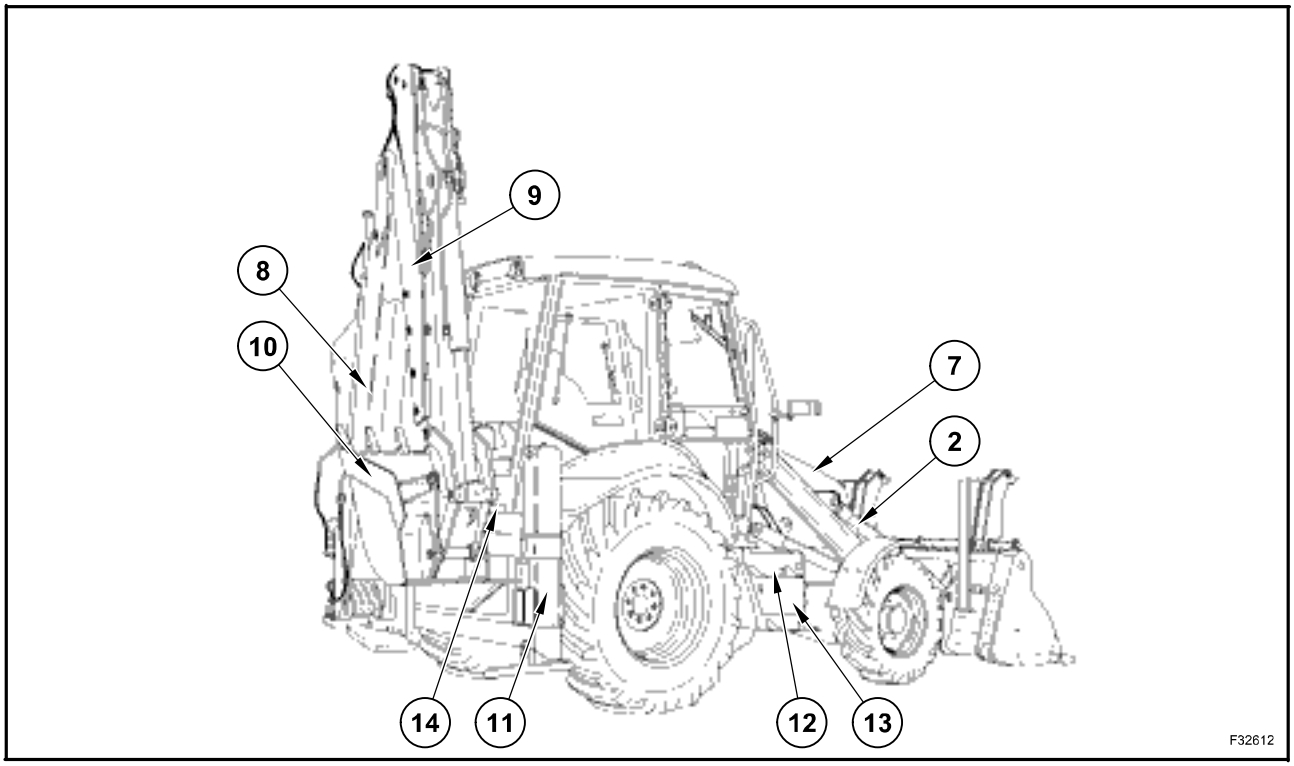
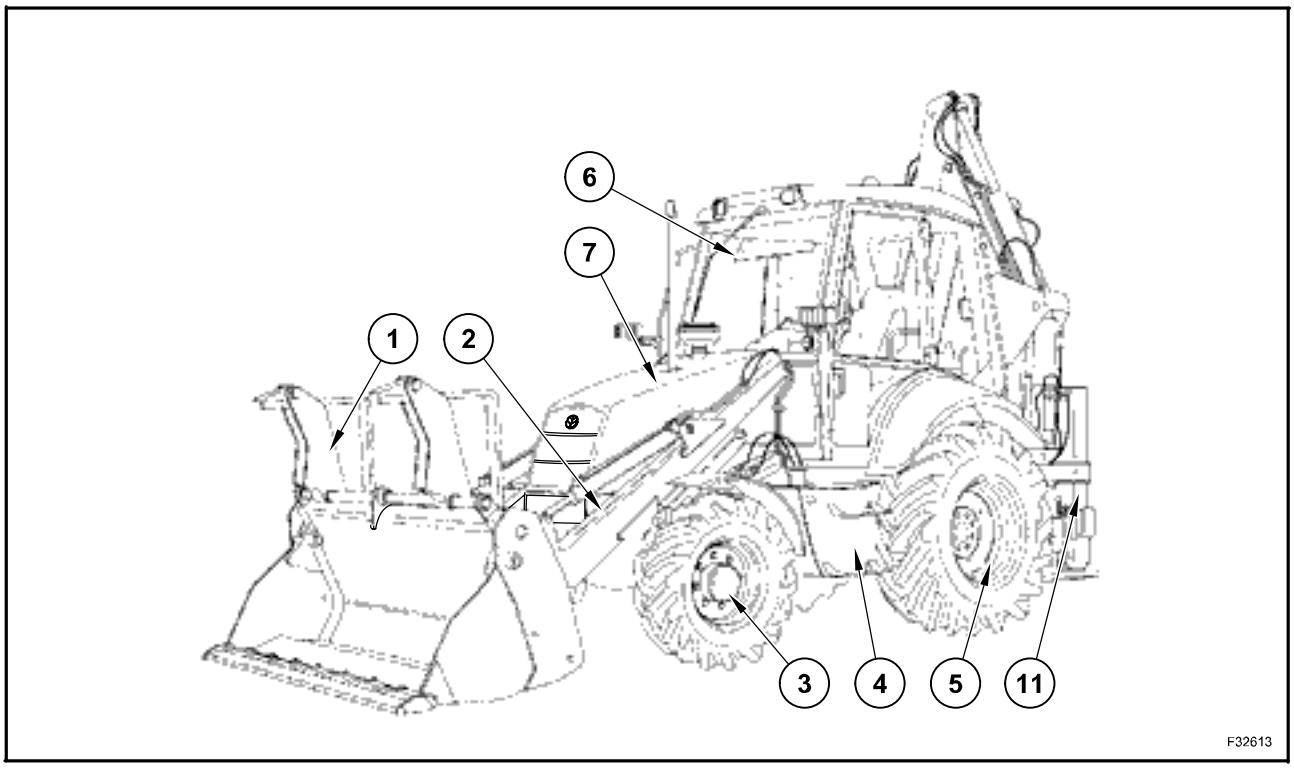
SAFETY RULES

