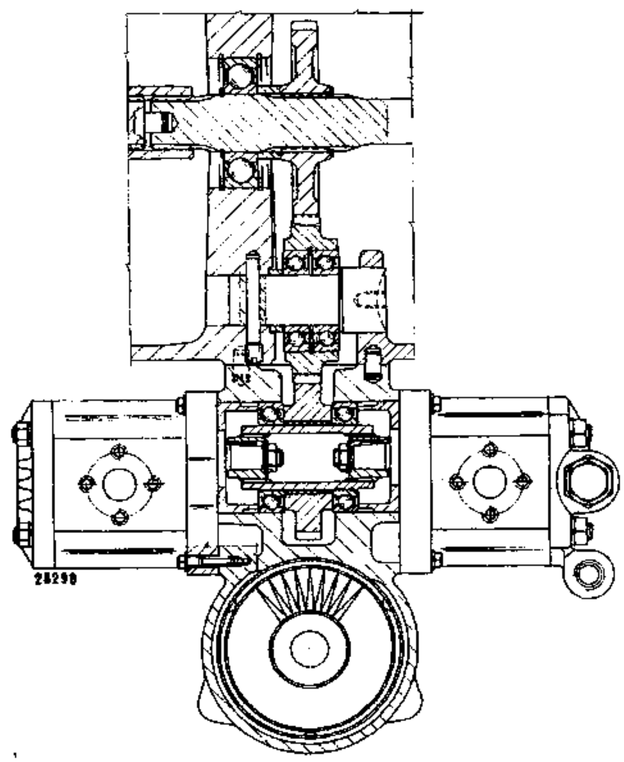

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REAR LIFT HYDRAULIC PUMP

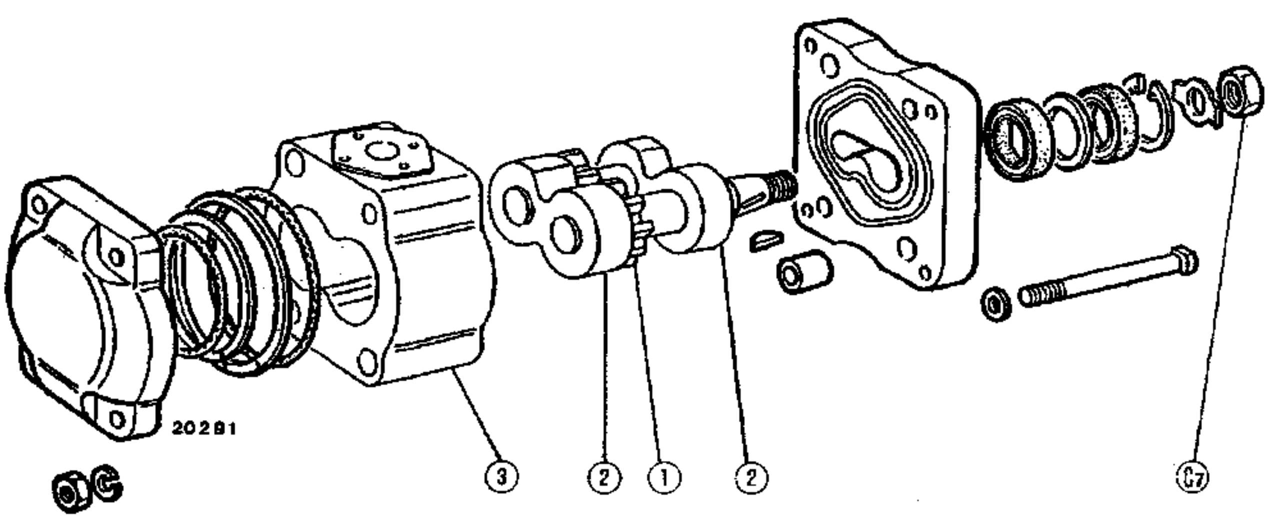
(cont.)

Drive/driven gear (1) shaft dia. .... Bearing seat (2) I.D. .... Shaft running clearance .... – max. permissible wear	17.400 to 17.418 mm (.6850 to .6857 in) 17.450 to 17.475 mm (.6870 to .6880 in) 0.032 to 0.075 mm (.001 to .003 in) 0.1 mm (.004 in)
Gear (1) radial clearance in pump body .... Max. permissible wear on pump body, gear location, suction side	0.020 to 0.064 mm (.0008 to .0025 in) 0.1 mm (.004 in)
Gear (1) flank width .... Bearing (2) width .... Gear and bearing housing (3) width in pump body .... End float of gears complete with bearings in pump body (on reconditioned pumps also)	30.800 to 30.815 mm (1.212 to 1.213 in) 24.490 to 24.510 mm (.964 to .965 in) 79.935 to 79.960 mm (3.147 to 3.148 in) 0.100 to 0.180 mm (.004 to 007 in)

IMPLEMENT LINKAGE

Type .... Category .... Draft control mode	3–point hitch 2nd through lower links and sensing bar
Max. lifting capacity, measured with centre of gravity at 610 mm (24 in) from the lower link ball ends, starting with links on horizontal position (upper link connected to top bracket hole): – without auxiliary ram .... – with auxiliary ram	 4354 daN (4440 kg) (9788 lb) 5464 daN (5572 kg) (12,284 lb)

(follows)



IMPLEMENT LINKAGE

(cont.)

Max. lifting load, starting with lower links in horizontal position (upper link connected to top bracket hole):	
– F100 (centre of gravity at 1394 mm or 54.88 in from ball ends):	
– without auxiliary ram	3899 daN (3976 kg) (8765 lb)
– with auxiliary ram	5756 daN (5870 kg) (12,940)
– F110 (centre of gravity at 1394 mm or 54.88 in from ball ends):	
– without auxiliary ram	3850 daN (3926 kg) (8655 lb)
– with auxiliary ram	5684 daN (5796 kg) (12,778 lb)
– F120 Turbo (centre of gravity at 1554 mm or 61.18 in from ball ends):	
– without auxiliary ram	3818 daN (3893 kg) (8582 lb)
– with 1 auxiliary ram	5636 daN (5747 kg) (12,670 lb)
– F130 Turbo (centre of gravity at 1650 mm or 65 in from ball ends):	
– without auxiliary ram	3771 daN (3845 kg) (8746 lb)
– with 1 auxiliary ram	5566 daN (5676 kg) (12,513 lb)
Max. travel at lower link balls with fully extended lift rods	740 mm (29.138 in)
Sensing bar dia.	34,861 to 34,900 mm (1.3795 to 1.3740 in)
Sensing bar end float	1,9 to 4,5 mm (.075 to .177 in)

REAR HYDRAULIC LIFT AUXILIARY RAM

Type	single–acting
Quantity	no. 1

REMOTE CONTROL VALVES

Filter	full–flow, with paper cartridge (the same of the lift hydraulics)
Pump	gear type (the same of the lift hydraulics)
Auxiliary rams	
Location	modular pack, in–line (up to a max. of four elements) attached to the top of the hydraulic lift
Control	by two hand levers
Relief valve setting	190 to 195 bar (194 to 199 kg/cm^2 – 2755 to 2827 psi)
Type	single and double acting, convertible, with float control and automatic release

TORQUE DATA

DESCRIPTION	Thread size	Torque		
		Nm	kgm	ft. lb
Hydraulic lift				
Capscrew, lift to rear transmission housing (C_1, page 35–2)	M 14x1.5	142	14.5	105
Capscrew, control valve to hydraulic lift (C_2, page 35–2)	M 8x1.25	32	3.3	23
Capscrew, lift arm pads (C_3, page 35–2)	M 14x1.5	142	14.5	105
Nut, position control lever pivot	M 10x1.25	14,7	1.5	11
Nut, hand lever quadrant bracket studs	M 8x1.25	23	2.4	17
Screw, hydraulic lift cylinder	M 16x1.5	279	28.5	206
Plug, check valve (C_4, page 35–4)	M 24x1.5	83	8.5	61
Cylinder safety valve (C_5, page 35–4)	M 20x1.5	83	8.5	61
Plug, pilot valve (C_6, page 35–4)	M 20x1.5	54	5.5	40
Hydraulic pump				
Nut, drive coupling (C_7, page 35–6)	20 UNC-2B	29	3	21.5
Capscrews, pump and filter support	M12x1.5	83	8.5	61.5
Implement linkage				
Capscrew, sensing bar support	M 18x1.5	304	31	224
Capscrew, check link mounting	M 18x1.5	304	31	224
Nut, draft control rod	M 10x1.25	36	3.7	27
Nut, arm thrust ring screw	M 12x1.25	98	10	72
Auxiliary rams				
Capscrew, ram mounting	M 10x1.25	127	13	94

SERVICE TOOLS

ATTENTION – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code **(X)**.
Besides, to work safely and achieve the best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjonction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

List of the special tools necessary to perform service operations covered by this section of the Manual:

	291359/2	Sling hook, hydraulic lift.
X	**293813**	Installer, lift piston w/ seal.
X	**293985**	Driver, rockshaft seal installation.
	291215	Hook, lift linkage spring removal–installation.
X	**293839**	Driver, needle roller bearing installation on lift control lever bushing.
X	**293838**	Driver, roller needle bearing installation on draft control lower lever.
X	**293838**	Driver, roller needle bearing installation on draft control upper lever.
X	**293838**	Driver, roller needle bearing installation on draft control linkage.
X	**293981**	Centering pin, draft control adjustment.
X	**291862**	Wrench, cylinder safety valve setting.
X	**291863**	Wrench, lift pressure relief valve setting ring–nut.
X	**293865/1**	Protection, seal installation on arms lowering speed setting pin (if already in possess of protection **293865**, consider that same can be modified following indications of working drawing on page 35–9 to be transformed into **293865/1**).
	292870	Pressure test kit.
	290284	Hand pump, valve setting.
X	**290828**	Adapter, cylinder safety valve setting.
X	**290824**	Adapter, lift pressure relief valve setting.

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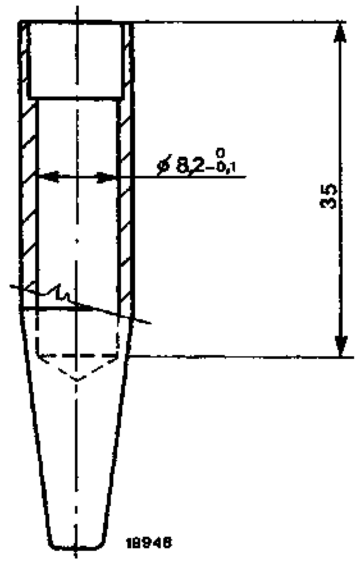
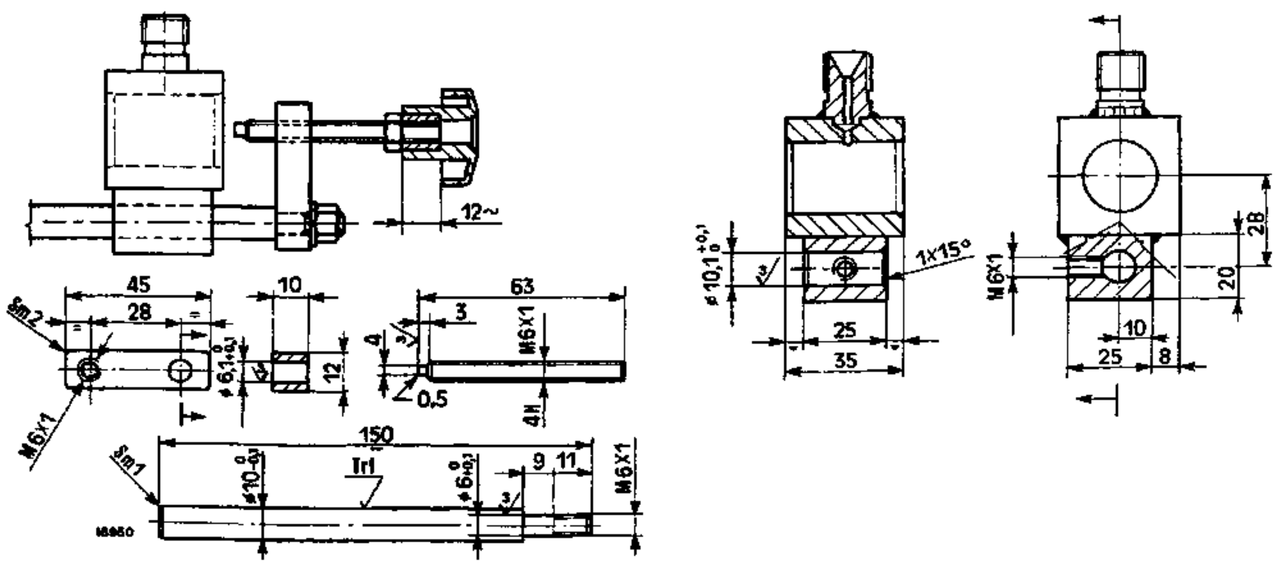
X	293982	Adapter, control valve fluid tightness check.
X	293978	Wrench, arms raising height setting.
X	293984	Protection, pilot valve seal.
X	293980	Adjuster, draft control.
X	293979	Adjuster, draft and position control.
	293987	Tierod, rockshaft bearing bushings.
	293988	Nut (for use in conjonction w/ **293987**)
	293989	Bushing (for use in conjonction w/ **293987**)
	293990	Bushing (for use in conjonction w/ **293987**)
	293983	Adapter (for use in conjonction w/ **291359/2**)



Modification of protection 293865 adapting it to seal installation on the arm lowering speed adjustment pin (pre-modification tool becomes 293865/1).



Modifications of adapter 293849 for checking fluid tightness of control valve metering (post-modification tool becomes 293849/1).

NOTE – This tool is superseded by the new 293982.

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REAR HYDRAULIC LIFT TROUBLE – SHOOTING CHART

Fault	Diagnosis	Correction
Lift fails to operate.	1. Clogged oil filter.	Replace filter.
	2. Control valve stuck at discharge.	Free control valve.
	3. Inefficient pump.	Overhaul or replace pump.
Erratic, jerking operation.	1. Clogged oil filter.	Replace filter.
	2. Ingress of air inside pump inlet line.	Check connection tightness and seal efficiency.
Rockshaft rises too slowly.	1. Clogged oil filter.	Replace filter.
	2. Oil leakage past seals and consequent pressure drop: piston gland or seal on cylinder delivery connection.	Replace sealing components found defective.
	3. Inefficient pump.	Overhaul or replace pump.
Rockshaft lowers too slowly.	1. Arm lowering speed out of adjustment.	Adjust correctly.
Rockshaft rises too fast.	1. Arm lowering speed out of adjustment.	Adjust correctly.
Rough lift interventions.	1. Presence of foreign particles between delivery control valve ball and seat.	Disassemble valve, remove foreign matter and inspect oil filter.
	2. Poor fluid tightness at delivery control valve ball.	Replace delivery valve.
	3. Stuck delivery valve piston.	Disassemble valve and remove causes of piston stucking.
Lift interventions too slow.	1. Clogged delivery valve discharge openings.	Disassemble valve, remove clogging matters and inspect oil filter.
	2. Stuck delivery valve piston.	Disassemble valve and remove causes of piston stucking.

(follows)

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REAR HYDRAULIC LIFT TROUBLE – SHOOTING CHART

(cont.)

Fault	Diagnosis	Correction
Lift fails to hold the load in raised position (continuous pitching movement while the engine is running, when stopped, the load is lowered down).	**1.** Poor check valve tightness.	Remove, check, clean and replace, if necessary , the parts involved.
	2. Oil leakage past control valve spool seals.	Replace seals.
	3. Poor valve spool tightness.	Remove, check tightness and, if found defective, replace the valve spool and body.
	4. Oil leakage past cylinder piston gland or through the cylinder delivery connection seals.	Replace seals.
	5. Poor tightness, or too–low setting, of the cylinder safety valve.	Replace valve.
Relief valve cracks off with lift arms in fully raised position.	**1.** Misadjusted lift arm travel.	Adjust correctly.
Poor lifting capacity.	**1.** Pressure relief valve out–of–setting.	Replace valve.
	2. Cylinder safety valve out–of–setting.	Replace valve.
	3. Low pump efficiency (normally accompanied by a susbstantial increase of lifting time).	Overhaul or replace pump.

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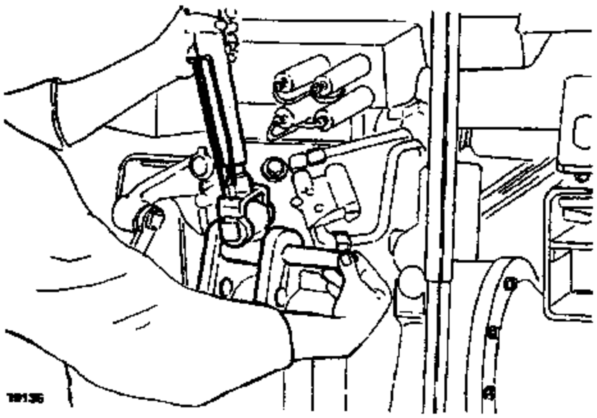
REAR–MOUNTED HYDRAULIC LIFT
Removal–Installation (Op. 35 110 30)

Proceed as follows:

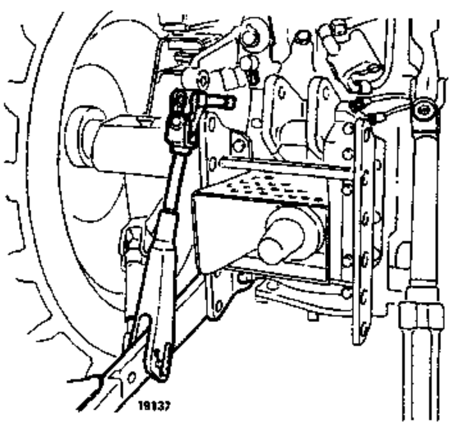
DANGER

Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.

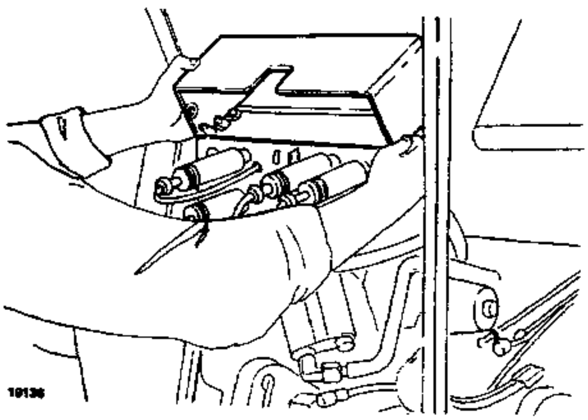
1. Disconnect battery cables.



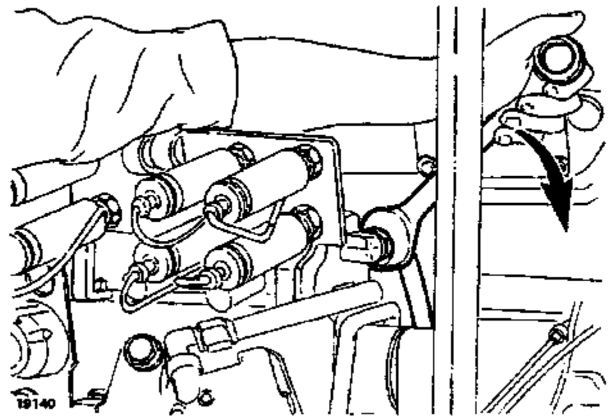
2. Remove the implement linkage upper link.



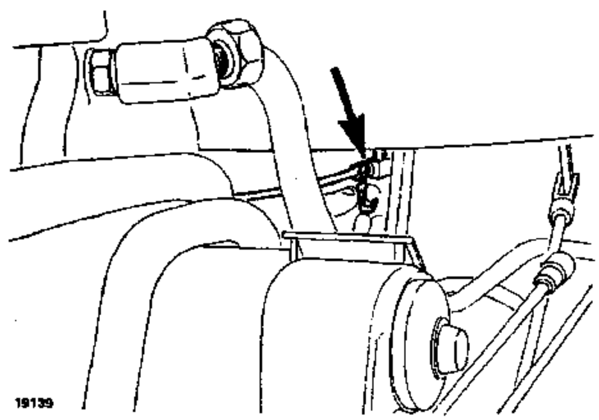
3. Disconnect the side lift rods from lift arms.



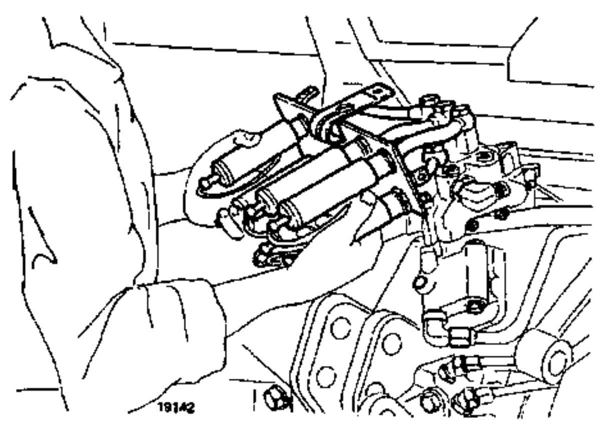
4. Remove the remote control valve cover.



5. Disconnect the two remote valve delivery/return oil lines, subsequently remove the delivery pipe.



6. Disconnect from under the platform the remote valve control rods from their respective levers.



7. Remove the remote control valve retaining capscrews and finally the valve pack together with control rods.

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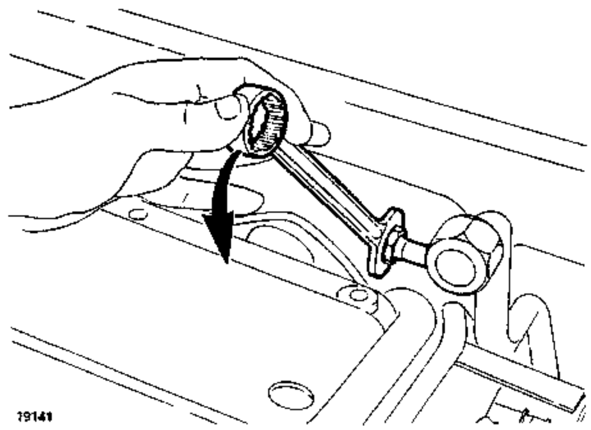
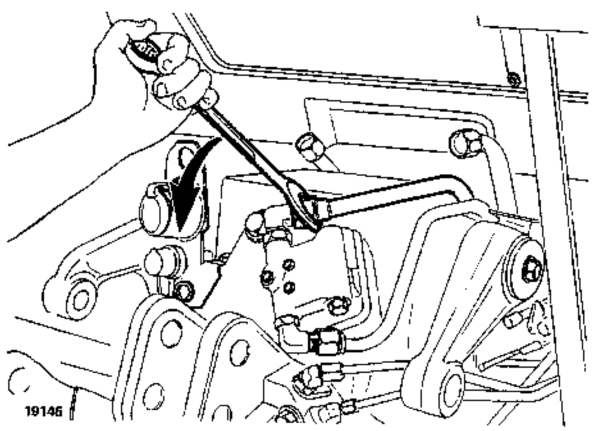


19141

8. Disconnect the delivery oil line to hydraulic ram from its connection located onto the hydraulic lift housing.



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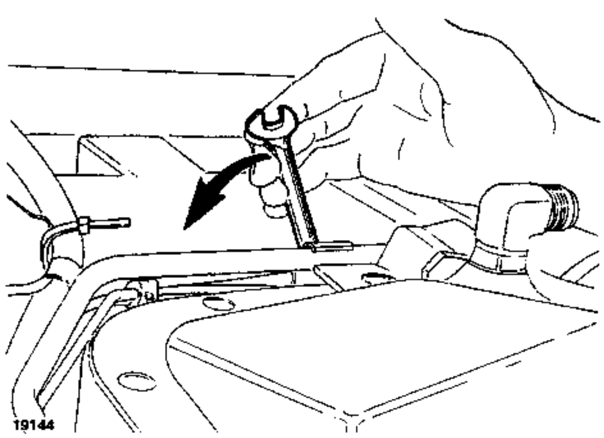
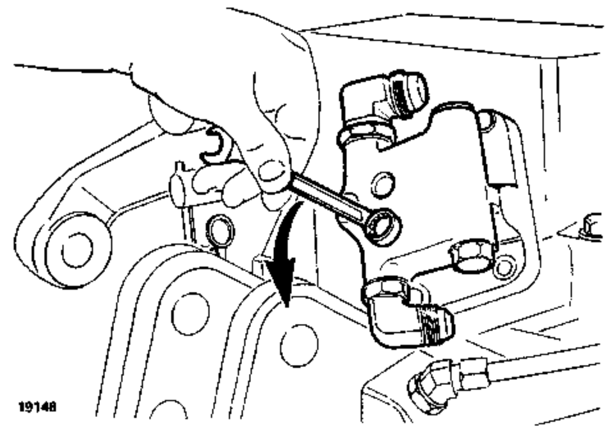
9. Disconnect from the hydraulic lift control valve the two delivery/return oil lines and finally remove them.



19144

10. Remove the trailer oil line mounting bracket (when installed) and the tractor brake oil lines.



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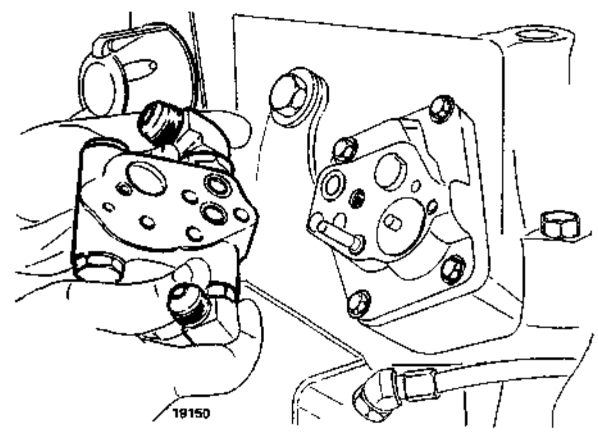
11. Remove the locknut from the arm lowering speed regulation valve screw.



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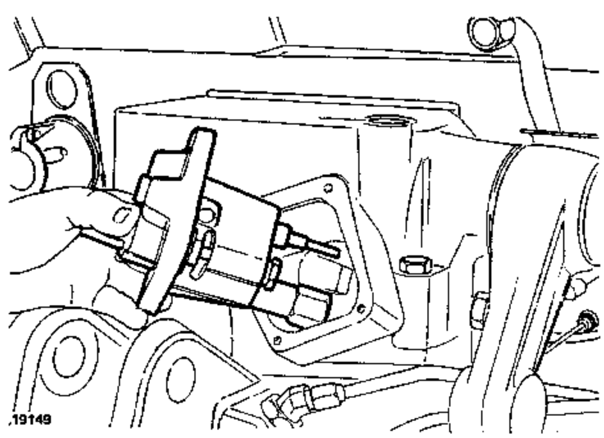
12. Remove the two retaining socket–head screws and control valve cover.



19149

13. Remove the four retaining screws and the control valve.

14. Where fitted, disconnect the trailer hydraulic brake line.

15. Disconnect the lube line from hydraulic lift housing.

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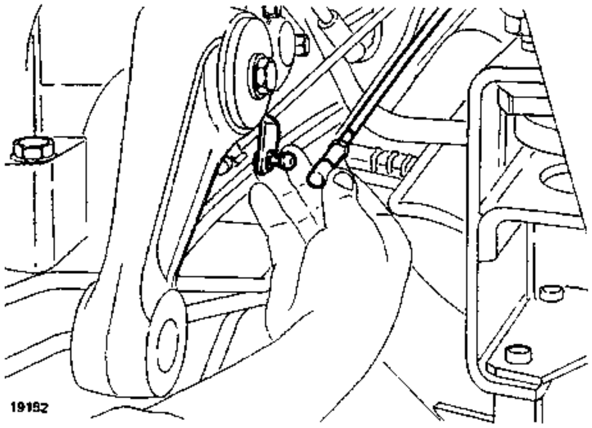
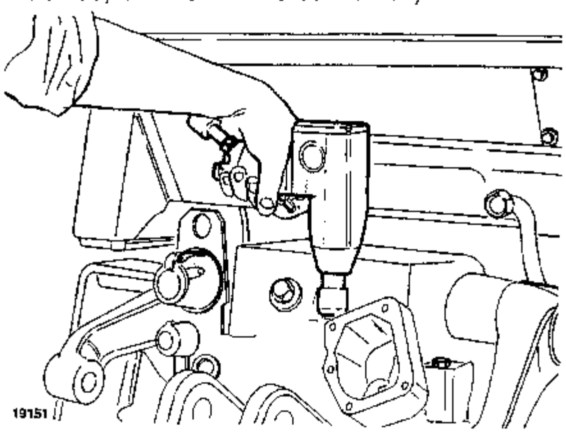
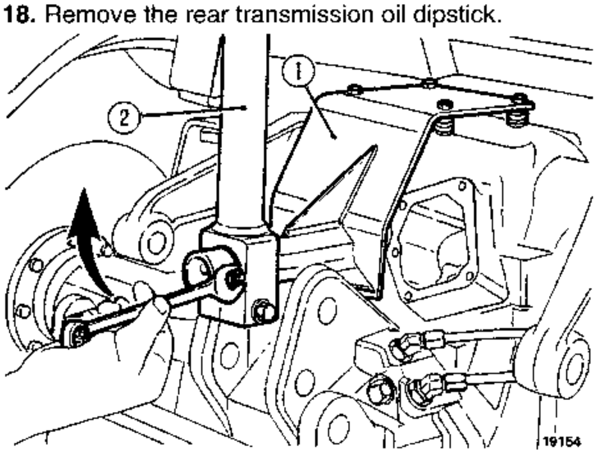


16. Disconnect control rods from respective levers on the hydraulic lift unit (position control rod, draft control rod, LIFT–O–MATIC control rod).



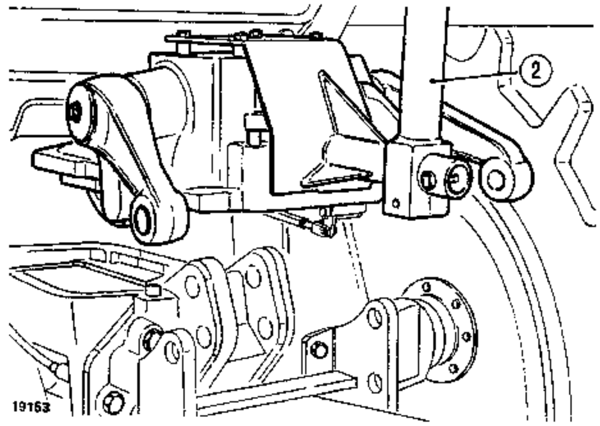
17. Remove the hydraulic lift mounting capscrews and recover the multi–socket supporting bracket retaining screw.

18. Remove the rear transmission oil dipstick.



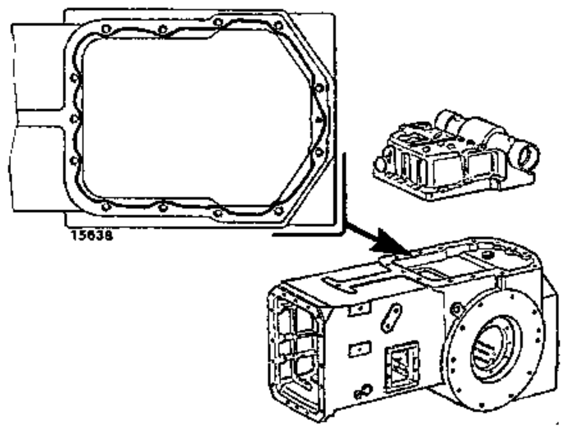
19. Install on the hydraulic lift the bracket tool no. **293983** (1) and connect the latter to the lifting hook tool no. **291359/2** (2); make sure to fit a safety bolt on the bracket to avoid any risk of its falling off the hook.

Note - When fitting the bracket **293983** check that mounting holes on the hydraulic lift housing are free and unplugged. In case, remove cork plugs.



20. Connect the hook **291359** (2) to a hoist and lift away the hydraulic lift assembly.

21. At installation proceed by reversing the previous removal sequence of operations and complying with the following additional directions:



22. Thoroughly clean mating surfaces aand apply a thin strip of sealing compound about 2mm (.08 in) round following the scheme shown.
Information on suitable types of sealing compounds are given on page 00–9.

23. Prior to refitting the control valve onto the hydraulic lift also apply some sealing compound.

24. Refit on top side of hydraulic lift any cork plug previously removed when attaching the bracket **293283**.

REAR–MOUNTED HYDRAULIC LIFT EXTERNAL CONTROLS
Disassembly–Assembly (Op. 35 110 17)

The disassembly–assembly operations of the hydraulic lift external controls can be carried out either with the lift unit removed and on bench or directly on the tractor with hydraulic lift installed.
Proceed as follows:

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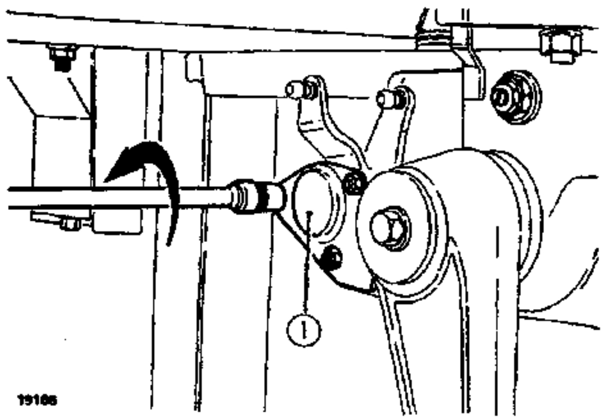
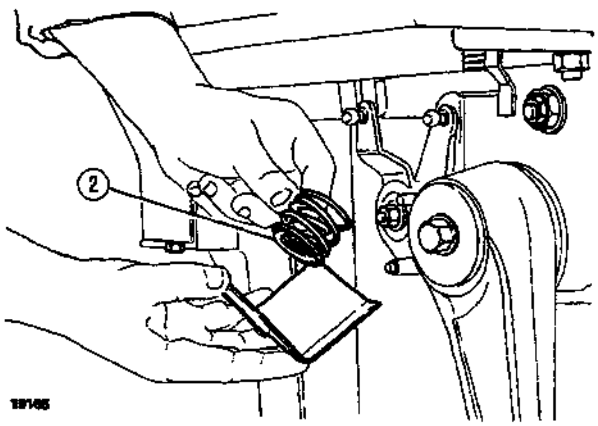
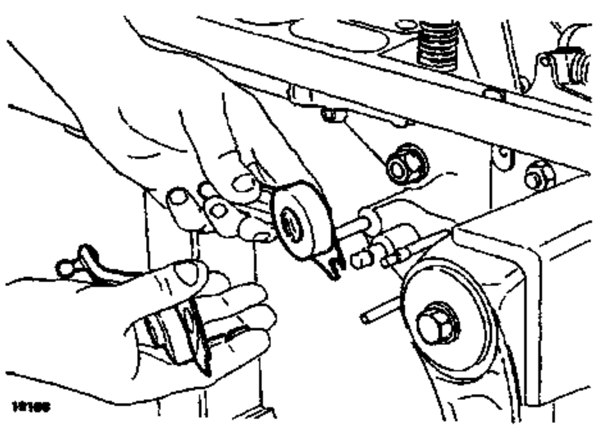


1. Remove the three nuts securing the protection cover (1) onto the hydraulic lift housing.



2. Retrieve cover and springs.



3. Remove the retaining nut and retrieve the draft and position control external levers complete with respective friction washers.
4. Refit external controls by reversing the removal sequence of previous operations.

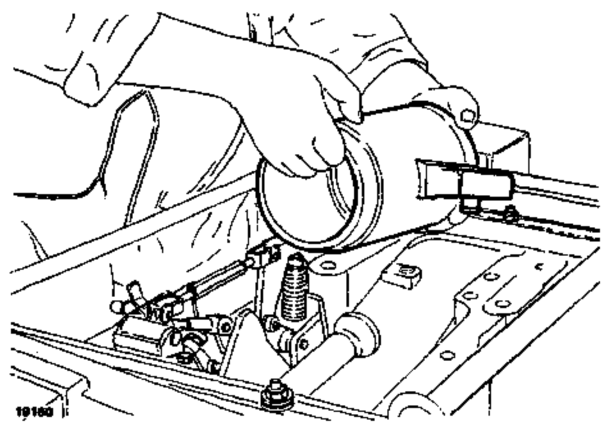
REAR-MOUNTED HYDRAULIC LIFT INSIDE CONTROLS
Disassembly-Assembly (Op. 35 110 40)

Proceed as follows:

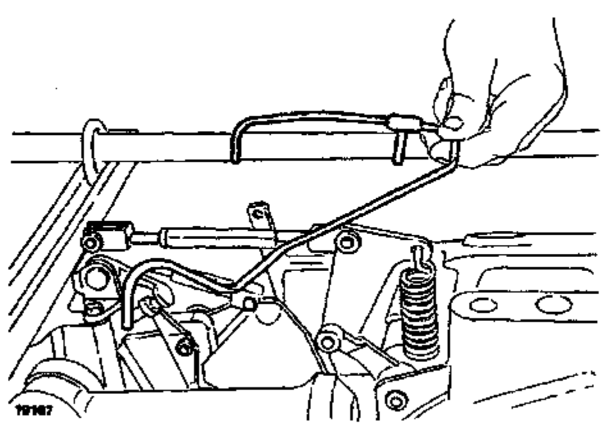
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

1. Install the hydraulic lift on a universal rotary stand paying attention to position the stand brackets so as the last lift/transmission mounting hole (control valve side) remains free to receive later on the tool no. **293980**.



2. Remove the four retaining screws and retrieve the cylinder complete with plunger.



3. Remove lube line.

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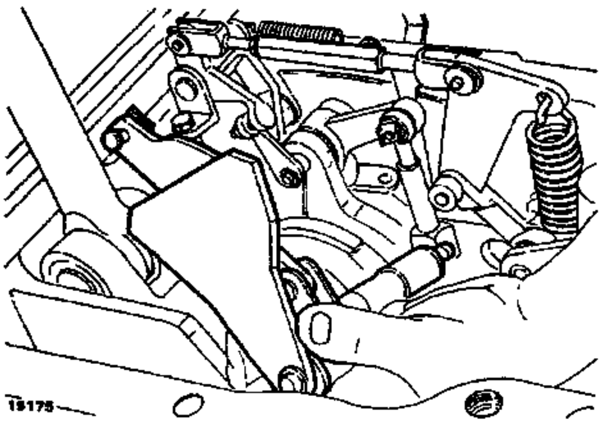
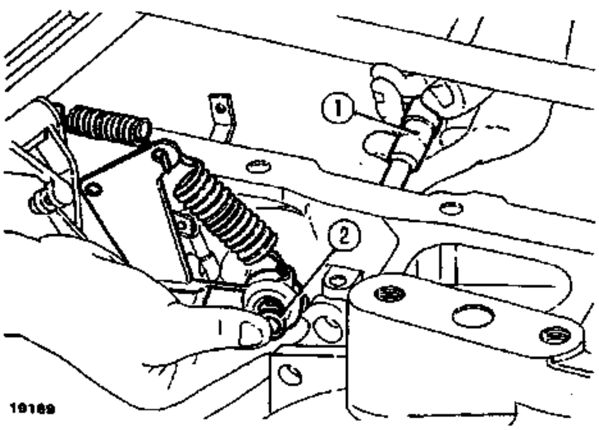
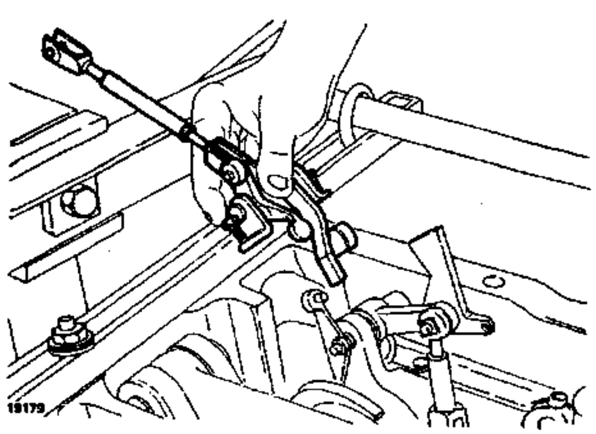

19175

4. Remove the position and draft control inside levers complete with their pins.



19189

5. Remove the control rod arm complete with lever and spring, unscrew the retaining pin (1) and retrieve thrust washer (2).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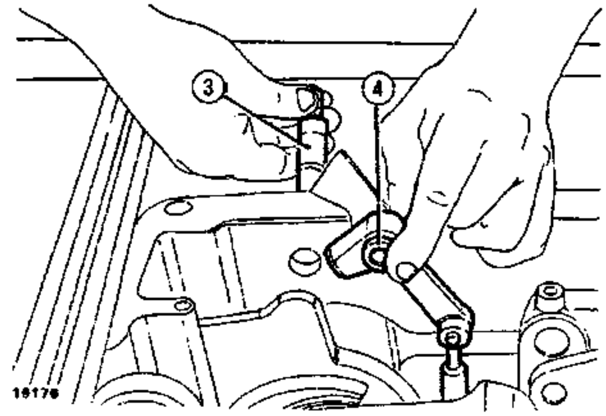
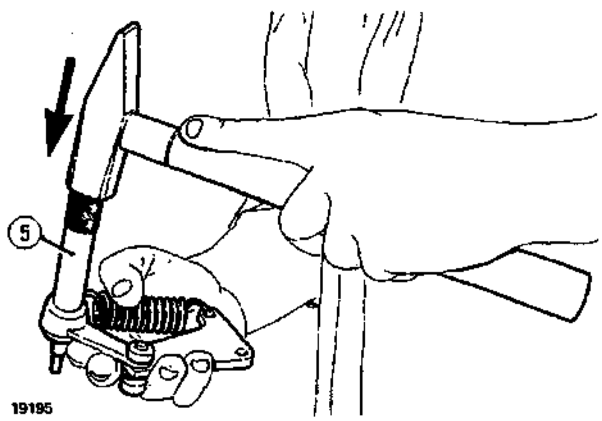
6. Remove the two retaining screws and the control valve lever complete with rod.



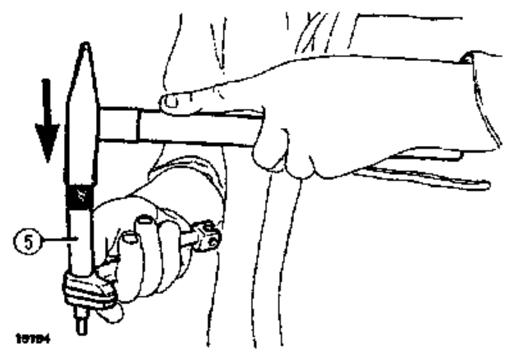
19176

7. Remove the draft control internal lever after removal of its retaining pin (3), then retrieve the thrust washer (4) and the pin retaining ring (3).



19195

8. Using the extractor–installer punch tool no. **293838** (5) replace the needle bearings located on the draft control rod arm.



19194

9. Using the extractor–installer punch tool no. **293838** (5) replace the draft control internal lever bearings.
10. Using the extractor–installer punch tool no. **293839** replace the control valve lever bearings.
11. At reassembly proceed by reversing the previous disassembly sequence of operations and complying with the following additional directions:

ATTENTION – Adjustments must be carried out in the given sequence.

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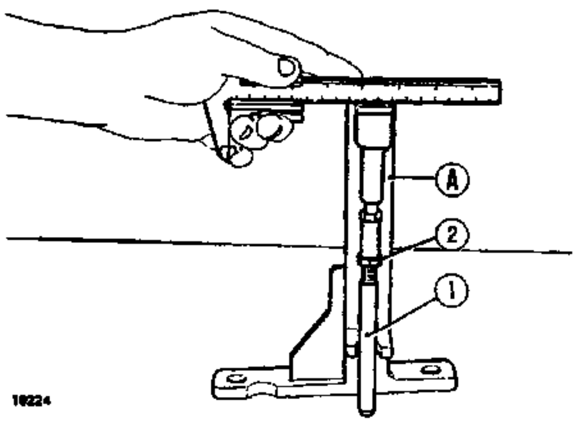
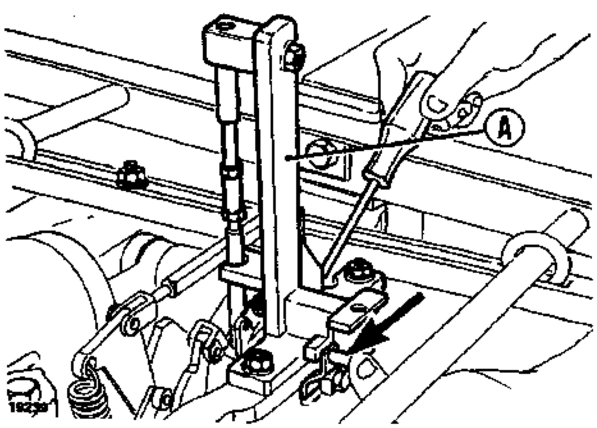
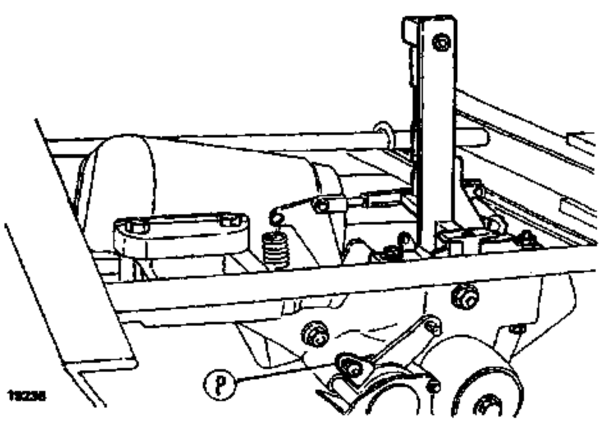
Position control adjustment
Proceed as follows:



12. Place the tool **293980** (A) on surface gauge plate and screw or unscrew the rod (1) end until its upper side is level with the tool. Tighten the locknut (2).

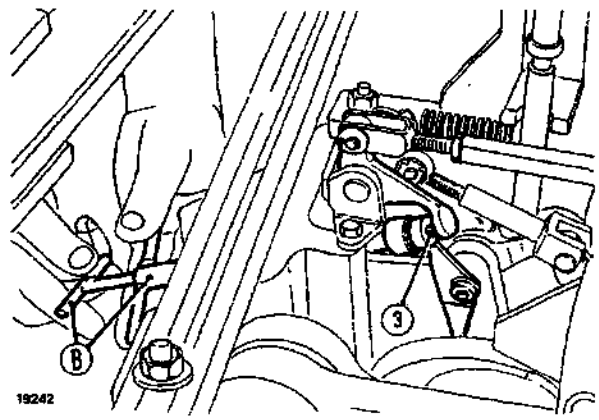


13. Connect the LIFT–O–MATIC lever to the tool **293980** (A) through the specific pin.

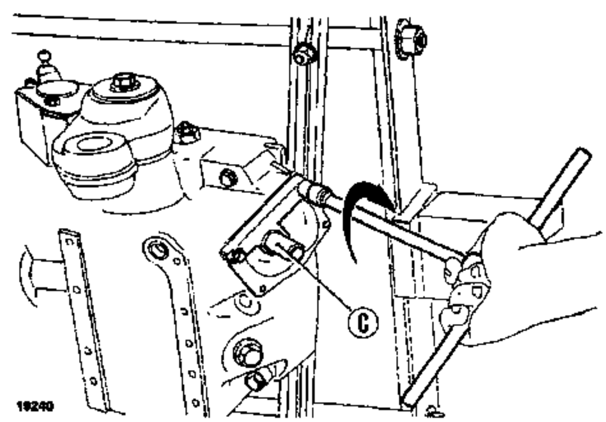


14. Bring the position control external lever (P) completely forward against the spacer 15. Check that the inside arm is flush with the hydraulic lift.

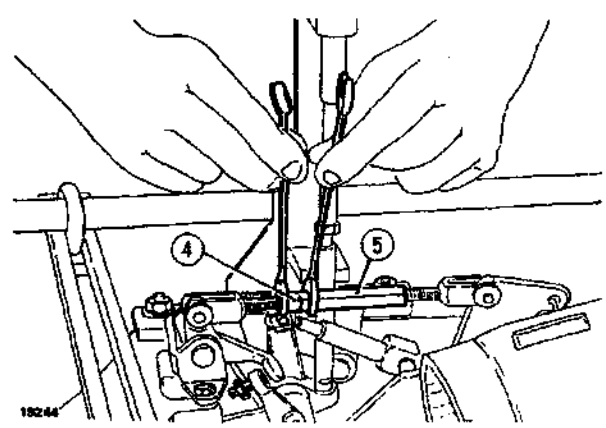
15. Verificare che il braccio interno sia a contatto del corpo sollevatore.



16. Using the wrench tool no. **293978** (B) back out the adjustment screw (3) until the latter is out of contact with the control levers.



17. Fit in place instead of the control valve the tool no. **293979** (C) and check that the tool end rests against the valve control lever.



18. Using two wrenches unscrew the jam nut (4), then act on the adjustable rod (5), turning it clockwise or counterclockwise.

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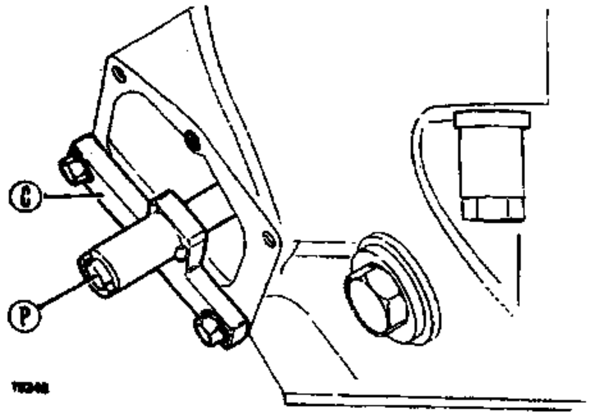
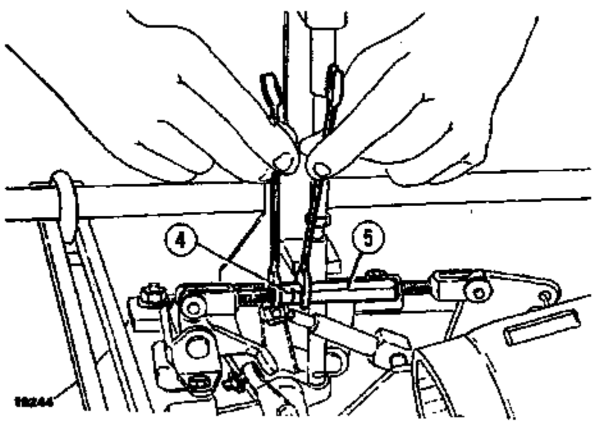
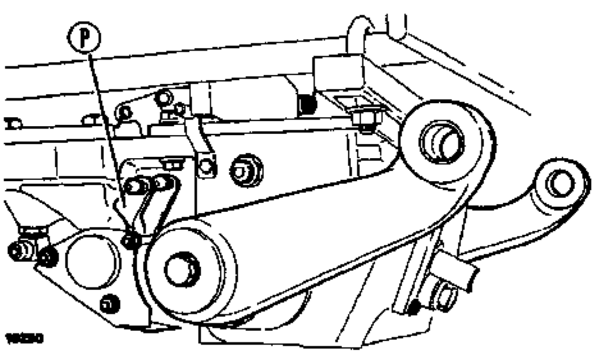


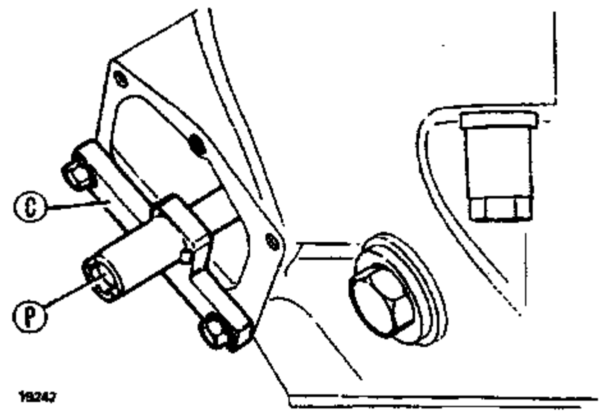
19. Check that the tool rod tip (P) is aligned with the outer reference plane of the tool (C) as shown in the figure. If not, correct through the adjustable rod (5, page 15–23).



20. Tighten the locknut (4) of the adjustable rod (5).

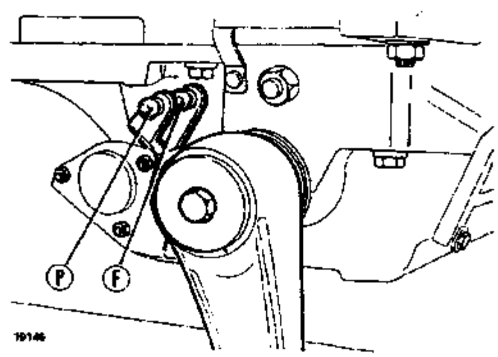


21. Bring the position control external lever (P) all the way back and flush against the spacer, then turn the arms shaft to position the cylinder piston all forward on its stroke.

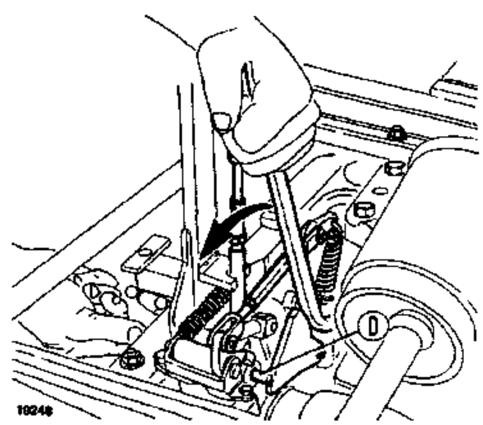


22. Check that rod (P) is either level or further recessed with respect to the inside plane of the tool (C).

Draft control adjustment
Proceed as follows:



23. Bring the position control external levers (P) and of draft control (F) all back against the spacer.



24. Remove the retaining excentric pin (3, page 35–22) from the draft control internal lever and replace it with the pin tool no. **293981** (D).

Note – To facilitate the removal of the retaining pin and subsequent refitting of the pin (D) it is advisable to unload the control valve compression spring with the aid of a lever or bar as shown in the figure.

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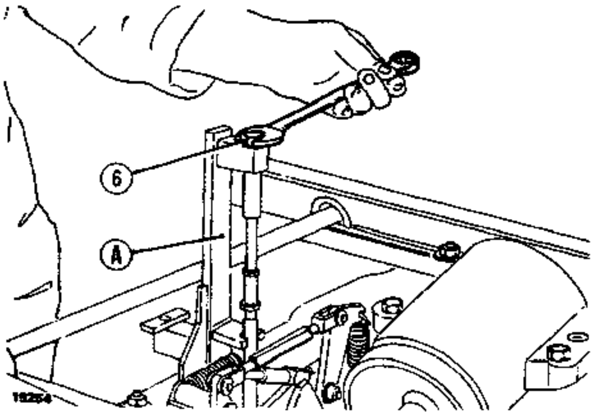
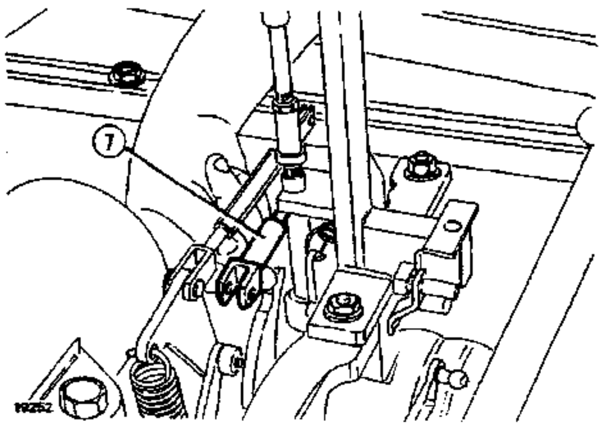
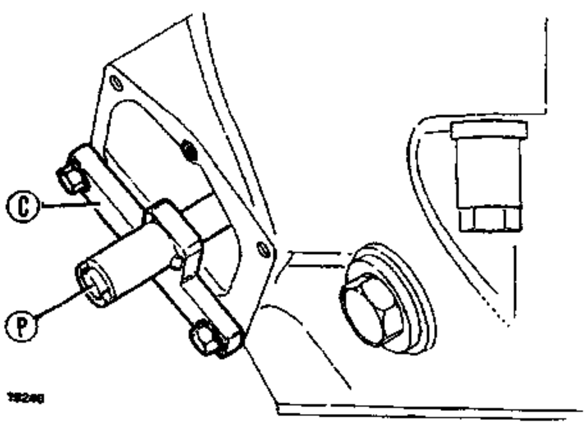


25. Turn the screw (6) of the tool **293980** (A) clockwise.



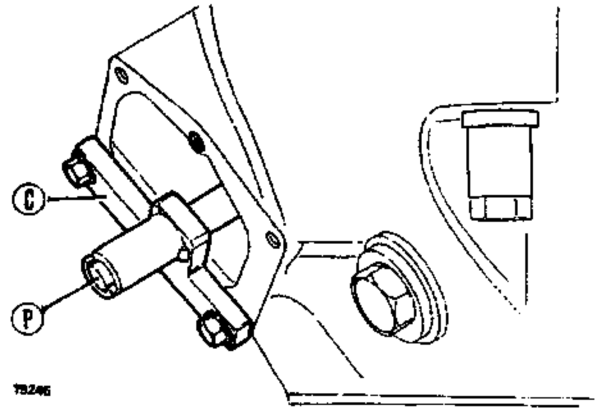
26. Turn adjustable clevis (7) clockwise or counterclockwise after removing the retainer spring and withdrawing the attachment pin to the draft control inside lever.



27. Check approximate complanarity of tool rod (P) end with outer reference plane of tool **293979** (C) as shown in the figure.

Note – One turn of the adjustable rod corresponds to a movement of about 3 mm (.12 in) of the tool rod (P).

28. Remove the tool **293981** (D, page 35–24) and fit in its place the excentric pin (3, page 35–22); torque tighten the lock ring securing the latter to the hydraulic lift housing.

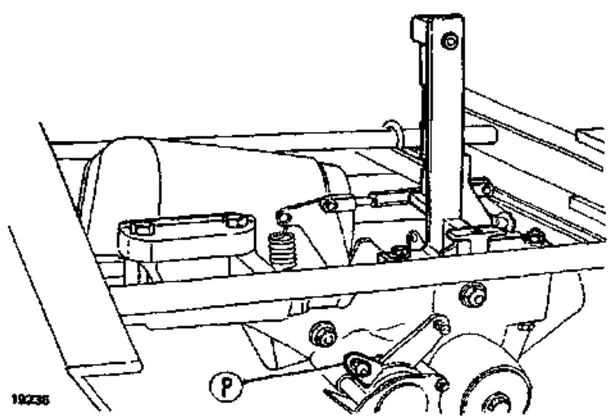


29. Turn the excentric pin until the tool rod tip (P) is perfectly aligned with the outer reference plane of tool **293979** (C).

30. Tighten the excentric pin jam nut.

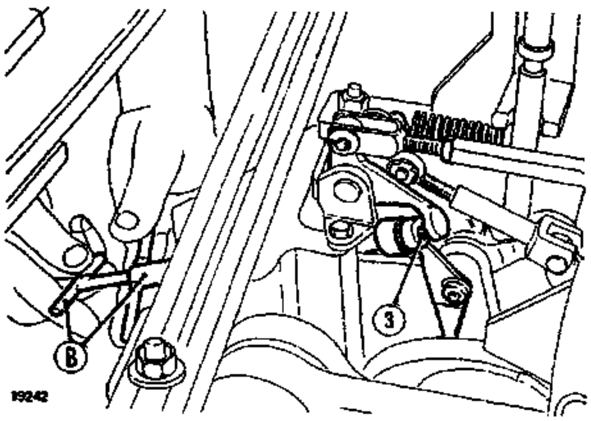
Lift arms max. height adjustment.

Proceed as follows:

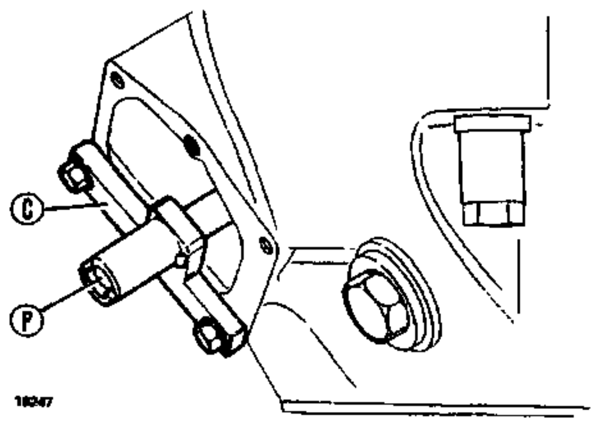


31. Bring the plunger outside control lever (P) completely forward against the spacer.

32. Check if the inside arm is in contact with the hydraulic lift housing.



33. Turn on the adjustment screw (3) using the wrench tool no. **293978** (B).



34. Make sure that the tool rod tip (P) is exactly aligned with the inner reference plane of the tool **293979** (C) as shown in the figure.

35. When re–installing the rear hydraulic lift unit on the tractor pay attention to the following:

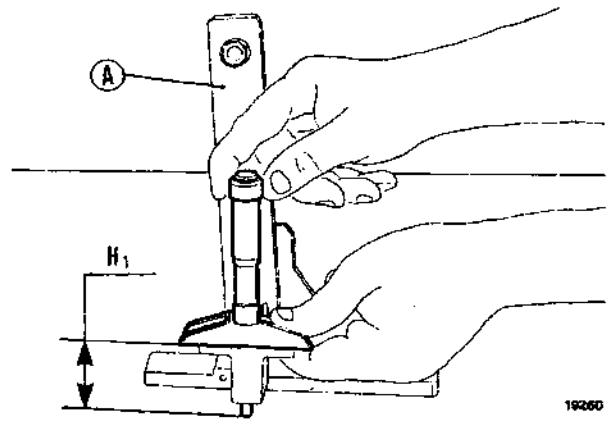
a. proceed by reversing the previous removal sequence of operations starting from no.24 (page 35–14) back to no.1 (page 35–12);

b. tighten fastenings to torque specification data of page 35–8;

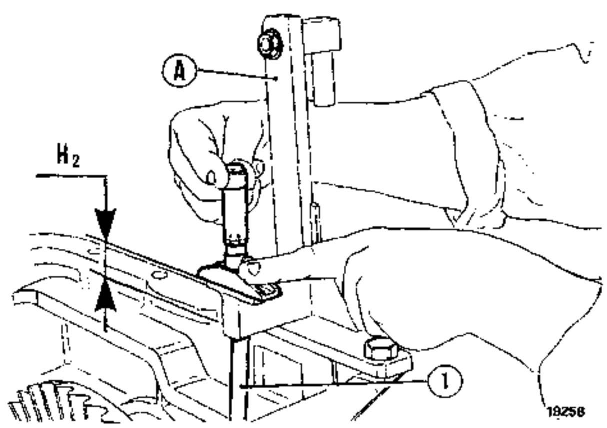
c. adjust the draft control rod as per following instructions.
Following its adjustment, the draft control rod protrudes of about 31.5 ± 0.1 mm (1.24 ± .004 in) over the transmission housing.

Adjustment of the draft control rod installed position.

Proceed as follows:



36. Place the tool **293980** (A) on a surface gauge plate and measure dimension (H1) with a depth gauge.



37. Install the tool **293980** (A) securing it to two holes of the transmission housing so that the draft control rod (1) is exactly aligned and fits in the tool.

38. Measure with a depth micrometer gauge the dimension (H_2) equivalent to the distance between the rod top and the surface on which the micrometer rests on the tool.

39. Dimension (H_2) is found by:

$$H_2 = H_1 - 31.5 \text{ mm } (1.24 \text{ in})$$

where:
H_1 = dimension measured with tool **293980** placed on the surface gauge plate.
31.5 mm (1.24 in) = working protrusion of the draft control rod over the transmission housing top surface.

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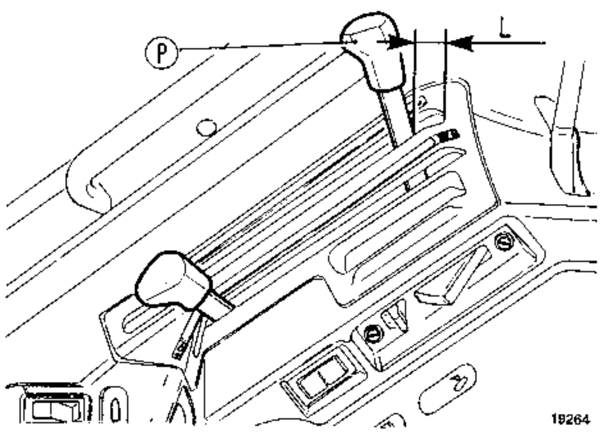
40. If the reading differs, adjust through the draft control rod until correct by screwing up to increase dimension (H_2, page 35–20) or unscrewing to reduce it.

LINKAGE ADJUSTMENT (Op. 35 110 08)

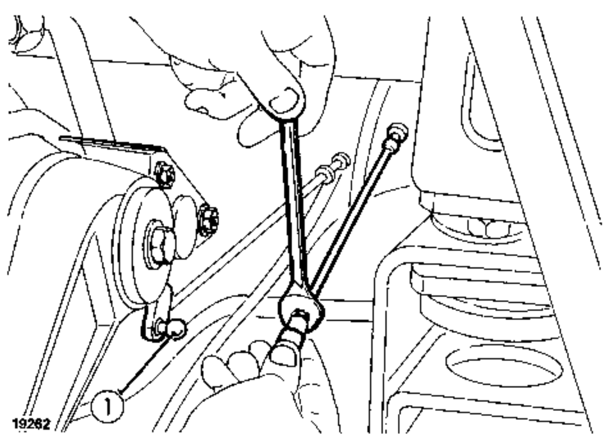
Position control link adjustment.

Proceed as follows:



19264

1. Bring the position control lever (P) fully back on the quadrant and check that dimension (L) equals approximately 11 mm (.43in).



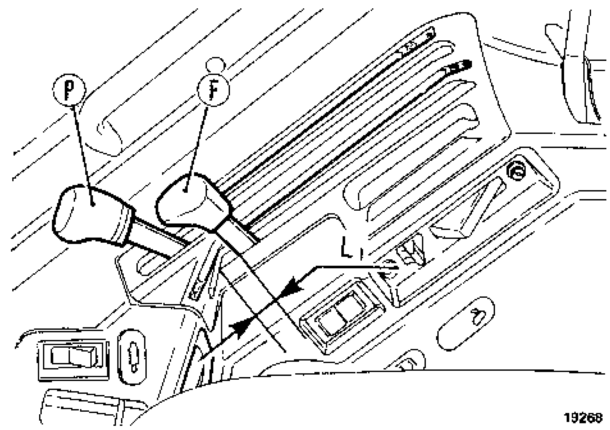
19262

2. Bring the position control outside lever (1) fully forward against the spacer.

3. Connect the control link and, if necessary, adjust its length.

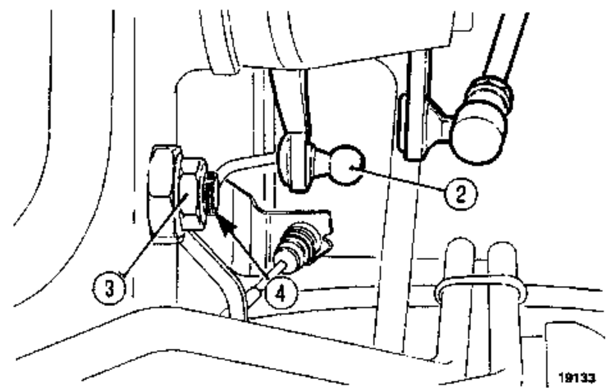
4. Lock the link through its jam nuts.

Draft control link adjustment.
Test conditions:
– linkage lower arms without added weights;
– engine running at medium speed.
Proceed then as follows:



19268

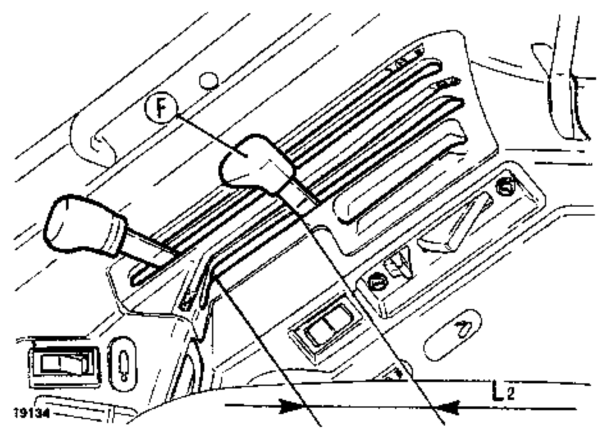
5. Bring the position control lever (P) fully forward in the quadrant and the draft control lever (F) at a distance (L1) = 27 to 30 mm (1.06 to 1.18 in) from where the slot begins.



19133

6. Bring the draft control external lever (2) fully back against the spacer.

7. Connect the control link and, if necessary, adjust its length.



19134

8. Bring the draft control lever (F) at a distance (L_2) = 180 to 185 mm (7.08 to 7.28 in) from where the slot begins in the quadrant and check if in that position the linkage lower arms start moving upwards.

9. If not, adjust through the excentric pin (4, central figure) to re–establish the correct dimension.

10. Lock the excentric pin through its jam nut (3).

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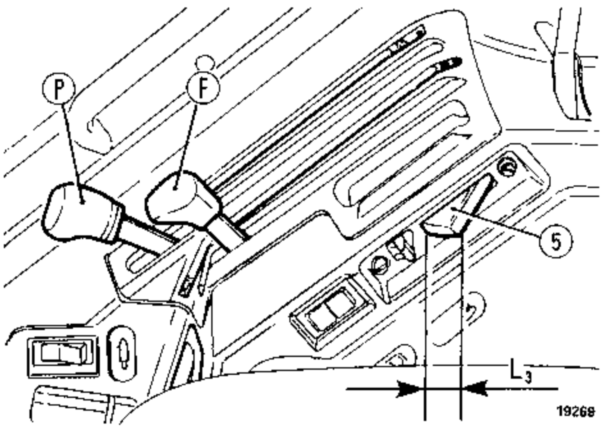
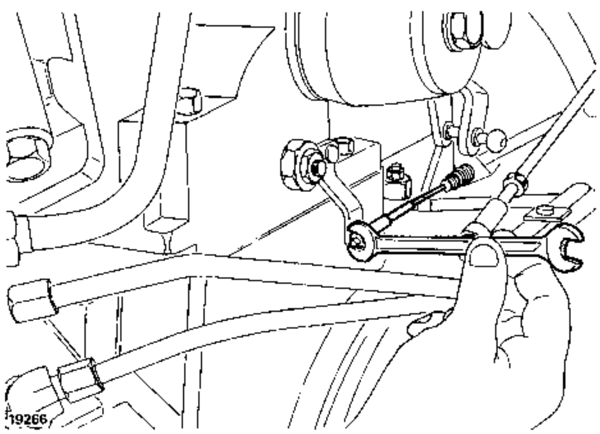
LIFT–O–MATIC adjustment

Proceed as follows:



11. Bring the position (P) and draft (F) control levers completely forward in the quadrant.
12. Press the push–button (5) and see that discharge begins (arms lowering) with a residual travel (L3) of push–button (5) = 9 to 12 mm (.35 to .47 in)(up to chassis no. 362950 model F 100, no. 290207 model F 110, no. 431291 model F 120 and no. 426041 model F 130) or 15 to 16 mm (.590 to .620 in)(from chassis serial no. 362951 model F 100, no. 290208 model F 110, no. 431292 model F 120 and no. 426042 model F 130).



13. Should the residual travel (L3) of push–button (5) be less than 9 to 12 mm (.35 to .47 in) adjust the flex cable through its nut as shown in the figure.

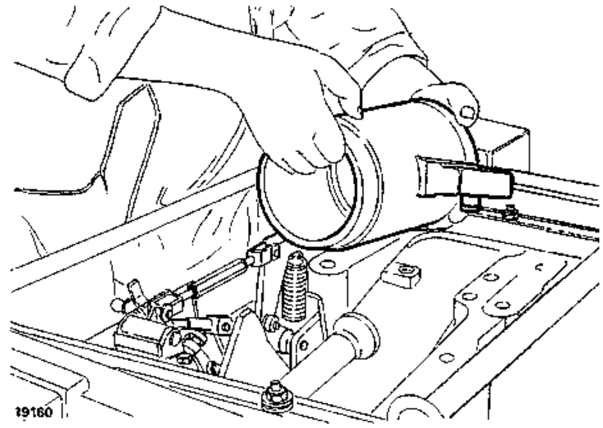
DISASSEMBLY–ASSEMBLY OF ROCKSHAFT AND LIFT CYLINDER (Op. 35 110 42).

Proceed as follows:

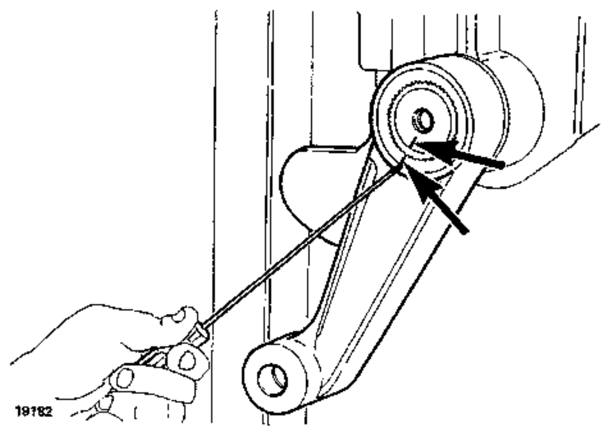
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

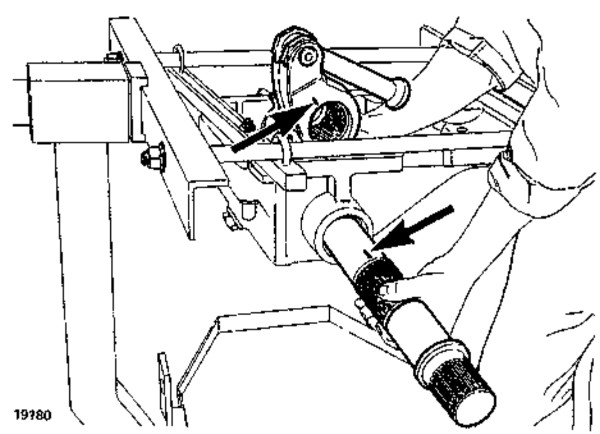
1. Install the hydraulic lift on a shop rotary stand.



2. Remove the four capscrews and the cylinder complete with plunger.

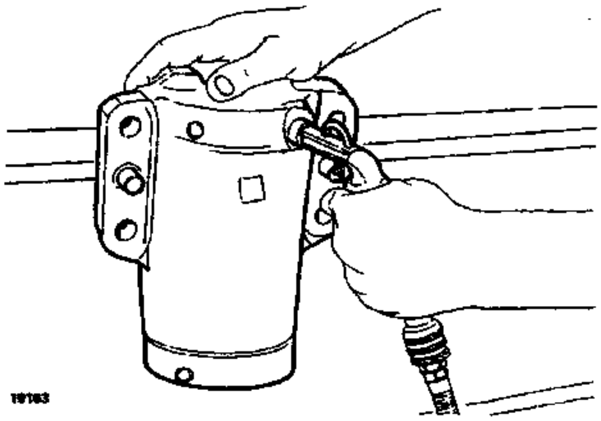


3. Remove the lift arms after having checked, prior to removal, that reference marks are present both on lift arms and rockshaft; if not, trace the two marks.

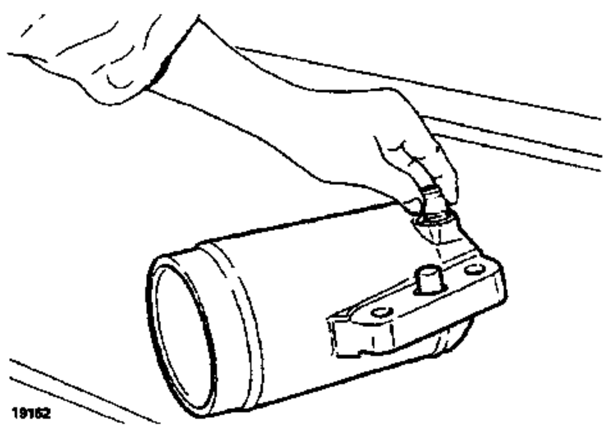


4. Remove the rockshaft and retrieve the ram arm from inside the housing after having checked, prior to removal, that reference marks are present both on rockshaft and ram arm; if not, trace the two marks as shown.

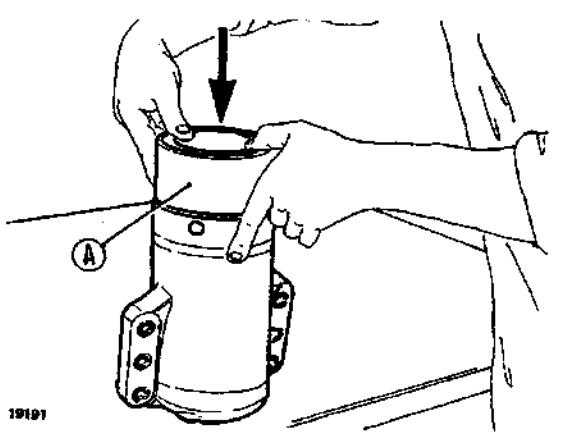
5. Check the state of wear of the rockshaft seals and replace them if unreliable.


19183

6. Retrieve plunger from cylinder by blowing compressed air inside through the oil delivery hole.


19182

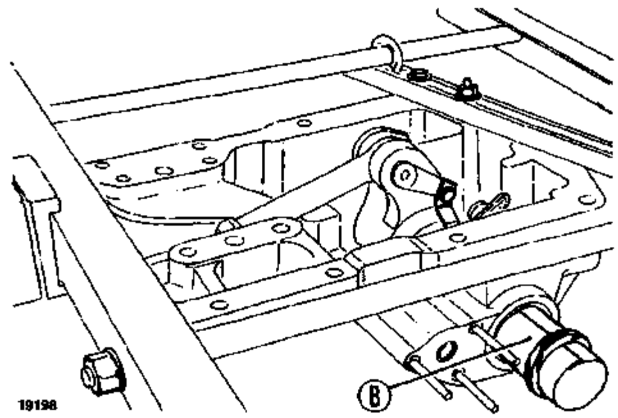
7. Remove the plunger inlet connection and check the state of wear of the O–ring seals.



19191

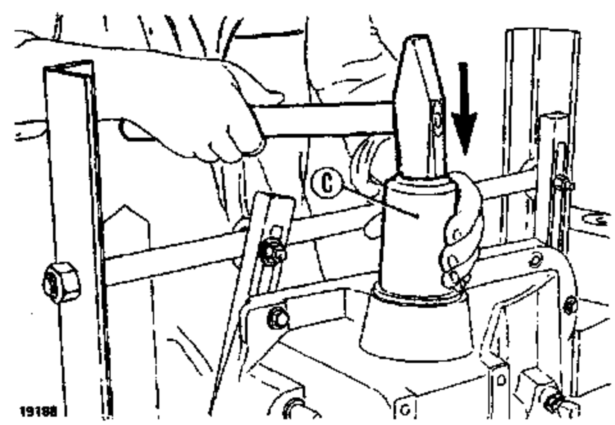
8. Introduce the plunger into the cylinder barrel using the pilot ring tool no. 293813 (A) to avoid damaging the oil seal.

9. Re–install the rockshaft making sure that the alignment marks on the rockshaft and arm correspond to each other.



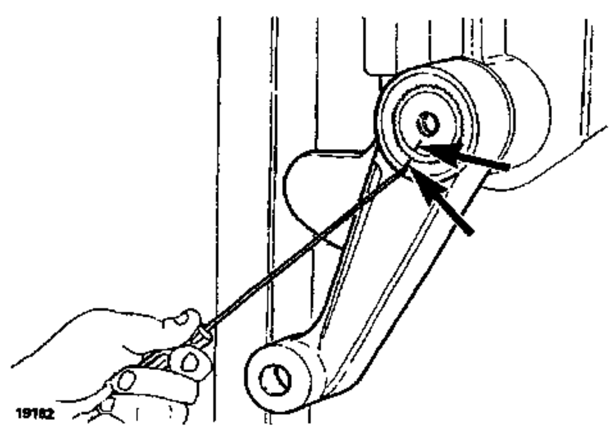
19198

10. To prevent damage to the seallips , fit the protection tool no. 293199 (B) on the rockshaft.



19188

11. Using the installer pilot punch tool no. **293985** (C) fit the seals onto the rockshaft.


19182

12. Re–install the lift arms onto the rockshaft with reference marks aligned.

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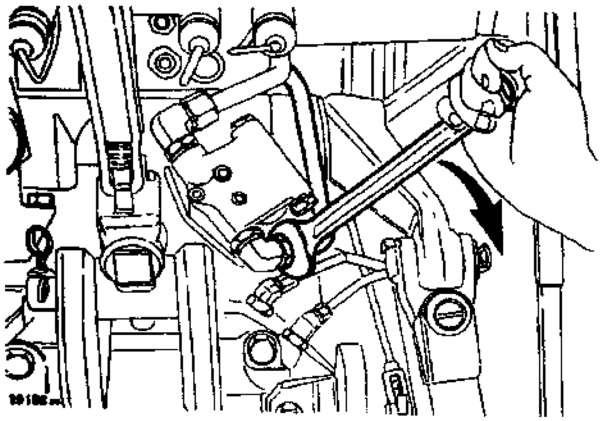
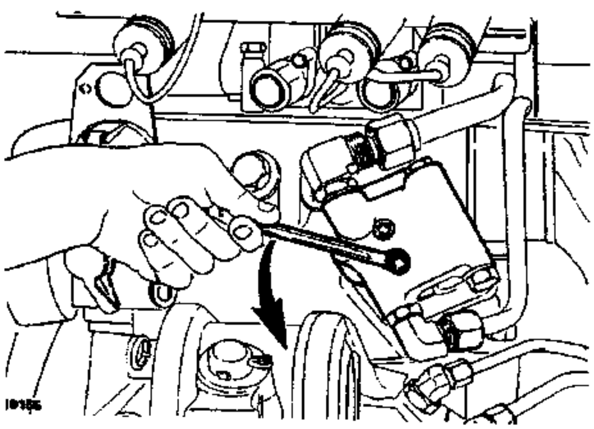
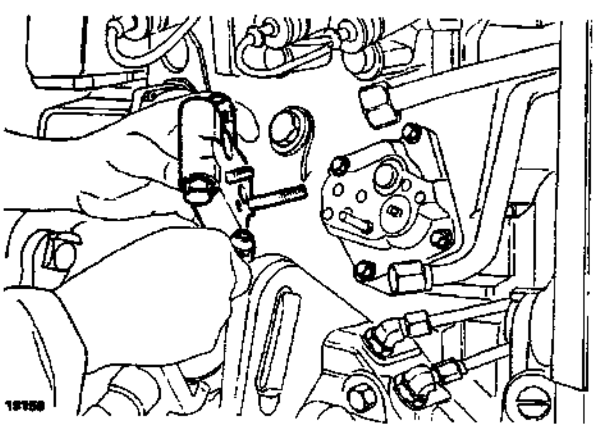
HYDRAULIC LIFT CONTROL VALVE
Removal–Installation (Op. 35 114 10)
Proceed as follows:


19188

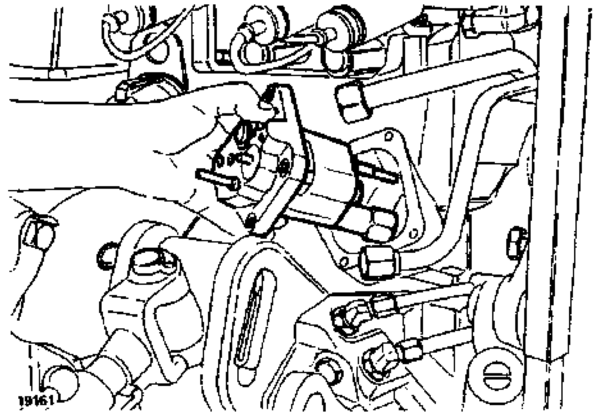
1. Disconnect both delivery and return oil lines.


19155

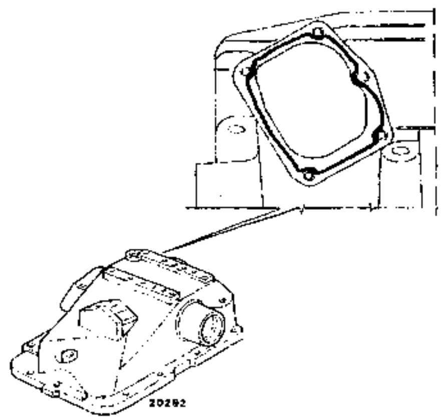
2. Remove the arm lowering speed adjustment screw jam nut.


19159

3. Remove the socket–head screws and the control valve cover.

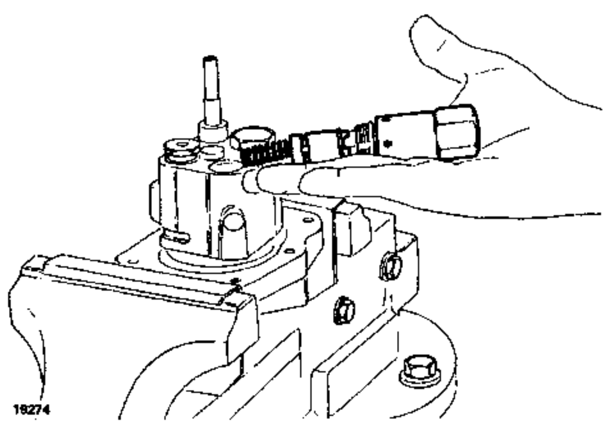

19161

4. Remove the four retaining capscrews and finally the control valve.
5. At installation, just reverse the previous removal sequence of operations and in addition comply to the following notice:


20292

6. Clean first mating surfaces very accurately and then apply on the lift housing surface a bead of a suitable sealing compound about 2 mm (.08 in) thick following the scheme shown in the figure.

HYDRAULIC LIFT CONTROL VALVE
Disassembly – Assembly (Op. 35 114 14)
Proceed as follows:


19274

1. Remove the cylinder safety valve.

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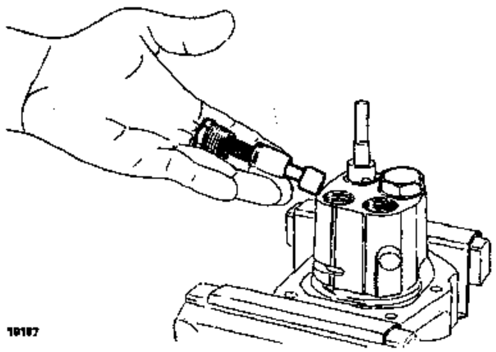
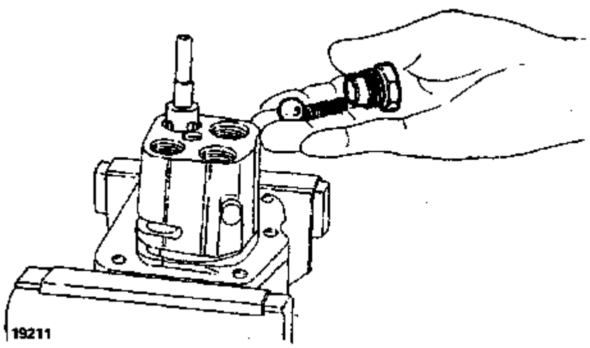
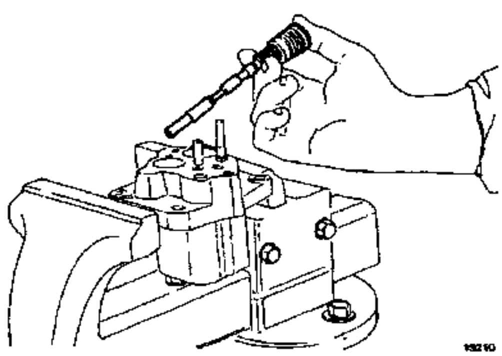


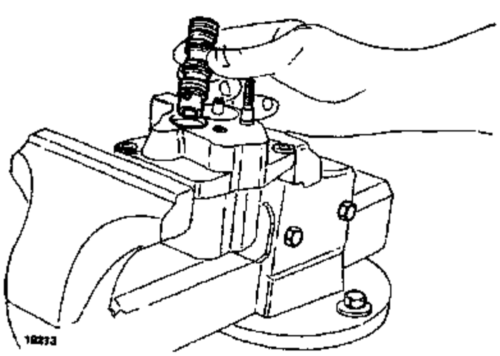
2. Remove the pilot valve spool.



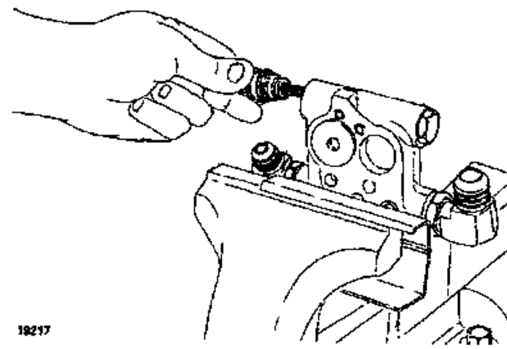
3. Remove the check valves.



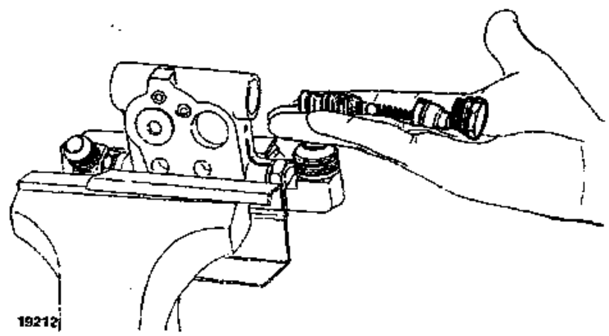
4. Remove the control valve spool.



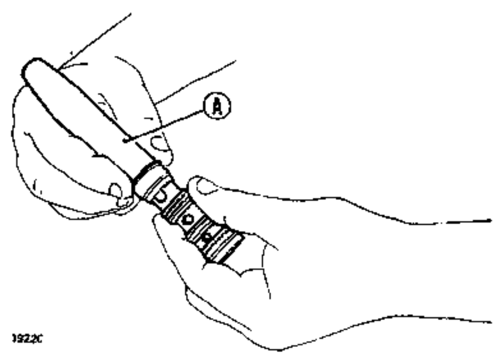
5. Remove the spool seat.



6. Remove the plug and spool spring from the response valve.

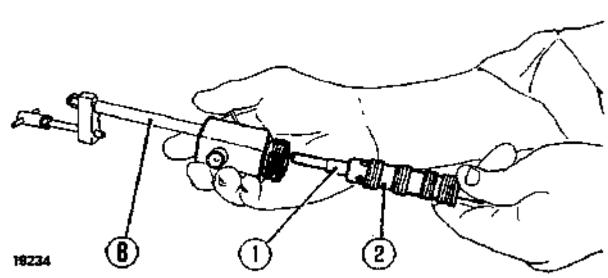


7. Remove plunger, spring , ball and spool from the response valve.

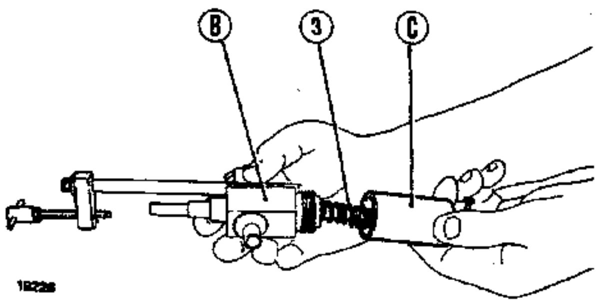


8. Check the state of wear of the control valve spool seat oil seals and replace them if damaged using the protection tool no. **293984** (A).

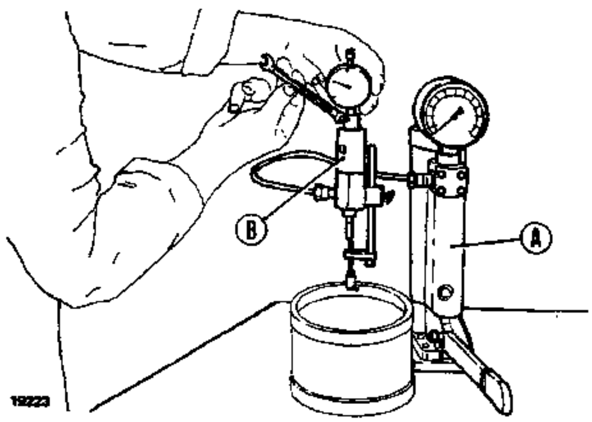
9. Check fitness of the valve spool as follows:



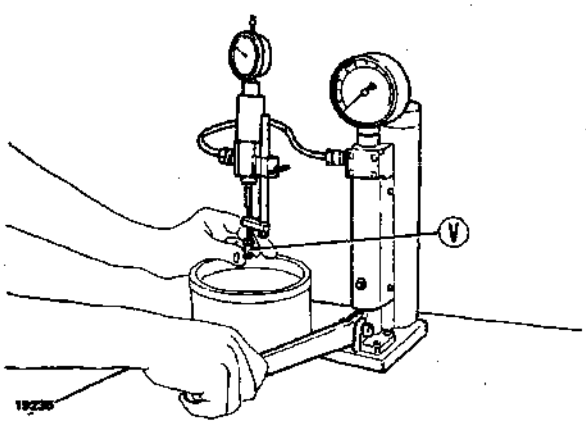
10. Install the spool (1) complete with seat (2) on the tool **293982** (B).



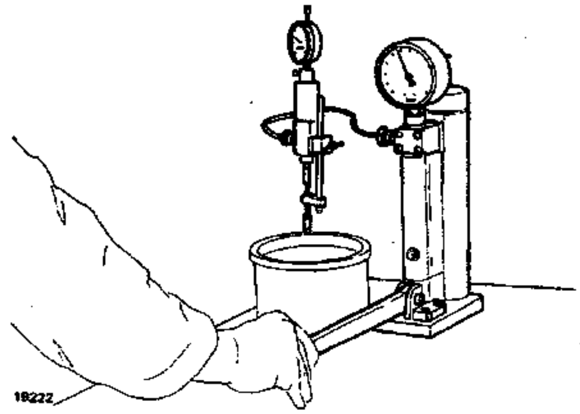
11. Fit the control valve spool spring (3) and the plug (C) of the adapter tool no. **293892** (B) screwing it on to stop and making sure that the valve spool is a free sliding fit in its seat.



12. Install the adapter tool no. 293982 (B) on the hand pump tool no. **290284** (A) supplied with **Oliofiat IDRAULICAR AP 51**, then connect to the tool a comparator dial gauge secured through its specific screw.



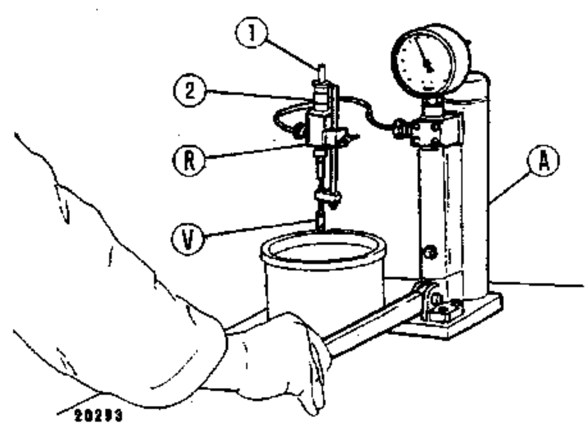
13. Actuate the hand pump and simultaneously turn the tool screw (V) clockwise until the flow of oil coming out of the valve spool seat stops.
14. Set comparator dial at zero.
15. Further turn the tool screw (V) movingthe control valve spool on about 1.8 to 2 mm (.07 to .08 in) as per dial gauge reading.



16. Operate pump to bring circuit to an initial pressure of 245 bar (250 kg/sq.cm = 3626 psi, then check through the gauge that it takes more than six seconds for the oil pressure to drop from 196 bar(200 kg/sq.cm = 2901 psi) to 98 bar (100 kg/cm^2 =1451 psi). If not, replace valve spool which is supplied as a spare part together with its seat.

ATTENTION – If already in possess of tool **293849** the same can be used in alternative to the tool **293982** to check the control valve spool. To serve this purpose, however, the tool **293849** must be modified as shown in the figure on page 35–9.
The modified tool becomes **293849/1**.

Using the modified tool **293849/1**, proceed as follows:



17. Fit the valve spool (1) complete with its seat (2) onto the tool **293849** (R) checking in meanwhile that the two seals in the lower end of seat assure tightness on the connection with hand pump **290284** (A) supplied with **Oliofiat IDRAULICAR AP 51**.

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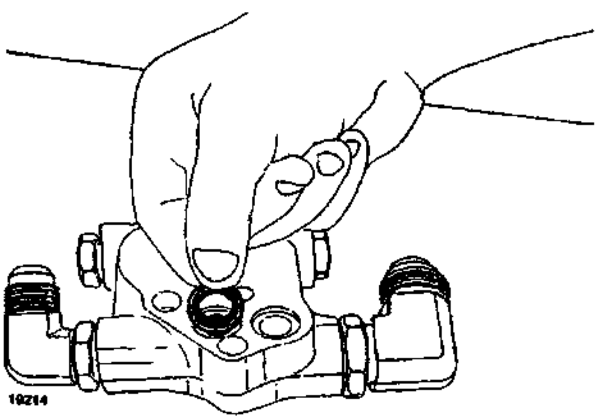
18. Push from top end the valve spool (1, page 35–32) flush against its seat (2).

19. While operating the hand pump turn the connection screw (V, page 35–32) until the outcoming flow of oil through the seat outlet (2) stops.

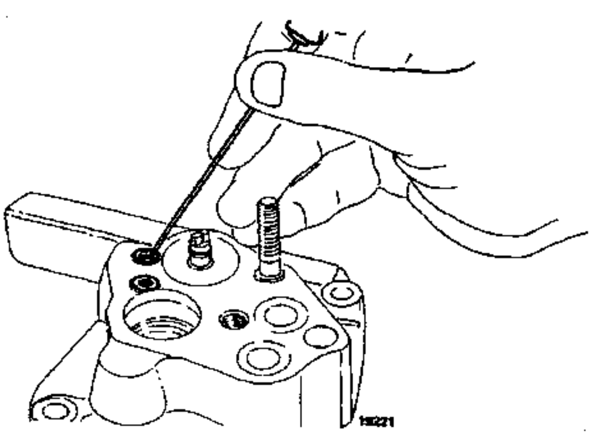
20. Give the screw (V, page 35–32) two more turns.

21. Operate pump to bring circuit to an initial pressure of 245 bar (250 kg/sq.cm = 3626 psi) then check through the gauge that it takes more than six seconds for the oil pressure to drop from 196 bar (200kg/cm2 = 2901 psi) to 98 bar (100 kg/cm^2 ≈ 1451 psi). If not, replace the valve spool which is supplied as a spare part together with its seat.



19214

22. Check and replace if necessary the control valve cover gasket.

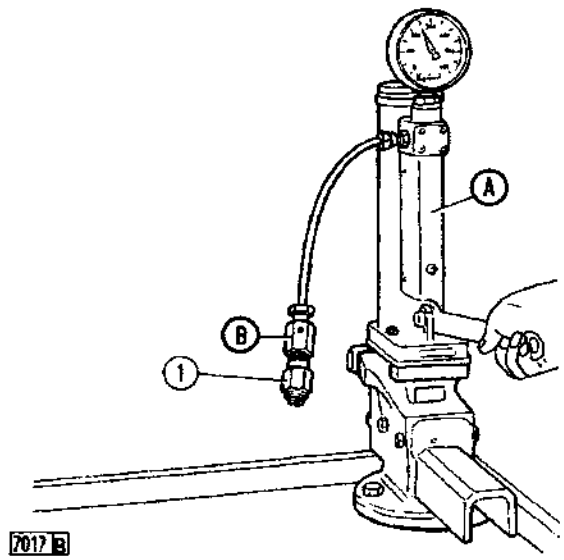


19221

23. Check and replace if necessary the control valve gaskets shown in the figure.

24. Check and replace if necessary the response valve plunger seal using protection tool no. **293865**.

25. Check the cylinder safety valve setting as follows:



7017 B

26. Fit the cylinder safety valve (1) onto the valve–holder connection tool no. **290828** (B) and connect the latter to the hand pump tool no. **290284** (A).

27. Operate the hand pump (A) and check that the cylinder safety valve opens at a pressure of 210 to 215 bar (214 to 219 kg/cm2 or 3104 to 3176 psi). Should the valve setting not correspond to these specifications, it will be advisable to replace it. However, if necessary, adjustment is possible through the threaded plug and the wrench tool no. **291862**, by screwing up to increase the pressure setting or unscrewing to reduce it.

28. When re–assembling the control valve pay attention to the following:

a. proceed by reversing the previous disassembly sequence of operations starting from no. 27 back to no. 1;

b. see illustrations on page 35–4 for the correct placement and orientation of parts and components;

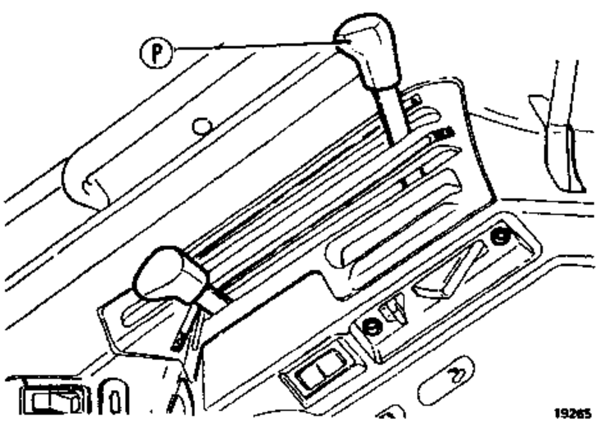
c. tighten fastenings to the torque specification data of page 35– 8.