- Carefully follow specified repair and maintenance procedures.
- Do not wear rings, wristwatches, jewels, unbuttoned or flapping clothing such as ties, torn clothes, scarves, open jackets or shirts with open zips which could get hold into moving parts.
  We advise to use approved safety clothing such as anti-slipping footwear, gloves, safety goggles, helmets, etc.
- Never carry out any repair on the machine if someone is sitting on the operator's seat, except if they are certified operators to assist in the operation to be carried out.
- Never operate the machine or use attachments from a place other than sitting at the operator's seat.
- Never carry out any operation on the machine when the engine is running, except when specifically indicated.
- Stop the engine and ensure that all pressure is relieved from hydraulic circuits before removing caps, covers, valves, etc.
- All repair and maintenance operations should be carried out with the greatest care and attention.
- Service stairs and platforms used in a workshop or in the field should be built in compliance with the safety rules in force.
- Disconnect the batteries and label all controls to warn that the Machine is being serviced. Block the machine and all equipment which should be raised.
- Never check or fill fuel tanks and accumulator batteries, nor use starting liquid if you are smoking or near open flames as such fluids are flammable.
- Brakes are inoperative when they are manually released for maintenance purposes. In such cases, the machine should be kept constantly under control using blocks or similar devices.
- The fuel filling gun should remain always in contact with the filler neck.
  Maintain this contact until the fuel stops flowing into the tank to avoid possible sparks due to static electricity buildup.
- Use exclusively specified towing points for towing the machine. Connect parts carefully.
  Ensure that foreseen pins and/or locks are steadily fixed before applying traction.
  Do not stop near towing bars, cables or chains working under load.
- To transfer a failed machine, use a trailer or a low loading platform trolley if available.
- To load and unload the machine from the transportation mean, select a flat area providing a firm support to the trailer or truck wheels. Firmly tie the machine to the truck or trailer platform and block wheels as required by the forwarder.
- For electrical heaters, battery-chargers and similar equipment use exclusive auxiliary power supplies with a efficient ground to avoid electrical shock hazard.
- Always use lifting equipment and similar of appropriate capacity to lift or move heavy components.
- Pay special attention to bystanders.
- Never pour gasoline or diesel oil into open, wide and low containers.
- Never use gasoline, diesel oil or other flammable liquids as cleaning agents. Use non-flammable non-toxic proprietary solvents.
- Wear protection goggles with side guards when cleaning parts using compressed air.
- Do not exceed a pressure of 2.1 bar (30 psi), in accordance with local regulations.
- Do not run the engine in a closed building without proper ventilation.
- Do not smoke, use open flames, cause sparks in the nearby area when filling fuel or handling highly flammable liquids.
- Do not use flames as light sources when working on a machine or checking for leaks.
- Move with caution when working under a Machine, and also on or near a Machine. Wear proper safety accessories:
  helmets, goggles and special footwear.
- During checks which should be carried out with the engine running, ask an assistant to sit at the operator's seat and keep the service technician under visual control at any moment.
  In case of operations outside the workshop, drive the machine to a flat area and block it. If working on an incline cannot be avoided, first block the Machine carefully. Move it to a flat area as soon as possible with a certain extent of safety.
- Ruined or plied cables and chains are unreliable. Do not use them for lifting or trailing. Always handle them wearing gloves of proper thickness.
- Chains should always be safely fastened. Ensure that fastening device is strong enough to hold the load foreseen. No persons should stop near the fastening point, trailing chains or cables.
- The working area should be always kept CLEAN and DRY. Immediately clean any spillage of water or oil.
- Do not pile up grease or oil soaked rags, as they constitute a great fire hazard. Always place them into a metal container. Before starting the Machine or its attachments, check, adjust and block the operator's seat. Also ensure that there are no persons within the Machine or attachment operating range.
- Do not keep in your pockets any object which might fall unobserved into the Machine's inner compartments.

2. IDENTIFICATION OF MAIN COMPONENTS





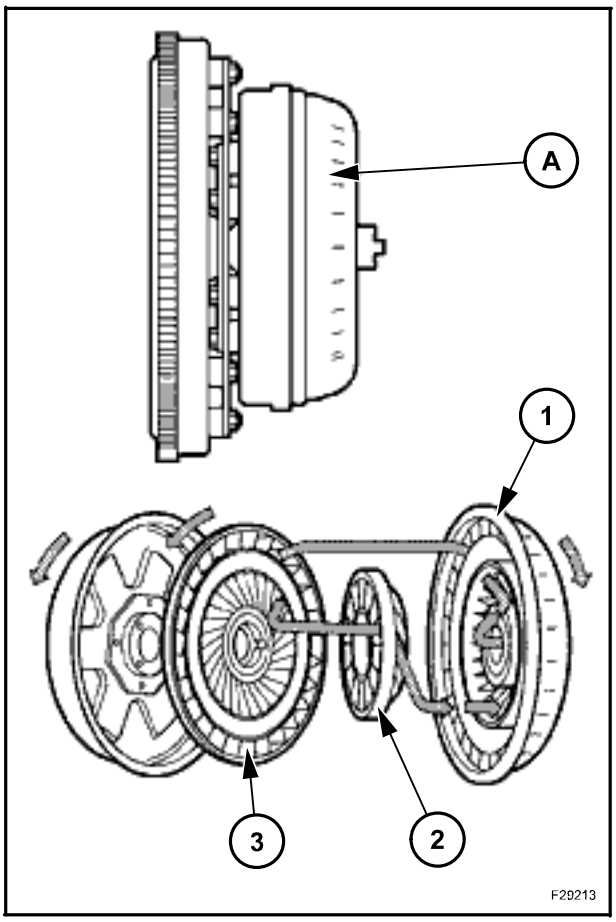
1. Loader bucket
2. Loader arm
3. Front axle (2WD or 4WD)
4. Fuel tank
5. Rear axle
6. Operator's compartment - cab
7. Engine side guards
8. Backhoe boom
9. Backhoe dipper or telescopic dipper
10. Backhoe bucket
11. Stabilizers
12. Battery box
13. Oil tank
14. Swing cylinders

1. POWERSHUTTLE TORQUE CONVERTER

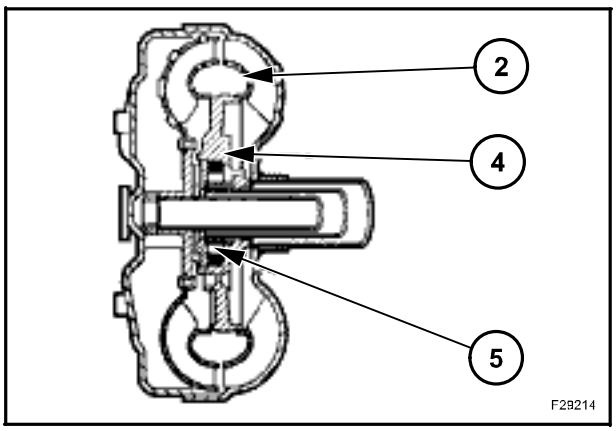
1.1 DESCRIPTION AND OPERATION

The torque converter is the connection between the engine and the transmission and is hydraulically actuated. The main parts of the torque converter (A) are the impeller (pump), the turbine, the stator and the front and rear covers. The impeller is integral with the rear cover and is driven by the engine flywheel by means of a drive plate.
The stator, is splined to a stationary shaft (stator support) through a one-way clutch that permits the stator to rotate only in the same direction as the impeller. All of the converter parts are enclosed in an oil-filled housing. The front and rear cover, being welded together, form the housing.
The turbine (2), splined to the front input shaft, is splined to a stationary shaft (stator support) through a one-way clutch that permits the stator (3) to rotate only in the same direction as the impeller (1). All of the converter parts are enclosed in an oil-filled housing. When the engine is running, the oil in the converter flows from the impeller (1) to the turbine (2) and back to the impeller through the stator (3). This flow produces a maximum torque increase.