MAXIMUM LIFT ARM TRAVEL ADJUSTMENT WITH HYDRAULIC LIFT INSTALLED ON TRACTOR.

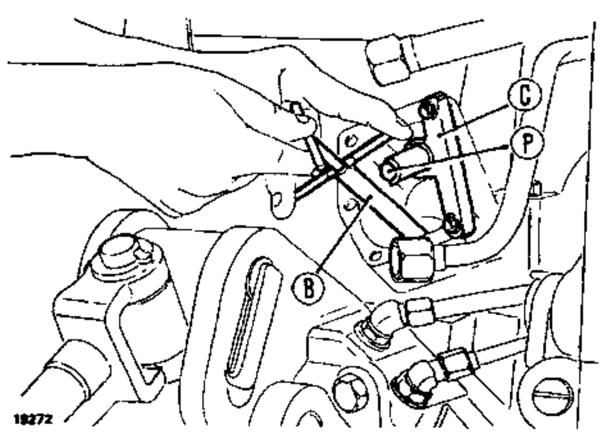
It can be carried out in both ways, directly on the tractor with hydraulic lift installed or on the workbench or stand.

If the adjustment is to carried out on the workbench see directions given on pages 35–19 and 35–20.
With the hydraulic lift installed on tractor, proceed instead as follows:

1. Remove the control valve unit from the hydraulic lift as per directions given on page 35–24 and replace it provisionally by the tool no. **293879**.



2. Bring the position control lever (P) completely back, at 3.
3. Manually lift arms in upper position.

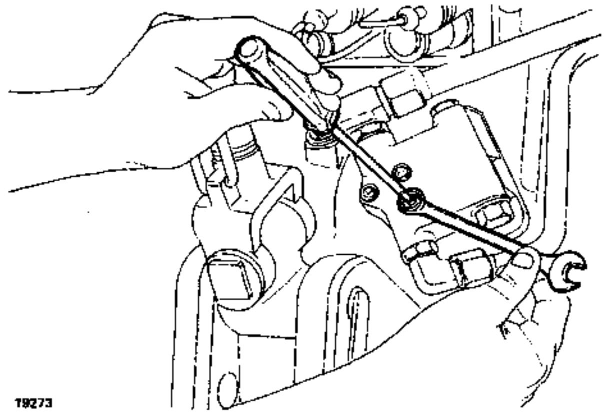


4. Check that rod (P) is perfectly aligned with the inner reference reference plane of gauge tool no. **293979** (C). If not, adjust to the screw using the wrench tool no. **293978** (B).

ARM LOWERING SPEED ADJUSTMENT

Proceed as follows:

1. Mount ballasts on ball ends for an approximate weight of 900 to 1000 kg (2286 to 2540 lb).
2. Bring the oil to a 50 to 60 °C (251 to 284 °F) temperature.
3. Remove the protection cap located on the hydraulic lift housing.

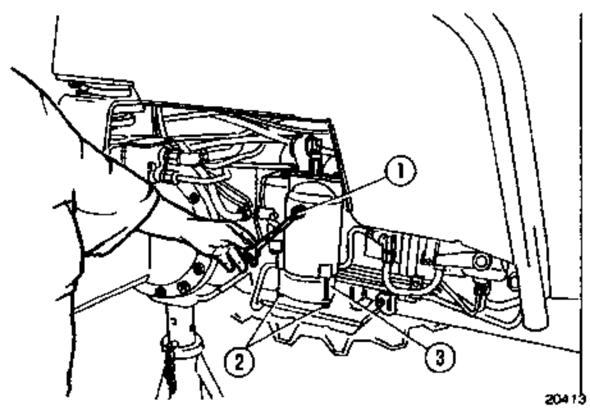


4. Slacken the jam nut and, using a screwdriver, turn the adjustment pin either clockwise (to increase arm lowering speed) or counterclockwise (to reduce it).
5. Once obtained the desired arm lowering speed, tighten the jam nut and install the protective cap.

OIL FILTER

Replacement (op. 35 100 06)

Proceed as follows:



1. Loosen screw (1) to let oil flow from filter back to trasmission case.
2. Remove screws (2) and cover (3).
3. Remove paper element from filter.
4. Install a new element, refit cover (3) and tighten screws (2 and 1).

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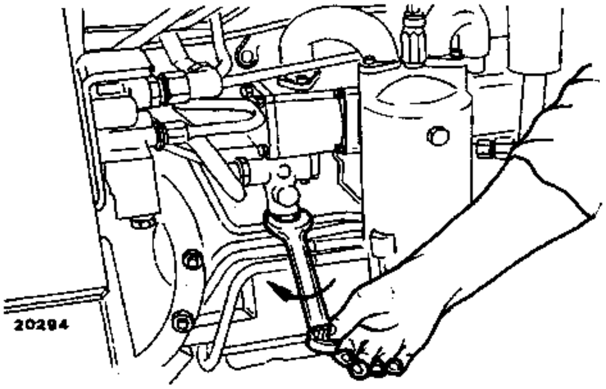
HYDRAULIC LIFT SAFETY VALVE
Removal–Installation (Op. 35 114 30)

The safety valve is located between oil delivery and hydraulic pump.

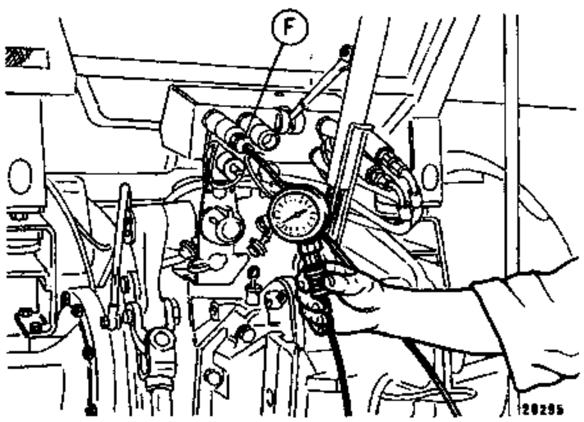


In case of anomaly disassemble the valve.

HYDRAULIC LIFT SAFETY VALVE
Pressure setting (Op. 35 114 32)

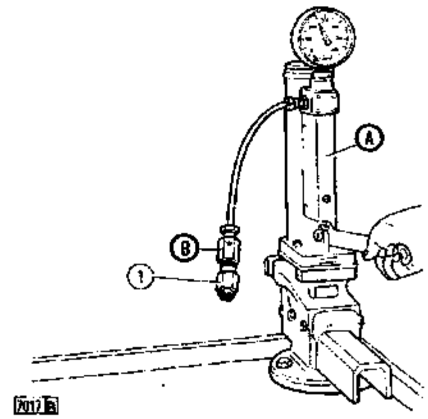
Proceed as follows:

1. Warm up the engine to about 50 °C (250 °F) oil temperature.



2. Fit the connection tool no. **293449** (F) to a quick–connect female coupling and to the 0 to 250 kg/cm^2 pressure gauge of the kit **292870**.
3. Operate the control valve lever of the chosen coupling until the safety valve starts blowing.
4. With engine running at medium rpm the correct pressure gauge reading is about 186 to 191 bar (190 to 195 kg/cm^2 or 2697 to 2769 psi). Should the valve setting not correspond to these specifications it will be advisable to replace it.
   However, if necessary, adjustment is possible through the threaded plug and wrench tool no. **291863**, screwing up to increase the valve pressure setting or unscrewing to reduce it.

Note – The pressure setting of the pressure valve can be verified on the test bench also; in this case, proceed as follows:



5. Fit the cylider safety valve (1) onto the valve–holder connection tool no. **290824** (B) and connect the latter to hand pump tool no. **290284** (A).
6. Operate the hand pump (A) and check that the cylinder safety valve opens at a pressure of about 186 to 191 bar (190 to 195 kg/cm^2 or 2697 to 2769 psi).

Attention – At the Factory the pressure setting of the safety valve is carried out with oil circuit under capacity-conditions and therefore the values obtained in the present hand pump test are to be considered indicative only. It is therefore suggested thet the safety valve pressure setting be carried out with the valve installed on the tractor as previously illustrated.

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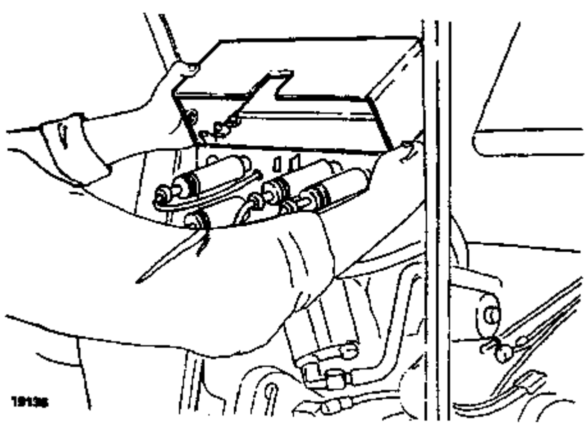
AUXILIARY RAMS – ASSEMBLY
Removal–Installation (Op. 35 204 40)

Proceed as follows:

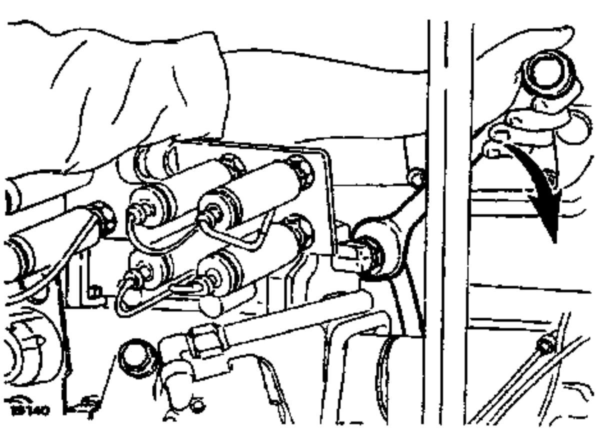
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

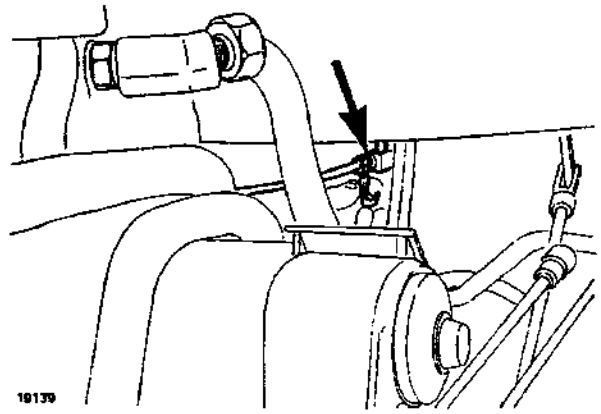
1. Disconnect battery cables.



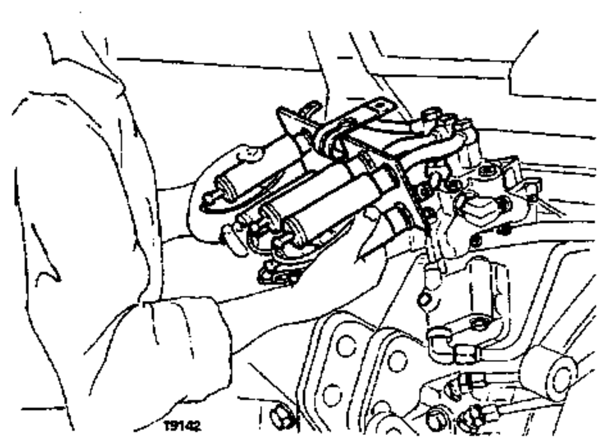
2. Remove the auxiliary ram protective cover plate.



3. Disconnect both delivery and return oil hoses.



4. Disconnect, from under the platform, the ram control rods from their respective levers.



5. Remove the capscrews securing auxiliary rams to hydraulic lift an then the complete pack complete with control rods.
6. Install the auxiliary rams by reversing the previous disassembly sequence of operations.

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HYDRAULIC LIFT CIRCUIT OIL PUMP
Disassembly–Assembly (Op. 35 104 10)

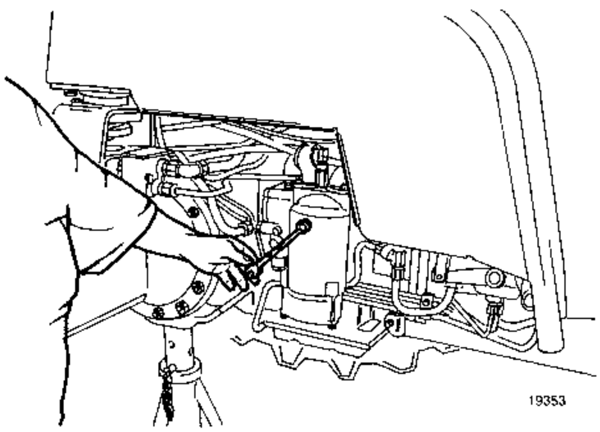
Proceed as follows:

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

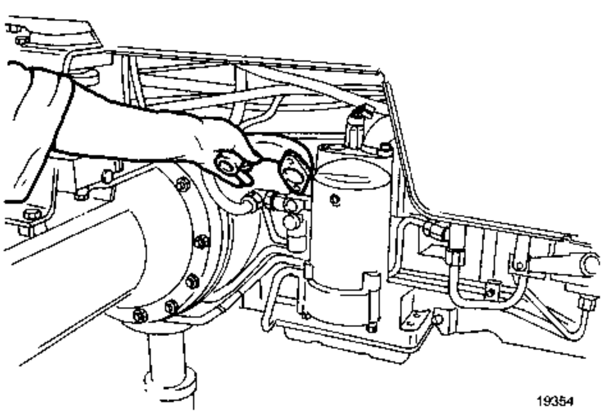
1. Disconnect battery cables.
2. Place a stand under the RH side final drive and remove the tractor wheel.

Note – The lift hydraulic pump can be removed also without removing the tractor rear RH side wheel. This, howerer, makes removal operations more difficult whereas all is considerably easier if the wheel is removed first.



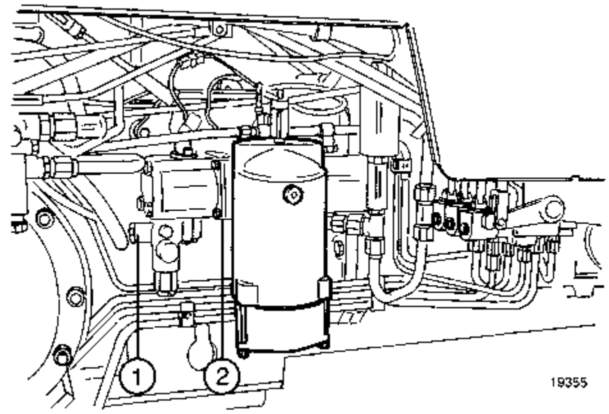
19353

3. Remove oil breather.



19354

4. Remove the oil suction elbow from filter bracket to oil pump.



19355

5. Remove connection (1) from the hydraulic lift circuit pressure relief valve.
6. Remove both capscrews (2) securing oil pump to filter bracket and finally the pump itself.
7. Install the oil pump by reversing the previous removal sequence of operations.

HYDRAULIC LIFT AND POWER STEERING PUMP MOUNTING SUPPORT ASSEMBLY
Removal–Installation (Op. 27 170 30)

Proceed as follows:

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

1. Disconnect battery cables.
2. Place a stand under the RH side final drive and remove tractor wheel.

Note – The mounting support for both hydraulic lift circuit and power steering oil pumps can be removed as well with the tractor RH side rear wheel installed. This however makes operations more difficult while without the wheel the removal and subsequent installation of the hydraulic lift and power steering pumps will result much easier.

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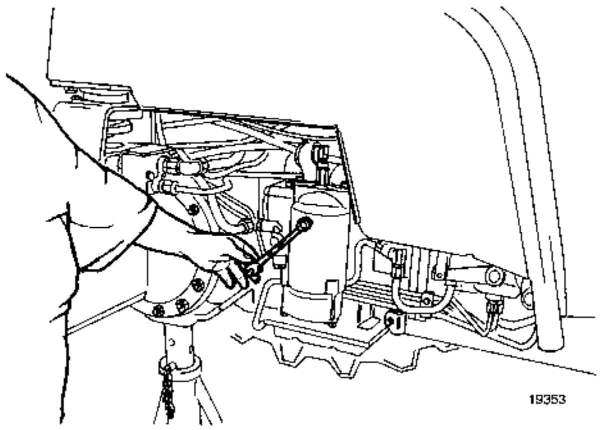
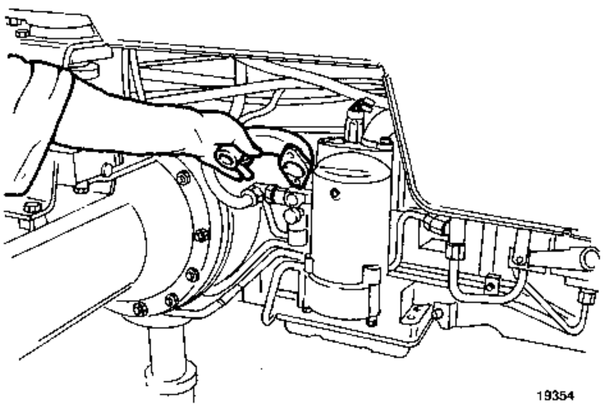
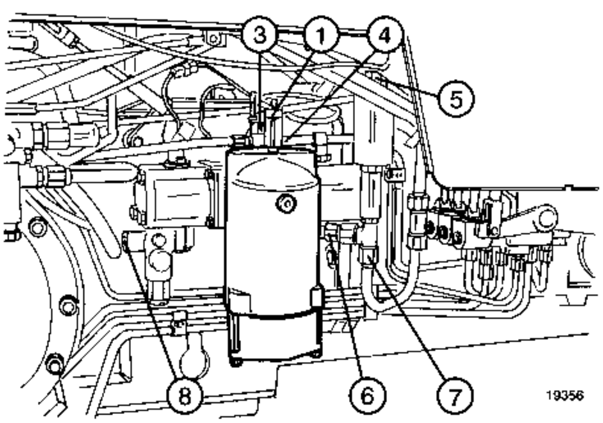


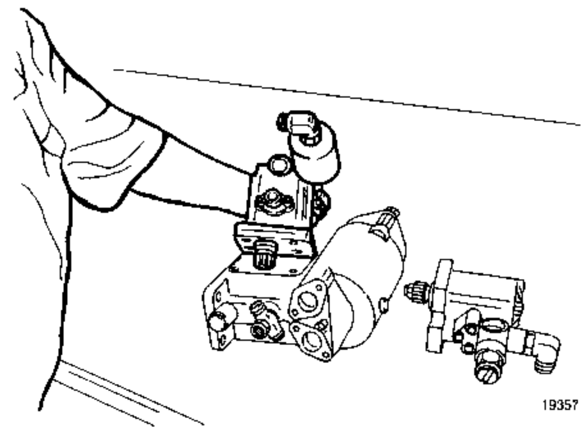
3. Remove the oil breather from filter.



4. Remove the oil suction elbows from filter mounting bracket to the pumps (this will make subsequent operations easier).



5. Disconnect the spy switch (1) located on the filter mounting bracket.
6. Remove oil line connections (2,3 and 4) from filter mounting.
7. Remove connection (5) from the filter resonance damper.
8. Remove oil line connections (6 and 7) from power steering pump.
9. Remove oil line connection (8) from the hydraulic circuit pressure relief valve.
10. Remove the five capscrews and finally the filter mounting bracket complete with oil pumps.



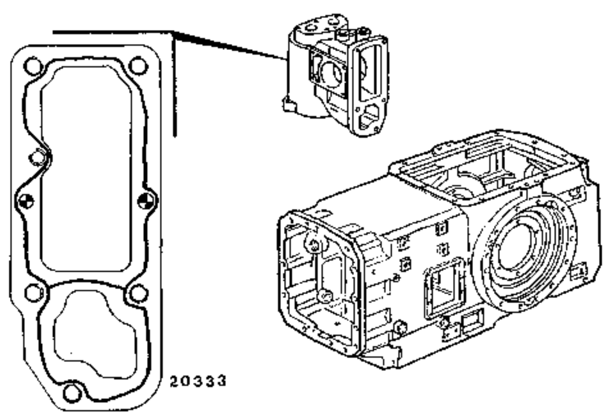
11. Subsequently remove the pump screws and split the oil pumps from mounting bracket on a workbench.
12. When installing the hydraulic circuit and power steering pump mounting bracket pay attention to the following:

    a. proceed by reversing the previous removal sequence of operations starting from no. 11 back to no. 1;

    b. see illustrations on page 35–5 for the correct placement and orientation of parts and components;

    c. prior to refitting the hydraulic pump supporting unit, thoroughly clean and degrease mating surfaces, then apply a bead (about 2 mm or. 08 in diameter) of sealing compound following the application scheme shown in the figure above;

    d. tighten fastenings to the torque specifications of page 35–8.



Application scheme for sealing compound coating of mating surfaces at hydraulic pump supporting unit installation on tractor rear drive transmission housing.

Information on suitable types of sealing compounds are given on page 00–9.

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ELECTRONICALLY–CONTROLLED REAR HYDRAULIC LIFT

Refer to specifications and description of pages 35–5, 35–6, 35–7 35–8 and to the following additional information:	
Type Controls	position draft and mixed control through ECU (electronic control unit) located on the RH side of driver seat and comprising: – n.1 sensitivity control knob; – n.1 arm raising upper–stop regulation knob; – n.1 draft control knob; – n.1 position control knob; – n.1 arm raising and 1 arm–lowering control push–buttons; – n.1 arm lowering speed control knob; – n.1 haulage safety button; – n.1 internal control activation push–button; – n.1 external control activation push–button; – n.1 set of indicator lights for the system self–diagnosis.
Ground controls	through four push–button controls (two for raising and two for lowering), mud–guard–mounted.
Single–acting cylinder: – nominal diameter and stroke – capacity Pressure relief valve setting Cylinder safety valve setting	 115 x 159 mm 1651 cu.cm (100.74 cu.in) 190 to 195 bar (194 to 199 kg/sq.cm – 2755 to 2827 psi) 210 to 215 bar (214 to 219 kg/sq.cm – 3104 to 3176 psi)
Piston dia. Cylinder barrel I.D. Running fit, clearance of piston in barrel	114.978 to 115.000 mm (4.5302 to 4.5310 in) 115.036 to 115.071 mm (4.5280 to 4.5300 in) 0.036 to 0.093 mm (.0014 to .0036 in)
Rockshaft di. at bearing bushings: – RH side – LH side Iinside dia. of bushings force–fitted in lift case seats: – RH side (1) – LH side (2) Running fit, clearance of rockshaft in bearing bushings Interference fit, bushings in their seats End play of rockshaft and arms assy.	 59.970 to 60.000 mm (2.340 to 2.360 in) 64.970 to 65.000 mm (2.557 to 2.559 in) 60.100 to 60.184 mm([1]) (2.344 to 2.346 in) 65.100 to 65.184 mm ([1]) (2.562 to 2.566 in) 0.100 0.214 mm (.0039 to .0084 in) 0.065 to 0.185 mm (.0025 to .0072 in) 0.2 to 1.4 mm (.008 to .055 in)

(follows)

([1]) After force–fitting, without reaming.

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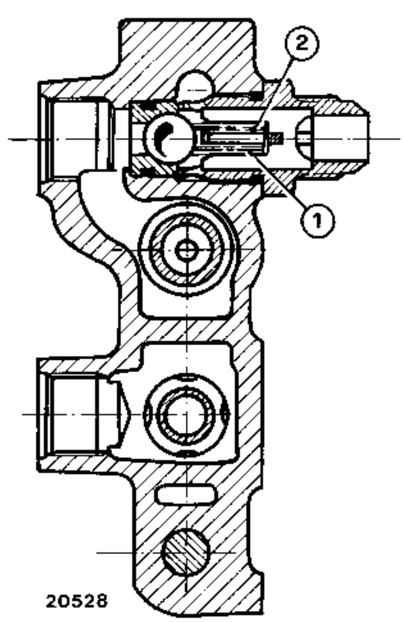
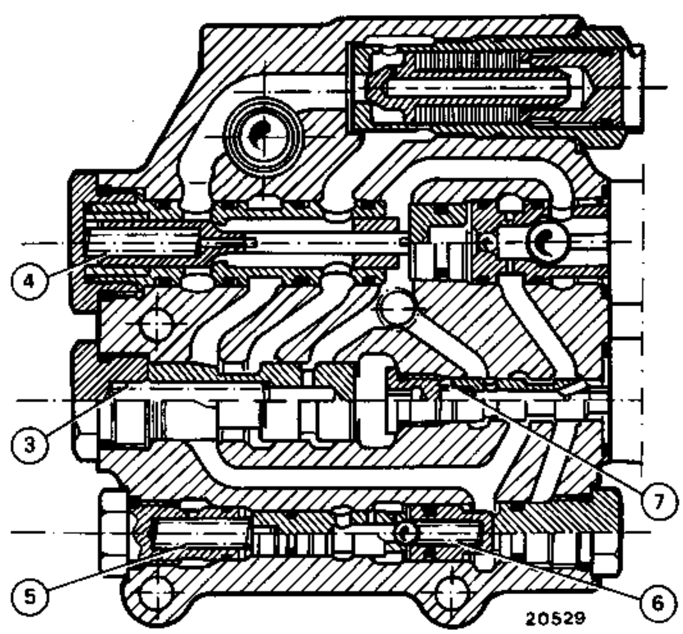
ELECTRONICALLY–CONTROLLED REAR HYDRAULIC LIFT

(cont.)

Check valve return spring (1): – free length .... – under load: 35.3 to 38.7 N (3.65 to 3.95 kg – 9.8 to 10.6 lb)	 25.5 mm (1 in) 20 mm (.8 in)
Check valve inner return spring (2): – free length .... – under load: 25.5 to 27.5 N (2.6 to2.8 kg – 7 to 7.4 lb)	 23 mm (.9 in) 20 mm (.8 in)
Delivery valve spring (3): – free length .... – under load: 48 to 53.9 N (4.9 to 5.5 kg – 13 to 14.7 lb)	 80 mm (3.1 in) 54 mm (2.1 in)
Drain valve spring (4): – free length .... – under load: 134.2 to 158.8 N (14.6 to 16.2 kg – 39 to 43.4 lb)	 36 mm (1.4 in) 29.15 mm (1.15 in)
Sensitivity control valve spring (5): – free length .... – under load: 64.7 to 70.6 N (6.6 to 7.2 kg – 17.7 to 19.3 lb)	 48 mm (1.9 in) 32 mm (1.3 in)
Sensitivity control valve inner spring (6): – free length .... – under load: 0.9 to 1 N (0.09 to 0.11 kg – .24 to .29 lb)	 21 mm (.8 in) 13 mm (.5 in)
Rockshaft arm raising valve spring (7): – free length .... – under load: 15.8 to 17.5 N (1.61 to 1.79 kg – 4.3 to 4.8 lb)	 14.5 mm (.6 in) 11 mm (.4 in)
Clearance fit of delivery valve (7, page 35–58) in control valve seat .... Clearance fit of arm raising valve (5) in control valve seat .... Clearance fit of reaction valve (9) in control valve seat	0.008 to 0.014 mm([1]) (.0003 to .00055 in) 0.008 to 0.014 mm([1]) (.0003 to .00055 in) 0.008 to 0.014 mm([1]) (.0003 to .00055 in)

([1]) Control valves are specially selected and matched at assembly in order to meet fit specifications.





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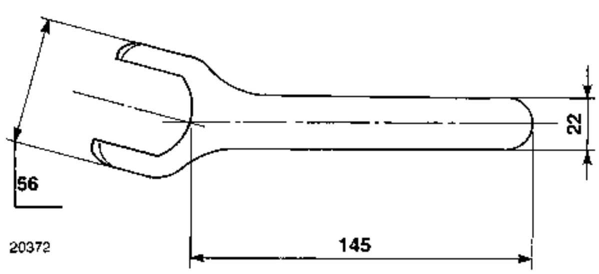
SERVICE TOOLS

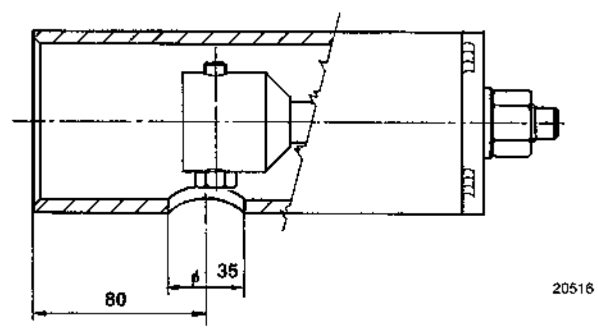
ATTENTION – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code (**X**).
Besides, to work safely and achieve best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjunction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

List of the special tools necessary to perform service operations covered by this section of the Manual:

	291359/2	Sling hook, hydraulic lift.
X	**293813**	Installer, lift piston w/ seal.
X	**293985**	Driver, rockshaft seal installation.
X	**291862**	Wrench, cylinder safety valve setting.
X	**291863**	Wrench, lift pressure relief valve setting
	292870	Pressure test kit.
	290284	Hand pump, valve setting.
X	**290828**	Adapter, cylinder safety valve setting.
X	**290824**	Adapter, lift pressure relief valve setting.
X	**294003**	Adapter, discharge valve fluid tightness check.
X	**292847/1**	Puller, draft sensor pin.
	293987	Tierod, rockshaft bearing bushings
	293988	Nut (w/ **293987**).
	293989	Bushing (w/ **293987**).
	293990	Bushing (w/ **293987**).
	293983	Adapter (w/ **291359/2**).
X	**294009**	FIATGEOTECH tester (see pages 35–40 and 35–41).
	293512	Torque wrench, discharge valve pressure setting.
	50070	Wrench, position control sensor.



Modifications to a standard 36 mm wrench for removal, adjustment and installation of the position control sensor (etch part no. 50070 on tool – Metric dimensions).



Modifications to puller part no. 292847 for removal of draft sensor pins from their mounting (modified puller takes part no. 292847/1 – Metric dimensions).

ELECTRONICALLY–CONTROLLED HYDRAULIC LIFT TROUBLE–SHOOTING CHART

NOTE – To diagnose faults possibly originated by the electrical system or electronic components of the lift, check by using the specific FIATGEOTECH TESTER **294009** and associated instructions found in the specific Manual, print no.**604.74.354.00**.

Fault	Diagnosis	Correction
Lift fails to operate (*).	**1.** Discharge valve (5, page 35–58) stuck open.	Free control valve.
	2. Inefficient oil pump.	Overhaul or replace pump.
	3. Delivery solenoid (1) stuck on off position.	Overhaul or replace solenoid.
	4. Poor current feeding to delivery solenoid (1): disconnected terminals or damaged parts.	Check with tester **294009**, re–connect wiring and replace damaged parts.

(follows)

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ELECTRONICALLY–CONTROLLED HYDRAULIC LIFT TROUBLE–SHOOTING CHART

(con.)

Fault	Diagnosis	Correction
Erratic, jerking operation (*).	**1.** Clogged oil filter.	Replace filter.
	2. Ingress of air along the pump suction duct.	Check connection tightness and seal efficiency.
	3. Poor current feeding to delivery solenoid (1, page 35–58): disconnected terminals or damaged parts.	Check using tester **294009**, restore electrical connections and replace damaged parts.
Rockshaft rises too slowly (*).	**1.** Clogged oil filter.	Replace filter.
	2. Fluid leakage past oil seals and consequent pressure drop: piston seals, oil delivery connection to operating cylinder or from the response control valve (9, page 35–58).	Replace sealing components found defective.
	3. Inefficient oil pump.	Overhaul or replace pump.
	4. Impurities inside the response control valve (9. page 35–58).	Remove clogging matters and check oil filter.
	5. Oil leakage at remote control valves or trailer brake valve neutral line.	Replace sealing components found defective.
Rockshaft will not lower down (*).	**1.** Discharge solenoid (2, page 35–58) stuck on off position.	Overhaul or replace solenoid.
	2. Poor current feeding to discharge solenoid (2): disconnected terminals or damaged parts.	Check using tester **294009**, restore electrical connections and replace damaged parts.
	3. Impurities inside the lowering control valve (6).	Remove clogging matters and check oil filter.
	4. Excessive discharge valve spring (4, page 35–38) load.	Adjust correctly (see page 35–61).
Excessively rough and/or slow response (*).	**1.** Damaged response control valve (9, page 35–38).	Replace the response control valve.
	2. Presence of foreign particles between response control valve (9) and seat.	Disassemble valve, remove clogging matters and check oil filter.
	3. Impurities inside the response control valve (9, page 35–58).	Remove clogging matters and check oil filter.
	4. Response control valve spring (6, page 35–38).	Replace spring.
Lift fails to hold the load in raised position (continuous pitching movement while the engine is running; when stopped, the load is lowered down) (*).	**1.** Poor check valve tightness (4, page 35–58).	Remove, check, clean and replace, if necessary, the parts involved.
	2. Oil leakage through discharge valve (5) and selas.	Replace discharge valve and/or seals.

(follows)

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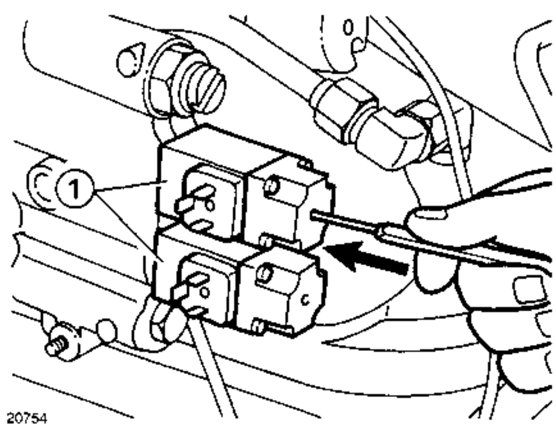
ELECTRONICALLY–CONTROLLED HYDRAULIC LIFT TROUBLE–SHOOTING CHART

(cont.)

Fault	Diagnosis	Correction
	3. Poor response control valve (9) tightness.	Remove, check, clean and replace, if necessary, the parts involved.
	4. Fluid leakage past oil seals and consequent pressure drop: piston gland or on delivery connection to cylinder.	Replace seals found defective.
	5. Poor tightness, or too low setting, of the cylinder safety valve (3).	Replace valve.
Relief valve cracks off with lift arms in fully raised position (*).	**1.** Misadjusted lift arm travel.	Adjust correctly (see page 35–48).
	2. Stuck lifting control valve (8, page 35–58).	Free and, if necessary, replace valve.
	3. Damaged position sensor.	Check w/tester **294009** and, if necessary, replace sensor.
	4. Inefficient Electronic Control Unit.	Check w/tester **294009** and, if necessary, replace ECU.
Poor lifting capacity (*).	**1.** Pressure relief valve out–of–setting.	Replace valve.
	2. Cylinder safety valve (3, page 35–58) out–of–setting.	Replace valve.
	3. Low pump efficiency (normally accompanied by a substantial increase of lifting time and by a high temperature differential between pump body and adjacent delivery pipe).	Check pump performance, overhaul or replace it.

(*) Preliminary check to establish the type of fault



(*)When a fault is found, we suggest carrying on the following test in order to establish whether the fault involves the electric system or the hydraulic one. Proceed as follows:

– position the transmission speed and shifter levers in neutral, brake down the tractor by engaging hand brake and wedging up wheels;
– disconnect electric terminals from delivery and discharge control solenoids (1);
– start the engine and, using a suitable tool, press on solenoid holes (see illustration on side);
– if the fault persists, the hydraulic system is involved whilst if lift works correctly, the fault is to be found in the electrical system.

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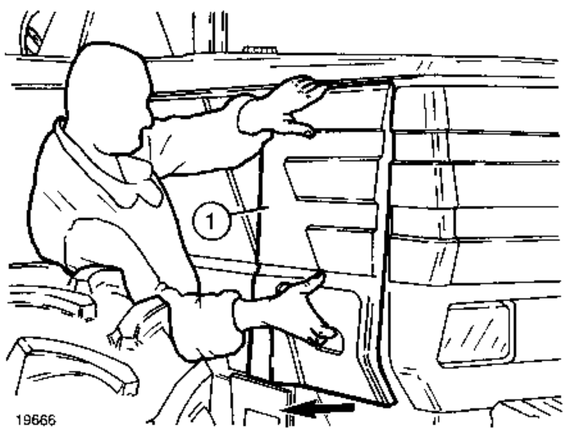
ELECTRONICALLY–CONTROLLED, REAR–MOUNTED HYDRAULIC LIFT
Removal–Installation (Op. 35 134 30)

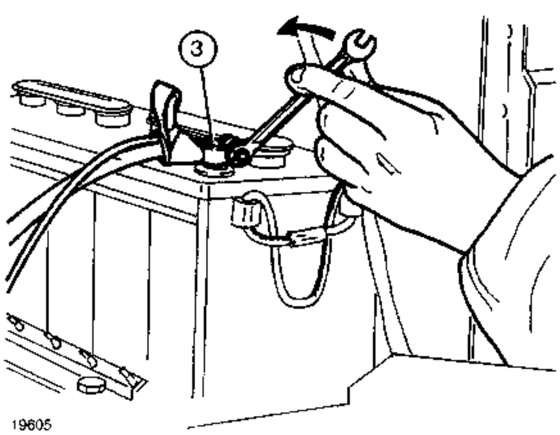
Proceed as follows:

DANGER

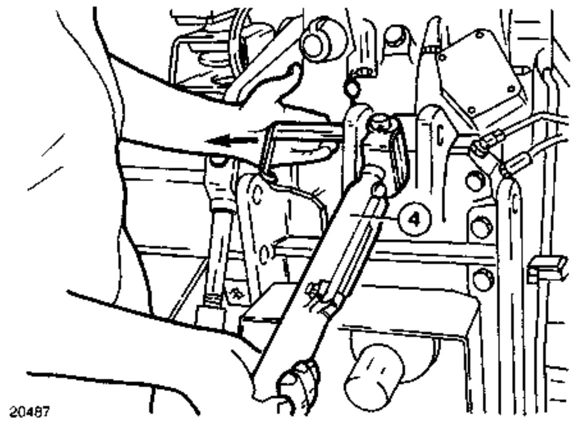
Lift and handle all heavy components using a suitable lift.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.



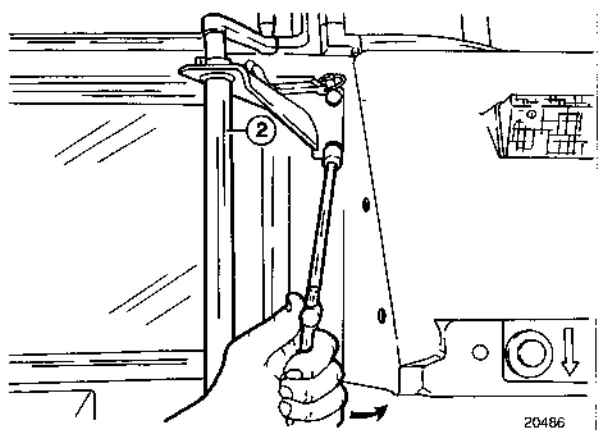
1. Remove the RH side front body panel (1).



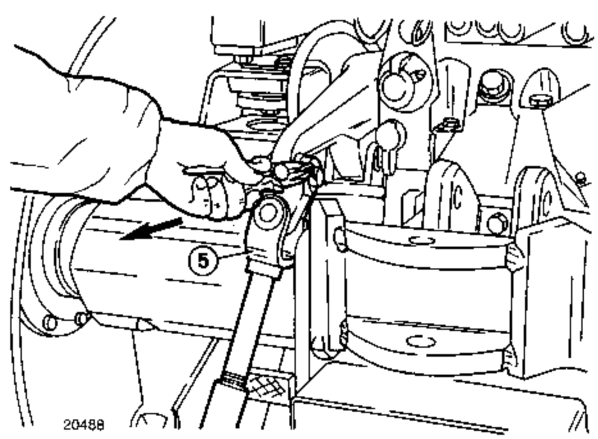
2. Disconnect battery positive cable (3) and insulate it.



3. Withdraw pin and remove the implement hitch top link (4).



4. Remove attaching screws and the RH lift arm height adjustment rod (2).



5. Disconnect side lift rod (5) from lift arm (on both sides).

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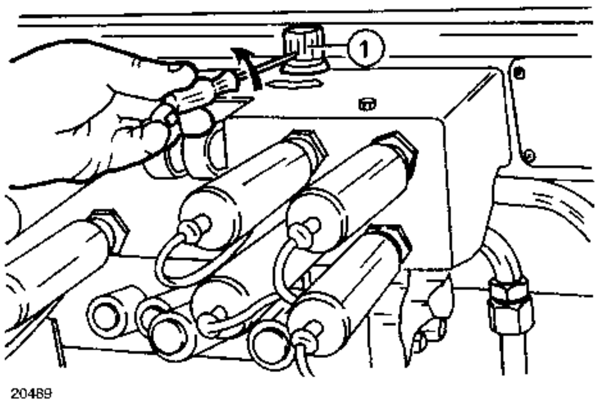
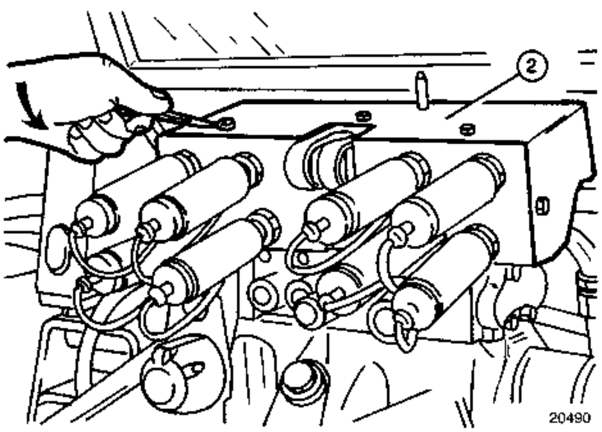
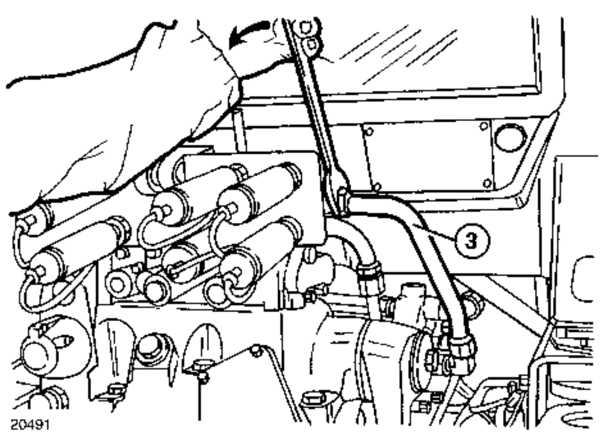


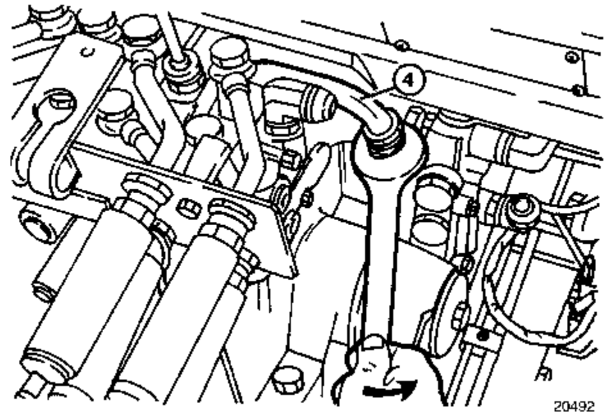
6. Remove attaching screw and retrieve the remote control valve adjusting knob (1).



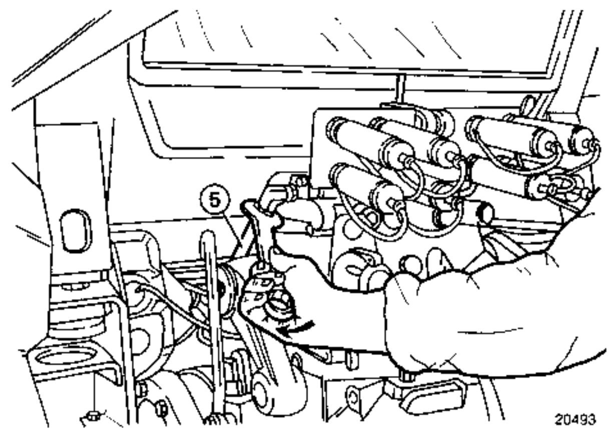
7. Remove screws and remote control valve cover (2).



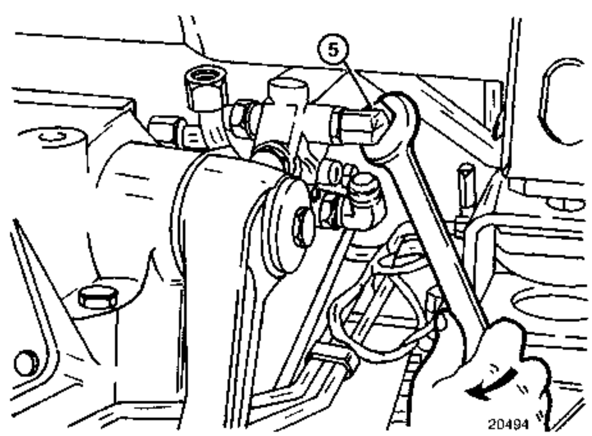
8. Disconnect and remove pipe (3).



9. Disconnect and remove pipe (4).



10. Disconnect pipe (5) from remote control valve pack.



11. Disconnect and then remove pipe (5) from control valve.

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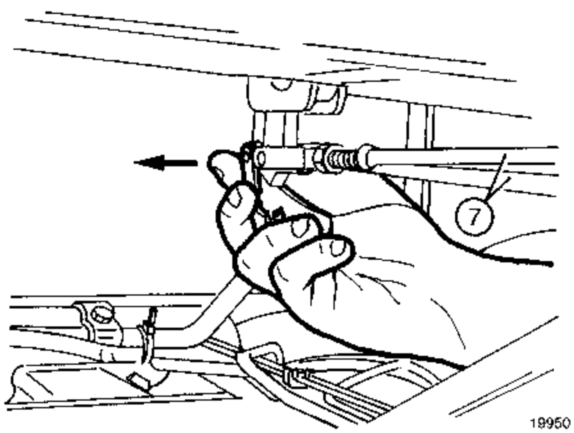
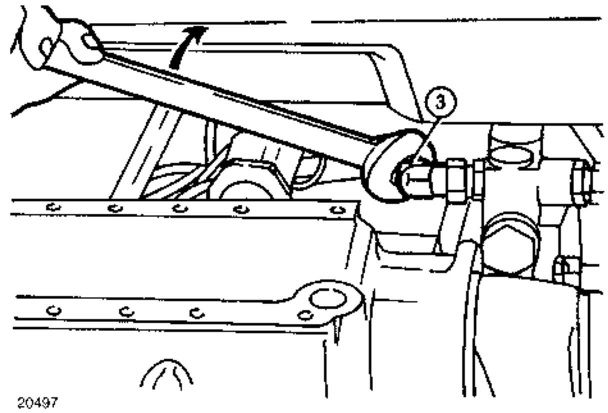
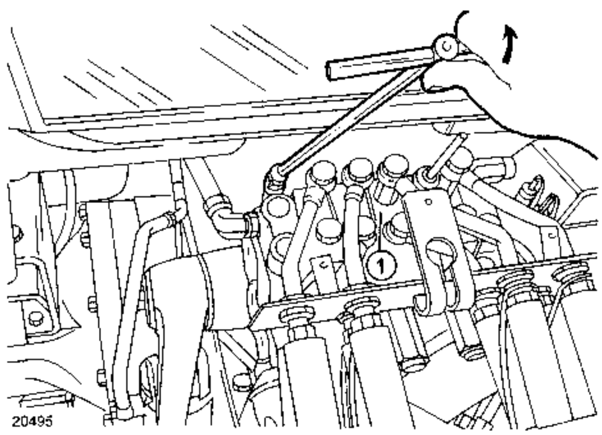


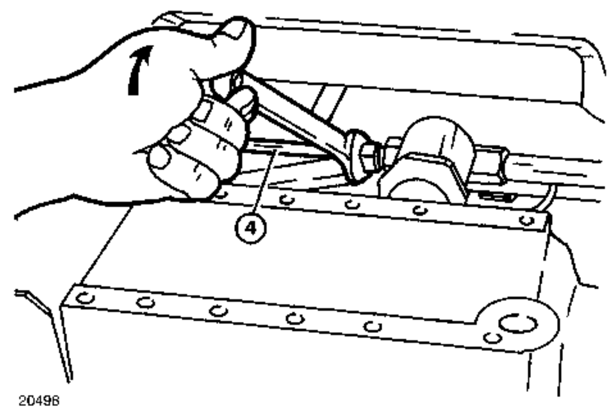
12. Detach retaining spring clips and remove the remote control valve hand levers (7).



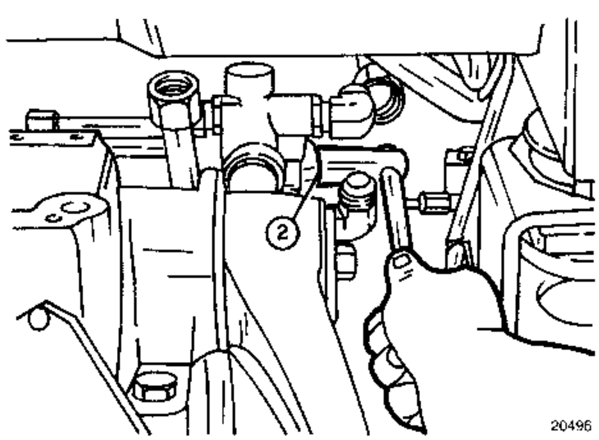
15. Disconnect and remove the lift control pipe (3).



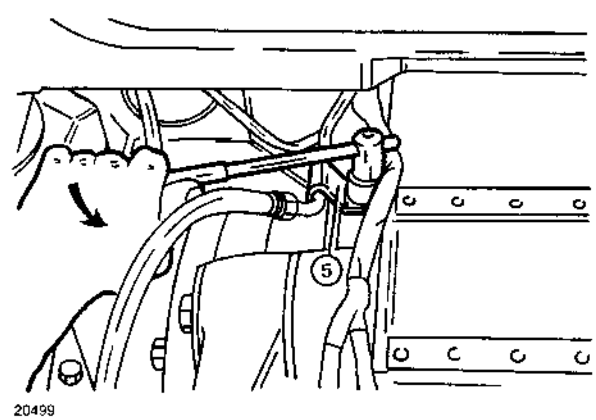
13. Remove attaching screws and remote control valve pack (1).



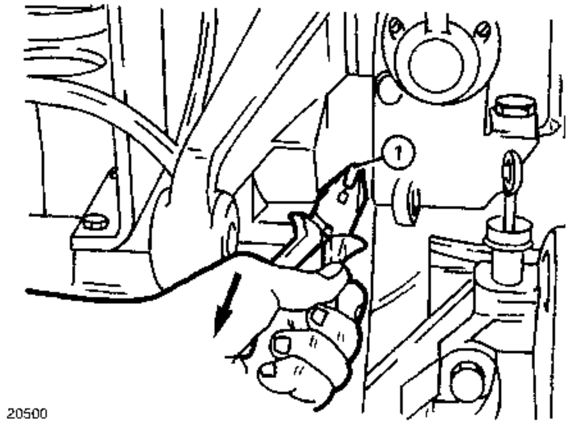
16. Disconnect the auxiliary cylinder control pipe (4).



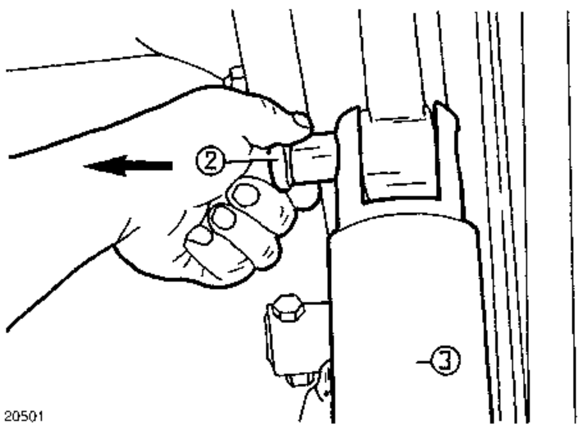
14. Disconnect the leakage drain pipe (2) from control valve.



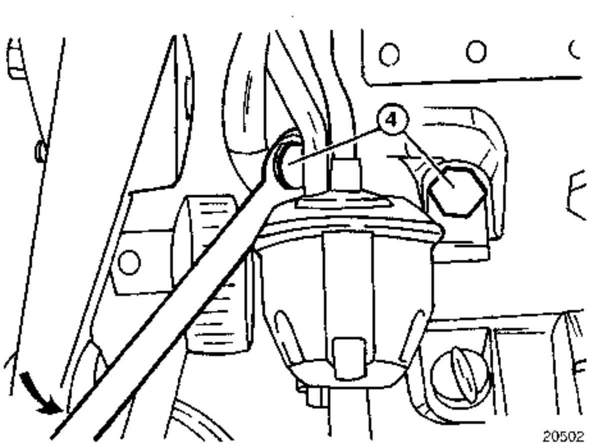
17. Back off the auxiliary cylinder control pipe bracket (5) screw.



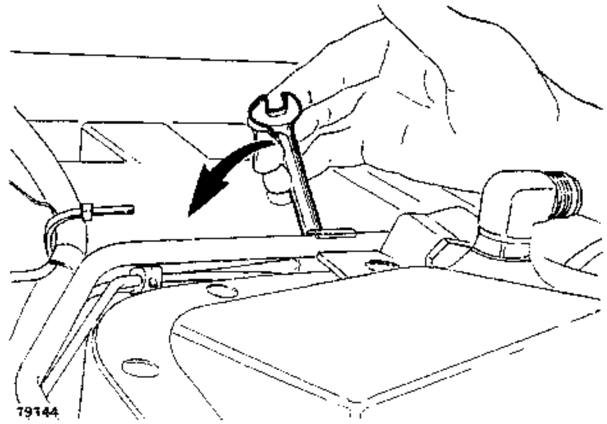
18. Withdraw cotter pin and remove the auxiliary cylinder upper hinge pin (1).



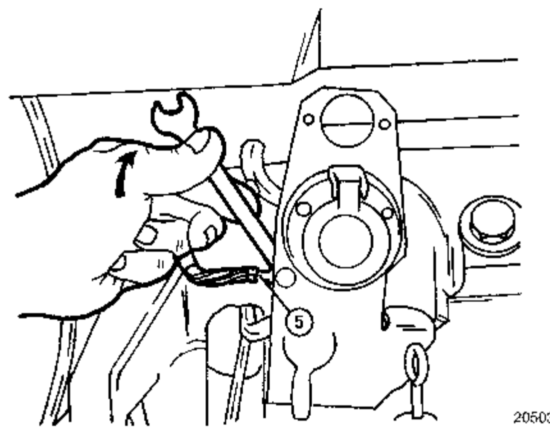
19. Withdraw cotter pin, remove the lower hinge pin (2) and finally the auxiliary cylinder (3) assembly.



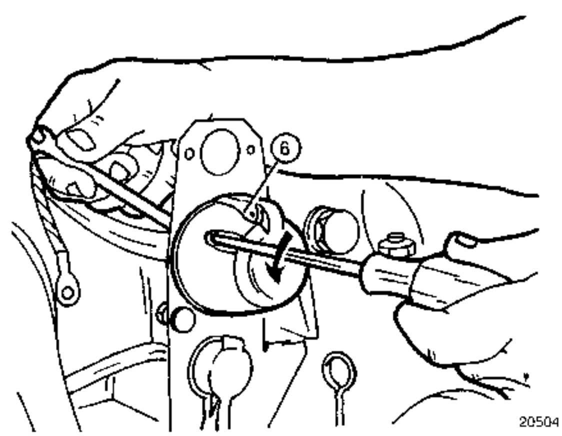
20. Remove attaching screws (4) and free the trailer brake engagement and single–pole socket supporting bracket.



21. Remove the mounting bracket for trailer brake and tractor brake control pipes.



22. Disconnect ground (5) from bracket.



23. Remove screws and single–pole socket (6).

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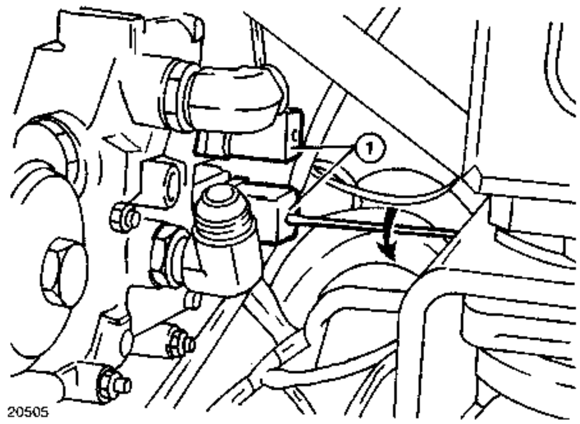
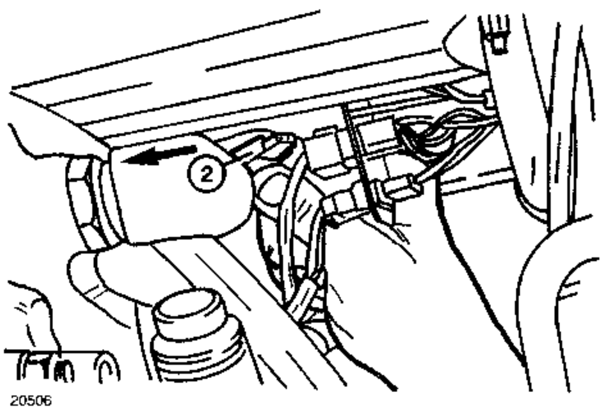
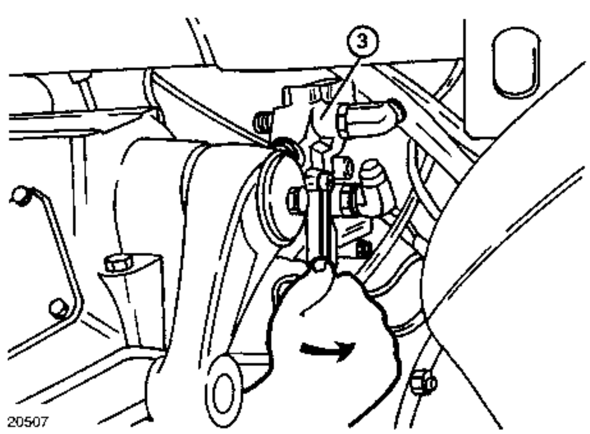


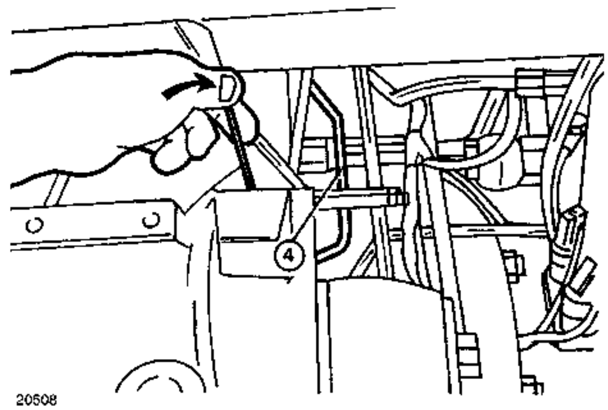
24. Remove screws and electro–valve connections (1).



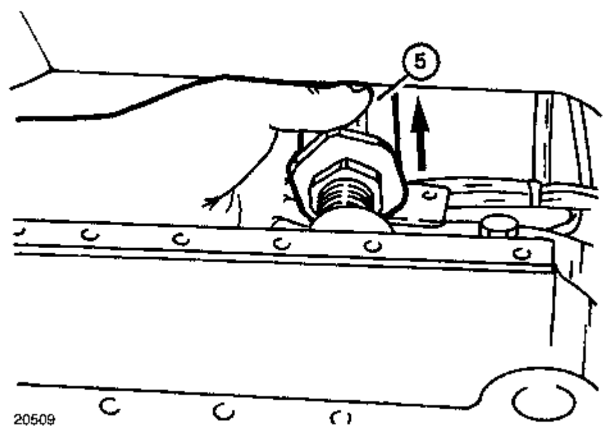
25. Detach position control sensor connection (2).



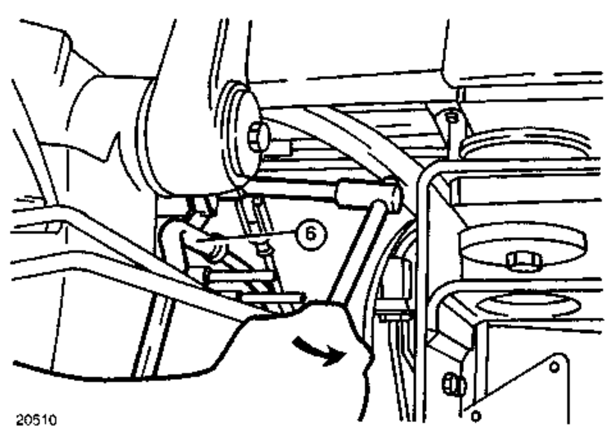
26. Remove screws and control valve (3).



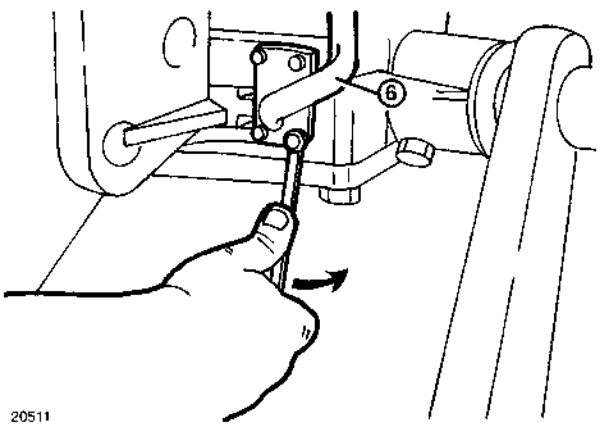
27. Disconnect lube oil line (4) from lift body.



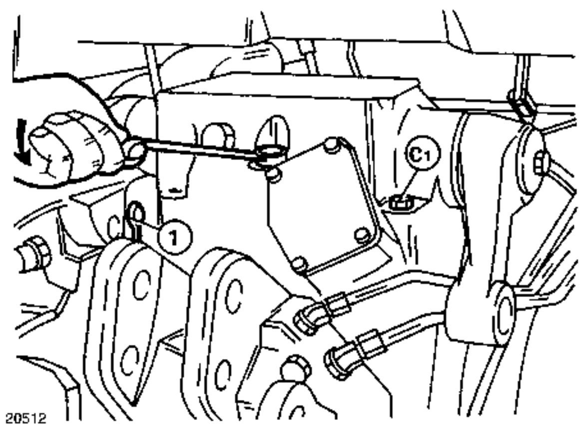
28. Using wrench tool no. **50070** (see page 35–39) unscrew and remove the position control sensor (5).



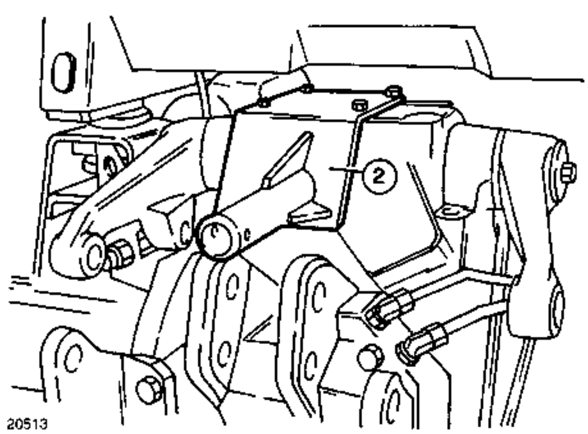
29. Remove screw securing the draft sensor to electronic control box connecting cable guard pipe (6).



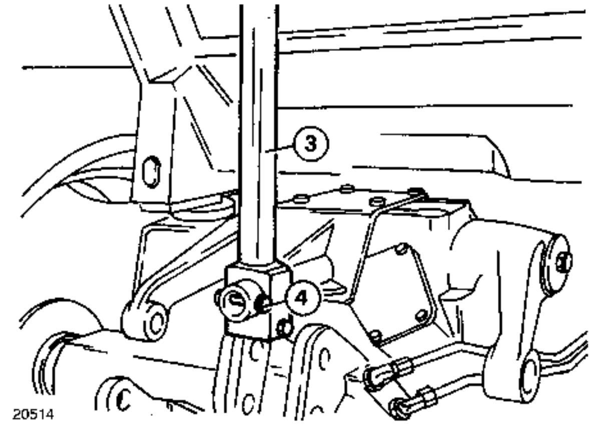
30. Back off the screws securing pipe (6) to sensor supporting bracket and move the former sideways.



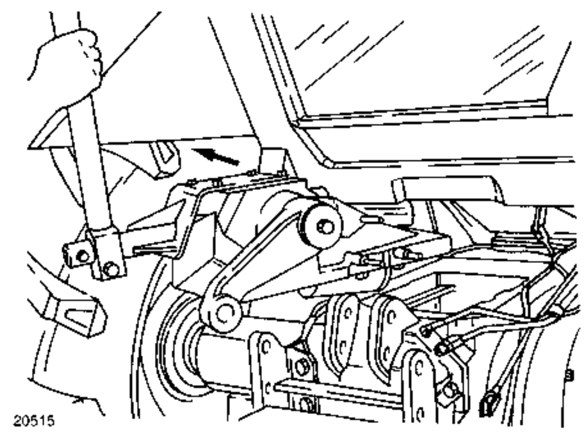
31. Remove screws (C_1, page 35–8) securing hydraulic lift assembly to transmission housing and withdraw the oil level dipstick (1).



32. Fit bracket tool no. **293983** (2) to hydraulic lift w/ four screws.



33. Connect bracket (2) to lifting hook tool no. **291359/2** (3) and screw on a safety bolt and nut on the bracket.



34. Connect to a hoist and lift away the hydraulic lift assembly.

35. Install the hydraulic lift on the tractor rear drive housing paying attention to comply with following directions:

a. proceed by reversing the previous removal sequence of operations starting from no. 34 back to no. 1;

b. prior to installation, thoroughly clean and degrease mating surfaces and then apply a bead of about 2 mm (.08 in) diameter following the layout scheme shown on page 35–48;

c. strictly comply to torque tightening specifications of page 35–8;

d. carry on adjustments of page 35–48.

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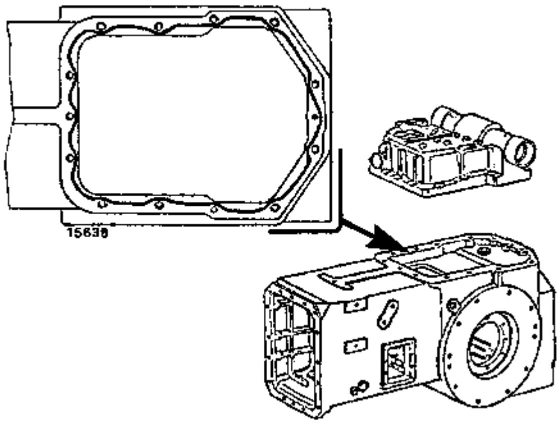

15638

Application scheme of sealing compound to mating surfaces of hydraulic lift and tractor rear drive housing

Sealing compound types are indicated on page 00–9.

ELECTRONICALLY–CONTROLLED HYDRAULIC LIFT ADJUSTMENTS (Op. 35 134 08)

Setting the lifting stroke upper stop and adjusting the position control sensor

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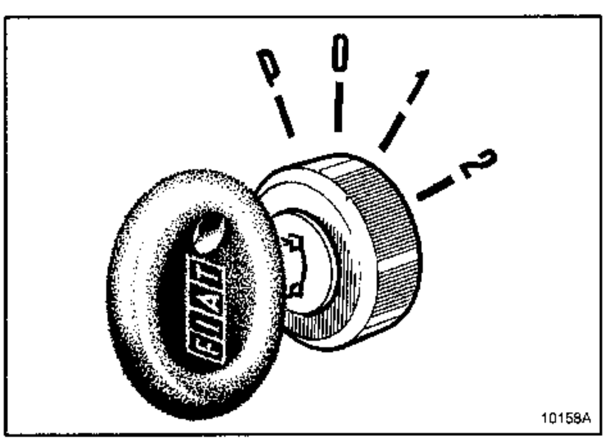
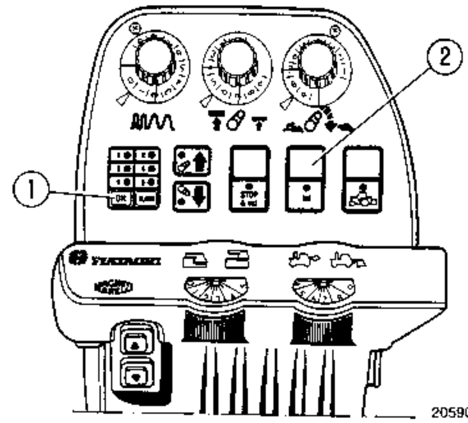
Note – Carry on the following adjustment with lift installed on tractor and engine shut off. Proceed as follows:



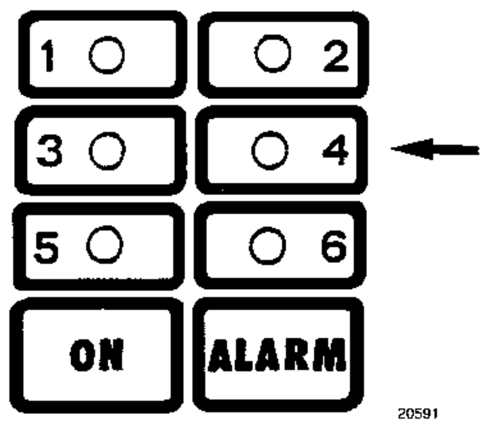
10158A

36. Turn starting switch on position 1.



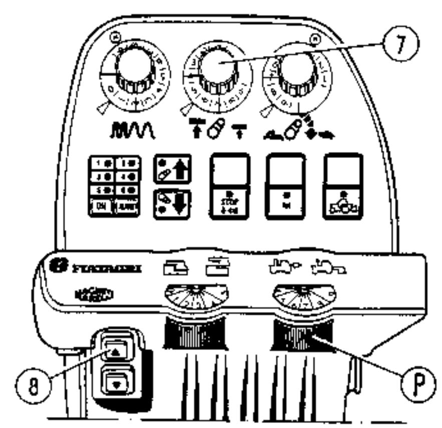
20590

37. Wait until indicator lights of electronic control unit are out with the exception of the green light ON (1) and red one (2).



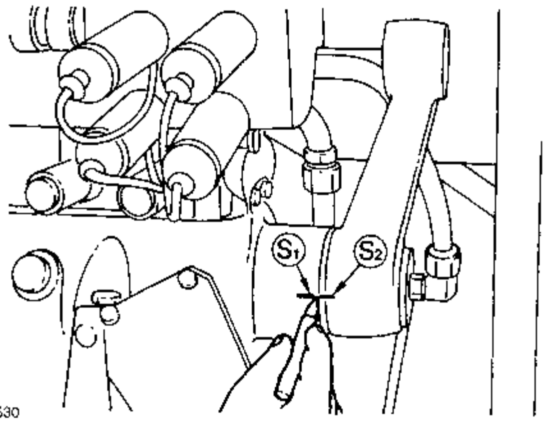
20591

38. Self–diagnosis indicator lights 1, 2, 3, 5 and 6 must be out. The indicator light 4 (position control sensor) will go out when the position control sensor is connected to the tractor electric plant.



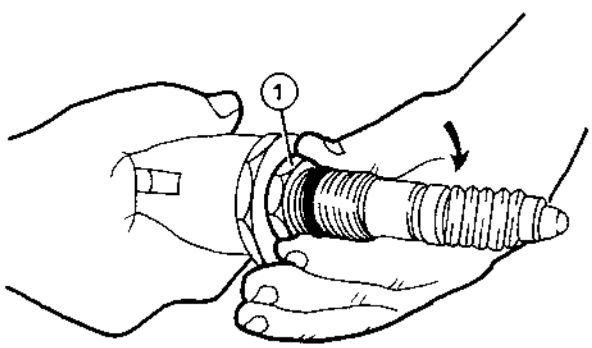
20592

39. Turn the position control knob (P) and rockshaft arm upper stop (7) on 0. Press the arm lifting push–button control (8).



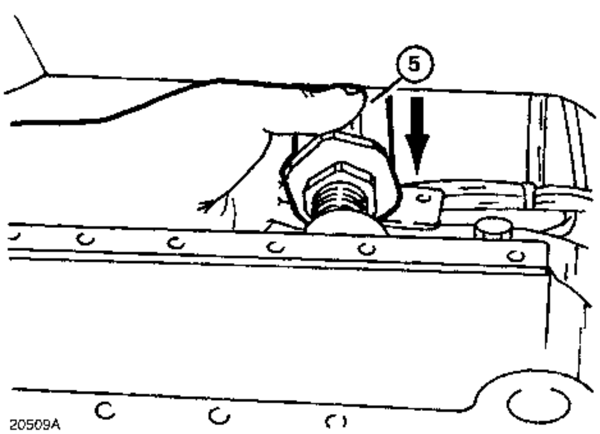
20530

40. Raise lift arms to full travel so that the inside arm comes into contact with the lift housing (mechanical stop) and trace two reference marks on lift housing (S_1) and arm (S_2), respectively.



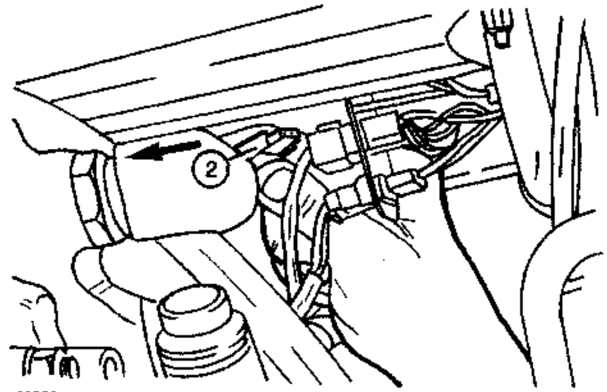
20531

41. Screw on ring nut (1) until abutting against the sensor.



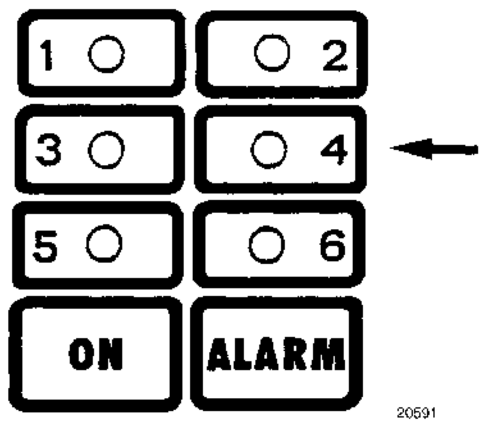
20509A

42. Introduce the draft control sensor (5) in the lift housing seat and hand–tighten it until the ring nut distance from lift housing is about 10 mm (.4 in), that can be checked by feeler gauge.



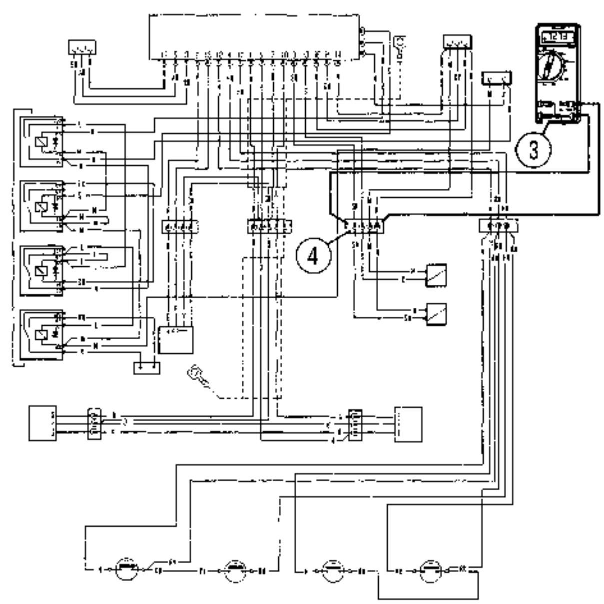
20506

43. Connect the sensor connection (2) to the electrical system.



20591

44. Check that the self–diagnosis spy lamp no. 4 is out.



20593

45. Connect tester (3) to delivery valve connection (4) (electric cables N=BLACK and SN= PINK/BLACK) without detaching the connection block.

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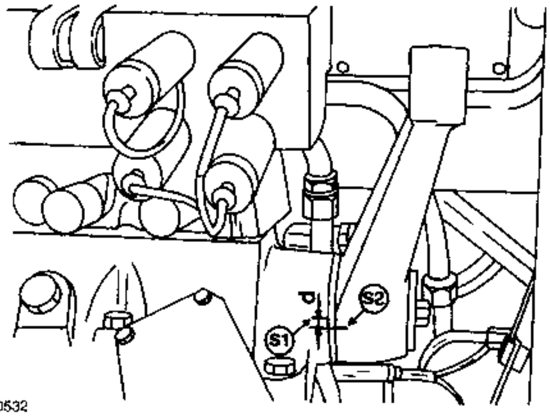
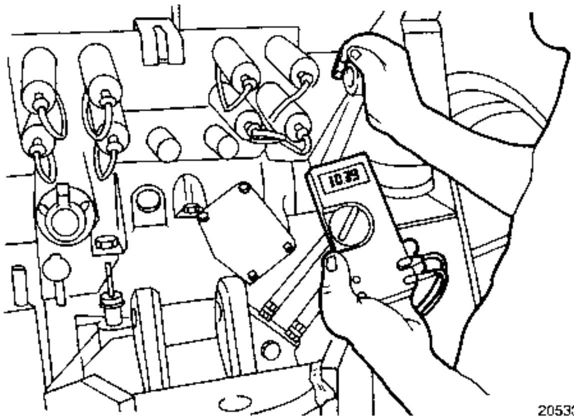


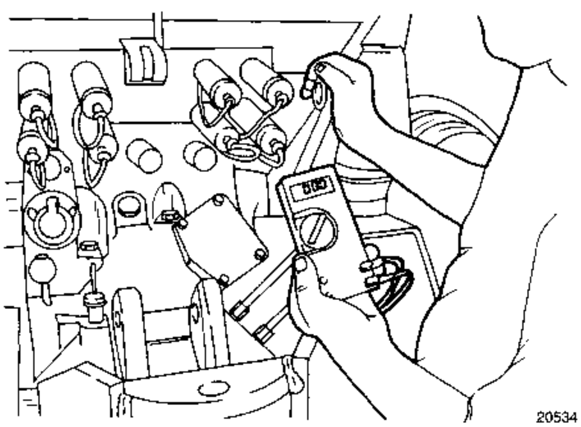
20532

46. From full height position lower the rockshaft arms until distance (d) between the two reference (marks S_1 and S_2) measures 3,5 to 4,5 mm (.14 to .18 in).



20533

47. By hand, slowly screw on the position sensor until current feeding of delivery coil starts (this will be confirmed by a tester reading different from 0).



20534

48. Slowly unscrew the position sensor until shutting off current from delivery coil (tester reading = 0 will confirm).

49. Using wrench tol no. **50070** (see page 35–39) torque tighten the position sensor ring nut to about 20 Nm (2 kgm = 14.5 ft–lb).

50. Bring arms to full upper stop and susbsequently to full lower stop making sure that no electronic control unit warning light is on.

NOTE – The start of current feeding the delivery solenoid can also be found using the FIATGEOTECH TESTER **294009**, instead of the tester tool no. **293970**, by proceeding as follows.

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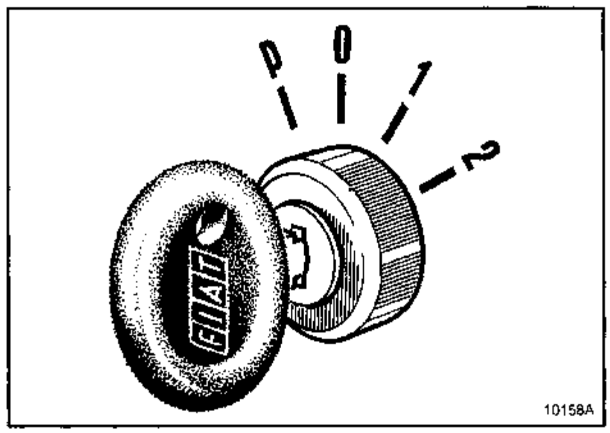
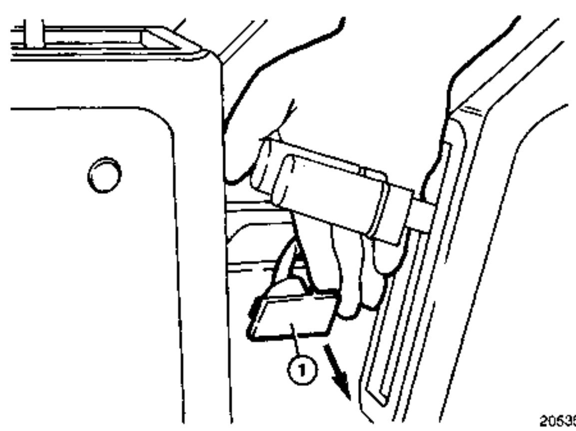
51. Carry on the previous operations starting from no. 36 up to no. 44, then proceed as follows:



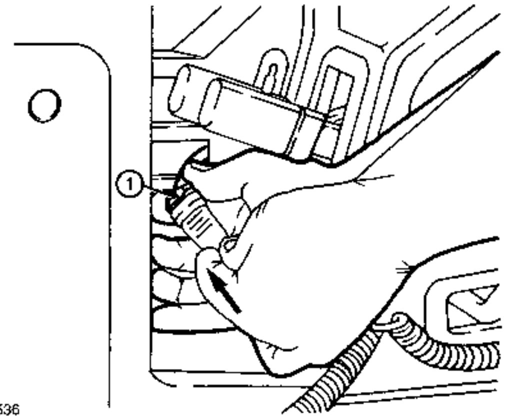
10158A

52. Set starter switch on position 0.



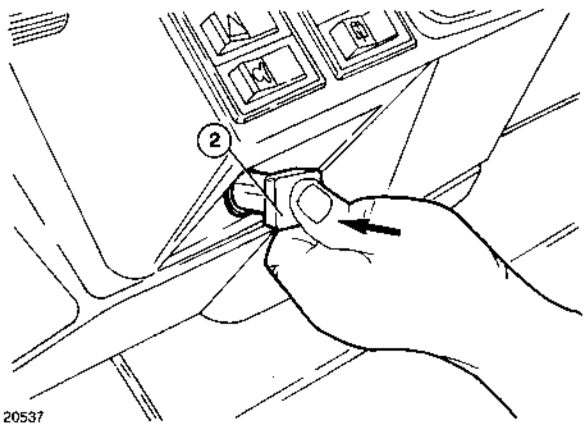
20535

53. Detach lid (1), using a steel blade to split it off the panel, if necessary.



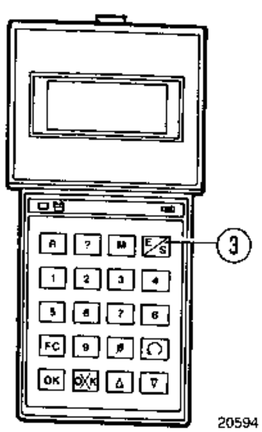
20536

54. Connect the terminal of the TESTER **294009** to the diagnostics socket.



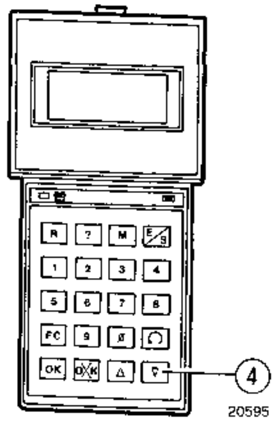
20537

55. Introduce the current feed block (2) of the TESTER **294009** in the cigarettel lighter



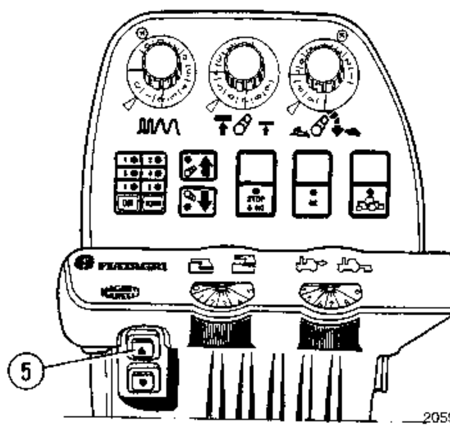
20594

56. Check display for appearance of AUTOMATIC indication and press button E/S (3). Set the starter switch on 1 and wait for the reading of the LH draft sensor on the display.



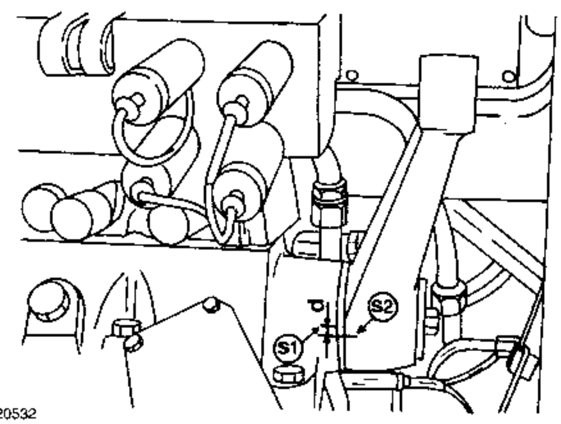
20595

57. Press button (4) three times: three readings will appear on the display, i.e., the RH draft pin value, position sensor value and drain and delivery valve values, in the order.



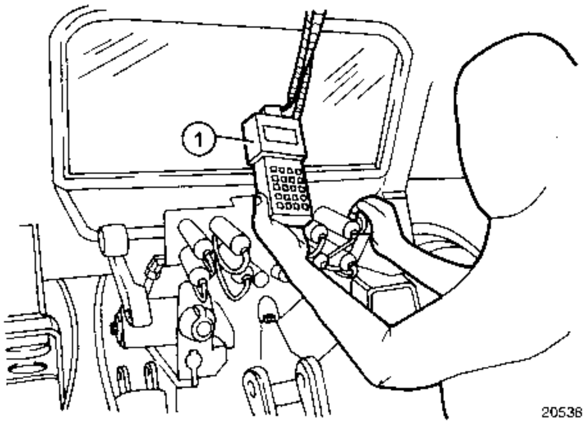
20596

58. Press button (5) corresponding to the lift arm raising function.



20532

59. Starting from fully raised position, turn the lift arms downwards until the distance between the two reference marks (S_1 and S_2) measures from 3.5 to 4.5 mm (.14 to .18 in).

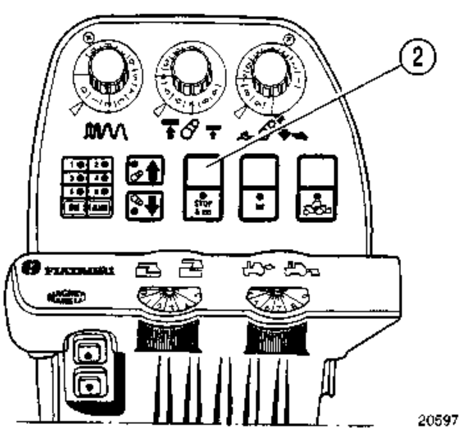


60. Manually, screw on **very slowly** the position sensor until on the display of the FIATGEOTECH TESTER **294009** (1) the reading associated with the delivery valve changes from OFF to ON. Unscrew the sensor still **very slowly** until the same ON reading on the display will change again back to OFF.

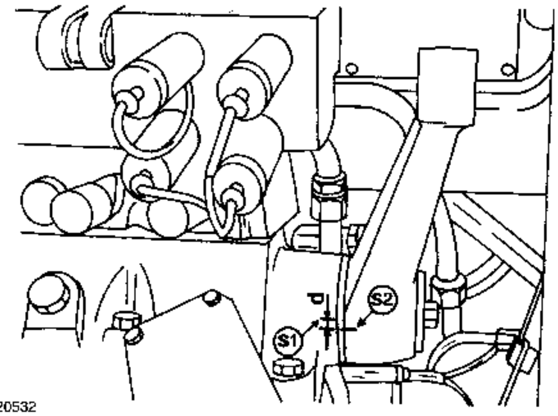
61. Using special wrench **50070** (see page 35–39), torque tighten the position sensor ring nut at about 20 Nm (2 kgm – 14.5 ft.lb).

62. Move lift arms up to stop and immediately after lower them down to stop making sure that none of the electronic control unit warning indicators is lighted.

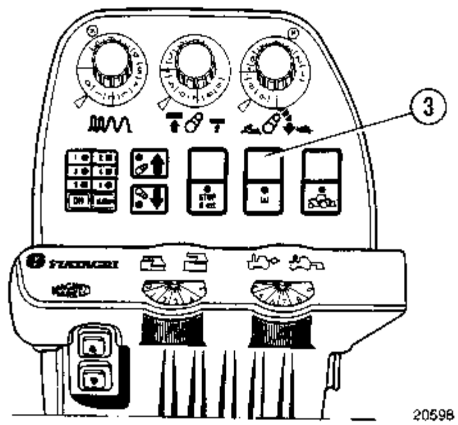
Checking functionality of the lifting arm upper stroke stop.



63. Once adjusted the upper stroke stop setting for the lift arms, press on push–button control (2) to activate external controls.

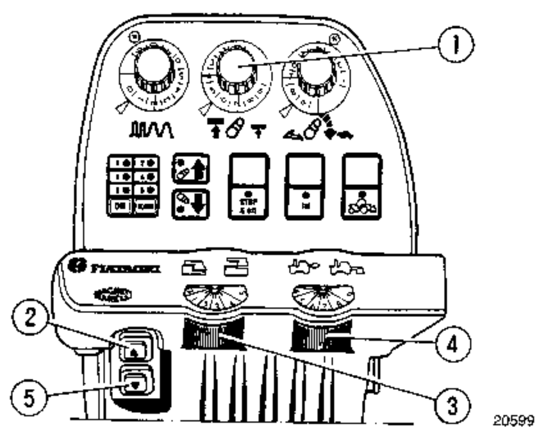


64. Raise lift arms up until the distance (d) between reference marks (S_1 and S_2) = 1 mm (.04 in).



65. Verify if the control unit has again selected internal controls, in the positive case the indicator (3) lights up.

Checks with engine started



66. Turn the upper arm stop control knob (1) on 0, press the arms raising push–button control (2) and verify that arms raising travel occurs regularly and over the full length of stroke.

67. Turn knob (1) on 9 and verify that full arms down stroke is completed.

68. Re–set knob (1) on 0 , turn the draft control knob (3) on 9 and position control knob (4) on 0, press on the arms lowering control push–button (5) and check that arms move down over their complete stroke.

69. Turn knob (4) on 0 and check that arms move up over their complete stroke.

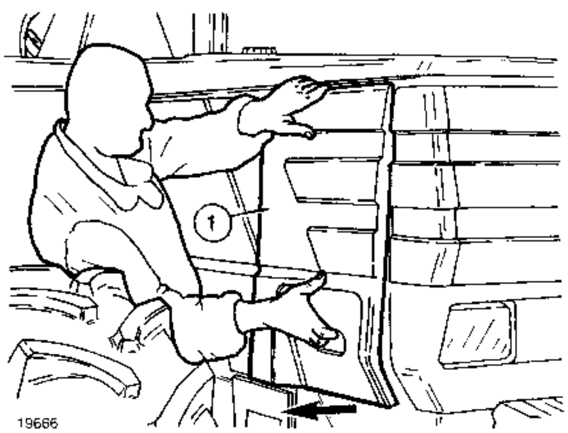
ARM MAXIMUM HEIGHT SENSOR

Replacement (Op. 35 130 32)

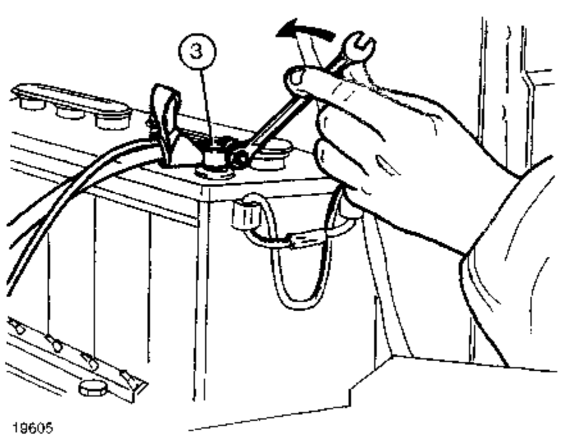
Proceed as follows:

CAUTION

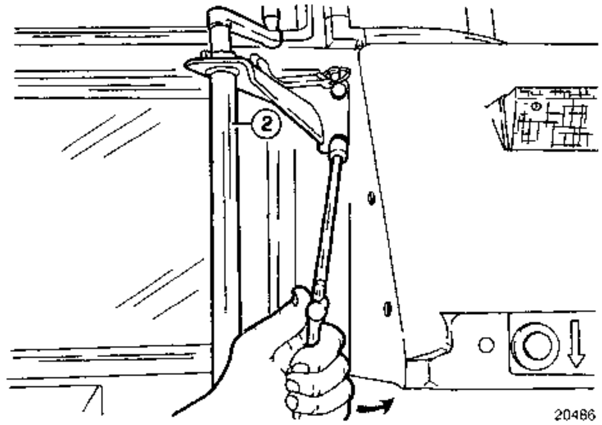
Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.



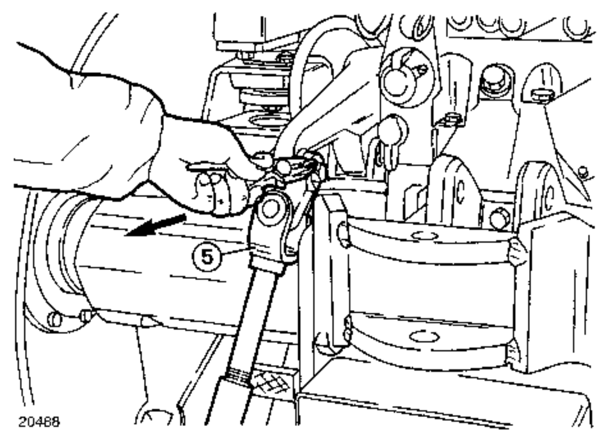
1. Remove the RH side front body panel (1).



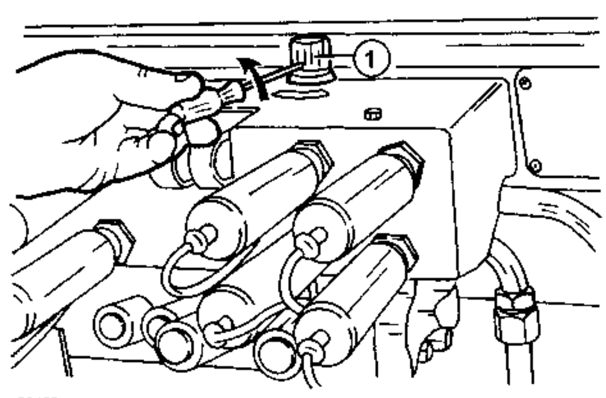
2. Disconnect battery positive cable (3) and insulate it



3. Remove attaching screws and the RH lift arm height adjustment rod (2).



4. Disconnect side lift rod (5) from lift arm (on both sides).



5. Remove attaching screw and retrieve the remote control valve adjusting knob (1).

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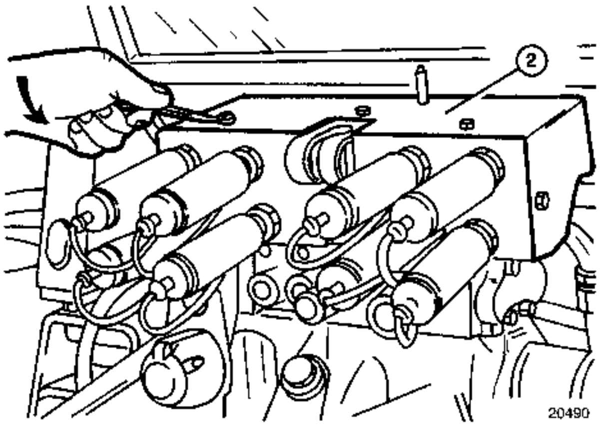
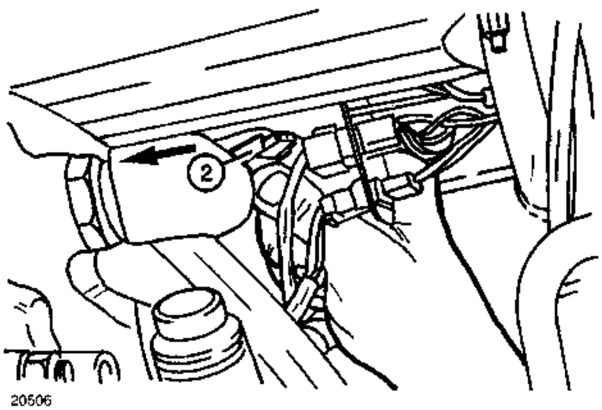
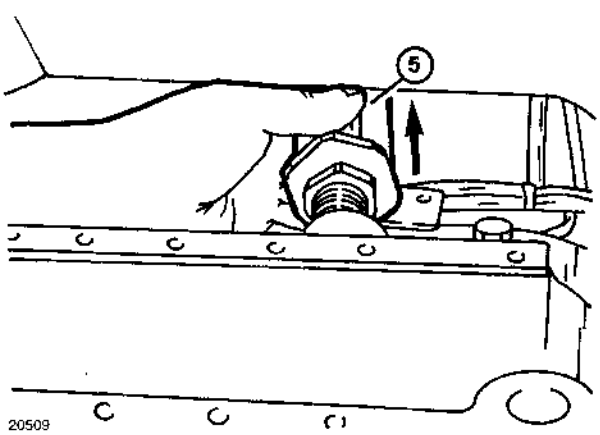


6. Remove screws and remote control valve cover (2).



7. Disconnect position control sensor connecting block (2).



8. Unscrew and recover the position sensor (5) using special wrench **50070** (see page 35–39).

9. Re–fit the position control sensor onto the lift body taking the following into account:

a. proceed by reversing the removal sequence of operations, starting from no. 8 back to no. 1;

b. adjust as reported on page 35–48.

ELECTRONICALLY–CONTROLLED REAR HYDRAULIC LIFT

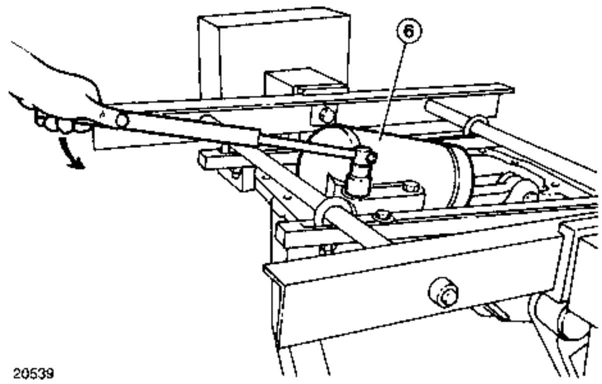
Disassembly – Assembly (Op. 35 134 42)

Proceed as follows:

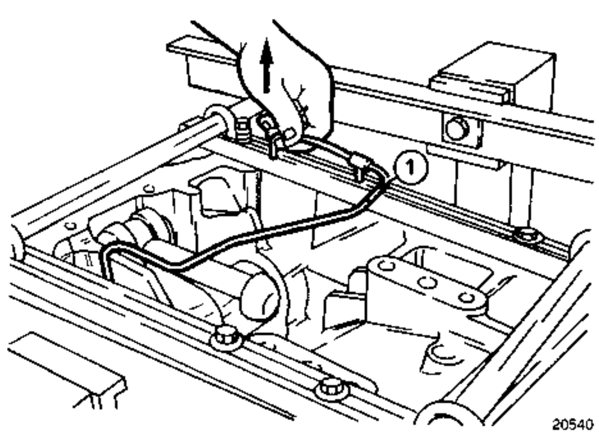
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

1. Install hydraulic lift unit on turn–over type workshop stand.



2. Remove the four attaching screws and the lift hydraulic cylinder (6) complete with piston.



3. Take out the internal lube line (1).

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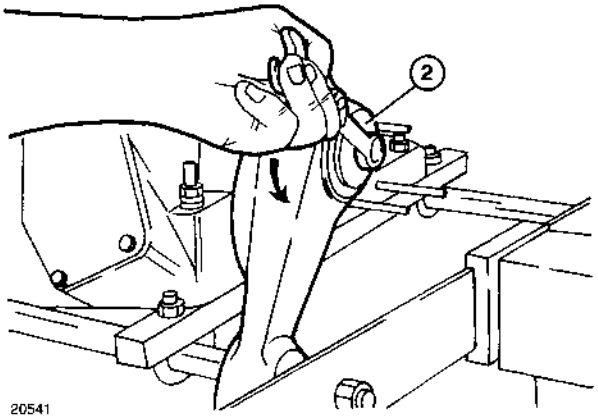
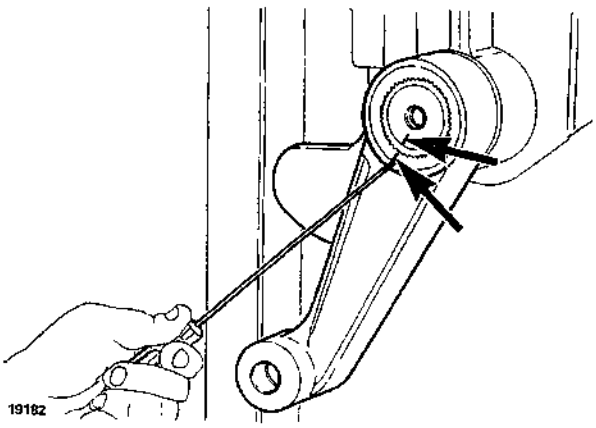


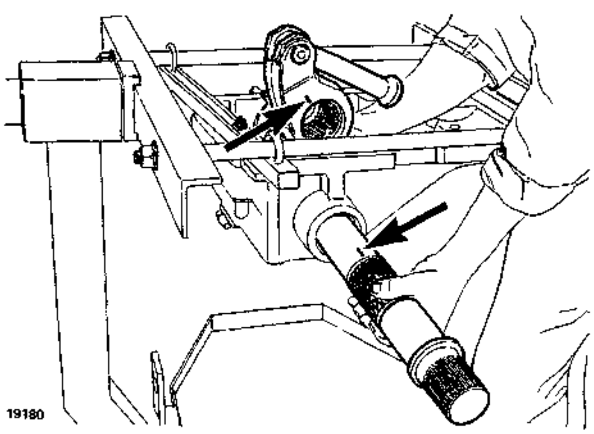
20541

4. Remove the roskshaft arm mounting screws and recover thrust washers (2).



19182

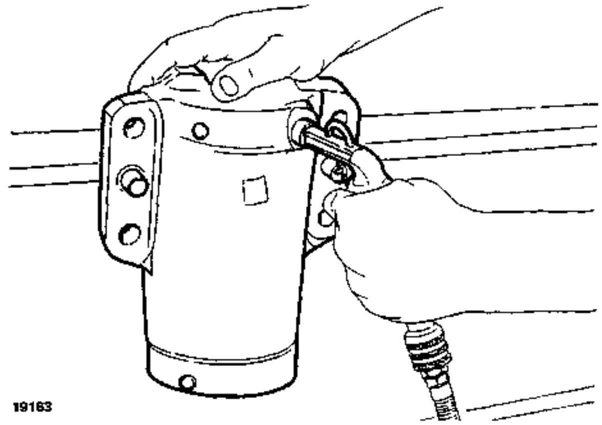
5. Remove the rockshaft arms after checking that reference marks are present both on arms and rockshaft. If not, make the marks shown in the illustration.