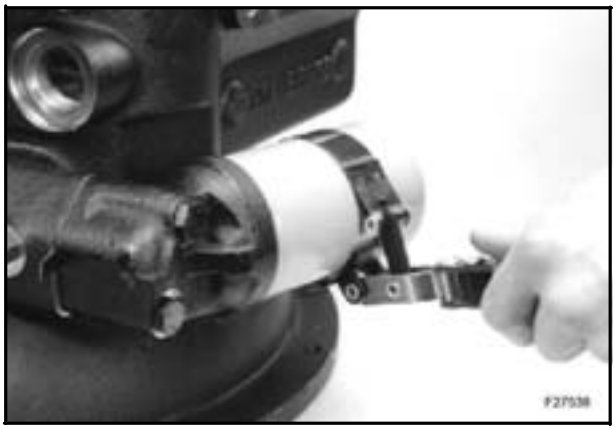
When enough oil flow is developed by the impeller, the turbine begins to rotate, driving the front input shaft. The torque multiplication gradually decreases as turbine speed approaches impeller speed, and becomes 1 to 1 when the turbine is being driven at nine tenths impeller speed.



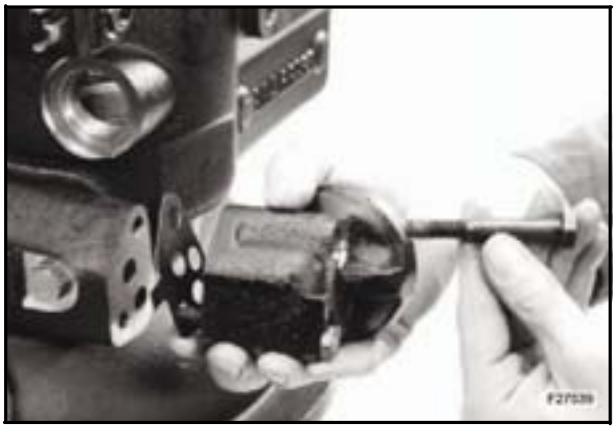
When the turbine (2) is rotating at approximately nine tenths impeller speed, the converter stops multiplying torque because the oil is now acting on the rear face of the stator blades (4). The action of the oil on the rear face of the stator unlocks the one-way clutch (5), permitting the stator to rotate in the same direction as the turbine (2) and impeller (1). Through this action the converter becomes an efficient fluid coupling by transmitting engine torque from the impeller to the turbine. To achieve optimum operation the engine performance, transmission ratios, hydraulic power delivery and converter torque multiplication are all “Matched” to provide the necessary vehicle drive torque when required. When the turbine is rotating less than nine tenths impeller speed (1), the converter is multiplying torque through the action of the stator (3). This action, produced by oil acting on the front face of the stator blades, tends to rotate the stator in the opposite direction of the impeller (1) and turbine (2). However, the one-way clutch prevents this opposite rotation and allows the stator to direct oil back to the impeller, thereby producing torque multiplication. Maximum torque multiplication is achieved when the impeller is driven at stall speed and the turbine is stationary.



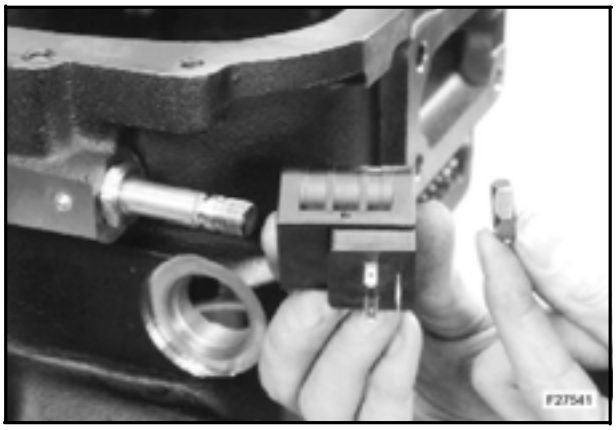
Using a strap wrench remove and discard the oil filter.



Remove 2 bolts and take of the oil filter housing and the gasket.

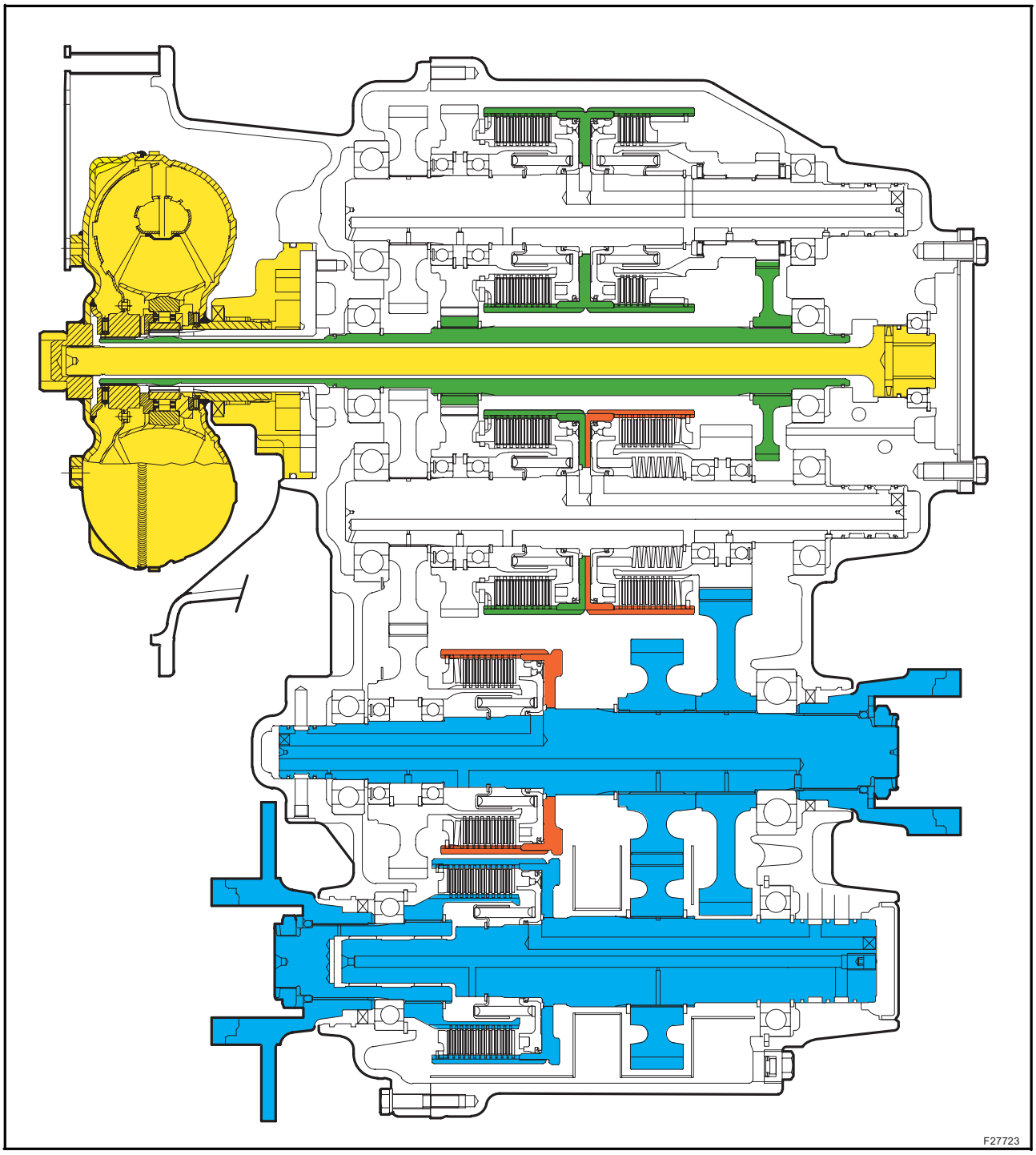


Remove the 4WD solenoid coil and retaining nut.



Remove the 4WD solenoid spool.

Basically the transmission is composed of five main assemblies:



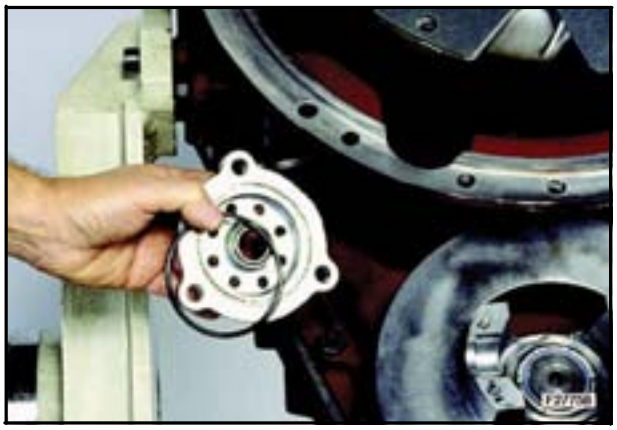
The converter and pump drive section
The input or directional clutches
The range clutches
The output section

TRANSMISSION DISASSEMBLY

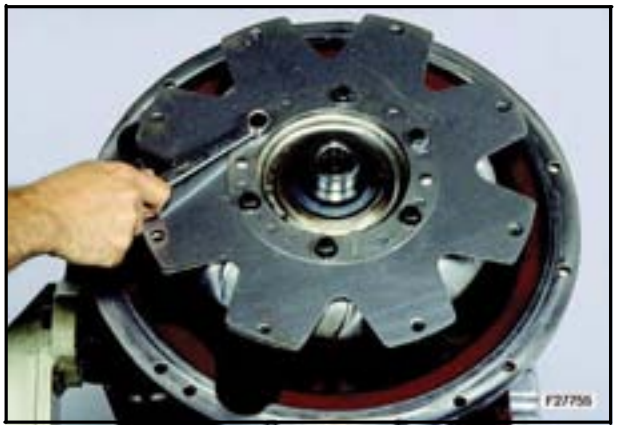
Remove the oil filter.

Remove the filter adapter screws.