19180

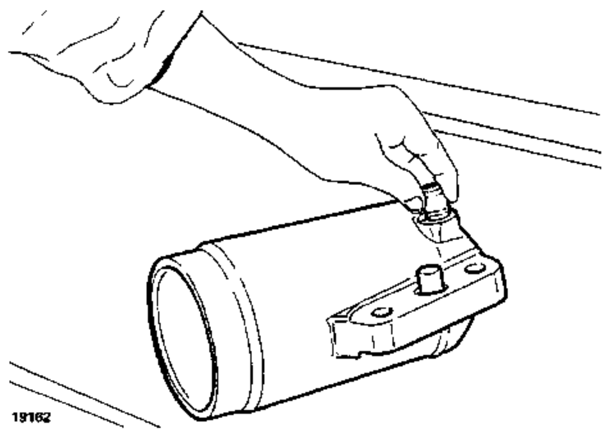
6. Remove the rockshaft, retrieve the internal arm from inside the lift housing and check, prior to removal, that reference marks are present both on the rockshaft and internal arm. If not, make the marks shown in the illustration.

7. Check the state of wear of rockshaft seals and replace them if poor.



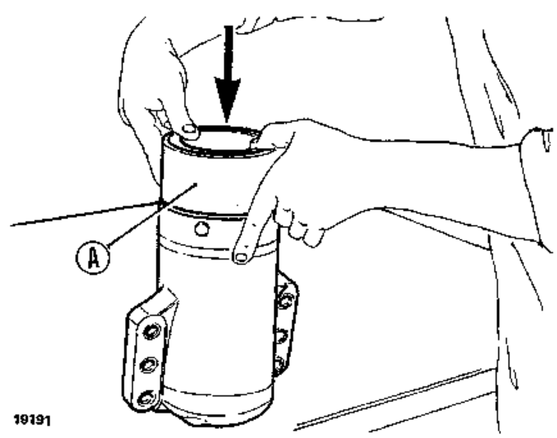
19163

8. Blow compressed air inside the cylinder through the delivery port and pull piston out.



19162

9. Remove the oil inlet connection and check O–rings for wear.



19191

10. Introduce the piston into the cylinder barrel using the installation ring **293813** (A) to avoid damaging the oil seal.

11. Re–install the rockshaft and align reference marks present on both shaft and internal arm.

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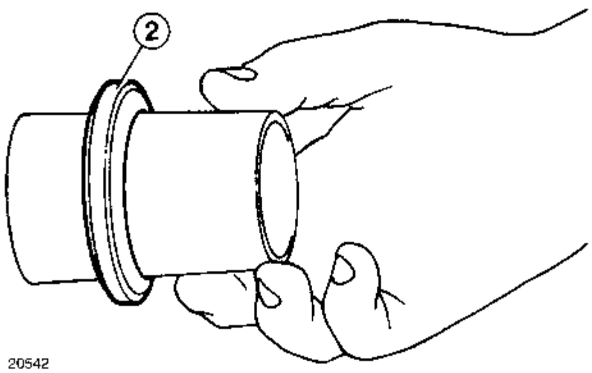
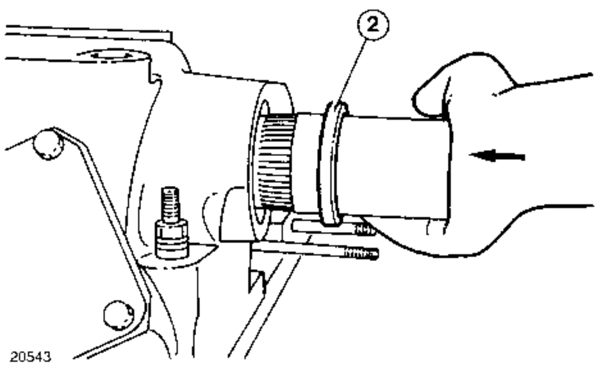
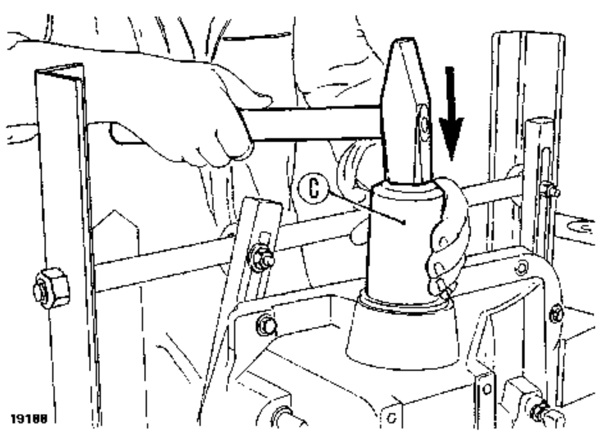


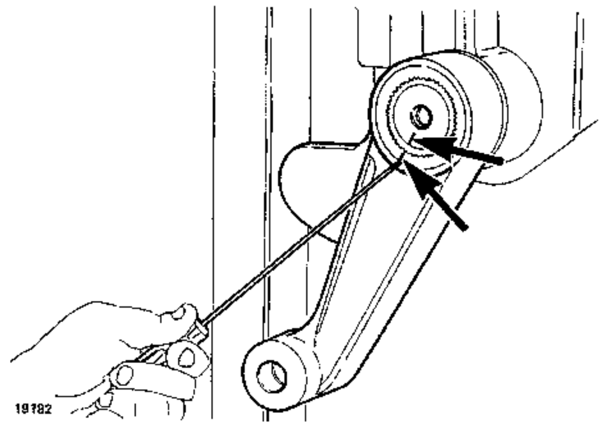
12. To prevent damage to the inner lip of seals (2), use a flexible brass blade 200x90 mm (about 7–7/8 in x 3–1/2 in), 0.05 to 0.1 mm (.002 to.004 in) thick, roll it up and pull seal on.



13. Position the assembly on the spline,then push, by hand, the seal (2) in place and withdraw the brass blade.



14. Use installation driver tool **293985** (C), complete the fitting of seals into their seats in the hydraulic lift case.



15. Re–fit lift arms on rockshaft and align reference marks.

16. Block arms with their thrust washers and torque–tighten screws to specifications (see page 35–8).

17. Fit the internal lube line.

18. Place the hydraulic cylinder, complete with piston, inside the lift case and tighten screws to torque specifications (9, page 35–8).

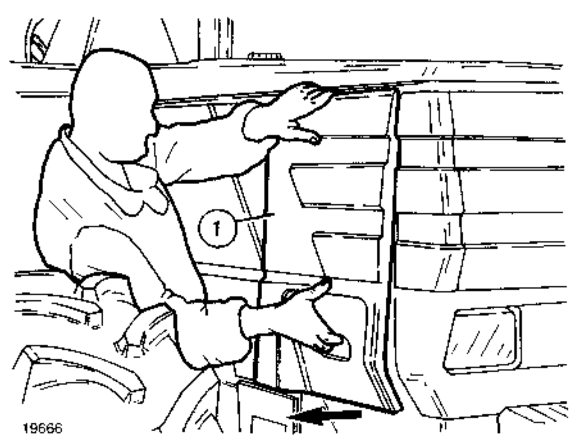
ELECTRONICALLY–CONTROLLED HYDRAULIC CONTROL VALVE

Removal – Installation (Op. 35 138 20)

Proceed as follows:

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.



1. Remove the RH side front body panel (1).

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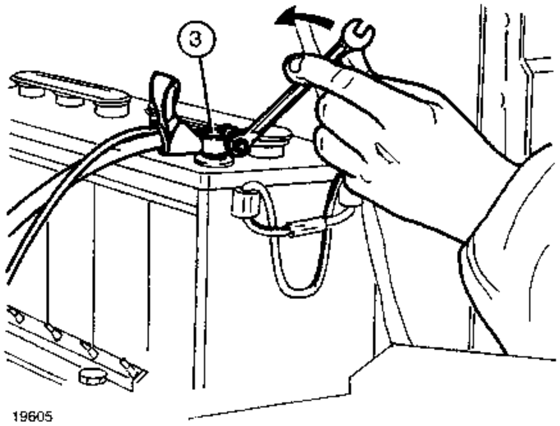
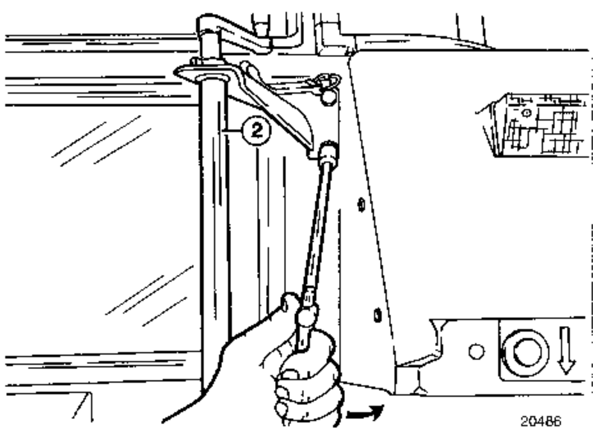
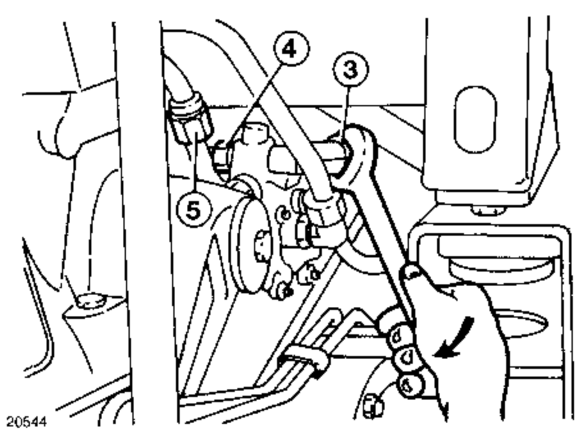


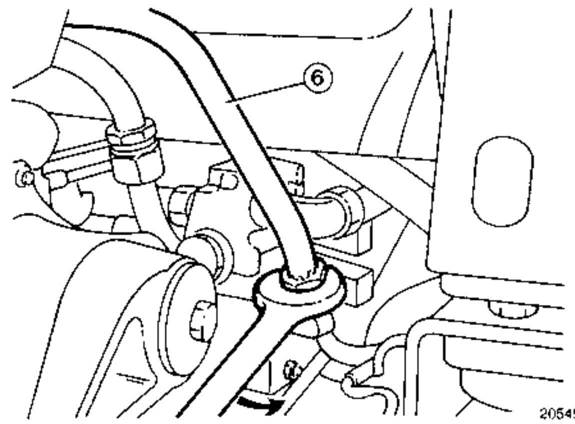
2. Disconnect the battery positive cable (3) and insulate it.



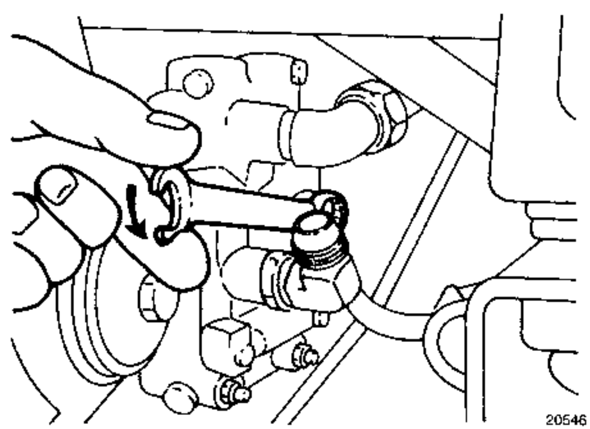
3. Remove attaching screws and the RH lift arm height adjustment rod.



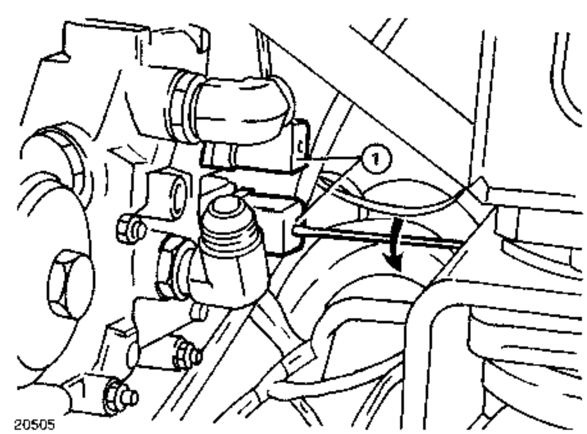
4. Disconnect oil lines (3,4 and 5) from control valve.



5. Disconnect and remove pipe (6).



6. Disconnect the oil leaks drain line.



7. Remove monting screws and connecting blocks from electro–valves (**1**).

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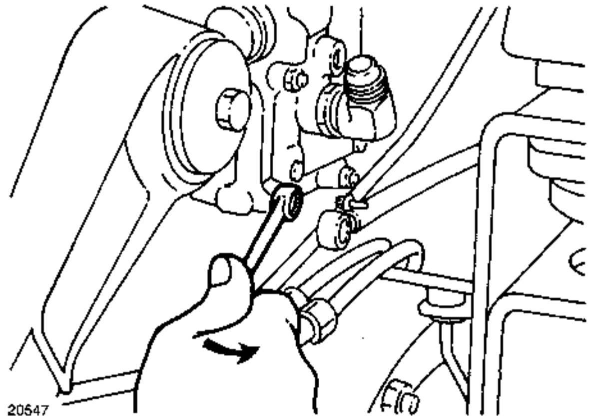
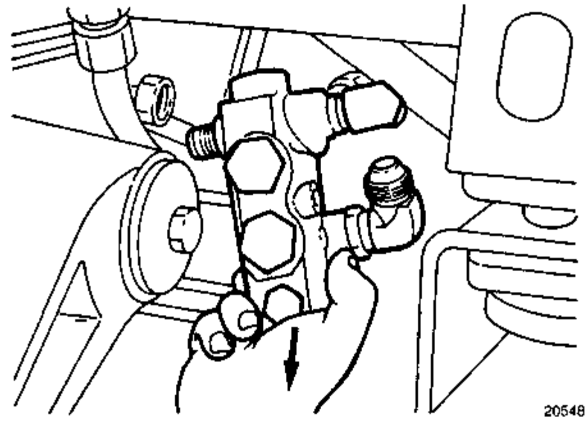
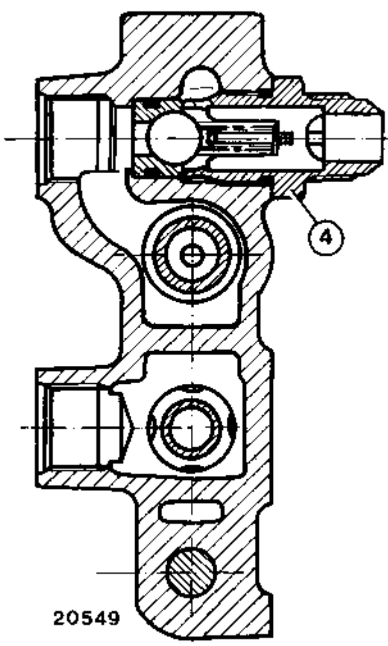


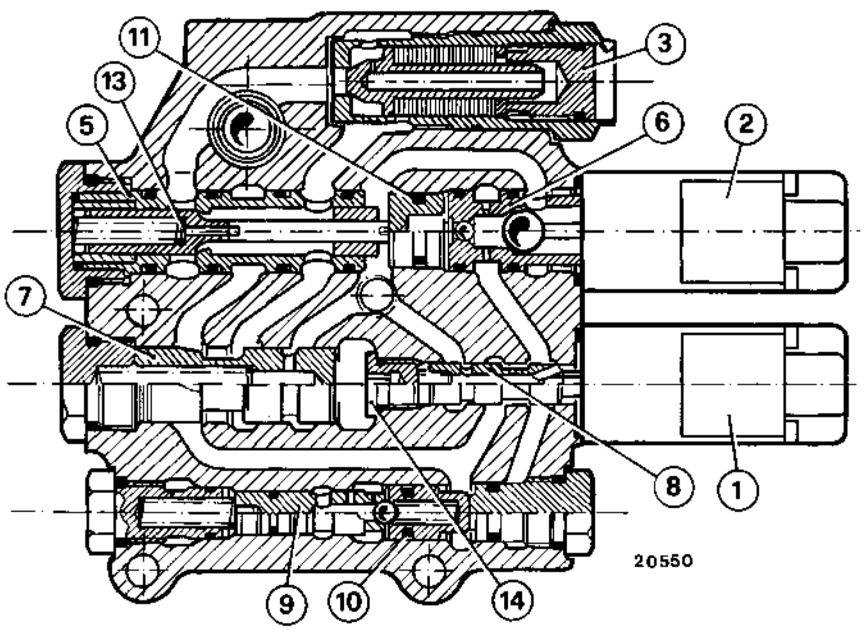
8. Unscrew the nuts securing control valve to hydraulic lift.

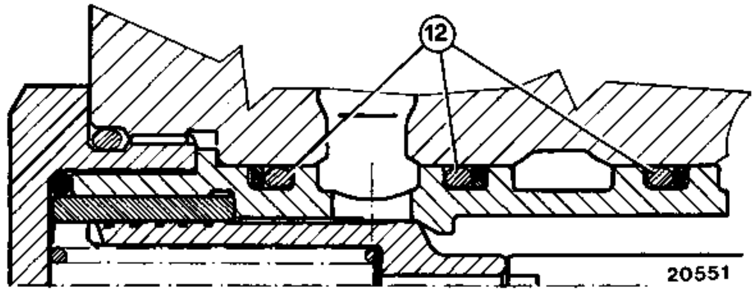


9. Remove the control valve.

10. Install the control valve on hydraulic lift by reversing the previous removal sequence of operations starting from no. 9 back to no. 1.







Cut–out views of the hydraulic control valve fitted on the electronically–controlled lift.

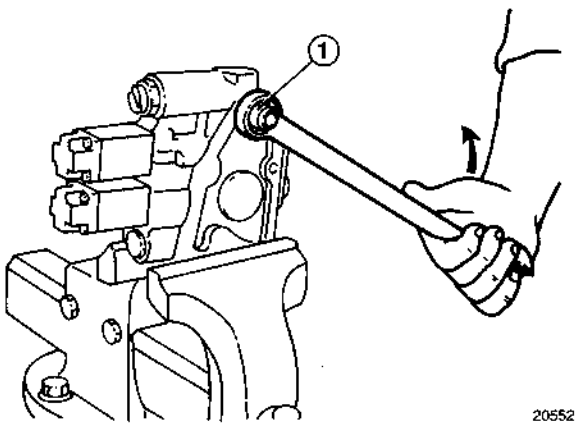
a. Detail view of drain valve for correct positioning of oil seals and their anti–extrusion rings at assembly – 1. Delivery control solenoid – 2. Drain control solenoid – 3. Cylinder safety valve – 4. Check valve – 5. Drain valve – 6. Arm lowering control valve – 7. Delivery valve – 8. Arm raising control valve – 9. Response control valve – 10 and 11. Oil seals with external anti–extrusion ring – 12. Oil seals with side anti–extrusion ring – 13. Discharge valve adjustment shim – 14. Plug.

Note – Spread thread–locking Loctite over plug (14) prior to screwing it onto the hydraulic control valve.

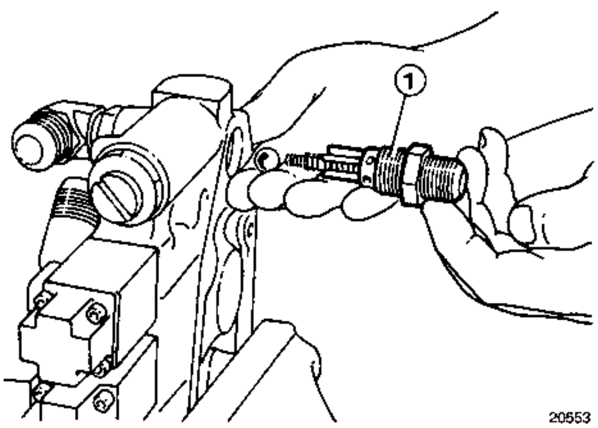
ELECTRONICALLY–CONTROLLED HYDRAULIC CONTROL VALVE (REMOVED)

Disassembly–Assembly (Op. 35 138 24)

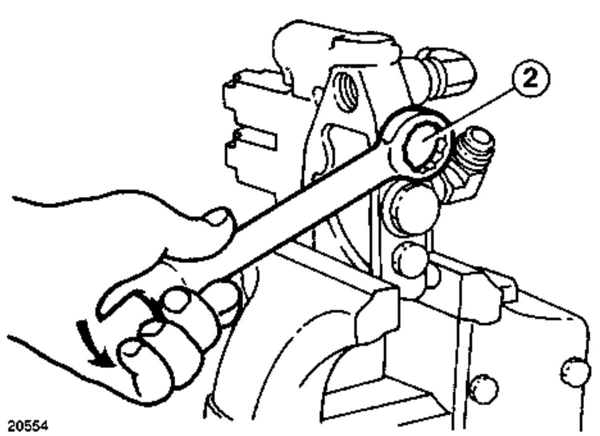
Proceed as follows:



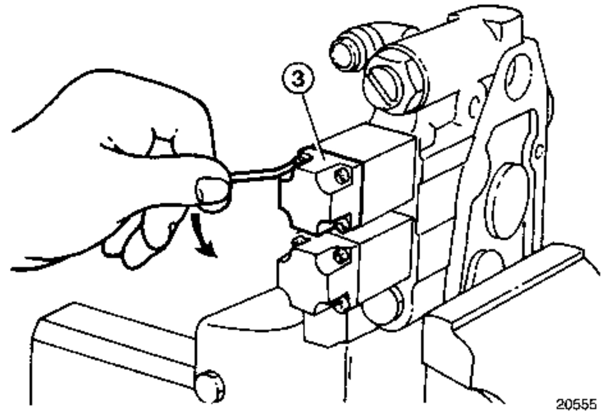
1. Unscrew the check valve (1).



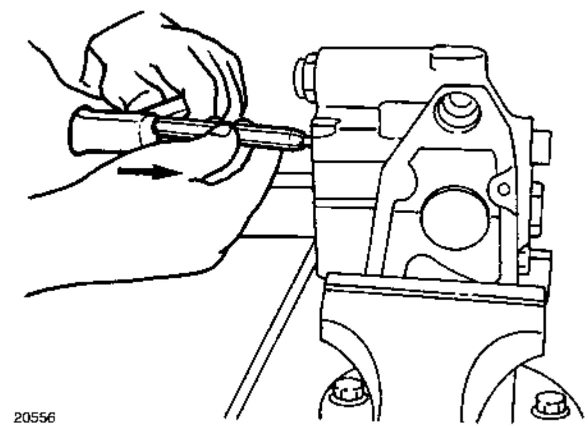
2. Recover the check valve body (1), ball and the two springs.



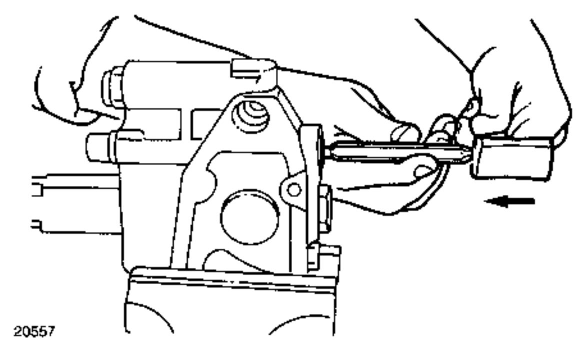
3. Unscrew and remove the drain valve (2).



4. Remove screws and electro–magnet (3).



5. Acting on electro–magnet side, push out some of the inside parts.



6. Acting on the side opposite the electro–magnets, retrieve the remaining inside parts.

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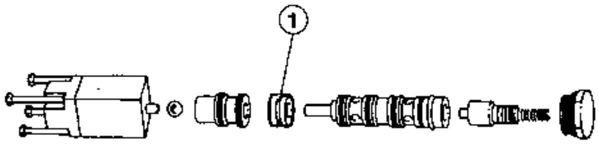
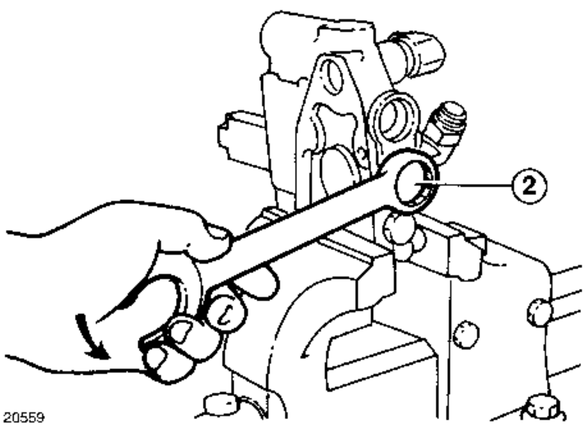


20558

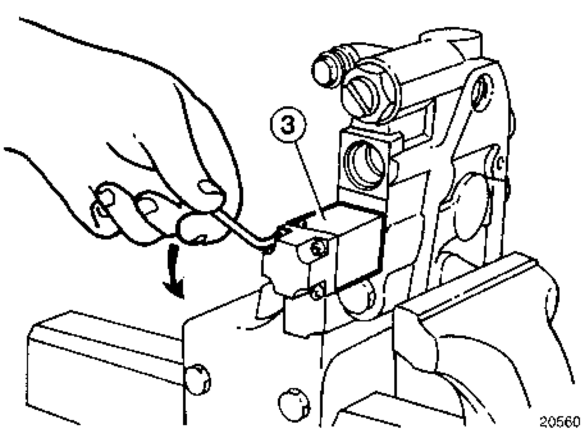
7. Check all the internal parts of the drain and drain control valves and replace any damaged one.

Note – Should seal (1) need to be replaced together with its anti–extrusion ring, fit the latter in the shortest possible time to avoid plastic deformation.



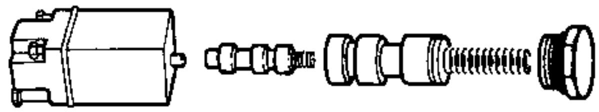
20559

8. Unscrew and remove the delivery valve (2).



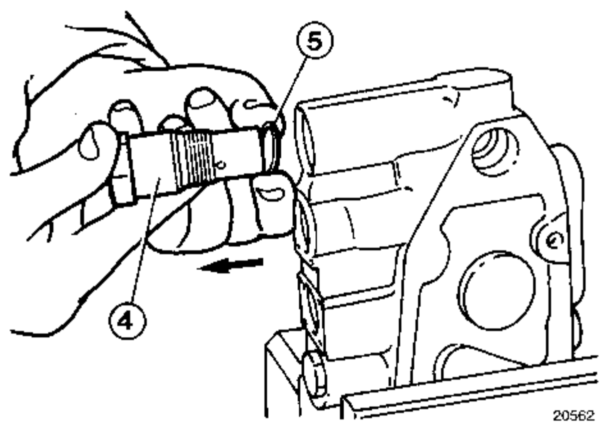
20560

9. Remove the screws and electro–magnet (3).



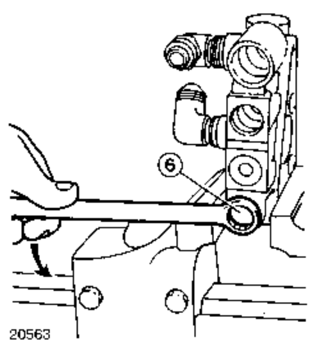
20561

10. Retrieve inside parts of the delivery and arm raising control valves and verify their integrity.

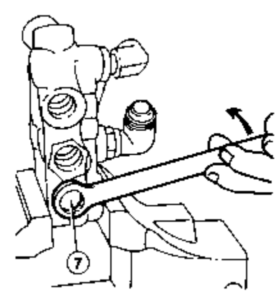


20562

11. Remove the hydraulic cylinder safety valve (4) and recover gasket ring (5).

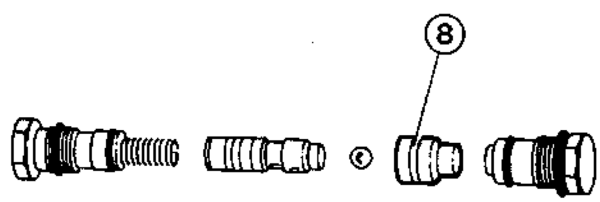


20563



20564

12. Remove plugs (6 and 7) of the response control valve.



20565

13. Retrieve inside parts of the control valve and verify their integrity.

Note – Should seal (8) need to be replaced, together with its anti–extrusion ring, fit the latter in the shortest possible time to avoid plastic deformation.

14. Proceed to assemble all parts of the hydraulic control valve taking the following points into account:

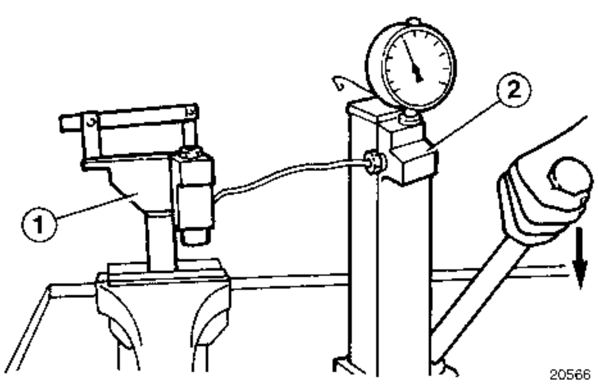
a. proceed by reversing the previous disassembly sequence of operations starting from no. 13 back to no. 1;

b. verify all oil seals and, if necessary, replace them referring to the note on page 35–60 and the one above on this page;

c. carry on the drain valve adjustment and setting as per indications that follow on this same page;

d. see illustrations on page 35–58 for the correct placement of various component parts.

Fluid tightness check and setting of the drain valve

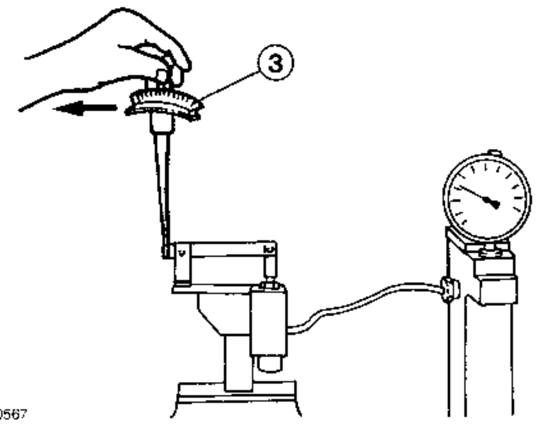


20566

15. Install the drain valve together with its holder and complete with O–rings and associated anti–extrusion rings on fixture tool no. **294003** (1) and lock it in place with its own plug.

16. Connect fixture tool no. **294003** (1) to hand pump tool no. **290284** (2) supplied with **IDRAULICAR AP 51**

17. Actuate hand pump (2) to bring oil pressure to 250 bar (255 kg/sq.cm or 3625 psi) and check, on pressure gauge, that pressure takes over 6 sec. time to drop from 200 bar (204 kg/sq.cm = 2900 psi) to 100 bar (102 kg/sq.cm = 1450 psi).



20567

18. Bring again oil pressure up between 100 and 200 bar (102 to 204 kg/sq.cm = 1450 to 2900 psi) and, using a torque wrench (3) connected at 90° as shown in the above figure, verify opening of the drain valve starting from an applied torque of 0.65 to 0.70 daNm (kgm or 4.70 to 5.05 ft.lb).

19. Should this condition fail to occurr act on the spring adjustment shim pack (13, page 35–58) by adding or removing shims so to obtain the correct load by the valve opening spring. Hold in mind that the thickness of each shim of pack (13) is 0.15 mm (.01 in).

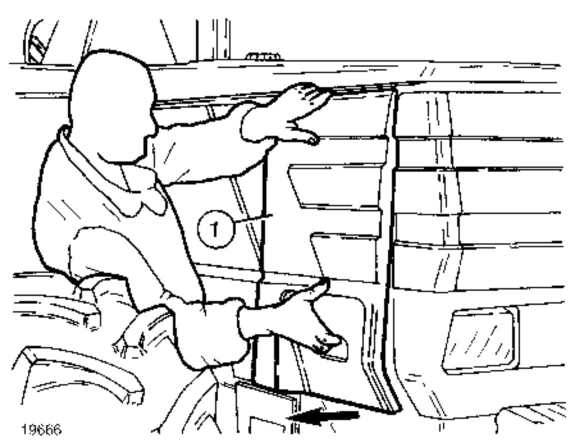
ELECTRONICALLY–CONTROLLED HYDRAULIC LIFT DRAFT SENSOR

Removal–Installation (Op. 35 130 56)

Proceed as follows:

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.



19686

1. Remove the RH side front body panel (1).

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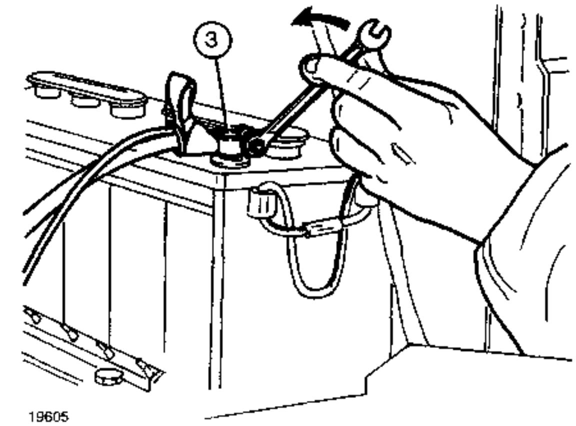
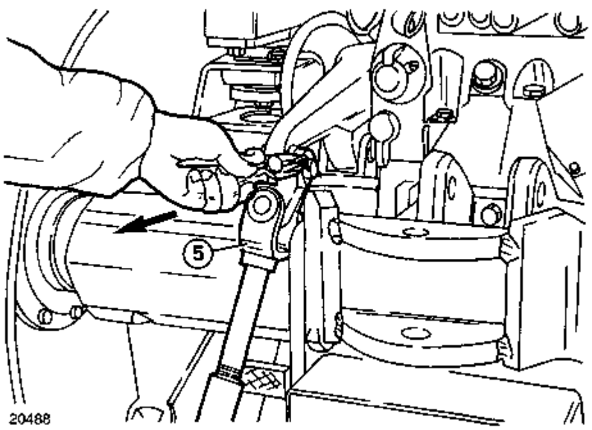
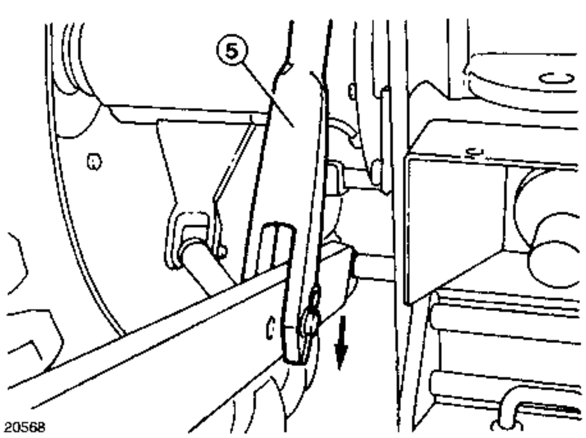


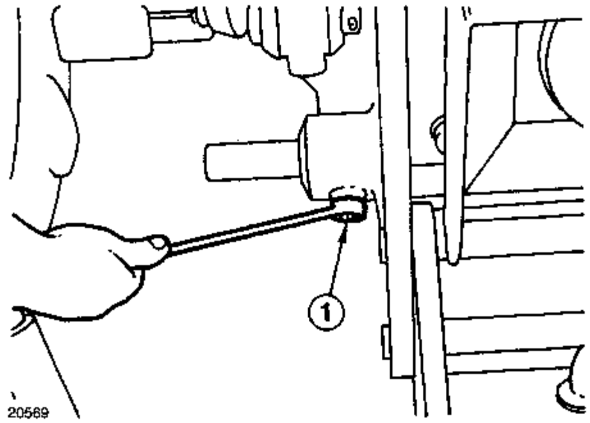
2. Disconnect the battery positive cable (3) and insulate it.



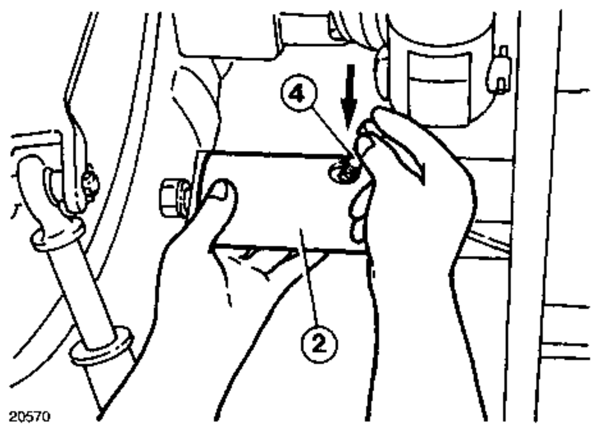
3. Disconnect side lift rod (5) from lift arm (on both sides).



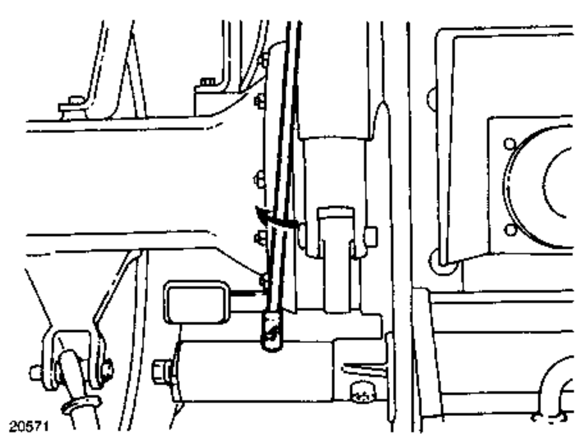
4. Take the lift rod (5), together with associated lower link, off the draft sensor pin.



5. Remove screw (1) securing the draft sensor to tits supporting bracket.



6. Install tool **292847/1** (2), complete with inside screw (4), on the draft sensor.



7. Lock the above mentioned inside screw (4) onto the draft sensor using a suitable wrench.

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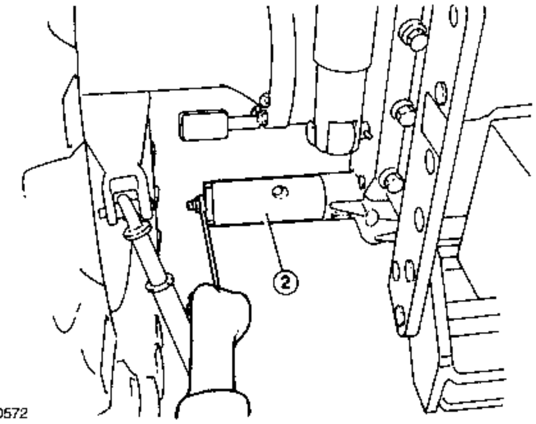
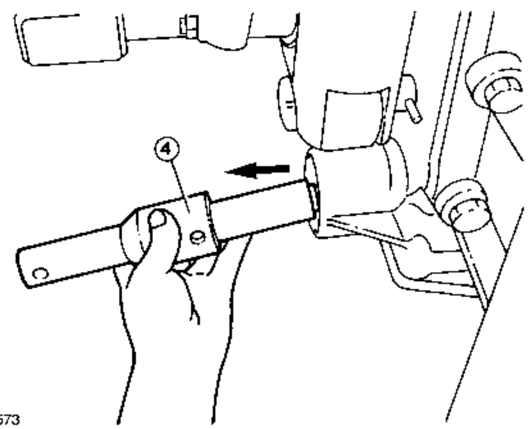


20572

8. Act upon the tool **292847/1** (2) outside screw until the sensor is free.



20573

9. Disconnect tool (2), withdraw the draft sensor (4), disconnect it electrically, recover the O–ring and inside bushing.
10. Re–install sensor on its supporting bracket taking the following points into account:

    a. proceed by reversing the previous removal operations starting from no. 9 back to no. 1;

    b. keep in mind that the draft sensor must be introduced maintaining the lower link locking hole in vertical position.

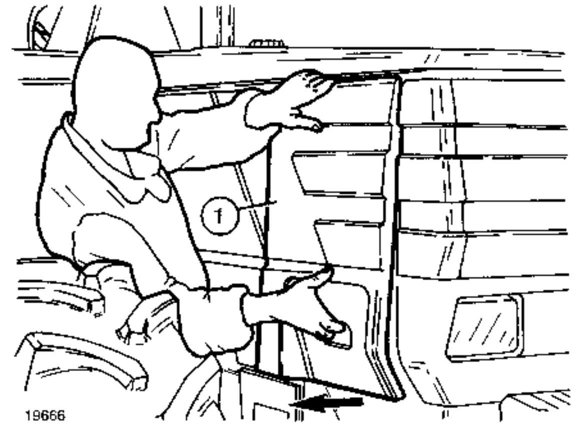
HYDRAULIC LIFT ELECTRONIC CONTROL UNIT (ECU)

Replacement (Op. 35 130 30)

Proceed as follows:

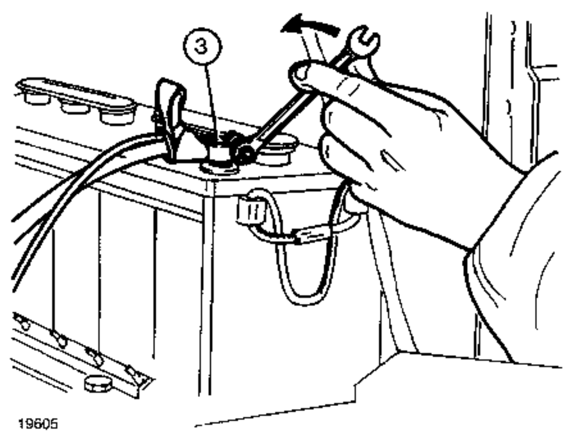
CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.



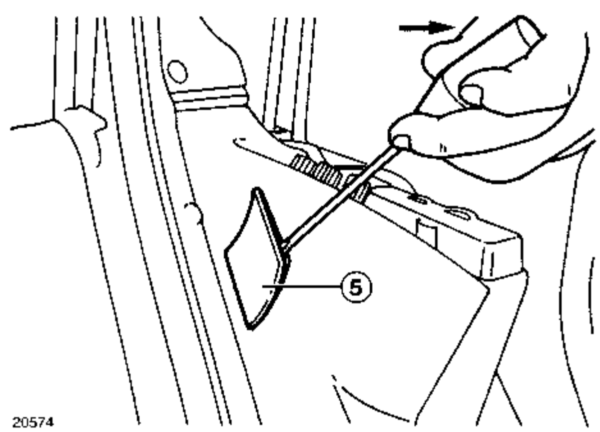
19666

1. Remove the RH side front body panel (1)



19605

2. Disconnect the battery positive cable (3) and insulate it.



20574

3. Remove the side lid (5) from the cab RH side panelling.

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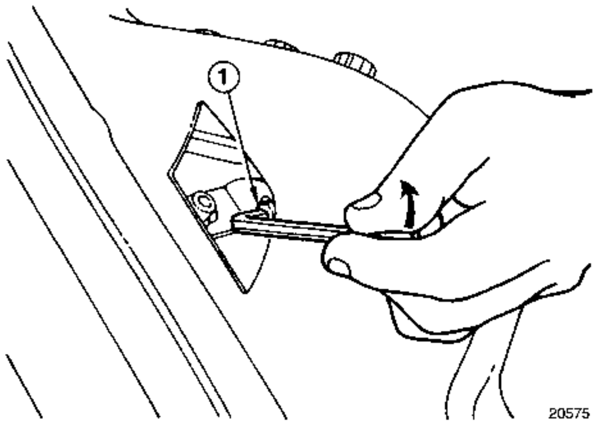
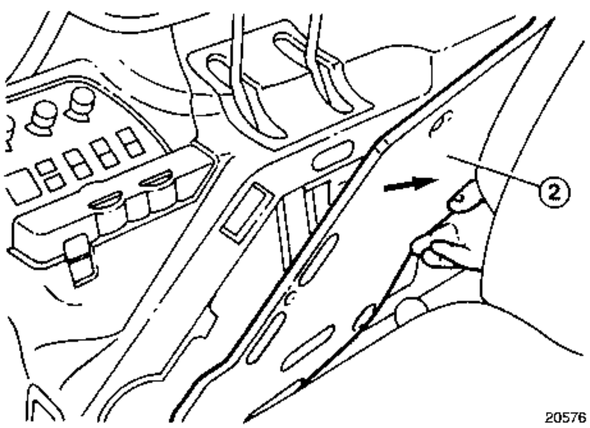
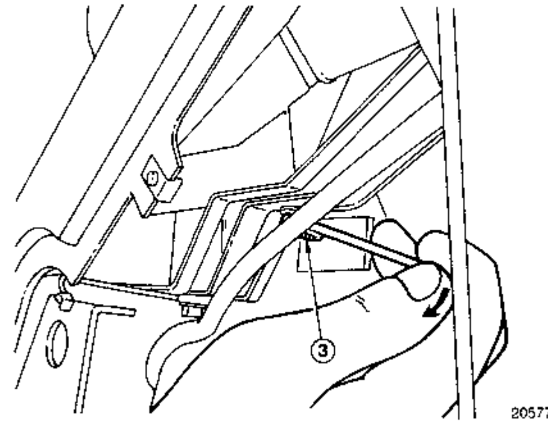


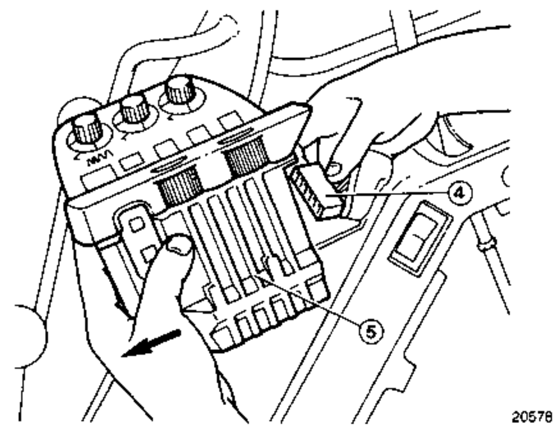
4. Remove the ECU side mounting screw (1).



5. Remove screws and the RH side lining panel (2).



6. Remove the two ECU mounting screws (3) located inside the compartment made accessible by the previous removal of panel (2).



7. Disconnect electric terminals (4) and retrieve the ECU.

8. Re–install the ECU by reversing the previous removal operations starting from no. 7 back to no. 1.

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HYDROSTATIC STEERING

Type	hydrostatic control
Hydraulic system	indipendent, hydraulic pump feeding from transmission case oil compartment
Oil filter	paper element, same of hydraulic lift
Control valve, make	DANFOSS
Type	ORBITROL, rotating–valve type directly controlled from steering column: manual steering is assured in case of oil pump is defective
Outfit code:	
– 2 WD models	OSPC 100 ON – 150 N
– 4 WD models	OSPC 160 ON – 150 N
Pressure relief valve setting (24, page 41–3):	
– 2 WD models . . . . bar	100 = 102 kg/cm^2 (1450 psi)
– 4 WD models . . . . bar	125 = 127 kg/cm^2 (1822 psi)
Cylinder safety valve setting (33, page 41–3):	
– 2 WD models . . . . bar	160 = 163 kg/cm^2 (2320 psi)
– 4 WD models . . . . bar	185 = 189 kg/cm^2 (2682 psi)

HYDRAULIC PUMP

Type	gear–type, incorporated metering device, feeding from transmission oil compartment
Placement	on transmission rear drive case, R.H. side
Model	A31 XRP 2
Make	FIAT
Drive	through PTO shaft
Rotation (from drive end)	counterclockwise
Engine/pump rpm ratio	1:1.261
Rated speed (with engine turning at rated power speed)	2092 rpm
Corresponding nominal capacity	41 l/min(8.2 UK Gal/min)
Nominal capacity at 1000 rpm	14.8 l/min (3.25 UK Gal/min)
Controlled capacity starting speed	1150 rpm
Controlled delivery capacity	17 to 21 l/min (3.75 to 4.62 UK Gal/min)

(follows)

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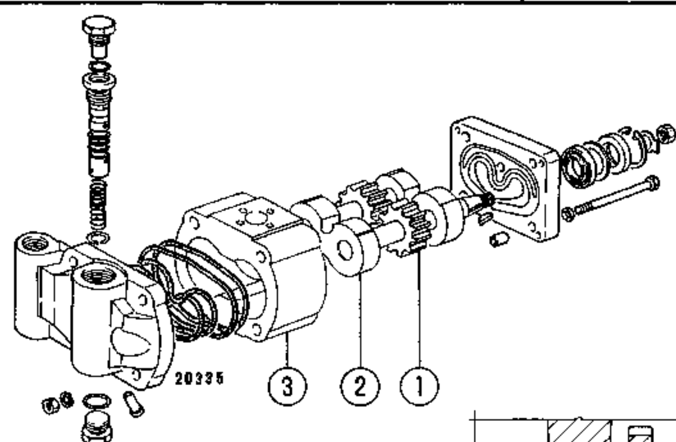
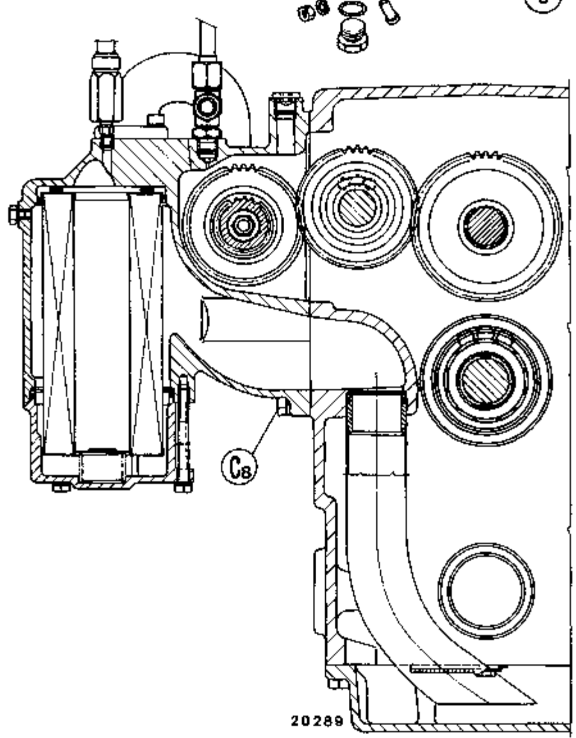
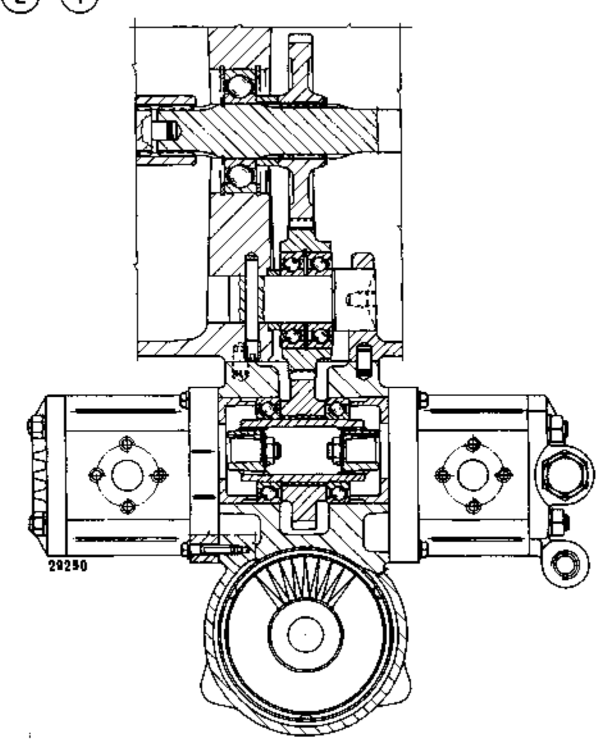
HYDRAULIC PUMP

(cont.)

O.D., drive and driven gear shafts	17.400 to 17.418 mm (.6850 to .6857 in)
I.D., bearing seats	17.450 to 17.470 mm (.6870 to .6878 in)
Running fit, shaft/seat clearance	0.032 to 0.070 mm (.0012 to .0027 in)
– permissible wear limit	0.1 mm (.0039 in)
Radial clearance, pump gears w/body	0.020 to 0.064 (.0008 to .0025 in)
Max. permissible pump wear, suction end, gear compartment	0.1 mm (.0039 in)
Width, gears (1)	24.000 to 24.015 mm (.9449 to .9649 in)
Width, bearings (2)	24.490 to 24.510 mm (.9642 to .9649 in)
Width, gear and bearing seat, pump body (3)	73.135 to 73.160 mm (2.8793 to 2.8803 in)
End play, gear/bearing in pump body (manufacturing and reconditioning dimension)	0.100 to 0.180 (.0039 to .0071 in)







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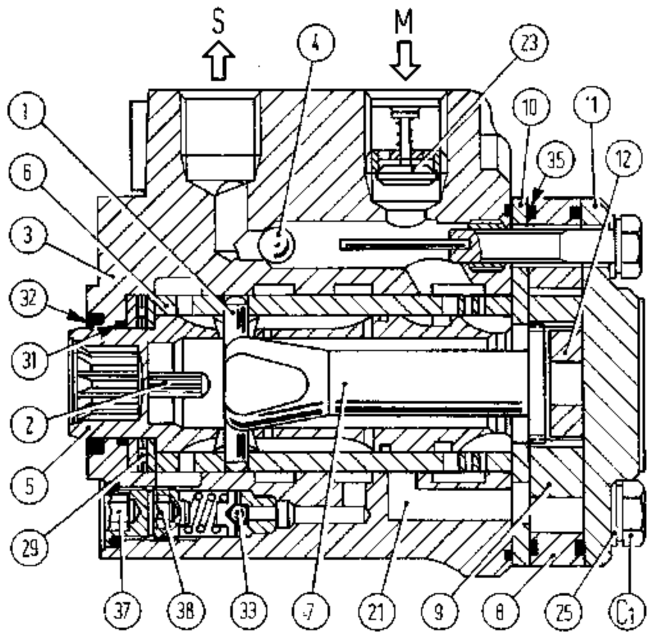

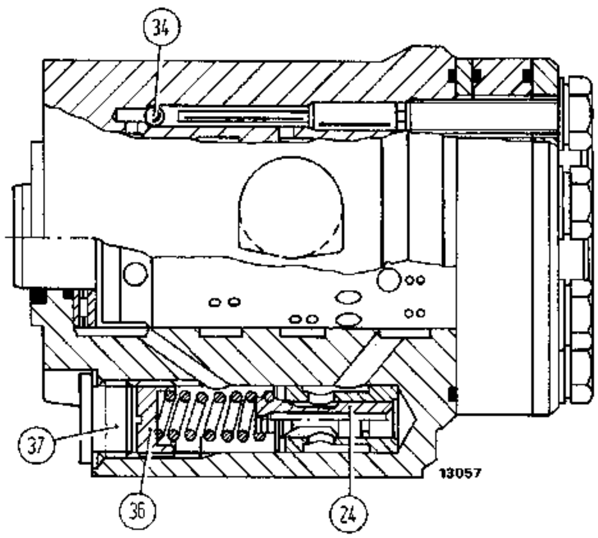

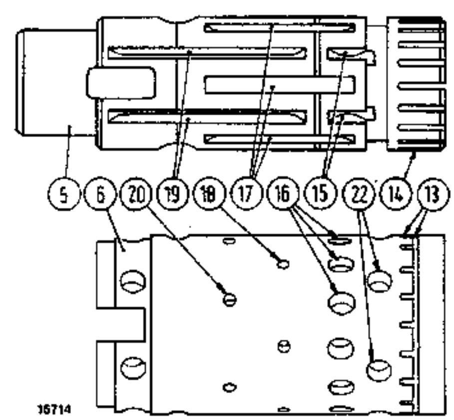

Sectional views of the hydrostatic steering control valve

C_1. Control valve cover screws – M. Pump delivery – S. Discharge – 1. Drive pin, sleeve (6) and rotor shaft (7) – 2. Sleeve (6) return springs – 3. Control valve body – 4. Check valve – 5. Rotary valve– 6. Sleeve, valve (5) seat – 7. Rotor (9) drive shaft – 8. Rotor stationary ring – 9. Rotor – 10. Abutment plate – 11. Cover – 12. Spacer – 13 and 14. Neutral position oil ports – 15. Rotor feeding oil passages (q.ty:6) – 16. Oil ports (q.ty:12) communicating with passages (15 and 17), alternatively – 17. Outlets (q.ty:6) to power cylinder connecting with with rotor outlet passages and ports (18 and 20) – 18. Power cylinder RH chamber outlet or exhaust ports (q.ty:6)–19. Power cylinder exhaust passages (q.ty:6) communicating with ports (18 and 20) – 20. Power cylinder LH chamber outlet or exhaust ports (q.ty:6) – 21. Connecting ports (16) to rotor inlets or outlets – 22. Feed ports to passages (15) – 23. Check valve – 24. Pressure relief valve – 25. Washer – 26. Connecting line to power cylinder LH chamber – 27. Connecting line to power cylinder RH chamber – 29. Thrust bearing – 31. Oil seals – 32. Dust shield – 33. Power cylinder safety valves – 34. Compensating valves – 35. O–ring seals – 36. Valve (24) set screw – 37. Plugs – 38. Valve (33) set screw.

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HYDROSTATIC STEERING TROUBLE–SHOOTING CHART

Fault	Diagnosis	Correction
Oil leakage at hydrostatic unit: **a.** Drive end. **b.** Cover end.	**1.** Defective O–ring seal (31, page 41–3).	Replace seal and associated anti–extrusion ring using special tool **293955**.
	2. Insufficient tightening of capscrews (C_1).	Tighten capscrews to specification torque value (24 to 36 Nm – 2.5 to 3.7 Kgm = 18 to 27 ft.lb), as indicated on page 41–20.
	3. Defective gaskets (25) or O–ring seals (35).	Replace gaskets and seals.
Hard steering.	**1.** Hydraulic pump inoperative.	Rectify pump.
	2. Check valve (4) stuck open, presence of impurities or missing ball.	Remove impurities and clean filter; fit a new ball in valve seat (if missing).
	3. Misadjusted pressure relief valve (24).	Adjust valve pressure setting.
	4. Pressure relief valve (24) stuck or open due to presence of impurities.	Remove impurities and clean filter.
	5. Steering column binding in bushing owing to rust, seizure, etc.	Rectify causes.
Loose steering.	**1.** Excessive clearance fit of steering column and rotary valve (5, page 41–3).	Replace worn parts.
	2. Excessive clearance fit of shaft (7) and drive pin (1).	Replace worn parts.
	3. Excessive spline clearance fit of shaft (7) and rotor (9).	Replace worn parts.
	4. Summation of previous clearances.	Replace parts evidencing more wear.
	5. Broken or weakened leaf springs (2).	Replace springs.
Steering wheel turns normally but:	**1.** Poor fluid tightness of power cylinder seal.	Replace seal.
a. Steering is too slow.	**2.** Broken cylinder rod.	Replace damaged part.
b. No steering.	**3.** Broken rotor shaft (7, page 41–3) or pin (1).	Replace damaged part.
With engine stopped, steering is inoperative.	**1.** Excessive wear between rotor (9, page 41–3) and stationary ring (8).	Replace worn parts.
	2. Damaged check valve (23).	Replace control valve.
	3. Power cylinder safety valves (33) stuck open owing to presence of impurities **or because damaged**.	Remove impurities and clean filter or replace control valve.

(follows)

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HYDROSTATIC STEERING TROUBLE–SHOOTING CHART

(cont.)

Fault	Diagnosis	Correction
Jerking and chattering at steering wheel, steering out–of–control, tractor wheels turning opposite to steering direction.	**1.** Wrong hydrostatic phasing.	Rectify phasing.
	2. Inverted oil lines to power cylinder.	Rectify connections.
Impossible to hold selected course, continuous corrections needed.	**1.** Worn cylinder piston gland.	Replace gland.
	2. Power cylinder safety valves (33, page 41–3) or compensating valves (34) stuck open owing to presence of impurities, or damages.	Remove impurities and clean filter or replace control valve.
	3. Worn control valve mechanical components.	Replace control valve.
Impossible to obtain hydrostatic neutral phase. When manually controlled, steering is normal, otherwise steering wheel tends to turn on its own, or remains stationary, but steering action slowly continues along the direction originally selected ("motoring" effect), requiring continuous corrections of steering wheel asset.	**1.** Broken or weakened leaf springs (2) controlling sleeve (6) return to neutral.	Replace leaf spring pack.
	2. Sleeve (6) and rotary valve (5) stuck on delivery owing to presence of impurities.	Remove impurities and clean filter.
	3. Sleeve (6) squeezed on rotary valve (5) owing to excessive fluid pressure.	Check pressure setting of pressure relief valve (24, page 41–3).
Front wheel shimmy.	**1.** Air inside power cylinder.	Bleed system and remove causes of any entry of air.
	2. Worn steering linkage mechanical joints.	Replace worn parts.
	3. Power cylinder safety valves (33) or check valve (34) stuck open owing to presence of impurities, or damaged.	Remove impurities and clean filter or replace control valve. Check pump and pressure relief valve (24, page 41–3) setting.
Difficult steering in general or in one direction only.	**1.** Fluid pressure insufficient.	Check oil pump and relief valve pressure setting (24, page 41–3).
	2. Poor fluid tightness inside control valve.	Replace control valve.
	3. Misadjusted power cylinder safety valves (33) or presence of foreign particles tightness of either valve.	Remove impurities and clean filter. If problem persists, replace control valve.

SERVICE TOOLS

ATTENTION – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code **(X)**.
Besides, to work safely and achieve the best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjunction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

List of the special tools necessary to perform service operations covered by this section of the Manual:

	75297784	Test bench checking equipment for hydrostatic steering control valve (see page 22 for service tools).
	293390	Retaining lever, rotor.
X	**291182/1**	Puller, steering wheel.
	292870	Universal pressure gauge kit.
X	**293955**	Installer, toroidal seal.
	292927	Extractor, power cylinder hinge pin.

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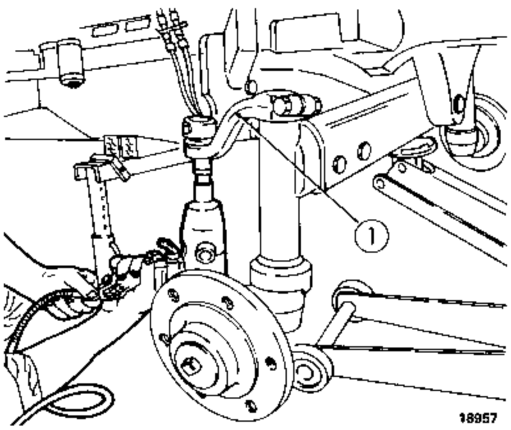
FRONT AXLE – POWER STEERING CYLINDER
Removal – Installation (Op. 41 216 20)

CAUTION

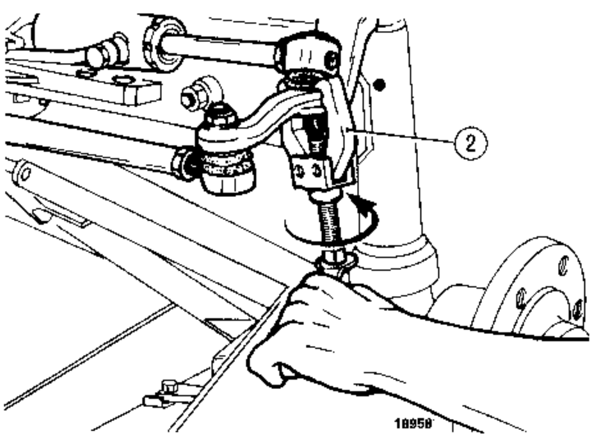
Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes

To remove the power steering cylinder proceed as follows:

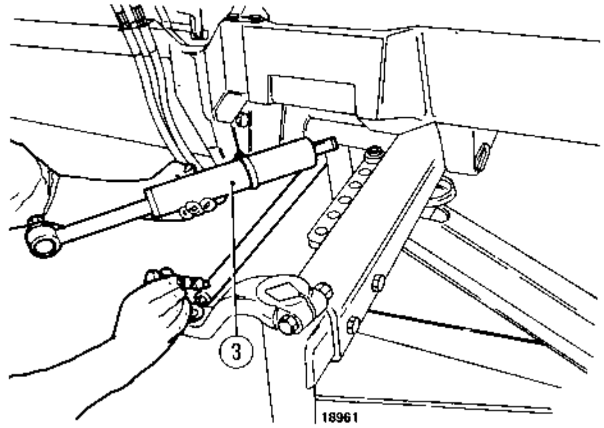
1. Disconnect battery cables.
2. Disconnect the cylinder inlet and outlet oil connections and remove hose clamps.



3. Remove the nut securing the cylinder rod ball head to the steering arm(1).



4. Using puller (2), separate ball–head socket joint from power cylinder rod.



5. Remove the power cylinder mounting pin to front axle and retrieve power cylinder (3).
6. At installation proceed by reversing the removal sequence of operations.

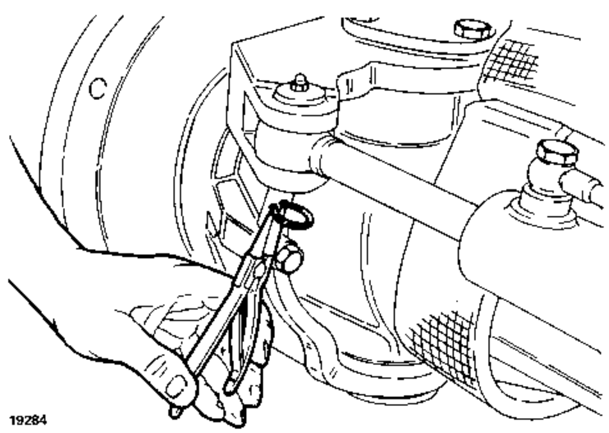
LIVE FRONT AXLE – POWER STEERING CYLINDER
Removal–Installation (Op. 41 216 10)

CAUTION

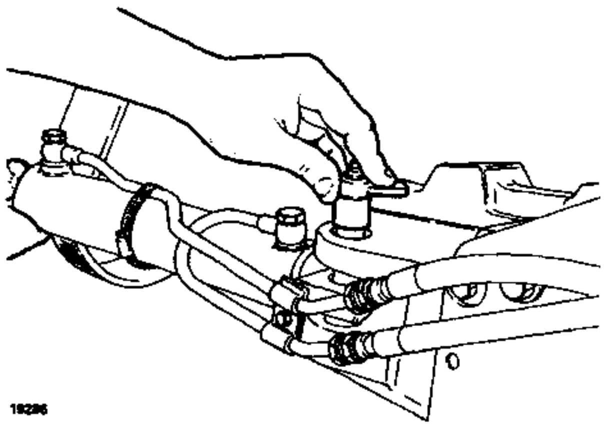
Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes

To remove the power steering cylinder from the front axle proceed as follows:

1. Disconnect battery cables.
2. Disconnect the cylinder inlet and outlet oil connections and remove hose clamps.



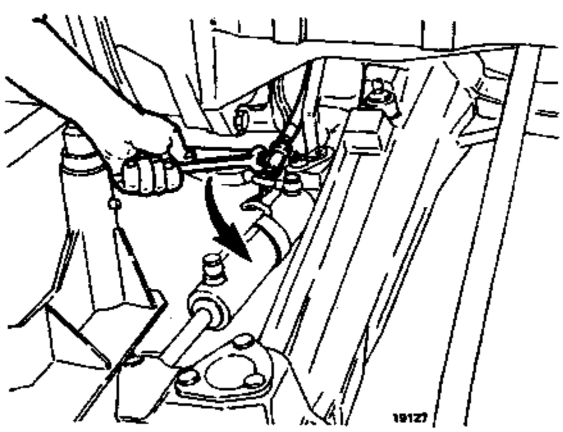
3. Remove the retaining snap ring and the cylinder rod – steering knuckle carrier pivot pin.



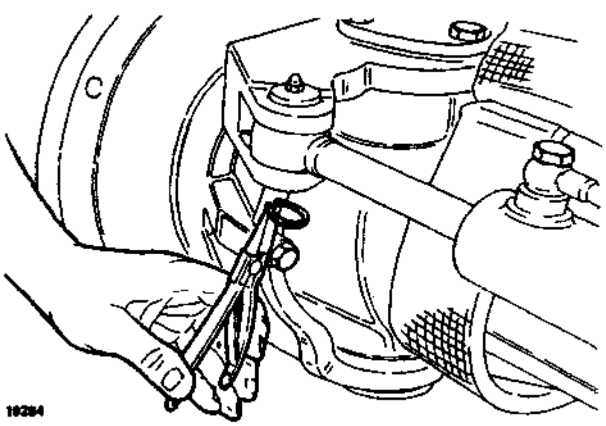
4. Remove the retaining screw, the pin securing the power cylinder to front axle housing and finally retrieve it.

In case both cylinders complete with oil intake lines should be removed, proceed as follows:

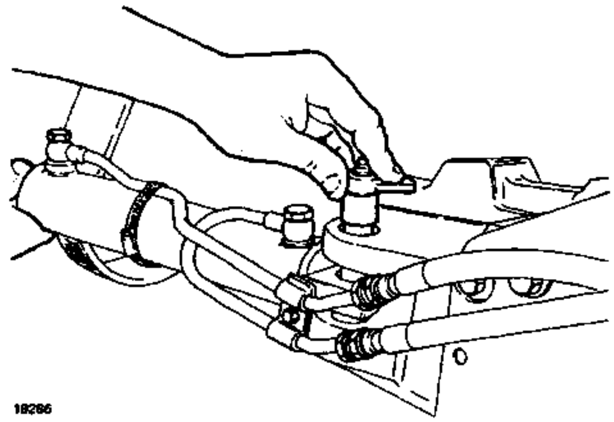
1. Remove battery cables.



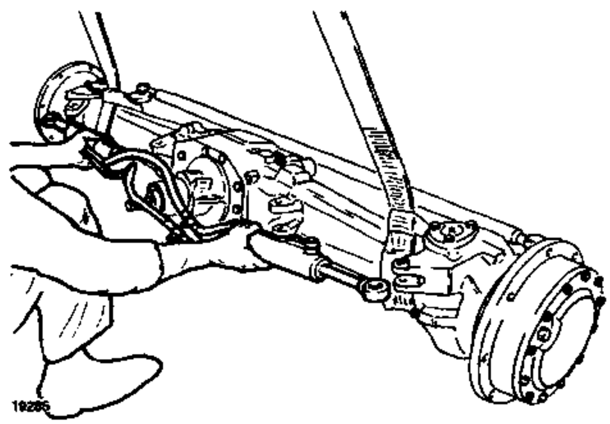
2. Remove the two connections of power steering plant and cylinder oil lines.



3. Remove the retaining rings and the cylinder rod – steering knuckle carrier pivot pin.



4. Remove the screws and the pins securing cylinders to front axle housing.



5. Remove both cylinders complete with their oil intake lines.

POWER STEERING CONTROL VALVE
Removal–Installation (Op. 41 204 30)

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes

To remove the power steering control valve proceed as follows:

1. Remove side panels.
2. Disconnect battery cables.

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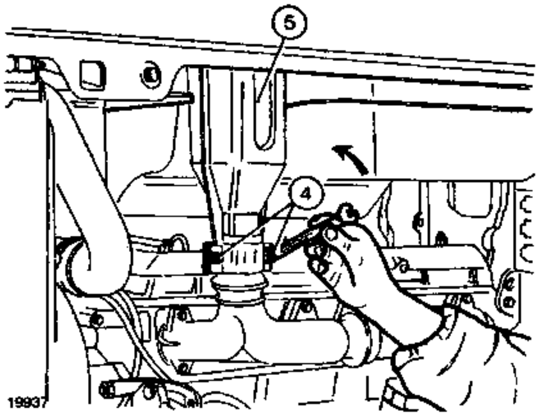
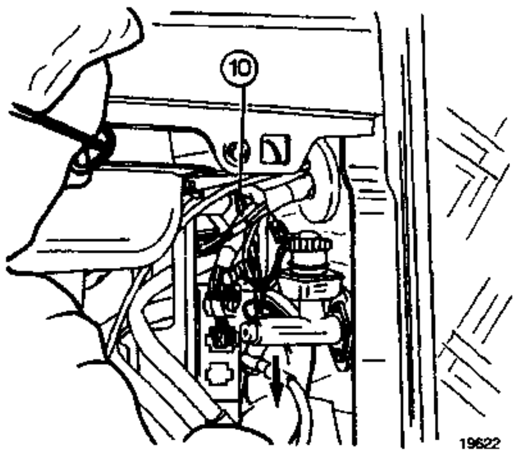
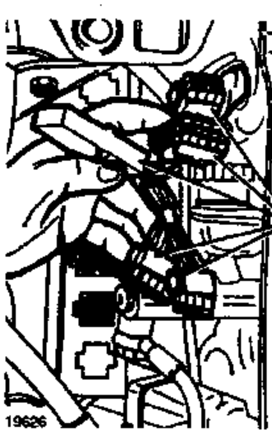
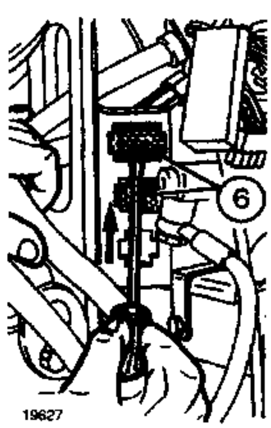


3. Remove attaching screws (4) and the exhaust muffler (5).

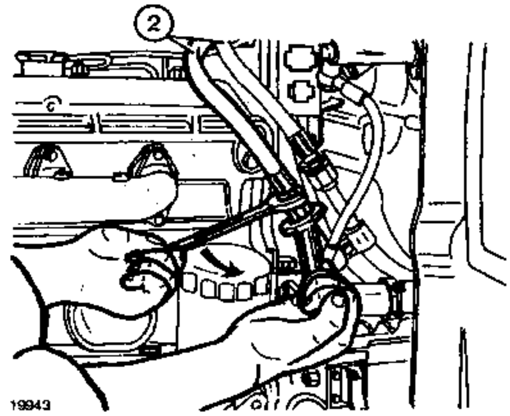


4. Disconnect the windshield washer tubelet (10) withdrawing it from the fitting located on the fixed central hood section.
5. Remove the fixed central hood section.

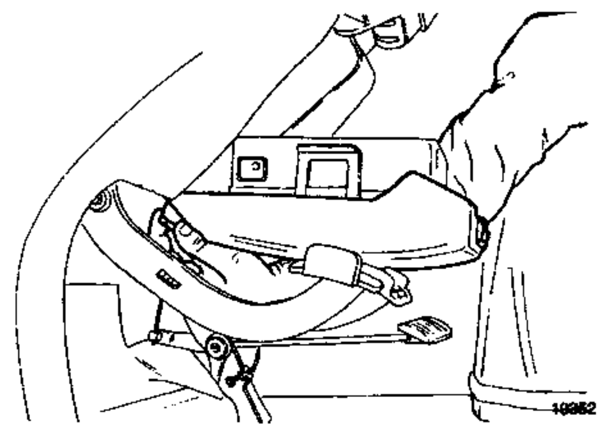




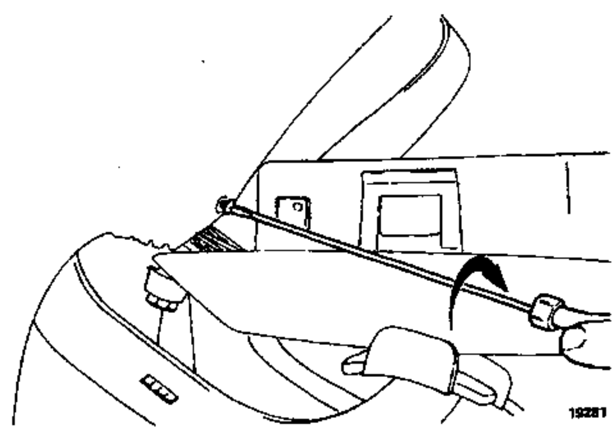
6. Disconnect electrics (5 and 6).



7. Disconnect the four oil inlets and outlets from the control valve.



8. Loosen the knob and open the lid of the electrical fuse and relay compartment.



9. Remove the three plugs located on the L.H. side of the protection panel on the left of the control board and the four retaining screws (three of these are located under the three plugs while the fourth one is positioned in the central part of the panel, corresponding to the electrical fuse and relay compartment).

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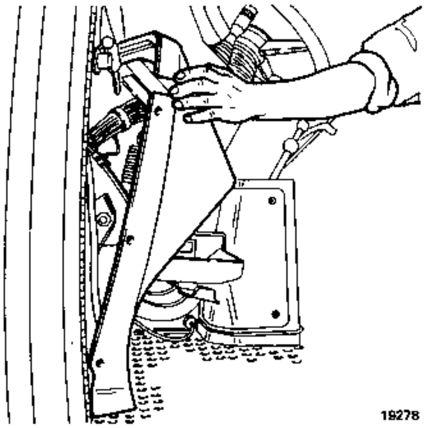
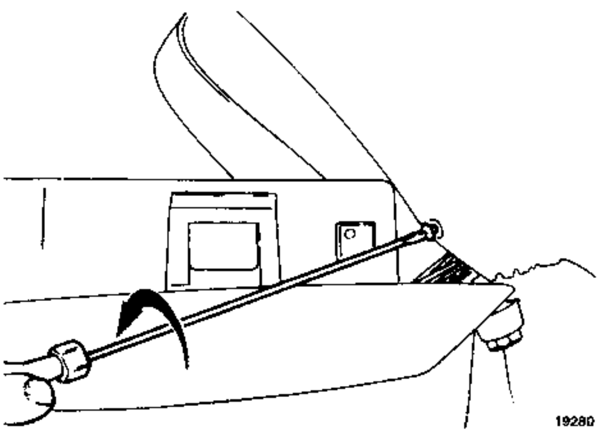


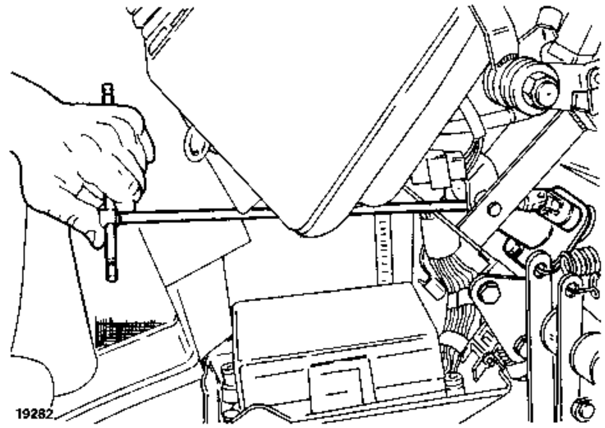
10. Remove the control board L.H. side panel.



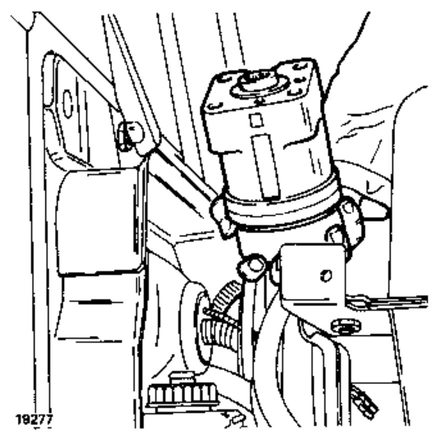
11. Remove the three plugs located on the R.H. side of the protection panel on the left of the control board and the four retaining screws (three of these are located under the three plugs while the fourth one is positioned in the central part of the panel, corresponding to the electrical fuse and relay compartment).

12. Remove the control board R.H. side panel.

Note - Removing the L.H. and R.H. side control board protection panels is not mandatory for the subsequent removal of the power steering control valve; however, it is recommended because it allows considerably easier performance of the operations that follow.



13. Remove the four screws securing the control valve onto the steering shaft.



14. Retrieve the control valve from the outside, cabin or platform.

15. When re–installing the control valve pay attention to the following important points:

a. proceed by reversing the removal sequence of operations starting from no. 14 back to no. 1;

b. make sure that the holes on the hydrostatic control valve are aligned with the screws securing it to the steering column.

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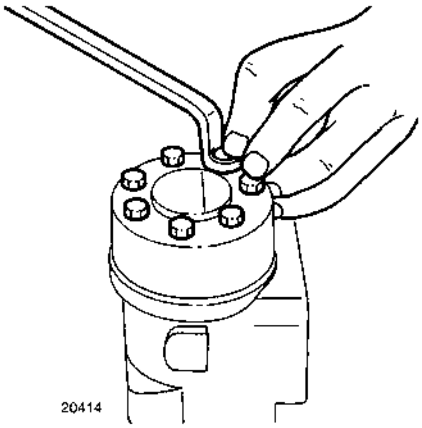
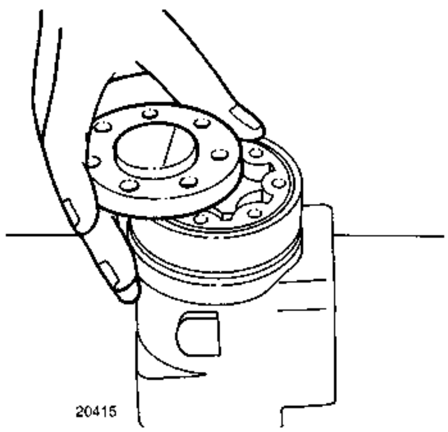
HYDROSTATIC STEERING CONTROL VALVE
Disassembly – Assembly (Op. 41 204 34)
w/ control valve removed

To disassemble the hydrostatic steering control valve, removed from tractor, proceed as follows:



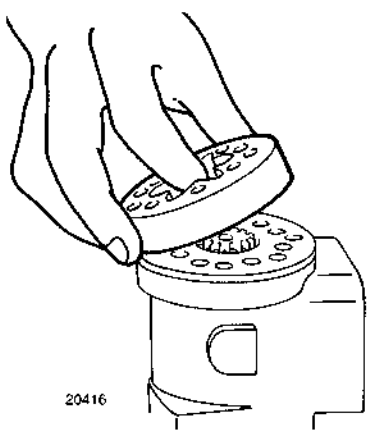
20414

1. Remove cover screws.



20415

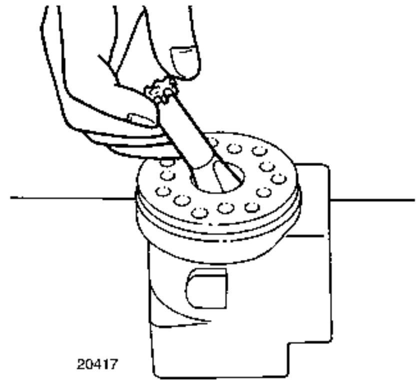
2. Remove cover by sliding it sideways.



20416

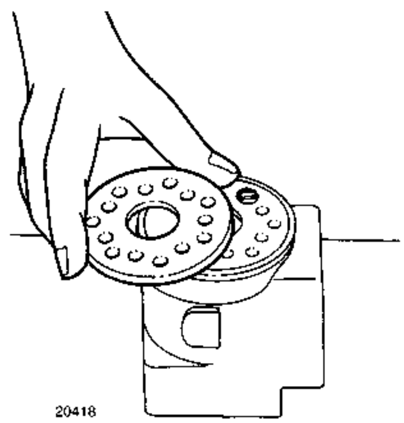
3. Remove the rotor stationary ring, rotor and associated inside spacer.

4. Remove the two o–rings fitted on the rotor stationary ring.



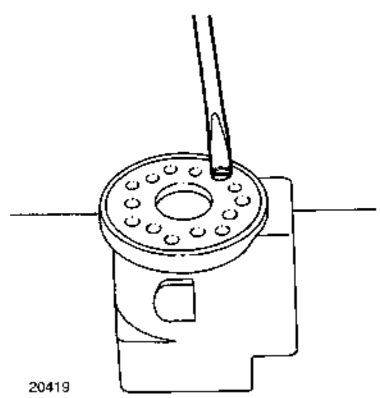
20417

5. Pull rotor drive shaft out.



20418

6. Remove thrust washer.



20419

7. Remove threaded plug from the check valve seat.

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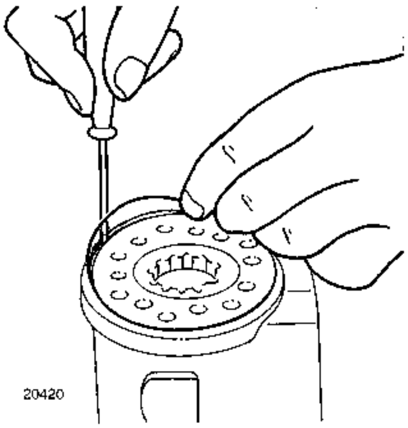
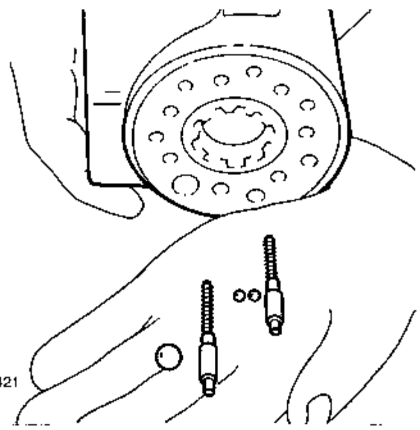
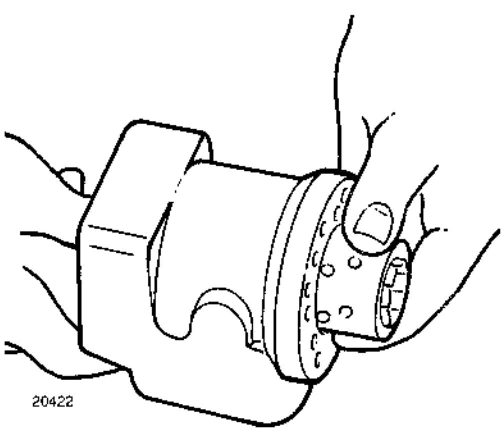

20420

8. Remove O–ring from control valve.

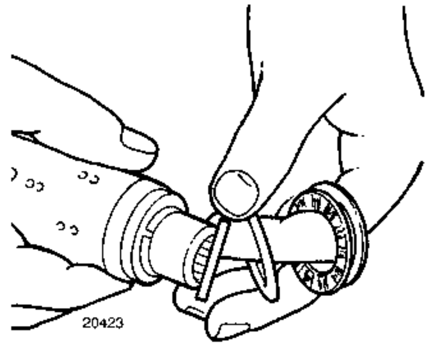

20421

9. Turn the control valve over and remove the check valve ball, the two balls with associated pins and the flow valve springs.

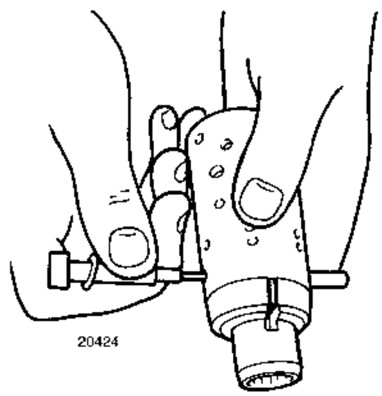

20422

10. Place the control valve body and rotor drive shaft with the sleeve–drive shaft drag pin horizontal.

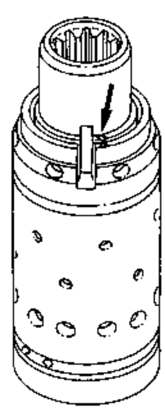
11. Push rotating valve inwards to allow withdrawal from control valve body of the same valve, sleeve and thrust bearing.


20423

12. Remove the rotating valve thrust bearing complete with the two outer rings and withdraw the spring retainer ring from the valve seat sleeve.


20424

13. Push the valve–sleeve drag pin out


20425

Attention: at assembly, two reference marks have been made on both rotary valve and sleeve, corresponding to the neutral position held by the springs. Prior to removing the springs, make sure that reference marks are clearly visible; if not, re–make them.

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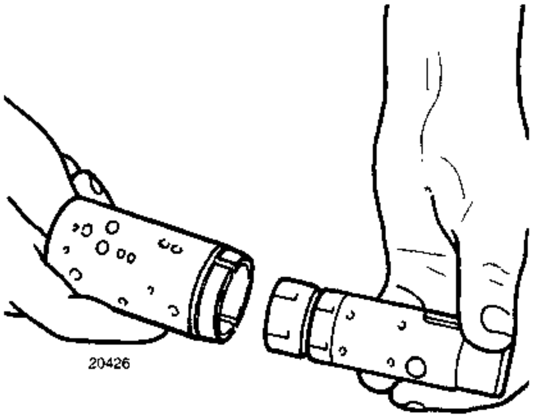
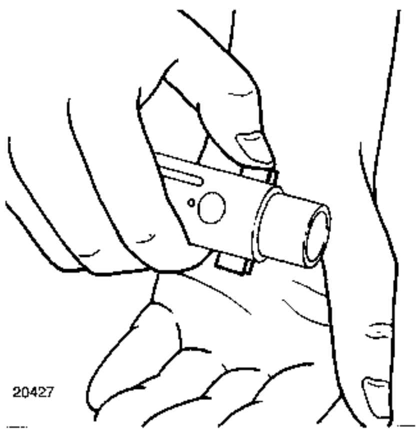


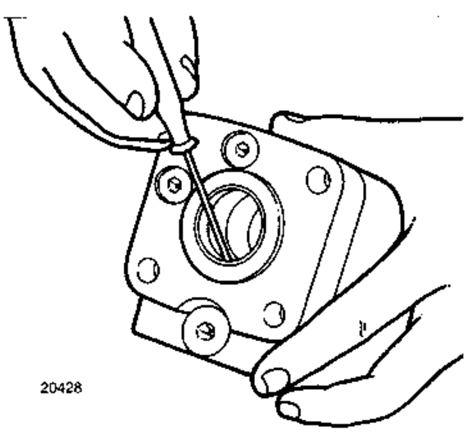
20426

14. Pull rotary valve out of valve seat sleeve.



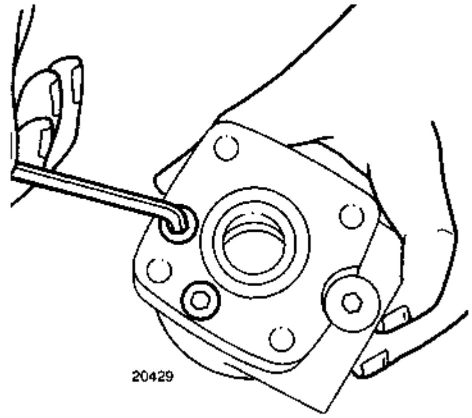
20427

15. Remove springs of the **neutral** position by withdrawing them from their seats.



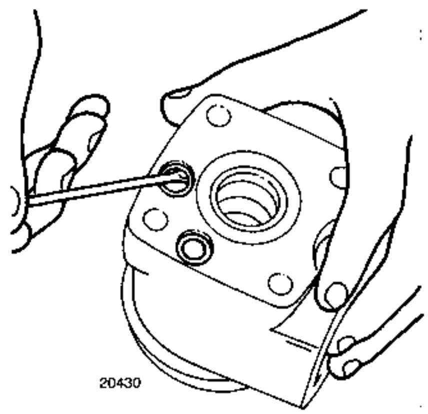
20428

16. Remove dust shield and O–ring from their respective seats in control valve body.



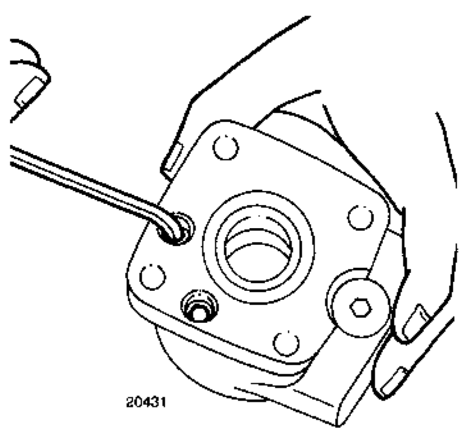
20429

17. Remove the cylinder safety valve plugs using a 6 mm Allen wrench.



20430

18. Remove seal washers.



20431

19. Remove the cylinder safety valve pressure set screws using a 6 mm Allen wrench.

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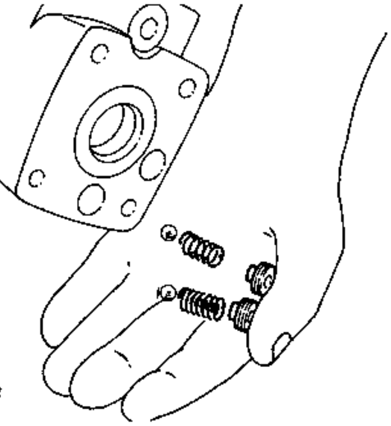
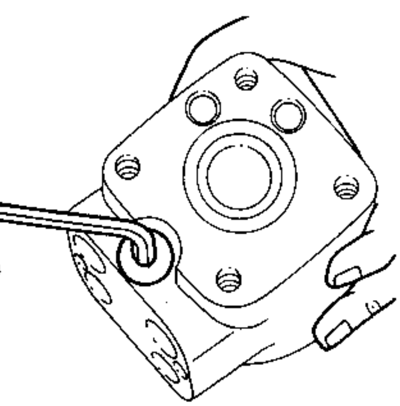


20432

20. Turn control valve upside down, extract the balls, springs and spring guides from the two cylinder safety valves.

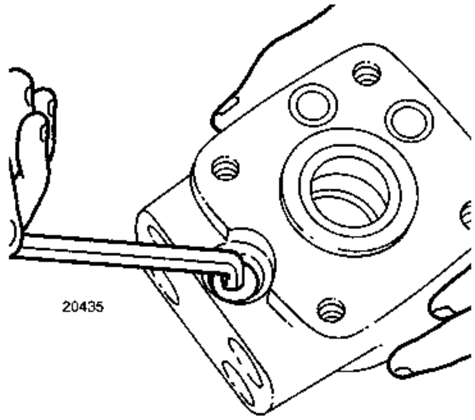
20433

Exploded view of the cylinder safety valves (disassembly–assembly sequence).



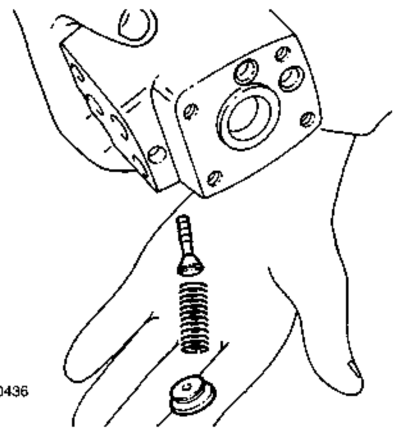
20434

21. Using a 6 mm Allen screw, remove the pressure relief valve threaded plug and extract the seal washer.



20435

22. Remove the pressure relief valve adjustment screw.



20436

23. Turn control valve upside down and complete disassembly by extracting the spring and the pressure relief valve piston.

20437

Exploded view of the pressure relief valve (disassembly–assembly sequence).

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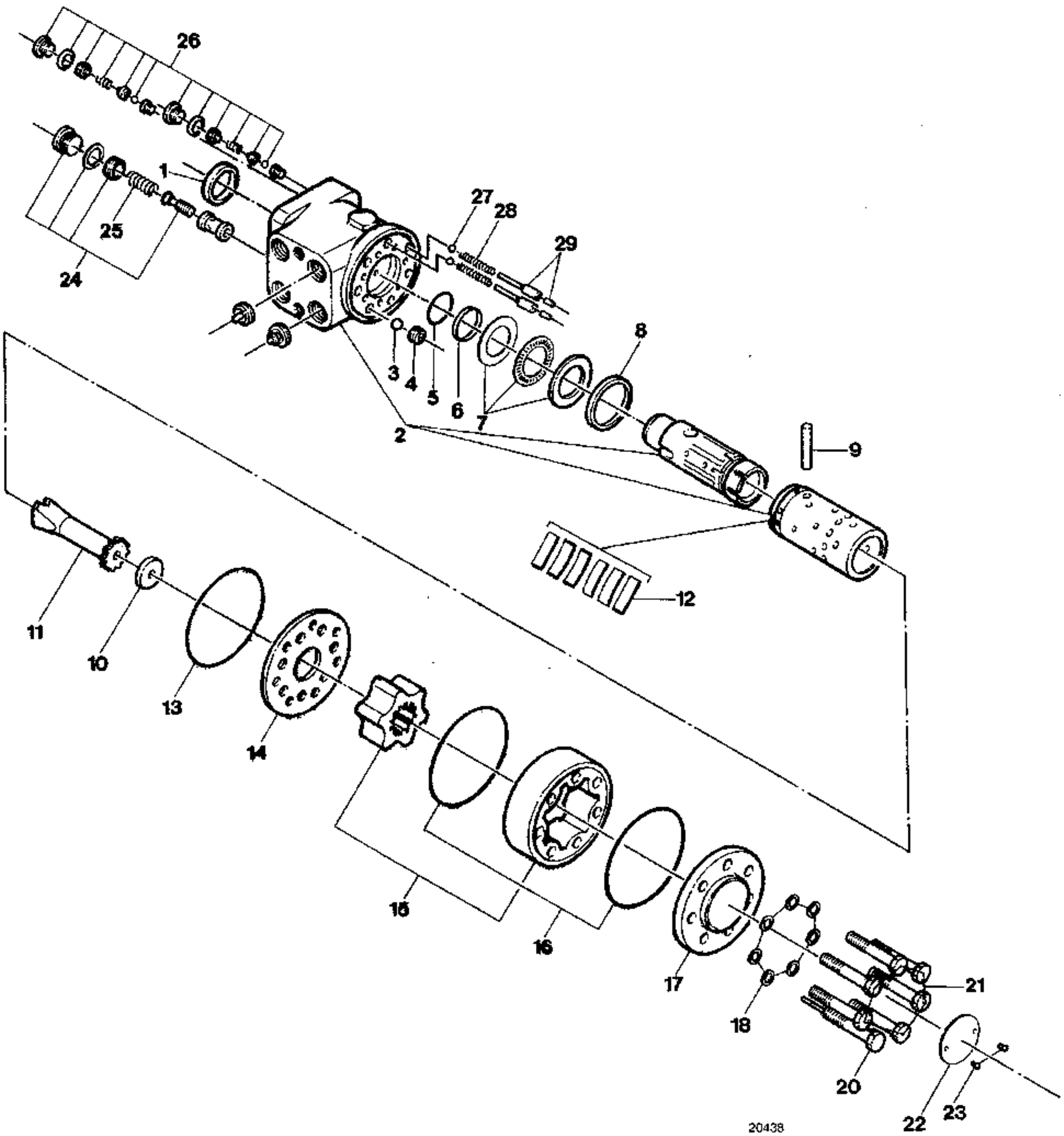

Exploded view of the hydrostatic steering control valve

1. Dust shield – 2. Control valve body, rotary valve and rotary valve housing sleeve – 3. Check valve ball – 4. Check valve threaded plug – 5. O–ring seal – 6. O–ring (5) back–up ring – 7. Thrust bearing parts – 8. Spring (12) retaining ring – 9. Rotor drive sleeve–shaft drag pin – 10. Spacer – 11. Rotor drive shaft – 12. Sleeve return springs to **neutral** – 13. O–ring seal – 14. Back–up ring – 15. Rotor and stationary ring – 16. O–ring seals – 17. Cover – 18. Washers – 20. Check valve seat set screw – 21. Cover screws – 22. Plate – 23. Plate screw – 24 and 25. Pressure relief valve and spring – 26. Cylinder safety valves – 27. Return valve balls – 28. Return valve springs – 29. Return valve pins.

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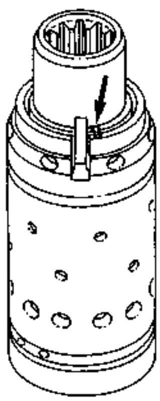
24. Clean all control valve parts thoroughly.

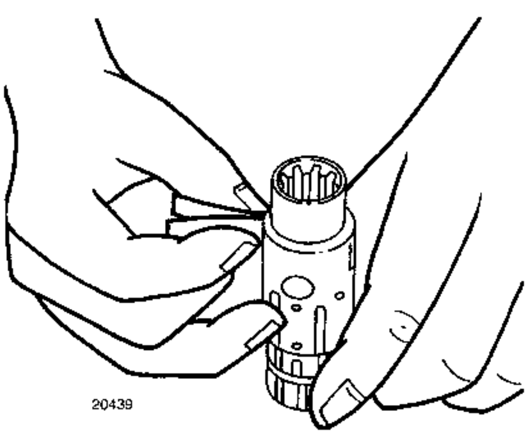
25. Replace washers and seals.