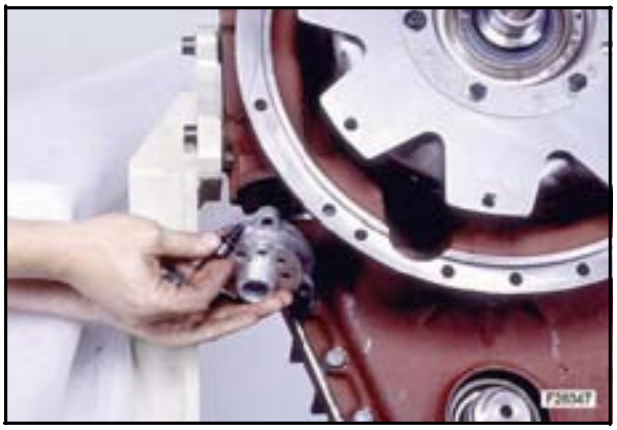
Remove the filter adapter with the O-ring.



Remove the drive plate screws.

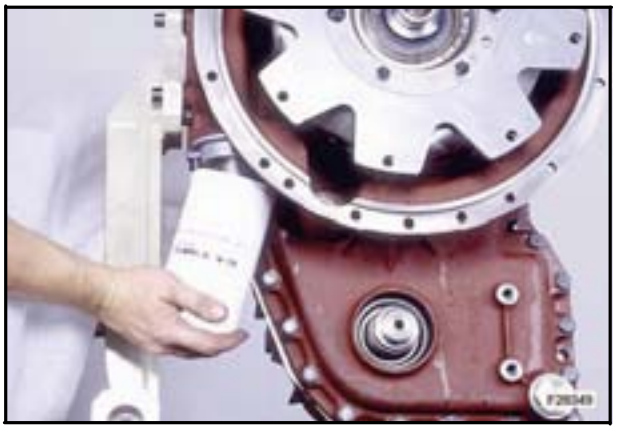


Install the filter adapter, the O-ring, the lock washers and the mounting screws.



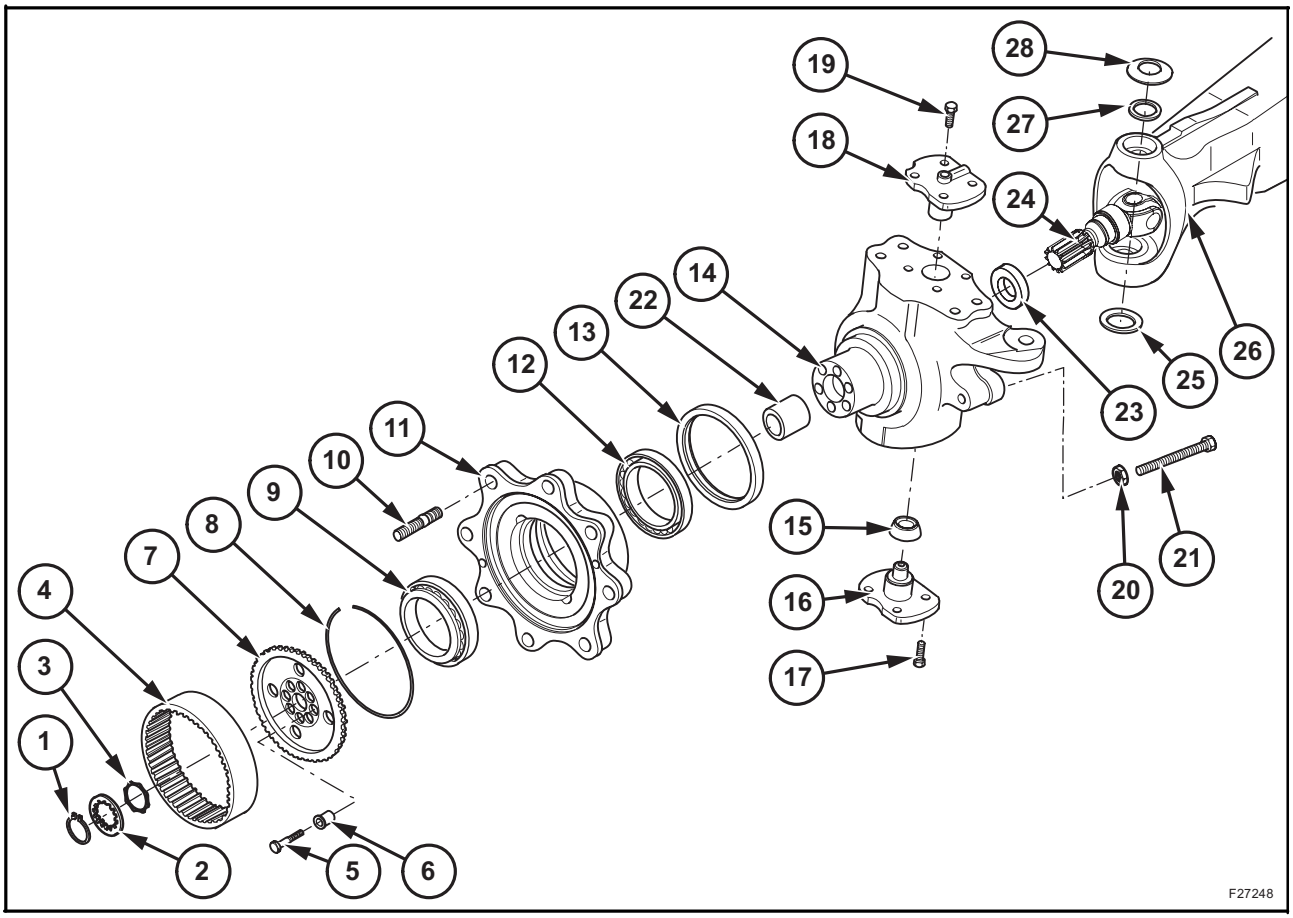
Tighten the screws.