26. Check mechanical parts accurately and replace those showing signs of significative wear.

27. Prior to re–assembly, lubricate parts in hydraulic oil.


20425

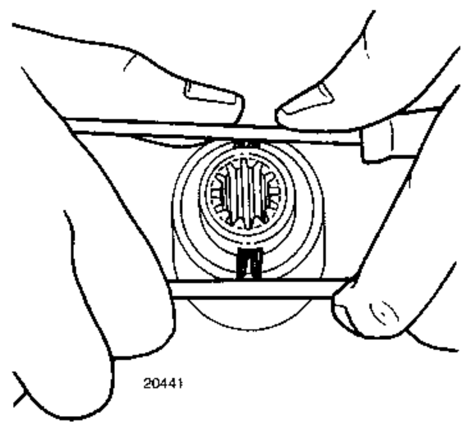
28. Re–install the rotary valve on sleeve, verifying correct alignment of reference marks shown in the figure.


20439

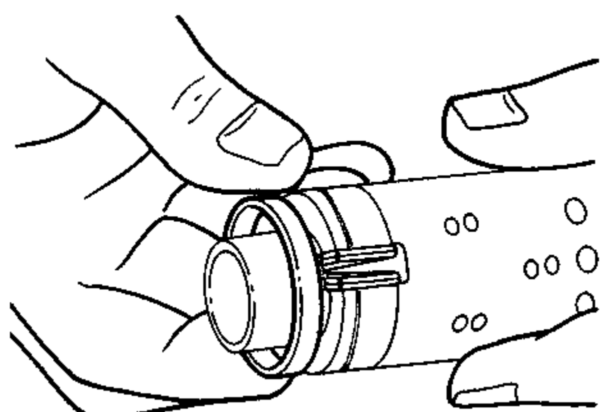
29. Introduce the two flat and the two shaped springs, pressing them by hand into their respective seats as evidenced in the assembling scheme shown at the top of the right column on this page.


20440

Assembling scheme of springs in **neutral**.


20441

30. Line up and center the spring set of the **neutral** position.


20442

31. Install the **neutral** position spring retaining ring on the valve housing sleeve, keeping in mind that the same ring must be free to rotate without any interference by the springs.

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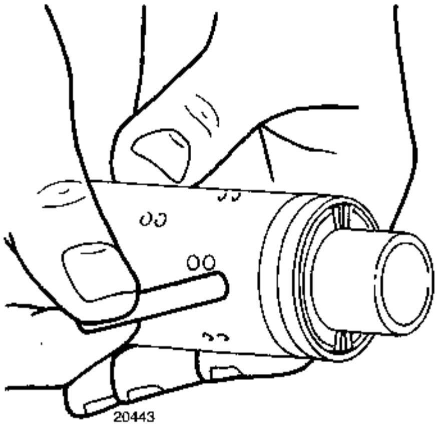
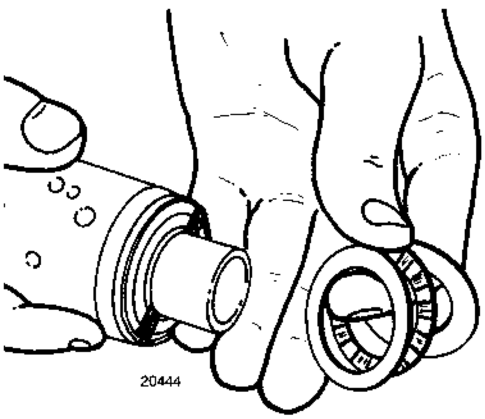
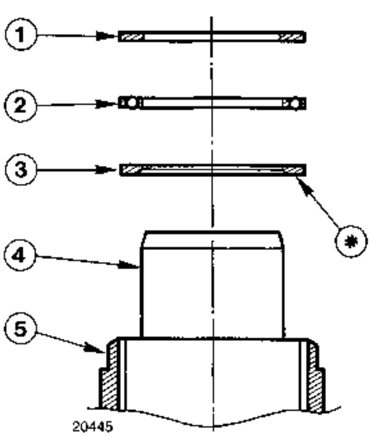


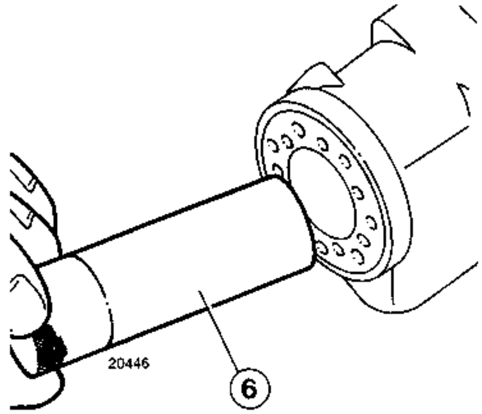
32. Introduce the drag pin in the rotor drive sleeve–shaft assy.



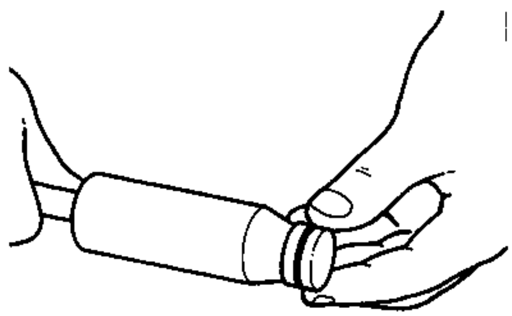
33. Fit the thrust bearing making sure to follow the sequence and notices reported in the figure below.

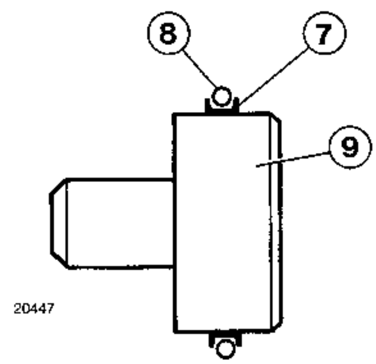


1. Bearing outer ring – 2.Thrust bearing – 3. Bearing race with chamfer* facing the shoulder of detail (5) – 4. Rotary valve – 5. Rotary valve seat sleeve.



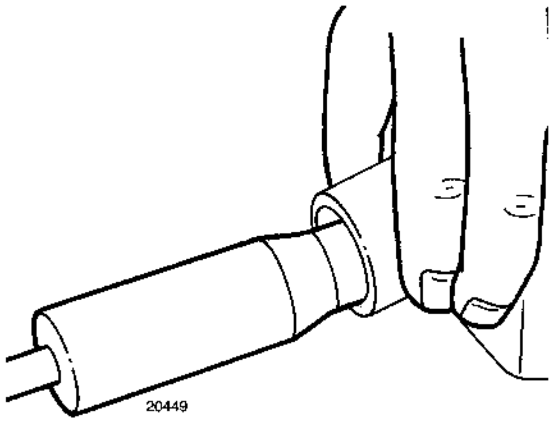
34. Place the control valve body so that the rotary valve sleeve housing is positioned horizontally, then introduce the pilot bushing (6) of tool no. **293955.**





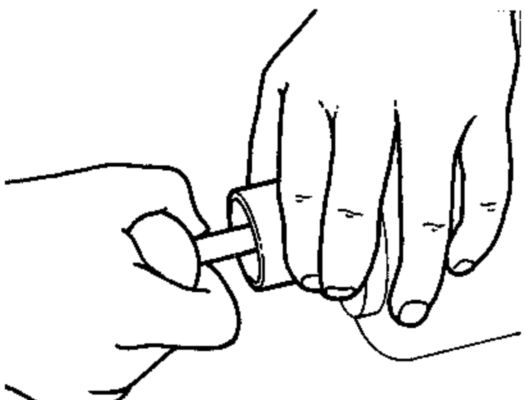
Supporting head for abutment and seal rings (part of special tool 293955)

35. Lubricate with hydraulic oil the abutment ring (7), O–ring seal (8) and install them on head (9) of special tool **293955** as shown in the above figures.



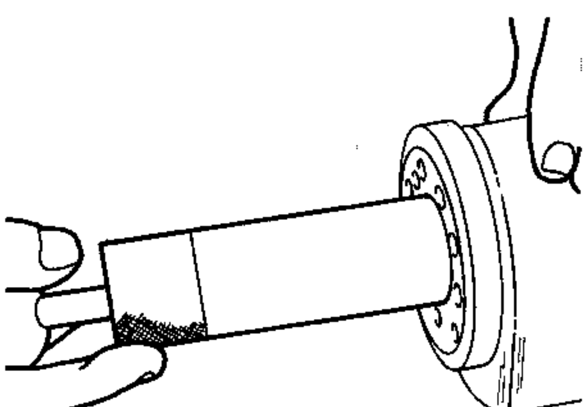
20449

36. Introduce the complete drive punch inside the pilot bushing previously installed.



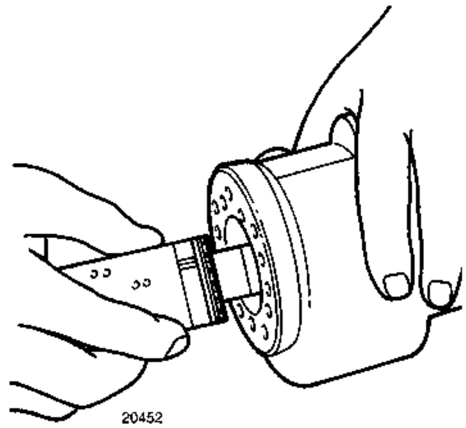
20450

37. Holding the outer bushing with your hands, press down and simultaneously turn the drive punch to ease the ingress of the seal ring into its seat on the control valve body.



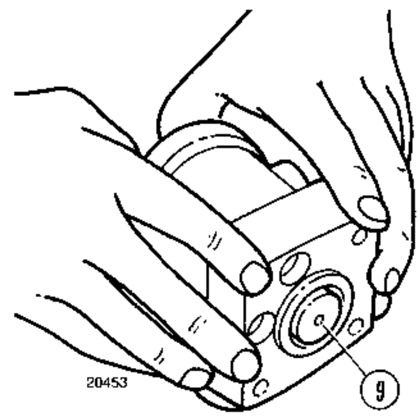
20451

38. Pull out the special tool **293955** parts (outer bushing and drive punch). **Note**: the supporting head for abutment and seal rings (see page 41–16) will remain on the control valve body.



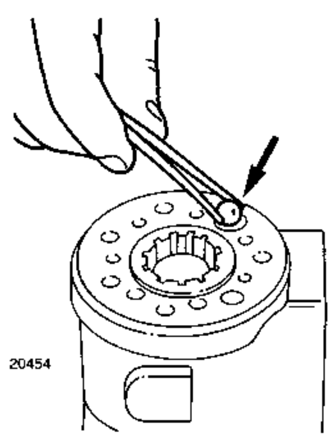
20452

39. Introduce inside the control valve body the parts previously fitted conforming to operations 28 thru 33 and hold the rotor drive sleeve–shaft assy. drag pin on a horizontal position to prevent it from sliding out and accidentally insert itself in the grooves existing inside the control valve body.



20453

40. Press on the rotary valve to bring the thrust bearing against the control valve; scope of this operation is to simultaneously expel the head (9) of the special tool **293955** (see pages 41–16) and the entry of rings (7) and (8) in their seats on the control valve body.



20454

41. Turn the control valve and fit the check valve ball in the seat shown by the arrow.

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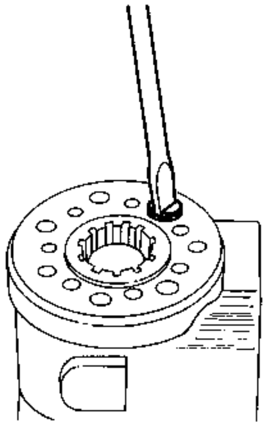
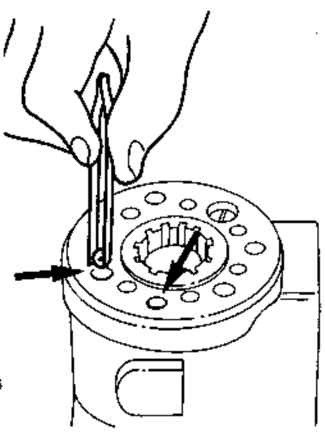


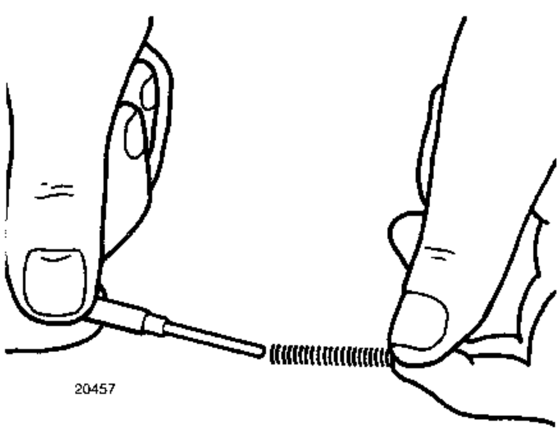
20455

42. Screw the theaded plug in the check valve seat until its top surface is below the control valve body mating surface.



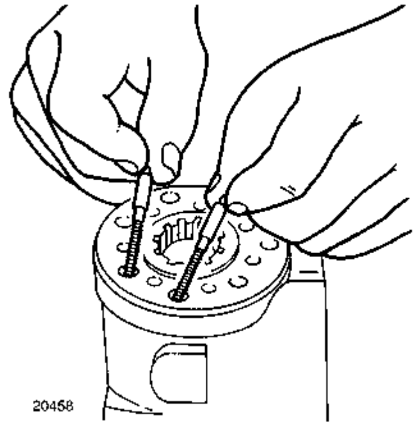
20456

43. Fit the return valve balls in the two arrowed seats.



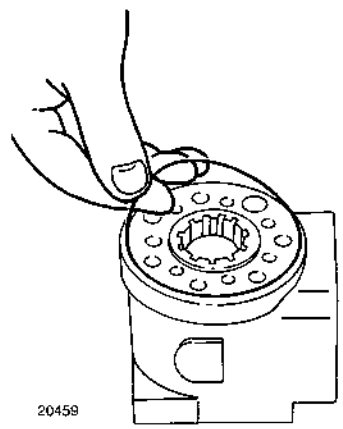
20457

44. Fit springs on return valve pins.



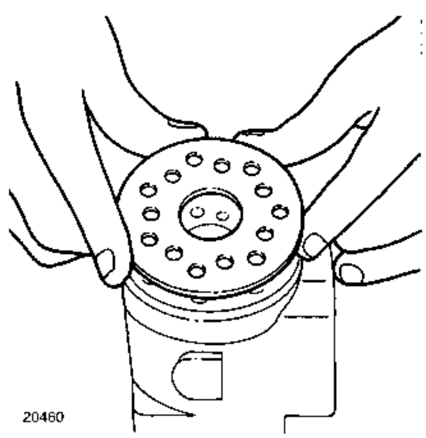
20458

45. Fit the pins with springs in the return valve arrowed seats (see op.43).



20459

46. Lubricate the O–ring seal and fit it in its seat on control valve.



20460

47. Install the end washer aligning its holes with those on the control valve.

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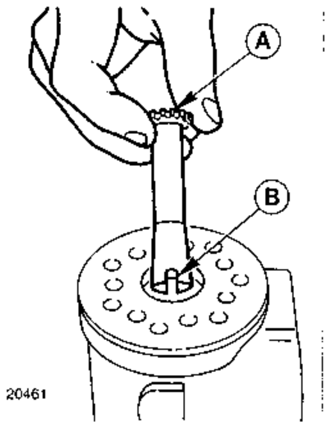
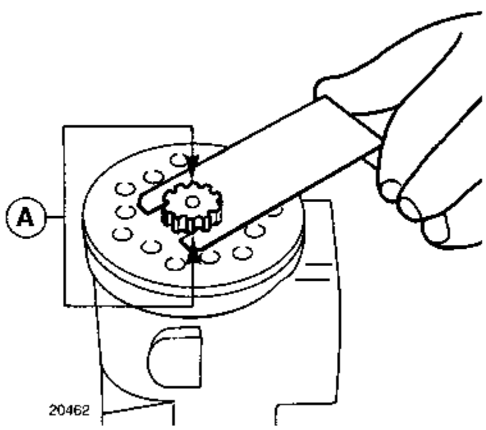


48. Make a reference mark on the upper part of teeth (A), in correspondance of seat (B), to show the exact position of the valve–sleeve drag pin.

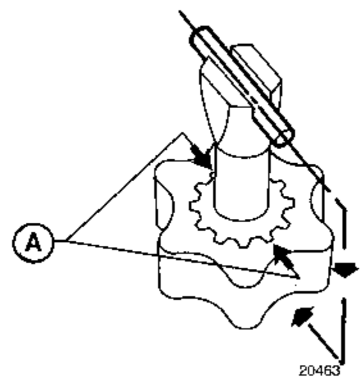


49. Introduce the drive shaft inside the control valve housing, fit the rotor drive shaft retaining–centering tool **293390** in between rotor drive shaft and end washer, as shown in the figure, and turn the shaft in order to favour the correct mating of seat (B) with the drag pin fitted on the sleeve.

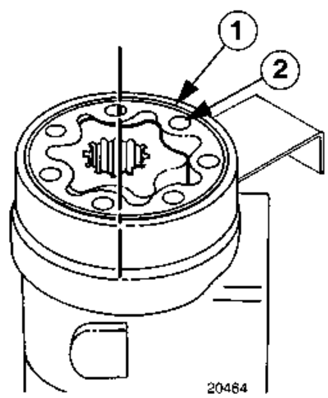
50. Proceed with rotor installation keeping the following notices in mind:

a) every time the hydrostatic steering is dismantled, turn rotor upside down in order to limit the wear process of the splined coupling;

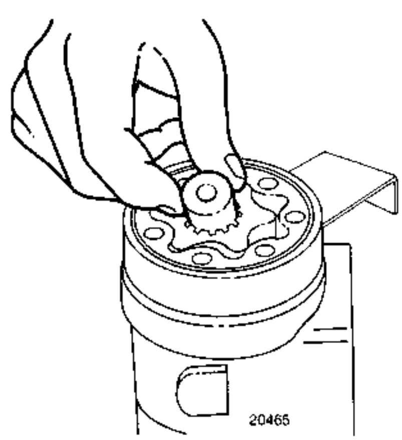
b) The following figure has been drawn with rotor drive shaft removed in order to show correct phasing among rotor, rotor drive shaft and drag pin;



c) Install rotor on drive shaft, keeping in mind that phasing requires the alignment of teeth (A) on the drag pin axial plane , as evidenced in operation **48**, with the center line of a rotor vane.



51. Lubricate the two O–ring seals (1) with hydraulic oil and fit them in their seats on the rotor stationary ring and, finally, install the rotor making sure that fitting holes (2) are aligned with the corresponding ones on the end washer.



52. Fit inside spacer.

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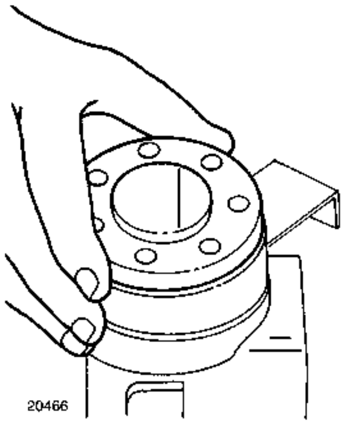
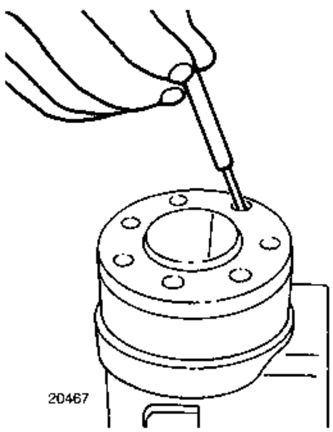
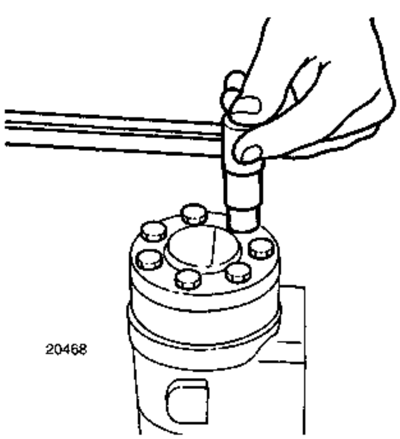

20466

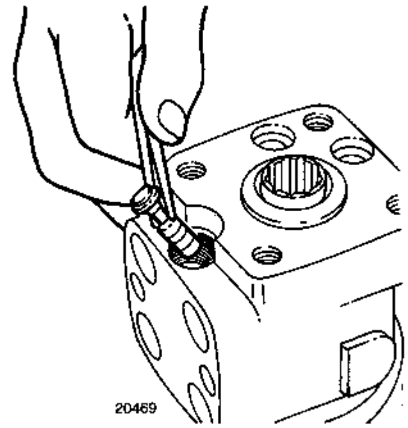
53. Fit cover lining up its holes with the corresponding ones present on the rotor stationary ring.


20467

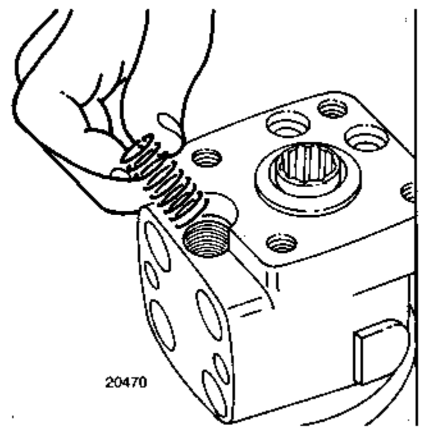
54. Remove reatainer tool **293390** and fit on the check valve, shown in the figure, the special screw and washer.


20468

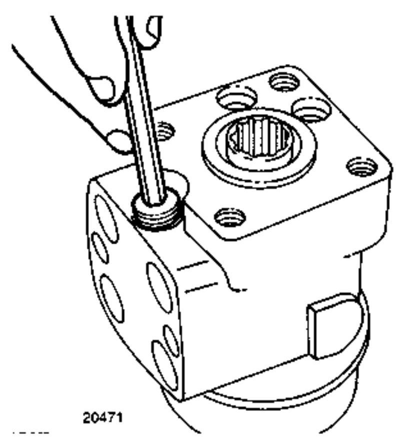
55. Fit the remaining six cover screws complete with their respective washers and tighten them in crossed sequence to a torque of 24 to 36 Nm (2.5 to 3.7 kgm or 18 to 26.7 ft.lb).


20469

56. Turn control valve body upside down and insert the pressure relief valve piston in its seat as shown in the figure (see page 13 for parts detail).


20470

57. Fit the pressure relief valve spring.


20471

58. Fit the pressure relief valve setting screw using a 8 mm Allen screw.

Note: pressure setting will be subsequently carried on on bench or on tractor in accordance to the values given in the data chart of page 41–1.

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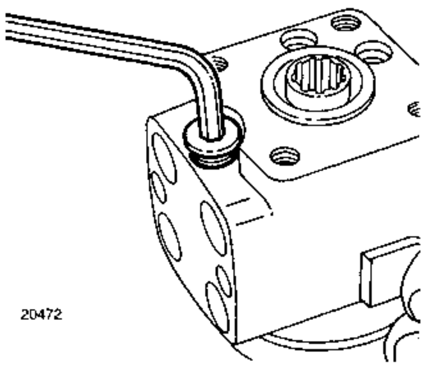
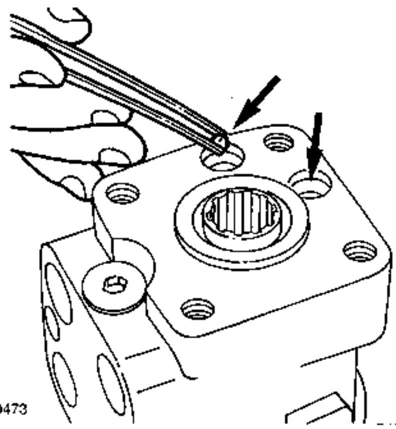


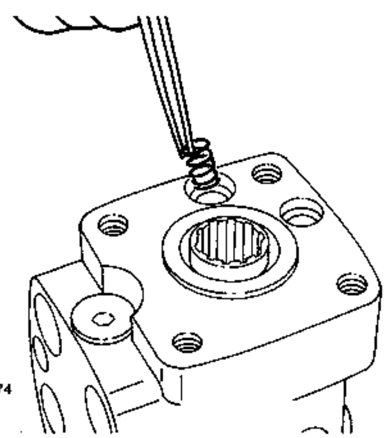
20472

59. Screw on the plug complete with associated seal using a 8 mm Allen wrench and, after pressure setting on bench or on tractor, torque tighten at 40 to 60 Nm (4.1 to 6.1 Kgm or 30 to 44 ft.lb)



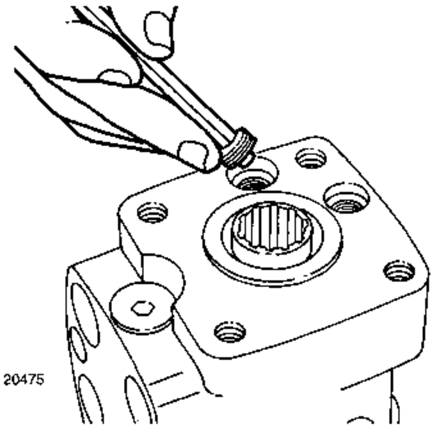
20473

60. Introduce the two balls inside their cylinder safety valve seats shown by the arrows (see parts detail on page 13).



20474

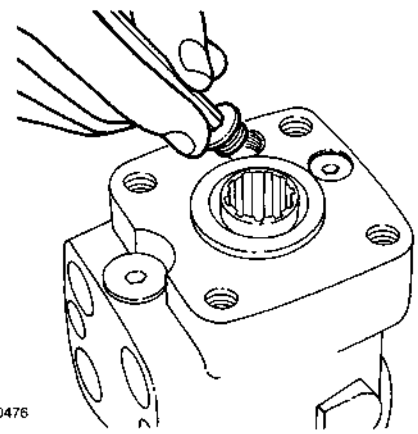
61. Introduce spring guides and springs into their cylinder safety valve seats.



20475

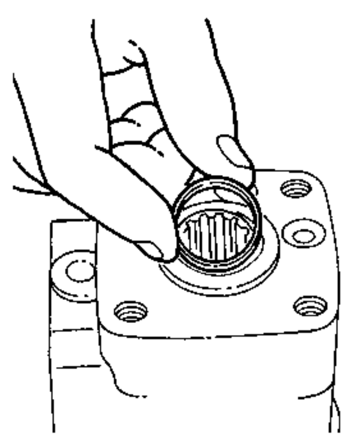
62. Screw on the two cylinder safety valve pressure setting screws using a 6 mm Allen wrench.

Note: pressure setting will be subsequently carried on bench or on tractor in accordance with the values given in the data chart of page 41–1.



20476

63. Screw on the two plugs and associated oil seals using a 6 mm Allen wrench, perform pressure setting, torque tighten at 30 Nm (3 Kgm or 21 ft.lb).



20477

64. After completion of assembly, fit the dust shield ring on control valve body.

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HYDROSTATIC STEERING CONTROL VALVE

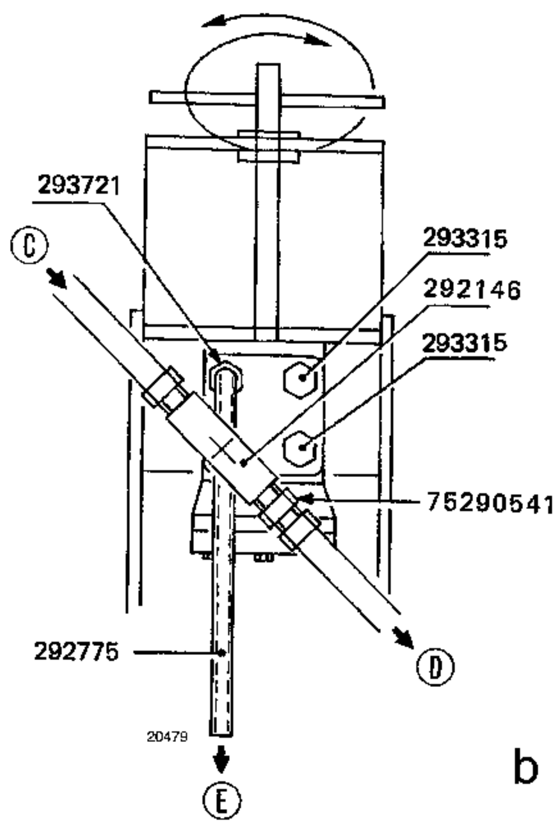
Test bench checks (Op. 41 204 38)

A – ROTARY VALVE WEAR TEST

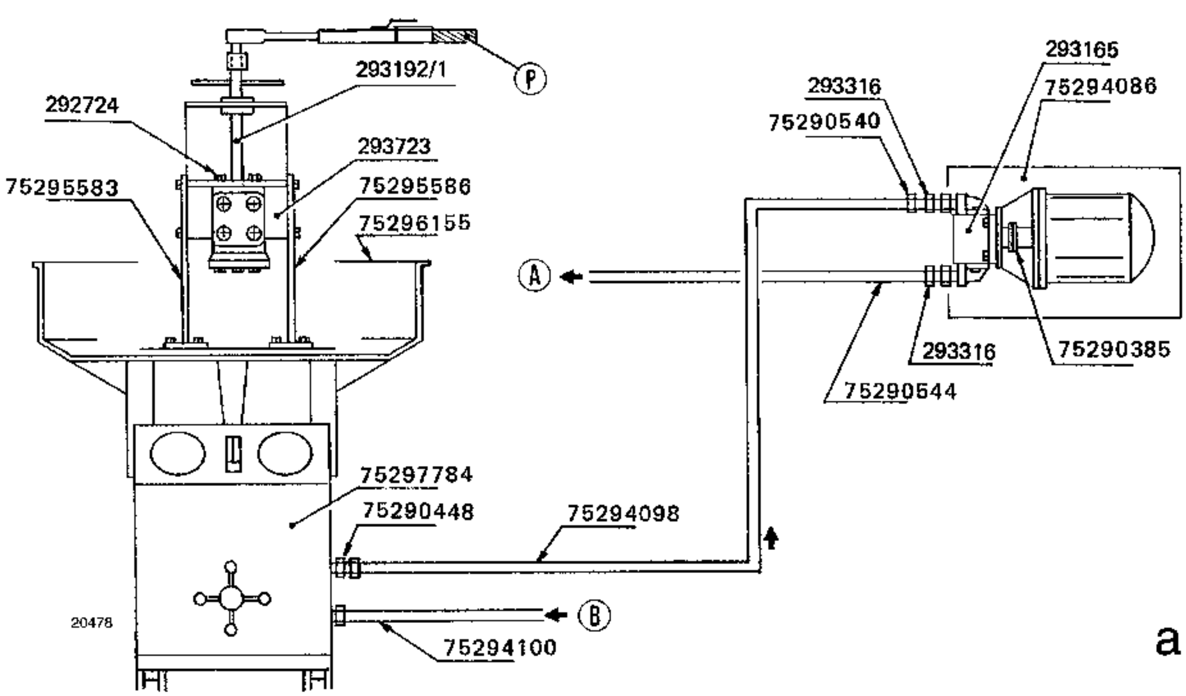
1. Make all necessary bench connections as shown on scheme of Fig. **a** and complete the circuit as per scheme **b.** Hold steering control on steering position (right or left) using special tool **293192/1**.
2. Acting on the handwheel of device **75297784**, increase pressure in the system until approaching the pressure relief valve setting without its cracking–off (24, page 41–**1**).
3. Fit a torque wrench to the tool **293192/1**, apply a torque of about 34 Nm (3.5 Kgm or 25 ft.lb) and check that it takes more than ten seconds to the rotary valve (5, page 41–3) to make a full turn. If less, replace rotary valve and associated sleeve

Test specifications

Oil type . . . . **IDRAULICAR AP51**
Oil viscosity . . . . SAE 20 W
Oil temperature . . . . 60°C
Capacity of oil pump idraulic **293165**
. . . . 12 dm^3 (l/1=2.64 UK or 3.17 US Gal)
Speed of electric motor **75294086** . . . . 1450 rpm

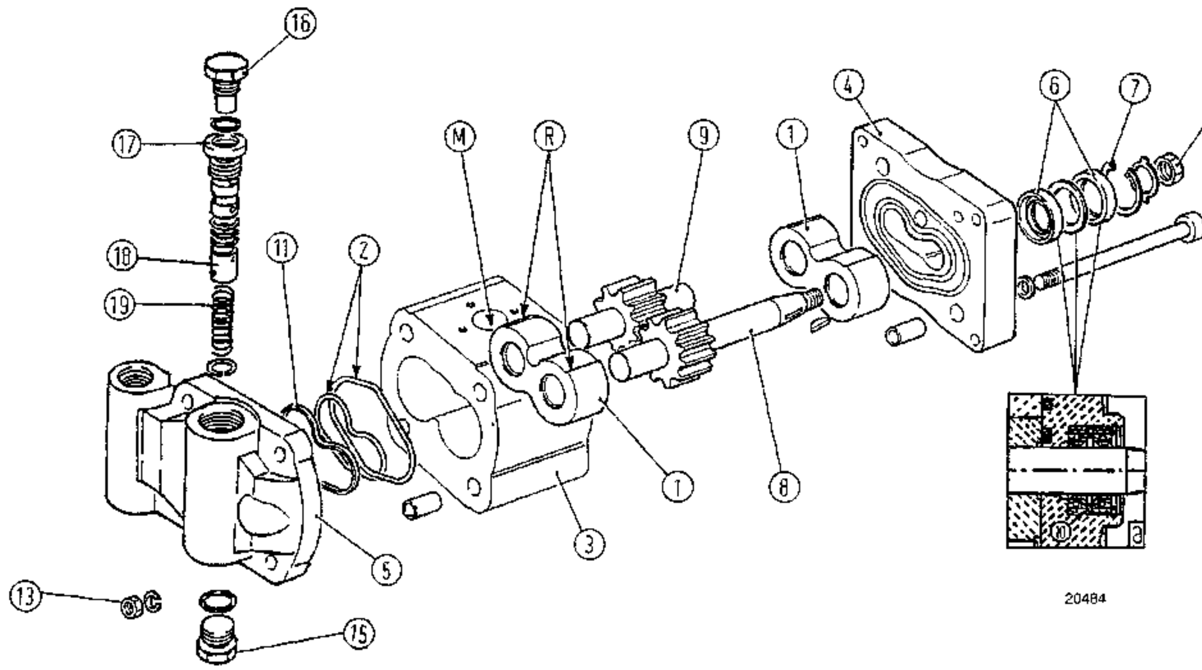


Rotary valve wear test
C. From delivery – D. To throttle – E. Drain.



Test equipment and tool installation scheme for rotary valve check, oil seal tightness check, pressure relief valve and cylinder safety valve setting.

A. Delivery – B. Throttle – P. Torque wrench.



Oil pump exploded view

a. Detail of oil seal installation – M. Pump oil delivery duct – R. Gear bearing fillets – 1. Gear bearings – 2. Cover seals – 3. Pump case – 4. Rear end cover – 5. Flow regulator case – 6. Drive shaft oil seal – 7. Seal retainer ring – 8. Drive gear shaft – 9. Driven gear shaft – 10. Spacer – 11. Anti–extrusion ring – 12. Pump drive shaft and sleeve coupling nut and lockwasher – 13. Cover bolt nuts – 15 to 19. Flow regulator exploded view – 15 and 16. Plugs – 17. Cartridge – 18. Slider – 19. Spring

HYDROSTATIC STEERING OIL PUMP
Disassembly–Assembly of removed pump
(Op. 41 206 20)

Proceed as follows:

1. Remove cover nuts (13), bolts and lockwashers.

2. Remove nut (12) securing sleeve coupling to drive shaft and associated lockwasher.

3. Remove rear end cover (4), retaining ring (7) and oil seals (6).

4. Mark parts (1), (3), (4) and (9) to re–install them in the same original position if found efficient.

5. Remove bearings (1), gears (8) and (9) from rear cover (4) and pump case (3).

6. Retrieve oil seals (2) and anti–extrusion rings (11).

7. Remove plugs (15) and (16) and associated seals, remove from flow regulator case (5) all component parts and, precisely, the cartridge (17), slider (18) and spring (19).

With all parts loose, proceed as follows:

8. Check planarity and squareness of gears and bearings mating surfaces by interposing a thin film of carbon black powder; if very slight surface roughness is present, remove it with extra–fine grade, lubricated abrasive paper.

9. Check end play of the gear–bearing sub–assembly inside the pump against specifications (0.100 to 0.180 mm = .004 to .007 in).

If necessary, use lubricated abrasive paper to remove minimum quantities of materia.

10. Clean all parts thoroughly.

11. Replace oil seals (2), (6) and (11).

12. Lubricate loose parts with the same oil used for the hydrostatic steering plant operation and re–assemble the pump, referring to the exploded view shown on this page and paying attention to the following points:

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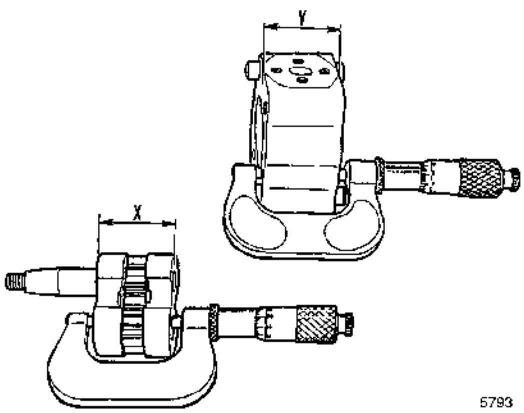


Checking end play of gear–bearing unit inside oil pump case

Dimension X should be smaller than Y by 0.100 to 0.180 mm (.004 to .007 in)

a) re–assemble the pump by reversing the disassembly sequence of operations starting from 7 back to 1;

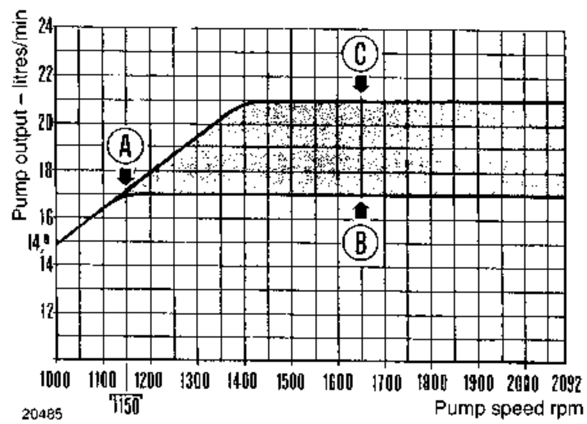
b) make sure to always work under top cleanliness conditions in order to avoid any ingress of foreign material which might damage the pump.

c) Interface parts (1), (3), (4) and (9) previously marked for this purpose and see description of operation 4, page 41–29 in order to re–fit them in their respective original positions.

d) install by hand the gear bearings (1) inside the pump, positioning them so the fillets (R) on circumference coincide with the oil delivery duct (M) and front surfaces provided with milled spiders for lubrication are brought to face the gears;

e) insert the plastic anti–extrusion ring (11) on the inside with respect to the central O–ring (2);

f) fit seals (6) on rear cover (4), complete with spacer (10), give orientation shown in detail a), page 41–29 and fill cavity between lips with grassofiat **TUTELA G9** graese.



Speed–output diagram of the hydrostatic steering drive pump

Test pressure	100 bar (102 kg/cm^2 or 1499 psi)
Oil temperature	55° to 65° C (131° to 149° F)

A. Commencement of metered output – B. Minimum limit for metered output – C. Maximum limit for metered output.

13. Re–install the pump on tractor, filling the suction line as well as the pump case with **TUTELA MULTI F** oil to facilitate priming and avoid any risk of seizure during the initial period of operation.

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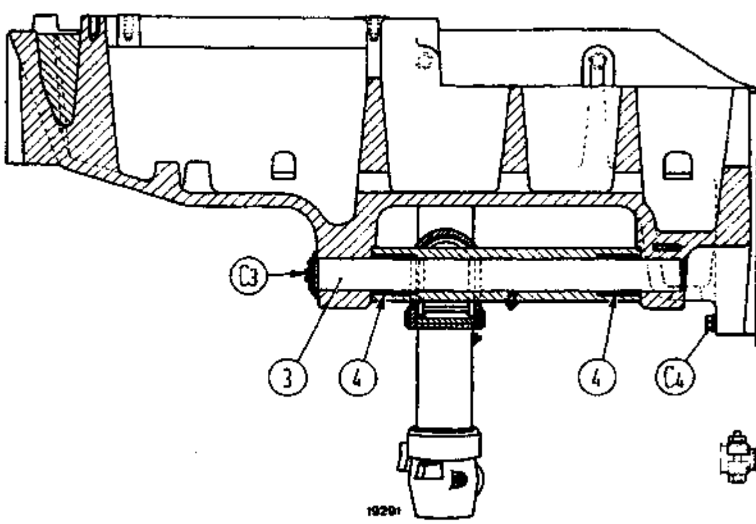
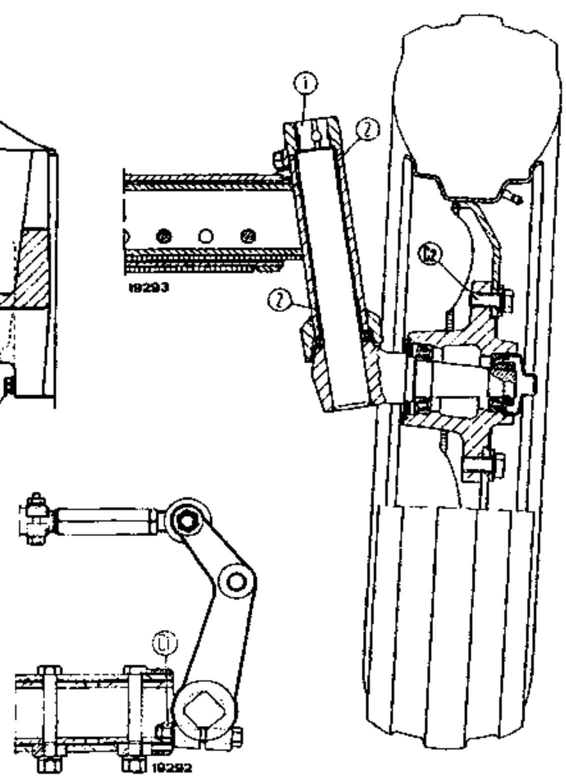
FRONT AXLE

Type	Inverted "U", telescoping and centrally pivoted
Tracks (Q.ty: 6)	1515–1615–1715–1815–1915–2015 mm (59–63–67–71–75–79 in)
Wheel camber Toe–in	2°, equivalent to approx. 15 mm (.59 in) for 16" rims 0 to 5 mm (0 to .20 in)
Steering knuckles Kingpin (1) journal dia. Force–fit bushes (2) I.D. Kingpin clearance fit	 44.961 to 45.000 mm (1.7701 to 1.7716 in) 45.050 to 45.140 (1) (1.7736 to 1.7771 in) 0.050 to 0.179 mm (.0019 to .0070 in)
Pivot mounting Pivot pin (3) dia. Force–fit bushes (4) I.D. Axle pivot pin clearance	 37.961 to 38.000 mm (1.4945 to 1.4960in) 38.050 to 38.140 mm (1) (1.3811 to 1.5015 in) 0.050 to 0.179 mm (.0019 to .0070 in)

(1) Final dimension without grinding.





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TORQUE DATA

DESCRIPTION	Thread size	Torque		
		Nm	kgm	ft.lb
Front axle Capscrew, front axle carrier to engine (C_4, pag. 44–1)	M 18x1.5	353	36	260
Nut, steering arms (C_3)	M 10x1.25	49	5	36
Nut, axle end	M 16x1.5	211	21.5	155
Nut, steering arms (C_1)	M 16x1.5	294	30	217
Nut, steering tie–rod head	M 14x1.5	118	12	86
Nut, steering tie–rod	M 20x1	176	18	130
Screw, front wheel to hub (C_2)	M 18x1.5	314	32	230

SERVICE TOOLS

ATTENTION – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code **(X)**.
Besides, to work safely and achieve the best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjonction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

List of the special tools necessary to perform service operations covered by this section of the Manual.

X	**293521**	Wrench, king pin lock nut.
X	**290793**	M12x1.25 adapter, axle pivot pin (with 292927).
	293890	Tester, wheel toe–in.
	292400	Sling hook, wheel lifting.

TROUBLE–SHOOTING CHART

Fault	Diagnosis	Correction
Premature tyre wear.	1. Wrong inflating pressure.	Inflate tyres to the pressures suggested on the tractor Operator's Manual and comply in all cases with the specifications and instructions issued by the tire Manufacturer.
	2. Wrong front wheel toe–in.	Rectify toe–in.
Poor tractor stability.	1. Wrong inflating pressure.	Inflate tires correctly in accordance with what stated above.

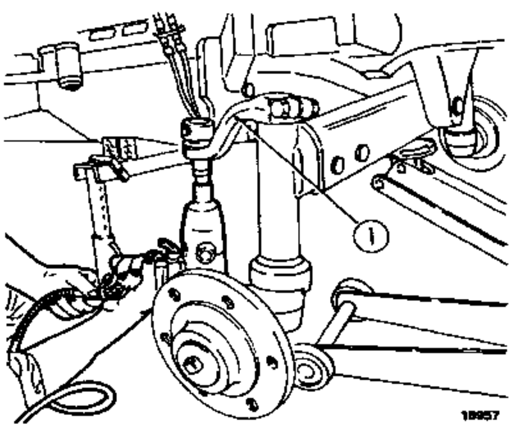
FRONT AXLE
Removal–Installation (Op. 44 101 30)

DANGER

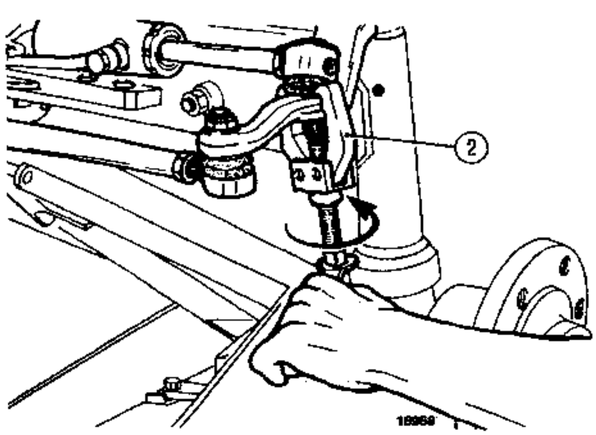
Lift and handle all heavy components using a lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no one is in the vicinity of the load to be lifted.

To remove the front axle assembly from tractor proceed as follows:

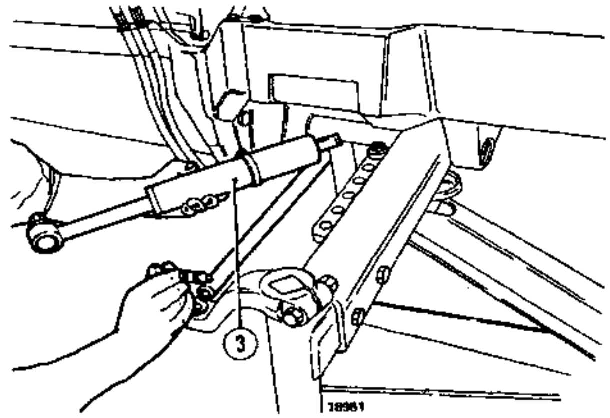
1. Disconnect battery cables, install wedge blocks under the rear wheels and remove front ballasts with carrier.
2. Prop up the front end with an hydraulic jack.
3. Place a shop floor stand under the engine oil sump with a list of wood in between.
4. Remove front wheels.



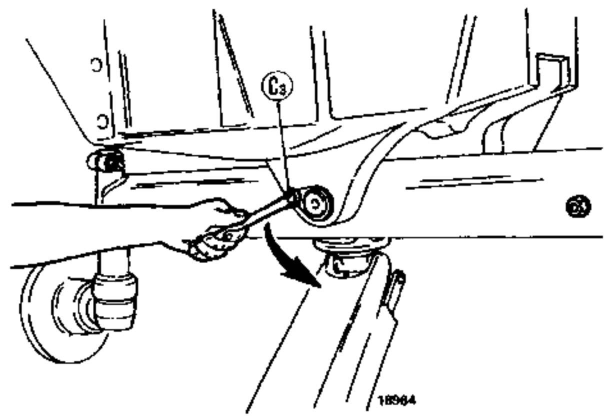
5. Remove the nut securing the power steering cylinder rod head to the steering arm (1).



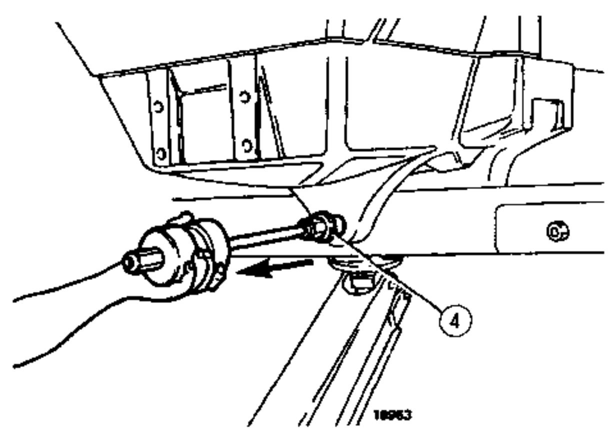
6. Using a suitable puller (2) detach the cylinder ball head.



7. Retrieve the power steering cylinder (3) from front axle.



8. Place an hydraulic jack under the axle and remove the central pivot pin capscrew (C3).



9. Using the slide hammer–type extractor tool no. **292927** complete with adapter tool no. **290793** remove the front axle pivot pin (4).

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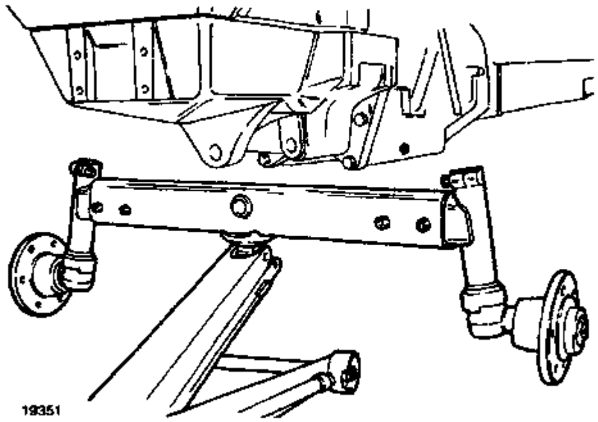
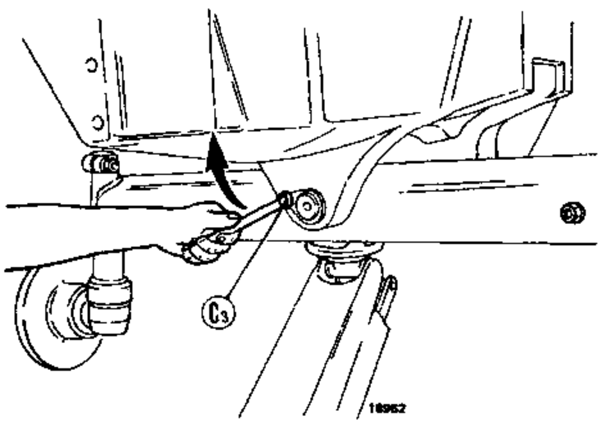
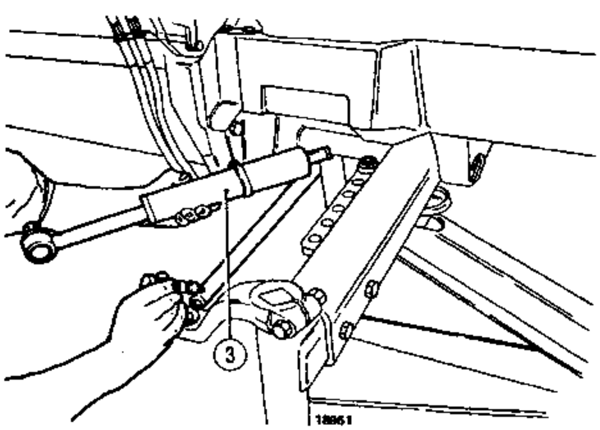


10. Lower the hydraulic jack and retrieve the axle assembly.

11. To install the front axle assembly onto the tractor just reverse the removal sequence of operations and make sure to fit the axle pivot pin (4, op. 9, page 44–3) using a bronze punch.



12. Fit the pivot pin retaining cap screw (C_3)



13. Re–install the power steering cylinder (3) attaching the cylinder rod to the steering kingpin arm as shown in the operation 5, page 44–3.

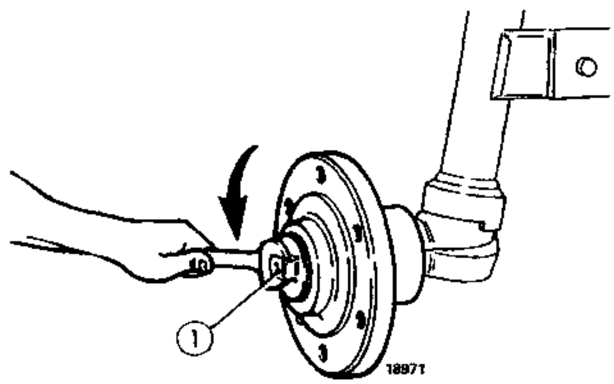
FRONT AXLE WHEEL HUB
Disassembly – Assembly (Op. 44 101 22)

CAUTION

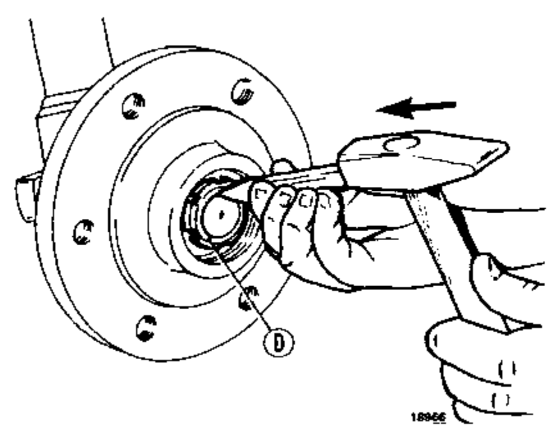
Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes

Wheel hubs can be removed directly on the tractor with front axle installed by proceeding as follows (for each wheel):

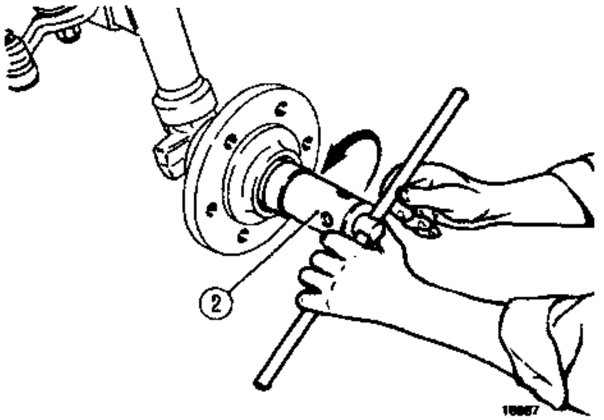
1. Disconnect battery cables and place wedge blocks under the rear wheels.
2. Prop up the front end with an hydraukic jack.
3. Place a shop floor stand under the engine oil sump with a list of wood in between.
4. Remove front wheel.



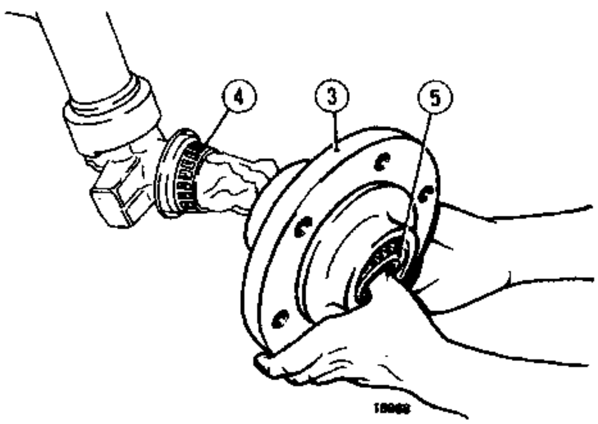
5. Remove the wheel hub bearing greaser cup (1).



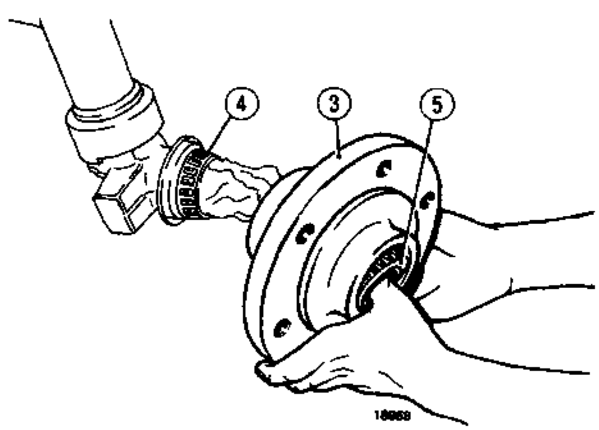
6. Free the bearing adjustment ring nut (D) from the securing lock.



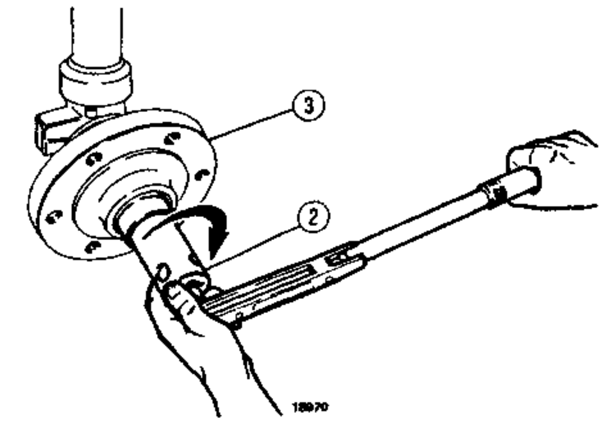
7. Using the special wrench tool no. **293521** (2) unscrew the wheel hub bearing adjustment lock ring.



8. Remove wheel hub (3) and retrieve bearings (4 and 5).
9. Replace poor seals and worn bearings using systematically suitable pullers, axtractors and punches.
10. Refill the wheel hub with grease (**grassofiat TUTELA G9**).

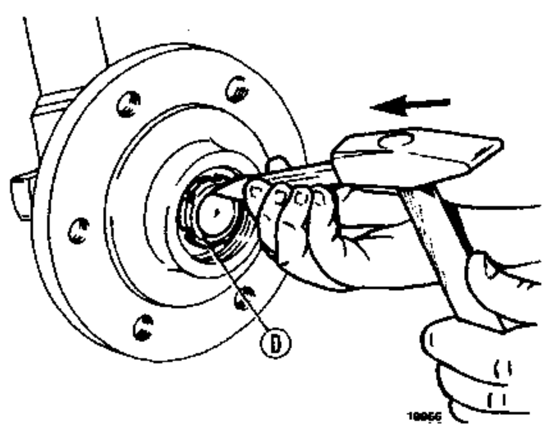


11. Install the wheel hub (3) complete with bearings (4 and 5).

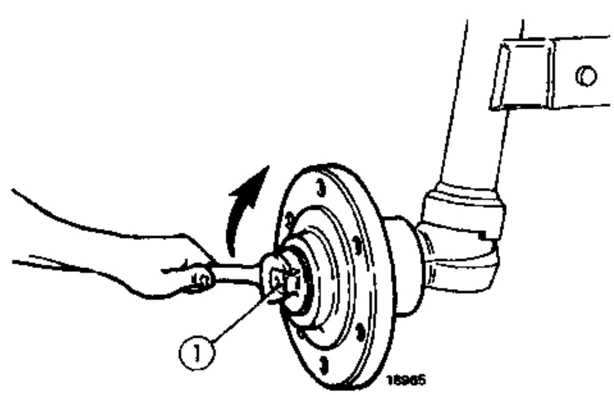


12. Torque tighten the lock ring at 196 Nm (20 kgm – 144 ft.lb) using torque wrench and specific wrench tool no. **293521** (2) while turning the hub by hand in order to properly bed bearings in.
13. Slacken the lock ring and retighten it at a torque value of 24 to29 Nm (2.5 to 3 kgm – 18 to 21 ft.lb), keeping on manually spinning the hub.

Note - The lock ring must be replaced at each removal–installation operation.



14. Re–lock the ring (D) in place with punch and hammer.



15. Re–fit the wheel hub greaser cap (1).

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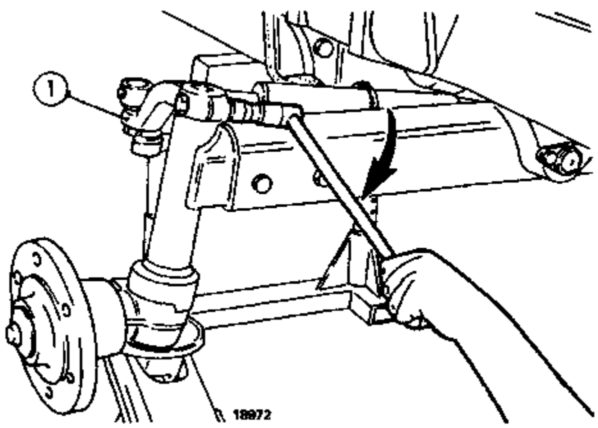
STEERING KNUCKLE
Overhauling (Op. 44 101 46)

⚠ CAUTION ⚠

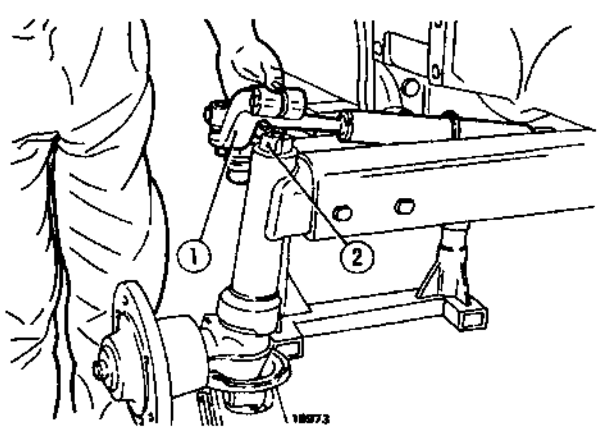
Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes

Steering knuckles can be disassembled directly on tractor with front axle installed by proceeding as follows (for each wheel):

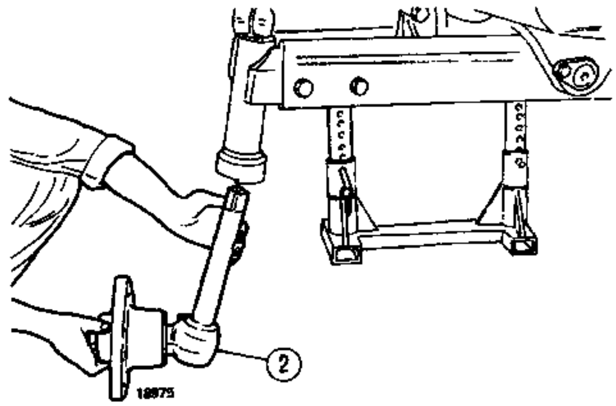
1. Disconnect battery cables and place wedge blocks under the rear wheels.
2. Prop up front end with an hydraulic jack.
3. Place a shop floor stand under the engine oil sump with a list of wood in between.
4. Remove front wheel.



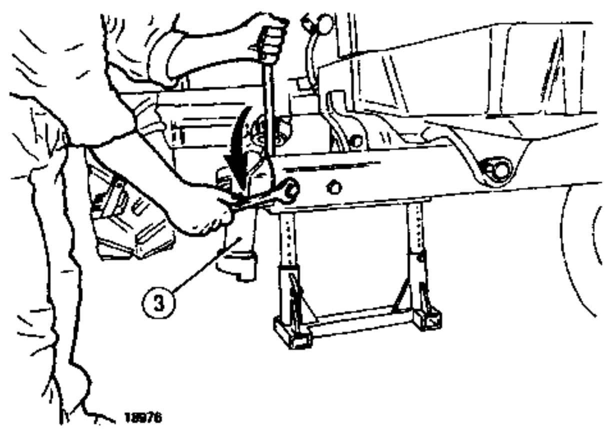
5. Place a hydraulic jack under the steering knuckle and remove the retaining screw at the steering arm (1).



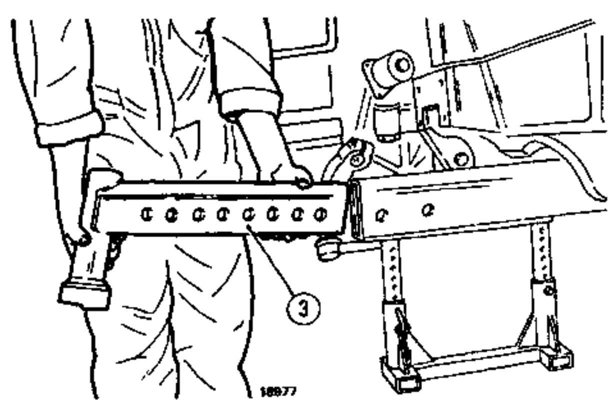
6. Withdraw the steering arm (1) from steering knuckle (2).



7. Lower the hydraulic jack and retrieve the steering knuckle (2).



8. Unscrew the front axle end retaining capscrews (3).



9. Remove axle telescopic end section (3).

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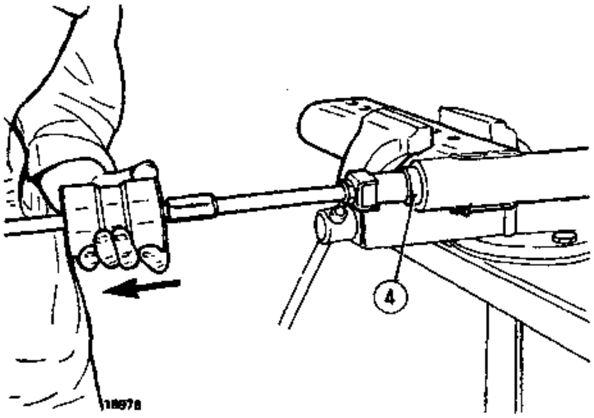
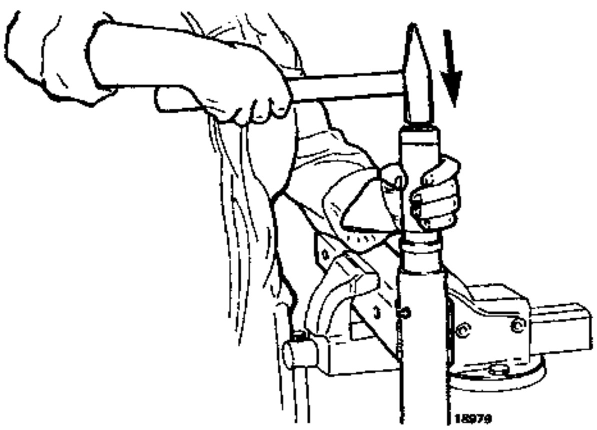
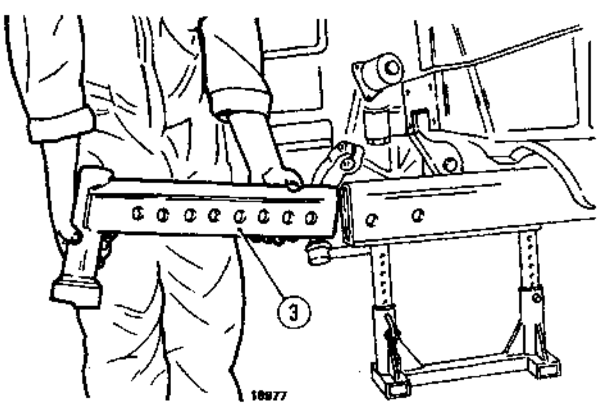


10. Tighten the axle telescopic end in a bench vice and using a slide hammer–type puller remove the steering knuckle kingpin pivot bushes (4).

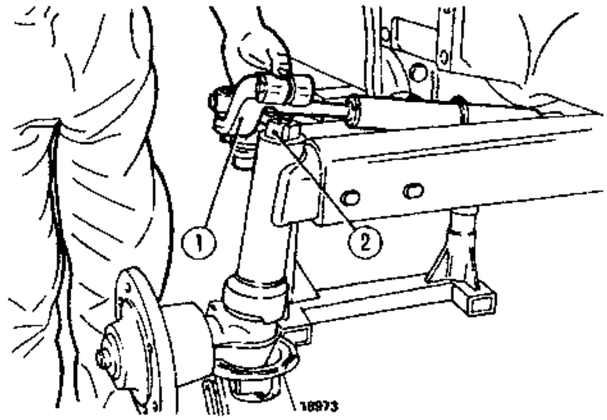


11. To install the steering knuckle onto the front axle just reverse the removal sdequence of operations making sure to use a specific flat–head punch to introduce new bushes into the axle end seat.



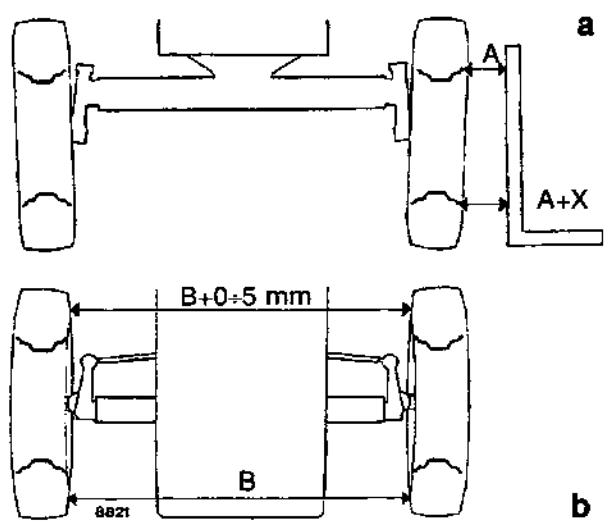
12. Install the front axle telescopic end (3).

13. Install steering knuckle on front axle end section.



14. Place the steering arm (1) on the steering knuckle kingpin (2) and then tighten the retaining screw.

FRONT STEERING WHEEL ALIGNMENT CHECK (Op. 44 511 80)



Wheel alignment check diagram

a. Wheel camber check – b. Toe–in check – X = 15 mm (.59 in) approx. for 16" rims.

Check front steering wheel alignment taking into consideration that:

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– in straight–ahead driving the wheels must have a 2° inclination with respect to the ground corresponding to approx. 15 mm (.59 in) difference (on 16" rims) measured between rim edges (fig. a). Also, in straight–ahead driving, wheels must be parallel to the tractor longitudinal axis, or with a slight toe–in up to a max.of 5 mm (.20 in), measured on the inside between rim edges;

– to correct the toe–in turn the adjustable track rod ends.

1. Inflate tyres at a pressure of 2.5 bar (kg/cm^2 or 36 psi.).
2. Turn steering wheel half–way, with one rung aligned with the tractor longitudinal centre line.
3. Check if wheels are parallel to the tractor longitudinal axis.
4. Measure on the horizontal plane passing through the wheels centre line, the distance (B) between **front inside edges** of rims (see fig. b on page 44–7).
5. Then measure, still on the horizontal plane passing through the wheels centre, the distance between the **rear inside edges** of rims, making sure that the latter measurement is equal to (B) or larger up to a maximum of 5 mm (.20 in) (see fig. b on page 44–7).
6. For any correction of the wheels toe–in, turn the front axle track rod adjustable end.

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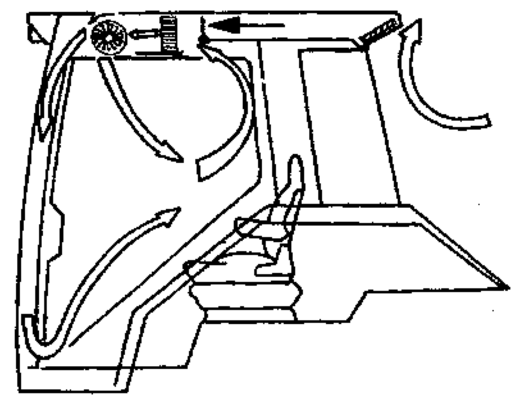
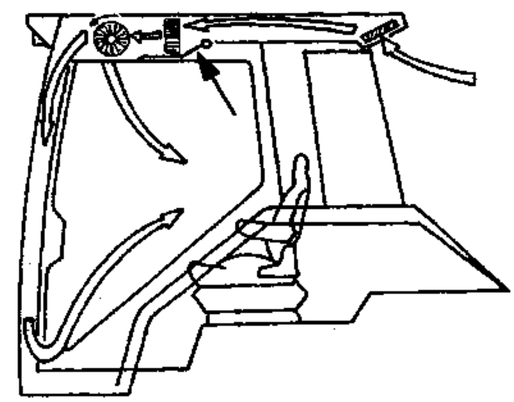


Air–flow pattern with inside air intakes open.



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Air–flow pattern with air intakes closed.

AIR CONDITIONING SYSTEM

SAFETY PRECAUTIONS

Refrigerant must be handled with caution in order to avoid hazards.

Undue direct contact with liquid refrigerant can produce freezing of skin and eyes.

Keep away the refrigerant container from flame or heat sources, the resulting pressure increase can cause the container to explode.

If in direct contact with open flames or heated metal surfaces, the refrigerant will result in a toxic gas: **phosgene**.

The latter, if inhaled, will cause serious intoxication.

Make sure to comply with the following indications and simple precautions to avoid any risk of injury:

◊ When discharging the refrigerant in the system make sure you are operating in well–ventilated premises with good circulation and far away from open flames.
Similarly, do not bring open flames near the system.

◊ When charging and discharging the system take suitable precautions to protect the face in general and the eyes in particular from the refrigerant fluid.

◊ In the event of an accident, proceed as follows:

◊ if the refrigerant has reached the eyes, wash them immediately with a few drops of mineral oil, continue by bathing them thoroughly with a boric acid and water solution (one teaspoonful of boric acid in a 1/4 cup of water) and seek immediate medical help.

◊ Freezing caused by liquid refrigerant can be treated by progressively warming the affected skin area with cold water and by applying an oily or greasy skin cream. Call a doctor immediately in any case.

◊ The oil and refrigerant mixture inside the air–conditioning system is pressurized.
Consequently, never loosen fittings or tamper with lines unless the system has been properly discharged.
Also, do not unscrew the oil level check plug on a charged system.

◊ Before loosening any connection cover the fitting in question with a cloth in order to prevent refrigerant from reaching the skin or eyes.

◊ Do not heat the refrigerant container.
Above 50 °C, pressure increases sharply with heat.

◊ Keep heat sources away from the air–conditioning system to prevent possibility of explosion.

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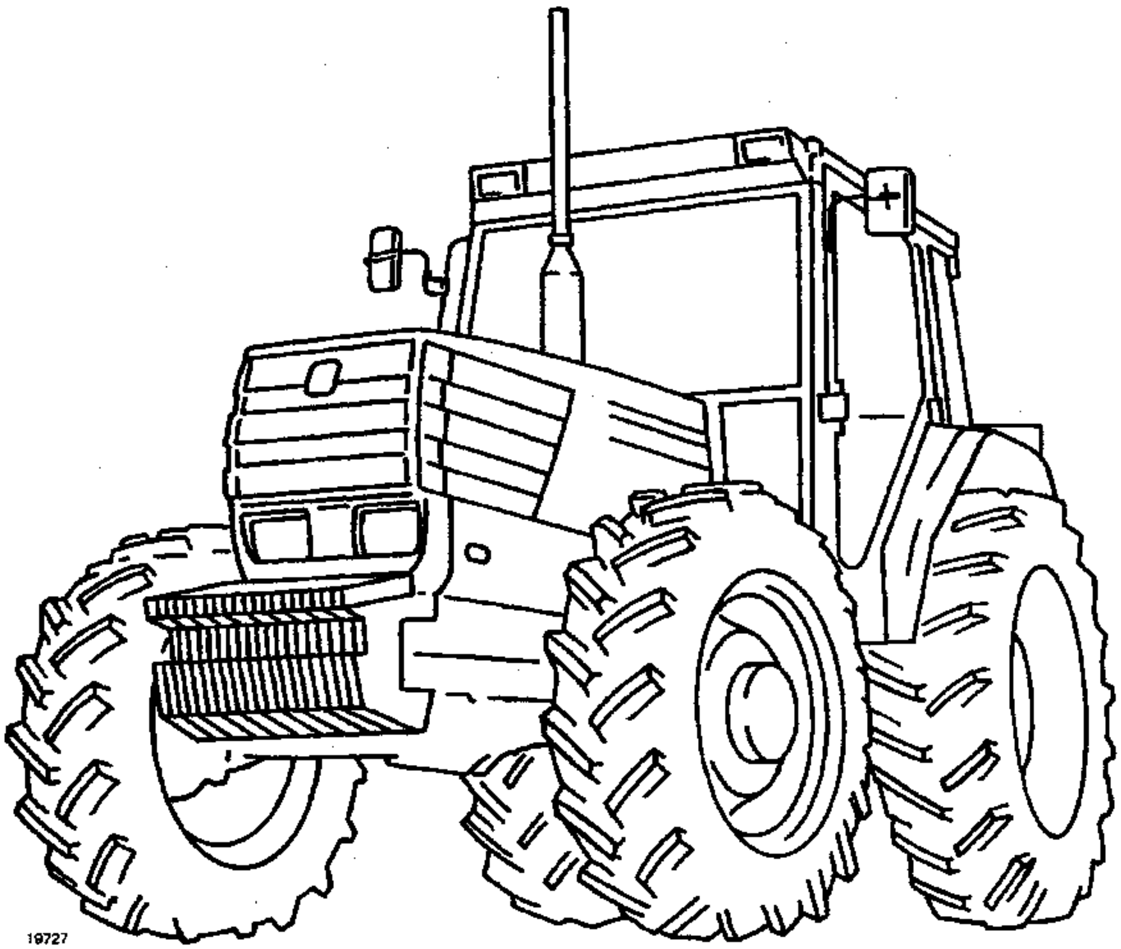
CAB VERSIONS



WINNER RANGE MODELS	VENTILATED AND HEATED CAB	AIR CONDITIONED CAB
F100 – F110 – F120 – F130 Turbo	Standard	Optional

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SERVICE TOOLS – CAB AIR CONDITIONING SYSTEM

ATTENTION – Operations included in this section of the Manual must be performed using the **ESSENTIAL** tools further evidenced by the identification code **(X)**.
Besides, to work safely and achieve the best technical results, with additional savings of time and fatigue, these mandatory tools should be used in conjonction with the suggested special tools listed below and further integrated with the self–made ones for which you will find the necessary working drawings and specifications directly on this manual.

List of the special tools necessary to perform servicing operations envisaged in this Section.

Air conditioning system

X	**292744**	Pressure gauge set (with 293824).
X	**294005**	Charge and evacuation station (with gas recovery).
X	**293823**	Leak detector, acoustic warning.
	293824	Hose, evacuation and charging.
X	**293825**	Oil can, vacuum pump.
	293826	Tape, heat resistant, expansion valve.
X	**293831**	Comb, condenser and evaporator fin cleaning and straightening.

Conditioner compressor

X	**292936**	Lock wrench.
X	**292938**	Puller, front plate.
	292941	Pliers, retaining ring.
	292944	Pliers, retaining ring.
X	**292951**	Puller, pulley.
X	**292952**	Striker tool and pilot bushing.
X	**292971**	Protection, shaft.
	292994	Remover, O–ring.
	292995	Tongs.
X	**292999**	Pilot pin, seal.
X	**293000**	Holder, seal.
	293048	Scraper.
X	**293051**	Wrench, service valves.
X	**293054**	Gauge, angle.
X	**293055**	Rod, oil level indicator.

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HEATED AND VENTILATED CAB CONTROLS

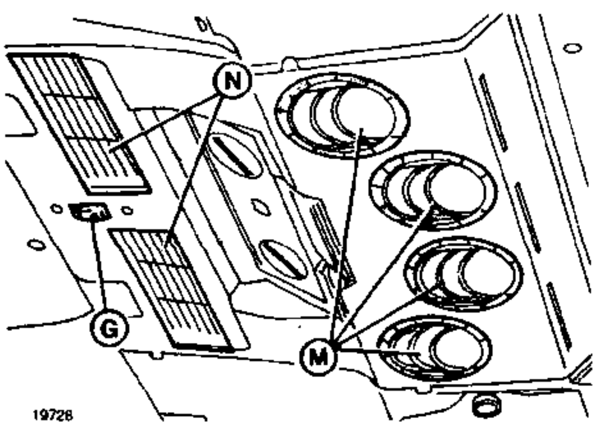
L – 3–speed heater fan control knob.

Air can be optionally drawn from the outside or from inside the cab by acting on the air inlets (N) which can be set on two different positions through the air inlet control (G).
With inlets closed , air is aspirated from the outside through inlets (R).
With inlets open, a larger volume of air is drawn from inside the cab through inlets (N).
Set the electric fan switch (L) on one of the chart positions corresponding to the desired performance.

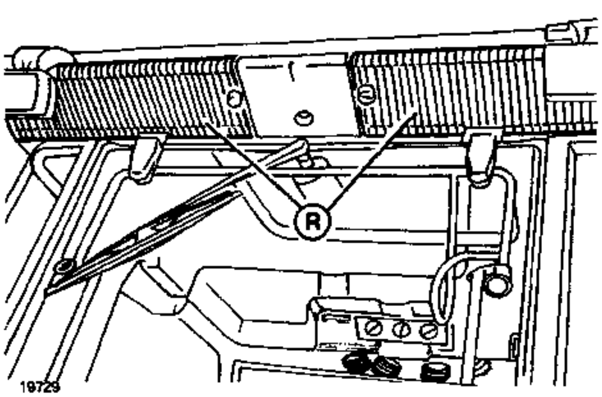
P – Heater control switch.

Set air temperature through control knob (P), as follows:

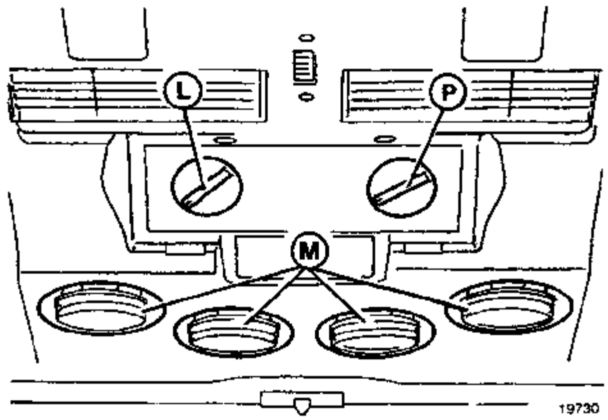
– For max. temperature, turn knob (P) clockwise on red sector.
– To stop warm air circulation inside the cabin, turn control knob (P) counter–clockwise on the blue sector.



G. Air inlet (N) control – M. Air outlets – N. Inside air inlets.



R. Outside air intakes.

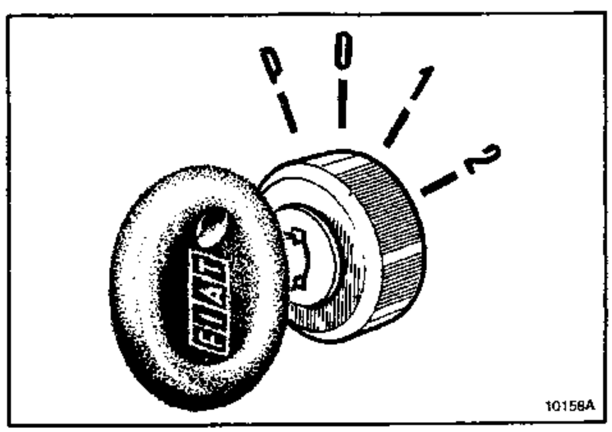


L. Electric fan switch control knob – M. Air outlet – P. Warm air setting control knob.

Electric fan control switch (L).

Operates with starter switch key on position 1.

Position	Electric fan speed
0	Off
I	Low speed
II	Medium speed
III	High speed



Starter switch

1. Engine starting energized. Warning indicators and instruments activated. Miscellaneous user circuits energized.
2. Ignition (when released, the key automatically returns to position 1).

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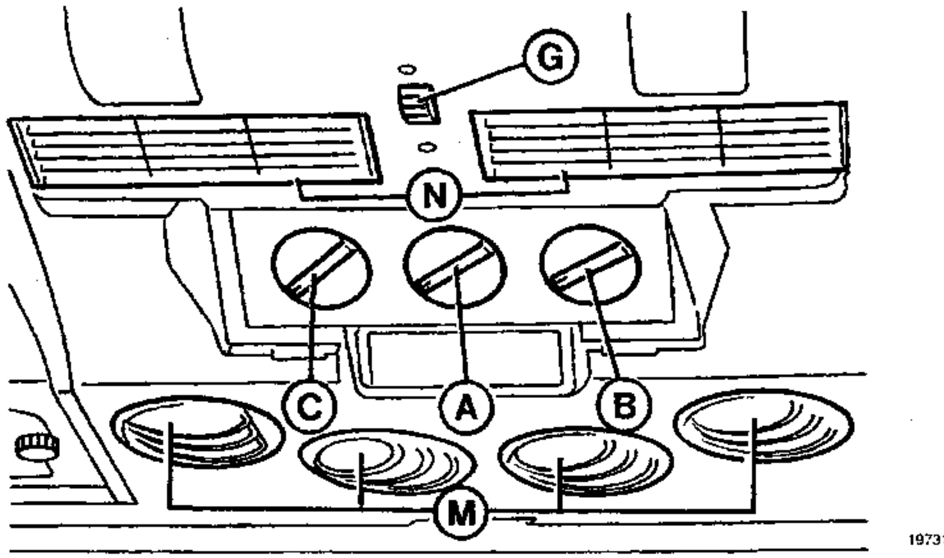
AIR CONDITIONED CAB CONTROLS



A. Air conditioner and temperature regulation control knob – B. Heater control knob – C. 3–speed electric fan control knob – G. Inside air inlet (N) control –M. Air outlets – N. Inside air inlets.

A – Air conditioner and temperature regulation control knob.

Activated with starter switch on position 1, with the electric fan control switch (C) on positions **1 – 2** or **3**, turning knob (A) clockwise in order to activate the air–conditoner. By further turning the knob clockwise, the temperature inside the cab is lowered, and vice–versa it increases if same is turned counterclockwise.

B – Heater control knob.

Set air temperature through control knob (B) as follows:
– For max. temperature, turn knob (B) clockwise on red sector.
– To stop warm air circulation inside the cabin, turn control knob (B) counter–clockwise on the blue sector.

C – 3–speed electric fan control knob.

Air can be optionally drawn from the outside or from inside the cab by acting on the air inlets (N) which can be set on two different positions through the air inlet control (G).

With inlets closed, air is aspirated from the outside through inlets (R, page 3).

With inlets open, a larger volume of air is drawn from the inside of the cab through inlets (N).

Set the electric fan control knob (C) on one of the chart positions corresponding to the desired performance.

Electric fan control knob (C).
Operates with starter switch key on position 1.

Position	Electric fan speed
0	Off
I	Low speed
II	Medium speed
III	High speed

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SPECIFICATIONS

CAB AIR CONDITIONING SYSTEM

Refrigerant fluid .... FREON 12

Capacity .... 2000 grams (70.6 oz)

Maximum system pressure .... 13 to 24 bar (188 to 348 psi)

Minimum system pressure .... 0.5 to 3 bar (.72 to 43.5 psi)

High pressure switch setting .... 25 bar (362 psi)

Low pressure switch setting .... 2 bar (29 psi)

Refrigerant temperature at compressor outlet .... 60 to 120 °C (140 to 248 °F)

Refrigerant temperature at condenser outlet .... 50 to 80 °C (122 to 176 °F)

Refrigerant temperature at evaporator outlet .... 0 to 20 °C (32 to 68 °F)

Maximum centrifugal fan flow rating .... 9 to 11 cu.m/min (318 to 388 cu.ft/min)

COMPRESSOR

Type .... SANKYO SD–510

Number of cylinders 5

Bore and stroke .... 36x31.7 mm (1.41x1.25 in)

Displacement .... 161 cu.cm (9.8 cu.in)

Maximum permissible speed .... 4000 rpm

Weight .... 4.9 kg (10.8 lb)

Lube oil quantity .... 135 cu.cm (8.23 cu.in)

OPERATION

The air conditioning system is designed to create inside the cab the best possible environment conditions for operator's comfort.

These conditions depend mainly on four factors, namely temperature, humidity, flow and cleanliness of air inside the cab.

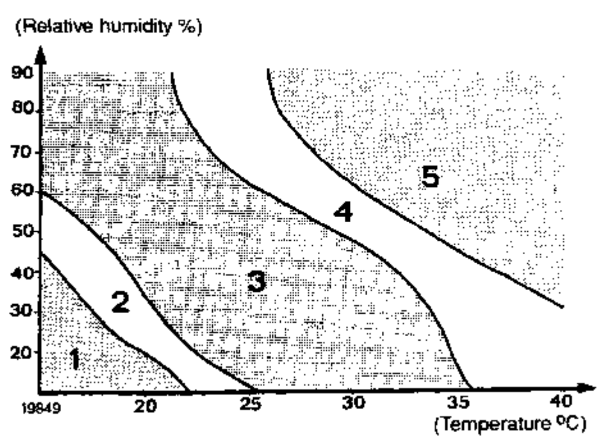
Although optimum values cannot be fixed owing to different individual requirements,limits can be envisaged to create sufficient comfort in the majority of cases.

As regards temperature and humidity, an area of environmental comfort, or of physical well–being, has been identified corresponding to certain temperature–humidity values, in relation with each other.

The chart shows that ideal humidity values are comprised between 30 and 70% ((below 30%, dehydration causes nose and throat soreness, whereas above 70% transpiration or unpleasant feelings due to the presence of moisture over skin areas are experienced); comfortable temperature can vary between 18 ° and 28 °C (62 and 84 °F), approximately.

Air flow rate should not be excessive to avoid physical annoyance and irritation. Values of .07 to .25 m/sec. are considered normal.

No strict limit has been defined for air cleanliness. However, it is a known fact that the human body alters the composition of air in the surrounding environment by increasing the percentage of carbon dioxide, raising humidity and decreasing oxygen content, etc.



Simplified temperature–humidity chart.

1. Sensation of unbearable cold – 2. Sensation of cold – 3. Area of physical comfort – 4.Sensation of heat – 5. Sensation of unbearable heat.

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These adverse effects can be rectified by drawing in small quantities of air from the outside. This, in turn, in view of the dusty conditions in which agricultural tractors are called upon to operate (ground processing, hay making, etc.) requires a particular attention and the installation of dry air cleaners on the air intakes.

Air conditioners are thus installed on tractors and agricultural machinery in general in order to neutralize the causes of discomfort (heat and humidity) generated inside the cab. The air conditioner modifies the thermal and hygrometric characteristics of the air existing inside or of that drawn in from outside to obtain a cooling effect and a humidity level physically agreable to the operator.

The operating principle of an air conditioner is similar to that of a domestic refrigerator. To cool the ambient, heat is taken away through a physical process (evaporation of a liquid) which to take place absorbs heat from the surrounding environment.

The liquid utilized for the purpose is, in this case, a fluid refrigerant made of difluorodichlorometane, known as Freon 12 or R 12, a product offering a high coefficient of refrigeration capacity, low toxicity and good mixability with lubrication oils.

The air–conditioning system consists of the following five main components:

1 – Compressor
2 – Condenser
3 – Air cleaner
4 – Expansion valve
5 – Evaporator

Suitable refrigerant lines connect the various elements and maintain fluid pressure inside the system in which R12 circulates.

In order to understand the working cycle of the air–conditioning system, follow the fluid flow starting from the compressor, as illustrated in the annexed lay–out and flow chart.

The compressor draws the refrigerant fluid, cold at the vapour stage with a pressure of 0.5 to 3 bar, and compresses it to 13 to 24 bar.

The fluid, heated by compression to 60 – 120 °C., is then admitted, always at vapour stage, inside the condenser coil located ahead of the engine radiator.

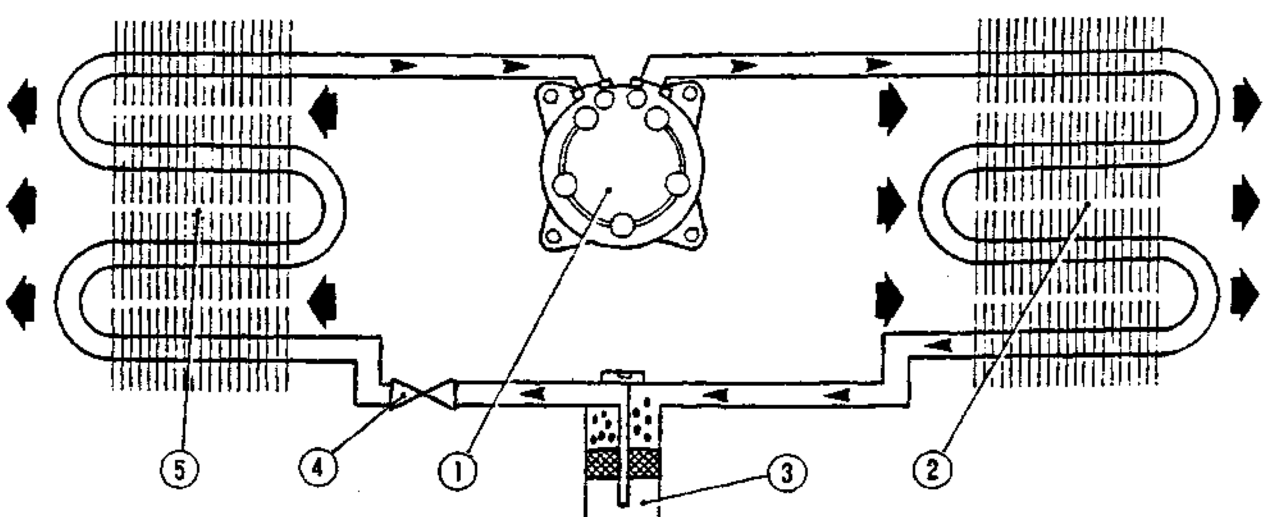
The flow of air produced by the movement of the machine cools the fluid through a heat exchange process.

Consequently the Freon vapour, which reaches the condensation point from 50 to 80 °C. ambient temperature, becomes a liquid.

The refrigerant fluid at the liquid stage and under high pressure passes on to the expansion valve , through a restriction which lowers the Freon pressure.

Through the valve, a part of the R12 liquid is transformed into low temperature vapour and the resulting mixture of liquid Freon and low–temperature and pressure Freon–vapour enters the evaporator.

Here the electric fan generates a continuous flow of air from inside the cab over the evaporator fins thus facilitating heat absorption on the part of the Freon which is finally fully vaporized.



Air conditioning system flow–chart.

1. Compressor – 2. Condenser – 3. Receiver–drier filter – 4. Expansion valve with thermostatic sensor – 5. Evaporator.

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The Freon evaporation process removes heat from the air impinging on the evaporator; as air is cooled the cab inside temperature lowers.

Air flowing over the cold surface of the evaporator also causes part of the water content of the air to condense, resulting in less humidity inside the cab.

The low–pressure Freon vapour out–flowing from the evaporator at 0 to 20 °C. is again aspirated by the compressor and a new cycle begins.

CAB AIR CONDITIONING SYSTEM MAIN COMPONENTS

COMPRESSOR

The compressor functions are to provide circulation and pressurization of the refrigerant fluid within the system.

It is of the reciprocating axial type and is driven by the engine crankshaft through a V–belt.

Schematically, the compressor functions as follows:

Actuator plate (2) resting on swash plate (1) carries the ball–head socket joint rods of pistons (3).

As it rotates, the swash plate exerts a continuous thrust on the actuator plate which cannot turn being meshed with stationary gear (4).

Due to the angled position of the swash plate surface with respect to its axis of rotation, each piston will move alternatively endwise.

The cylinder heads incorporate a single, five–lobe reed valve (one lobe for each piston) designed to permit continuous suction and discharge phases in the cylinders.

Valve opening and closing are automatic and depend on the pre–loading of the reeds.

The compressor inside rotating parts are permanently lubricated by a special oil introduced at production, a part of which flows mixed with the refrigerant fluid.

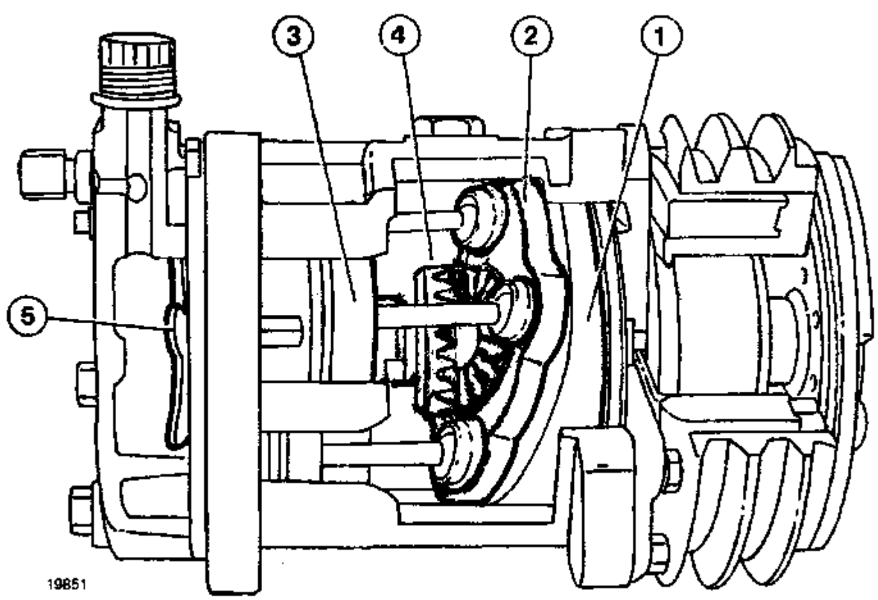
CONDENSER

The condenser is designed to convert refrigerant vapour into a liquid fluid.

As this transformation occurs through heat transfer from the vapour to the outside ambient air, the principle of operation of the condenser is similar to that of the engine radiator.

It consists of a finned tube core through which the refrigerant is circulated. The thin aluminium foil fin pack pressed onto the tubes dissipates heat to the exterior.

The condenser is installed ahead of the engine radiator to exploit at best the flow of air necessary to produce the heat exchange process.



SANKYO reciprocating axial compressor

1. Swash plate – 2.Actuator plate – 3.Piston with gland – 4. Stationary pilot gear – 5. Combined suction–discharge valve.

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RECEIVER–DRIER FILTER

The receiver–drier mounted between condenser and expansion valve performs two basic functions. It acts as a filtering element to retain water and solids and as a refrigerant reservoir during variable load conditions.

The elimination of water from the system is important to prevent corrosion which would adversely affect the system components.

To this end, the filter contains specific materials to absorb moisture.

Similarly, solid particles such as grit and sand, metal particles originating from wear of compressor parts, oxidation deposits and particles shed by piping which could cause damage to the system are retained through suitable filtering elements.

THERMOSTATIC EXPANSION VALVE

This valve is designed to reduce the liquid Freon pressure flowing out of the condenser to facilitate its conversion of state inside the evaporator and thus removing heat from the ambient to be cooled.

The expansion valve performs two basic functions:

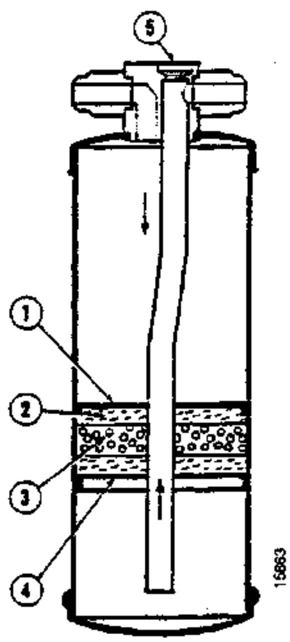
- metering function: a calibrated orifice inside the valve body produces a refrigerant pressure differential between inlet (liquid state) and outlet (mixed liquid–vapour state). The calibrated orifice is also designed to "atomize" the liquid to facilitate subsequent evaporation;

- modulating function: a thermostatically controlled sensor inside the valve body moves between extreme positions (fully open and fully closed) thereby metering the fluid flow through the valve. This ensures that the correct amount of refrigerant is allowed into the evaporator in order to obtain complete evaporation.

If the thermostatic sensor (6, page 50–10) detects an increase of temperature inside the cab, it will increase the flow of refrigerant.

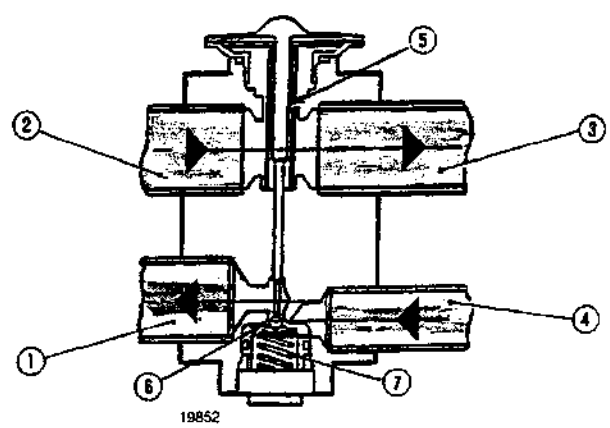
Conversely, as temperature decreases or compressor output increases (owing to increased engine speed),the sensor determines a reduction of the refrigerant flow to the evaporator.

The expansion valve is fitted on the evaporator inlet connection.



Receiver–drier filter

1. Top shield – 2. Disc – 3. Drier pack – 4. Bottom shield – 5. Sight glass.



Thermostatic expansion valve.

1. To evaporator inlet – 2. From evaporator outlet – 3. To compressor intake – 4. From receiver–drier filter – 5. Thermostatic sensor – 6. Orifice and ball – 7. Spring.

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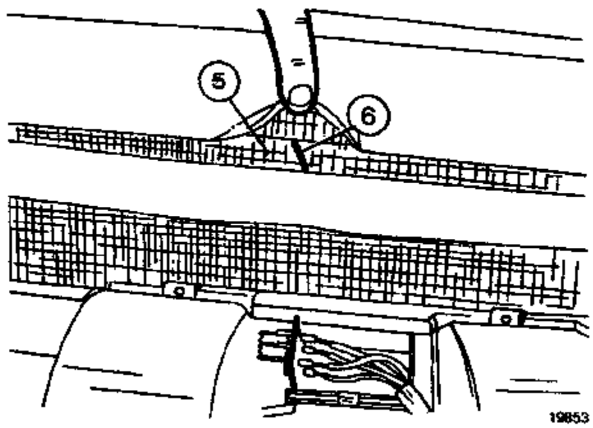
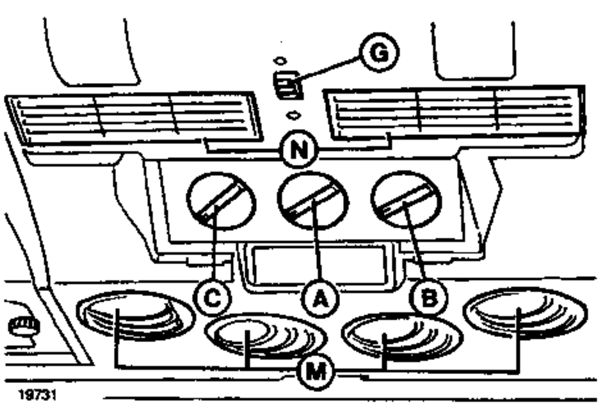
THERMOSTATIC SWITCH

The thermostatic switch, or simply thermostat, is a control device sensing the fluid temperature at the evaporator.



5. Evaporator core. – 6.Thermostatic sensing capillary tube.

It is provided with a capillary sensing tubelet suitably placed into the evaporator core for a continuous control of the evaporator temperature with respect to the setting values.



A. Air–conditioner and temperature regulation control knob – B. Heater control knob – C. 3–speed electric fan control knob – G. Air inlet (N) control – M. Air outlets – N. Inside air inlets.

This sensor is filled with a special gas the volume of which varies with temperature; acting on a diaphragm connected to a complex mechanism, it will open or close an electric circuit directly connected to the compressor electro–magnetic clutch.

Thus, depending on the setting of control knob (A) , the compressor will be driven by the engine for a certain short period of time and will supply the desired cooling inside the cab.

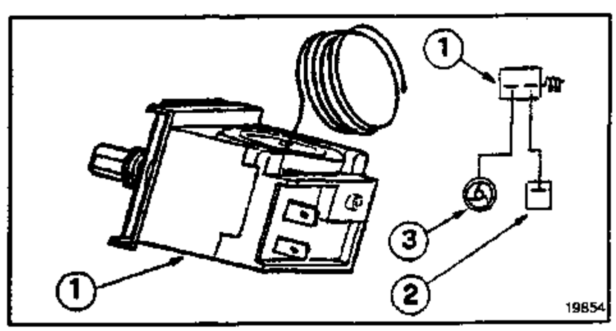
Once established a predetermined temperature value at the evaporator at which the compressor is disconnected, the device is designed to make the following engagement occur at a temperature higher of 3 °C. with respect to the previous disengagement.

The thermostat, through its sensor, also functions to prevent, in the event of a high level of moisture present in the air to be treated, the evaporator pack from freezing and thus hindering the circulation of the same air.

It is therefore important that the sensing capillary tube be placed in the position (6) shown in the accompanying figure on this page, otherwise the system cannot function correctly.

The functional range of the thermostatic switch extends over evaporator temperatures from +2 to +16 °C (36 to 61 °F).

The thermostatic switch, of the dual–contact type, and its electric connections are illustrated in the figure below.



Dual–contact thermostat and electric connections

1. Thermostatic switch – 2. Electric fan switch – 3. Solenoid clutch.

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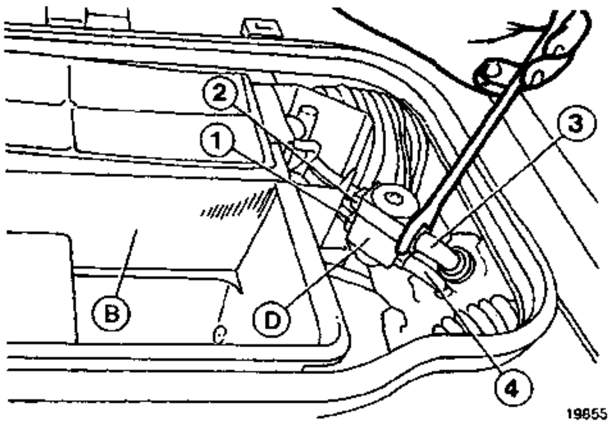


Evaporator with block–type expansion valve

D. Expansion valve – E. Evaporator – 1. To evaporator inlet – 2. From evaporator outlet – 3. To compressor intake – 4. From receiver–drier filter.

EVAPORATOR

The refrigeration cycle is completed inside the evaporator.

The refrigerant fluid flowing out of the evaporator is a mixture of vapour and liquid at low temperature and pression.

As it passes through the evaporator, it absorbs heat from the ambient to be cooled, vaporizes to produce the required cooling effect and is subsequently aspirated by the compressor in the vapour state.

The evaporator is functionally controlled by the expansion valve which meters the exact amount of refrigerant needed to produce the requested cooling.

The operation of the evaporator is exactly opposite to that of the compressor but its basic construction is identical except for main dimensions and internal circuit configuration.

Moreover, the evaporator has the added function of dehumidifying the air.

As the air admitted to the evaporator contains a certain amount of moisture, if the latter is not carefully controlled and removed, the optimum comfort for the operator cannot be obtained inside the cab.

Part of the moisture is eliminated in the form of condensate depositing on evaporator fins as air cools down.

The centrifugal electric fan is installed in order to draw ambient air through the fins for cooling and dehumidification prior to delivery to cab interior.

The enclosure housing both fin pack and electric fan is provided with a condensate trap and drain tubes.

CAB AIR CONDITIONING SYSTEM REPAIR NOTES

At low temperatures, starting the conditioner may result in compressor damage. The air conditioner should be activated only after the engine has warmed up and the temperature inside the cab has reached 20 °C (68 °F).

When disconnecting refrigerant lines always seal open ends with plastic plugs or caps to prevent entry of dust and moisture.

The thermostatic sensing capillary tubelets must be handled with care to avoid damage which may jeopardize the air–conditioning system performance.

When unscrewing fittings, always use a back–up wrench to prevent permanent deformation or torsional strains.

Never use engine oil of any type to lubricate conditioner system and compressor.

Do not leave compressor oil container open. Always make sure that it is always closed tight as oil absorbs ambient humidity which is detrimental to the system.

Do not transfer compressor oil from one container to another.

Do not re–use drained oil.

Do not add anything but pure refrigerant and refrigerant oil into the system.
Any additional compound can contain foreign substances not compatible with the chemical makeup of the refrigerant, causing it to become chemically unstable and to lose its qualities and characteristics.

Make sure that the thermostatic sensing capillary tube (6, page 50–10) is correctly placed into the evaporator core in order to assure efficient performance of the system.

CAB AIR CONDITIONING SYSTEM CHARGING AND DISCHARGING

CHARGING STATION (294005)

Vacuum pump

The **294005** charging station is equipped with oil–bath, double stage, self–purging, rotary type vacuum pumps.

The pump reaches its maximum efficiency after warming up, with "fresh" lubricant free from refrigerant and water (which when mixed with the lube oil reduce the cohesion of the sealing film coating the stator circumference, separating suction from delivery).

The self–purging feature is designed to protect oil from contamination. Pumps are thus able to eliminate consistent volumes of condensates without contaminating the oil.

With self–purging, gas is admitted during the pump compression phase causing the discharge valve to open before the volume of air is reduced; this will cause an increase of operating temperature in the pump preventing condensation to take place.

The self–purging control should be kept open for a couple of minutes on initial pump operation. The "sound" produced by the pump may vary from light buzzing to a strong "bubbling" noise. The latter occurs when the pump works at high pressure on suction side, i.e.,"always" in the starting phase.

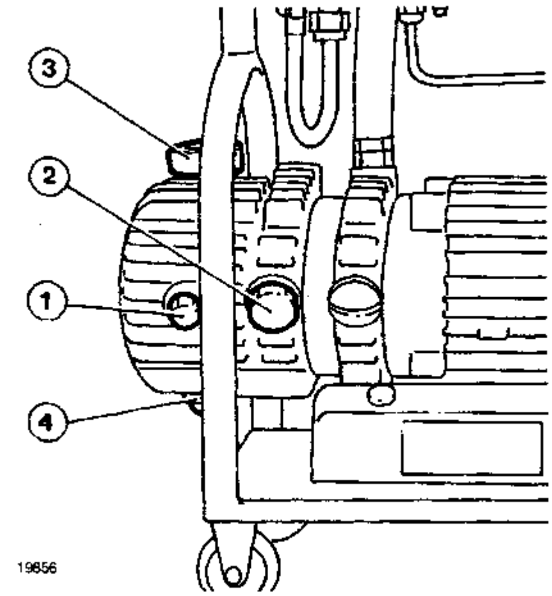
If the bubbling noise continues after a few minutes from starting, the problem may be due to:

a) water infiltrating upstream of the pump (leaking system or line hoses or seals);
b) low oil level;
c) self–purging device open.

Pump efficiency depends to a great extent on lubrication oil conditions.

Possible causes of oil contamination and degrading are refrigerant and water vapours, corrosive vapours and acids (such as hydrochloric and hydrofluoric) generated in a system affected by the compressor seizure and burning.

In such instances, in order to prevent pump malfunction, the only remedy is to replace the oil charge with a warm pump.



Vacuum pump.

1. Sight glass – 2. Self–purging device – 3. Filler plug – 4. Drain plug.

In some cases it will be necessary to flush the system using a reduced charge of lubricant which will be expelled after a few minutes of operation.

Charging station hoses (293824)

The charging station is equipped with two hoses, for high and low pressure connections, respectively (the high pressure hose may also be used for charging the graduated cylinder). Maximum hose pressure specification is stamped on each hose.

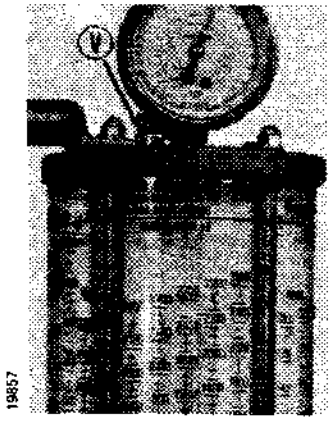
Hose fittings consist of knurled, straight sleeve adapters allowing to effect connections without using wrenches.

One end of each hose incorporates an inside striker which allows opening the compressor mounted "Schrader" valves.

Graduated charging cylinder

Maximum charge level is indicated by a line mark at the top of the transparent cylinder.

The quantity of refrigerant contained in the charging cylinder can be read directly off the graduated scale (in grams) marked on the transparent cylinder.



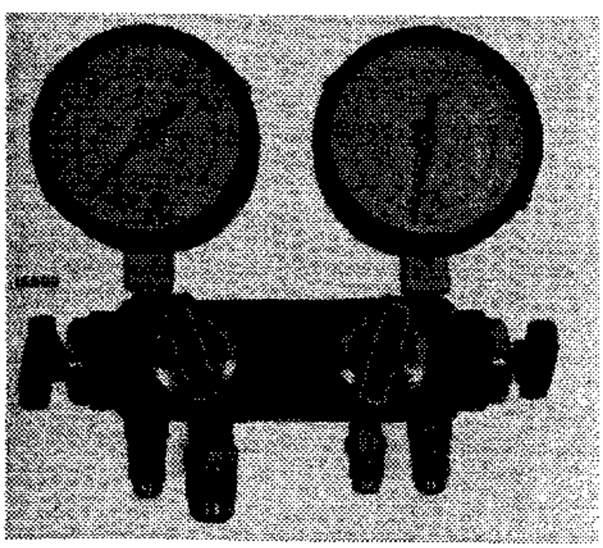
Graduated charging cylinder

V. Cylinder drain valve.

To read the refrigerant level proceed as follows: turn the graduated transparent cylinder so that the set of scales corresponding to the type of refrigerant used (R12) is facing the reader. Select the scale providing, in addition to the maximum level line, a pressure value corresponding to that indicated by the pressure gauge fitted to the top of the same cylinder, superimpose it on the level indicator and take the reading.

Pressure gauge set (292744)

The pressure gauge set is provided with 4 fittings, 4 valves and 2 pressure gauges. It makes it possible to carry out all operations of discharging, charging and pressure reading of the cooling system without the necessity of moving the two flexible hoses connecting the system to the charging station.



Low–pressure gauge (left) and high–pressure gauge (right) with scales graduated in bar and kPa.

The **high–pressure** gauge, used to read condensation pressure values, has a scale graduated from 0 to 4 bar (from 0 to 3400 kPa*); the **low–pressure** gauge, or hand–vacuum gauge, used to read evaporation pressures (in some cases lower than the 0 value), has a negative pressure scale graduated from 0 to –76 cm Hg (from 0 to –100 kPa) and a positive pressure scale graduated from 0 to 8 bar (from 0 to 800 kPa).

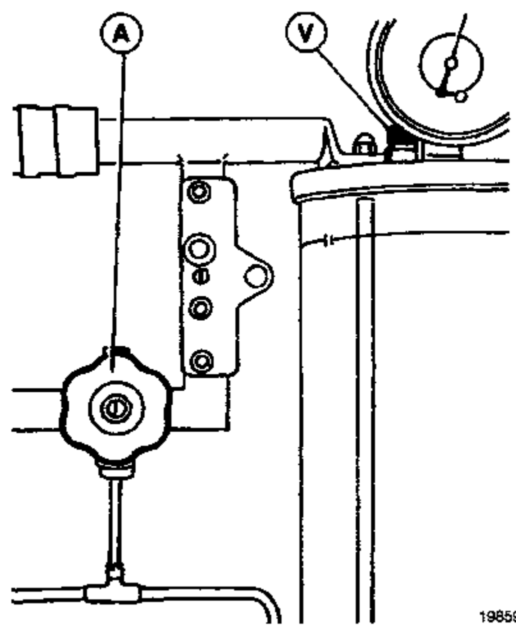
* The Pa, or pascal, is the unit of pressure (N/sq.cm) adopted by the International System of Measurements (SI), whereas the kPa, or kilopascal, is its multiple widely used for practical applications: 1 kg.sq.cm =98 kPa.

Charging valve

Two–way, handwheel type.
The upper fitting is available for connecting to the pressure container from which the refrigerant will be drawn to charge the cylinder, whereas the lower fitting is connected, through a copper pipe, directly to the charging cylinder and pressure gauge set.

SYSTEM FILLING

The refrigerant fluid used is Freon 12 (code: R12 or F12).
The charging station pressure gauges are also provided with temperature scales. On the R12 scale, for each pressure value, it is possible to read the corresponding temperature of the fluid in the saturated vapour range.



Charging station filler valve

A. Charging station filling valve – V. Cylinder bleeding valve.

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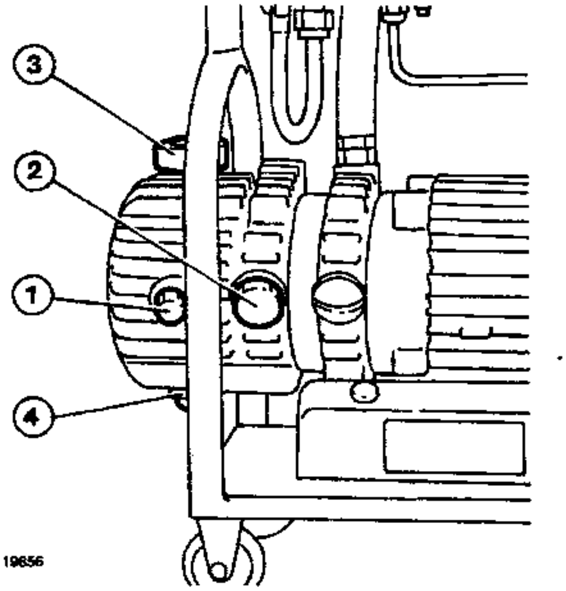
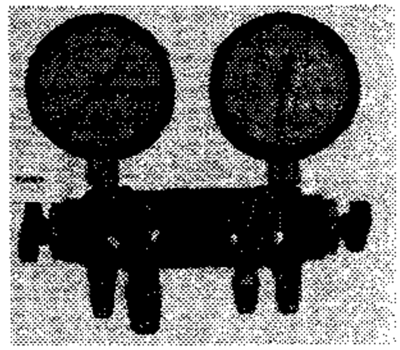


Vacuum pump.

1. Sight glass – 2. Self–purging device – 3. Filler plug – 4. Drain plug.



Low–pressure gauge (left) and high–pressure one (right) with scales graduated in bar and kPa.

Preparation of charging station

Prior to activate the charging station check the pump oil level and for the presence of any impurity.

Proceed as follows:

– check oil level on sight glass (1);

– partially open the self–discharging device (2) for about three minutes;

– start the pump;

– allow pump to operate 5 minutes and then check oil surface through sioght glass (1) for impurities. Also make sure that the oil level reaches just above the middle of the sight glass.

If the above conditions are not met, top up or replace the oil.

Topping up should be made with the pump warm and the oil level should not be below or above the marks on the sight glass.

Oil should be replaced when it is found to be cloudy and greyish in colour. Make sure the pump is still warm and proceed as follows:

– open filler plug (3);

– open drain plug (4);

– allow oil to drain completely. Oil will flow out carrying any impurities with it;

– re–fit and tighten plug (4);

– refill with .45 liters (3/4 pint) of oil **293825** (viscosity 6 ° Engler) through the upper plug (3);

– check oil level.

Filling the graduated charging cylinder

Make sure all cocks and valves of the charging station are closed, then proceed as follows:

– superimpose the selected graduated scale onto the indicator located inside the cylinder;

– read, in correspondence to the level, the quantity in grams of the refrigerant fluid present inside the cylinder. If the quantity found is less to that required to fill the system, fill the metering cylinder and proceed as follows:

– place the refrigerant pressurized container upside down and higher tan the charging station;

– connect the container to the valve (A) leaving the fitting partially loose;

– open the container valve slightly only and let refrigerant fluid outflow for 2 to 3 seconds in order to eliminate the air present inside the connecting line;

– tighten connection by hand;

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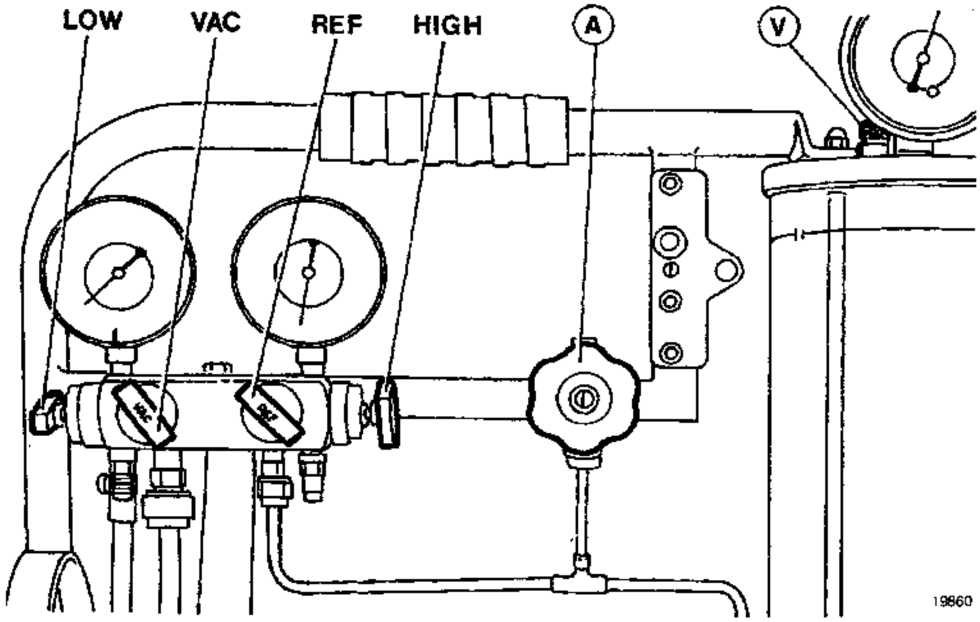
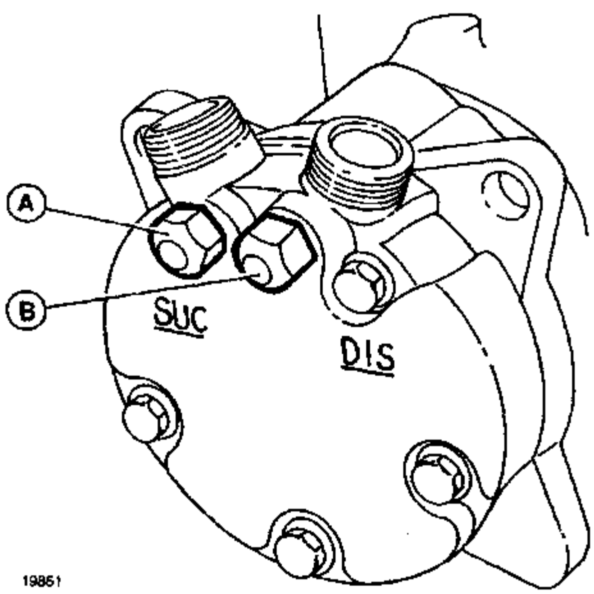


Charging station valves

A. Charging station filling valve – HIGH. High–pressure valve – LOW. Low–pressure valve – REF. System charging valve – V. Cylinder bleeding valve – VAC. System emptying valve.

- slowly open valve (A) and remove plug from bleed valve (V);
- press slightly on the needle so to open and close repeatedly the bleed valve;
- once the refrigerant fluid has reached the desired level, close filler valve (A) and refit plug on the bleed valve.



Compressor service valve

A. Valve on intake – B. Valve on delivery.

ATTENTION – All connections on operating lines must be tightened by hand only. Do not use tools.

Connecting the charging station to the air conditioning system

Proceed as follows:

- remove caps from the compressor service valves (A) and (B);
- connect plunger ends of station hoses to the compressor service valves, as follows:
- low–pressure service hose, low–pressure gauge side to the compressor intake valve (A) marked SUC;
- high–pressure service hose, high–pressure gauge side, to the compressor delivery valve (B) marked DIS;
- make sure that the station pressure gauge set hand valves are closed. Charging station service hoses are evacuated simultaneously with the system.

ATTENTION – Lubricate charging hose fittings with compressor oil, to prevent seizing, and tighten them by hand (never with tools). Do not use oil of a different type.

- open the charging station HIGH and LOW valves to an intermediate position;

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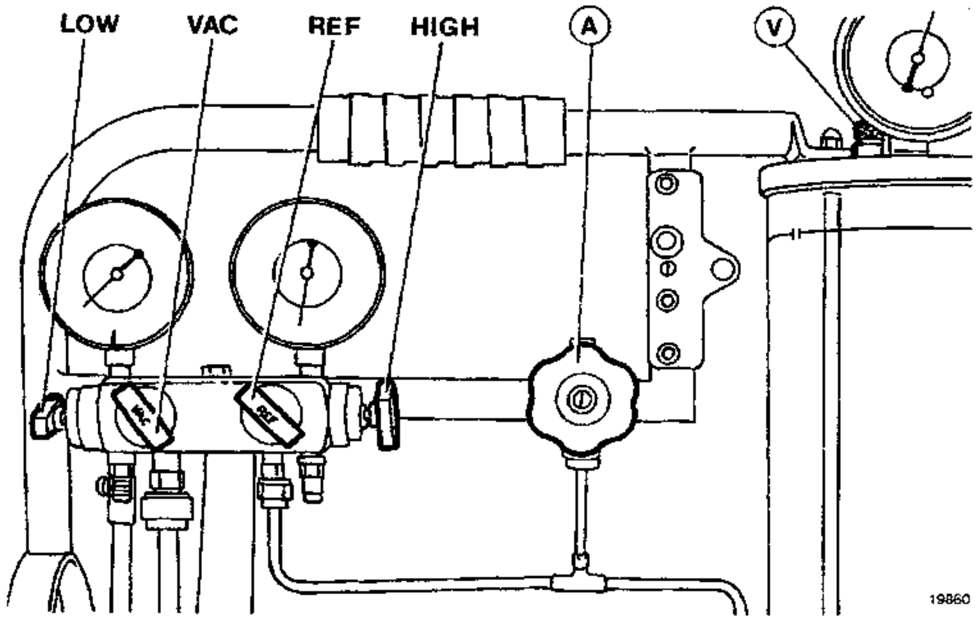

Charging station valves

A. Station filler valve – HIGH. High–pressure valve – LOW. Low–pressure valve – REF. System charging valve – V. Cylinder bleeding valve – VAC. System emptying valve.

System evacuation

To put the system under vacuum conditions proceed as follows:

– start the charging station electric motor;
– open VAC valve;
– allow pump to run for about half an hour.

After approximately ten minutes the system should reach about 700 to 700 mmHg of vacuum, which can be read on the low–pressure gauge. If the refrigerant in the system is not normally discharged, check all connections and, if necessary, leak–test the system (see page 50–19).

If evacuation is normal, after approximately thirty minutes:

– close VAC valve;
– stop vacuum pump;
– check the system tighteness by verifying that there is no rise in pressure.

If the pressure reading on the low–pressure gauge increases rapidly, check for leaks and rectify as necessary.

If, on the contrary, the system fluid tightness is correct, proceed with charging.

System charging (Op. 50 200 04)

The quantity of refrigerant to be introduced in the system is 2000 grams (70.6 oz).

After establishing charging station connections and evacuating the system, proceed as follows:

– open the system charging valve REF;
– open the high–pressure valve HIGH.

Under these conditions, the refrigerant fluid starts flowing from the charging station cylinder to the air–conditioning system, high–pressure side.

Upon reaching a 3 to 4 bar pressure, referred to an ambient temperature of 20 °C (68 °F), proceed to:

– close valve HIGH and open valve LOW;
– set the evaporator thermostat, located inside the cab, for maximum cooling;
– set the electric fan for maximum speed;
– start the tractor engine and keep it at idling speed until the air conditioning system has absorbed the full charge.

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Refrigerant level in the graduated cylinder of the charging station must decrease by an amount corresponding to the quantity needed for charging the system, the value of which is obtained by making the difference between initial and final readings.

Once charging has been completed, proceed as follows:

- close REF valve;
- close LOW valve;
- stop tractor engine;
- carry on functional checks with the system set for maximum performance levels.

CAB AIR CONDITIONING SYSTEM OPERATION CHECKS

With pressure gauges properly connected to system and valves closed, proceed as follows:

- start the engine and run it at 1500 rpm;
- set the system thermostat, located inside the cabin, for maximum cooling;
- set the electric fan for maximum speed.

After about 15 minutes of plant operation, take the following readings:

- compressor intake pressure, on the low–pressure gauge;
- compressor delivery pressure, on the high–pressure gauge;
- ambient air temperature;
- ambient relative humidity;
- air temperature at the outlets inside the cab.

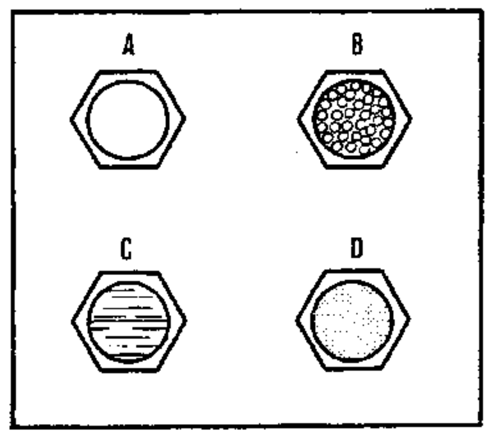
Pressure values obtained depend on external environment conditions.

Functionality of the plant can be considered normal if the pressure and temperature values obtained are within range limits given in the chart on page 50–18.

It will also be useful to physically check the actual temperature on the low and high pressure areas of the plant, as follows:

- high–pressure component surfaces, from compressor delivery end (B, page 50–15) to the evaporator expansion valve should feel uniformly warm to the touch;
- low–pressure component surfaces, from evaporator outlet to compressor intake (A), should feel uniformly cold to the touch.
  There should not be excessive condensation on both the intake line and compressor low–pressure connection.

Useful indications on the functionality of the air–conditioning plant can also be obtained through the sight glass located on the receiver–drier filter. Four different cases are possible, as shown in the figure below:



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A. Clear glass: it means that the system has been charged correctly, or on the contrary, that there is no refrigerant fluid inside (in the latter instance, a complete absence of cooling in the evaporator will be evident). In some case, the glass may result clear through, but charging of refrigerant fluid may have been excessive. If so, proceed checking pressure values.

B. Presence of bubbles: vapour bubbles or foaming indicates that the quantity of refrigerant fluid in the system is insufficient, or presence of air. Occasionally, the presence of bubbles may be noticed at plant starting or during the solenoid clutch disengagement phases.

C. Traces of oil: lack of refrigerant fluid and compressor oil circulating through the system.

D. Non–homogeneous, striped fluid: indicates that the drying material contained in the receiver–drier filter has separated and is freely circulating in the system following the failure of container plates.

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CAB AIR CONDITIONING SYSTEM TEMPERATURE RANGE VARIATION CHART

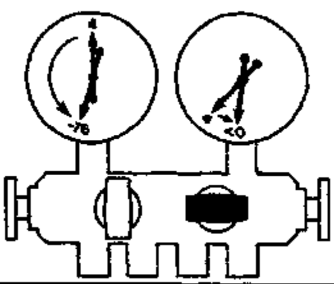
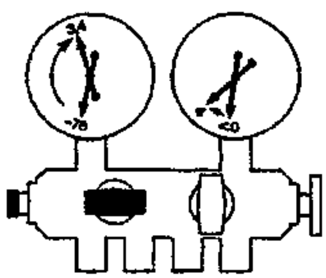
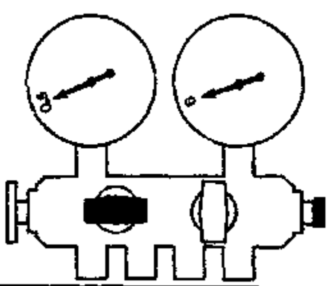
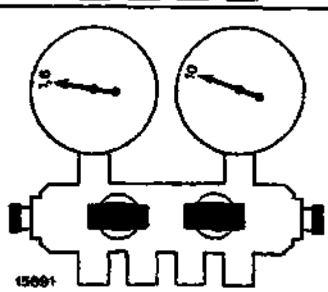
External ambient temperature	20 °C (68 °F)	27 °C (80 °F)	28 °C (82 °F)	35 °C (95 °F)	36 °C (97 °F)	43 °C (109 °F)
Air temperature at outlets (inside the cab)	4 to 8 °C (39 to 46 °F)		6 to 12 °C (43 to 54 °F)		12 to 20 °C (54 to 68 °F)	

When the external ambient temperaturte and the temperature of cooling air measured at the outlets located inside the cabin are in correct relationship and correspond to the data reported in the chart , then the air-conditioning plant can be considered efficient.

In the event that the the temperature of cooling air at the outlets inside the cab exceeds the top limit given in the chart, proceed with trouble-shooting following the information given on pages 50–20 through 50–24 in order re–establish plant efficiency.

SUMMARY OF THE CAB AIR CONDITIONING SYSTEM CHARGING OPERATIONS

(Note: pressure values are indicative and referred to an external ambient temperature of 25 °C=77 °F).

	■ Valve closed □ Valve open **Evacuation** During evacuation, vacuum pump aspirates simultaneously from both low and high–pressure sections of system. Compressor is off.
	**Initial charging** Vacuum conditon is ended by directing refrigerant to the high–pressure section of system. Refrigerant, through the expansion valve, is transferred to low–pressure section thus activating the associated gauge. Compressor is off.
	**Charging** Refrigerant is directed to the low–pressure section of system in small quantities. Compressor, activated,draws fluid and delivers it to high–pressure section.
 15691	**Saturation pressure and temperature readings** The four pressure–gauge set valves are closed; however, gauges remain connected with both sections of system and show saturation pressure and temperature values. Low–pressure gauge will give a reading approaching the evaporation temperature value, whereas high–pressure gauge will give a value approaching condensation temperature.

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LEAKAGE SEARCH USING THE ELECTRONIC LEAK DETECTOR

LEAK DETECTOR

Freon gas leak detector **293823** is contained in a case together with batteries, sensitivity check test tube and headphone connection.
The instrument consists of the detector unit and connected flexible sonde with end sensor pick–up. To correctly position the pick–up slacken the knob located on the bottom left corner by turning it counterclockwise.
The front end of the instrument incorporates a sliding type on/off switch, the associated red indicator light (led) and acoustic signal warning of the presence of R12 gas. The headphone round socket is located on the back of the instrument. A spare sensor and a number of felts are contained inside the battery compartment.

Use

Set switch on "ON" position: start searching for leakage. The frequency and amplitude of the sound signal increase in the presence of R12 gas.

Turn the instrument off and on again over areas affected by R12 gas leakage: it will automatically set itself on a new sound level. Check instrument this way every time before use.
Keep the sensor close to the test tube (open) to check sensitivity; as soon as the instrument produces a warning sound turn it on and off. If the signal amplitude continues to increase , turn the instrument on and off again. The instrument will thereby automatically adjust its sensitivity depending on the presence of R12 gas in the proximities of the pick–up. This check is performed solely through the on/off switch.

In ventilated areas it may be extremely difficult to detect a consistent leakage as the refrigerant gas leaves the leakage point too rapidly. In this case, after identifying the position of a potential source of leakage it will be necessary to screen it in order to take more precise readings.
Wherever serious leakages may cover the presence of minor ones, it is suggested that the former be localized and repaired first, thus facilitating any further searching and detection.

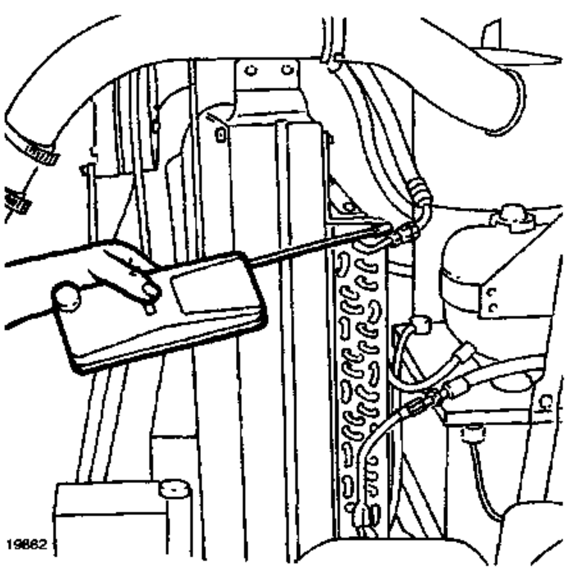
Maintenance

Always make sure that the instrument is turned off before replacing the pick–up. To replace the latter, turn it counterclockwise, fit a new one with a new protective felt and turn them both clockwise on the tip of the flexible sonde.
Do not turn the detector on until the pick–up is securely fastened.
Prior to assembly, make sure that the connecting hole between sonde and sensor is free from any grease or dust deposit.

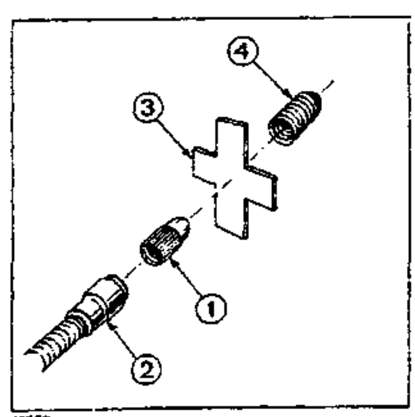
Leakage test

With system charged and gauges properly connected, proceed as follows:

- start the engine;
- set the thermostat, located inside the cab, for maximum cooling;
- set the electric fan for maximum speed;



Refrigerant fluid leakage test



Leakage detector sonde .

1. Sensor – 2. Flexible sonde – 3. Felt – 4. Protection.

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- bring engine speed to approx. 1500 rpm;
- activate the electronic leak detector;
- check, using the sonde pick–up, every fluid line connections and any potential search of leakage;
- presence of refrigerant, and consequently of a leakage point, is evidenced by the instrument through an increased frequency of the sound signals.

NOTE – Move pick–up under hoses, joints, seals and any other possible place where a leak is liable to occur. This is because refrigerant R–12 is heavier than air.

DIAGNOSING FAULTS OF THE CAB AIR CONDITIONING SYSTEM

The main conditions evidenced in case of a problem are:

– air conditioner inoperative;

– insufficient cooling;

– compressor faults.

Provided that insufficient cooling may depend on external causes often a preliminary mechanical and visual checks can give sufficient indications on the conditions and state of efficiency of an air–conditioning plant.
These information may then be usefully supplemented by an electrical check.
If at this stage the problem has not been yet detected, proceed to a more detailed search analyzing pressure values in the different areas of the air–conditioning system.

VISUAL INSPECTION OF COMPONENTS

Make sure that engine and the heating and air–conditioning plants are switched off, then proceed as follows:

– check fastenings of compressor and bracket, pulley alignment and belt tension;

– check for traces of refrigerant leaks evidenced by the presence of oil over the fluid line connections;

– check for visual evidence of cooling fluid;

– inspect fluid line conditions, in particular where in contact with the engine, as well as hoses and band clamps;

– check evaporator, heating radiator and condenser and remove any foreign material;

– check conditions and positioning of the thermostat feeler tubelet (6, page 50–10) in the evaporator (5).

– check the cab external air intakes for obstructions or clogging;

– see that condensation drain lines are free.

FUNCTIONAL CHECK

Start the engine, set the air–conditioner for maximum cooling and after 15 minutes of operation proceed to the following checks and inspections:
– the receiver–drier filter sight glass should look transparent and, any bubbles that may appear during the joint engagement phase should disappear immediately after;
– compressor should run without abnormal noise, engagement should be accompanied by an audible click;
– the following components should feel cold when touched: expansion valve outlet, evaporator, low–pressure line, compressor intake connection;
– following components should feel relatively warm when touched: condenser, expansion valve inlet, compressor delivery connection, high–pressure line.
– listen to the sound produced by the expansion valve: squealing means that pressure is too low and moisture is present inside the system;
– check evaporator for any ice formation.

CHECKING THE PLANT THROUGH OPERATING PRESSURES

The following pages are dedicated to plant diagnosis through operating pressure readings. Remedies to correct any identified problem will also be given.
Check consists in connecting test pressure gauges to the system as described on page 50–15, taking the reading of operating pressures as indicated on page 50–17, comparing the latter with the data of the chart on page 50–18.
As pressure varies with altitude, to obtain actual pressure values subtract from test readings the correction factor given in the table below.

PRESSURE/ALTITUDE CORRECTION FACTORS		
Altitude a.s.l. (m)	Absolute atmospheric pressure (kg/sq.cm)	Correction factor (kg/sq.cm)
0	1.029	0
300	0.994	–0.035
600	0.959	–0.070
900	0.924	–0.105
1200	0.889	–0.140
1500	0.854	–0.175
1800	0.819	–0.210
2100	0.791	–0.238
2400	0 763	–0.268

ATTENTION – Wherever, in the following pages, it is required to carry on the expansion valve test with R12, proceed as follows:
– set the thermostat for maximum cooling;
– spray a small quantity of liquid R12 on diaphragm cover or on thermostatic sensor and check the reading of the low–pressure gauge. If value drops, the valve works correctly and consequently the cause of malfunction should be traced elsewhere.

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AIR CONDITIONING SYSTEM TROUBLE–SHOOTING GUIDE

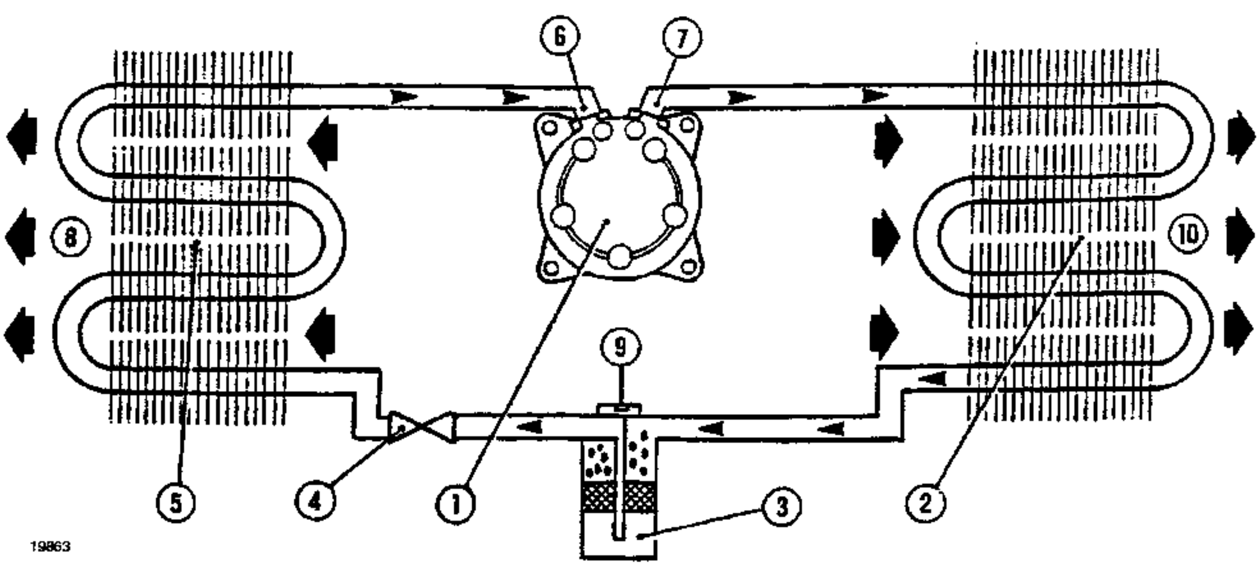
CONDITIONER FAILS TO OPERATE

Check:

1. Fuses.
2. Compressor belt tension.
3. Clutch solenoid coil for current supply.
4. Contact of ground connection.

Inspect and verify:

5. Control system and components (relays, wiring, thermostat, etc.).
6. Visually, conditions of fluid lines, hoses and connections.
7. Gap (clearance) between solenoid clutch front plate and pulley.



Air conditioning system lay–out and flow chart

1. Compressor – 2. Condenser – 3. Receiver–drier filter – 4. Expansion valve with thermostatic sensor – 5. Evaporator – 6. Intake line – 7. Delivery line – 8. Cold and dried air – 9. Sight glass – 10. Warm air.

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AIR CONDITIONING SYSTEM TROUBLE–SHOOTING GUIDE *(cont.)*

POOR COOLING EFFECT

HIGH DISCHARGE PRESSURE AND/OR HIGH SUCTION PRESSURE

CHECK ON SIGHT GLASS

EXCESS OF REFRIGERANT FLUID
Note: bubbles might be evidenced. Drain fluid until bubbles appear consistently, then add fluid until a bubble–free flow is obtained.

ENGINE WATER COOLING PLANT
Inspect (and check):
1. Fan belt tension.
2. Radiator cap and thermostat pressure setting.
3. Rubber hoses.
4. Antifreeze supplied.

CONDENSER
1.Check if clogged and air starving. Clean core fins.

EXPANSION VALVE
Test valve with R12 (see page 50–20).
1. Positive test: remove thermostatic sensing tube from evaporator core and clean probing area; re–install in correct position (6, page 50–10).
2. Negative test: replace valve.

LOW DISCHARGE PRESSURE AND/OR LOW SUCTION PRESSURE

CHECK ON SIGHT GLASS

BUBBLING EVIDENCE
Insufficient refrigerant fluid quantity possibly caused by minor leaks.
1. Search for leaks and rectify.
2. Add refrigerant until bubble–free fluid flow is obtained and both pressure gauges give normal readings.

BUBBLE–FREE SIGHT GLASS
Pressure gauge readings too low: possibly no refrigerant liquid flowing through glass.
1. Major leak.
2. Expansion valve might be stuck closed.
Replace valve.

NORMAL DISCHARGE PRESSURE AND/OR NORMAL SUCTION PRESSURE

Note – Test reading may evidence vacuum or normal pressure.
INSIDE MOISTURE
1. Drain out refrigerant fluid.
2. Replace receiver–drier filter.
3. Evacuate system and re–charge with refrigerant.

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AIR CONDITIONING SYSTEM TROUBLE–SHOOTING GUIDE *(cont.)*

POOR COOLING EFFECT

HIGH DISCHARGE PRESSURE AND/OR NORMAL SUCTION PRESSURE

Note – Constant high–pressure gauge reading, should not drop.

AIR INSIDE SYSTEM

1. Drain out refrigerant fluid.
2. Replace receiver–drier filter.
3. Evacuate system and re–charge with refrigerant.

HIGH DISCHARGE PRESSURE AND/OR LOW SUCTION PRESSURE

RESTRICTION

With water or ice formation downstream (on receiver–drier filter or on condenser outlet to expansion valve line).

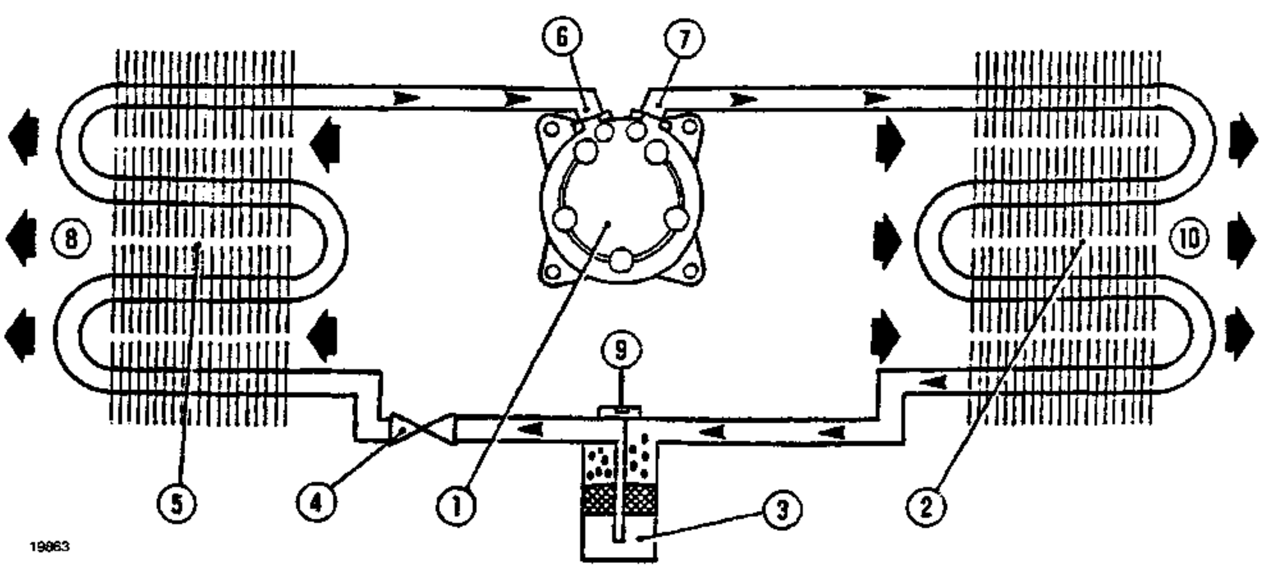
1. Remove component involved, rectify restriction or replace component.

NORMAL DISCHARGE PRESSURE AND/OR NORMAL–TO–HIGH SUCTION PRESSURE

THERMOSTATIC SWITCH

Compressor solenoid–type clutch goes on and off too rapidly.

1. Faulty thermostat.
2. Replace thermostat (6, page 50–10), do not squeeze capillary sensing tubelet, re–install it in same position and depth inside evaporator core.



Air conditioning system lay–out and flow chart

1. Compressor – 2. Condenser – 3. Receiver–drier filter – 4. Expansion valve with thermostatic sensor – 5. Evaporator – 6. Intake line – 7. Delivery line – 8. Cold and dried air – 9. Sight glass – 10. Warm air.

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AIR CONDITIONING SYSTEM TROUBLE-SHOOTING GUIDE *(cont.)*

COMPRESSOR AND ELECTRO-MAGNETIC CLUTCH

UNUSUAL NOISE WITH CLUTCH ENGAGED

Check:
1. Compressor fastenings.
2. Engine components in compressor area.
3. Clutch for discontinuous operation or slippage.
4. Clutch bearing.
5. Clutch pulley smoothness.
6. Compressor lube oil level.

NO COOLING EFFECT

Compressor noisy or inoperative.

Check:
1. Compressor belt conditions and tension.
2. Gap (clearance) between clutch front plate and drive pulley.
3. Solenoid coil for: voltage, current absorption, lead wire, ground contact.
4. Clutch pulley for smoothness.
5. Right quantity of refrigerant fluid.
6. Compressor for leaks.
7. Air conditioning plant for leakage.

UNUSUAL NOISE WITH CLUTCH DISENGAGED OR CHATTER

Check:
1. Current supply.
2. Gap (clearance) between front plate and pulley.

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AIR CONDITIONING SYSTEM MAINTENANCE

At the start of every working season operating conditions and efficiency of the air conditioning plant should be assessed by verifying that the difference between ambient temperature and the air outlet temperature inside the cab correspond to the values reported on the data chart on page 50–18.
If these values are met, the air conditioning plant is fully efficient and the only checks required are the following preliminary inspections involving the main components:

A) COMPRESSOR – Verify fastening, check drive belt tension and oil level.

B) CONDENSER – Verify fastening and check finned area which should be free from an excess of dirt or foreign material.
Wherever fins are bent, straighten them using the comb–type tool **293831**. Proceed in the same way for the EVAPORATOR and HEATER.

C) RECEIVER–DRIER FILTER – Useful indications on plant conditions and functionality can be drawn by checking the sight glass as reported on page 50–17. Replace the filter after every two repairs made to the plant.

D) EXPANSION VALVE – Maintenance–free, in case of any problem contact specialized service workshops of the FIATAGRI network.

DISCHARGING THE SYSTEM

If a charged system has remained inactive for a considerable period of time, any oil flown from compressor to other parts of the system should be sent back to the compressor.

For this purpose, start and run the engine at 1500 rpm for about 10 minutes.

The air conditioning system should have the thermostat set for maximum cooling and the electro–fan at maximum speed.

DANGER

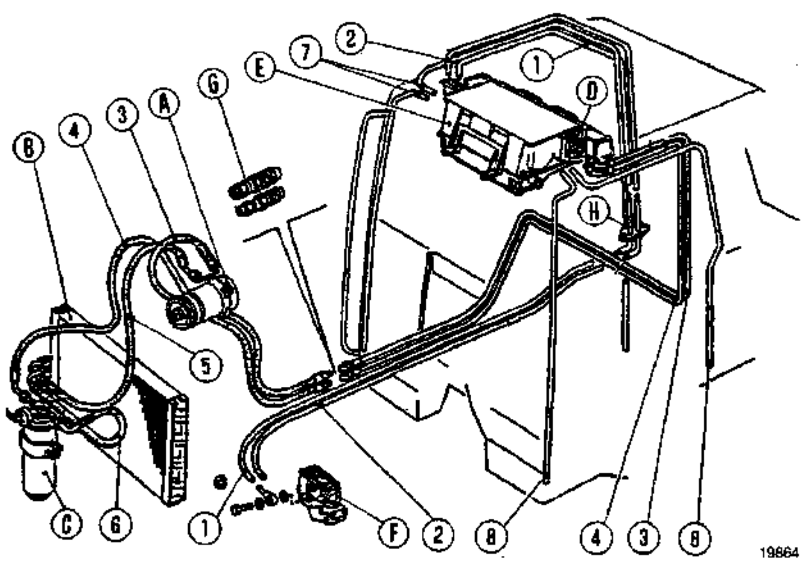
Discharging must be carried out in well–ventilated premises with good circulation and far away from open flames of any kind, thoroughly complying with the safety rules of page 50–1.

The plant discharging operation should be started from highest point in the plant, proceeding as follows:

– slacken the refrigerant fluid inlet connection on the expansion valve located on the evaporator–heater unit inside the cabin;

– let Freon gas out very slowly in order to avoid both oil leakages in the plant and freezing of the expansion valve;

– once the system has been completely discharged, screw back the inlet connection onto the expansion valve and tighten it.



High–pressure refrigerant

In delivery lines (4), (5) and (6) connecting compressor (A) to expansion valve (D).

Low–pressure refrigerant

In return lines (3) connecting expansion valve (D) to compressor (A).

Air conditioning plant lay–out and flow chart

A. Compressor – B. Condenser – C. Receiver–drier filter – D. Evaporator expansion valve – E. Climatization unit (evaporator + heater) – F. Water pump – G. Quick–connectors – H. Connecting pipe lines – 1. Delivery lines to heater – 2. Return lines from heater – 3. Return lines from evaporator expansion valve (D) to compressor (A) – 4. Receiver–drier (C) delivery line to expansion valve (D) – 5. Compressor (A) delivery line to condenser (B) – 6. Delivery line from condenser (B) to filter (C) – 7 and 8. Climatizer unit (E) condensate drains.

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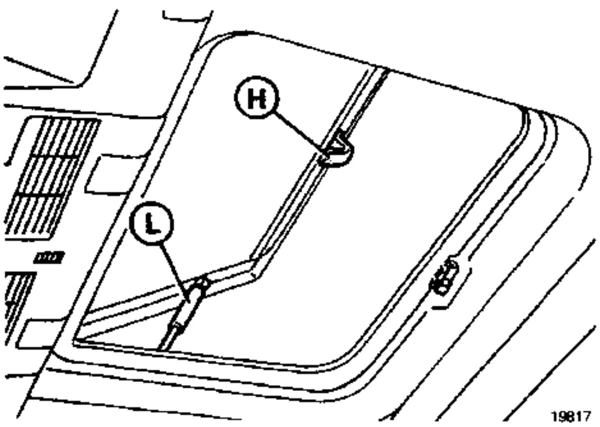
SERVICING AND REPAIR PROCEDURES

AIR CONDITIONER EVAPORATOR
Replacement (Op. 50 200 04 – 50 206 56)

Proceed as follows:



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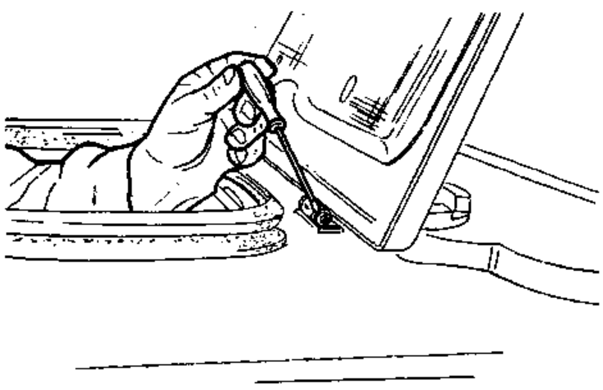
1. Turn handle (H), open the roof emergency hatch and detach damper rods (L) from the ball– joint socket plastic support by striking the hatch with the palm of the hand.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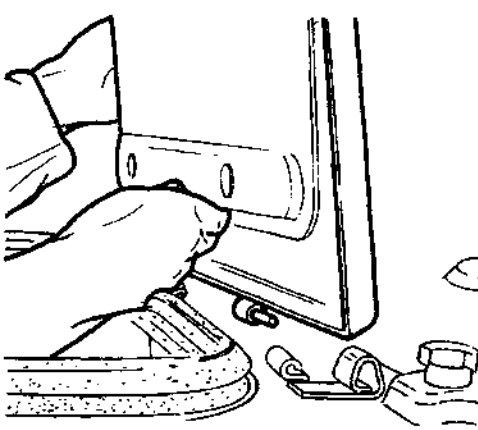
2. Remove the hatch hinge–pin snap rings.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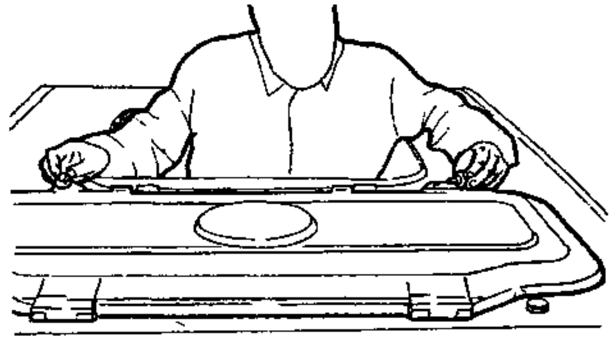
3. Remove complete roof hatch from cab.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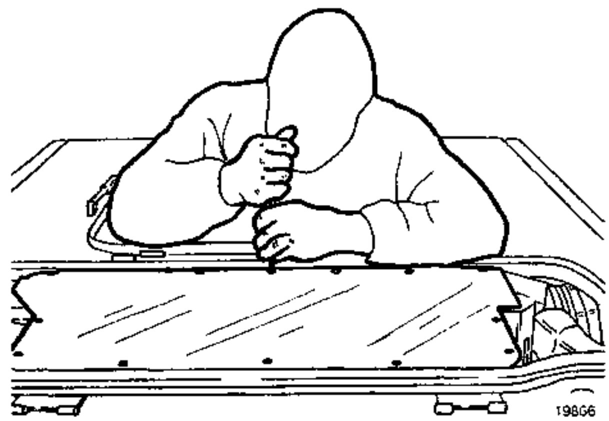
4. Working on the outside of the cab roof, remove the two air–conditioning/heating plant housing cover fastening knobs.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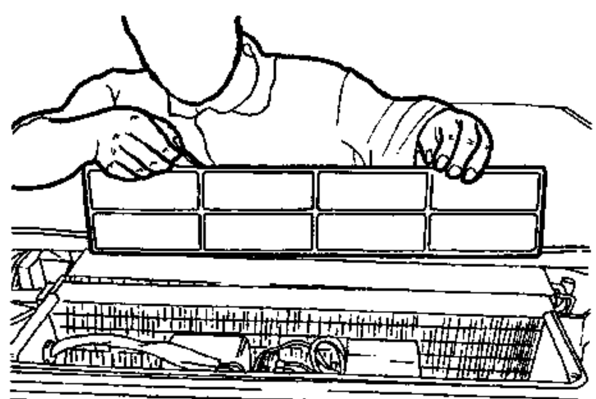
5. Remove the cross–slotted head screws securing the air–conditioning/heater plant housing cover.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6. Remove and check the state of cleanliness of filters placed between radiator core and heater.

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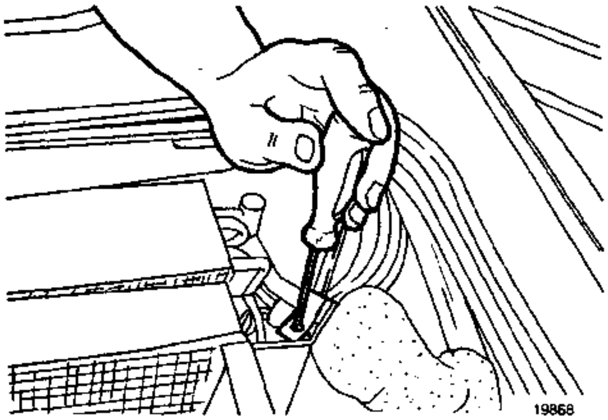
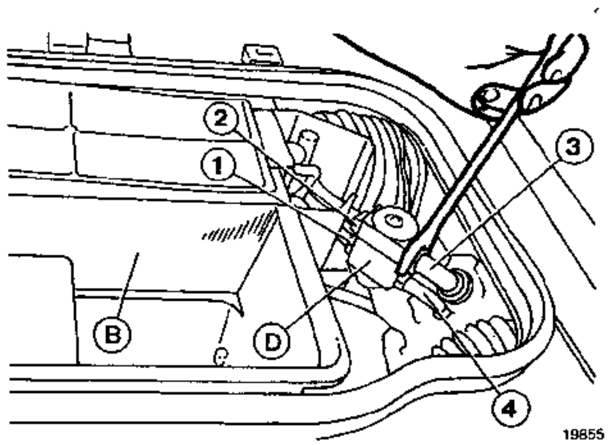


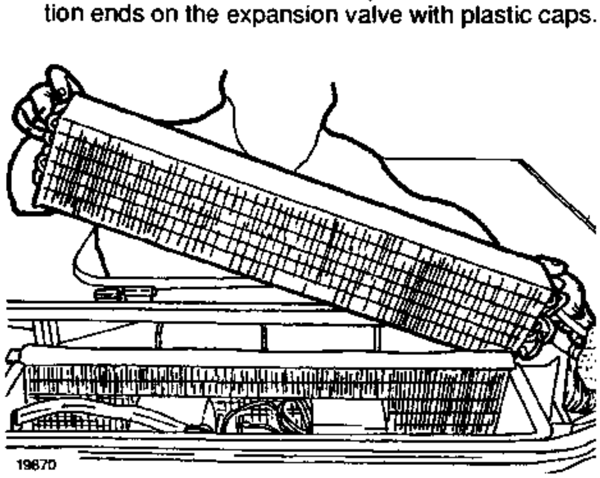
7. Remove the cross–slotted head screws securing the evaporator unit to its plastic support.

DANGER

8. Discharge the air–conditioning system following instructions given in the specific chapter, page 50–25.



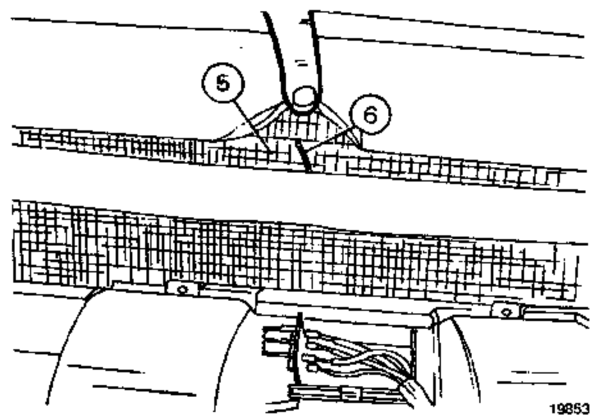
9. Disconnect and remove the Freon delivery (4) and return (3) lines to expansion valve (D) after removal of the thermic insulator, seal open line and connection ends on the expansion valve with plastic caps.



10. Remove evaporator unit with expansion valve.

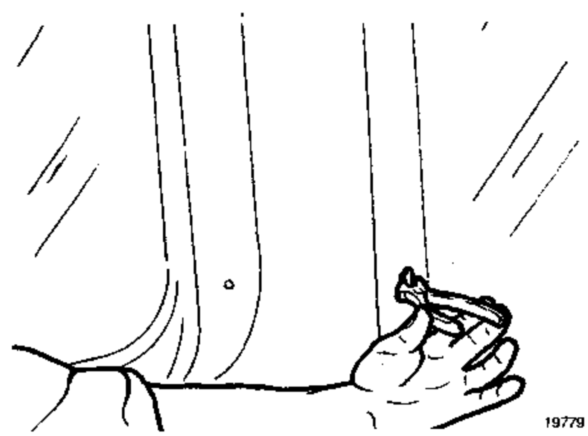
11. Proceed to install the conditioner evaporator unit as follows:
   a. reverse the previous sequence of operations starting from no. 10 back to no. 1;
   b. see illustrations on pages 50–26 and 50–27 for the correct placement and orientation of component parts;
   c. always make sure to operate in clean and moisture–free surroundings. Should the unit remain temporarily disassembled, make sure that fluid lines are sealed tight;
   d. charge the system as indicated on page 50–16.

ATTENTION – To obtain good performance of the plant, check during installation of the core (5) of the evaporator unit that the thermostatic sensing capillary tube (6) is correctly placed in it, between fins, as shown in the figure.



AIR CONDITIONING SYTEM HOSES ON COMPRESSOR DELIVERY END
Replacement (Op. 50 200 04 – 50 200 60)

Proceed as follows:



1. Remove the plastic buttons fastening the lining to the upright frame member, then the lining itself.

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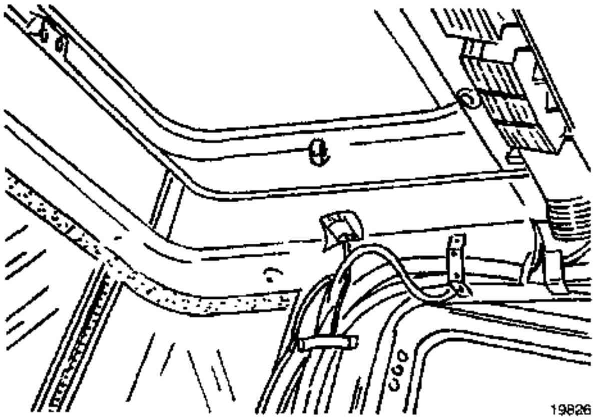
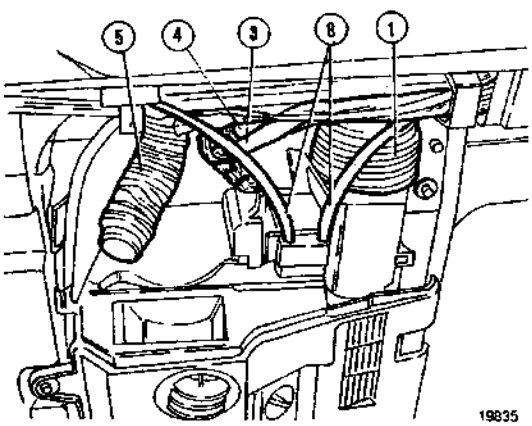
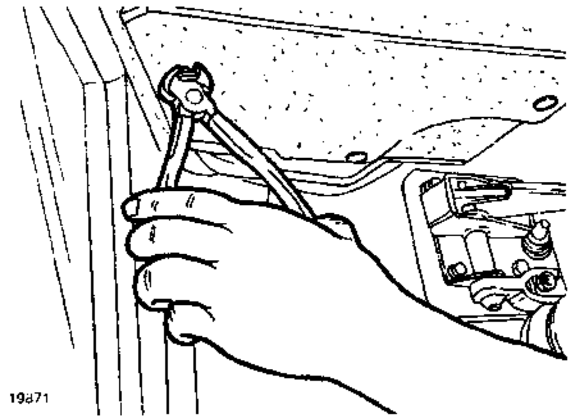


2. Remove the cab rear under–roof lining, as described in operations 1 to 6, page 50–16.

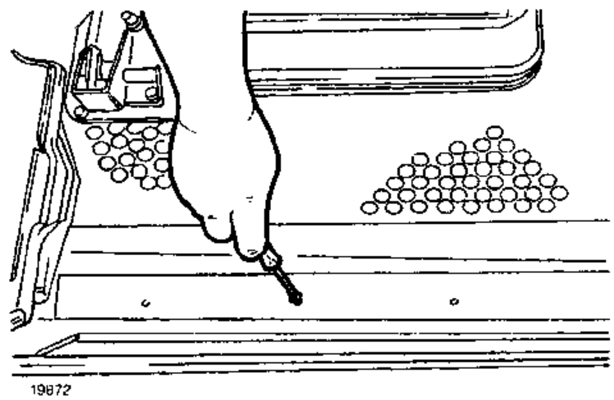


3. Remove the cab front L.H. side under–roof lining, as described in operations 1 to 11, pages 50–17 and 50–18.

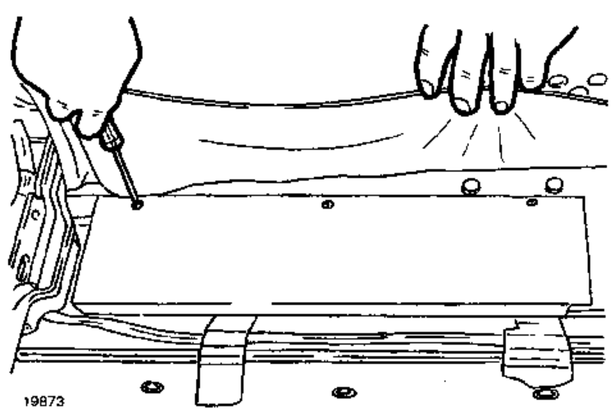
Note – Once this operation is completed, access is gained to the following parts and components:
1. Bellow hose, outside air intake on cab rear end – 3. Return line from evaporator expansion valve – 4. Delivery lines to evaporator expansion valve – 5. Bellow hose, air delivery to the cab L.H. side pillar bottom end – 8. Air conditioner condensate drain lines.



4. Remove fastening plastic buttons and left fender side panel.



5. Using a normal screwdriver, remove the screws securing the cab rear foot–board trim and then the trim itself.



6. Lift off the foot–board and remove cover of the evaporator expansion valve delivery and return lines.

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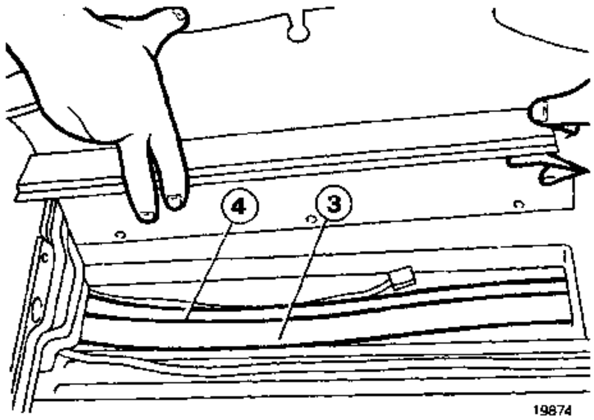
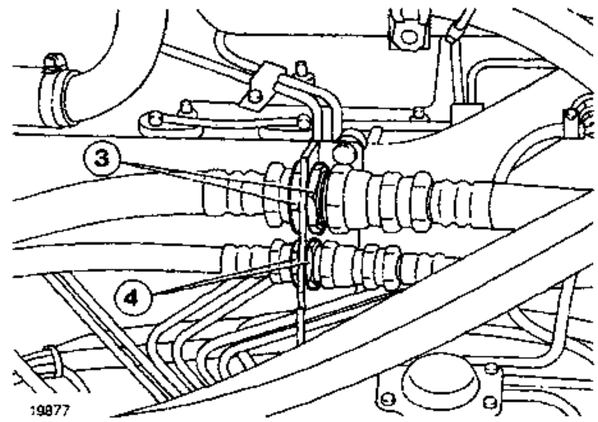


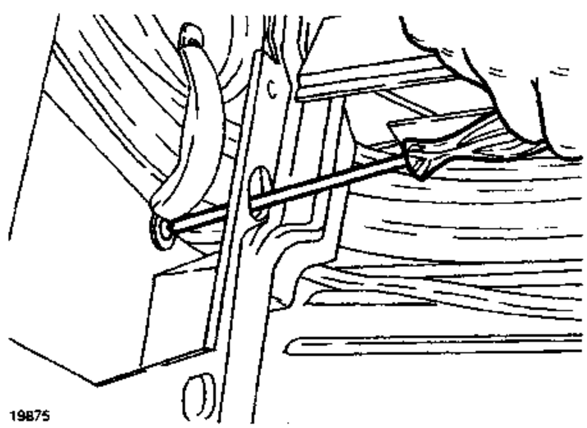
19874

7. Remove the evaporator expansion valve delivery (4) and return (3) line cover.



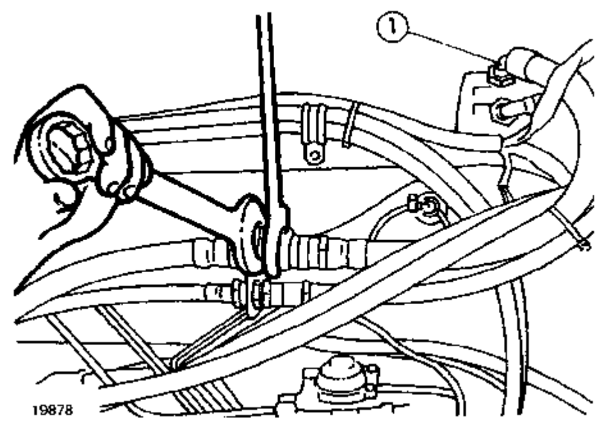
19877

Note – The evaporator expansion valve delivery (4) and return (3) lines incorporate sealing valves allowing to keep the system charged in case of separation of the engine from the transmission.



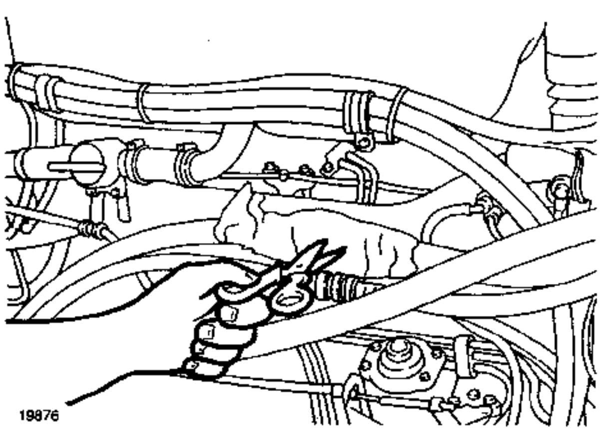
19875

8. Remove all cross–slotted head screws securing the line clamps inside the cab.



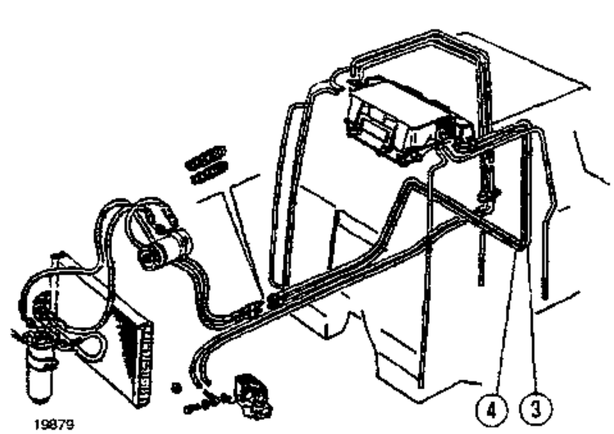
19878

10. Disconnect the delivery (4) and return (3) lines using two wrenches on the joints, then remove the lines leading to the evaporator unit, shown in the figure below.



19876

9. Remove the tractor L.H. side hood panel, then the thermic insulator on the evaporator return line.



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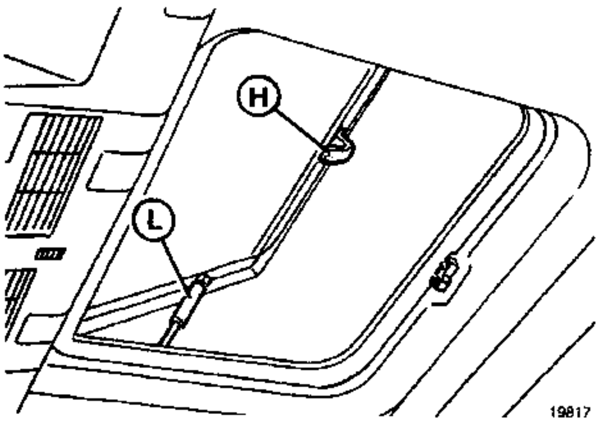
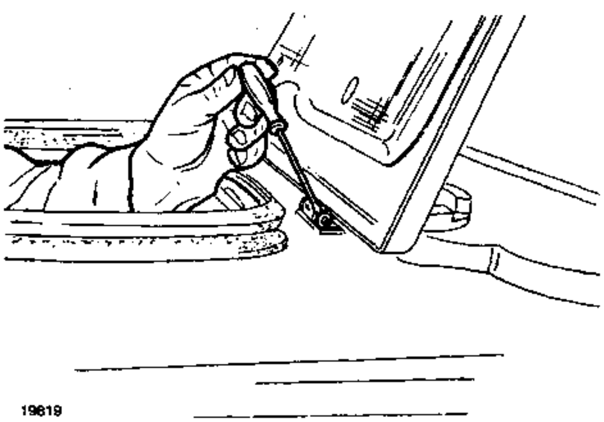
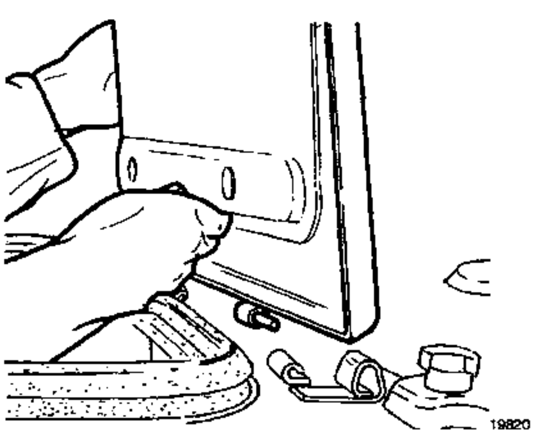


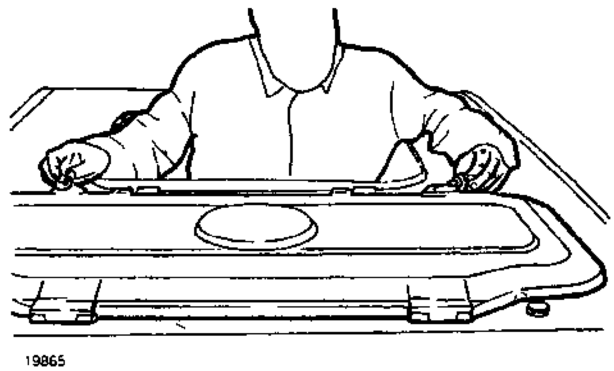
11. Turn handle (H), open the roof emergency hatch, detach the damper rods (L) from the ball–head socket joint plastic support by striking the hatch with the palm of the hands.



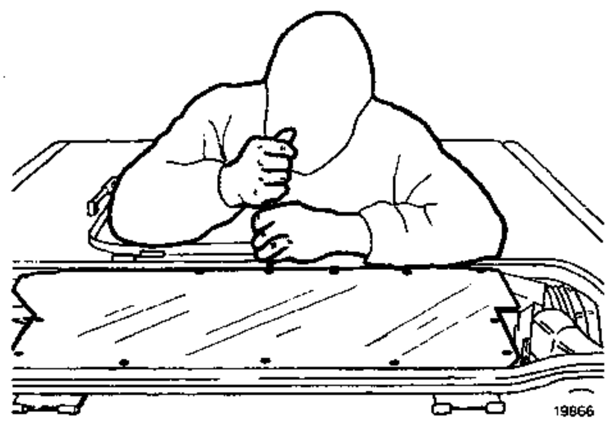
12. Remove the hatch hinge–pin snap rings.



13. Remove complete roof hatch from cab.



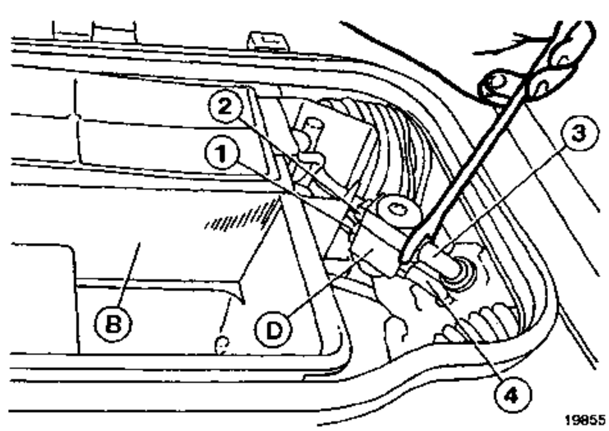
14. Remove the two air conditioning/heating plant housing cover fastening knobs.



15. Remove the cross–slotted head screws securing the air conditioning/heating plant housing cover.

DANGER

16. Discharge the system following the instructions of the specific chapter , page 50–25.



17. Disconnect and remove the Freon delivery (4) and return (3) lines to expansion valve (D) after removing the thermic insulator the accurately seal tight open lines and expansion valve (D) connections with plastic caps.

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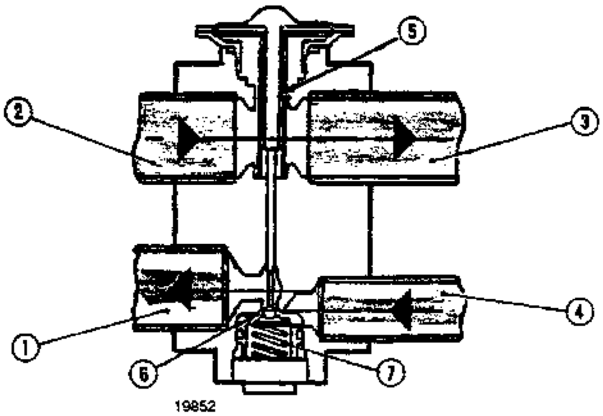


Thermostatic expansion valve.

1. To evaporator inlet – 2. From evaporator inlet – 3. To compressor intake – 4. From receiver–drier filter – 5. Thermostatic sensor 6. Orifice and ball – 7. Spring.

18. Proceed to install the air conditioner hoses on the compressor delivery end, as follows:
a. reverse the previous sequence of operations starting from no. 17 back to no. 1;
b. see illustrations on pages 50–27 through 50–30 for the correct placement and orientation of parts;
c. always make sure to operate in clean and moisture–free surroundings. Should the fluid lines remain temporarily disassembled make sure that open ends are sealed tight;
d. charge the air conditioning system as indicated on page 50–13.

AIR CONDITIONER HOSES PLACED DOWSTREAM OF THE QUICK–CONNEC T COUPLINGS
Replacement (Op. 50 200 04 – 50 200 64)

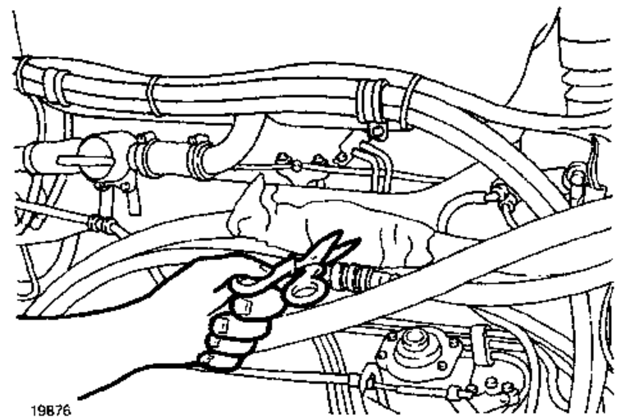
Proceed as follows:

DANGER

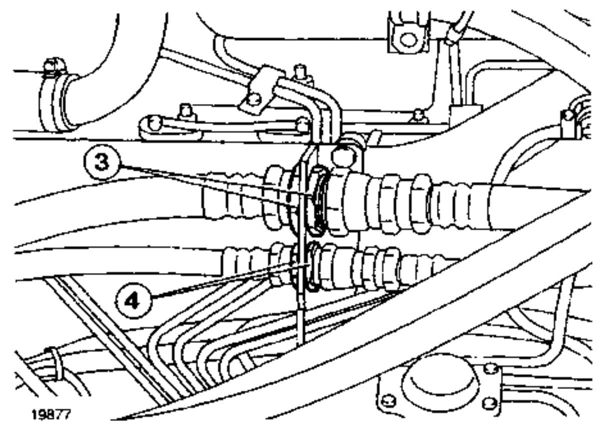
1. Discharge the system following the instructions of the specific chapter, page 50–25.

2. Remove R.H. and L.H. side engine hood panels.

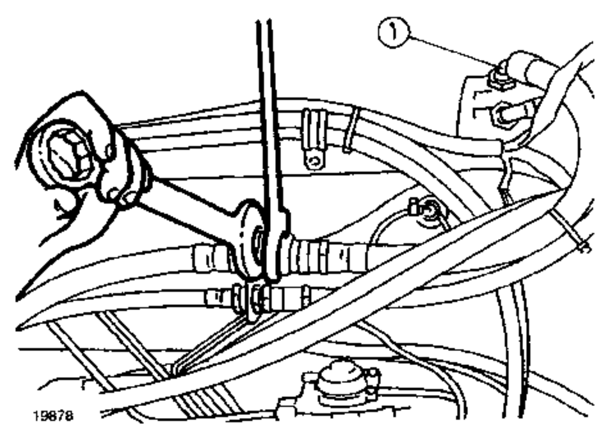
3. Remove complete front hood assembly with headlamps.



4. Remove thermic insulator applied on the quick–connect coupling of the return line from evaporator unit.



Note – The connections of evaporator expansion valve delivery (4) and return (3) lines incorporate sealing valves allowing to keep the system charged in case of separation of engine from transmission.



5. Disconnect the delivery (4) and return (3) lines using two wrenches on joints.

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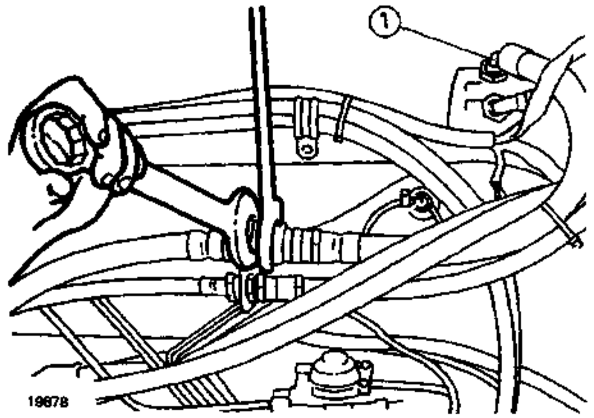
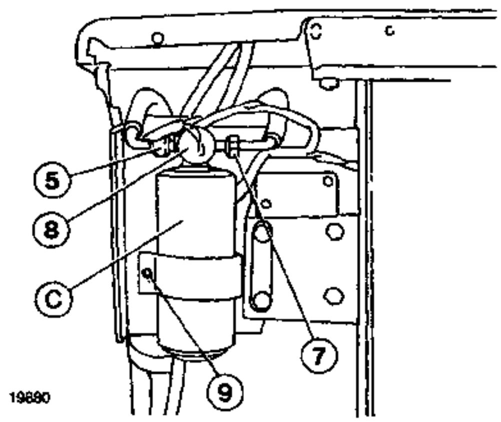
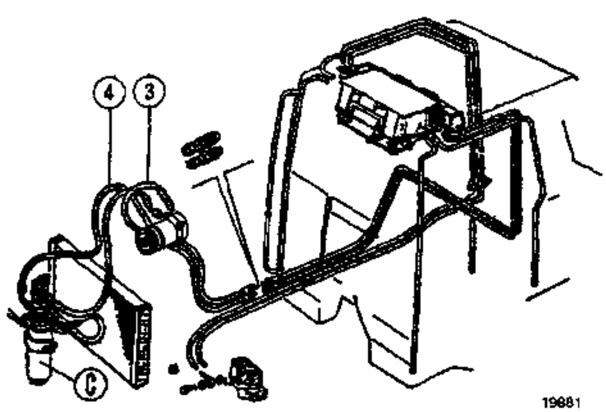


6. Disconnect fitting (1) installed on the compressor suction valve.



7. Facing the tractor front end, remove connection (5) located on the outlet of the receiver–drier filter (C) and both lines (3) and (4) shown in the figure below.



8. Proceed to install the air conditioning plant hoses, placed downstream of the quick–connect couplings, as follows:

a. reverse the previous sequence of operations starting from no.7 back to no. 1;
b. see illustrations on pages 50–31 through 50–32 for the correct placement of parts;
c. always make sure to operate in clean and moisture–free surroundings. Should the hoses remain temporarily disassembled, make sure that open ends are sealed tight.
d. charge the air conditioning system as indicated on page 50–13.

RECEIVER–DRIER FILTER
Replacement (Op. 50 200 04 – 50 200 74)

Proceed as follows:

DANGER

1. Discharge the system following instructions of the specific chapter, page 50–25.

2. Remove tractor hood R.H. and L.H. side panels.

3. Remove complete front hood assembly with headlamps.

4. Remove connections (5) and (7) placed, respectively, at the filter inlet and outlet, as shown on the side.

5. Remove electric connections.

6. Remove screw (9) securing the filter (C) to its support, then the filter itself.

7. Proceed to install the receiver–drier filter as follows:
a. reverse the previous sequence of operations starting from no. 6 back to no. 1;
b. always make sure to operate in clean and moisture–free surroundings. Should the component remain remain temporarily disassembled, make sure that the fuel line open ends are sealed tight;
c. charge the air conditioning system as indicated on page 50–13.

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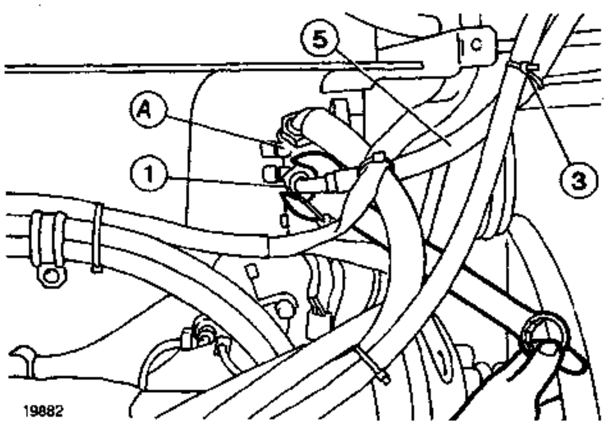
AIR CONDITIONER HOSES PLACED DOWNSTREAM OF COMPRESSOR
Replacement (50 200 04 – 50 200 68)

Proceed as follows:

DANGER

1. Discharge the system following instructions of the specific chapter, page 50–25.

2. Remove engine hood R.H. and L.H. side panels.
3. Remove complete front hood assembly with headlamps.



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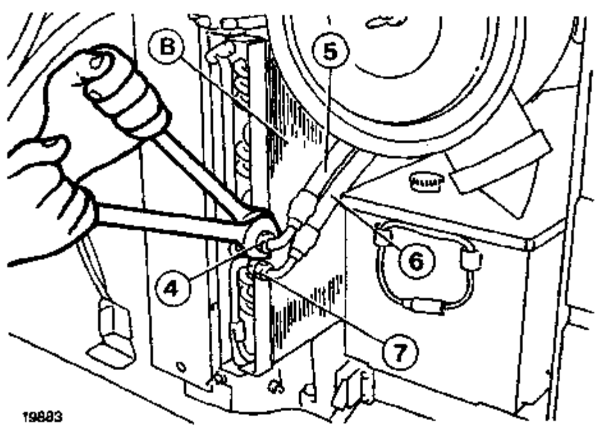
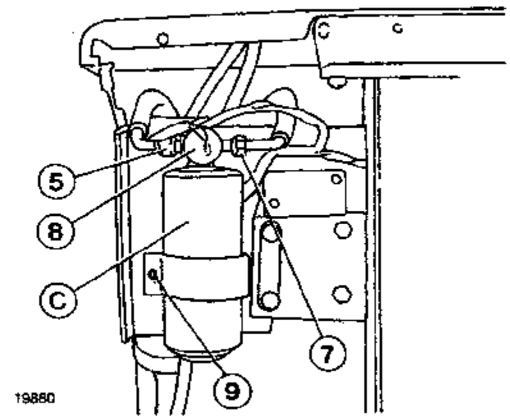
4. From the R.H. side of engine, disconnect fitting (1) installed on the compressor (A) valve.
5. Remove band clamps (3) all along the lay–out of line (5), from compressor to condenser (B).



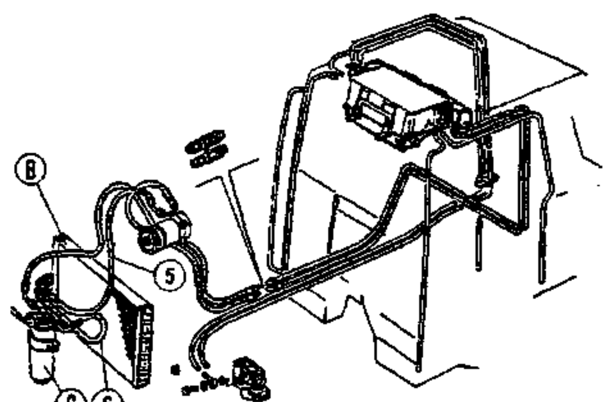
19883

6. Unscrew fitting (4), connecting fluid line (5) to the condenser (B) inlet.
7. Remove line (5),
8. Unscrew union (7) connecting fluid line (6) to condenser (B) outlet.



19880

9. Unscrew the other connection (7) installed on the receiver–drier filter (C) inlet.
10. Remove line (6) shown in the figure below.



19884

B. Condenser – C. Receiver–drier filter – 5. Compressor–condenser connecting line – 6. Condenser–filter connecting line.

11. Proceed to install the air conditioning plant hoses, placed downstream of compressor, as follows:
a. reverse the previous sequence of operations starting from no. 10 back to no. 1;
b. see illustrations above for the correct placement of parts;
c. always make sure to operate in clean and moisture–free surroundings. Should hoses remain temporarily disassembled, make sure that open ends are sealed tight;
d. charge the air conditioning system as indicated on page 50–13.

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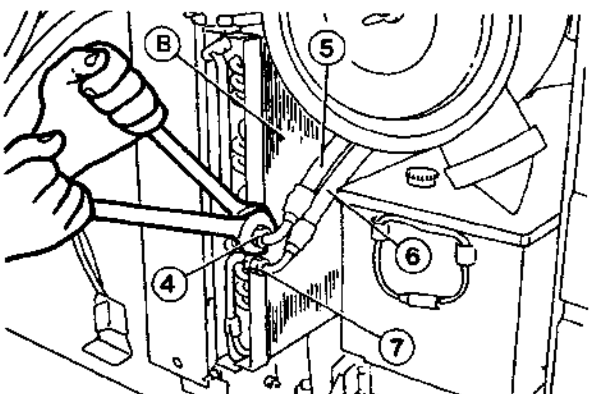
AIR CONDITIONING PLANT CONDENSER
Replacement (Op. 50 200 04 – 50 200 72)

Proceed as follows:

DANGER

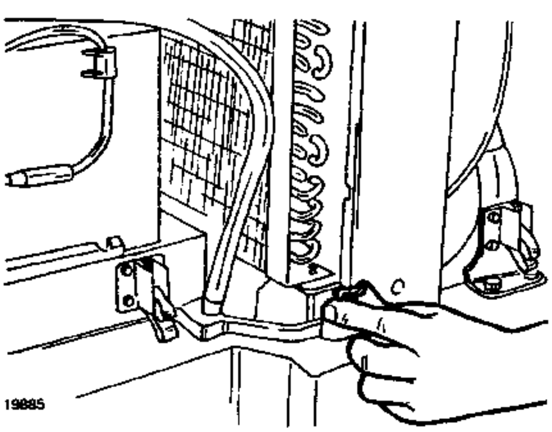
1. Discharge the system following instructions of the specific chapter, page 50–25.

2. Remove engine hood R.H. side panel.



19883

3. Disconnect union (4) installed on line (5) connecting compressor discharge valve and condenser (B) inlet lines.
4. Unscrew union (7), disconnecting line (6) between condenser (B) outlet line and receiver–drier filter.
5. Remove engine hood L.H. side panel.



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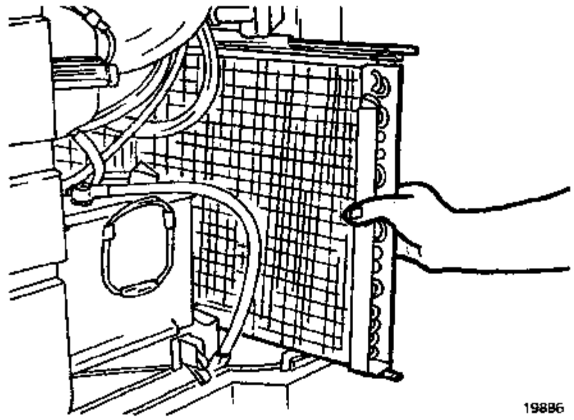
6. Remove both wing nuts blocking the condenser top and bottom ends.



19886

7. Working on the tractor R.H. side, withdraw the condenser from retaining guides.

8. Proceed to install the air conditioning plant compressor, as follows:

   a.reverse the previous sequence of operations starting from no. 7 back to no. 1;

   b.see illustrations above for the correct placement of parts;

   c.always make sure to operate in clean and moisture–free surroundings. Should the unit remain temporarily disassembled, make sure that fluid lines are sealed tight;

   d.charge the air conditioning system following indications on page 50–13.

COMPRESSOR
Removal–Installation (Op. 50 200 26)

Proceed as follows:

DANGER

1. Discharge the system following instructions of the specific chapter, page 50–25.

2. Remove engine hood R.H. side panel.

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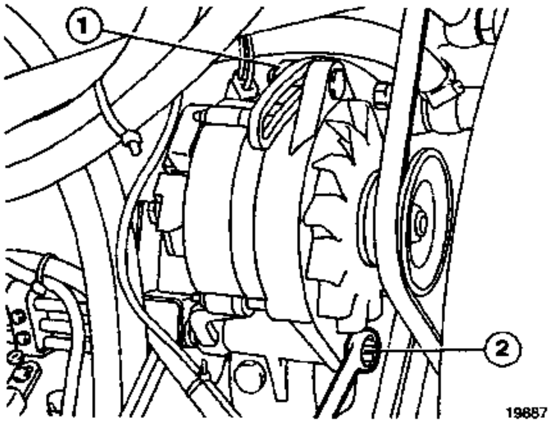
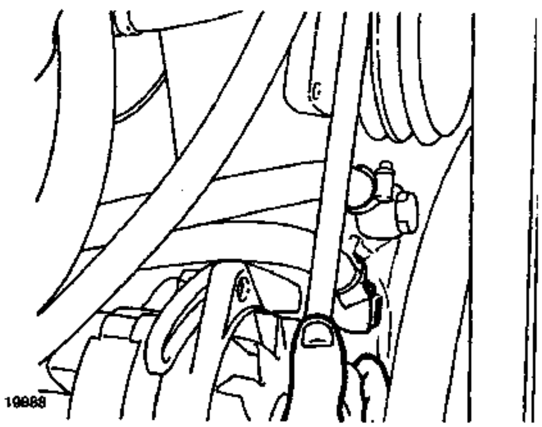
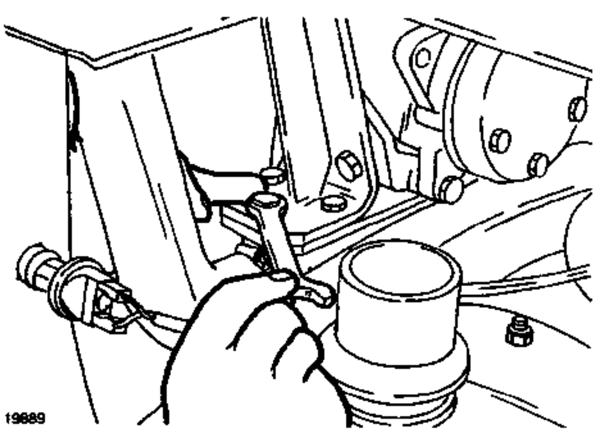


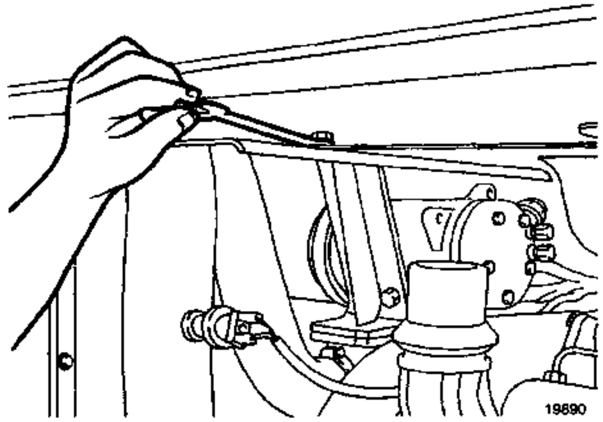
3. Loosen the alternator fastenings (1) and (2) to adjust compressor belt tension.



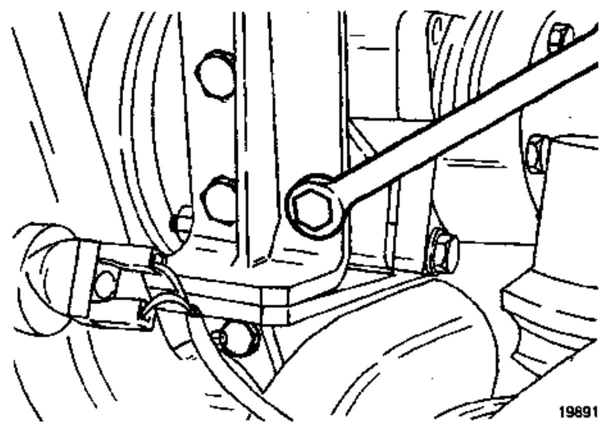
4. Remove compressor drive belt.
5. Disconnect compressor suction and delivery fittings.
6. Remove engine hood L.H. side panel.



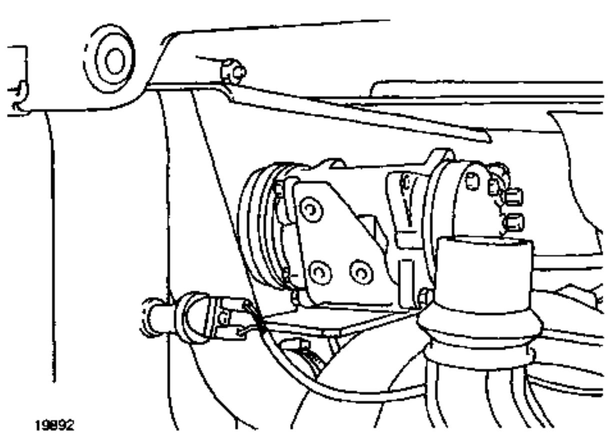
7. Remove the compressor mounting bracket bottom screws (q.ty: 3).



8. Remove the compressor monting bracket top screw.



9. Remove the three compressor attaching screws to the mounting bracket bracket.
10. Remove the compressor mounting bracket.



11. Remove complete compressor unit.

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12. Proceed to installation of the air conditioning plant compressor unit as follows:

a. reverse the previous sequence of operations starting from no. 11 back to no. 1;

b. see illustrations on page 50–35 for the correct placement of parts;

c. always make sure to work in clean and moisture–free surroundings. Should the unit remain temporarily disasembled, make sure that fluid lines are sealed tight;

d. charge the air conditioning system following indications of page 50–13.

COMPRESSOR OVERHAULING AND MAINTENANCE

FILLING AND CHECKING LUBE OIL LEVEL

The SANKYO compressor has already been filled at the Factory with the following lube oil quantities:

– Model 510 (130±14) grams = (135±15) cu.cm

Lubricant make and type are, in alternative, SUNISO 5 GS or TEXACO CAPELLA E 500.
In case of topping up or replacement use either type of these oils, exclusively.