Install the oil filter and tighten to 30 - 38 Nm (22 - 28 lbf·ft).



Install the output shaft front flange, the O-ring, the washer and the nut. Tighten the nut to 339 - 407 Nm (250 - 300 lbf·ft).

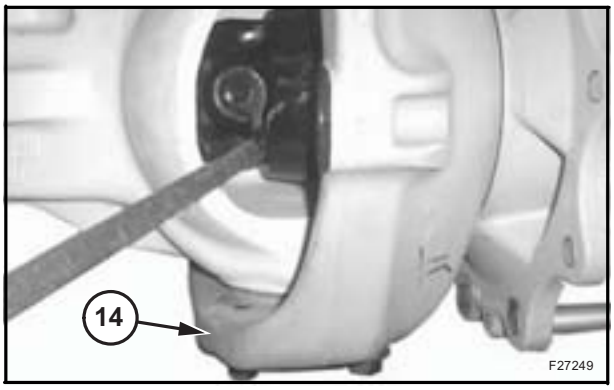
WHEEL HUB



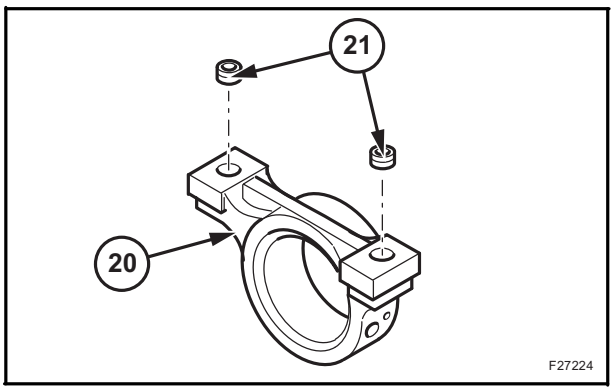
Disassembly

Insert a lever between the swivel housing (14) and the axle beam and fit it into the double U-Joint.
With the lever push the double U-Joint in the direction of the wheel hub to allow the lock ring removal.

⚠ WARNING
Do not damage the double U-Joint.



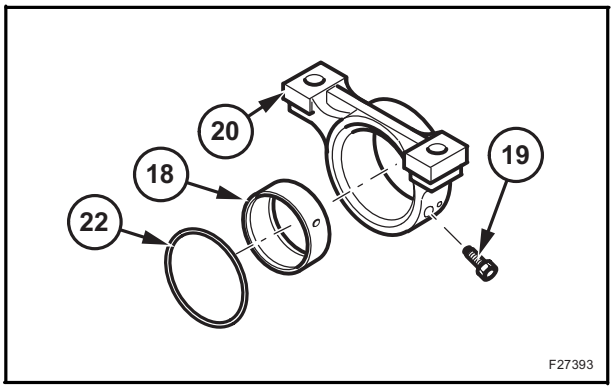
Apply sealant on the bushes (21) contact surface.
Assemble the bushes (21) to the front support (20) with a pad and a hammer.



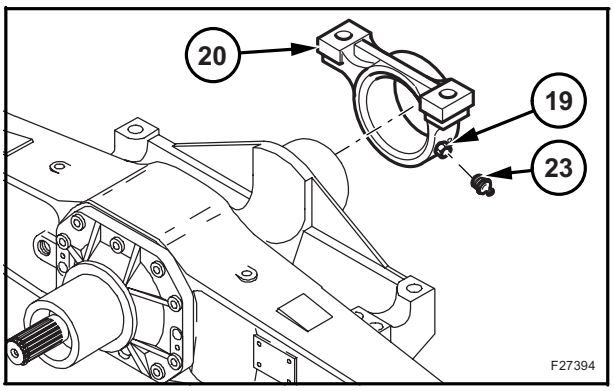
Assemble the bush (18) into the front support (20) with a suitable driver and a hammer.

⚠ WARNING
Align the bush hole with the bolt (19) hole.