Periodical oil level checks will not be necessary. In any case, should evidence occur requiring a check or if this control is a requirement of the Service diagnosis procedure, then proceed as follows:

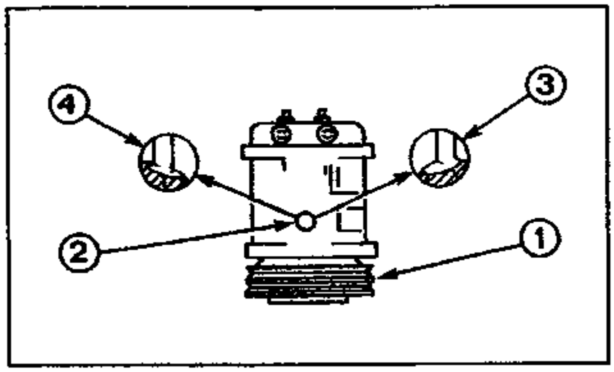
– switch on the conditioning plant and make compressor run 10 minutes with engine at 1500 rpm;

– discharge all of the refrigerant fluid in the system paying attention not to discharge the lube oil also (see page 50–25);

– find the compressor positioning angle: place angle gauge **293054** between two mounting points, set the level gauge and take the reading of the angle of inclination.

Slowly back out the oil filling plug; look through the filling hole and turn the clutch until the inside parts of compressor appear as shown in the figure, and precisely:

– When compressor is angled to the left (counterclockwise direction), turn clutch until inside parts appear placed as shown on position 3;



15874

Positioning for oil level check

1. Compressor – 22. Filling hole – 3. View of connecting rod (with compressor angled counterclockwise) – 4. View of connecting rod (with compressor angled clockwise).

– when compressor is angled to the right (clockwise direction), turn the clutch until inside parts appear as shown on position 4.
This procedure is necessary in order to assure the full introduction of the oil level gauge stick inside the compressor.

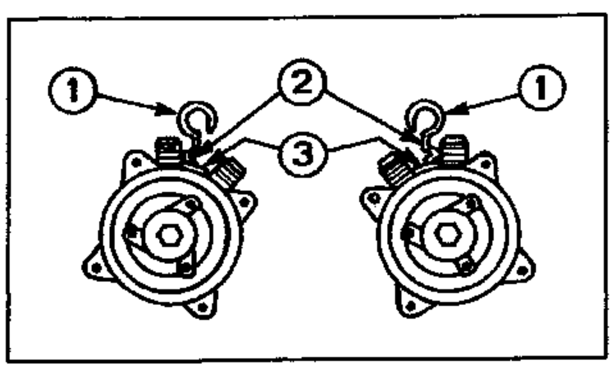
– introduce the level gauge stick **293055** fully to stop. The stop position is determined by a bend (sharp angle) made on the stick;

– stop position is reached with the bend turned to the left when the compressor is angled to the right;

– conversely, stop position is reached with the bend turned to the right when the compressor is angled to the left;

– in the remaining cases, the bottom surface of the stick bend should always rest on the abutment face in the oil filler hole;

– once introduced the oil level gauge stick, pull it out and find the level by counting the number of divisions wetted by the oil;



15875

Introducing the oil level gauge stick

1. Oil level gauge stick – 2.Position of stop – 3. Filling hole.

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– consult data chart below to determine the correct lube oil level in relation to the angle of installation of the compressor;

Angle of installation	Correct oil level (gauge stick division)
– degrees –	SANKYO SD –510
0	2–4
10	4–5
20	5–6
30	6–7
40	7–9
50	9–10

– if number of divisions on the stick do not coincide with the chart, add or remove oil until obtaining a number of divisions falling within chart average data;

– fit the oil filler plug after checking O–ring seal conditions and cleanliness of contact surfaces; if the O–ring appears to be rubbed, even slightly, replace it;

– finally, torque–tighten the plug to .8 to 1.2 kgm (6 to 9 ft.lb).

Should necessity arise to replace a compressor containing good lube oil by a new compressor, proceed as follows:

– drain oil from new compressor;

– drain and measure the quantity of oil in old compressor;

– prepare a new quantity of oil equivalent to that discharged from the old compressor, further add 30 grams (1 oz) approx., then fill the new compressor.

DRIVE PULLEY WITH ELECTRO–MAGNETIC CLUTCH

In case of functional faults, check the electro–magnetic clutch as follows:

– test coil for voltage and current: operating range is 3.6 to 4.2 A at 12 V;

– if current exceeds these values, coil is short–circuited.
If there is no current, coil is interrupted;

– if supply voltage is different from the nominal one, a poor ground contact is possible: check fatening bolts of both solenoid and compressor;

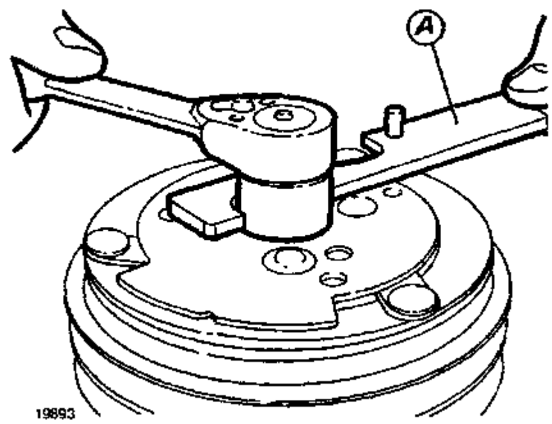
– check that gap between front disc and pulley is from .4 and .8 mm (.016 to .032 in);

– check clutch bearing conditions, replace it if noisy.

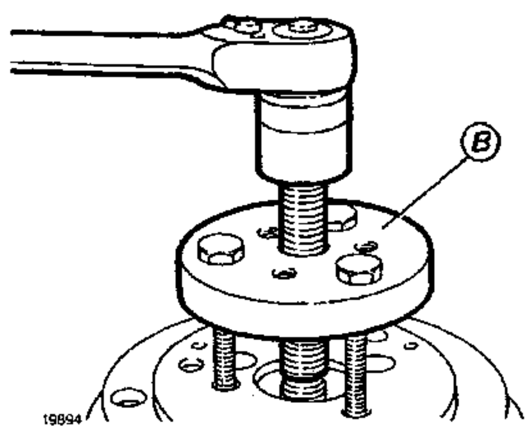
Follows description of operations necessary in case of clutch solenoid and bearing replacement and of assembly play check:

ELECTRO–MAGNETIC CLUTCH
Disassembly–Assembly (Op. 50 200 21)

Proceed as follows:



1. Fit the two pins of the holding wrench, tool **292936** (A), into the threaded holes of the front disc. Remove the disc lock nut using a 19 mm socket wrench.



2. Remove front disc using puller **292938**(B):

– align center bolt with compressor shaft and screw the three nuts onto the clutch front disc;

– turn the center bolt clockwise using a 19 mm socket wrench until the front disc has been pulled off.

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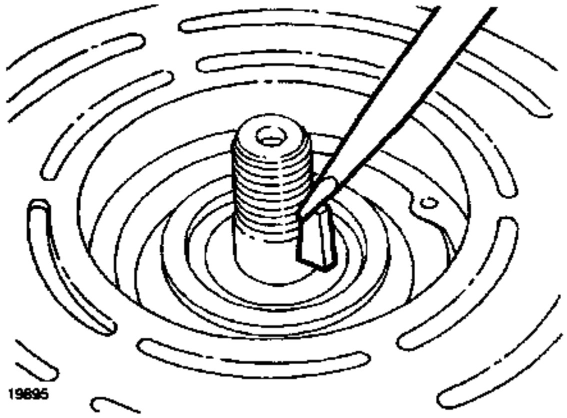
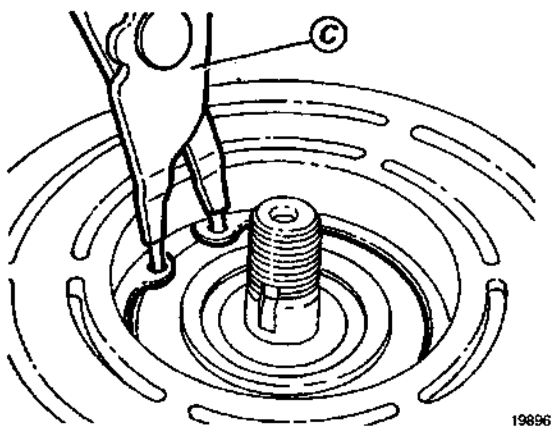
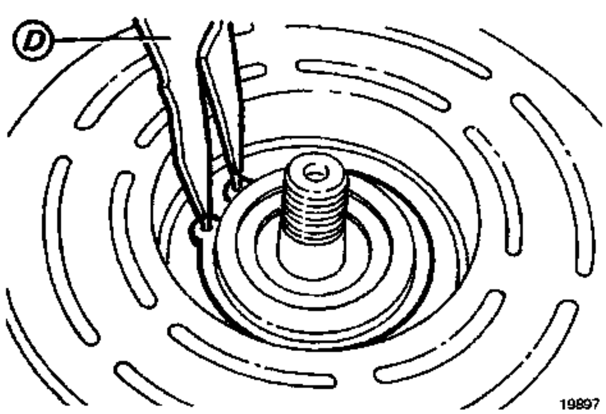


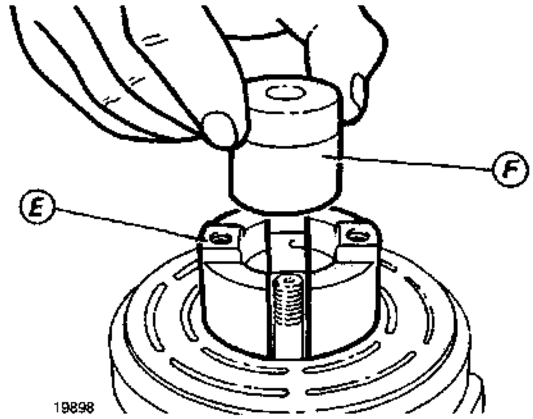
3. Remove key from shaft working softly with screw-driver and hammer.



4. Remove the bearing outer race retaining snap ring, using pliers **292941** (C).

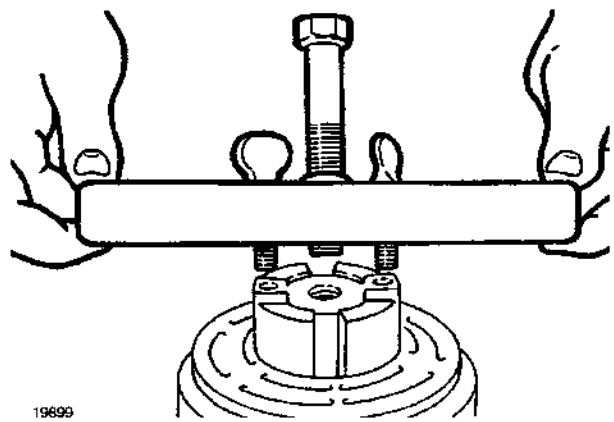


5. Remove the bearing inner race retaining snap ring, using pliers **293944** (D).

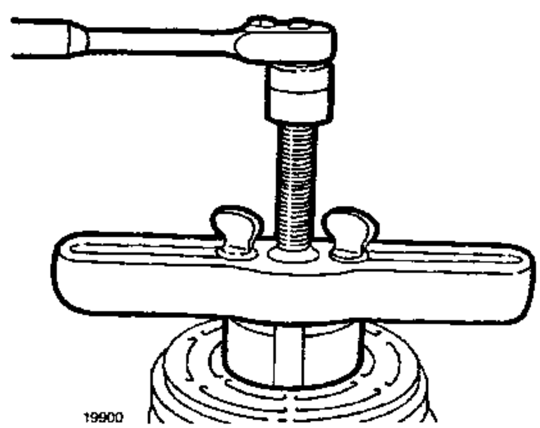


6. Remove the complete pulley:

– place jaw bottom ends of puller **292951** (E) inside the grooves of the outer retaining ring.
– install shaft protector **292971** (F) between jaws.



7. Fit wing–head screws onto the puller, align the same with the jaw holes and tighten them by hand.



8. Turn the puller center bolt clockwise using a 19 mm wrench.

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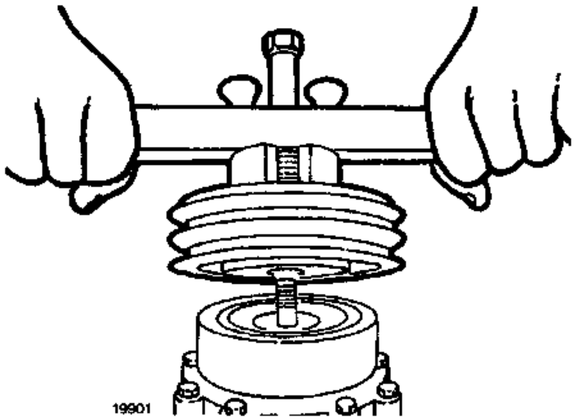
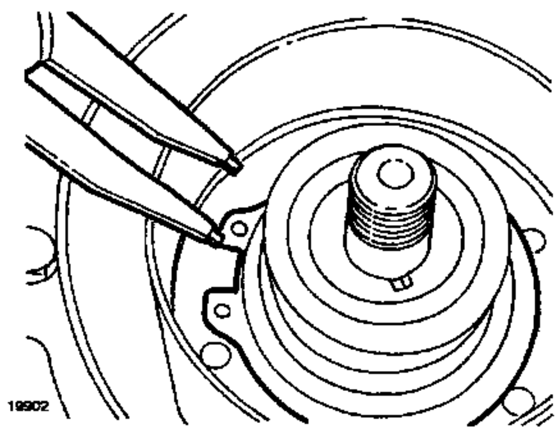


19901

9. Once completed the preceding operations, extract the belt pulley.

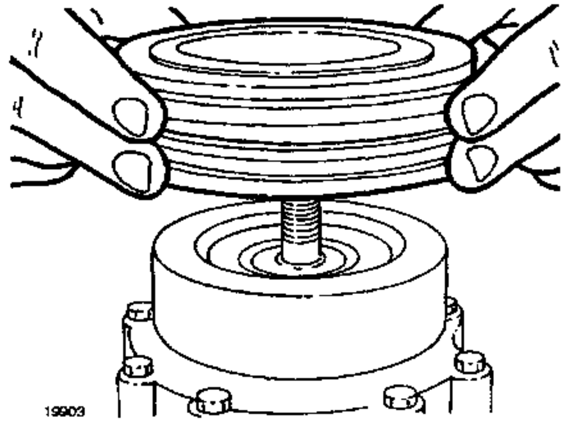


19902

10. Remove solenoid coil:

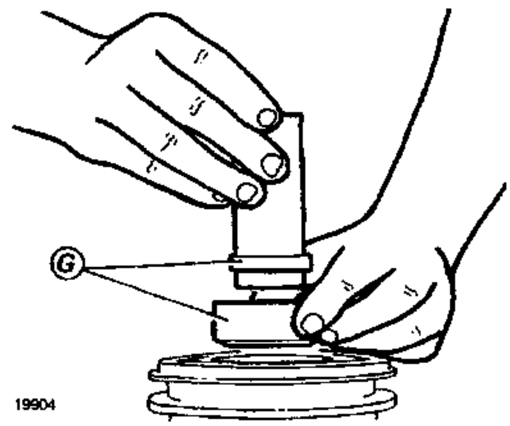
- loosen the feed cable clamp screw;
- remove retaining snap ring.

11. Install solenoid coil by a reversing the procedure followed before. Place the tongue on mating surface in correspondence with the hole in the compressor front disc: in this way the solenoid is correctly positioned.



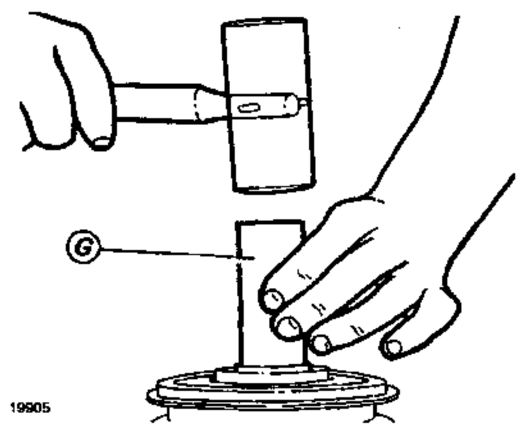
19903

12. Replace pulley and position compressor upright, suitably using mounting supports. Align pulley at right angle with drive shaft.



19904

13. Install the pilot bushing inside bearing seat and place drive punch inside the bushing **292952** (G).



19905

14. Tap on the driver tool **292952** (G) with a plastic mallet holding the tool square on line. Continue tapping until the pulley is fully home on the abutment.

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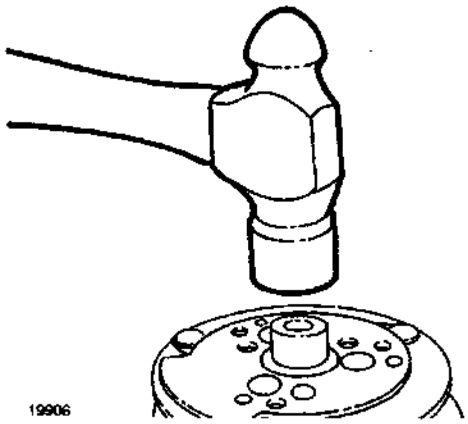
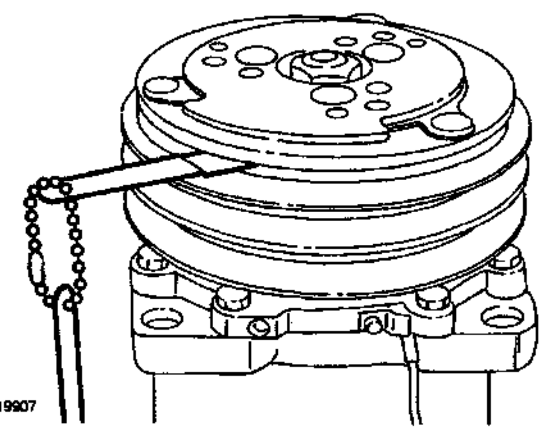


19906

15. Install the two retaining snap rings.

16. Replace front disc:
- make sure that shims are placed correctly;
- replace key;
- line up front disc keyway with key on shaft;
- tap on shaft protection with a hammer until the front disc is fully home on shims.



19907

17. Replace the front disc lock nut and torque tighten to 34.3 to 39.2 Nm (3.5 to 4 kgm – 25 to 29 ft.lb). Check clearance between front disc and pulley: correct value is from 0.4 to 0.8 mm (.016 to .031 in).

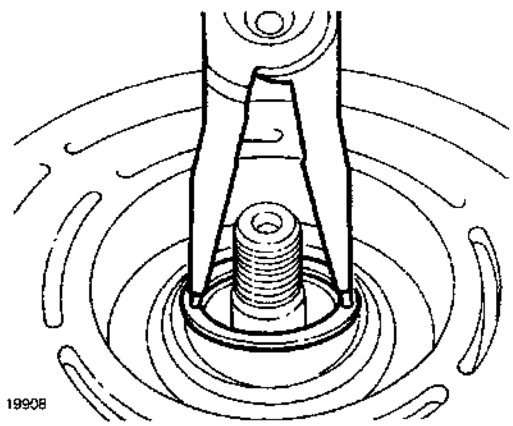
Note – The play between front disc and pulley is determined by shims. Whenever fitting a new clutch, first try existing shims, and if necessary rectify using 0.1 – 0.05 and 0.012 mm (.004–.002–.0005 in) shims until correct value is restored.

COMPRESSOR
Disassembly–Assembly w/electro–magnetic pulley removed (Op.50 200 28)

Prior to the description of the above operation, removal and subsequent installation of the motor shaft seal will be dealt with.

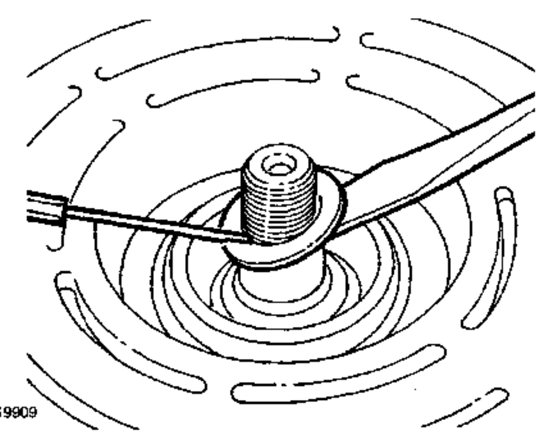
Removal of shaft seal

The seal must be removed on bench and replaced with a new part.



19908

1. Remove front disc following procedure of page 50–37.
2. Introduce pliers tips in felt ring holes and pull the complete ring out.



19909

3. Remove shims: use O–ring puller **292994** and a small screwdriver to avoid damaging the shaft.

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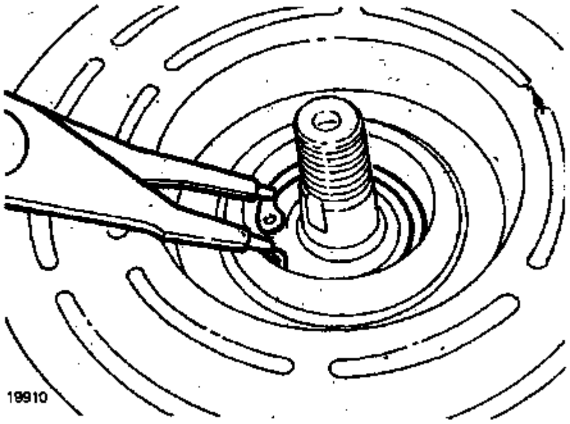
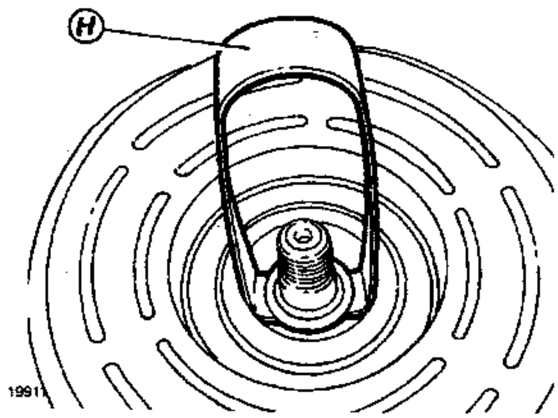


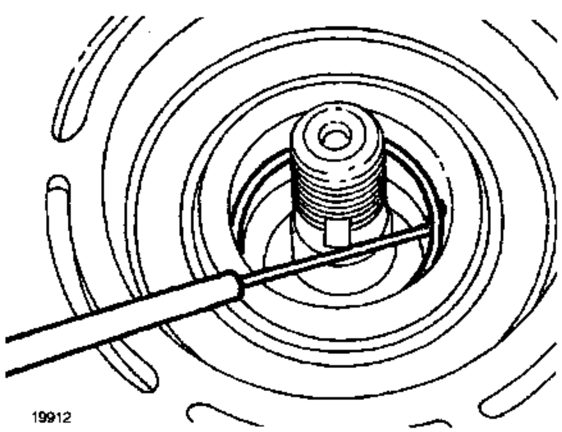
19910

4. Remove retaining ring using snap ring pliers, tool no. **292941**.



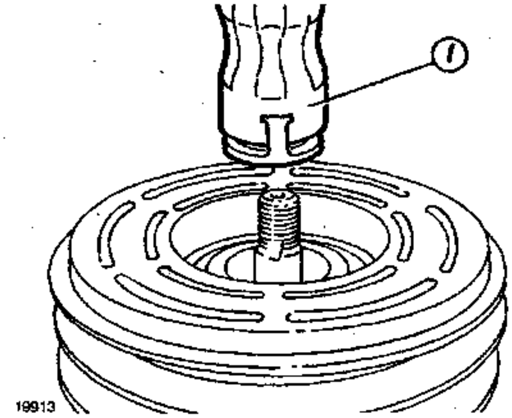
19911

5. Pull out the shaft seal back–up ring with special pliers **292995** (H).



19912

6. Use the special O–ring remover tool to pull out the outer seal.

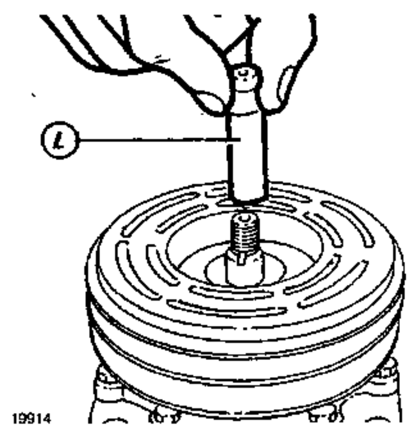


19913

7. Place the seal holder **293000** (I) inside the hub; push downwards against opposition by the inside spring and keep on turning the tool until it engages the seal. Remove the latter with the holder.

Oil seal installation on drive shaft

8. Thoroughly clean the seal seat with R12 fluid. Blow dry with moisture–free compressed aid. Check that any foreign material is removed.



19914

9. Place pilot pin **292999** (L) on compressor shaft; do not touch the new seal surfaces with unclean hands and dip it in compressor lube oil.

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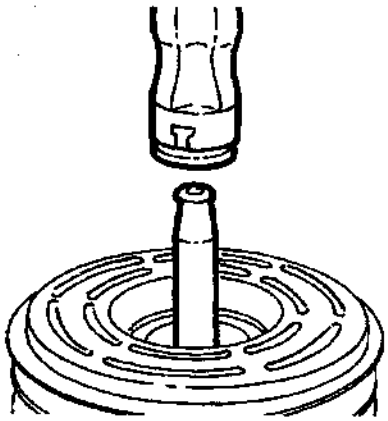
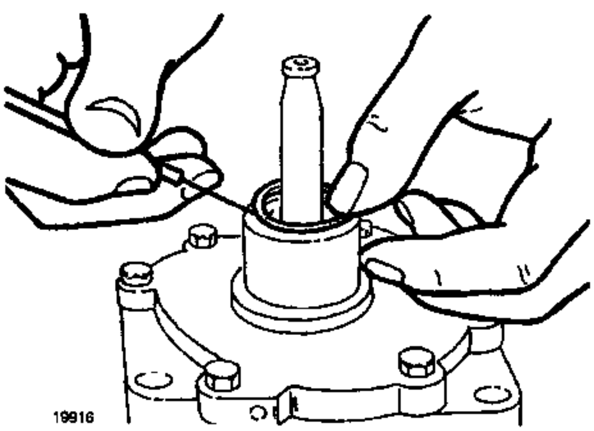


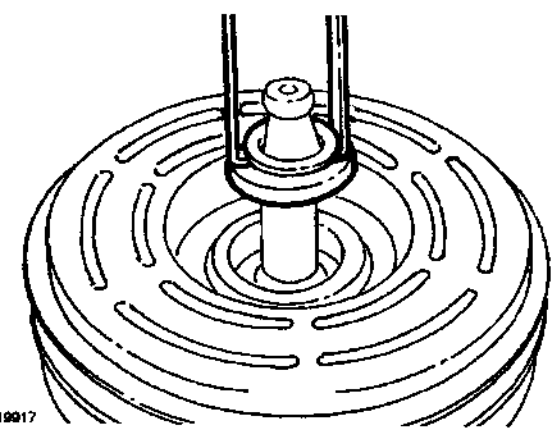
19915

10. Fit the new seal onto holder and carefully position the unit over the pilot pin. Press holder to bottom and turn it until disengaged from seal. Remove holder.



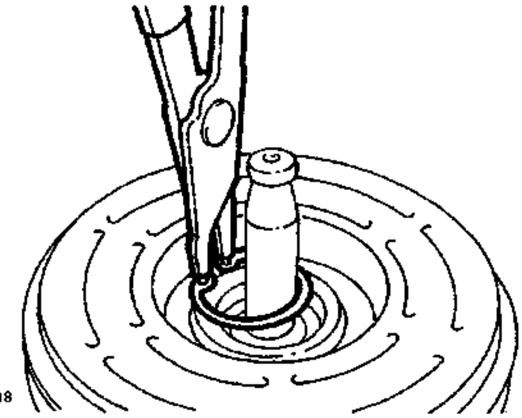
19916

11. Clean new O–ring thoroughly with compressor lube oil and place it in its seat using the specific extractor tool no. **292994.**



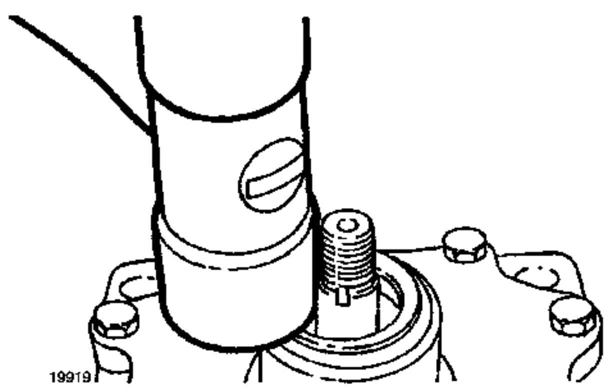
19917

12. Thoroughly clean the seal back–up plate with compressor lube oil and fit it using the special pliers tool no. **292995.**



19918

13. Install the retaining snap ring with smooth side facing compressor. The retaining ring should be pushed slowly downwards until it snap in its seat.



19919

14. Install shims.

15. Install a new felt and backing ring.

16. Install the clutch front disc.

Procedure for valve plate and head disassembly and subsequent assembly is outlined below.
Prior to start on removal, check head to verify conditions of connections and respective threads: if defective, the head must be replaced. Also, remove the service valve inner components using an appropriate wrench and inspect them. If necessary, replace the service valve using a 14 mm wrench. In this case it will also be possible to check the O–ring placed under the valve: replace it if damaged (this O–ring is the same as that fitted on the lube oil filler plug).

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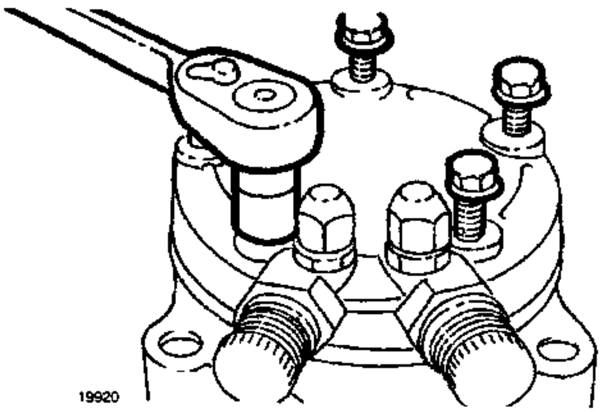
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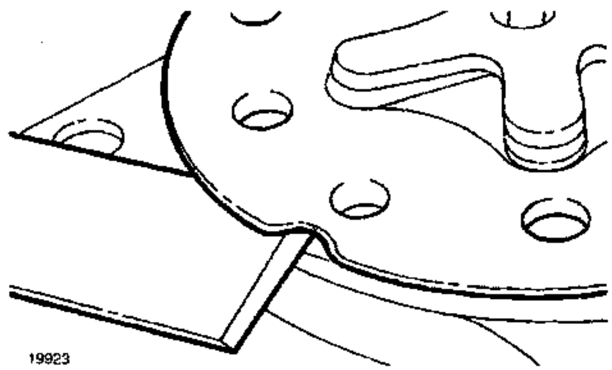
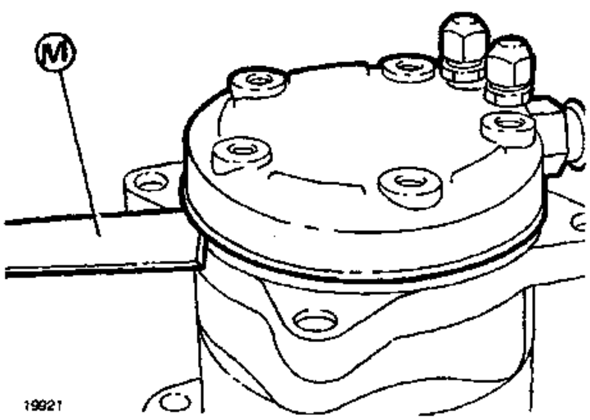

19923

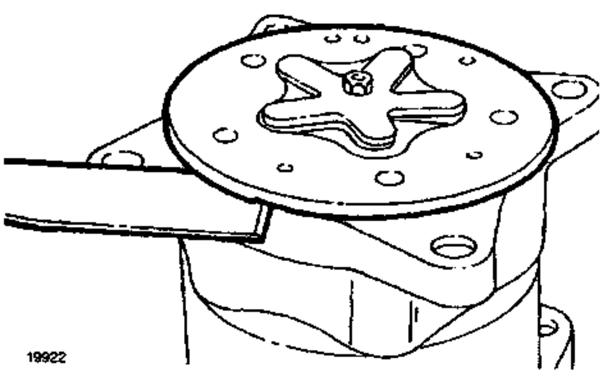
Valve plate and head disassembly

1. Remove the five head bolts using a 13 mm socket wrench.



19921

2. Using a small hammer and specific tool **293048** (M) pry on the outer face of the head until it separates from the valve plate over the entire surface. Inspect mating surfaces for any failure, cracks or rubbing marks.


19922

3. Insert the scraper between valve plate and block and slowly lift the plate.

4. Carefully check the valve plate, valve assembly and spring. If any fault or damage is evidenced, replace the complete valve plate assembly.
 When the valve plate and/or head are in good conditions and consequently can be re–installed, use the tool previously employed as a scraper to thoroughly remove the gasket taking care not to scratch mating surfaces of block and valve plate.

Head and gasket assembly

5. Inspect valve plate conditions.
6. Remove old gasket completely.
7. Clean the head mating surface with compressor lube oil.
8. Place new gasket on valve plate with the latter's dowels fitting in the corresponding gasket holes.
9. Place the head with suction–delivery connections lined up with the oil drain plug.

Valve head and gasket assembly

10. Clean the new valve plate gasket with compressor lube oil;
11. Place gasket with dowels on block surface fitting in the corresponding gasket holes;
12. Install valve plate;
13. Install head as previously explained.
14. Finally, fit the head bolts and torque tighten to 29.4 to 34.3 Nm (3 to 3.5.5 kgm – 21.7 to 25.3 ft.lb) in the sequence shown in the figure.

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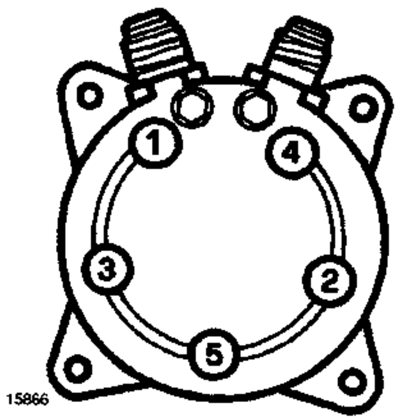


Compressor head bolt tightening sequence.

COMPRESSOR DRIVE BELT INSTALLATION AND TENSION CHECK

The compressor drive belt, conveying engine motion for the air conditioning plant,is an essential element for its efficient performance.
A particular attention must therefore be dedicated to this component, and precisely:

1) Assure a correct first installation.

2) Check tension.

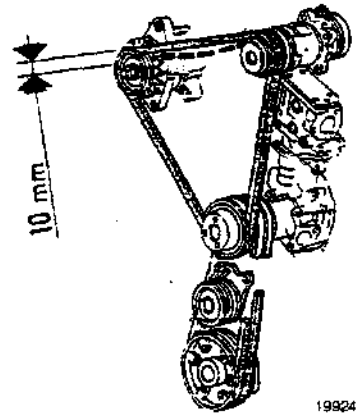
3) Inspect belt.

First drive belt installation

During its first installation the drive belt should not be forced upon, stretched with the use of scredrivers or pulled over and rotated on pulley edges: these abuses can cause abnormal stretching of the low–deformation cords with subsequent strains on other cords.
At its first installation, the new belt should be fitted at a higher tension then the value normally adopted in order to compensate for the initial setting–in, therefore belt tension should be checked after the first 50 hours of work and re–set to normal value.
This control is essential because if excessive tension is put on a drive belt at work, besides possible bearing damage,it will result in premature fatigue of the reinforcing cords and consequent deterioration of the belt itself. Conversely, too low a tension causes slippage, overheating and accelerated premature wear.

Drive belt tension check

With drive belt cold (below 40 °C = 40 °F), the belt yield under a load of 59 to 78 N (6 to 8 kg – 13 to 18 lb), applied as indicated in the accompanying figure, will be about 1cm (3/8 in).



Routine checks

It is recommended that the belt is inspected for wear at every tension check. Inspection may evidence one or more of the following conditions:

a) **Glazed belt**: glazed flanks can cause slippage on pulleys.

b) **Cracked belt:** may fail suddenly as cracks on inner face cause excessive flexion.

c) **Flank wear**: with worn flanks or inner side cracked, the belt may suddenly fail.

d) **Belt impregnated with grease**: grease impregnation causes core softening and rapid wear.

Remedies are the following, respectively:

a) Check tension and restore it if insufficient. If belt is too hot, replace it.

b) If crack is deeper than half tthe belt thickness, replace it.

c) Replace the belt.

d) If belt is too hot, replace it.

Besides, if belt squeals, check tension and replace it if necessary; if squealing persists, replace the belt.
Also, excessive stretching prevents correcting tension and therefore belt must be replaced.

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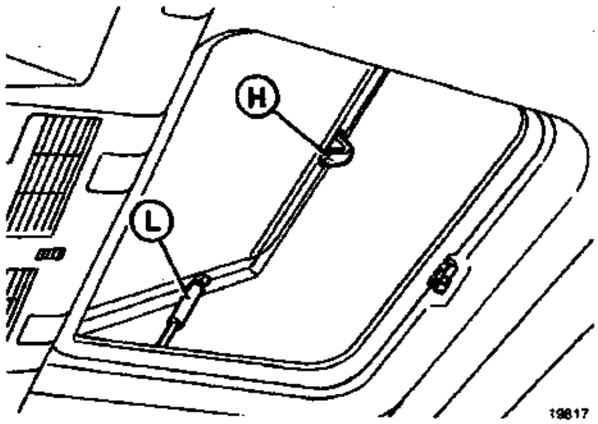
ELECTRIC FAN

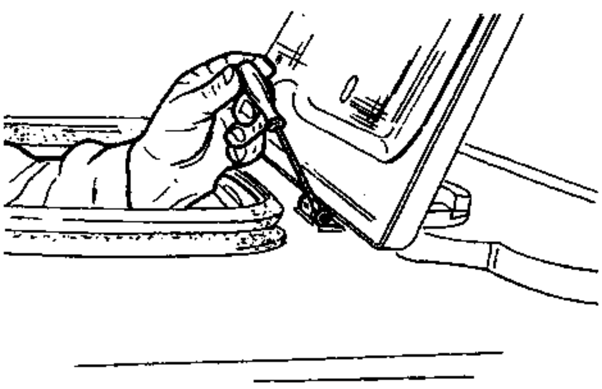
Disassembly–assembly, with air conditioner and heater units installed (50 206 67)

For disassembly, proceed as follows:



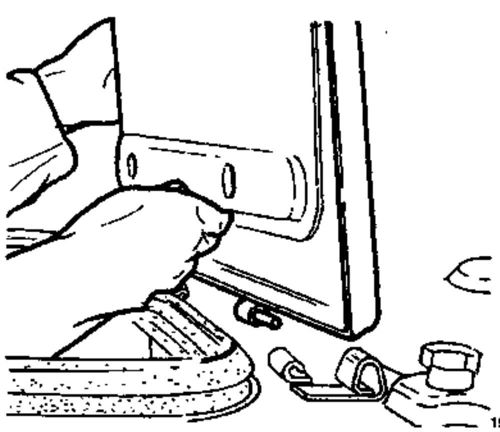
19817

1. Turn handle (H), open the roof emergency hatch and detach damper rods (L) from the ball–joint socket plastic support by striking the hatch with the palm of the hand.



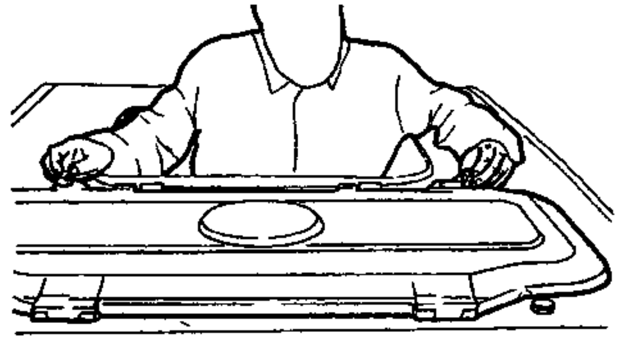
19819

2. Remove the hatch hinge–pin snap rings.



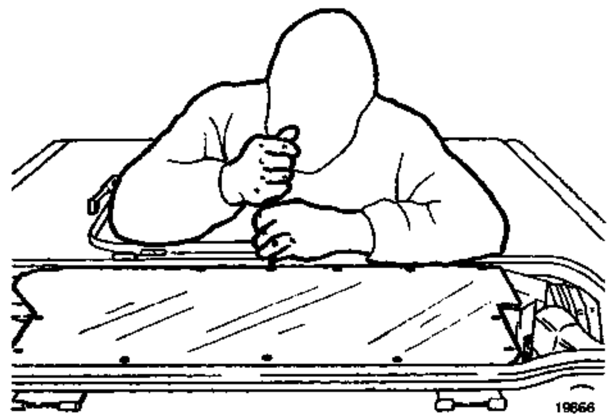
19820

3. Remove complete roof hatch from cab.



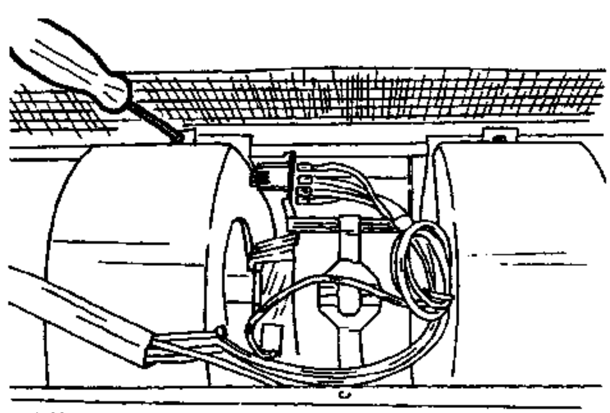
19865

4. Working on the outside of the cab roof, remove the two air–conditioning/heating plant housing cover fastening knobs.



19866

5. Remove the cross–slotted head screws securing the air–conditioning/heating plant housing cover.



19925

6. Remove the fan R.H. and L.H. housing attaching screws.

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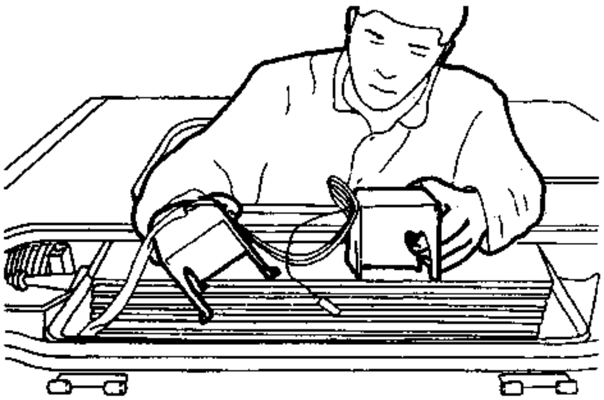
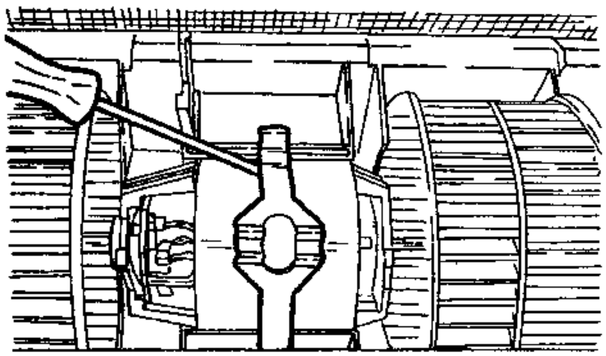


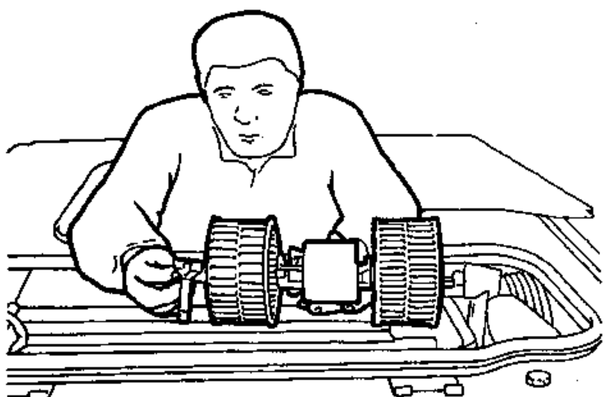
19926

7. Disconnect electric leads, then remove fan covers.



19927

8. Remove the fan spring retainer.



19928

9. Remove electric fan.

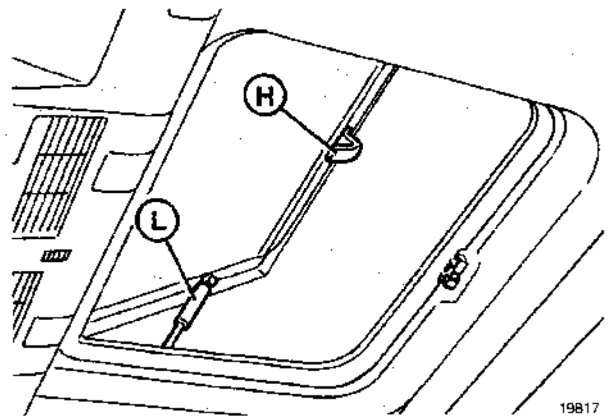
10. Proceed to the electric fan installation as follows:
   a. reverse the previous sequence of operations starting from no. 9 back to no. 1;
   b. see illustrations of pages 50–45 and 50–46 for the correct placement of parts.

ATTENTION – When assembling the electric motor make sure that fans are placed symmetrically with respect to their seat edges to prevent any possible interference with stationary parts of the heater.

CAB HEATER UNIT

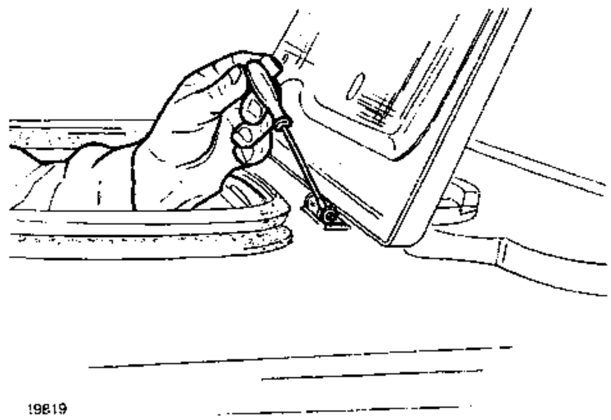
Disassembly–assembly, with air–conditioner and heater units installed (Op. 50 206 51 – 50 206 54)

For replacement, proceed as follows:



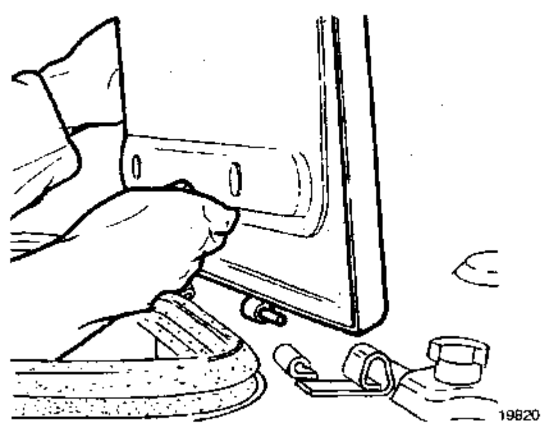
19817

1. Turn handle (H), open the roof emergency hatch and detach damper rods (L) from the ball–joint socket plastic support by striking the hatch with the palm of the hand.



19819

2. Remove the hatch hinge–pin snap rings.



19820

3. Remove the complete emergency hatch from cab top.

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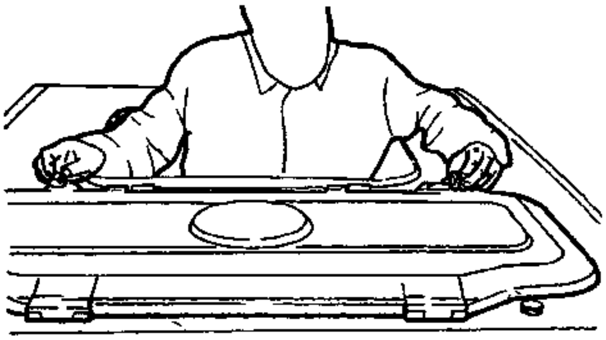
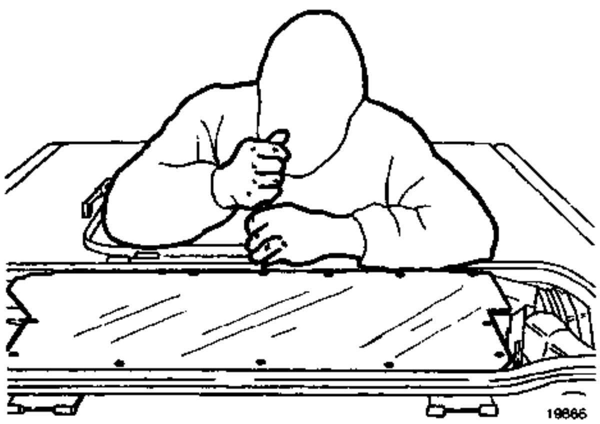


19865

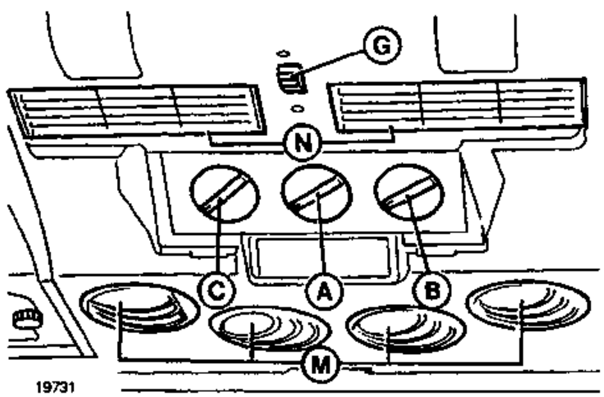
4. Remove the two air–conditioning/heating plant housing cover fastening knobs.



19866

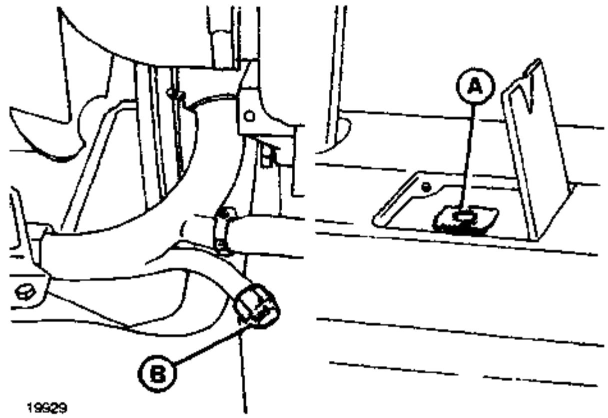
5. Remove the cross–slotted head screws securingthe air–conditioning/heating plant housing cover.

Drain about 5 to 6 liters (4–1/2 to 5–1/2 UK or 5–1/2 to 6–1/2 US quarts) of cooling liquid from radiator. Proceed as follows:



19731

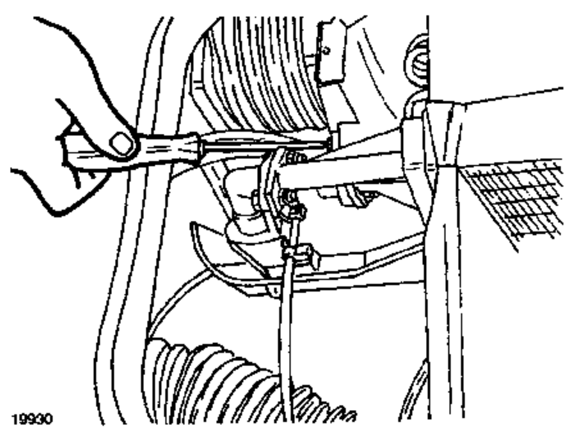
6. Open the heating plant cock by positioning control knob (B) on the red range sector.



19929

7. Unscrew the plug on radiator hose (B) and open filler cap (A) slightly just to ease the liquid out.

8. Re–tighten the plug on the radiator hose (B) and drain 5 to 6 liters (1 to 1–1/3 UK Gall) of liquid refrigerant.



19930

9. Using a screwdriver, remove the heater radiator delivery and return hose clamps.

10. Remove the heater delivery and return hoses and plug up openings to prevent entry of dirt and foreign material.

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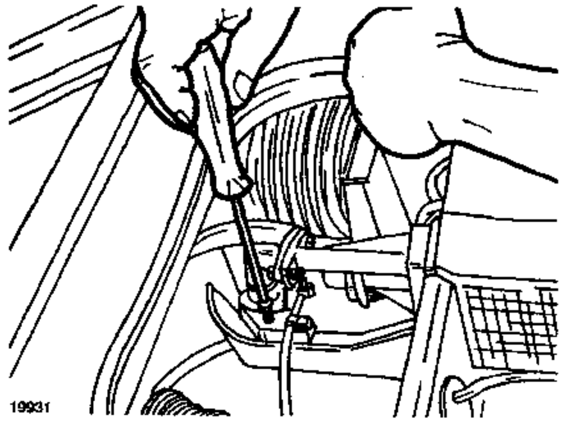
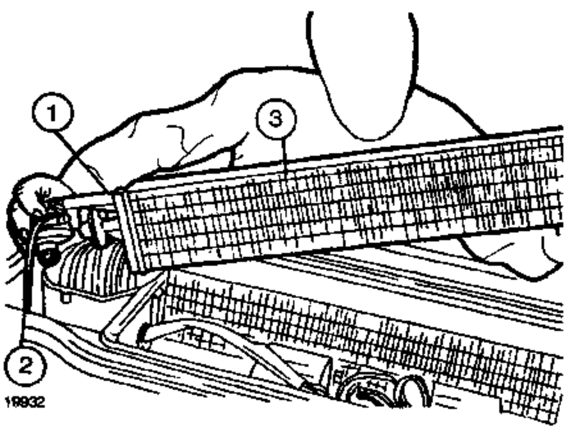


19931

11. Remove two of the radiator cross-slotted head screws.



19932

12. Remove the heater radiator (3) and disconnect cable (2) controlling the deviator opening–closing.

13. Proceed to install the cab heater unit as follows:
a. reverse the previous sequence of operations starting from no. 12 back to 1;
b. see illustrations of pages 50–46 through 50–48 for the correct placement of parts;
c. fill the engine cooling and cab heating systems as follows:

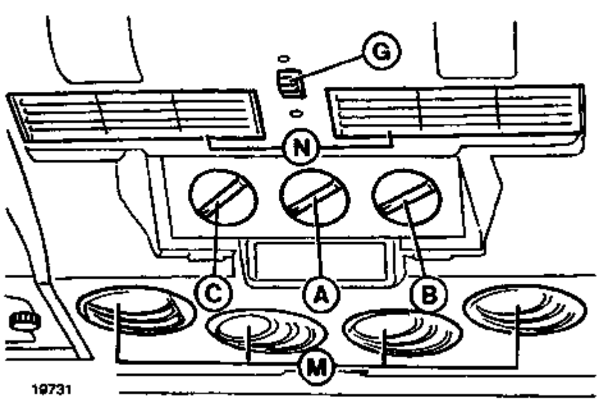
14. Fill the engine radiator with a water and FIAT "PARA-FLU 11" solution, then close the filler cap.

15. Close heater cock (control knob B on blu sector), start the engine and run at medium speed for about 5 to 10 minutes (this operation is necessary to pre–heat the engine cooling liquid).

16. Remove the radiator top cap, open heater cock (control knob B on red sector) and run the plant for about 5 minutes.

17. With engine running at high rpm, top up the liquid in the radiator , then close and block the filler cap.

ATTENTION – In cold climates, the operations which follow are suggested in order to verify the correct filling of the cab heater plant.



19731

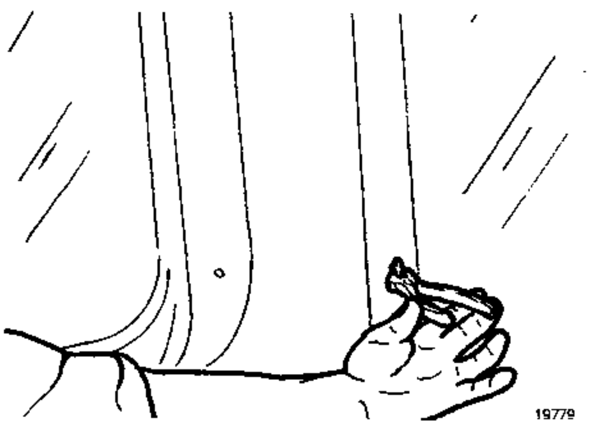
18. Close heater cock (control knob B on blue sector) and run the engine at medium speed to warm up cooling water, covering the radiator front with a sheet of paper to accelerate the process.

19. Open the heating cock and verify at the outlets inside the cab if warm air flows out when the fan is switched on.

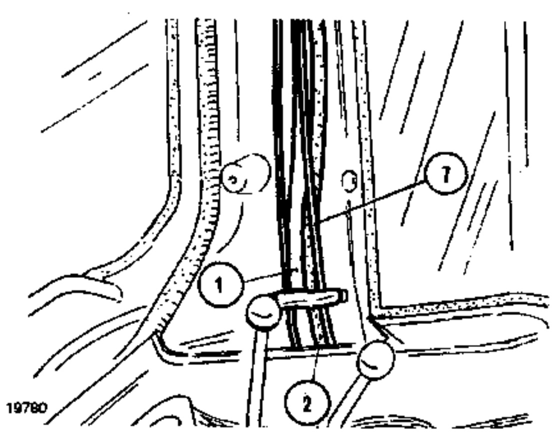
CAB HEATER DELIVERY AND RETURN HOSES
Replacement (Op. 50 200 40)

Proceed as follows:

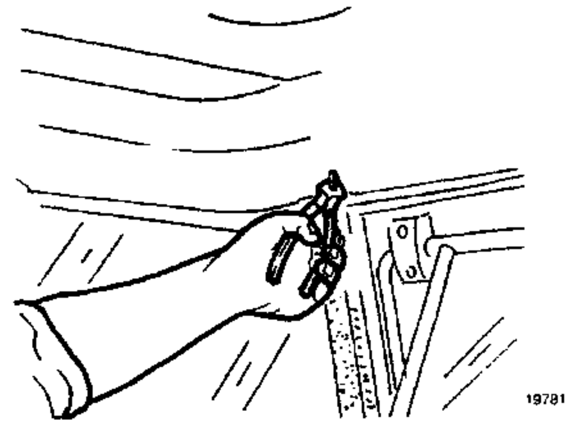
1. Drain about 5 to 6 liters (1 to 1-1/3 UK Gall) of radiator cooling liquid, disconnect the delivery and return hoses on heater as described in Op. 1 to 10 on page 46 and 47.



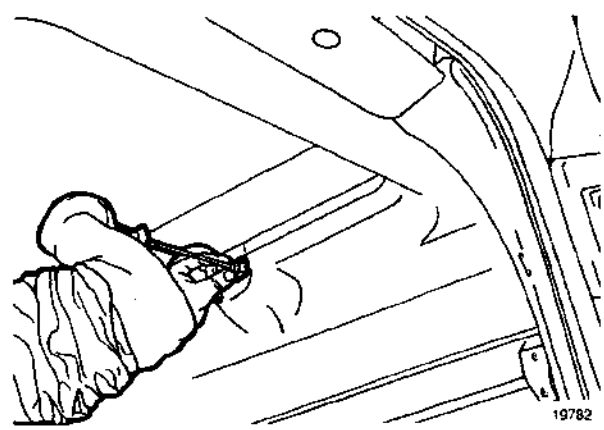
2. From inside the cab, remove the R.H. side pillar panel attaching plastic button fastenings.



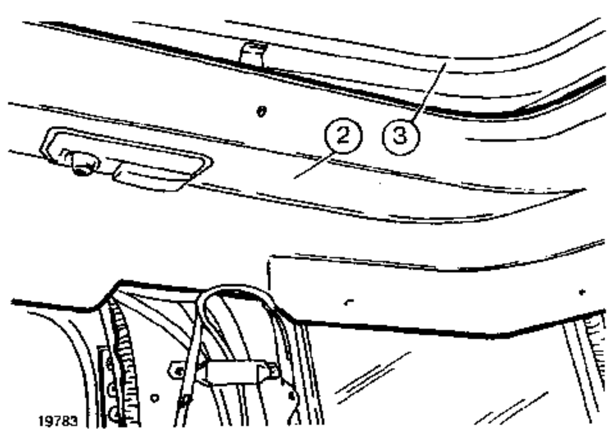
3. Remove panel to gain access to to the cold water return line (2) and warm water delivery line (1).



4. Remove plastic button fastenings securing the cab roof panel, rear and R.H. sides, as shown in the figure.



5. Remove the attaching screws and hatch closing support.



6. Pull the cab roof lining (2) downwards to create space between cab (3) and panel (2) for handling hoses (1) and (2).

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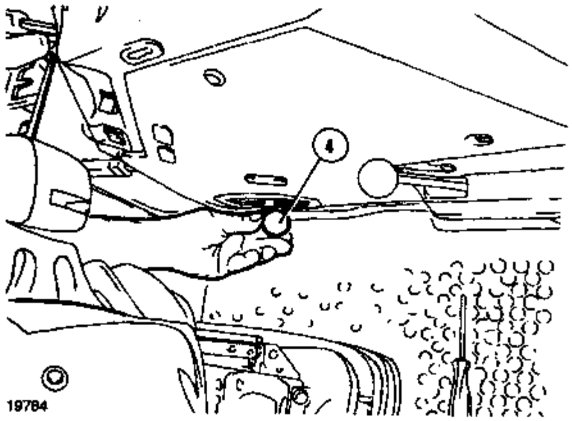
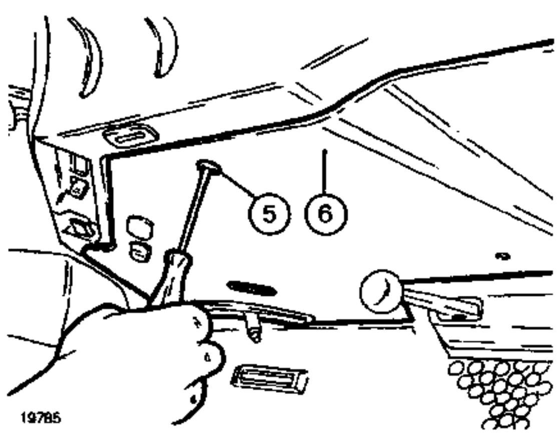
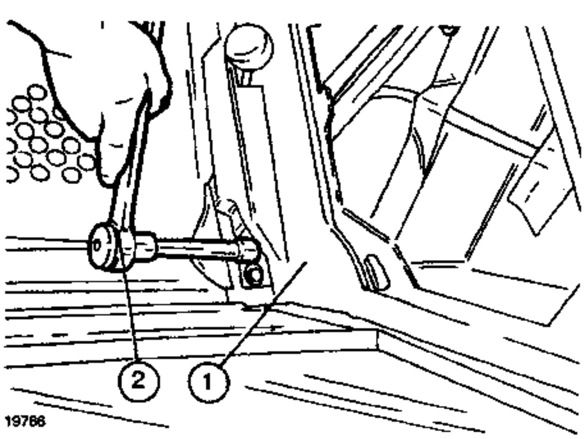


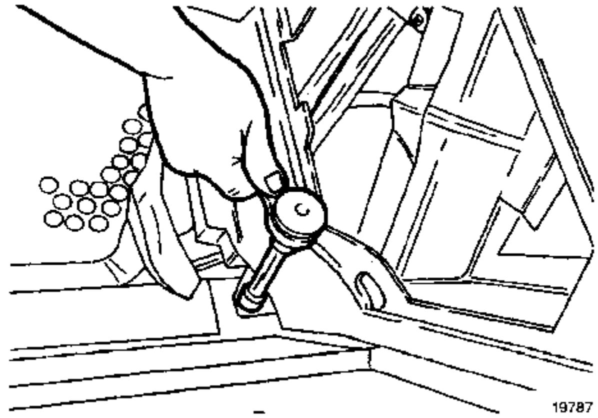
7. Remove the PTO control panel (4).



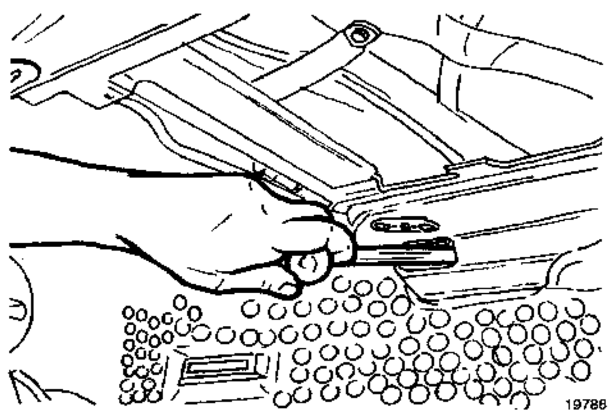
8. Remove the screws (5) and rear R.H. side fender lining (6).



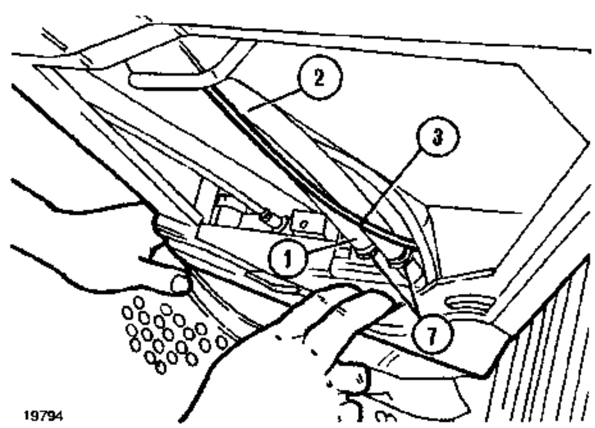
9. Using a socket wrench, remove supporting panel (1).



10. Still using the socket wrench, remove the screws attaching panel (1) to cab floor.



11. Remove the PTO engagement–disengagement control lever and rod.



12. From the R.H. side fender, remove the band clamps (7) for cold water return hose (2) and warm water delivery hose (1), withdrawing them from connecting lines.

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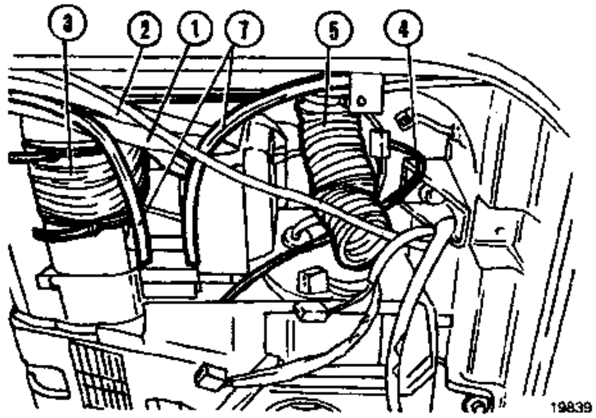
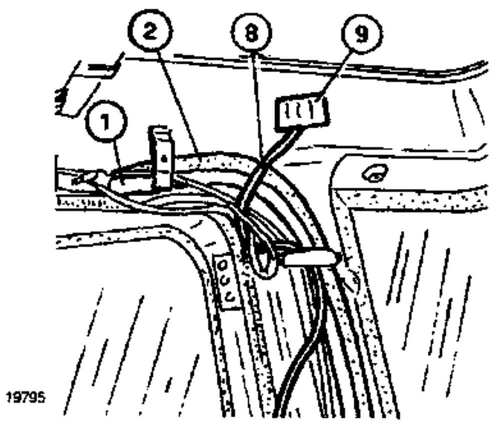
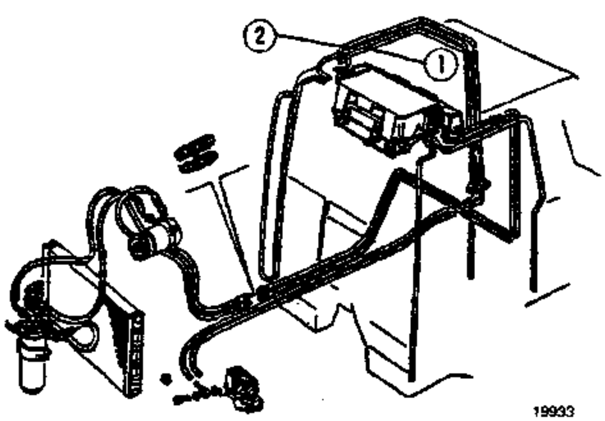


13. Remove the front R.H. side under roof lining as described in Op. 1 to 12, pages 90–19 and 90–20.



14. Pull the cab roof lining downwards as described in Op. 6, page 50–49, withdrawing return (2) and delivery (1) hoses; the under–lining lay–out of the hoses is shown in the accompanying figure.

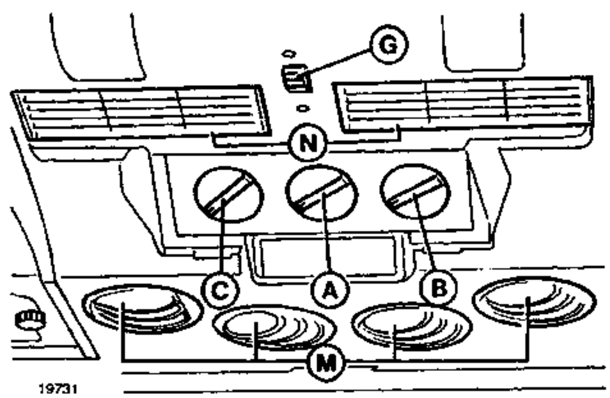


15. Proceed to the installation of heater delivery and return hoses as follows:
 a. reverse the previous sequence of operations starting from no. 14 back to no. 1;
 b. see illustrations of pages 50–49 and 50–50 for the correct placement of parts;
 c. always make sure to operate in clean and moisture–free surroundings. should fluid lines remain temporarily disassembled, make sure they are sealed tight;
 d. Fill the engine cooling and cab heating system as indicated on page 50–48.

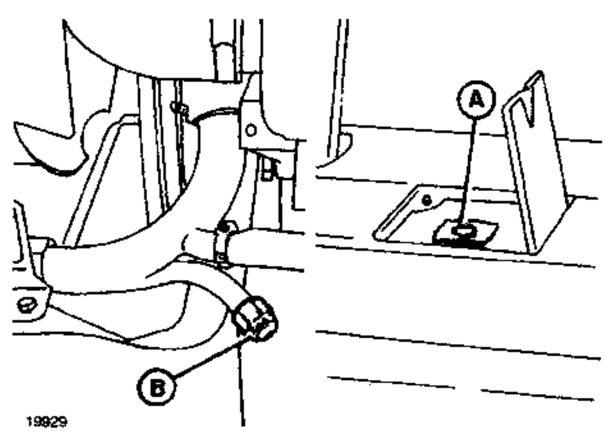
ENGINE – PIPING CONNECTING HOSES, DELIVERY AND RETURN
Replacement (Op. 50 200 46)

Proceed as follows:

Drain about 5 to 6 liters (1 to 1–1/3 UK Gall) of radiator cooling liquid as follows:



1. Open heating plant cock by positioning control knob (B) on red range sector.



2. Unscrew plug on radiator hose (B) and open filler cap (A) slightly just to ease the liquid out.

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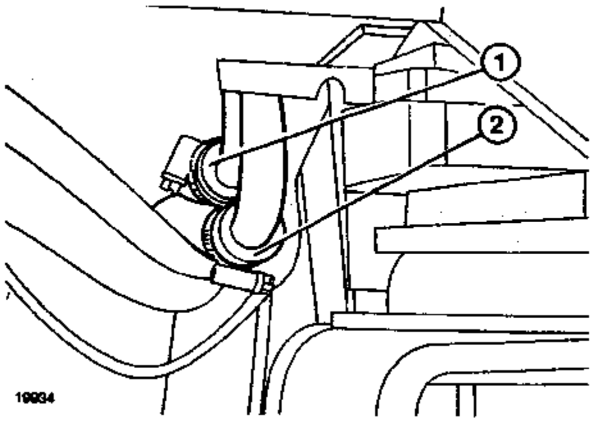
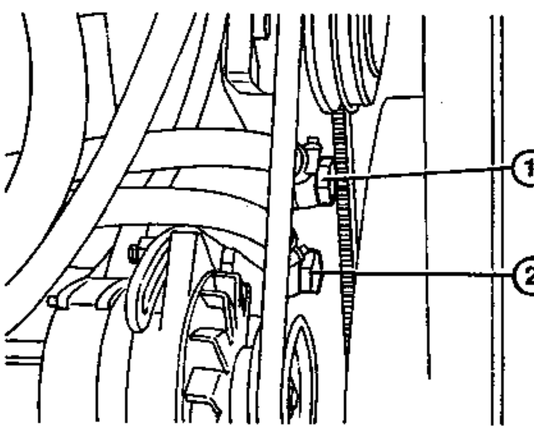
3. Let 5 to 6 liters (1 to 1–1/3 UK Gall) of cooling liquid drain out of radiator and screw the plug back on radiator hose.



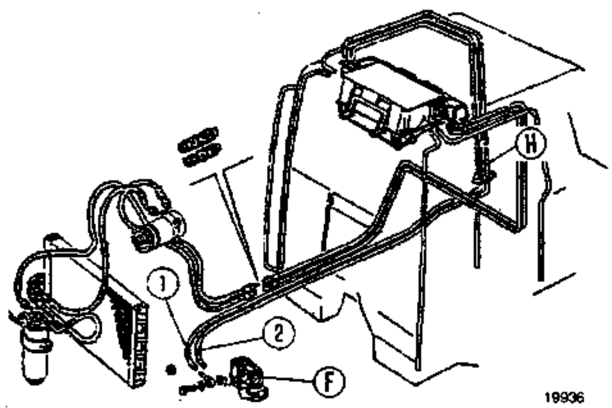
19934

4. Working from the cab rear lower side, slacken clamps and disconnect delivery (1) and return (2) hoses from connecting lines.



19935

5. Working from the tractor front end, remove the R.H. side panel, then the delivery (1) and return (2) connection screws.



19936

6. Withdraw hoses 1 and 2 all along their lay–out between pump (F) and lines (H) as shown in the figure.

7. Proceed to the installation of connecting hoses between pipelines and engine as follows:
a. reverse the previous sequence of operations starting from no. 6 back to no. 1;
b. see illustartions of pages 50–51 and 50–52 for the correct placement of parts;
c. always make sure to operate in clean and moisture–free surroundings. Should fluid lines and hoses remain temporarily disassembled, make sure they are sealed tight.
d. fill the engine cooling and cab heater systems following indications of page 50–48.

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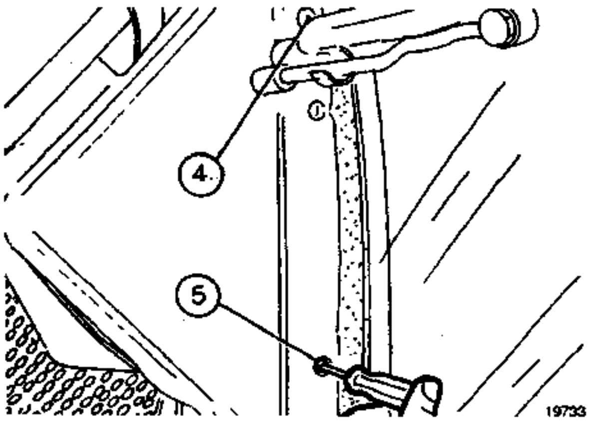
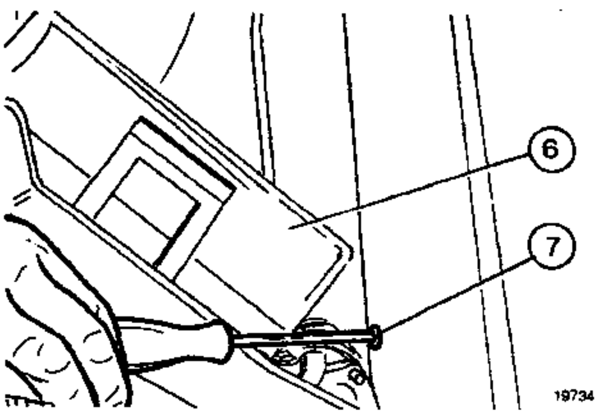
WINDSHIELD WIPER MOTOR

Removal–Installation (Op.55 218 52)

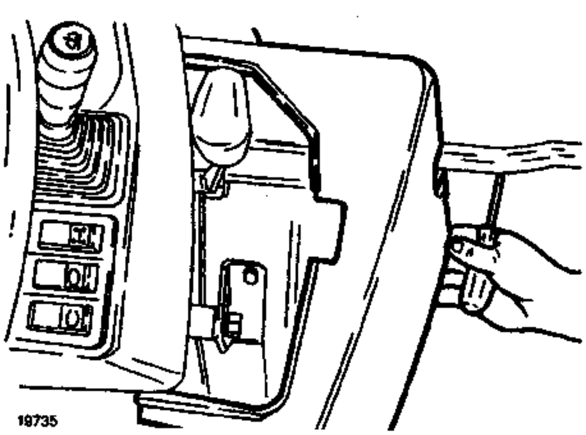
For removal, proceed as follows:



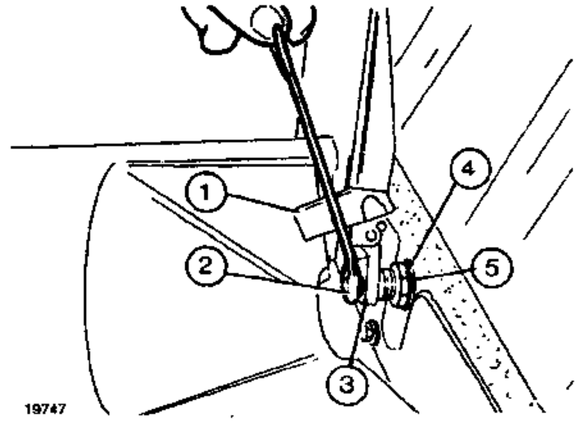
1. Remove plugs (4) and dashboard side panel screws (5).



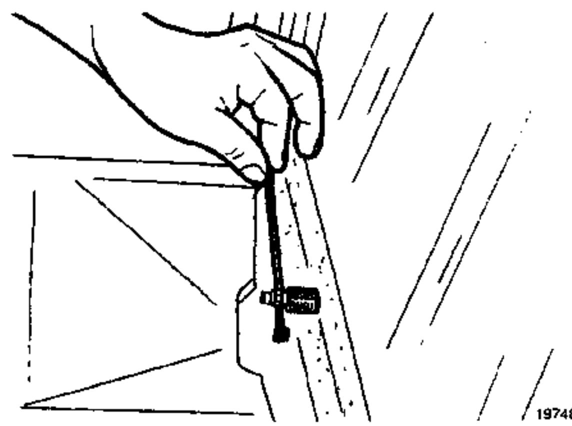
2. Unscrew the cover (6) retaining nut of the fuse box, located in the instrument panel lower side , open cover (6) and remove the side panel attaching screws (7).



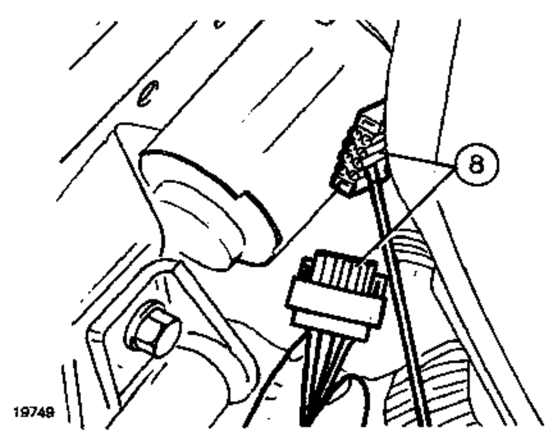
3. Remove the dashboard side panels.



4. Working on the outside of the cab: free cover cap (1), remove the wiper locknut (2) and arm (3), then the wiper motor ring nut (4) and washer (5).



5. Remove the two screws securing wiper motor to cab frame.



6. Disconnect electric wiring (8) on the inside.

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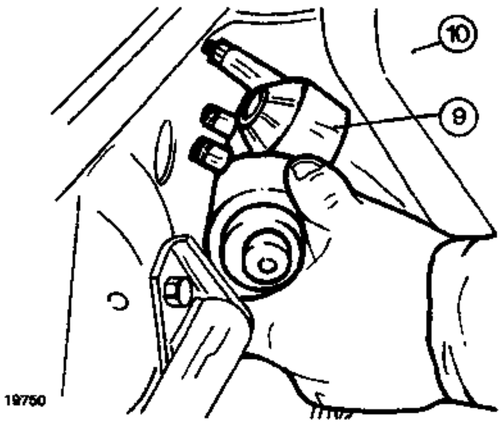


7. Remove wiper motor (9) through the space in between dashboard (10) and windshield glass.

8. Proceed to install the front windshield wiper motor as follows:
   a. reverse the previous sequence of operations starting from no. 7 back to no. 1;
   b. see illustrations of pages 55–1 and 55–2 for the correct placement of parts;
   c. check that the wiper blade stroke is correctly centered on the windshield between ends; if not, correct it by suitably changing its position on the knurled motor shaft.

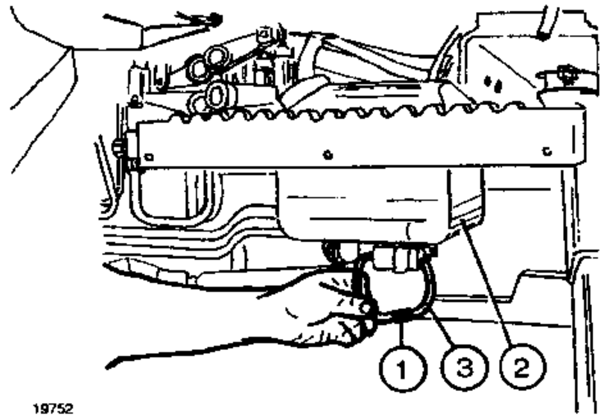
WINDSHIELD WASHER FLUID LINE CONNECTING CHECK VALVE AND JET SPRAY
Replacement (Op. 55 518 14).

For replacement, proceed as follows:

1. Remove the hood R.H. side panel.

2. Disconnect line from windshield washer nozzle under the hood and pull the latter downwards.

3. Take the line off from opposite end and disconnect it from the check valve (1) placed near the windshield washer fluid container (2).



4. Take out the line (3) connecting check valve and windshield washer jet spray after freeing it from all clamps in common with other fluid lines.

5. Proceed to install the hose between check valve and front windshield spray nozzle, as follows:
   a. reverse the previous sequence of operations starting from no. 4 back to no. 1;
   b. always operate in clean and moisture–free surroundings. Should the line remain temporarily disassembled, make sure that open ends are sealed tight;
   c. Fill the windshield washer liquid reservoir.

WINDSHIELD WASHER JET SPRAY NOZZLE
Replacement (Op. 55 518 24)

For replacement, proceed as follows:

1. Remove the hood R.H. side panel.

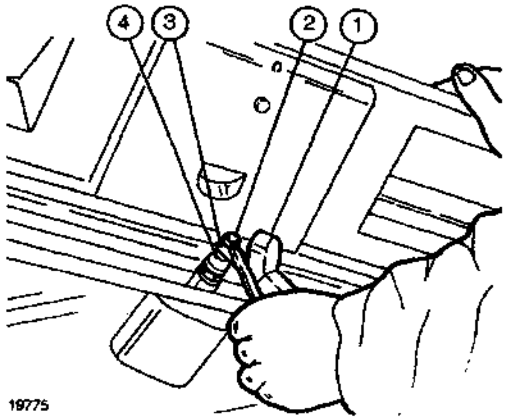
2. Disconnect line from windshield washer nozzle under the hood and pull the latter downwards.

3. Remove the windshield washer nozzle by inserting a 13mm wrench on the ring nut located under the hood and simultaneously unscrewing the nozzle on the upper end using a 12mm wrench.

4. Proceed for the installation of the windshield spray washer nozzle by reversing the previous sequence of operations, starting from no. 3 back to 1.

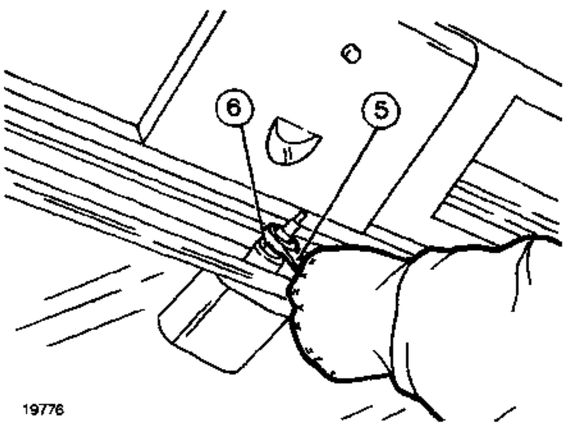
REAR WINDOW GLASS WIPER MOTOR
Removal–Installation (Op. 55 518 82)

For removal, proceed as follows:



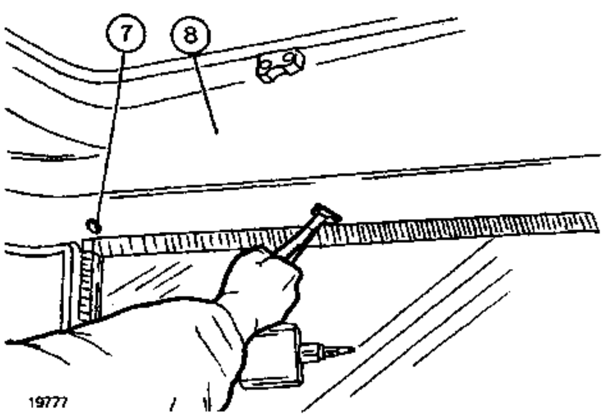
19775

1. Working on the outside of the cab: free cover cap (1), remove locknut (2) and wiper arm (3) and seal (4).



19776

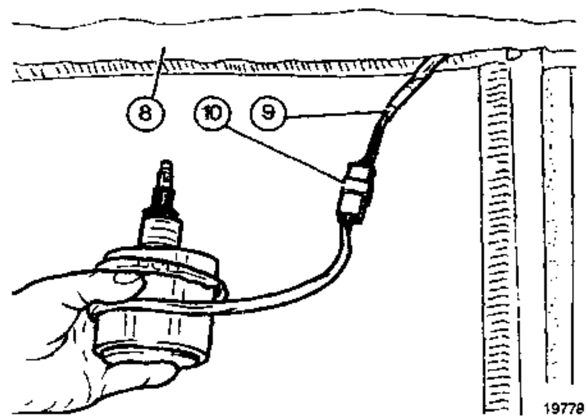
2. Remove the ring nut securing motor to glass using a box wrench (5) an then the washer and seal (6).



19777

3. Working on the inside of the cab, remove motor from glass and the three retaining plastic plugs (7) from the cab rear headlining (8).

in plastica (7) dal rivestimento superiore posteriore cabina (8).

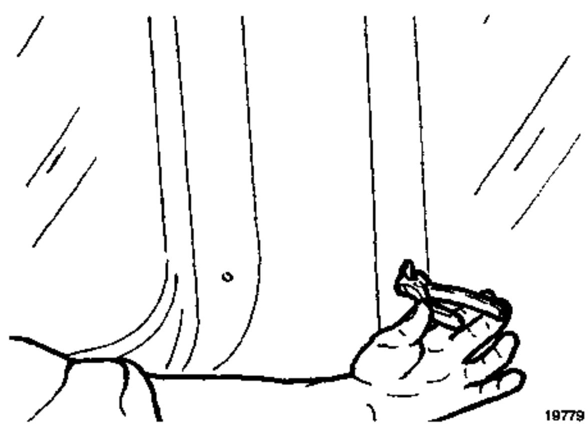


19778

4. Pull out from headlining (8) the wiper motor cable (9), disconnecting it from electric plugs (10).
5. Proceed for the installation of the rear window wiper motor as follows:
   a. reverse the previous sequence of operations starting from no. 4 back to 1;
   b. see illustrations above for the correct placement of parts;
   c. check that the wiper blade stroke is correctly centered on the windshield between ends; if not, correct it by suitably changing its position on the knurled motor shaft.

REAR WINDOW GLASS FLUID LINE CONNECTING CHECK VALVE AND JET SPRAY
Replacement (Op. 55 518 64)

For replacement, proceed as follows:



19779

1. Working on the inside of the cab, remove the R.H. side pillar trim retaining plastic plugs.

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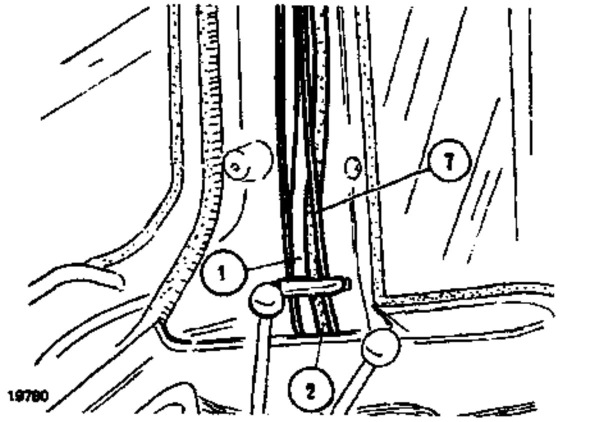
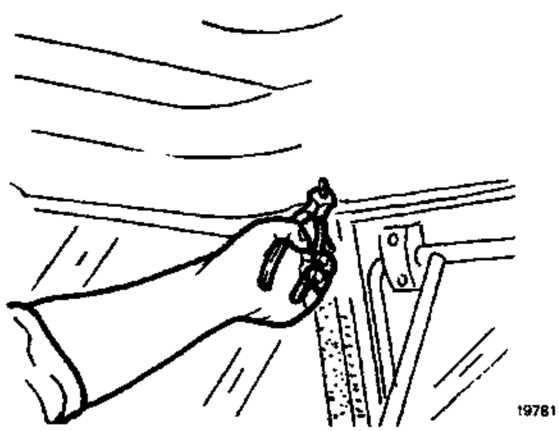
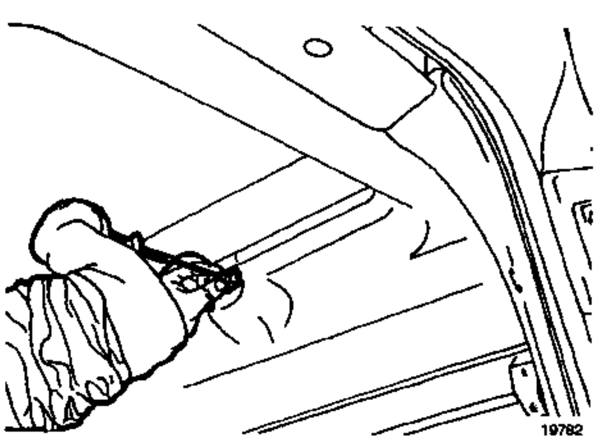


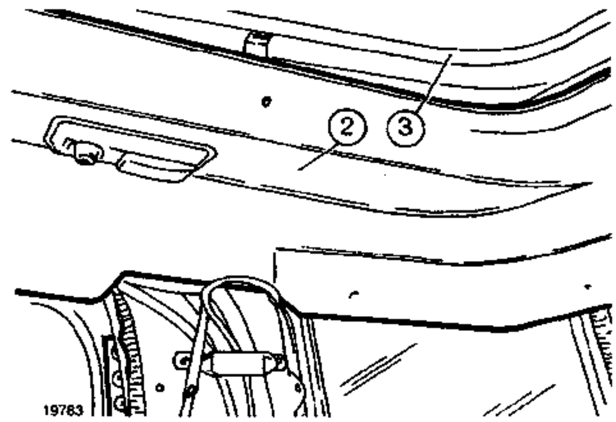
2. Remove the R.H. side pillar trim to gain access to the washer fluid line (7).



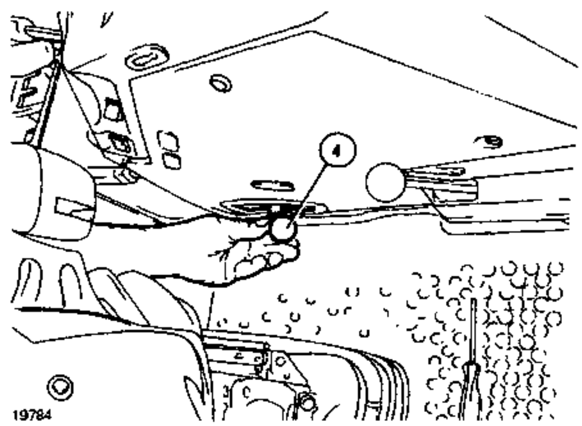
3. Remove the cab headlining retaining plastic plugs from the R.H. side and rear door area as shown in the figure.



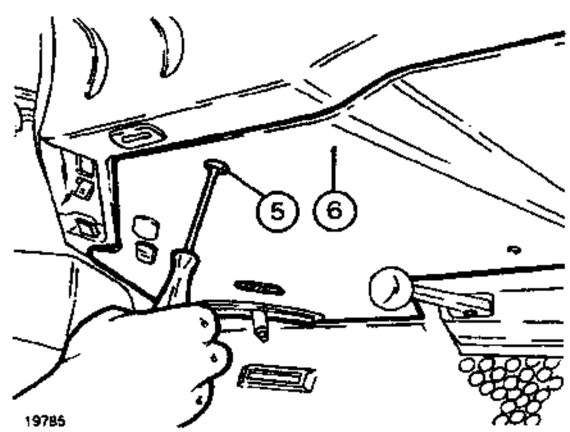
4. Remove the roof hatch fixed support attaching screws and the support itself.



5. Pull the cab roof headlining (2) down in order to make sufficient room between cab (3) and lining to allow subsequent access to the washer fluid line.



6. Remove the PTO control knob (4).



7. Remove screws (5) securing the rear R.H. side mudguard panel (6) and then the panel itself.

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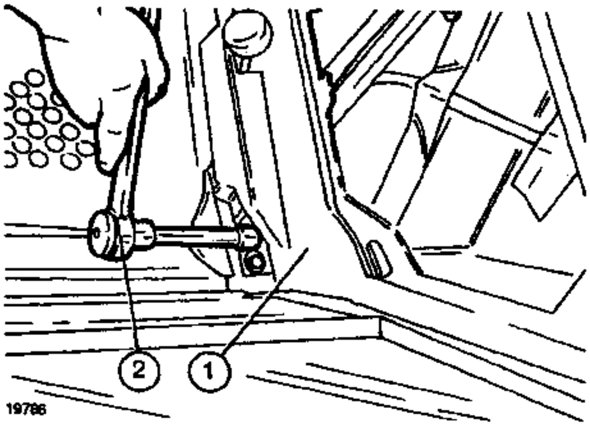
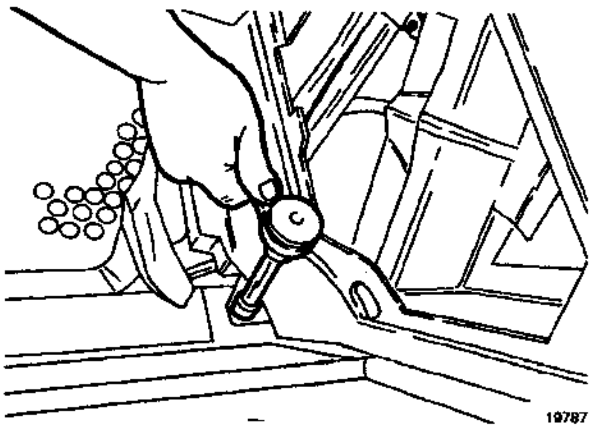
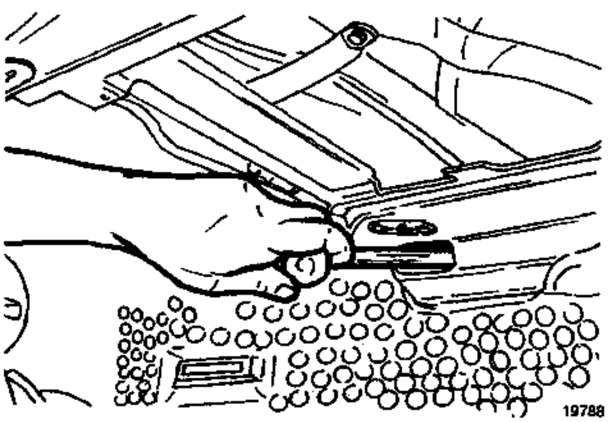


19786

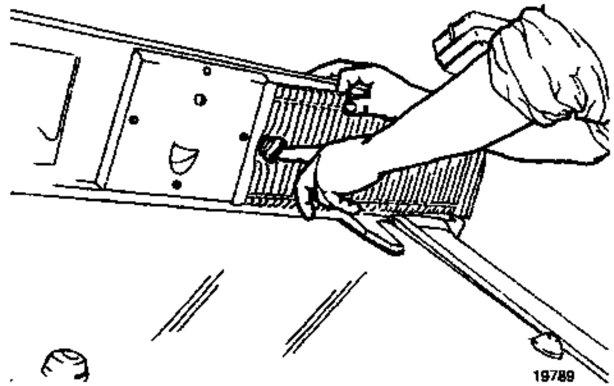
8. Remove the mounting panel (1) attaching screw using a box wrench (2).


19787

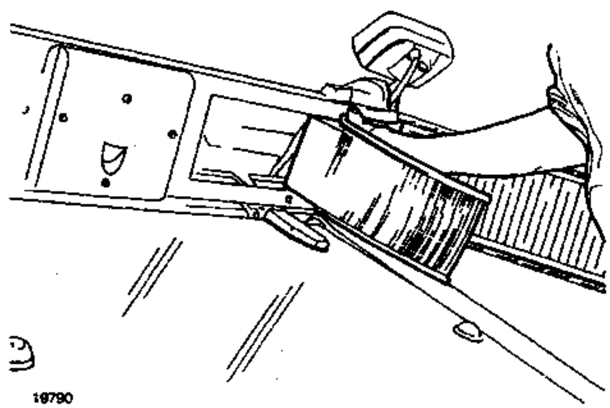
9. Remove the mounting panel (1) to cab floor attaching screw using a box wrench.


19788

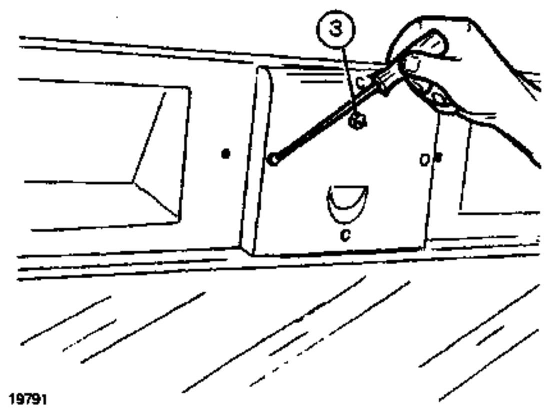
10. Remove the PTO control lever and rod.


19789

11. Working on the outside of cab rear end, remove the R.H. side air intake grille knob.


19790

12. Open it and remove air filter pad.



19791

13. Remove plugs covering the nozzle holder (3) support attaching screws.

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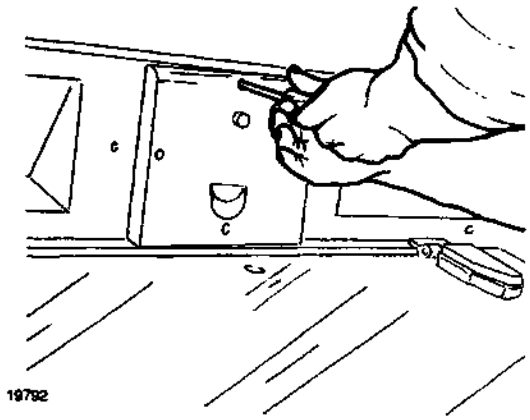
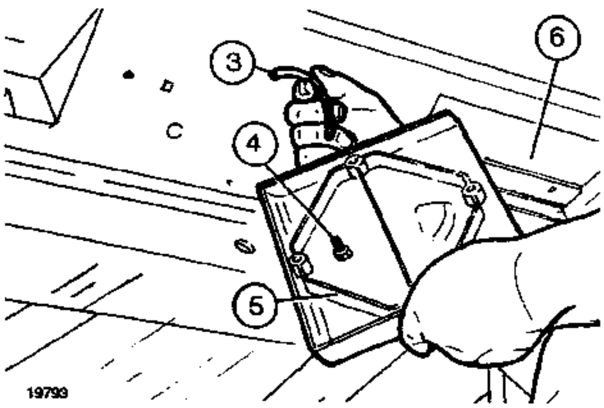
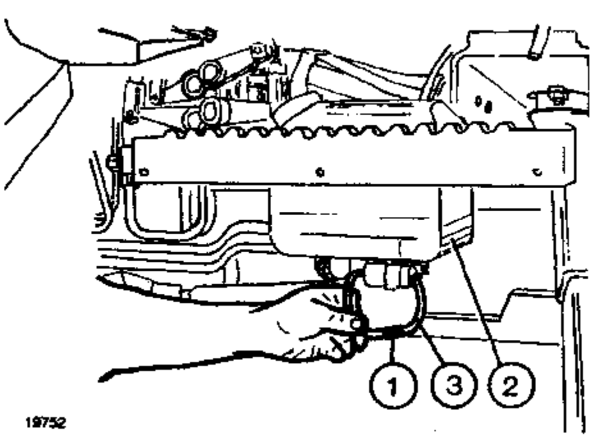


14. Remove the nozzle holder support screws using a Phillips–head screwdriver.



15. Disconnect washer fluid line (3) from nozzle (4) after removing the nozzle holder support (5).

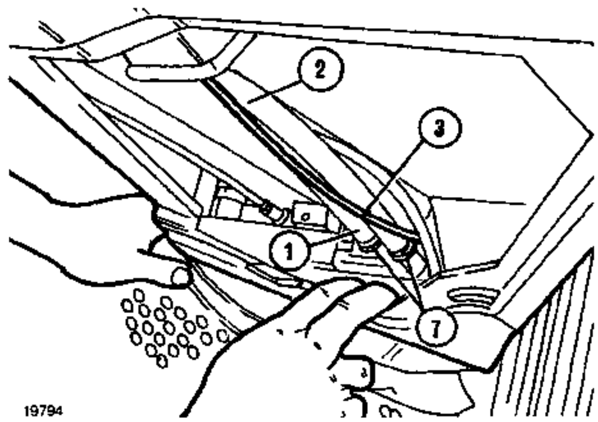
16. Slide out fluid line (3) from the central hole by hand, through the R.H. side air intake (6).



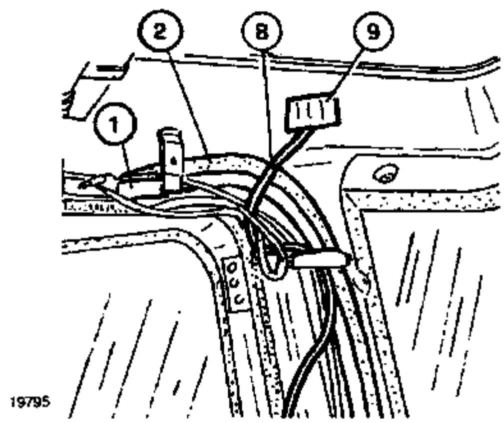
17. Detach oppposite end of line (3) from check valve 1 installed near the washer fluid container (2).

18. Withdraw the tube (3) from the outside, along its lay-out from fluid container to the cab lower rear end, after removing any retaining clamps to other lines along the same path.

Move inside the cab and proceed as follows:



19. From R.H. mudguard side pull fluid line (3) upwards until it is completely withdrawn.



20. Pull the cab headlining downwards (as described for operation 5 on page 4).Remove adhesive tape (9) and withdraw, pulling downwards, the line (8) at nozzle end , noting that the layout of the line (8) covered by the cab roof lining is that shown in the figure.

21. Proceed for the installation of the hose connectin check valve and rear windshield jet spray nozzle as follows:
a. reverse the previous sequence of operations starting from no. 20 back to 1;
b. see illustrations of pages 55–3 through 55–6 for the correct placement of parts.

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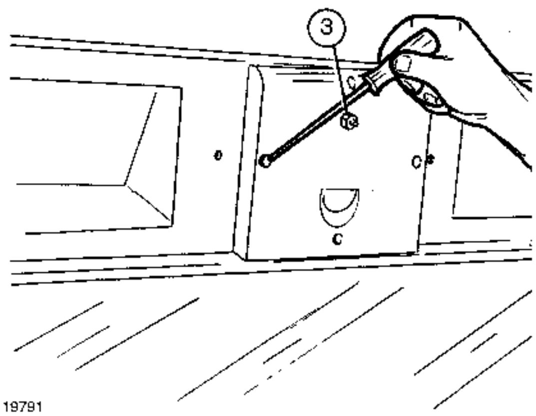
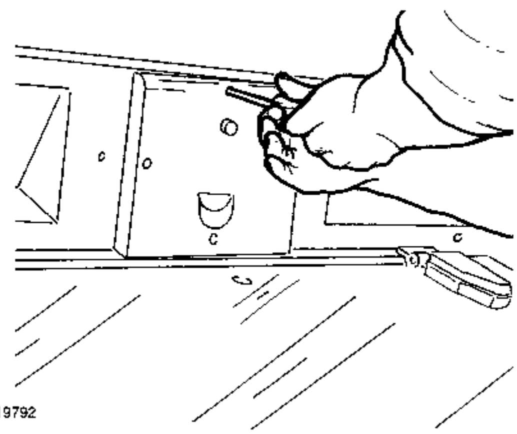
REAR WINDOW GLASS WASHER
Replacement (Op. 55 518 74)

For replacement, proceed as follows:



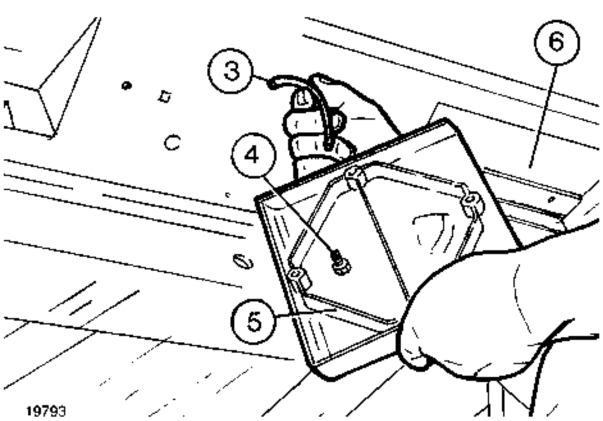
19791

1. Remove plugs covering the nozzle holder (3) support screws.



19792

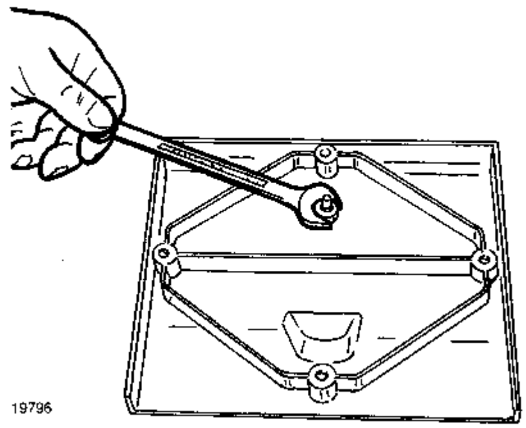
2. Remove the nozzle holder support screws using a Phillips–head screwdriver.



19793

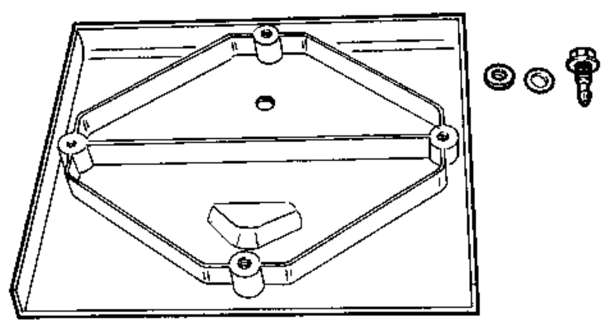
3. Disconnect fluid line (3) from nozzle (4) after removing the nozzle holder support (5).

With the nozzle holder support on worbench, proceed as follows:



19796

4. Remove the nozzle locknut using a 13mm wrench, holding the nozzle with a 12mm wrench.



19797

5. Retrieve component parts.

6. Proceed for the installation of the rear window glass spray nozzle by reversing the previous sequence of operations, starting from no. 5 back to no. 1;
a. for correct assembly of component parts follow the above illustrations;
b. always work under conditions of absolute cleanliness. Should the tubelet remain temporarily loose, make sure it is thoroughly sealed.

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MARELLI STARTING MOTOR

Type	MARELLI MT 68 LC 632168.96
Voltage rating	12 V
Rated output	3.5 kW
Rotation, (seen from pinion end)	clockwise
Gear tooth ratio, pinion and ring gear	9/127
Poles	4
Excitation (field windings)	in series
Engagement	lever and freewheel
Drive	solenoid
Bench test data	
Running test at 20°C (68°F):	
– current	≤ 700 Amp
– torque output	≥ 19 Nm (1.9 kgm) (13.75 ft.lb)
– speed	≥ 1700 rpm
– voltage	9.1 V
Breakaway test at 20°C (68°F):	
– current	≤ 1550 Amp
– voltage	5.7 V
– torque output	≥ 52 Nm (5.3 kgm) (38.3 ft.lb)
No–load test at 20°C (68°F):	
– current	≤ 80 Amp
– voltage	≥ 11.6 V
– speed	≥ 7000 rpm
Mechanical data	
Brush pressure (unworn)	1.28 to 1.52 bar (18.56 to 22.04 psi)
Insulation undercutting depth	1 mm (.04 in) max
Freewheel efficiency: slip torque to drag pinion into slow rotation	0.6 to 0.8 Nm (0.06 to 0.08 kgm) (.58 ft.lb)

(follows)

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MARELLI STARTING MOTOR

(cont.)

Commutator diameter	45.000 to 45.840 mm (1.7716 to 1.8047 in)
– permissible wear limit	44.000 mm (1.7323 in)
– maximum out–of–round	0.1 mm (.004 in)
– armature end float	0.1 to 0.4 mm (.004 to .016 in)
Solenoid	
Winding resistance at 20°C (68°F):	
– hold–in	0.23 ± 0.01 Ω
– pull–in	0.78 ± 0.04 Ω
Current consumption at 12 V	≤ 70 Amp
Activation voltage (minimum)	≤ 7 V
Moving contact stroke	2.2 to 3.5 mm (.087 to .138 in)
Plunger stroke	14.3 mm (.563 in)
Load at 12 V and plunger at end of stroke	≥ 392 N (40 kg = 88 lb)
Assembly data	
Pole shoe I.D	75.830 to 76.000 mm (2.9854 to 2.9921 in)
Armature O.D.	74.900 to 74.950 mm (2.9488 to 2.9508 in)
Drive end bushing I.D.	12.475 to 12.502 mm (.4911 to .4922 in)
Pinion shaft journal diameter	12.425 to 12.440 mm (.4892 to .4898 in)
Pinion shaft running clearance	0.035 to 0.077 mm (.0014 to .0030 in)
Intermediate bushing I.D.	20.200 to 20.264 mm (.7953 to .7978 in)
Shaft journal diameter	19.967 to 20.000 mm (.7861 to .7874 in)
Shaft running clearance	0.200 to 0.297 mm (.0079 to .0117 in)
Commutator end bushing I.D.	14.000 to 14.027 mm (.5512 to .5522 in)
Shaft running clearance	13.957 to 13.984 mm (.5495 to .5505 in)
Giuoco di montaggio tra albero e boccola	0.016 to 0.070 mm (.0006 to .0027 in)
Lubrication data	
Starter drive helical groove (at overhauls)	TUTELA MR3 grease
Commutator end thrust washer	TUTELA MR3 grease

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BOSCH STARTING MOTOR
(Provisional data)

Type BOSCH	JF → 12V 0001367029
Voltage rating	12 V
Rated output	2.95 kW
Rotation (seen from pinion end)	clockwise
Gear tooth ratio, pinion and ring gear	9/127
Poles	4
Excitation (field windings)	in series and in parallel
Engagement	lever and freewheel
Drive	solenoid
Bench test data	
Short–circuit test at 20°C (68°F)	
– current	760 to 900 Amp (1)
	650 to 800 Amp (2)
– torque output	4.6 kgm (33.2 ft.lb) (1)
	3.9 kgm (28.2 ft.lb) (2)
– voltage	4 V (1) 3.5 V (2)
No–load test at 20°C (68°F):	
– current	60 to 90 Amp
– voltage	11.5 V
– speed	4800 to 6800 rpm
Mechanical data	
Brush pressure (unworn)	2.6 to 2.8 kg (5.7 to 6.2 lb)
Armature end float	0.1 to 0.3 mm (.004 to .012 in)
Insulation undercutting depth	0.5 to 0.8 mm (.020 to .031 in)
Commutator diameter	42 mm (1.65 in)
Commutator permissible wear limit	39.5 mm (1.555 in)
Commutator out–of–round (max)	0.03 mm (.0012 in)
Stack out–of–round (max)	0.05 mm (.0019 in)

(follows)

(1) Measured with a charged battery (2) Measured with a discharged battery

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BOSCH STARTING MOTOR
(Provisional data)

(cont.)

Solenoid	
Winding resistance at 20°C (68°F)	
– hold–in	1.05 Ω
– pull–in	0.25 Ω
Current consumption of pull coil at 12°C (68°F)	60 Amp
Activation voltage (minimum)	9 V
Plunger stroke	12 to 14 mm (.472 to .551 in)
Assembly data	
Pole shoe I.D.	75.850 to 75.953 mm (2.9862 to 2.9903 in)
Armature I.D.	73 mm (2.87 in)
I.D. of armature self–lubricating bushes (force fitted):	
– pinion frame end bushing	12.475 to 12.502 mm (.4911 to .4922 in)
– intermediate field frame bushing	19.020 to 19.072 mm (.7488 to .7509 in)
– commutator frame end bushing	14.000 to 14.018 mm (.5512 to .5519 in)
Armature shaft diameter at:	
– pinion frame end bushing	12.425 to 12.440 mm (.4892 to .4898 in)
– intermediate field frame bushing	18.887 to 18.910 mm (.7436 to .7445 in)
– commutator frame end bushing	13.932 to 13.950 mm (.5485 to .5492 in)
Armature shaft running clearance:	
– pinion frame end	0.035 to 0.077 mm (.0014 to .0030 in)
– intermediate frame	0.110 to 0.195 mm (.0043 to .0077 in)
– commutator frame end	0.050 to 0.086 mm (.0020 to .0034 in)
I.D. of bushing force–fitted in pinion hub	14.245 to 14.272 mm (.5608 to .5619 in)
Armature shaft diameter at pinion hub bushing	14.123 to 14.150 mm (.5560 to .5571 in)
Armature shaft running clearance at pinion hub bushing	0.095 to 0.149 mm (.0037 to .0059 in)
Lubrication data (at overhauls)	
Starter drive helical groove	TUTELA MR3 grease

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BATTERY CHARGING SYSTEM

Alternator	
Type (3–phase, self–rectifying):	
– MARELLI	14V – 65 Amp
– BOSCH	14V – 65 Amp
Rated voltage	14V
Rotation (seen from pulley side)	clockwise
Cut–in speed at 12V 25°C (77°F):	
– MARELLI	≤ 1050 rpm
– BOSCH	≤ 1060 rpm
Current output at 14V across battery, at 7000 rpm (MARELLI) or 6000 rpm (BOSCH), after warm–up and with fully bedded in brushes	≥ 65 Amp
Installed alternator speed, at engine governed speed (models F 100 – F 110 and F 120)	3680 rpm
Installed alternator speed, at engine governed speed (model F 130 and models F 100 – F 110 – F 120 with air conditioner)	5593 rpm
Engine/alternator speed ratio (models F 100 – F 110 – F 120)	1 : 1.6
Engine/alternator speed ratio (model F 130 and models F 100 – F 110 – F 120 with conditioner)	1 : 2.43

BATTERY

Type:	
– standard	MARELLI 12V – 132 Amp/h – 580 Amp
– optional	MARELLI 12V – 176 Amp/h – 770 Amp
Rated voltage	12V
Rated output (at 20–hour discharge rate):	
– MARELLI 12V – 132 Amp/h – 580 Amp	132 Amp/h
– MARELLI 12V – 176 Ahmp/h – 770 Amp	176 Amp/h

LIGHTING – SIGNALS – ACCESSORIES

Two asymmetrical headlights, high and low beam, 45/50W double–filament bulb (white or yellow light).
Two headlamps including:
– parking light (5W bulb) with white lens;
– turn signal light (21W bulb) with orange lens.
Two rear lamps including:
– parking light (5W bulb) with red lens (the LH side one also used for license plate lighting):
– turn–signal light (21W bulb) with orange lens;
– stop light (21W bulb) with red lens.
Two rear reflex glasses (red).
Instrument and control panel including multi–function indicators and functional checks (see pages 55–13, 55–14 and 55–15).
7–pole DIN power point.
2–pole power point.
Thermostarter or start–pilote.
Lighter.
Flasher for tractor and trailer emergengy lights.

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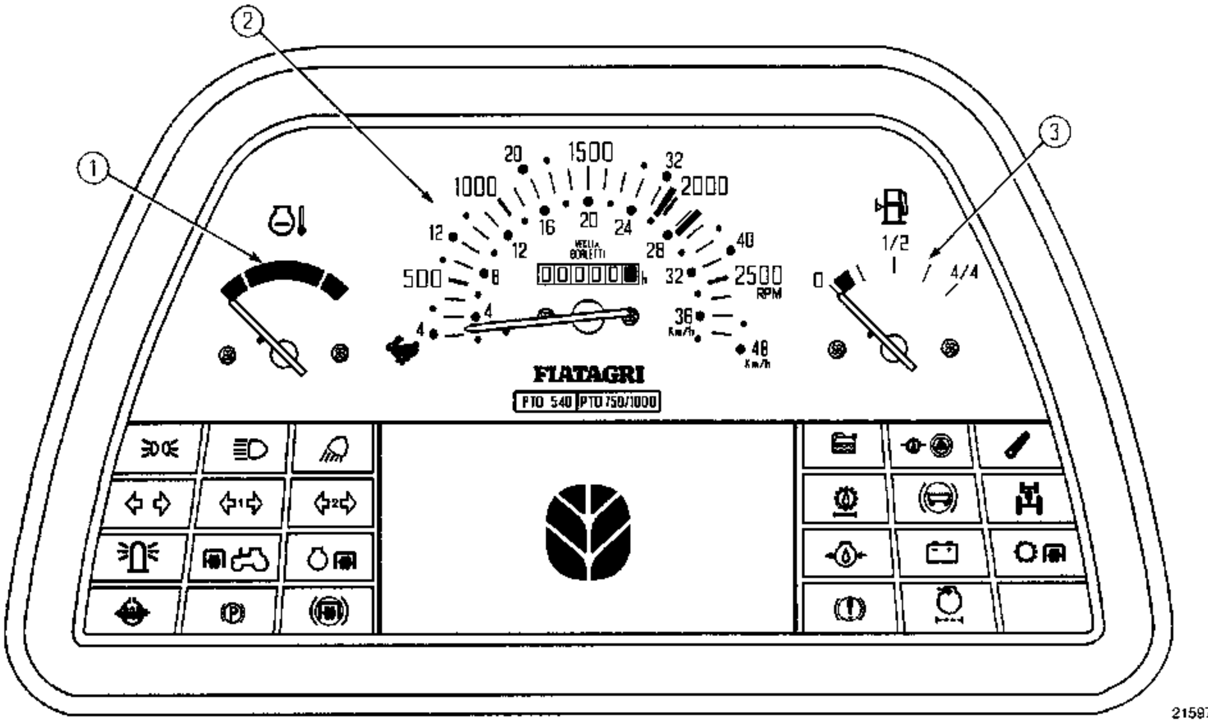

STANDARD INSTRUMENT PANEL

1. Engine coolant temperature gauge – 2. Chronotachometer – 3. Fuel level gauge.

Parking light indicator (green).

Hi–beam headlight indicator (blue).

Auxiliary worklights indicator (amber)

Tractor turn–signal indicator (green)

First trailer turn–signal indicator (green).

Second trailer turn–signal indicator (green).

Lighted gyrolight indicator (amber).

Engaged front PTO indicator (amber).

Engaged rear PTO indicator (amber).

Engaged differential lock indicator (amber).

Engaged hand brake flasher light (red).

Engaged PTO brake indicator (amber).

Condensate in fuel indicator (amber).

Low transmission or power steering oil level indicator (red).

Working front PTO indicator (amber).

Clogged rear drive oil filter indicator (red).

Engaged trailer brake indicator (red).

Engaged 4WD indicator (amber).

Low engine oil pressure indicator, w/in–built warning light (red).

Faulty battery charging plant operation indicator, w/built–in warning light (red)

Engaged ground–speed PTO indicator (amber).

Low brake fluid level indicator, w/built–in warning light (red).

Low engine oil level indicator, w/built–in warning light (red).

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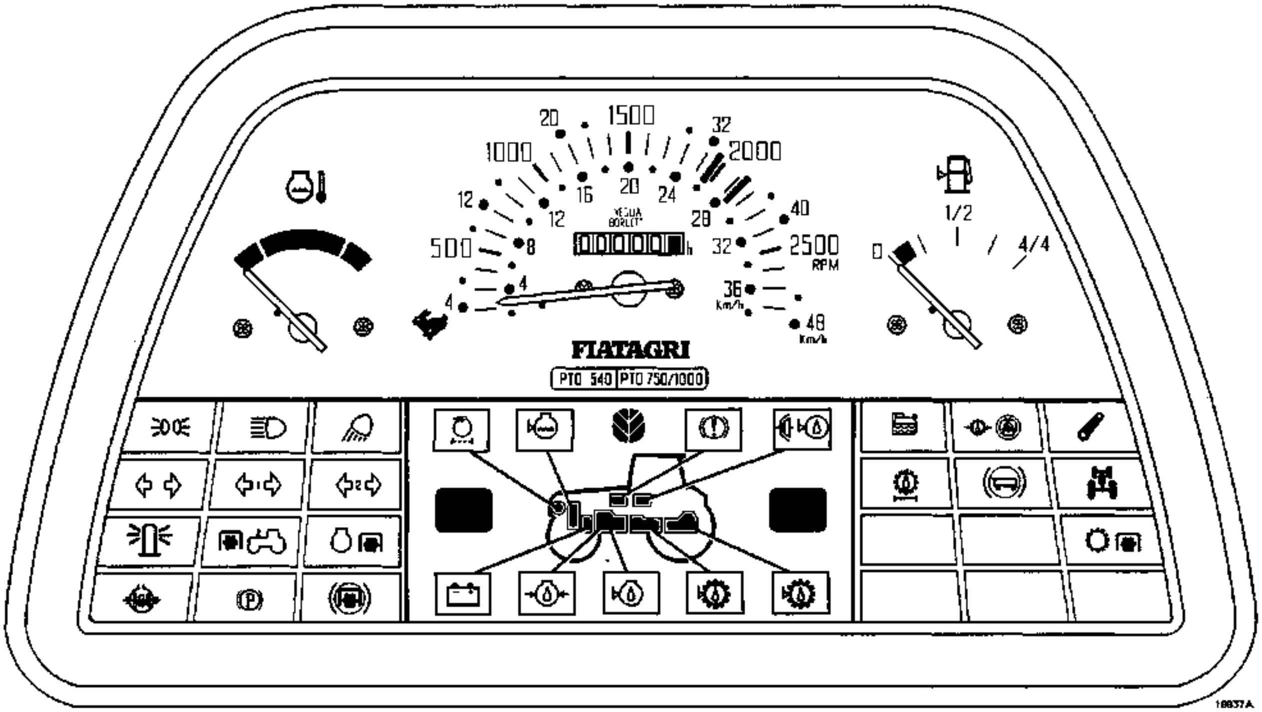

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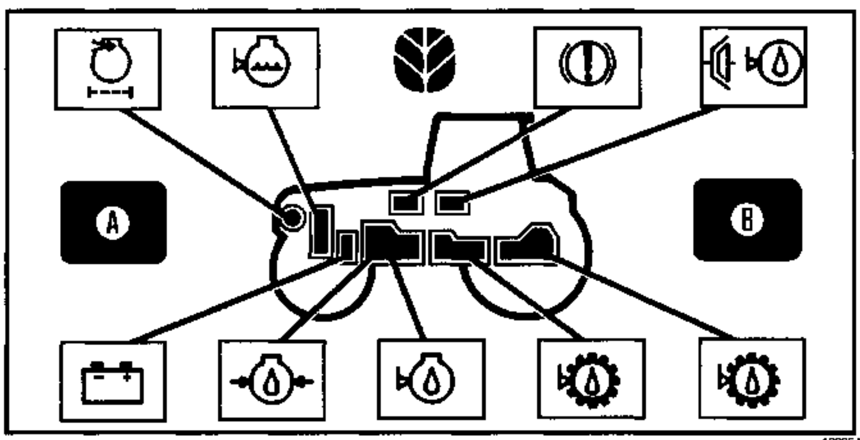

18835A

INSTRUMENT AND CHECK PANEL

Note – *For remaining indicators and gauges not included in this figure, see the "Standard instrument panel", page 55–13.*

Dry air cleaner restriction indicator (light blue).

Low engine coolant level indicator (light blue).

Low brake fluid level indicator (red).

Low engine–transmission clutch control oil level indicator (yellow).

A — General indicator warning light (green). It will go on when engine is shut off and starting switch key positioned on 1. It will go out about 10 seconds after the switch key is released from position.

B — General indicator light (red). It will go on simultaneously with the indicator light of a defective function or component. It must remain off when everything is normal.

Faulty battery charging plant operation indicator, w/in–built warning light (red).

Low engine lube oil pressure indicator w/ built–in warning light (red).

Low engine oil level indicator, w/in–built warning light (red).

Low transmission, rear drive, power shift, power take–off and hydraulic lift oil level indicator (yellow). All lights will go on simultaneously.

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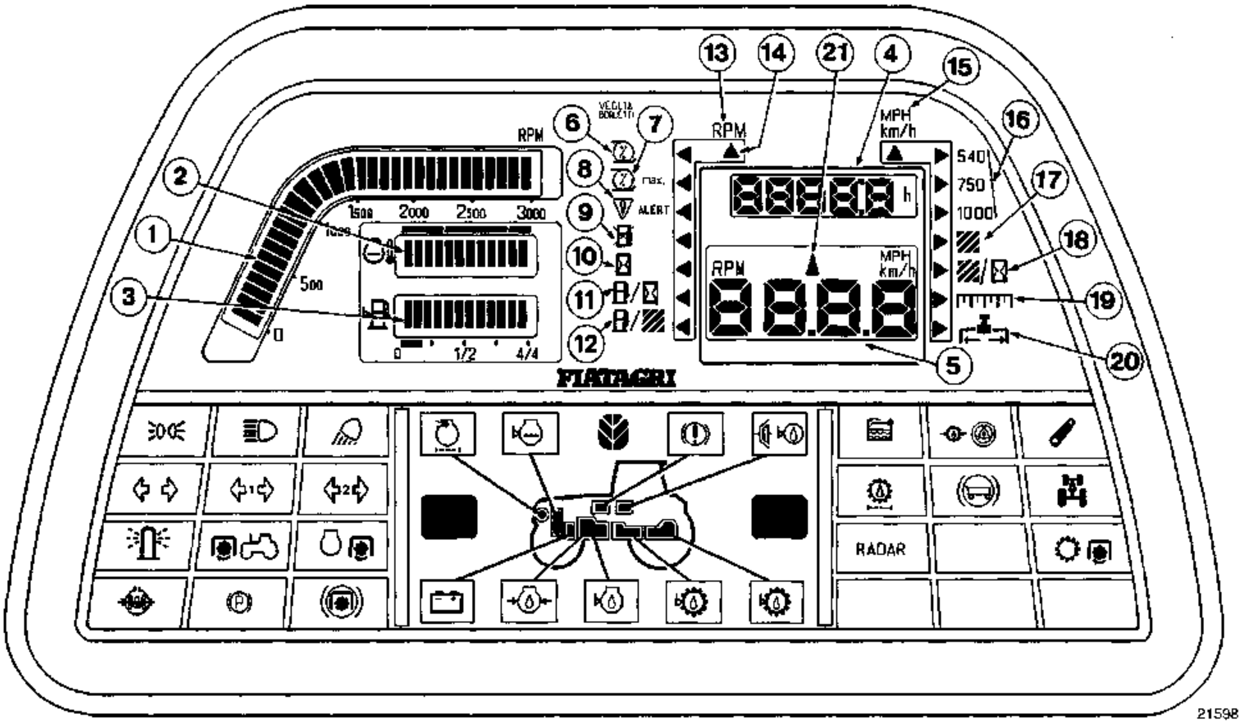
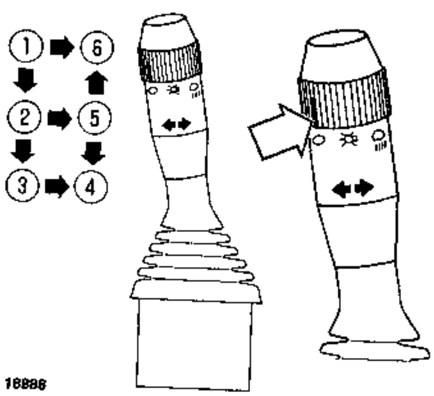


OPTOELECTRONIC INSTRUMENT PANEL

1. Analogical revolution counter (each sector corresponds to 100 rpm) – 2. Analogical engine coolant temperature gauge – 3. Analogical fuel level gauge – 4. Hourmeter – 5. Liquid–crystal instrument visualizing the engine starting revs (all other indications obtained through the selection keyboard (4, page 55–16) – 6. Real–time reading of rear wheel slippage – 7. Maximum rear wheel slippage – 8. Self–diagnosis (code reader) – 9. Total fuel consumption (liters) from last RESET – 10. Fuel operating range (in hours) – 11. Fuel consumption rate (liters/hour) – 12. Fuel consumption in liters per hectar of ground work – 13. Engine revolutions – 14. Index of selected function – 15. Tractor ground speed – 16. PTO revolutions – 17. Total hectars of ground work – 18. Hectars worked per hour – 19. Distance (kilometers) covered by tractor with a lowered implement – 20. Implement width (meters) – 21. Raised lift rocker arms indicator.

Note – For remaining indicators and gauges not included in this figure, see pages 55–13 and 55–14.



Lights, horn and turn–signal lights indicator switch (1, page 55– 16).


Horn: will work, by pressure, in every position of the lever.


Turn–signal lights switch:
– positions 1 and 6: turn to right;
– positions 3 and 4: turn to left.

Position 2 with knob index on following positions:


Lighting OFF.


Parking lights ON.


Hi–beam headlights ON.

Position 5 with knob index on following positions:


Lighting OFF.


Parking lights ON and possibility of flashing with hi–beam headlights.


Low–beam lights on w/possibility of hi–beam flash lights.


From positions 4, 5 and 6 push the lever further to the right for hi–beam flashing lights.

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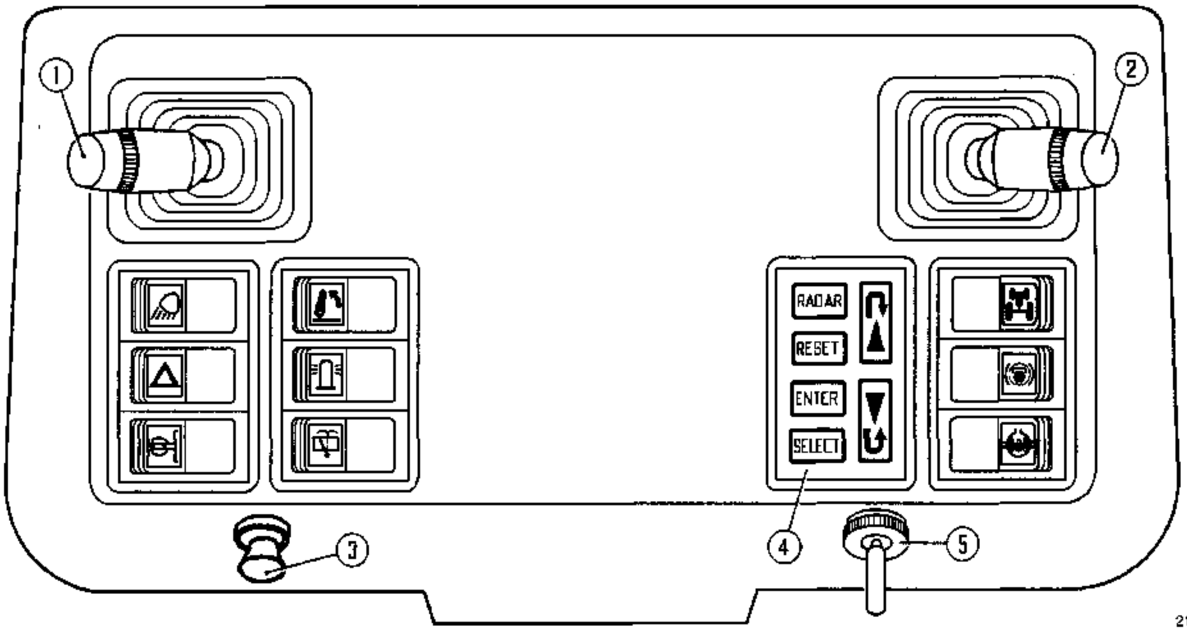


21599

CONTROL BOARD

1. Lights, horn and turn–signal switch – 2. Windshield wiper switch – 3. Lighter – 4. Optoelectronic instrument keyboard control – 5. Engine starting switch.

 Auxiliary worklights control switch.

 Emergency lights control switch.

 Thermostarter or start–pilote push–button control switch.

 Front lift control switch.

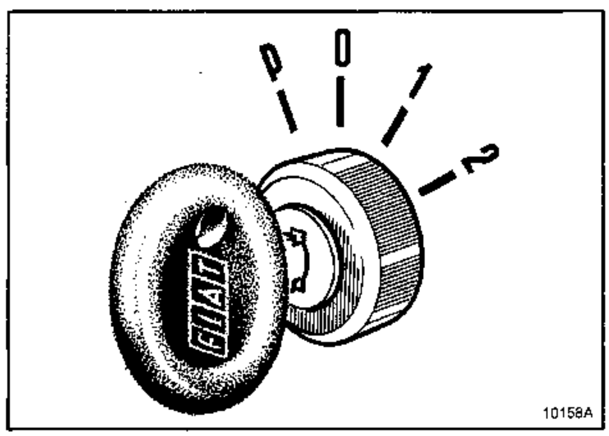
 Gyro safety light control switch.

 Rear window wiper control switch.

 4WD engagement control switch.

 PTO brake pre–setting control switch.

 Differential lock push–button control switch.



Engine starting switch

0 Emergency lights and single–pole socket (key removable).

1 Pre–setting for engine starting. Indicator and check panel instruments activated. Miscellaneous application circuits energysed.

2 Engine starting (the key, if released, will return automatically to position 1).

P Parking lights ON (key removable).

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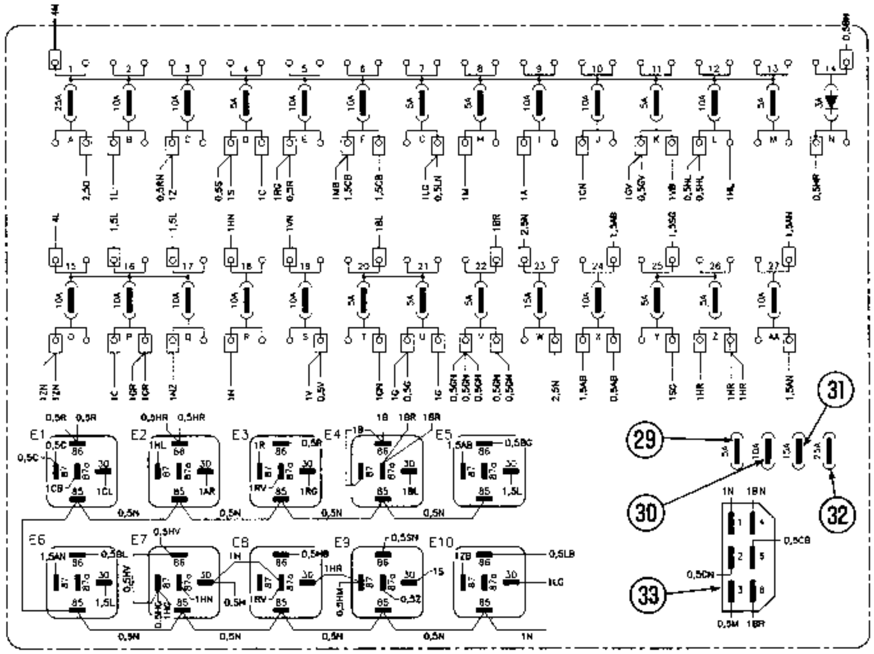

21699

FUSES

Twenty–six fuses, of which eleven 5–amps, twelve 10–amps, two 15– amps, one 25–amps, four for spares (29, 30, 31 and 32, respectively 5 Ah, 10 Ah, 15 Ah and 25 Ah) and one diode (14).

Fuse	ASSOCIATED CIRCUITS	Ampere
1	Ventilation unit.	25
2	Turn–signal lights, check panel instruments.	10
3	Electric seat, radar for optoelectronic instrument.	5
4	4WD and rear PTO circuit.	5
5	Stop lights, differential lock.	10
6	PTO and front lift circuit.	10
7	HI–LO circuit.	5
8	Lift electronic control unit energysing.	5
9	Windshield wiper, glass washer pump.	10
10	Rear window wiper, glass washer pump.	10
11	Implement hydraulic control, sedimenter filter circuit.	5
12	Trailer brake, hydraulic system pressure–operated cut–off switch circuit.	10
13	Unused.	5
14	Trailer brake circuit diode.	–
15	Electric horn, lighter.	10
16	Cab light, emergency lights, cab electric clock, radio.	10
17	Gyro safety light.	10
18	Low–beam headlights.	10
19	Hi–beam headlights.	10
20	Front LH side and RH side parking lights.	5
21	Front RH side and rear LH side parking lights, lighted parking lamps indicator.	5
22	Control board and instrument panel lighting.	5
23	Thermostarter.	15
24	Cab rear floodlights.	10
25	Engine shut–off solenoid.	5
26	Instruments and gauges.	5
27	Cab front floodlights.	10

RELAYS

E1	4WD electro–hydraulic engagement relay.	E7	Rear power take–off circuit relay.
E2	Trailer brake circuit relay.	E8	Rear power take–off circuit relay.
E3	Stop lights and differential lock circuit relay.	E9	Ground–speed PTO safety relay.
E4	Hand brake indicator light circuit relay.	E10	HI–LO circuit relay.
E5	Cab rear floodlights relay.	33	Emergency light flasher switch.
E6	Cab front floodlights relay.		

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WIRING DIAGRAM
(Standard version)

1. Multi–instrument and check panel comprehensive of:
   - **a.** parking lights indicator
   - **b.** hi–beam headlights indicator
   - **c.** auxiliary worklights indicator
   - **d.** tractor turn–signal lights indicator
   - **e.** 1st trailer turn–signal lights indicator
   - **f.** 2nd trailer turn–signal lights indicator
   - **g.** gyro safety light indicator
   - **h.** front power take–off indicator
   - **i.** rear power take–off indicator
   - **k.** differential lock indicator
   - **l.** hand brake indicator
   - **m.** rear power take–off pre–setting indicator
   - **n.** condensate in fuel indicator
   - **o.** transmission control oil pressure indicator
   - **p.** front lift indicator
   - **q.** clogged transmission oil filter indicator
   - **r.** trailer brake indicator
   - **s.** engaged 4WD indicator
   - **t.** low engine oil pressure indicator
   - **u.** alternator charge indicator
   - **v.** ground–speed PTO indicator
   - **z1.** dry air cleaner restriction indicator
   - **z.** low brake oil level indicator
   - **w.** lighting lamp
   - **x.** water temperature gauge
   - **y.** fuel level indicator.
2. Windshield wiper motor.
3. Lights switch.
4. Windshield wiper–washer tap switch.
5. Auxiliary worklights switch.
6. Front lift switch.
7. Emergency lights switch.
8. Thermostarter push–button control.
9. Gyro safety light switch.
10. Rear window glass wiper–washer switch.
11. 4WD switch.
12. Rear PTO brake pre–setting switch.
13. Differential lock switch.
14. Engine starting switch.
15. Electrical control unit comprehensive of:
    - 26 fuses
    - 1 diode holder, 1 amp–400 V
    - 1 electronic flasher
    - 10 micro–relais.
16. Lighter.
17. Engine starting inhibitor safety switch.
18. Brake fluid pressure–operated switch.
19. Connection block.
20. Ground.
21. Connectors, cab module, LH side.
22. Connectors, central and rear–end users.
23. Connectors, cab module, RH side.
24. Connectors, front–end users.
25. Brake fluid level control.
26. Engine–transmission clutch oil level control.

E1. 4WD electro–hydraulic engagement relay.
E2. Trailer brake circuit relay.
E3. Stop lights and differential lock circuit relay.
E4. Hand brake indicator circuit relay.
E5. Cab rear floodlights relay.
E6. Cab front floodlights relay.
E7. Rear power take–off circuit relay.
E8. Rear power take–off circuit relay.
E9 Ground–speed PTO safety relay.
E10. HI–LO unit circuit relay.

CABLE COLOUR CODE

A	=	Light blue	**HV**	=	Grey–Green
AN	=	Light blue–Black	**HG**	=	Grey–Yellow
AG	=	Light blue–Yellow	**L**	=	Blue
AB	=	Light blue–White	**LB**	=	Blue–White
AV	=	Light blue–Green	**LN**	=	Blue–Black
AR	=	Light blue–Red	**LR**	=	Blue–Red
B	=	White	**M**	=	Brown
BR	=	White–Red	**MB**	=	Brown–White
BN	=	White–Black	**MN**	=	Brown–Black
BL	=	White–Blue	**N**	=	Black
BG	=	White–Yellow	**NZ**	=	Black–Violet
C	=	Orange	**NB**	=	Black–White
CB	=	Orange–White	**NR**	=	Black–Red
CN	=	Orange–Black	**R**	=	Red
CL	=	Orange–Blue	**RN**	=	Red–Black
G	=	Yellow	**RG**	=	Red–Yellow
GV	=	Yellow–Green	**RV**	=	Red–Green
GN	=	Yellow–Black	**S**	=	Pink
GR	=	Yellow–Red	**SN**	=	Pink–Black
GL	=	Yellow–Blue	**SG**	=	Pink–Yellow
H	=	Grey	**V**	=	Green
HM	=	Grey–Brown	**VN**	=	Green–Black
HR	=	Grey–Red	**VB**	=	Green–White
HN	=	Grey–Black	**Z**	=	Violet
HB	=	Grey–White	**ZN**	=	Violet–Black
HL	=	Grey–Blue	**ZB**	=	Violet–White

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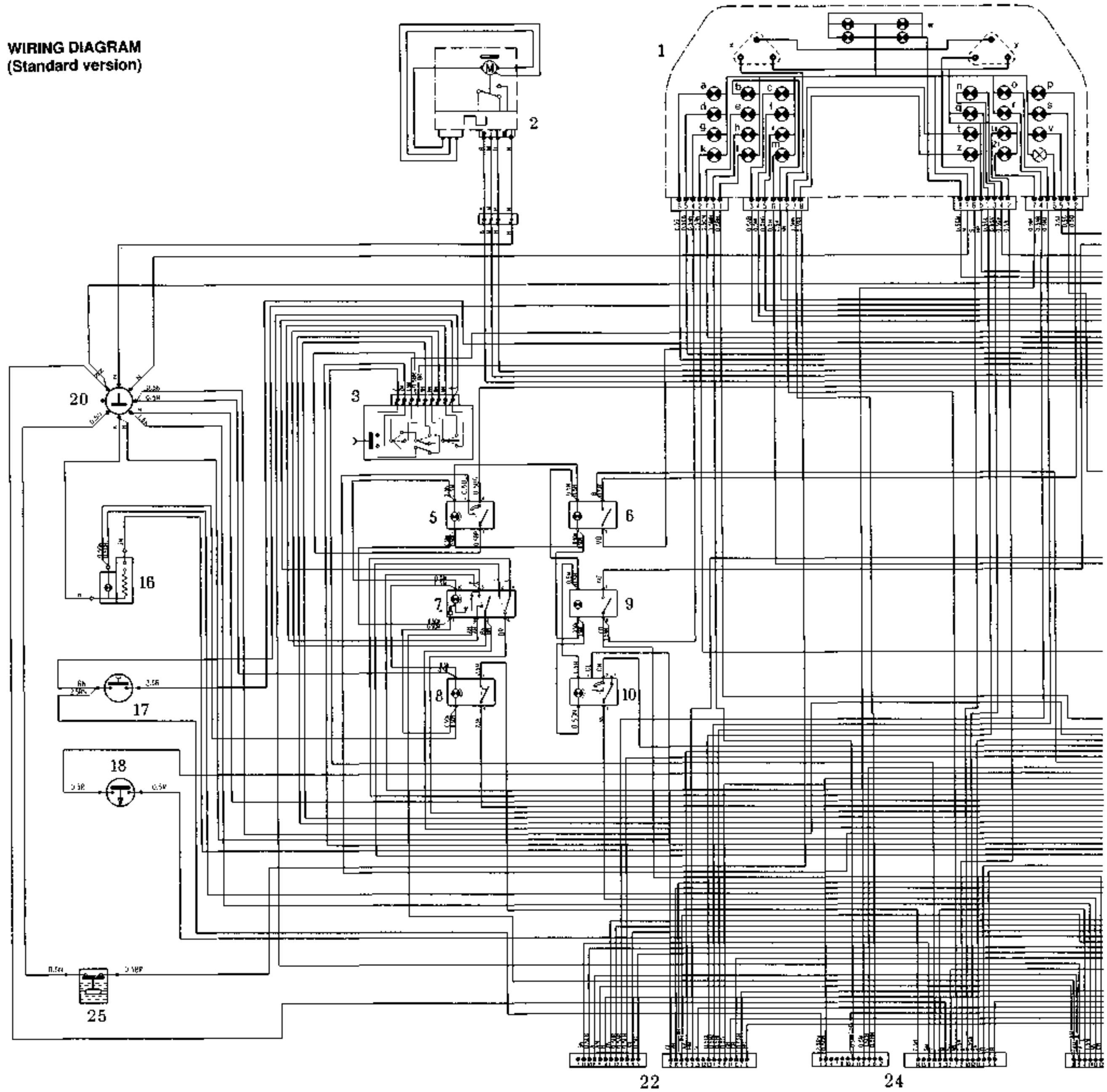
WIRING DIAGRAM
(Standard version)



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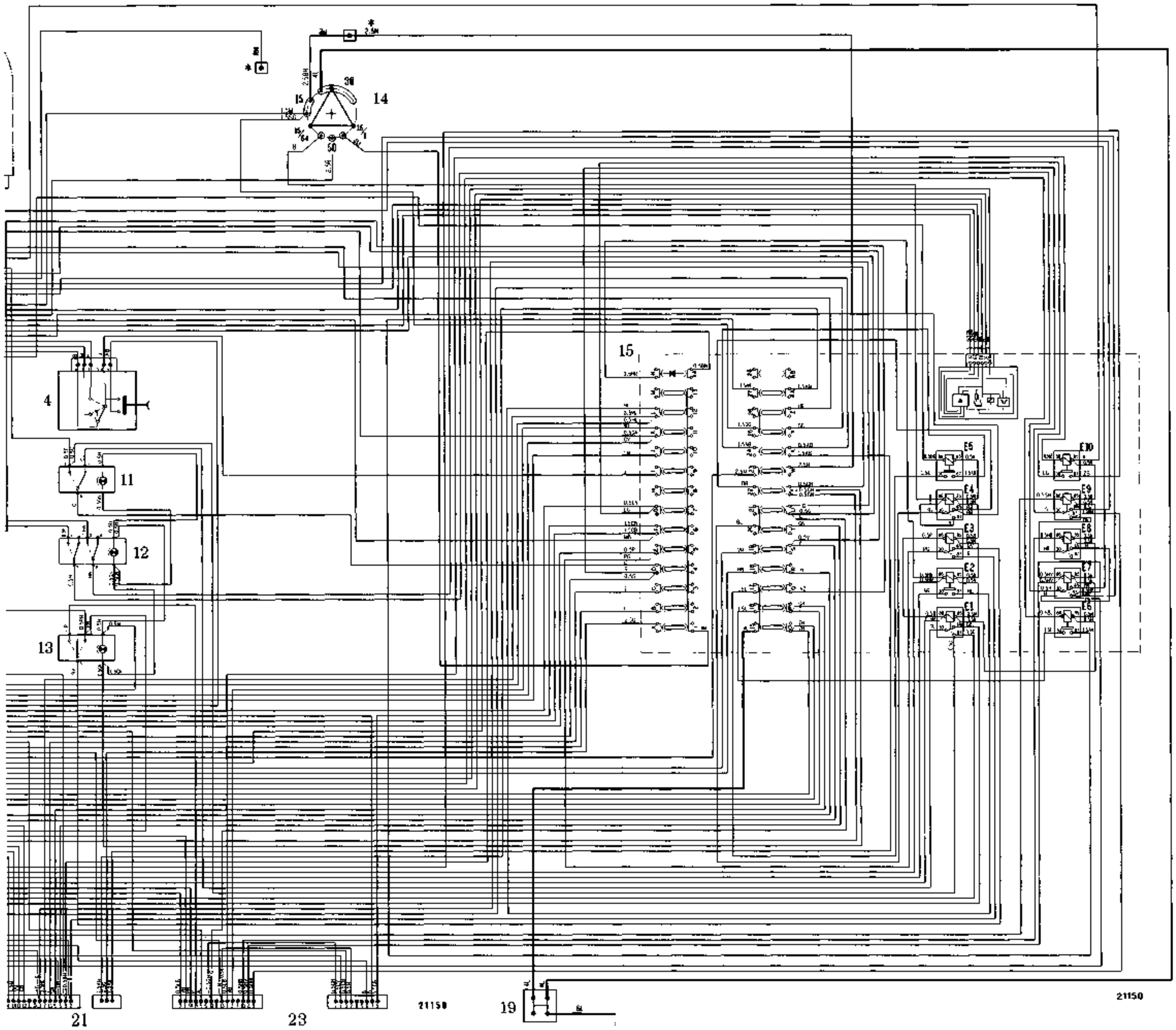
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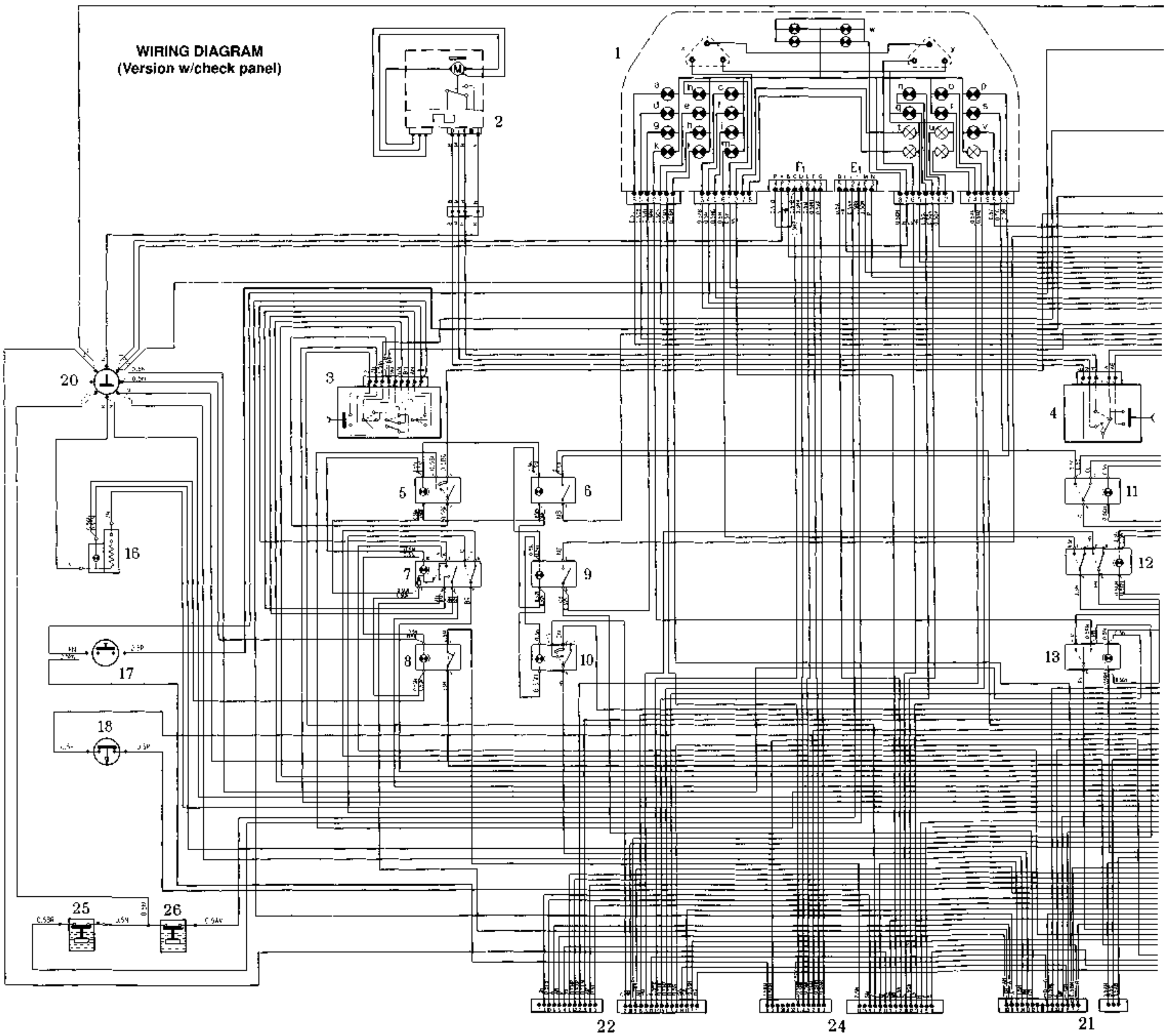
WIRING DIAGRAM
(Version w/check panel)
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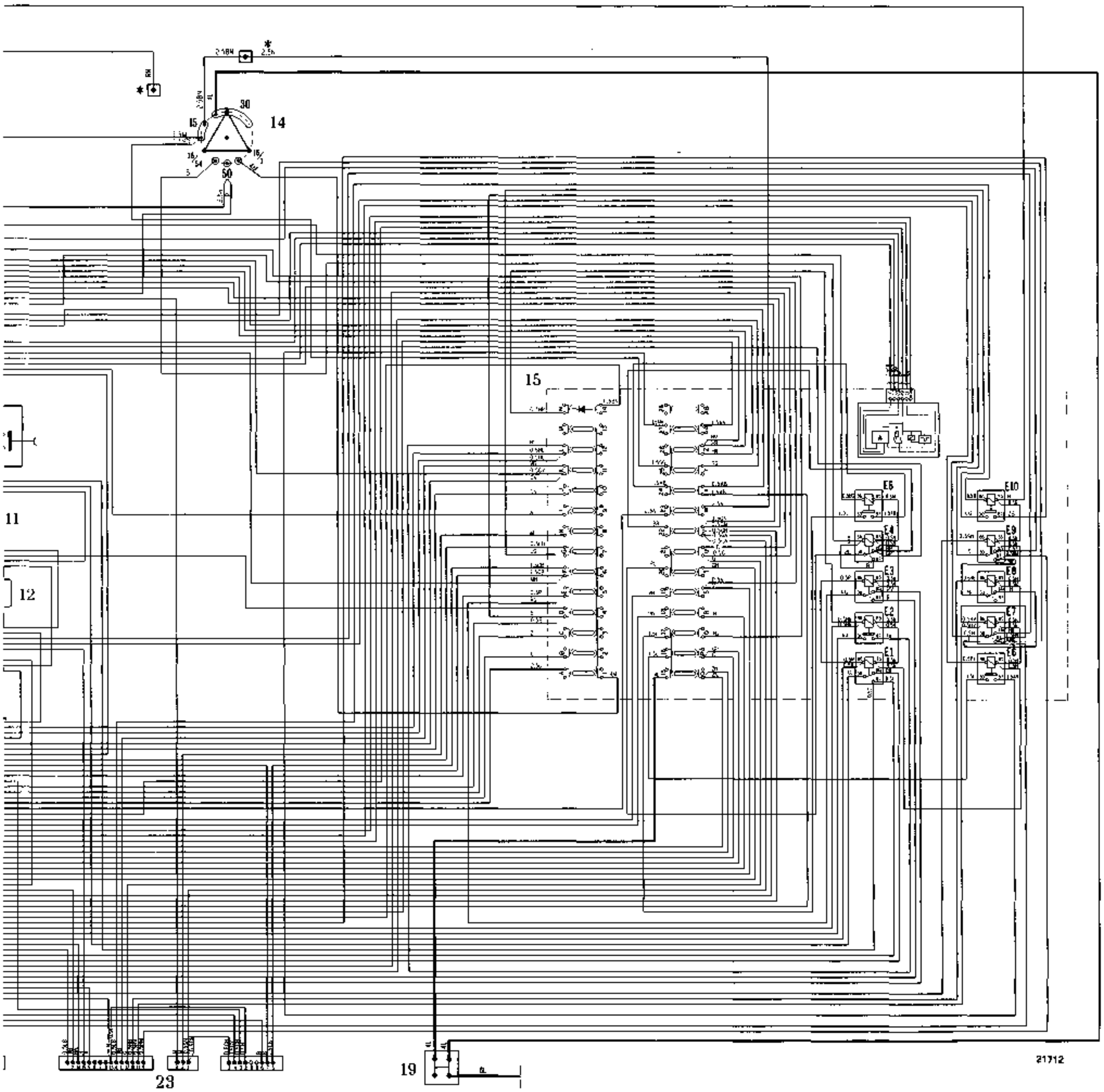

Print No. 603.54.276.01 – 12 – 1992

WIRING DIAGRAM
(Version w/check panel)

1. Multi–instrument and check panel comprehensive of:
   - **a.** parking lights indicator
   - **b.** hi–beam headlights indicator
   - **c.** auxiliary worklights indicator
   - **d.** tractor turn–signal lights indicator
   - **e.** 1st trailer turn–signal lights indicator
   - **f.** 2nd trailer turn–signal lights indicator
   - **g.** gyro safety light indicator
   - **h.** front power take–off indicator
   - **i.** rear power take–off indicator
   - **k.** differential lock indicator
   - **l.** hand brake indicator
   - **m.** rear power take–off pre–setting indicator
   - **n.** condensate in fuel indicator
   - **o.** transmission control oil pressure indicator
   - **p.** front hydraulic lift indicator
   - **q.** clogged transmission oil filter indicator
   - **r.** trailer brake indicator
   - **s.** engaged 4WD indicator
   - **v.** ground–speed PTO indicator
   - **w.** lighting lamp
   - **x.** water temperature gauge
   - **y.** fuel level indicator

   E1–F1 Check panel module connectors comprehensive of:
   - **A** ground indicator
   - **B–H** + 15/54 of starter switch
   - **C–P** transmission oil level indicator
   - **D** coolant level indicator
   - **E** dry air cleaner restriction indicator
   - **F** engine oil pressure indicator
   - **G** engine oil level indicator
   - **I** engine–transmission clutch oil level indicator
   - **L** brake oil level indicator
   - **M** lighting
   - **N** starter switch indicator
   - **O** alternator charge indicator
2. Windshield wiper motor.
3. Lights switch.
4. Windshield wiper–washer tap switch.
5. Auxiliary worklights switch.
6. Front lift switch.
7. Emergency lights switch.
8. Thermostarter push–button control.
9. Gyro safety light switch.
10. Rear window glass wiper–washer switch.
11. 4WD switch.
12. Rear power take–off brake pre–setting switch.
13. Differential lock switch.
14. Engine starting switch.
15. Electrical control unit comprehensive of:
    - 26 fuses
    - 1 diode holder 1amp – 400V
    - 1 electronic flasher
    - 10 micro–relay
16. Lighter.
17. Engine starting inhibitor safety switch.
18. Brake fluid pressure–control switch.
19. Connection block.
20. Ground.
21. Connectors, cab module, LH side.
22. Connectors, central and rear end users.
23. Connectors, cab module, RH side.
24. Connectors, front–end users.
25. Brake oil level control.
26. Engine–transmission clutch oil level control.

E1. 4WD electro–hydraulic engagement keyboard control.

E2. Trailer brake circuit relay.

E3. Stop lights and differential lock circuit relay.

E4. Hand brake indicator relay.

E5. Cab rear floodlights relay.

E6. Cab front floodlights relay.

E7. Rear power take–off circuit relay.

E8. Rear power take–off circuit relay.

E9. Ground–speed PTO safety relay.

E10. HI–LO unit circuit relay.

CABLE COLOUR CODE

A	=	Light blue	**HV**	=	Grey–Green
AN	=	Light blue–Black	**HG**	=	Grey–Yellow
AG	=	Light blue–Yellow	**L**	=	Blue
AB	=	Light blue–White	**LB**	=	Blue–White
AV	=	Light blue–Green	**LN**	=	Blue–Black
AR	=	Light blue–Red	**LR**	=	Blue–Red
B	=	White	**M**	=	Brown
BR	=	White–Red	**MB**	=	Brown–White
BN	=	White–Black	**MN**	=	Brown–Black
BL	=	White–Blue	**N**	=	Black
BG	=	White–Yellow	**NZ**	=	Black–Violet
C	=	Orange	**NB**	=	Black–White
CB	=	Orange–White	**NR**	=	Black–Red
CN	=	Orange–Black	**R**	=	Red
CL	=	Orange–Blue	**RN**	=	Red–Black
G	=	Yellow	**RG**	=	Red–Yellow
GV	=	Yellow–Green	**RV**	=	Red–Green
GN	=	Yellow–Black	**S**	=	Pink
GR	=	Yellow–Red	**SN**	=	Pink–Black
GL	=	Yellow–Blue	**SG**	=	Pink–Yellow
H	=	Grey	**V**	=	Green
HM	=	Grey–Brown	**VN**	=	Green–Black
HR	=	Grey–Red	**VB**	=	Green–White
HN	=	Grey–Black	**Z**	=	Violet
HB	=	Grey–White	**ZN**	=	Violet–Black
HL	=	Grey–Blue	**ZB**	=	Violet–White

Print No. 603.54.276.01 – 12 – 1992

WIRING DIAGRAM
(Version w/optoelectronic instrument)

1. Multi–instrument and check panel comprehensive of:
- **a.** parking lights indicator
- **b.** hi–beam headlights indicator
- **c.** auxiliary worklights indicator
- **d.** tractor turn–signal lights indicator
- **e.** 1st trailer turn–signal lights indicator
- **f.** 2nd trailer turn–signal lights indicator
- **g.** gyro safety light indicator
- **h.** front power take–off indicator
- **i.** rear power take–off indicator
- **k.** differential lock indicator
- **l.** hand brake indicator
- **m.** rear power take–off pre–setting indicator
- **n.** condensate in fuel indicator
- **o.** transmission control oil pressure indicator
- **p.** front hydraulic lift indicator
- **q.** clogged transmission oil filter indicator
- **r.** trailer brake indicator
- **s.** engaged 4WD indicator
- **v.** ground–speed PTO indicator
- **w.** lighting lamp
- **x.** water temperature gauge
- **y.** fuel level indicator

1g –1h. Check panel module connectors comprehensive of:
- **A** ground indicator
- **B–H** + 15/54 of starter switch
- **C–P** transmission oil level indicator
- **D** coolant level indicator
- **E** dry air cleaner restriction indicator
- **F** engine oil pressure indicator
- **G** engine oil level indicator
- **I** engine–transmission clutch oil level indicator
- **L** brake oil level indicator
- **M** lighting
- **N** starter switch indicator
- **O** alternator charge indicator

1a – 1b – 1c – 1d – 1e – 1f Connectors for optoelectronic instrument.

2. Windshield wiper motor.
3. Lights switch.
4. Windshield wiper–washer tap switch.
5. Auxiliary worklights switch.
6. Front lift switch.
7. Emergency lights switch.
8. Thermostarter push–button control.
9. Gyro safety light switch.
10. Rear window glass wiper–washer switch.
11. 4WD switch.
12. Rear power take–off brake pre–setting switch.
13. Differential lock switch.
14. Engine starting switch.
15. Electrical control unit comprehensive of:
- – 26 fuses
- – 1 diode holder 1amp – 400V
- – 1 electronic flasher
- – 10 micro–relay

16. Lighter
17. Engine starting inhibitor safety switch.
18. Brake fluid pressure–control switch.
19. Connection block.
20. Ground.
21. Connectors, cab module, LH side.
22. Connectors, central and rear end users.
23. Connectors, cab module, RH side.
24. Connectors, front–end users.
25. Brake oil level control.
26. Engine–transmission clutch oil level control.
27. Optoelectronic instrument keyboard control.
E1. 4WD electro–hydraulic engagement keyboard control.
E2. Trailer brake circuit relay.
E3. Stop lights and differential lock circuit relay.
E4. Hand brake indicator relay.
E5. Cab rear floodlights relay.
E6. Cab front floodlights relay.
E7. Rear power take–off circuit relay.
E8. Rear power take–off circuit relay.
E9. Ground–speed PTO safety relay.
E10. HI–LO unit circuit relay.

CABLE COLOUR CODE

A	=	Light blue	**HV**	=	Grey–Green
AN	=	Light blue–Black	**HG**	=	Grey–Yellow
AG	=	Light blue–Yellow	**L**	=	Blue
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AV	=	Light blue–Green	**LN**	=	Blue–Black
AR	=	Light blue–Red	**LR**	=	Blue–Red
B	=	White	**M**	=	Brown
BR	=	White–Red	**MB**	=	Brown–White
BN	=	White–Black	**MN**	=	Brown–Black
BL	=	White–Blue	**N**	=	Black
BG	=	White–Yellow	**NZ**	=	Black–Violet
C	=	Orange	**NB**	=	Black–White
CB	=	Orange–White	**NR**	=	Black–Red
CN	=	Orange–Black	**R**	=	Red
CL	=	Orange–Blue	**RN**	=	Red–Black
G	=	Yellow	**RG**	=	Red–Yellow
GV	=	Yellow–Green	**RV**	=	Red–Green
GN	=	Yellow–Black	**S**	=	Pink
GR	=	Yellow–Red	**SN**	=	Pink–Black
GL	=	Yellow–Blue	**SG**	=	Pink–Yellow
H	=	Grey	**V**	=	Green
HM	=	Grey–Brown	**VN**	=	Green–Black
HR	=	Grey–Red	**VB**	=	Green–White
HN	=	Grey–Black	**Z**	=	Violet
HB	=	Grey–White	**ZN**	=	Violet–Black
HL	=	Grey–Blue	**ZB**	=	Violet–White

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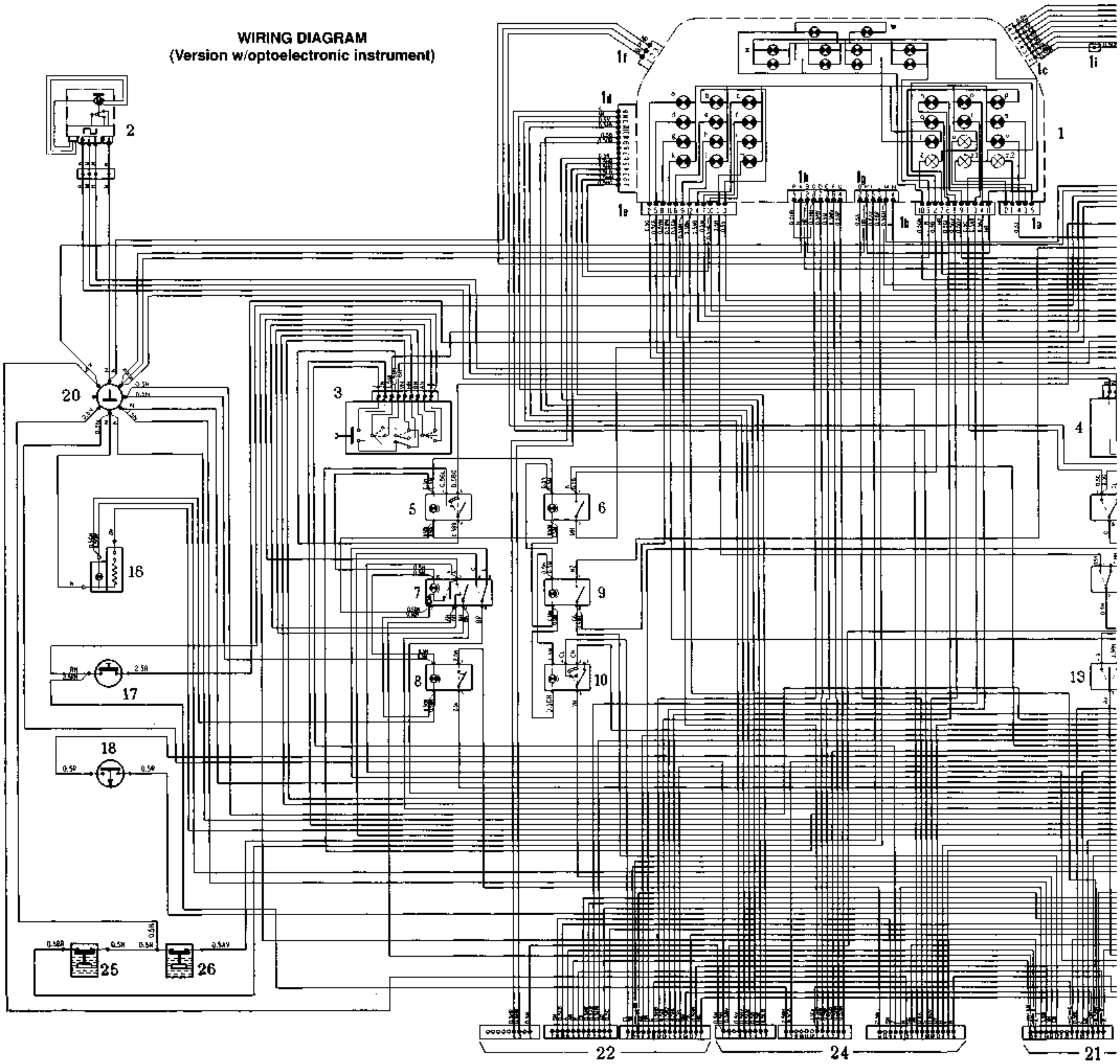
WIRING DIAGRAM
(Version w/optoelectronic instrument)



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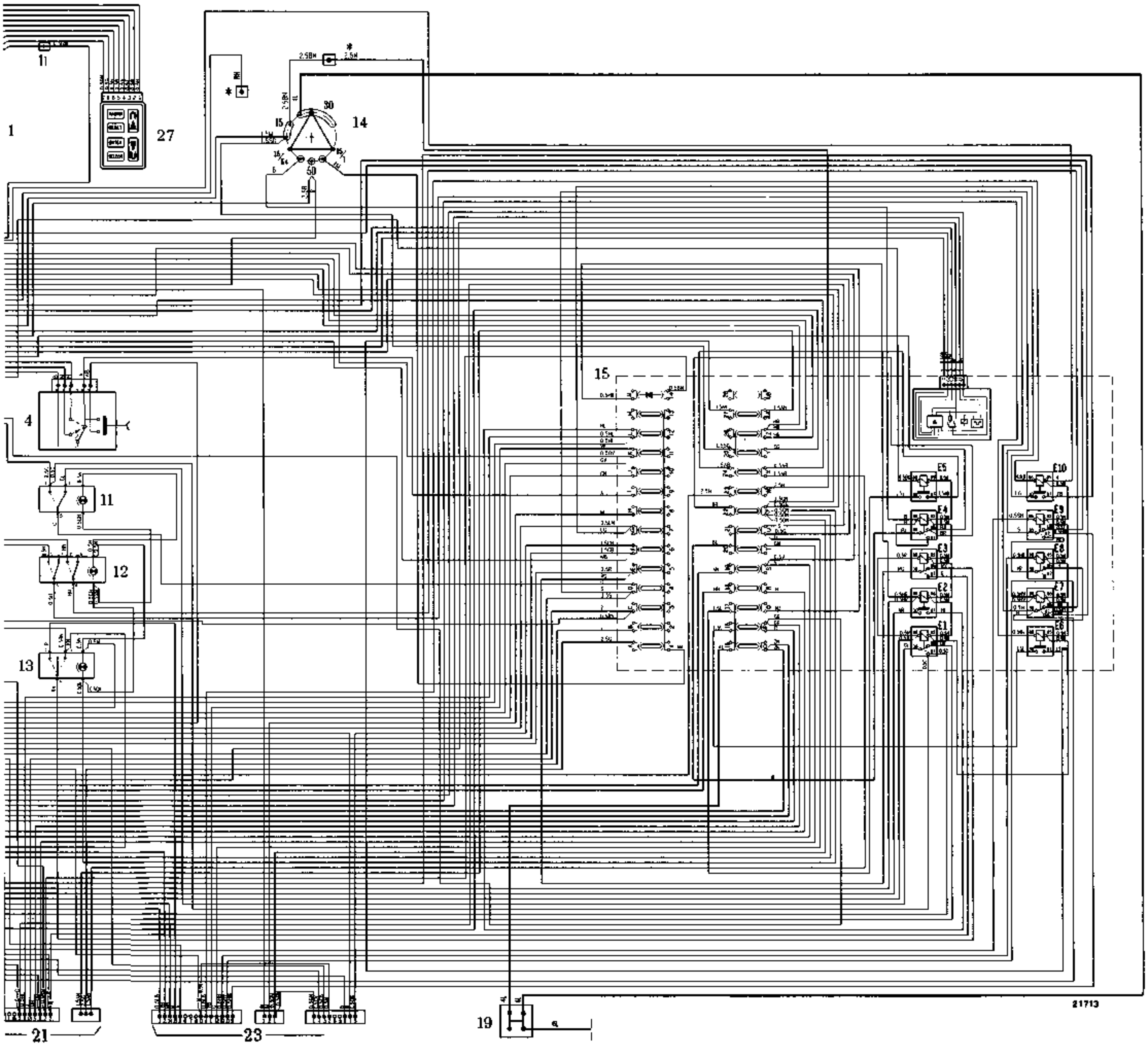
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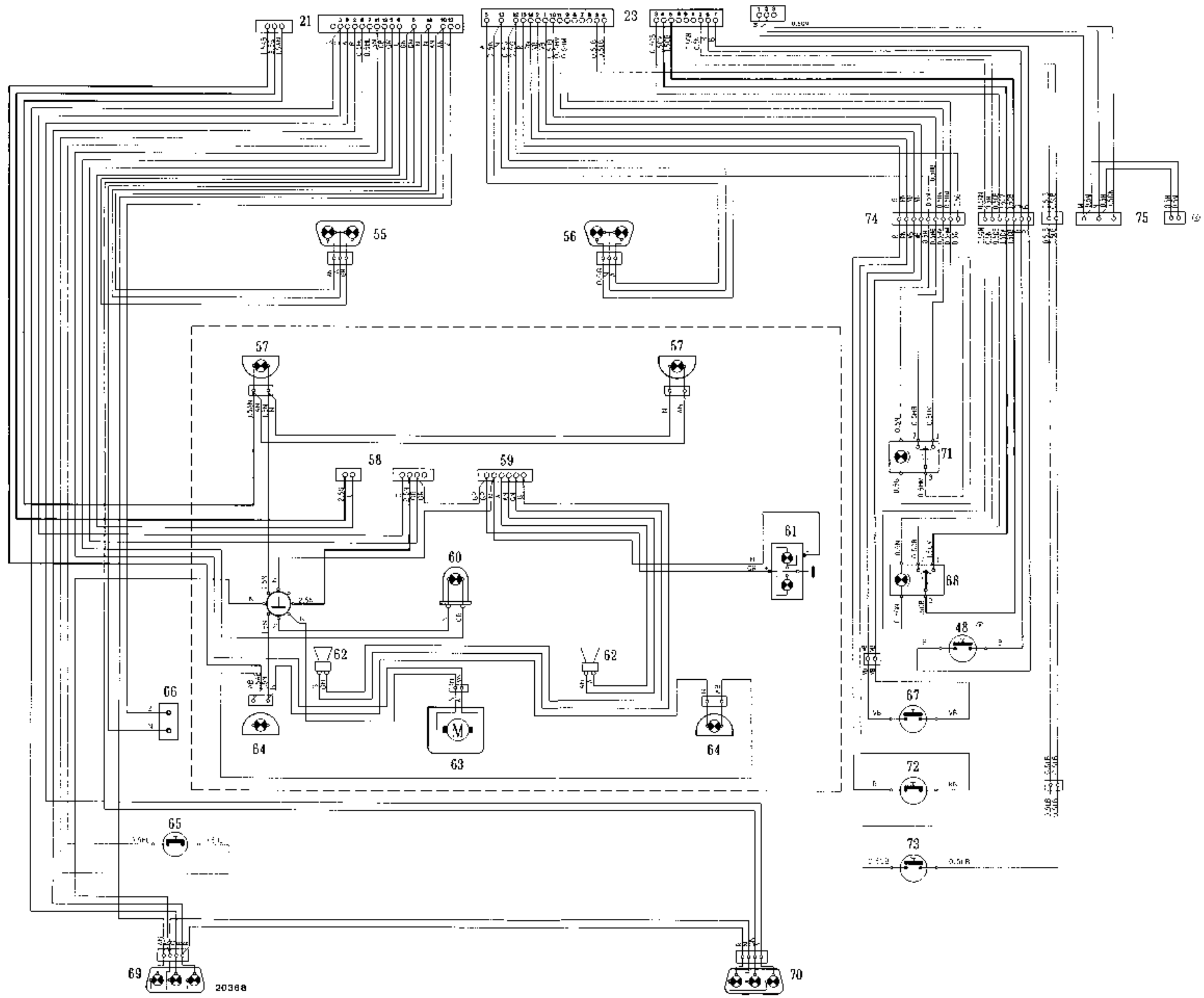
WIRING DIAGRAM
(From connectors 21 and 23 to cab module)

21. Connectors for cab LH side module (see main diagram).
23. Connectors for cab RH side module (see main diagram).
48. Micro–switch for front lift setting adjustments.
55. Front LH side lamp, turn and parking lights.
56. Front RH side lamp, turn and parking lights.
57. Auxiliary front floodlights.
58. Connector, ventilation unit.
59. Connector, radio.
60. Gyro safety light.
61. Ceiling lamp, w/built–in switch.
62. Loudspeakers.
63. Rear window glass wiper motor.
64. Auxiliary rear floodlights.
65. Engaged hand brake indicator switch.
66. Connector for electric seat.
67. Push–button control for implement hydraulically–operated setting adjustments.
68. Front power take–off control switch (optional).
69. Taillamp, LH side, w/parking, turn–signal, stop and license plate lights.
70. Taillamp, RH side, w/parking, turn–signal and stop lights.
71. Rear power take–off control switch.
72. Control switch, differential lock w/Lift–O–Matic.
73. Switch, transmission w/HI–LO.
74. Connectors, intermediate.
75. Intermediate connectors for electronic–control hydraulic lift.

CABLE COLOUR CODE

A	= Light blue	**HV**	= Grey–Green
AN	= Light blue–Black	**HG**	= Grey–Yellow
AG	= Light blue–Yellow	**L**	= Blue
AB	= Light blue–White	**LB**	= Blue–White
AV	= Light blue–Green	**LN**	= Blue–Black
AR	= Light blue–Red	**LR**	= Blue–Red
B	= White	**M**	= Brown
BR	= White–Red	**MB**	= Brown–White
BN	= White–Black	**MN**	= Brown–Black
BL	= White–Blue	**N**	= Black
BG	= White–Yellow	**NZ**	= Black–Violet
C	= Orange	**NB**	= Black–White
CB	= Orange–White	**NR**	= Black–Red
CN	= Orange–Black	**R**	= Red
CL	= Orange–Blue	**RN**	= Red–Black
G	= Yellow	**RG**	= Red–Yellow
GV	= Yellow–Green	**RV**	= Red–Green
GN	= Yellow–Black	**S**	= Pink
GR	= Yellow–Red	**SN**	= Pink–Black
GL	= Yellow–Blue	**SG**	= Pink–Yellow
H	= Grey	**V**	= Green
HM	= Grey–Brown	**VN**	= Green–Black
HR	= Grey–Red	**VB**	= Green–White
HN	= Grey–Black	**Z**	= Violet
HB	= Grey–White	**ZN**	= Violet–Black
HL	= Grey–Blue	**ZB**	= Violet–White



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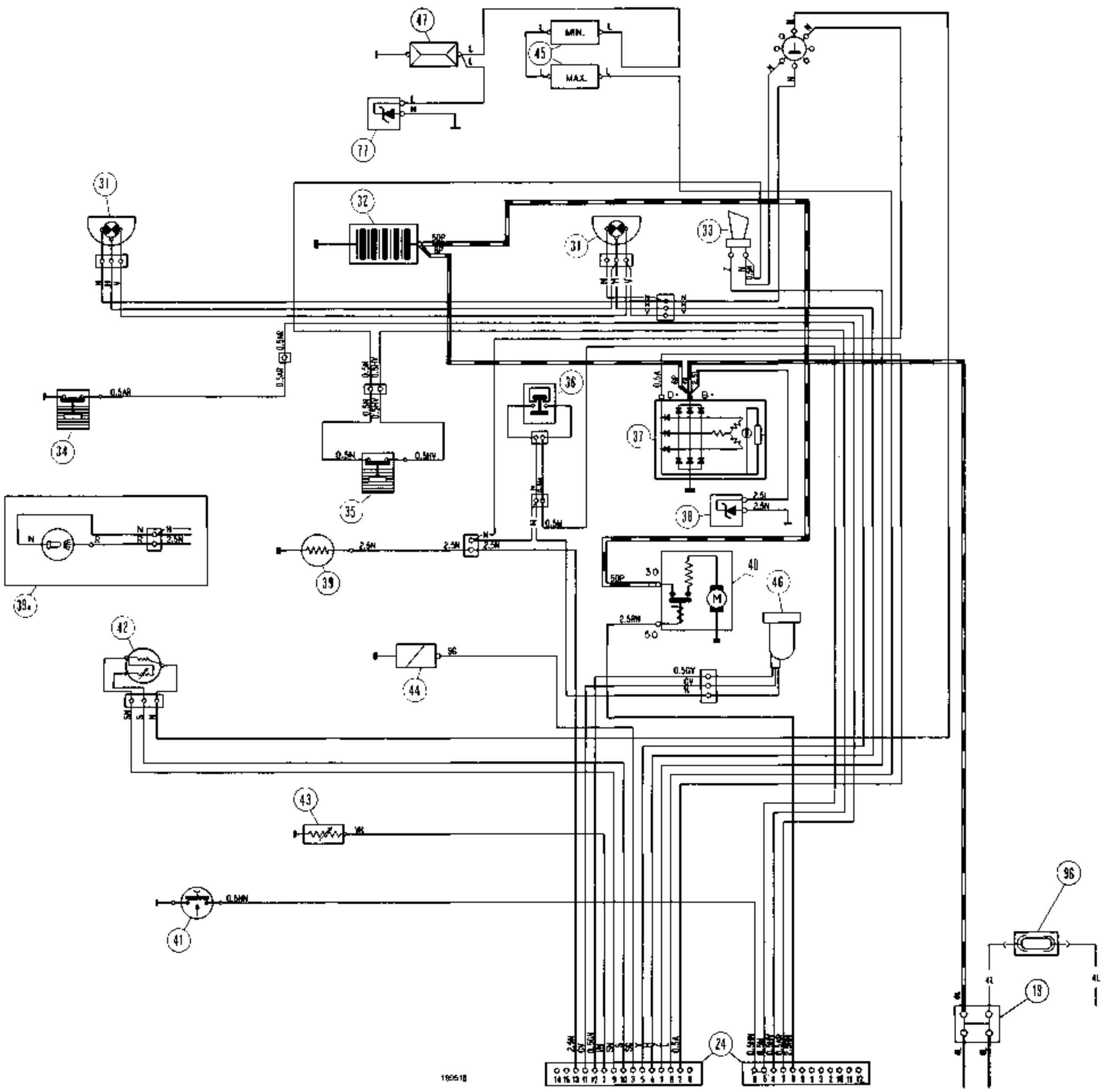

WIRING DIAGRAM
(From connectors 24 to front–end users)

19. Connection block (see main diagram).
24. Connectors for front–end users (see main diagram).
31. Headlights.
32. Battery.
33. Horn
34. Engine oil level control.
35. Coolant level control.
36. Dry air cleaner restriction indicator.
37. Alternator.
38. Voltage peaks protection device.
39. Thermostarter.
39a. Start–pilote.
40. Engine starting motor.
41. Engine oil pressure switch.
42. Fuel level control switch.
43. Electric thermometer sending unit.
44. Engine shut–off solenoid.
45. Receiver–drier filter.
46. Fuel sedimenter filter.
47. Connectors to compressor (air conditioner).
77. Voltage peaks protection device (air conditioner).
96. 25–amp fuse tubular sheath.

CABLE COLOUR CODE

A =	Light blue	**HV** =	Grey–Green
AN =	Light blue–Black	**HG** =	Grey–Yellow
AG =	Light blue–Yellow	**L** =	Blue
AB =	Light blue–White	**LB** =	Blue–White
AV =	Light blue Green	**LN** =	Blue–Black
AR =	Light blue–Red	**LR** =	Blue–Red
B =	White	**M** =	Brown
BR =	White–Red	**MB** =	Brown–White
BN =	White–Black	**MN** =	Brown–Black
BL =	White–Blue	**N** =	Black
BG =	White–Yellow	**NZ** =	Black–Violet
C =	Orange	**NB** =	Black–White
CB =	Orange–White	**NR** =	Black–Red
CN =	Orange–Black	**R** =	Red
CL =	Orange–Blue	**RN** =	Red–Black
G =	Yellow	**RG** =	Red–Yellow
GV =	Yellow–Green	**RV** =	Red–Green
GN =	Yellow–Black	**S** =	Pink
GR =	Yellow–Red	**SN** =	Pink–Black
GL =	Yellow–Blue	**SG** =	Pink–Yellow
H =	Grey	**V** =	Green
HM =	Grey–Brown	**VN** =	Green–Black
HR =	Grey–Red	**VB** =	Green–White
HN =	Grey–Black	**Z** =	Violet
HB =	Grey–White	**ZN** =	Violet–Black
HL =	Grey–Blue	**ZB** =	Violet–White

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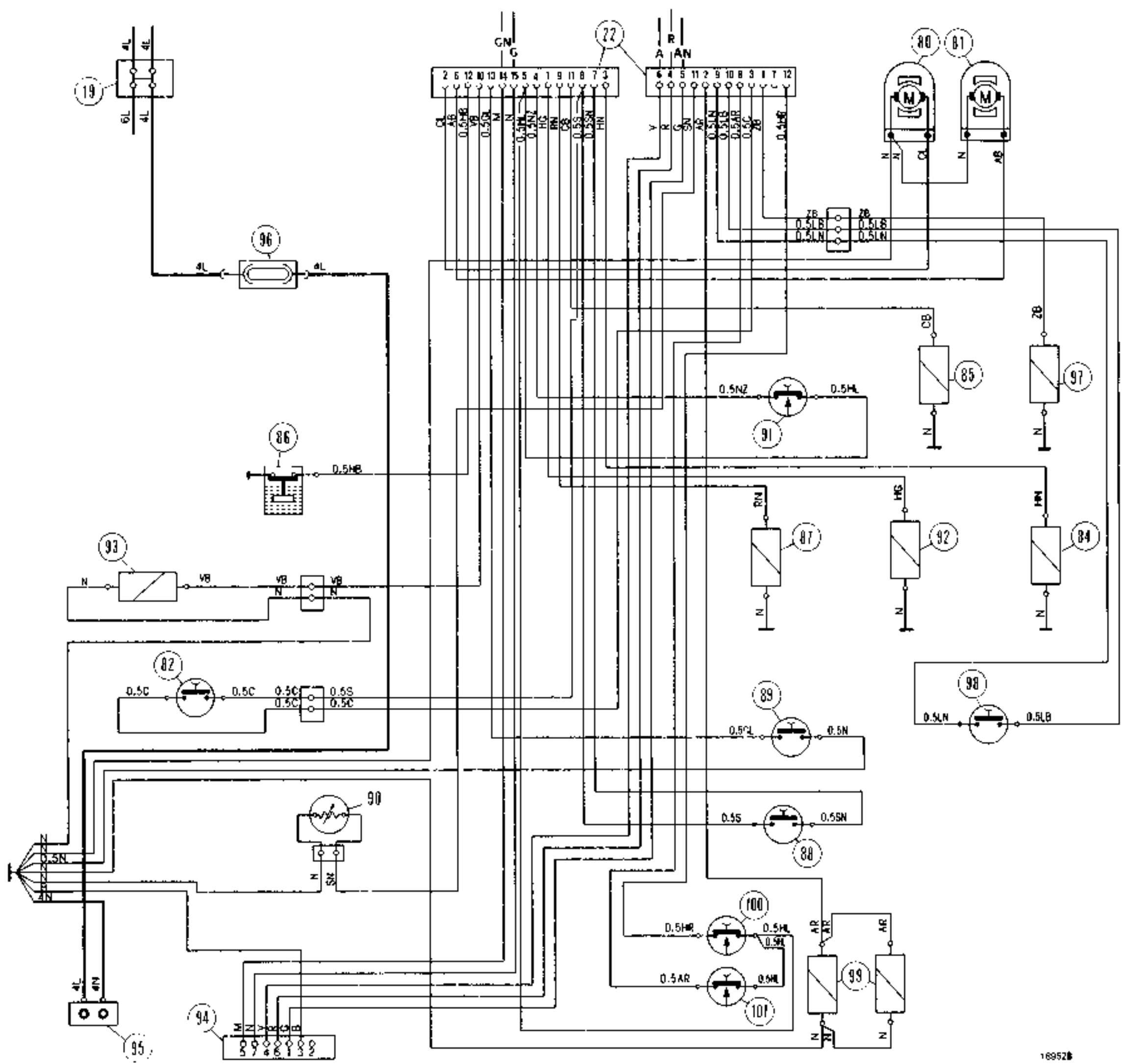
WIRING DIAGRAM
(From connectors 22 to central and rear users)

19. Connection block (see main diagram).
22. Connectors for central and rear–end users (see main diagram).
80. Rear window glass washer pump.
81. Windshield washer pump.
82. Engaged mechanical 4WD indicator switch.
84. Power take–off brake electro–valve.
85. 4WD electro–valve.
86. Transmission oil level control.
87. Differential lock electro–valve.
88. Ground–speed PTO switch.
89. Clogged transmission oil filter indicator.
90. Fuel level indicator control.
91. Hydraulic system indicator pressure–operated switch.
92. Rear power take–off electro–valve.
93. Electro–valve for implement hydraulically–operated setting adjustments.
94. 7–pole power point.
95. 25–amp, 2–pole socket.
96. 25–amp fuse tubular sheath.
97. Electro–valve, transmission w/HI–LO.
98. Reverser lever switch, transmission w/HI–LO.
99. Trailer brake electro–valve.
100. Trailer brake circuit, pressure–operated safety switch.
101. Engaged trailer brake indicator pressure–operated switch.

CABLE COLOUR CODE

A	=	Light blue	**HV**	=	Grey–Green
AN	=	Light blue–Black	**HG**	=	Grey–Yellow
AG	=	Light blue–Yellow	**L**	=	Blue
AB	=	Light blue–White	**LB**	=	Blue–White
AV	=	Light blue–Green	**LN**	=	Blue–Black
AR	=	Light blue–Red	**LR**	=	Blue–Red
B	=	White	**M**	=	Brown
BR	=	White–Red	**MB**	=	Brown–White
BN	=	White–Black	**MN**	=	Brown–Black
BL	=	White–Blue	**N**	=	Black
BG	=	White–Yellow	**NZ**	=	Black–Violet
C	=	Orange	**NB**	=	Black–White
CB	=	Orange–White	**NR**	=	Black–Red
CN	=	Orange–Black	**R**	=	Red
CL	=	Orange–Blue	**RN**	=	Red–Black
G	=	Yellow	**RG**	=	Red–Yellow
GV	=	Yellow–Green	**RV**	=	Red–Green
GN	=	Yellow–Black	**S**	=	Pink
GR	=	Yellow–Red	**SN**	=	Pink–Black
GL	=	Yellow–Blue	**SG**	=	Pink–Yellow
H	=	Grey	**V**	=	Green
HM	=	Grey–Brown	**VN**	=	Green–Black
HR	=	Grey–Red	**VB**	=	Green–White
HN	=	Grey–Black	**Z**	=	Violet
HB	=	Grigio–Bianco	**ZN**	=	Viola–Nero
HL	=	Grigio–Blu	**ZB**	=	Viola–Bianco



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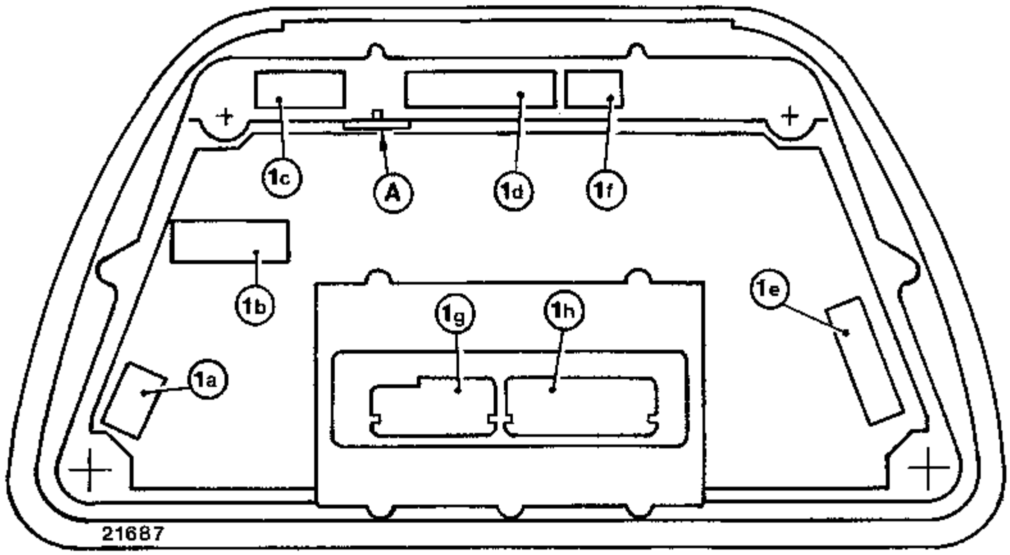

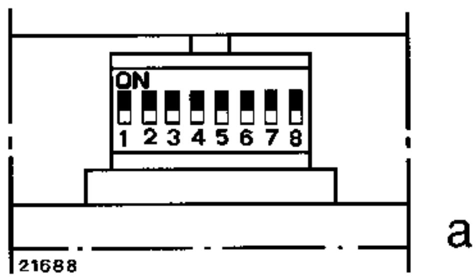

INSTRUMENT PANEL – REAR VIEW

a. Micro–switch compartment detail – A. Micro–switch (a) compartment lid – 1a, 1b, 1c, 1d, 1e, 1f, 1g, and 1h. Connectors, panel w/optoelectronic instrument.

OPTOELECTRONIC INSTRUMENT PANEL CALIBRATION MICRO–SWITCHES

Micro–switch functions

no. 1 and 2 : selection of unit of measurement;
no. 3 : radar type selection;
no. 4 and 5 : tractor series selection;
no. 6 and 7 : tank capacity selection.

Micro–switch position per Market

European markets
n. 1 = OFF
n. 2 = OFF
n. 3 = ON
n. 4 = ON
n. 5 = ON
n. 6 = ON
n. 7 = ON

English–speaking markets
n. 1 = ON
n. 2 = ON
n. 3 = ON
n. 4 = ON
n. 5 = ON
n. 6 = ON
n. 7 = ON

North–American market
n. 1 = ON
n. 2 = OFF
n. 3 = ON
n. 4 = ON
n. 5 = ON
n. 6 = ON
n. 7 = ON

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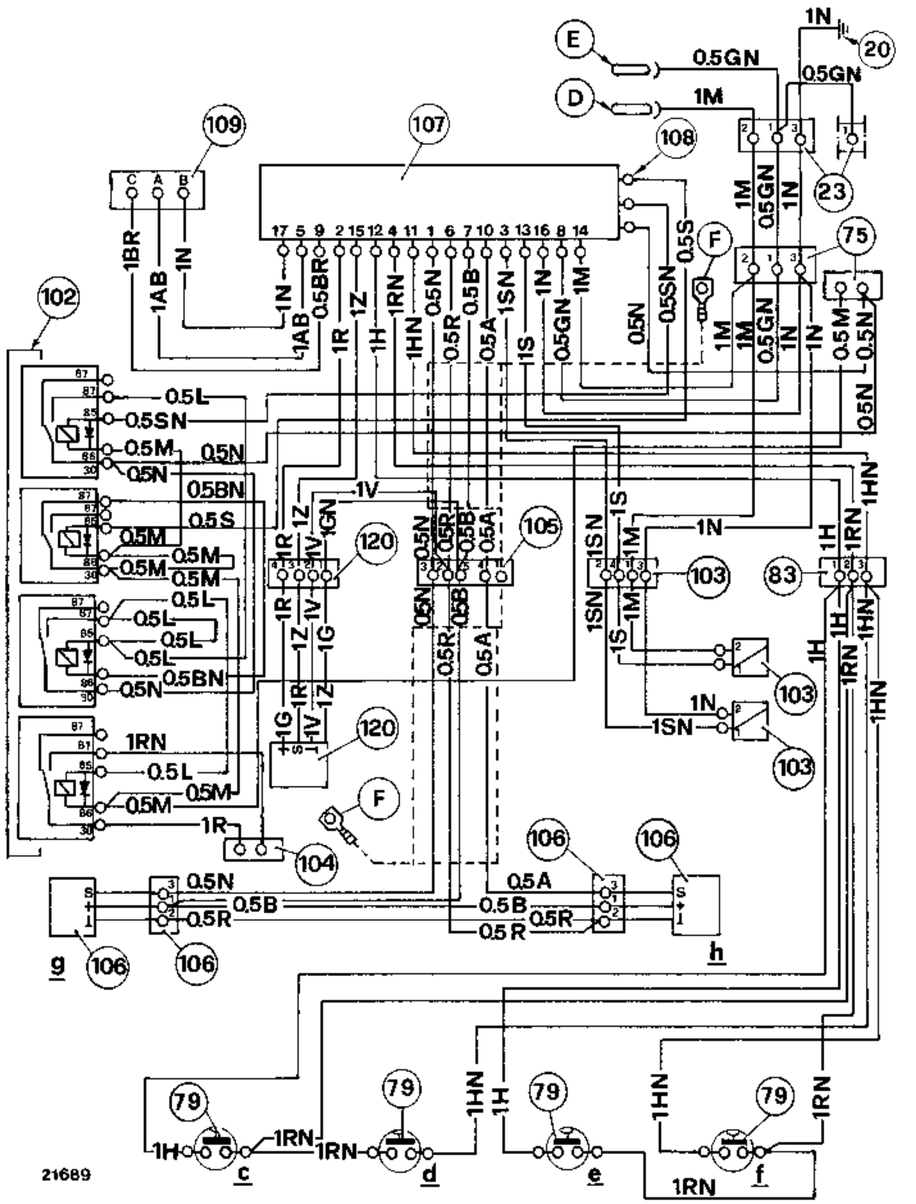


WIRING DIAGRAM
(Electronic lift circuit)

a. Discharge control electro–valve – b. Delivery control electro–valve – c. Lifting control switch (left fender) – d. Lowering control switch (left fender) – e. Lifting control switch (right fender) – f. Lowering control switch (right feneder) – g. Left draft sensor – h. Right draft sensor – D. Fuse no. 8 inside control unit (15, page 55–49) – E. Fuse no. 22 inside control unit (15, page 55–49) – F. Braided–wire shield for sensor (106) cable harness – 20. Instrument panel ground – 23. Connector for cab module, RH side – 75. Intermediate connector for electronic lift – 79. Electronic control external controls (see c–d–e–f) – 83. Intermediate connector for electronic lift external controls – 102. Relay cluster – 103. Electronic lift control electro–valves (a=discharge, b=delivery) and associated connector – 104. Connector between relays cluster and connector (74) – 105. Draft sensor intermediate connector – 106. Draft sensors and associated connectors (g=left sensor, h=right sensor) – 107. Electronic control unit and associated connector – 108. Connector between electronic control unit and relay cluster (102) – 109. TESTER **294009** connector – 120. Position sensor and associated connector.

CABLE COLOUR CODE

A = Light blue – **AB** = Light blue–White – **B** = White – **BN** = White–Black – **BR** = White–Red – **G** = Yellow – **GN** = Yellow–Black – **H** = Grey – **HN** = Grey–Black – **L** = Blue – **M** = Brown – **N** = Black – **R** = Red – **RN** = Red–Black – **S** = Pink – **SN** = Pink–Black – **V** = Green – **Z** = Violet.

HI–LO SAFETY SWITCH
Replacement (Op.21 168 62)

Proceed as follows:

CAUTION

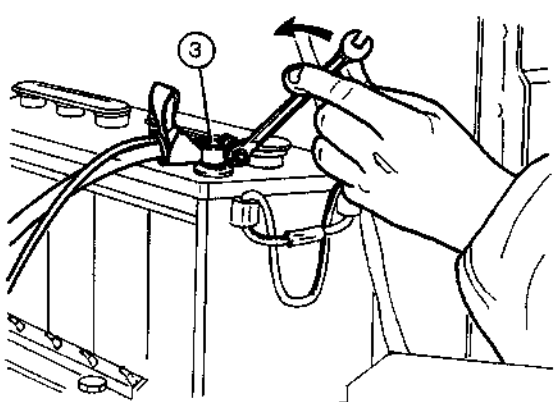
Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

CAUTION

Use suitable tools to align holes. DO NOT USE FINGERS OR HANDS.

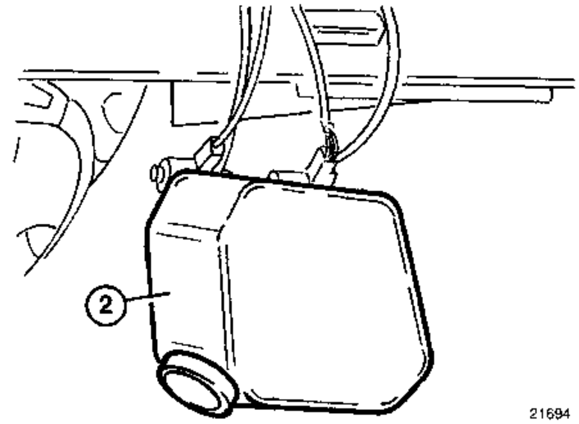
19666

1. Remove the side front panel (1) from the RH side of the tractor.



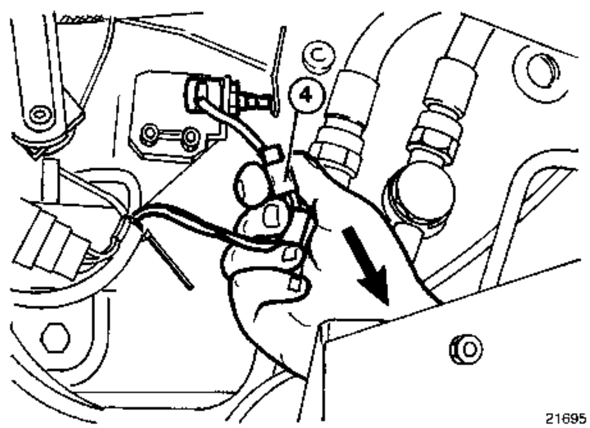
19605

2. Disconnect cable (3) from the positive pole of the battery and insulate it.



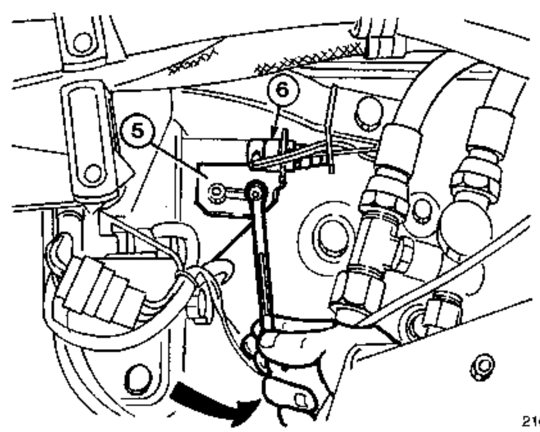
21694

3. Empty and then remove tank (2) from its supporting bracket.



21695

4. Disconnect connector (4) from the HI–LO safety switch.



21696

5. Remove retaining screws and mounting bracket (5) together with the HI–LO safety switch (6).

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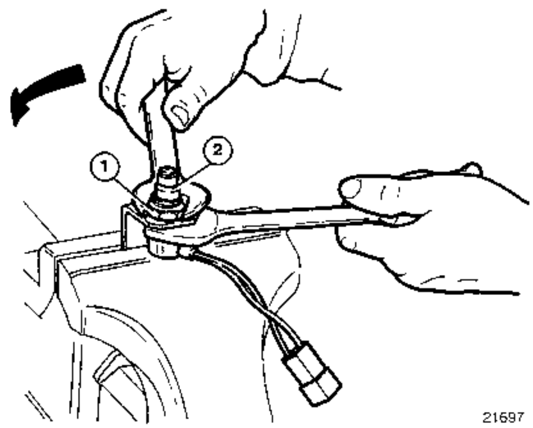
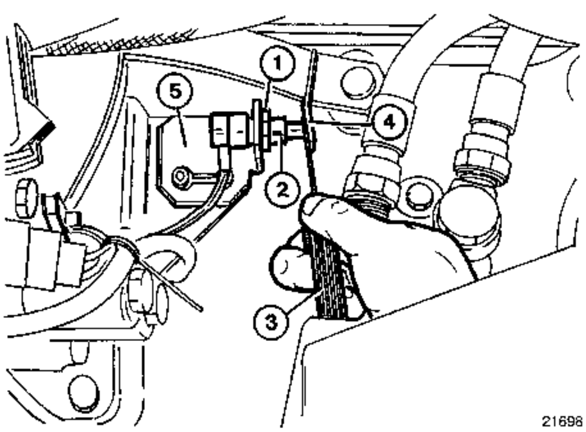


6. Remove jam nut (1) first and then the HI–LO safety switch (2).
7. Re–assemble the HI–LO safety switch and re–install it on the clutch–transmission case in accordance with the following directions:

   a. proceed by reversing the removal and disassembly sequence of operations starting from no. 6 back to no. 1;

   b. carry on adjustments further described on this page.



8. Set the reverser control lever in neutral.
9. Check, using feeler gauge (3), the distance between switch (2) and reverser control lever (4): 0.5 to 1 mm (.020 to .040 in).If a different value is found, move switch (2) nearer or farther, as follows: loosen screws and act on bracket (5) or directly on the switch after loosening jam nut (1). Finally, tighten jam nut (1) or the screws of the mounting bracket (5).

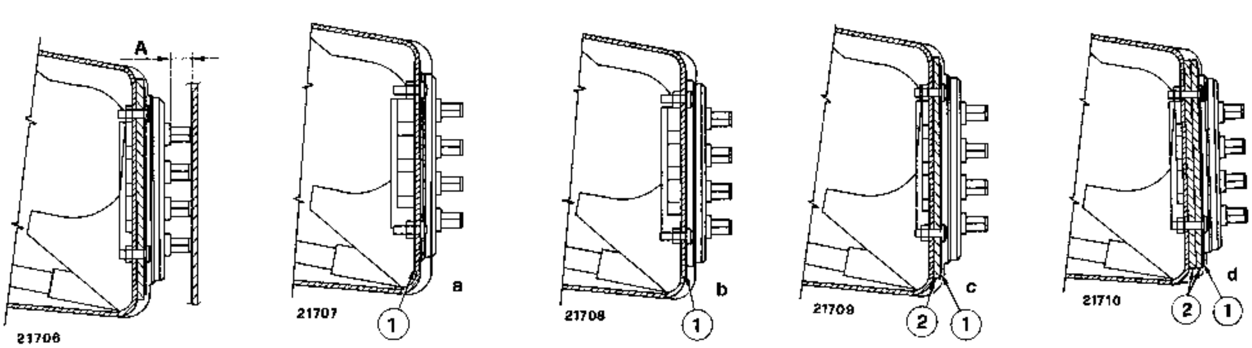
ADJUSTING THE WINDSHIELD GLASS WIPER ELECTRICAL CONTACTS ON CABS W/OPENING WINDSHIELD

Install and secure on the windshield the wiper assembly, taking care to position plate (1) and spacer (2) as shown in the accompanying figure, detail (**c**).

Close windshield tight and, using a suitable tool, check distance (**A**) between the support for adjustable contacts and the fixed contact plate: 5 to 7 mm or .20 to .28 in (measured on upper contact).

If the distance found differs from the above specification, proceed as follows:

1. If distance (A) is less than 5 mm or .20 in, loosen contacts because excessively pre–loaded. To do it, remove spacer (2) (as shown in **b**) and if not sufficient move plate (1) from the outside towards the inside of case (see illustration detail **a**).
2. If distance (A) is more than 7 mm (.28 in), move contacts closer because they are not sufficiently pre–loaded. To do it, add a second spacer (2), as shown in detail **d**.



ADJUSTING THE WINDSHIELD ELECTRICAL CONTACTS

A = 5 to 7 mm (.20 to .28 in). Distance between mobile contacts and fixed contact plate – 1. Sheet–metal plate – 2. Spacers.

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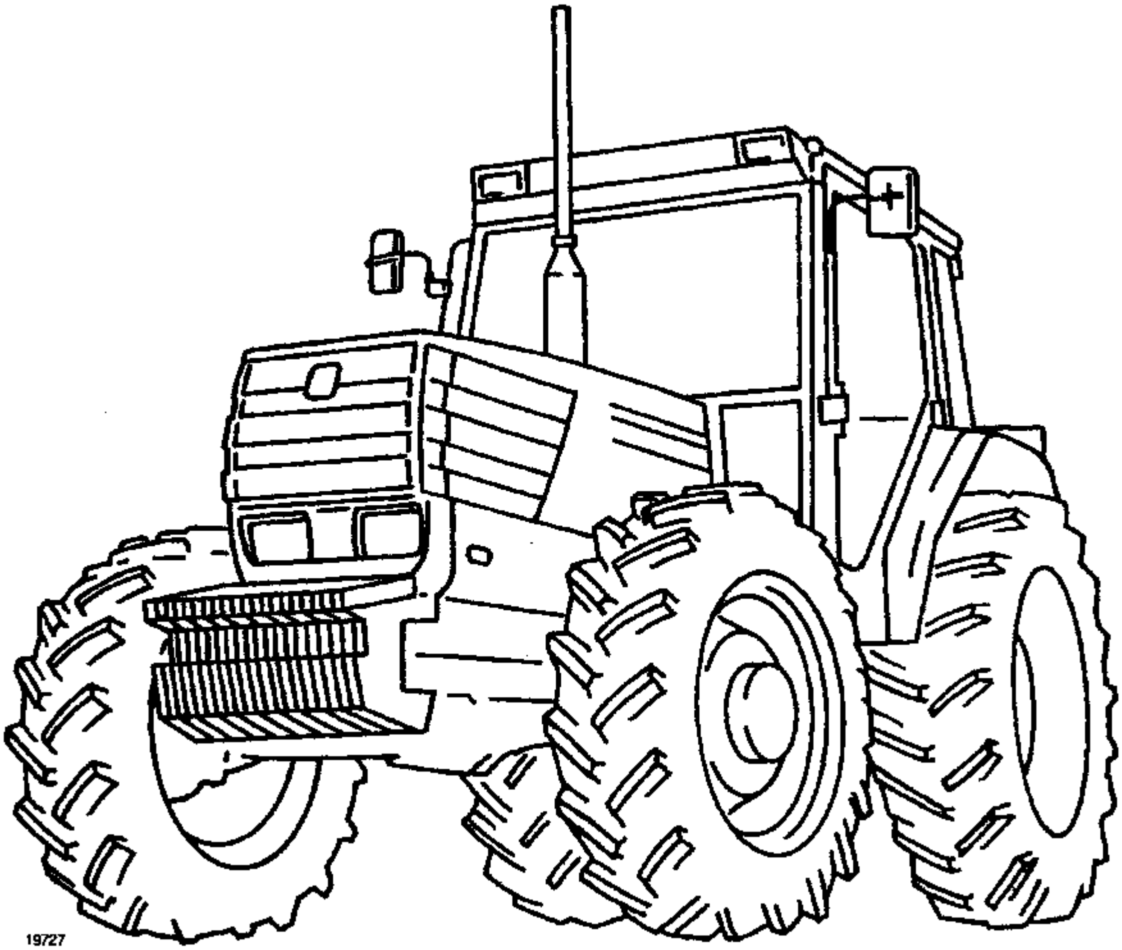

19727

PAINTS

Paints are synthetic enamels with melamine–acrylic resins available in the colour codes reported below.

TA/19	Brick red
TA/2	Brown
TA/21	White
TA/8	Black

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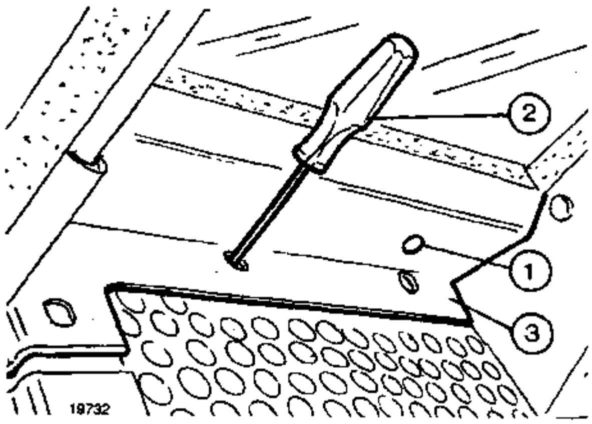
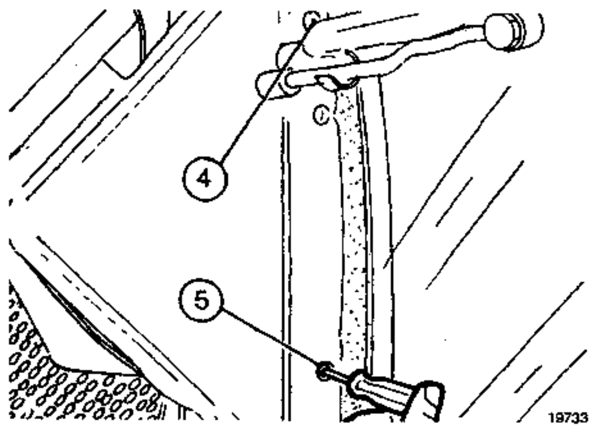
CAB WINDSHIELD GLASS
Replacement (Op. 90 156 15)

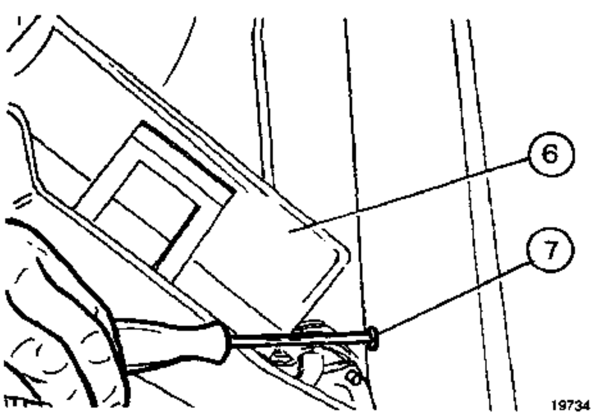
To remove glass, proceed as follows:



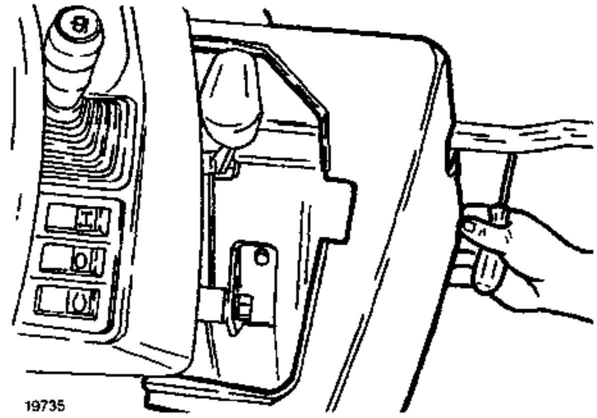
1. Working inside the cab, on the front, remove protection plugs (1), the self–tapping screws using a Phillips–head screwdriver (2) and finally the platform mat retaining plastic moldings (3).



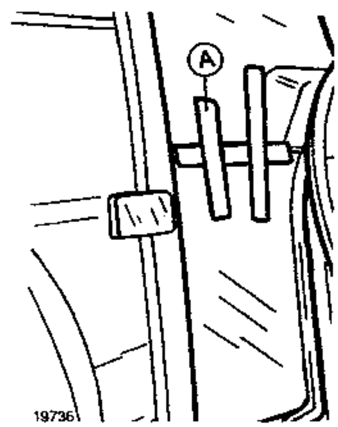
2. Remove plugs (4) and dashboard side panel cross–slotted head screws (5).



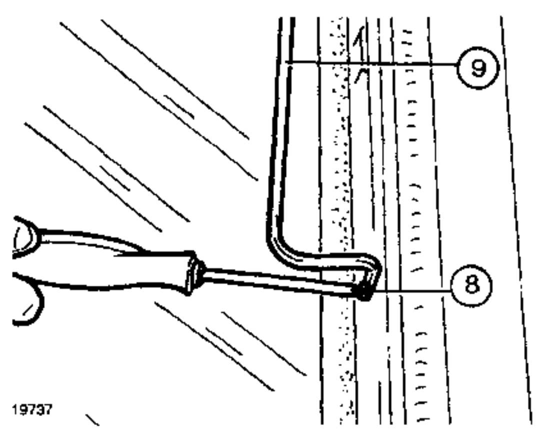
3. Unscrew the fuse box cover (6) retaining nut , located under the cowl, open cover (6) and remove the side panel attaching cross–slotted head screws (7).



4. Remove the dashboard side panels.



5. Apply a wide–band adhesive tape both on the inside and outside of the cab in order to hold the windshield glass assembled together with the lower glass sections, right and left.



6. Remove the cross–slotted head (8) and the sun blind guides (9).

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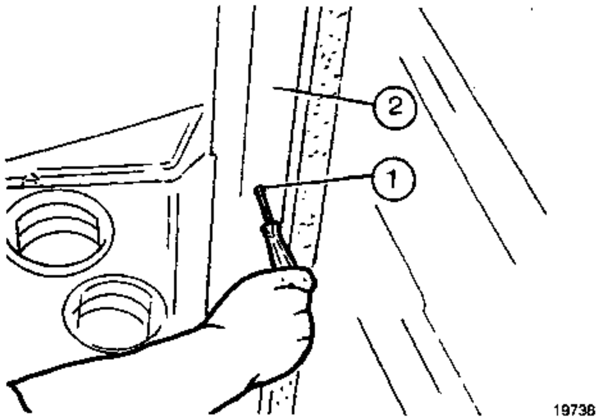
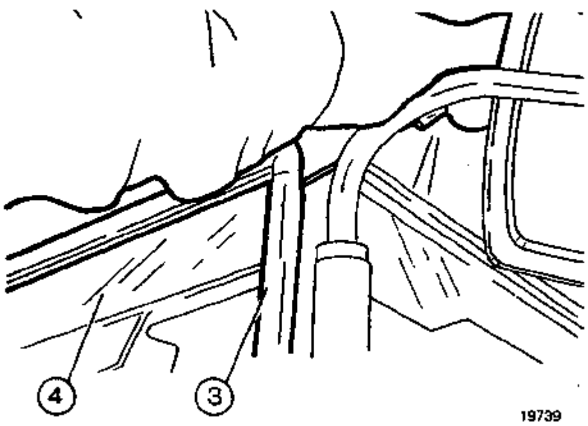
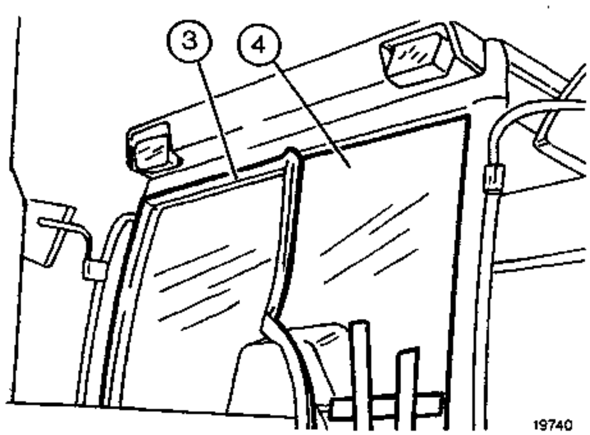


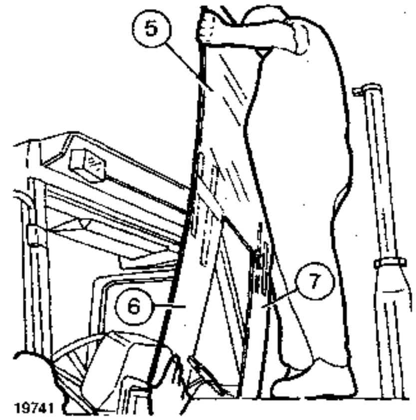
7. Remove the attaching screws (1) and sun blind (2).



8. Starting from the upper R.H. side corner of the windshield glass (4), pry up seal (3) with a screwdriver to separate it from cab frame.



9. Separate seal (3) from windshield glass (4) all along its perimeter and press glass outwards, with the palm of your hand, from inside the cab, until the glass comes off.



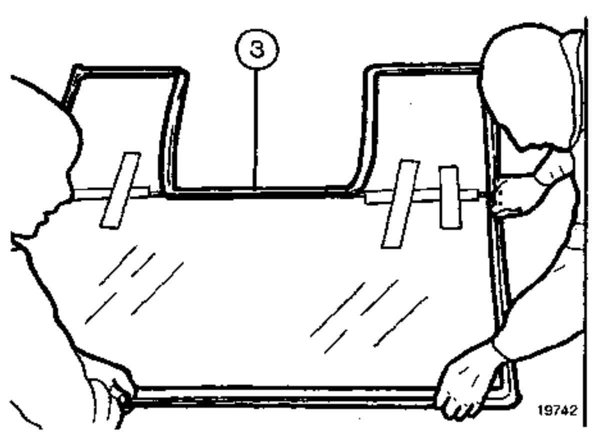
10. Remove the windshield glass (5) together with right and left lower glass sections (6 and 7, respectively), with the help of two other mechanics.

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

ATTENTION – When replacing a glass it is advisable to replace the seal also.Prior to installing a glass on the cab, lubricate seals with FIAT "PARAFLU 11" fluid or a soapy solution.Absolutely avoid using oil or grease which would negatively affect the life of the seals.

For installation, comply with the following:



11. Lay the complete windshield on a flat surface, refit seal (3) over its full length starting from the upper part of the glass as shown in the figure.

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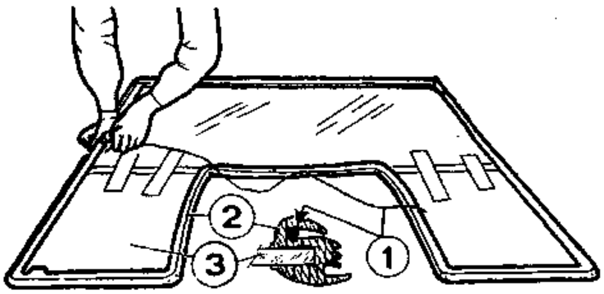
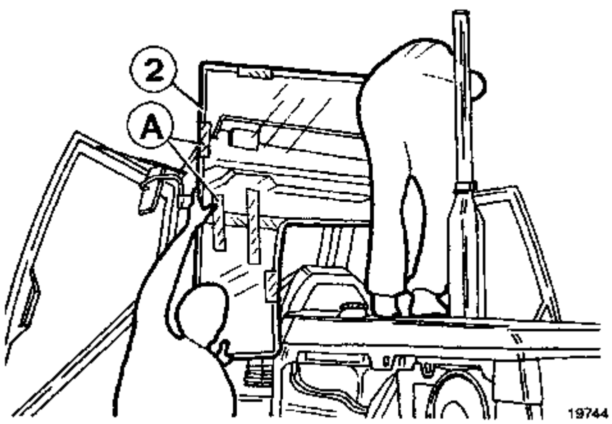


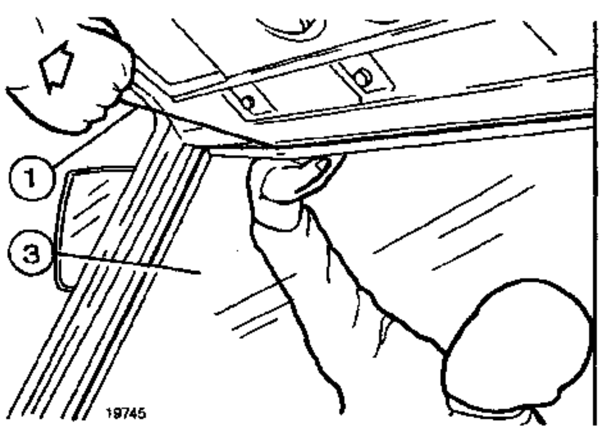
19743

12. Insert a string (1) of about 4/5 mm (.16/.20 in) dia. over the full perimeter of the seal (2) crossing it on the lower central part of the glass (3) as shown in the figure.



19744

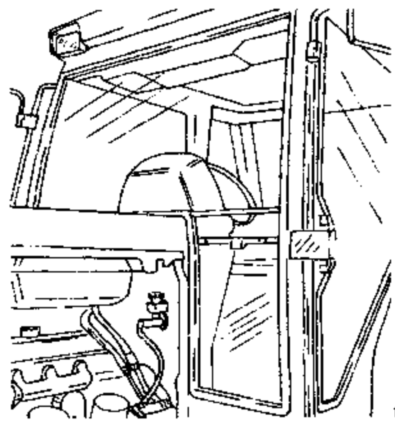
13. Apply wide–band adhesive tape (A) to secure the seal (2) in position over the entire perimeter of the windshield glass, then install the glass on the cab frame.



19745

14. Manually push on the glass (3) inwards from the outside along the length of string (1), simultaneously pulling the string from the inside of the cab and progressively adjusting the seal in position.

CAUTION – Pressure on glass must be applied exclusively with the palm of your hand. Absolutely avoid hitting it with fist or mallets.



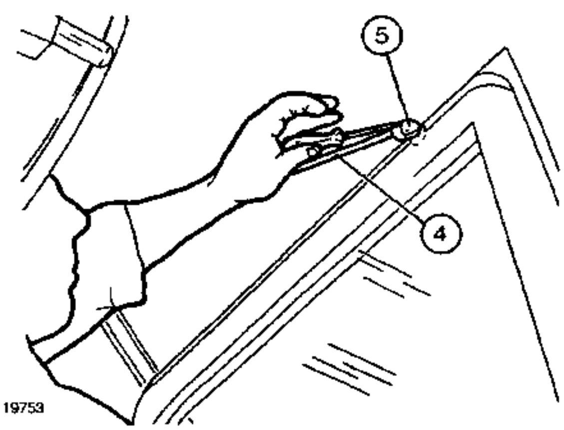
19746

15. Remove adhesive tape.

16. Proceed for the installation of the remaining parts by reversing the previous sequence of operations starting from no. 7 back to no. 1. See illustrations of pages 90–2 and 90–3 for the correct placement of parts.

CAB DOOR , R.H. or L.H. SIDE
Removal–Installation (Op. 90 154 10)

For removal, proceed as follows:



19753

1. Remove the door opening damper stop (4), after detaching the ball–socket joint spring clips (5).

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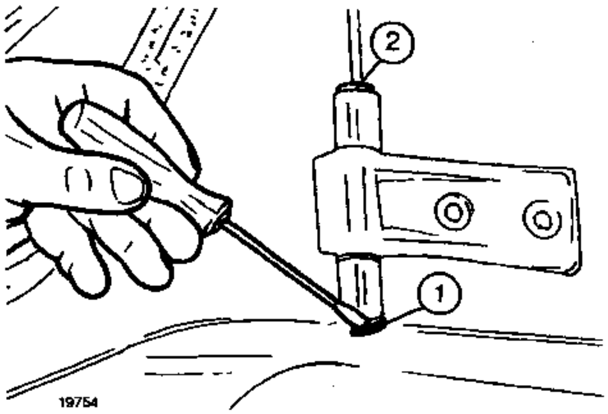
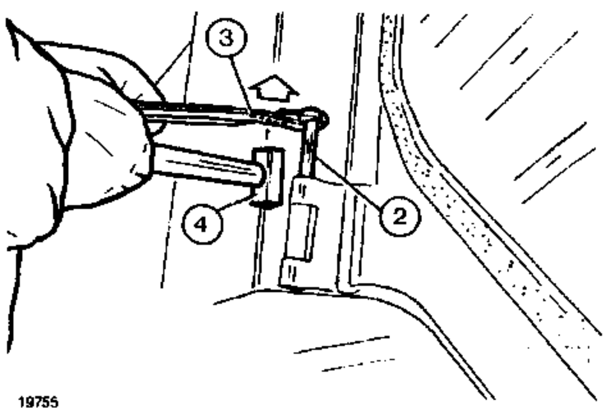
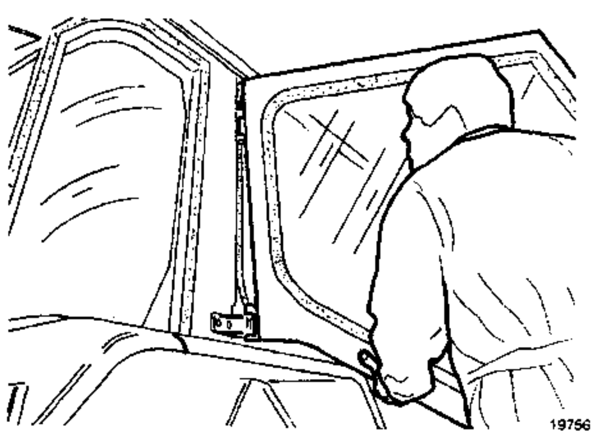


2. Remove rubber rings (1) from door hinge pins (2).



3. Remove hinge pins (2) using pliers (3) and hammer (4).

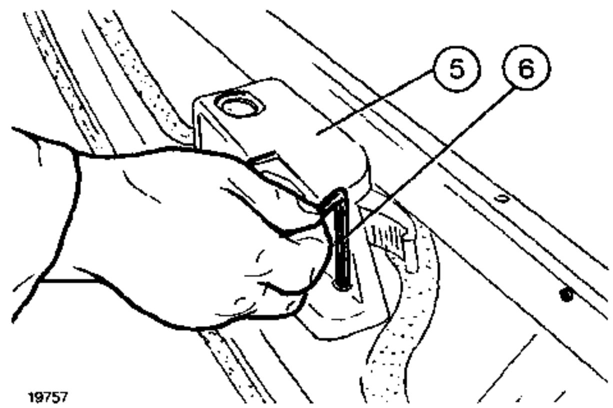


4. Remove complete door from cab frame.

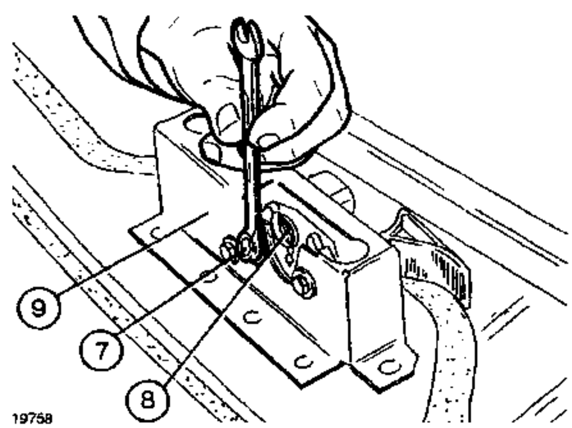
5. Re–install the door by reversing the previous removal sequence of operations, starting from no. 4 back to no. 1. See illustrations of pages 90–4 and 90–5 for the correct placement of parts.

DOOR HANDLE AND LOCK , R.H. or L.H. SIDE Replacement (Op. 90 154 30).

For replacement, proceed as follows:



1. Remove the two cover (5) screws using a set screw wrench (6).



2. Remove the three screws (7) securing the lock to plate (9) and then the lock itself (8).

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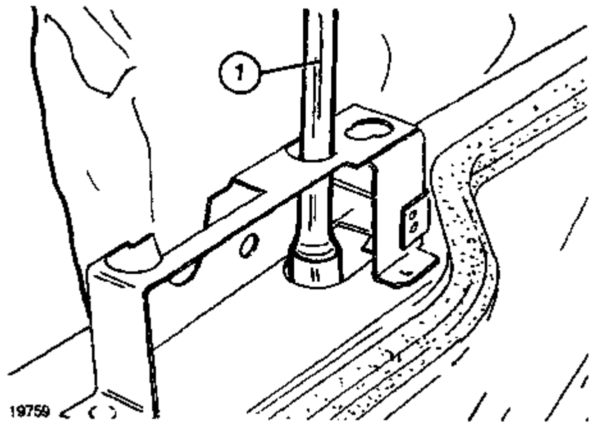


19759

3. Remove, using a box wrench (1), the two hex. nuts securing handle to door and finally the handle itself.

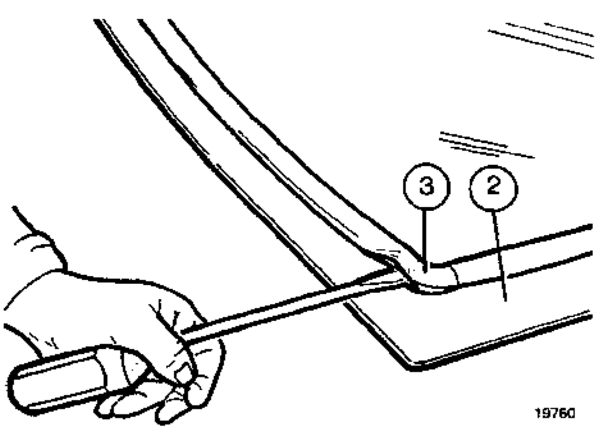
4. To refit parts, proceed by reversing the removal sequence of operations as previously described.

CAB DOOR GLASS
Replacement with door removed from cab frame (Op. 90 154 24)

CAUTION

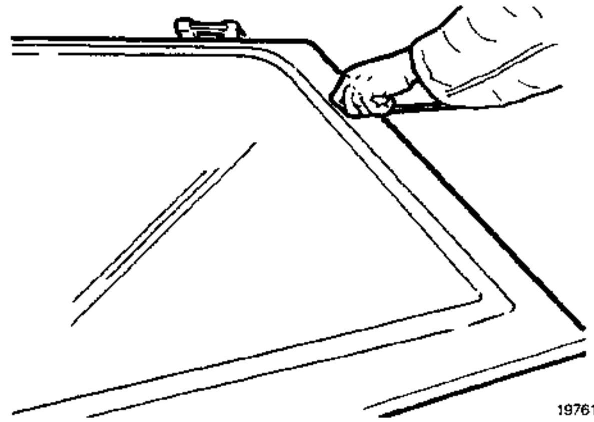
Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

For replacement, proceed as follows:



19760

1. Lay the door (2) down flat, outer side upwards, on a suitable flat working surface; insert a screwdriver between door and glass seal in the bottom corner of the door (3), pry up seal and simultaneously push from lower side of glass with the palm of your hand.



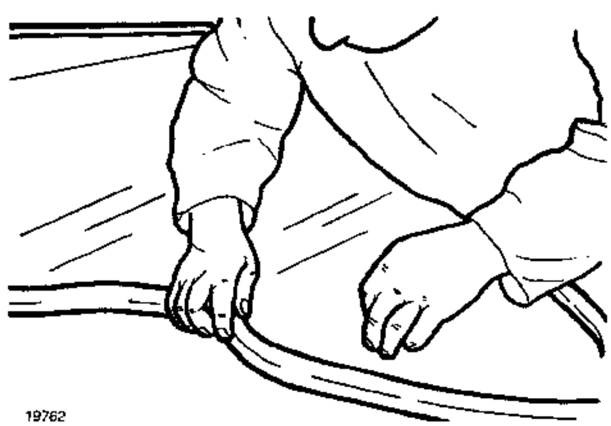
19761

2. Proceed all along the perimeter of the glass until the same comes off.

3. Remove seal starting from one corner of the glass.

ATTENTION – When replacing a glass it is advisable to replace the seal also.Prior to installing a glass on the cab, lubricate the seal with FIAT "PARAFLU" fluid or a soapy solution.Absolutely avoid using oil or grease which would negatively affect the life of the seal.

For installation, comply with the following:



19762

4. Lay glass on a flat working surface and refit the seal starting from a corner and following up along the full length of the glass.

5. Apply wide–band adhesive tape in order to hold seal in position on the glass along the complete perimeter.

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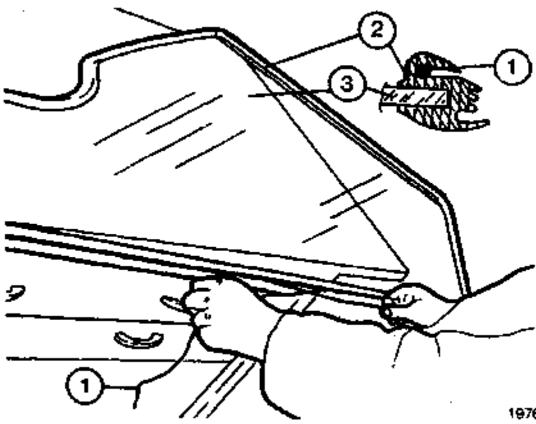
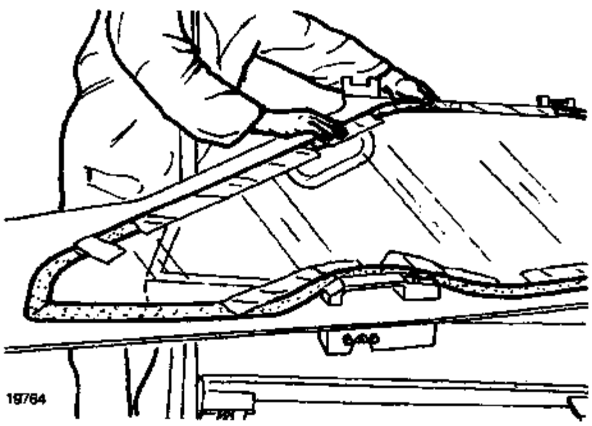


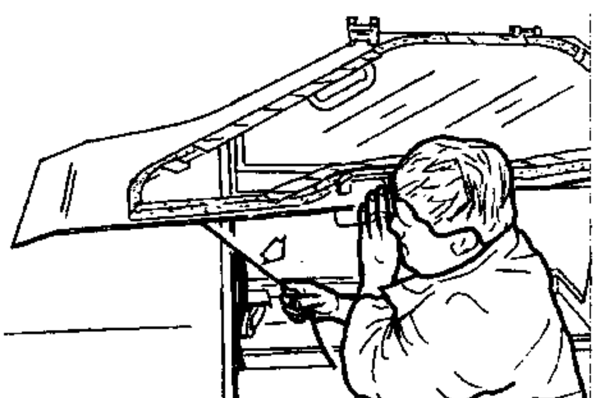
19763

6. Insert a string (1) of about 4/5 mm (.16/.20 in) dia.- over the full perimeter of the seal (2), previously installed onto the door glass (3), crossing it as shown in the figure.



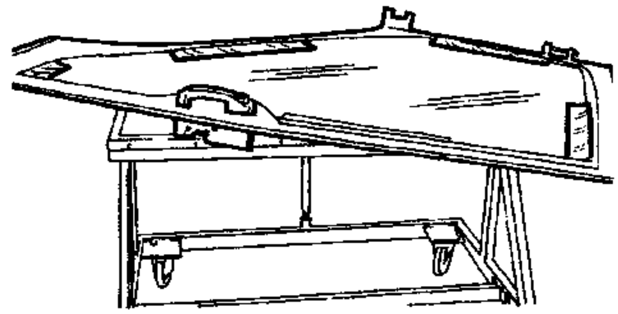
19764

7. Lay the door, outer side upwards, on a suitable flat working surface and position the glass over the door as shown in the figure.



19765

8. Pull on the string from bottom side following up all along the perimeter as shown in the figure.



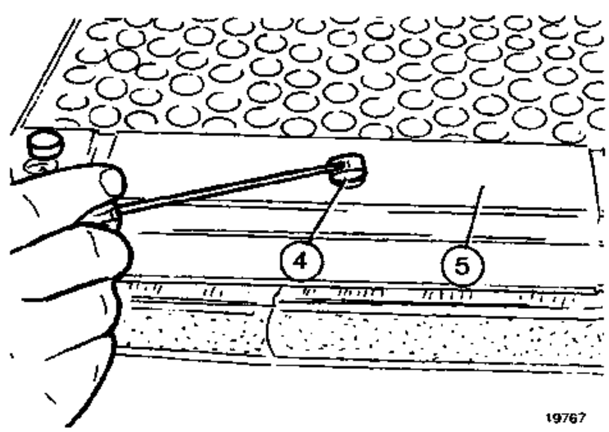
19766

9. Manually adjust the seal in position and remove the adhesive tape.

CAUTION – Pressure on glass must be applied exclusively with the palm of your hand. Absolutely avoid hitting the glass with fist or mallets.

CAB DOOR SEAL, R.H. or L.H. SIDE
Replacement w/ cab removed (Op. 90 154 20)

For replacement, proceed as follows:



19767

1. Remove the mat retaining profile (5) self–tapping screw cover plugs (4).

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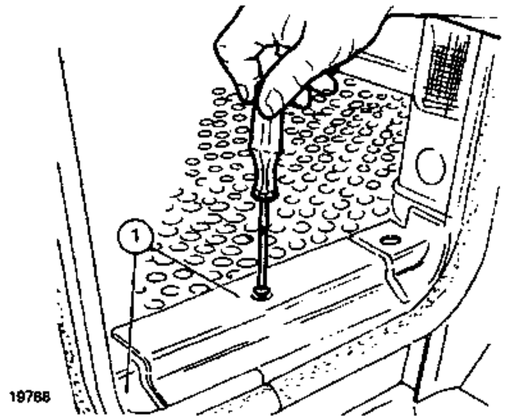
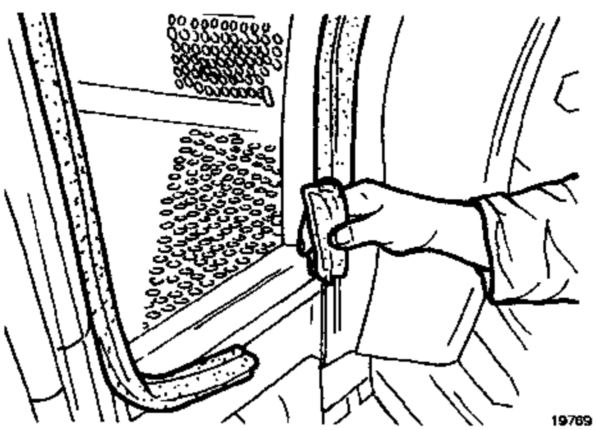


2. Remove cross–slotted head screws and mat retaining plastic moldings (1).



3. Starting from the cab lower end pull off the seal by hand, following the door frame perimeter.

4. To refit parts, proceed by reversing the removal sequence of operations as previously described.

ATTENTION – Lubricate seal with FIAT "PARAFLU" or soapy solution. Absolutely avoid using oil or grease which would negatively affect the life of the seal.

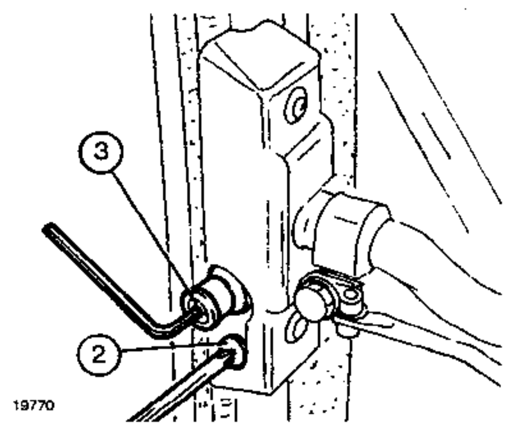
CAB DOOR ALIGNMENT AND CLOSING
Adjustment (Op.90 154 05)

Should doors be incorrectly positioned, proceed as follows:

1. Slacken the two screws securing the door bottom hinge.
2. Position the door making sure that clearance between same and cab frame is uniform all long its perimeter.
3. Tighten the hinge screws previously loosened.

NOTE: Upper door hinge is fixed and cannot be adjusted.

Should the doors not shut correctly or be slack or chattering when closed, proceed as follows:



4. Back out the bottom Phillips screw (2) securing the door lock pin.
5. Back out the 5mm set screw securing the door lock central pin (3).
6. Move pin (3) outwards if the door does not close correctly, or inwards if the door, once closed, is slack or shows any undue clearance.
7. Move pin (3) up or down whatever necessary to align it correctly with the retainer on the door.
8. Once verified that the door position is correctly adjusted, tighten the door lock pin screws (2 and 3).

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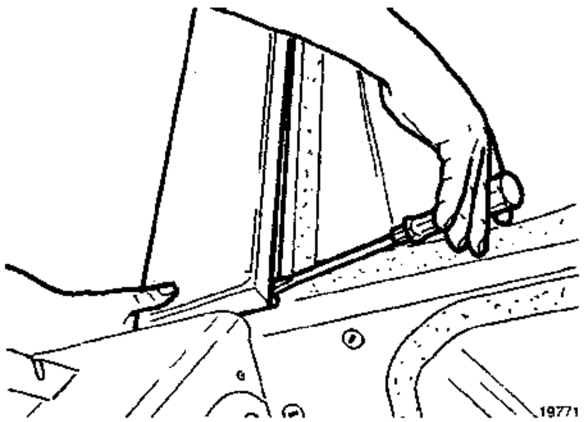
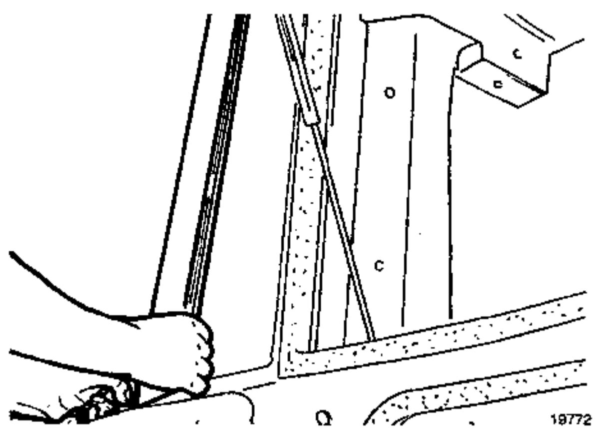
CAB REAR SIDE WINDOWS
Replacement (Op. 90 156 28)

To replace the window glass, proceed as follows:



1. Pry up the glass lower rear end with a screwdriver and press on the same glass outwards from inside the cab using the palm of your hands.

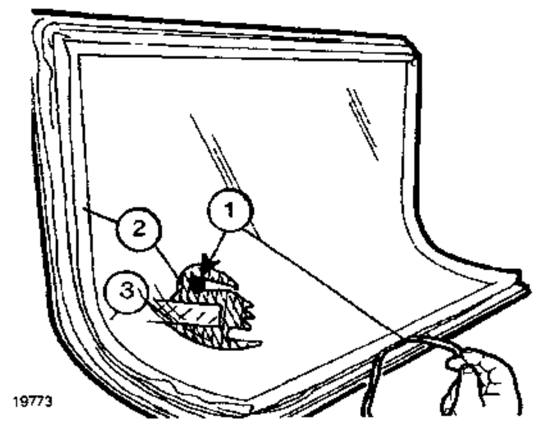


2. Remove glass complete with seal.
3. Remove seal from glass starting from a corner and proceeding all along the perimeter.

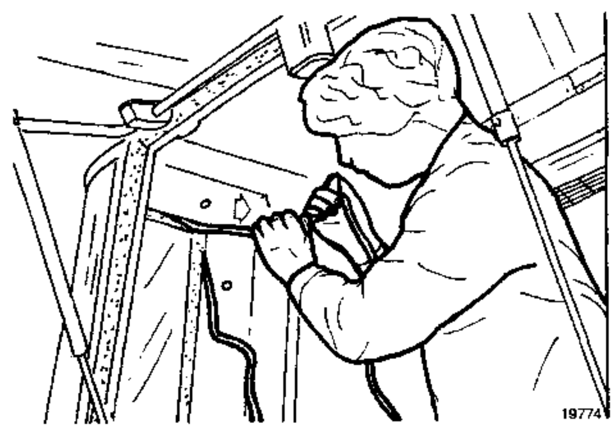
ATTENTION – When replacing a glass it is advisable to replace the seal also. Prior to installing a glass on the cab frame we also recommend lubricating the seal with FIAT "PARAFLU" or a soapy solution. Absolutely avoid using oil or grease which would negatively affect the life of the seals.

Per il montaggio attenersi a quanto segue:

4. Rimontare la guarnizione su tutto il perimetro partendo da un angolo del cristallo.



5. Insert a string (1) of about 4/5mm (.16/.20 in) dia. over the full perimeter of the seal (2), crossing on the middle part of the glass (3) as shown in the figure.



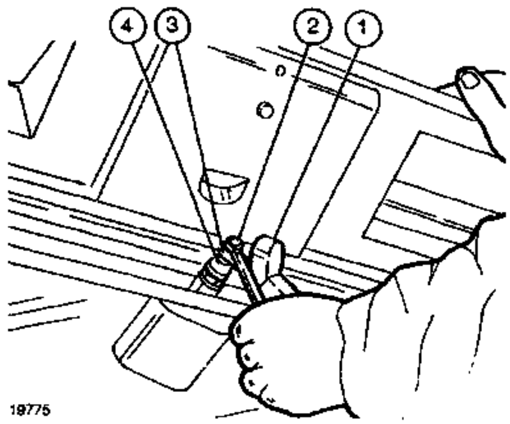
6. Press on the glass inwards from the outside of the cab along the perimeter of the string and simultaneously pull the latter from inside the cab.
7. Manually adjust the seal in position.

CAUTION – Pressure on glass must be applied exclusively with the palm of your hands. Absolutely avoid hitting the glass with fist or mallets.

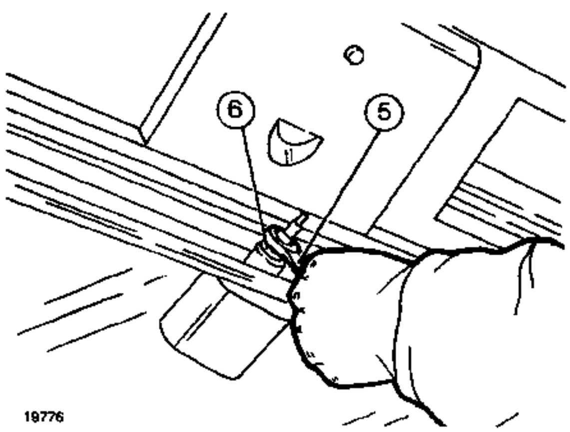
Print No. 603.54.276.00 – 01 – 1992

CAB REAR WINDOW GLASS
Replacement (Op. 90 156 52)

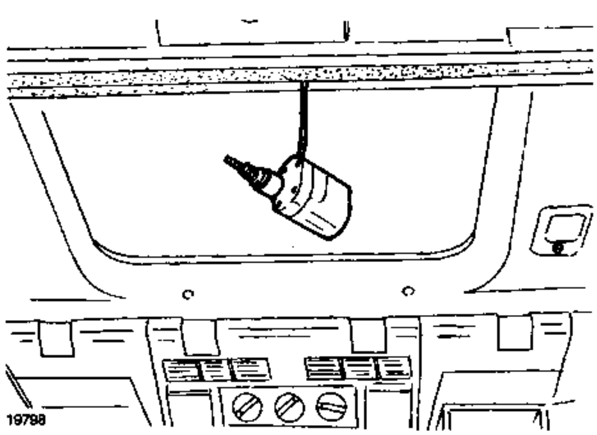
For replacement, proceed as follows:



1. Working on the outside of the cab, free the cover cap (1), remove the wiper lock nut (2) and then the wiper (3) and seal (4).

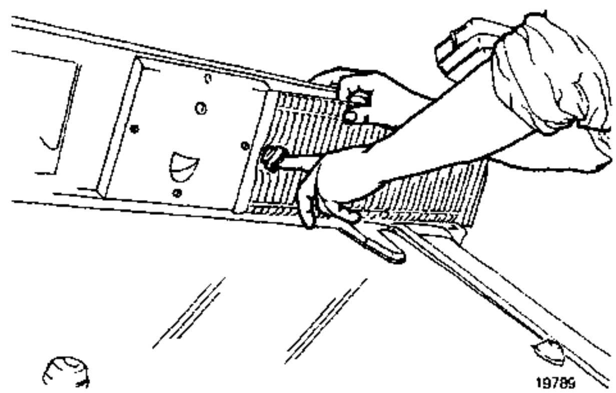


2. Remove the ring nut securing wiper motor onto glass using a box wrench (5) and, subsequently, washer and seal (6).

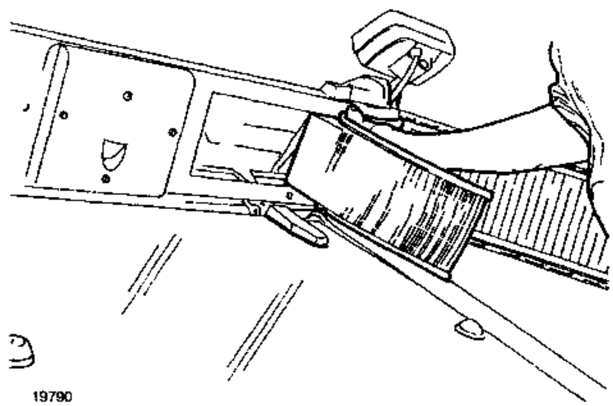


3. Separate motor from glass.

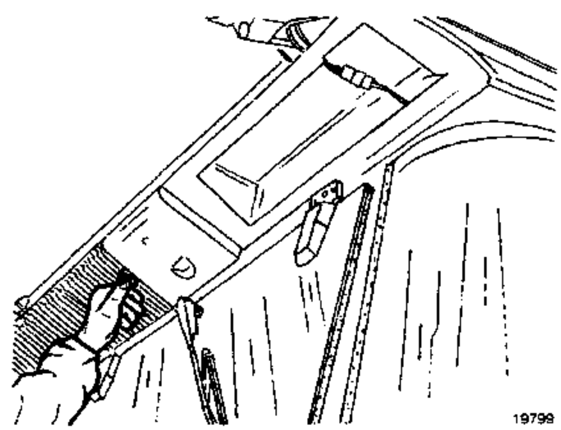
In order to remove the glass uuper hinges, proceed as follows:



4. Remove the cab R.H. side air intake grille knob.



5. Open grille and remove the air filter pad.



6. Open the L.H. side grille and remove air filter pad.

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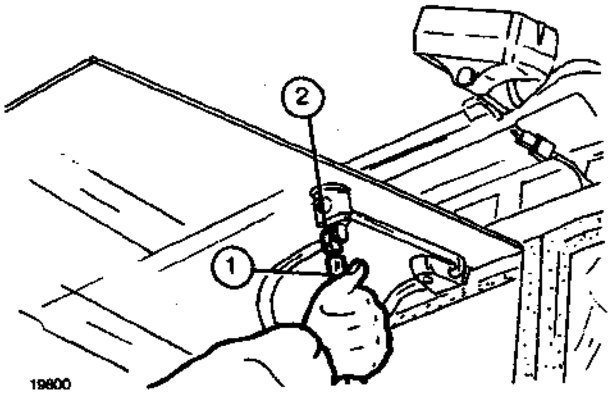
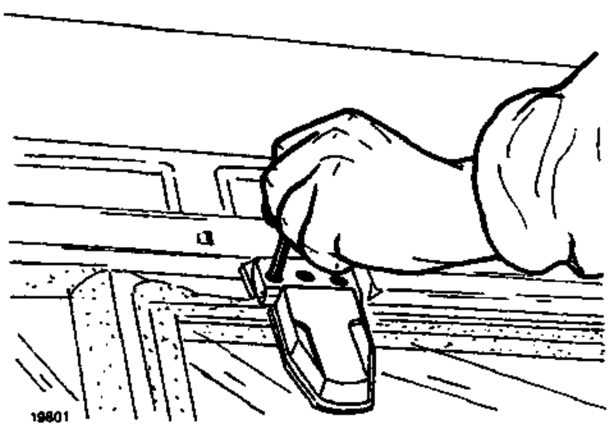


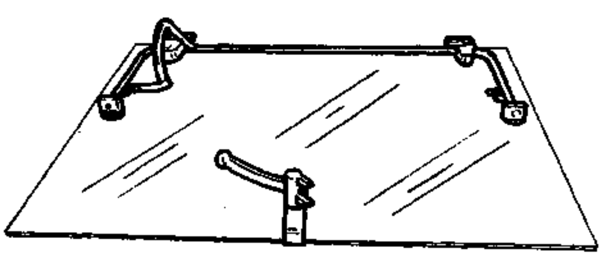
19800

7. Disconnect stops (1) after removal of the ball–socket joint spring clips (2).



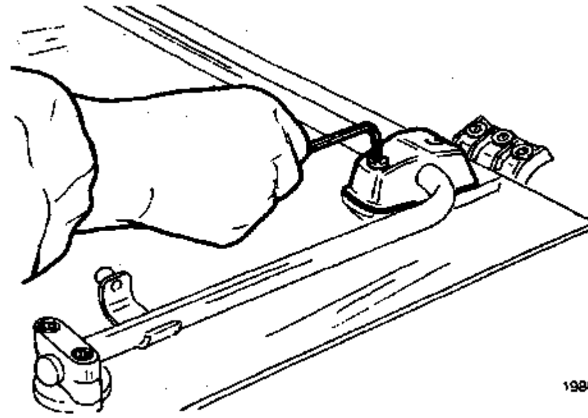
19801

8. Using a set screw wrench, remove the screws securing upper hinges to cab frame.



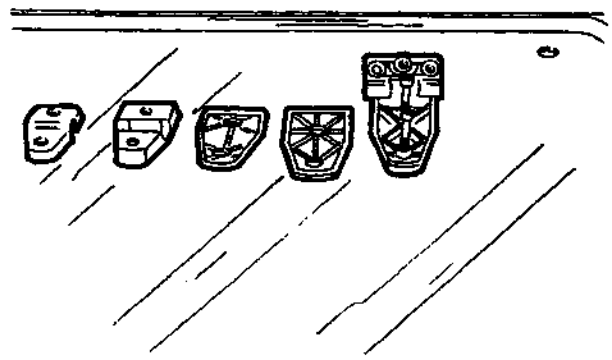
19802

9. Remove the glass, complete, from cab frame and lay it over a plain working surface as shown in the figure.



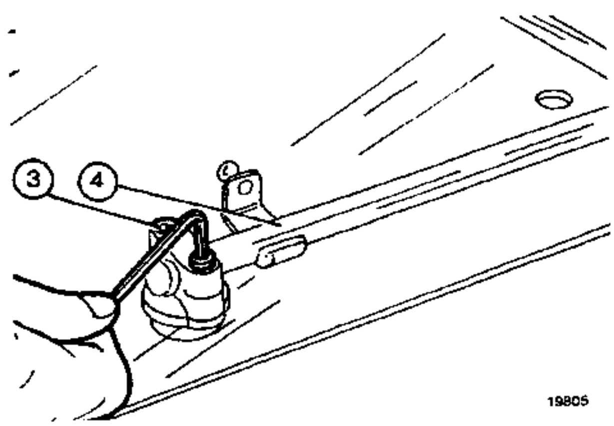
19803

10. Remove, using a set screw wrench, the screws securing upper hinges to glass.



19804

11. Remove component parts of each hinge and provisionally pre–assemble them following the assembly sequence and using their respective set screws.



19805

12. Remove screws (3) securing the inside window glass closure tubular element (4) and then the latter.

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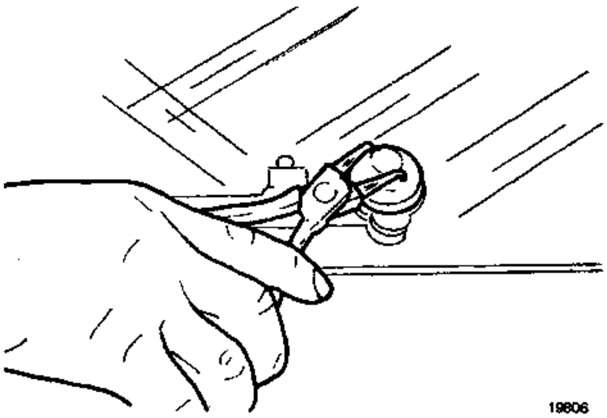
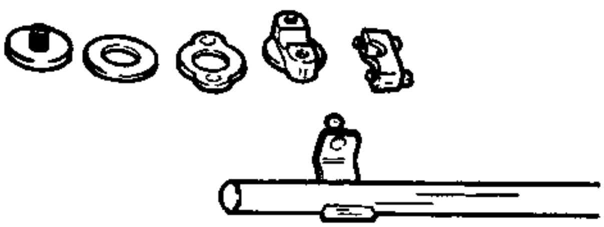


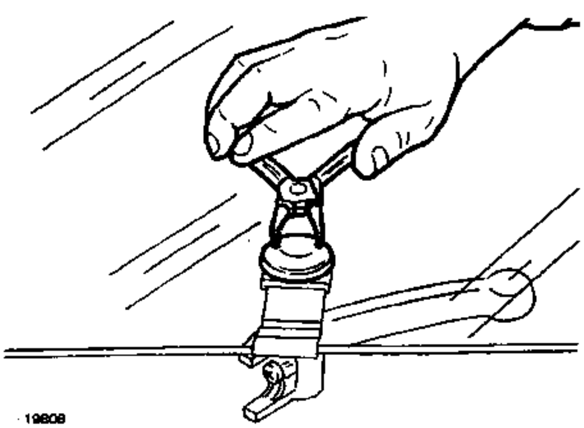
19806

13. Turn the glass upside down and remove the retainers securing the rod to the glass.



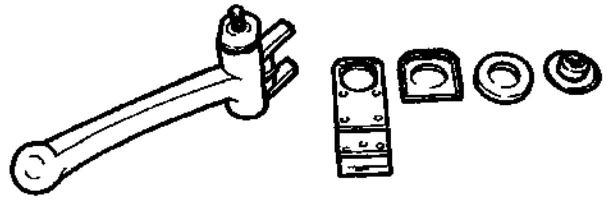
19807

14. Remove component parts and provisionally pre–assemble them following the assembly sequence and using their respective set screws.



19808

15. Remove ring nut securing handle to glass.



19809

16. Remove component parts and provisionally pre–assemble them following the assembly sequence and through the handle securing wring nut previously removed.

17. Proceed for the installation of tha cab rear window glass by reversing the previous sequence of operations, starting from no. 16 back to no.1. See illustrations of pages 90–10 through 90–12 for the correct placement of parts.

18. Adjusting and positioning the glass.

Following operations are required:

- Loosen the upper cab glass hinge screws and glass rod retainers.
- Position the glass correctly with respect to the seals fitted on the cab frame, taking advantage of the parts assembly clearance fit.
- Once positioned the glass, fix the tubular element blocking ring nuts, previously loosened, and tighten the hinge screws to a torque of 12 to 14 Nm (1.2 to 1.4 kg/m – 8.6 to 10 ft.lb).

19. Adjusting the glass closing handle.

Loosen the two screws securing the handle mounting plate on the cab frame, adjust position with respect to either the inside or the outside in oreder to increase or reduce, respectively, the pressure of the glass on the seal. Finally, tighten the screws previously loosened.

20. Adjusting the glass wiper stroke.

At re–assembly, check that the stroke made by the glass wiper is the same as before; if not, correct it by varying the position of the wiper on the motor shaft knurls.

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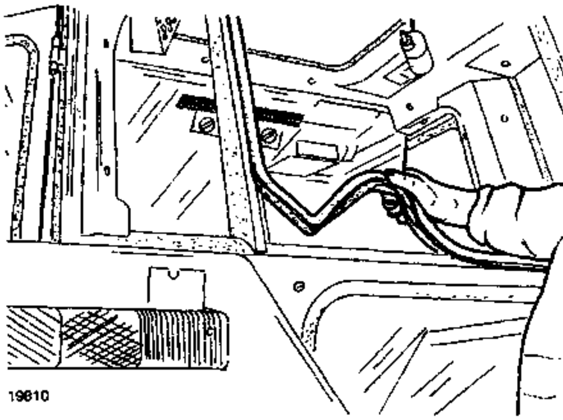
REAR WINDOW GLASS SEAL
Replacement (Op. 90 156 50)

For replacement, proceed as follows:



19810

1. Starting from the cab frame lower left corner, pull the seal outwards along its full length until removal is completed.

ATTENTION – Prior to fit the new seal we suggest lubricating it with FIAT "PARAFLU" fluid or with a soapy solution.Absolutely avoid using oil or grease which would negatively affect the life of the seal.

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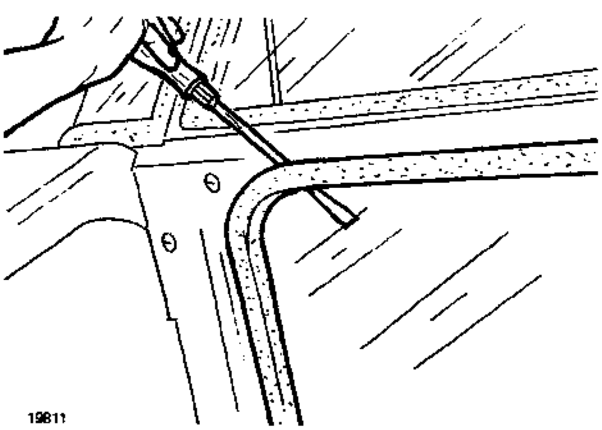
2. To refit the seal, place it in its seat starting from a corner and pulling it to the adjacent corners, simultaneously adjusting it by hand all along its perimeter.

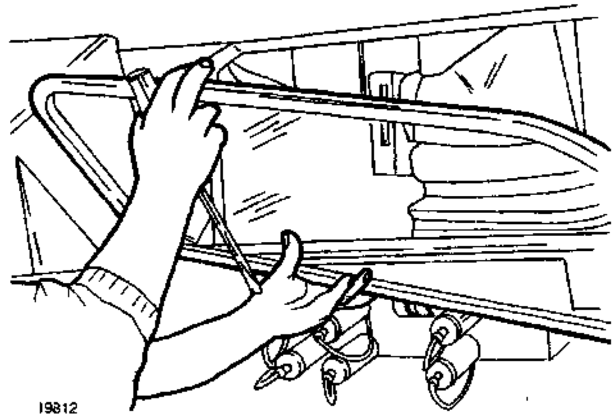
LOWER REAR WINDOW GLASS
Replacement (Op. 90 156 60)

For replacement, proceed as follows:



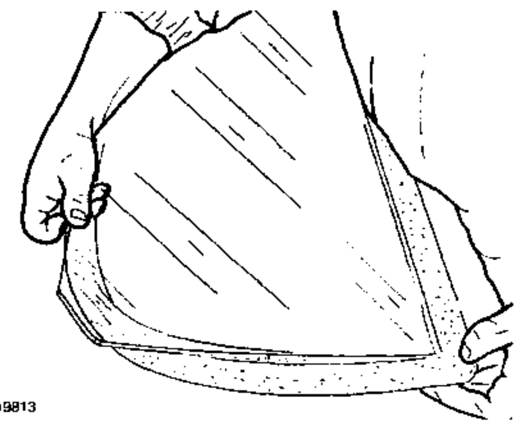
19811

1. Using a screwdriver inserted between seal and cab frame, pry up the seal starting from its upper left corner.



19812

2. Press on the glass outwards with respect to the cab, using the palm of your hand, until completely out.



19813

3. Remove seal starting from a corner and proceeding over the entire perimeter.

CAUTION

Handle all parts with great care. Do not put hands or fingers between parts.
Wear safety equipment such as goggles, gloves and special shoes.

ATTENTION – When replacing a glass it is advisable to replace the seal also.Prior to installing a glass on the cab frame we also recommend to lubricate it with FIAT "PARAFLU" fluid or a soapy solution.Absolutely avoid using oil or grease which would negatively affect the life of the seals.

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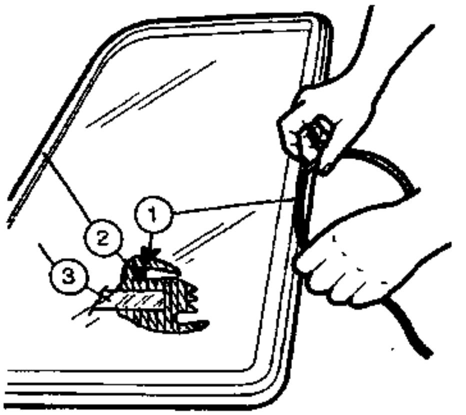
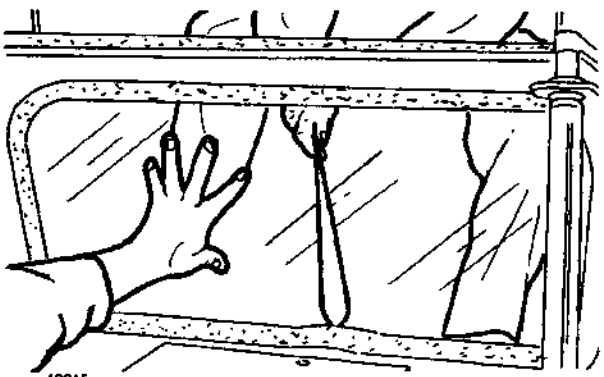
For assembly, proceed as follows:

4. Lay the glass over a flat surface and refit seal over its entire perimeter starting from an angle.

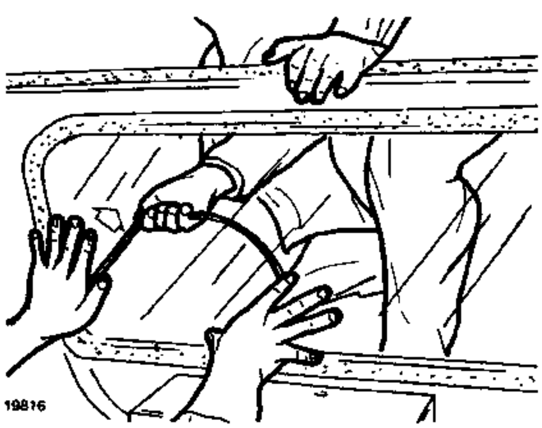


19814

5. Insert a string (1) of about 4/5mm (.16/.20 in) dia. over the entire perimeter of the seal (2), crossing it on the mid–lower part of the glass as shown in the figure.


19815

6. Apply glass onto the cab frame.


19816

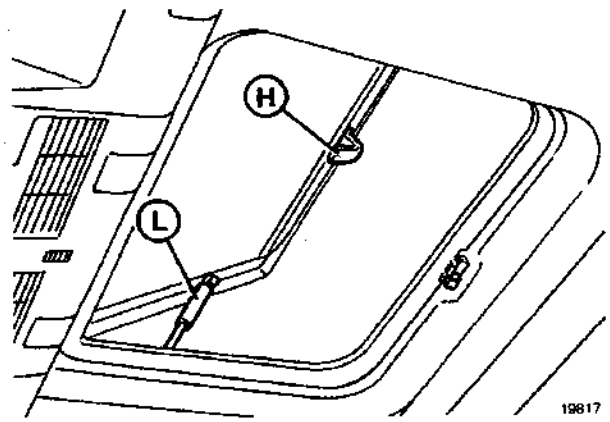
7. Push on the glass inwards from outside the cab along the path of the string, simultaneously pulling it from inside the cab.

8. Adjust seal by hand.

CAUTION – Pressure on glass must be applied exclusively with the palm of your hands. Absolutely avoid hitting the glass with fist or mallets.

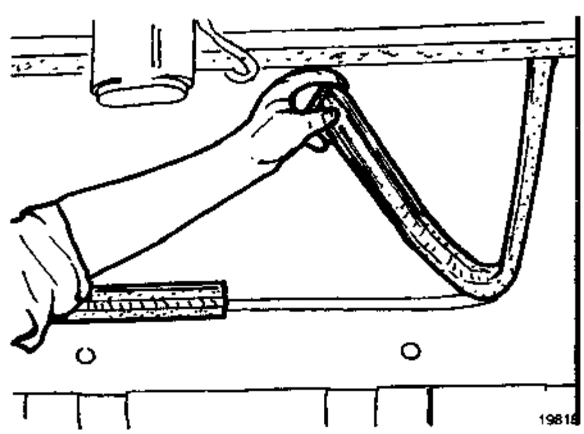
CAB ROOF SAFETY HATCH
Removal–Installation (Op. 90 154 52)

For removal, proceed as follows:



19817

1. Turn handle (H), open the hatch, detach damper cylinders (L) from their ball–joint plastic retainers by imparting a blow with the palm of the hand on the hatch.


1981?

2. Open the hatch, check seal and replace it in case of evidence of cuts or cracks.

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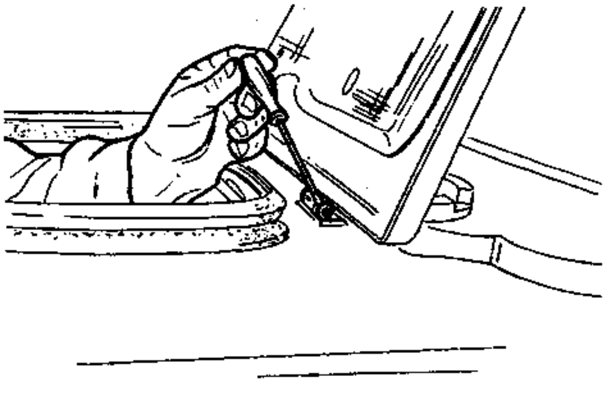
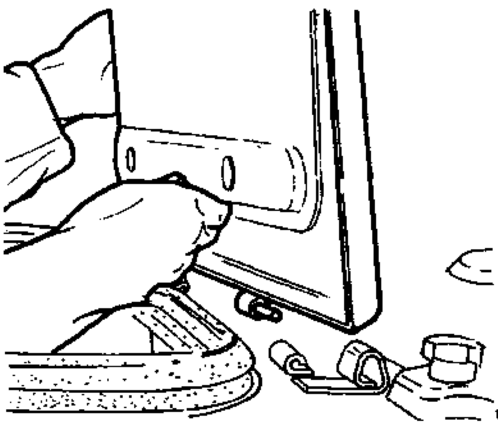


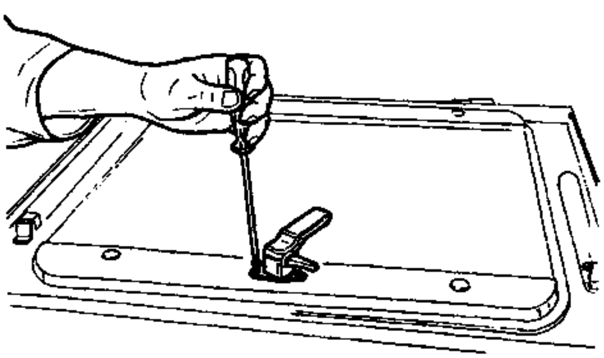
19819

3. Remove the hatch retainer rings from hinge pins.



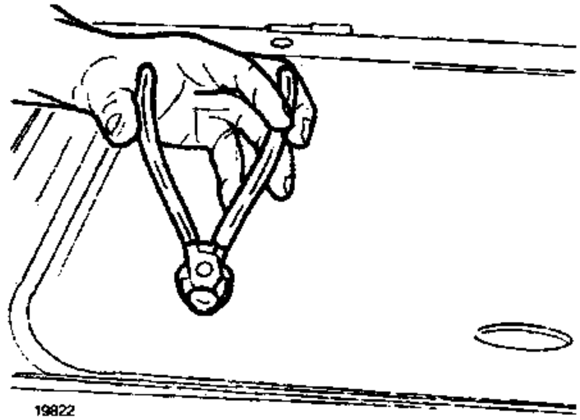
19820

4. Remove complete safety hatch from cab frame.



19821

5. Remove the hatch closing handle and associated Phillips screws.



19822

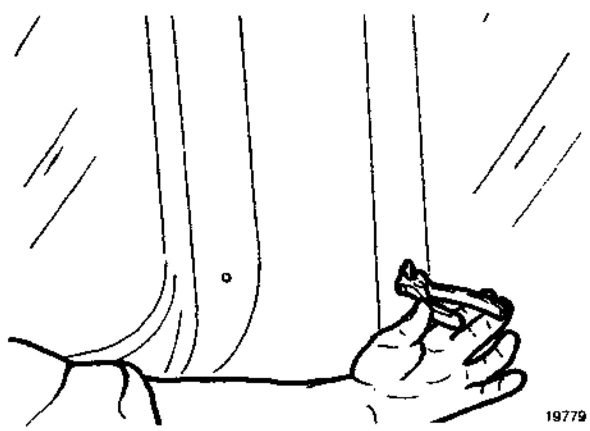
6. Remove the four plugs securing the hatch lining pad and finally the pad itself.

7. Proceed for the installation of the cab safety hatch by reversing the previous sequence of operations, staring from no. 6 back to no. 1. See illustrations of pages 90–14 and 90–15 for the correct placement of parts.

ATTENTION – In case of seal replacement, lubricate it with FIAT "PARAFLU" fluid or a soapy solution. Absolutely avoid using oil or grease which would affect negatively the life of the seal.

R.H. OR L.H. SIDE PILLAR TRIM
Replacement (Op. 90 160 16)

Proceed as follows:



19779

1. Remove the attaching plastic plugs and take off the trim from the cab frame pillar.

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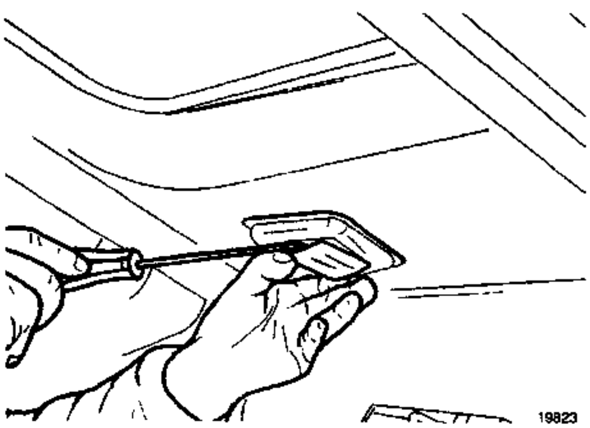
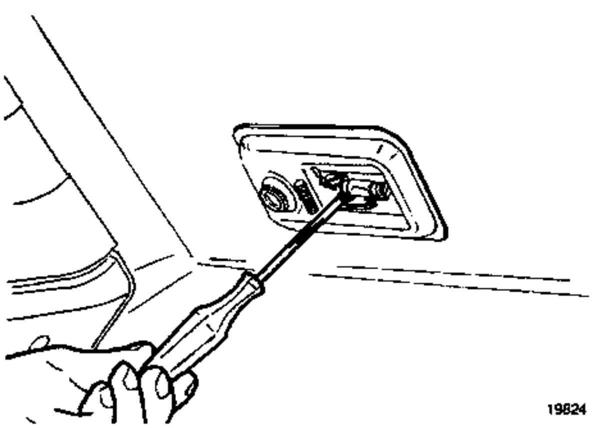
2. For re–fitting parts, reverse the removal procedure previously indicated.

REAR CAB HEADLINER
Replacement (Op. 90 160 60)

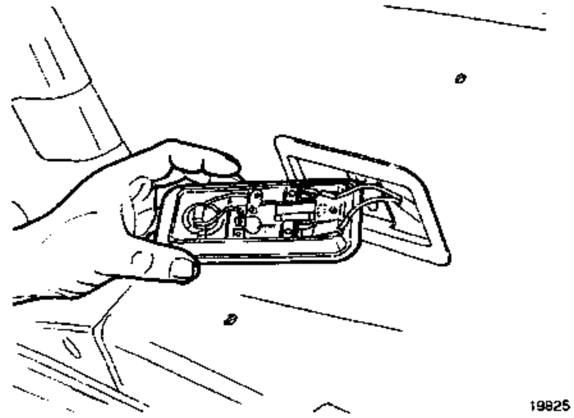
Proceed as follows:



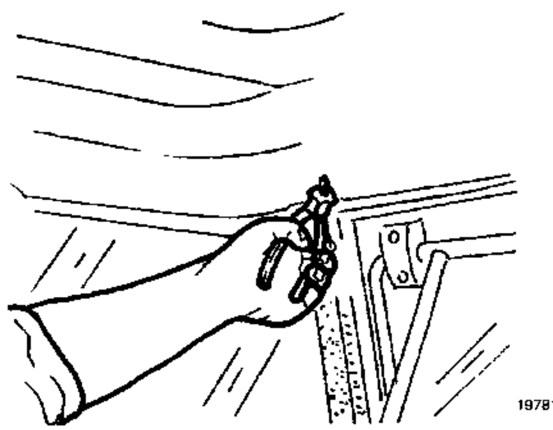
1. Using a screwdriver snatch off the roof lamp glass (plastics).



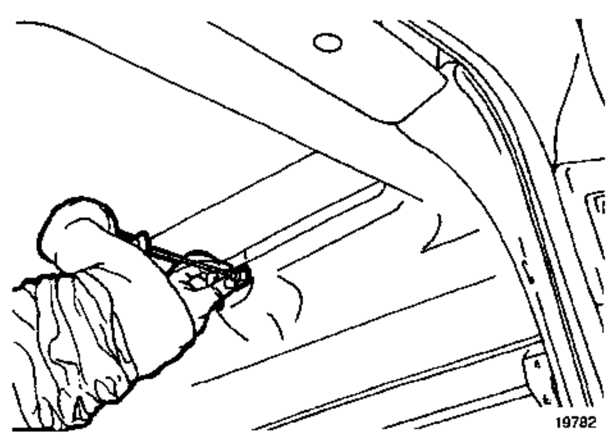
2. Remove the two Phillips screws securing the cab roof lamp.



3. Disconnect ground and current wires, remove lamp.



4. Remove plastic plugs securing the roof panel.



5. Remove the safety hatch fixed support cross–slotted head screws and then the support itself.

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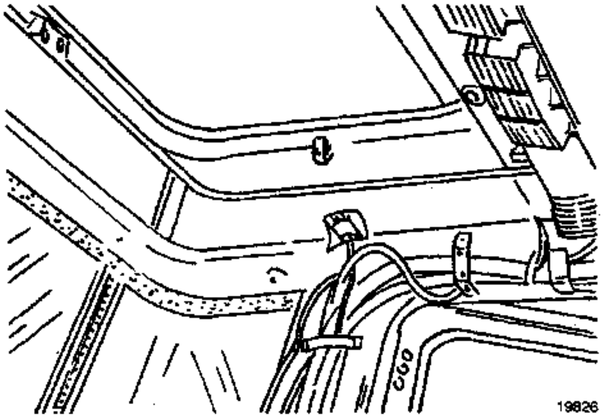
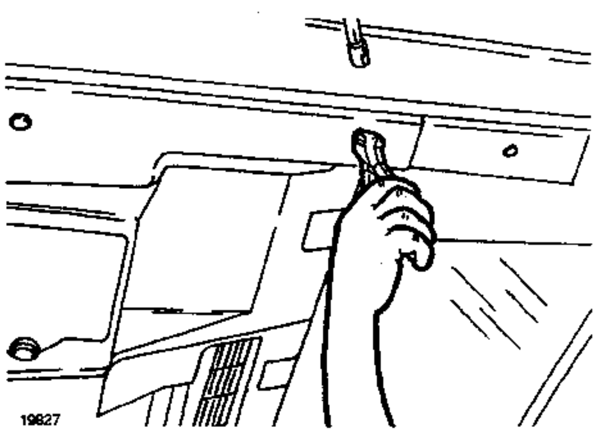


6. Remove the cab rear headliner.

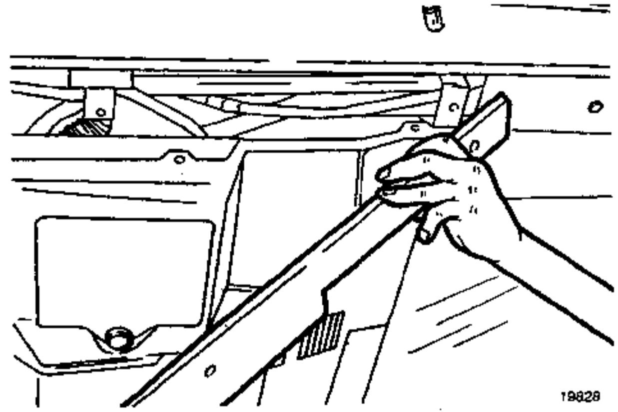
7. Proceed for the fitting of the cab rear roof liner by reversing the previous sequence of operations, starting from no. 6 back to no. 1. See illustrations of pages 90–16 and 90–17 for the correct placement of parts.

CAB FRONT LEFT–HAND SIDE HEADLINER
Disassembly–Assembly (Op. 90 160 62 – 90 160 64)

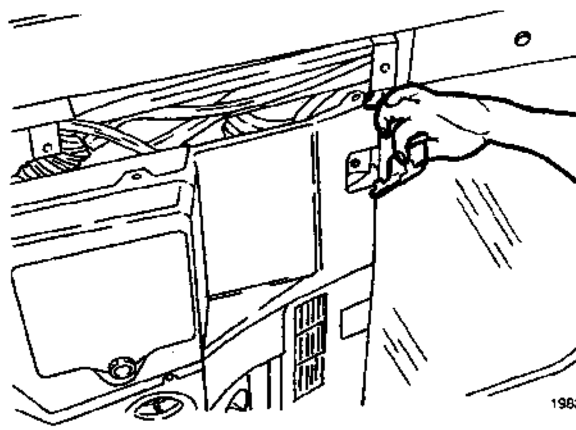
For disassembly, proceed as follows:



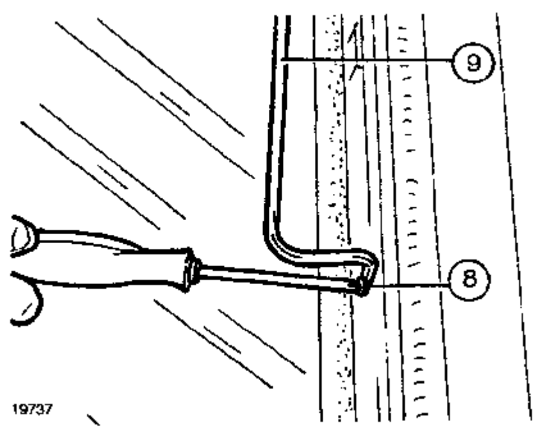
1. Remove plugs securing the cab front left–side lining strip.



2. Remove strip.



3. Remove the cover of the screw securing the left–front side roof lining.



4. Remove attaching cross–slotted head screws (8) then take off the sun blind guides (9).

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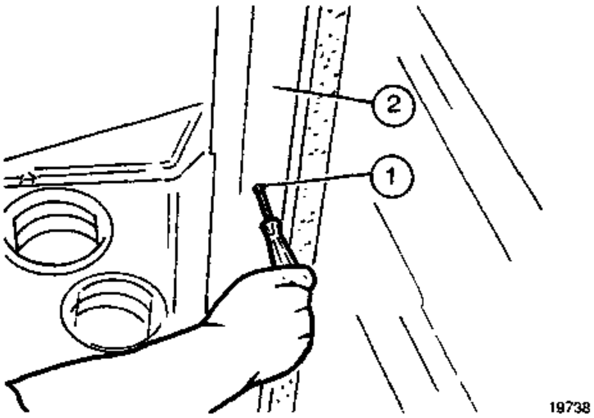
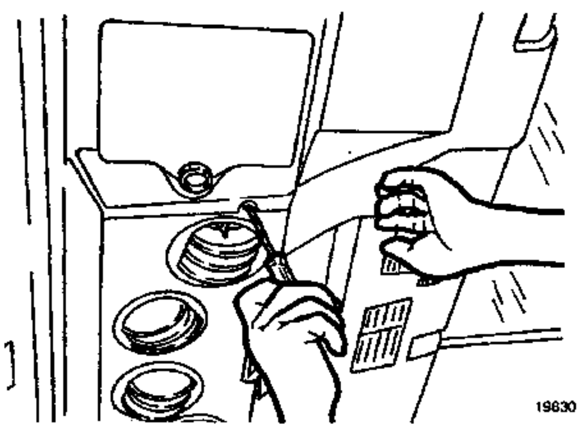
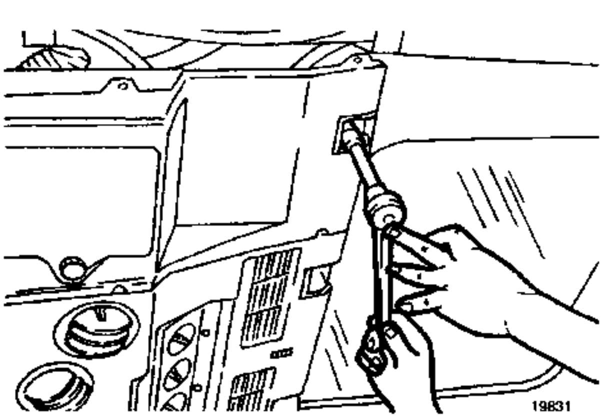


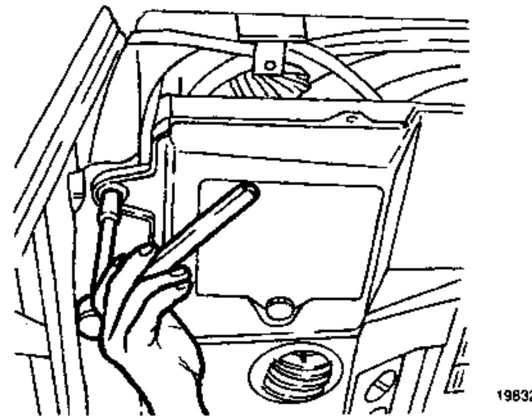
5. Remove the attaching screws and sun blind (2) using a a Philipps–head screwdriver (1).



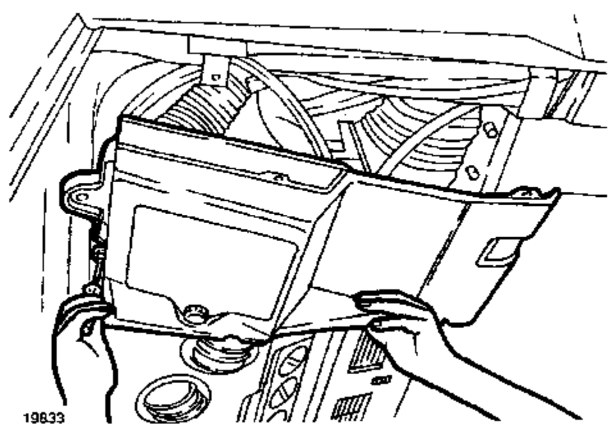
6. Still using a Phillips–head screwdriver, remove the cab front left–side roof lining attaching screws.



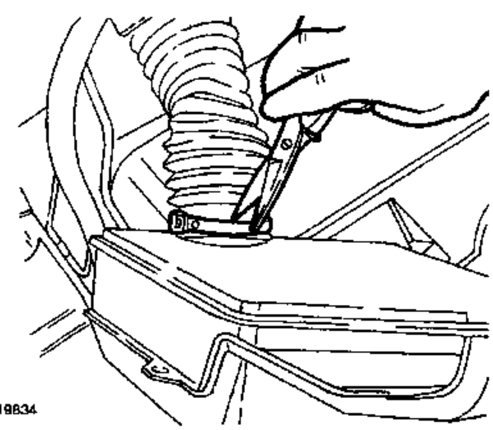
7. Remove, using a socket wrench, the rear attaching screw of the cab front left–side roof lining.



8. Remove, still using a socket wrench, the front attaching screw of the cab front left–side roof lining.



9. Using a Phillips–head screwdriver, remove the front attaching screw of the left side roof lining.



10. Remove the plastic band clamp securing the air intake bellow hose for the cab pillar lower end.

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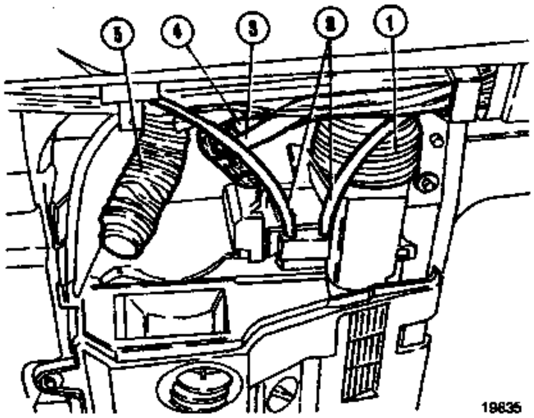


19835

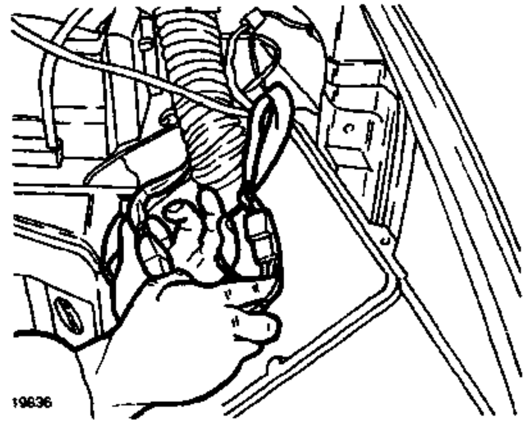
11. Remove the cab front left–side headliner.

NOTE: Completion of this operation allows gaining access to the following parts and components: 1. Bellow hose for outside air intake at cab rear end – 3. Evaporator expansion valve return lines – 4. Evaporator expansion valve delivery line – 5. Bellow hose for air delivery to the lower end of the cab frame left–hand pillar – 8. Air conditioner condensation discharge line, left–hand side.

12. Proceed for the installation of the cab front left–side headliner by reversing the sequence of the previous operations, starting from no. 11 back to no. 1. See illustrations of pages 90–17 through 90–19 for the correct placement of parts.

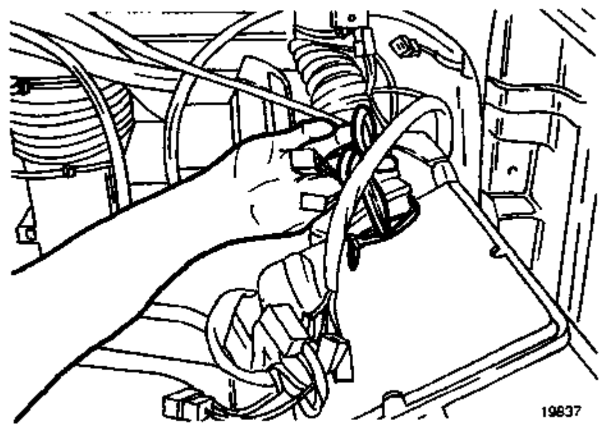
CAB FRONT RIGHT–HAND SIDE HEADLINER
Disassembly–Assembly (Op. 90 160 62 – 90 160 64

Carry out the first part of the disassembly of the cab front right–side headliner, following the sequence of operations 1 through 9, reported on pages 90–17 and 90–18 for the disassembly of the left–side headliner, and complete it as follows



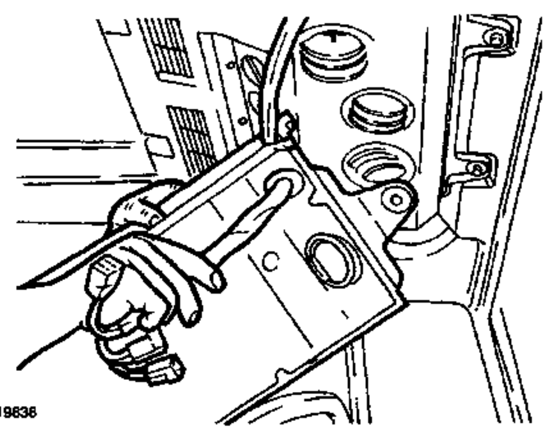
19836

10. Disconnect electric wiring, making sure to mark connections for assembly.



19837

11. Remove the air intake bellow hose plastic band clamp on the lower end of the cab frame pillar, right–hand side.



19838

12. Remove the right–hand side front headliner, sliding out the cable with electric connections.

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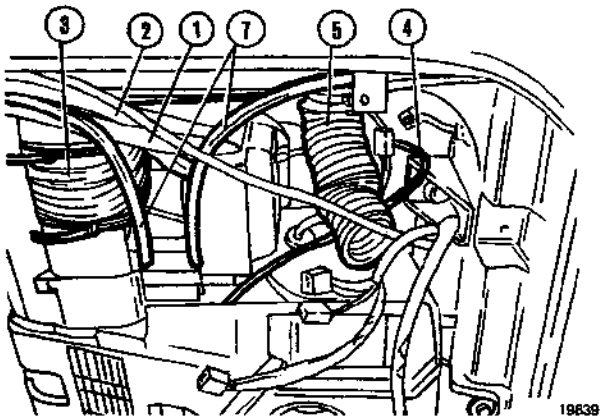
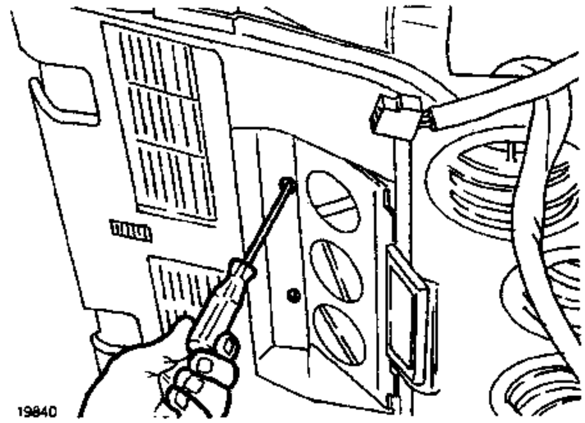


NOTE: With this last operation , disassembly is completed and access can be gained to the following parts: 1. Delivery line to heater unit – 2. Return lines from heater – 3. Bellow hose for outside air intake on cab rear end – 4. Heater cock opening control cable – 5. Bellow hose for air delivery to lower end of cab frame left–hand pillar– 7. Air conditioner condensation discharge, right–hand side.

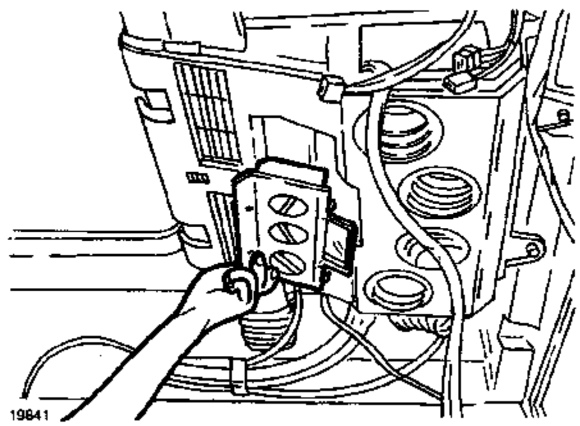
13. Proceed for the assembly of the cab front right–side headliner by reversing the sequence of the previous operations starting from no. 12 back to 1. See illustrations of pages 90–17 through 90–20 for the correct placement of parts.

CAB FRONT CENTRAL HEADLINER
Disassembly–Assembly

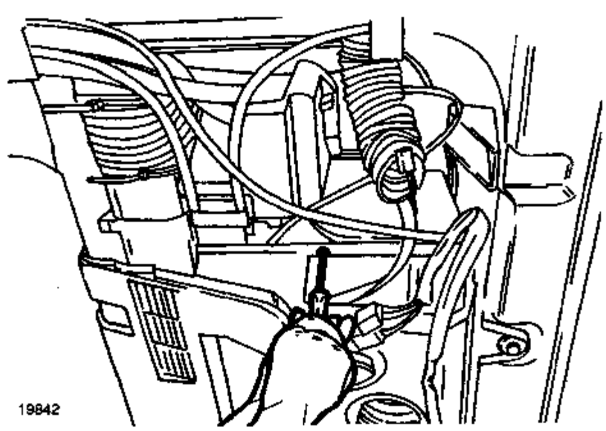
Disassemble the cab front headliners, right–hand and left–hand side, following the sequence of operations described on pages 90– 17, 90–18 and 90–19 and complete the disassembly procedure with the operations listed further on:



1. Using a Phillips–head screwdriver remove the two screws securing the inside temperature regulation control plate.



2. Disconnect wiring taking note of connections for assembly, remove control plate.



3. Using a Phillips–head screwdriver remove the central roof liner attaching screws.

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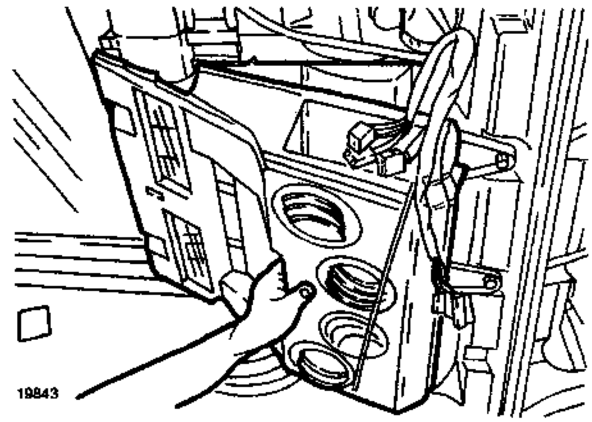
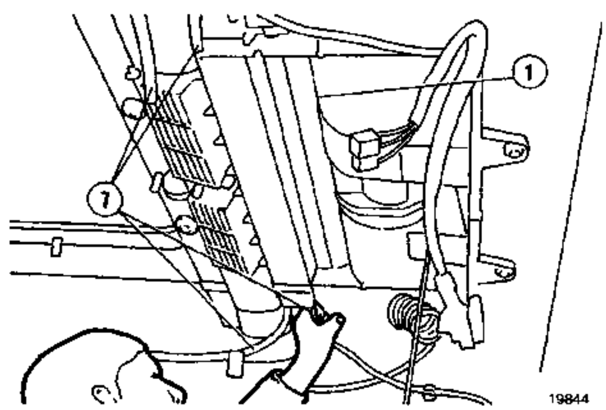


4. Remove the cab front central headliner.



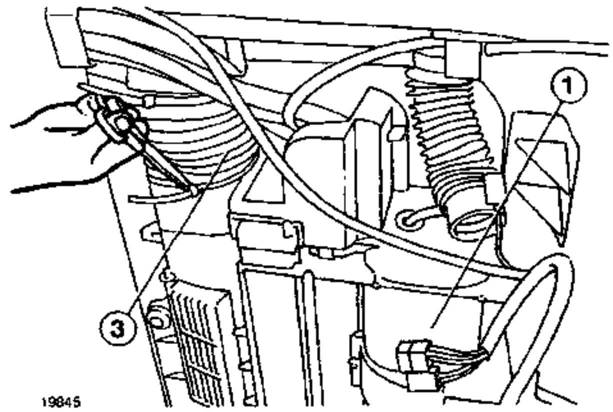
NOTE: Should replacement of support (1) be necessary, the following must be further removed:

5. Evaporator unit, as dealt with in operations 1 through 10, pages 26 to 27, Section 50.

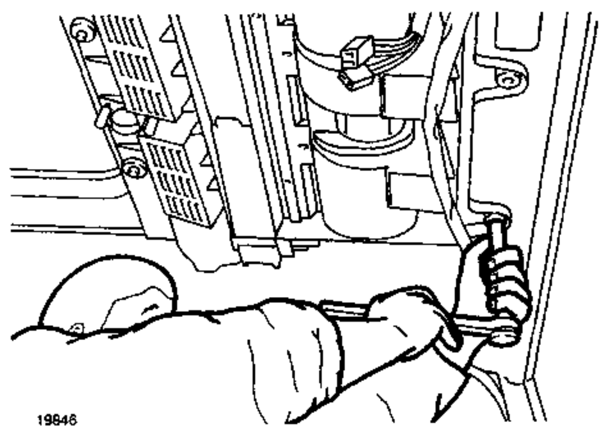
6. Electric fan, as dealt with in operations 6 through 9, pages 45 and 46, Section 50.

7. Cab heater unit, as per operations 6 through 16, pages 47 and 48, Section 50.

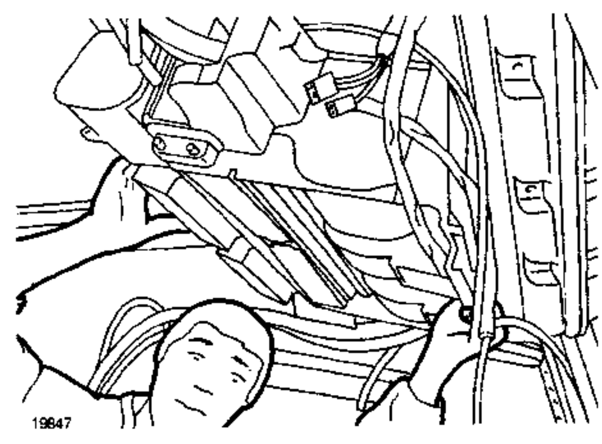
8. Withdraw the four air conditioner condensate discharge lines (7).



9. Remove clamps and bellow hoses (3)connecting the cab right–hand and left–hand side outside air intakes with support (1).



10. Remove, using a socket wrench, the four attaching screws.



11. Remove plastic support from cab frame.
12. Proceed for the assembly of the cab front central headliner by reversing the sequence of previous disassembly starting from no. 11 back to no. 1.
Assemble, subsequently, the cab front right and left–side headliner as indicated on pages 90–19 and 90–20.
As for operations 5, 6 and 7, at assembly, follow attentively the precautions and notices described in the specific paragraphs.

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