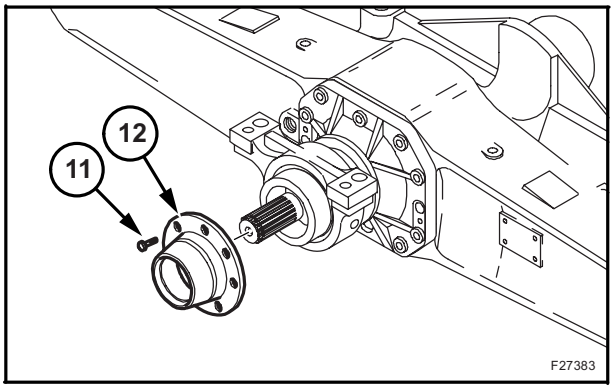
Mount the bolt (19).
Assemble O-ring (22).



Insert the front support (20) on the axle beam.
Tighten the bolt (19) to the requested torque.
Assemble the lube nibble (23).



Assemble the flange (12) and fasten by tightening the screws (11).



2.3 FAULT FINDING

PROBLEM	CAUSE										
	1	2	3	4	5	6	7	8	9	10	11
Wheel vibration; front tyre resistance; half shaft breakage	●	●	●		●						●
Steering is difficult; vehicle goes straight while it's turning	●	●	●	●							●
No differential action; jamming while steering	●			●	●						●
Transmission excessively noisy	●	●	●	●	●		●		●		●
Uneven wear of tyre	●	●	●	●	●	●	●				●
Friction noise	●			●	●			●	●	●	●
Vibration during forward drive, intermittent noise	●	●	●		●						●

1. Incorrect installation / defective axle
Correct installation or repair or replace the differential in case it does not survive any one of the test phases.

2. Overloading / incorrect weight distribution
Remove excessive weight and redistribute load, following instructions related to the vehicle.

3. Different rotation radius of the tyres
If one tyre has a smaller radius, it will cause partial wheel slipping when force is applied. The other tyre with bigger radius will have to support all the work. Replace the tyre or adjust pressure to have same radius on both tyres.

4. Broken half shaft
It is not advisable to operate the vehicle with a broken half shaft. It is acceptable to move the vehicle (engine off unloaded) a few metres away only.

5. Bent half shaft
Replace half shaft.

6. Blocked differential
Abnormal functioning of the differential or breakage/blockage of command device. Verify assembly and all components. Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp turns. Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.

7. Incorrect wheel adjustment
Verify group integrity and wheel side bearings.
Adjusting according.

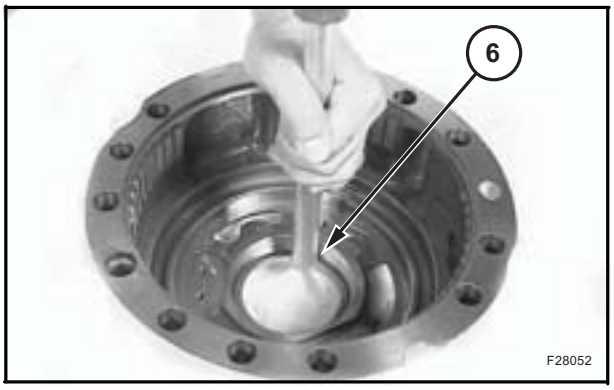
8. Spoiled or worn out axle parts
Check the condition of ring gear, pinion gear, bearings etc.
Replace whenever necessary.

9. Contamination in the axle box or incorrect assembly of parts
Look for foreign particles. Check assembly of the various parts of the axle.

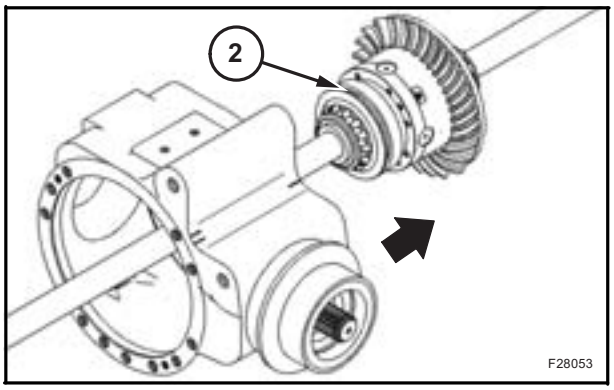
10. Incorrect adjustment of the bevel gear set: Parts of the transmission worn out
(Transmission gears, U joints, etc.). Replace or adjust as required.

11. Incorrect use of the product
See the vehicle producer's instructions once again.

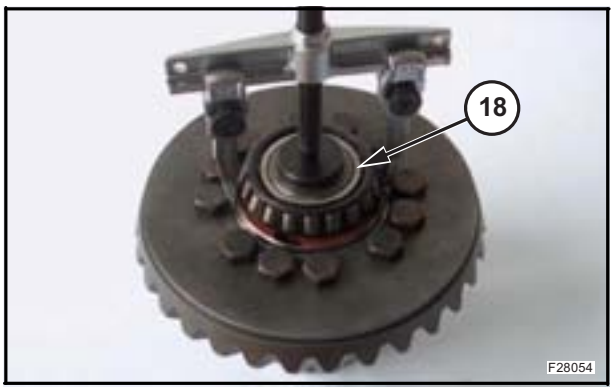
Remove the bearing cups (6) with a hammer.



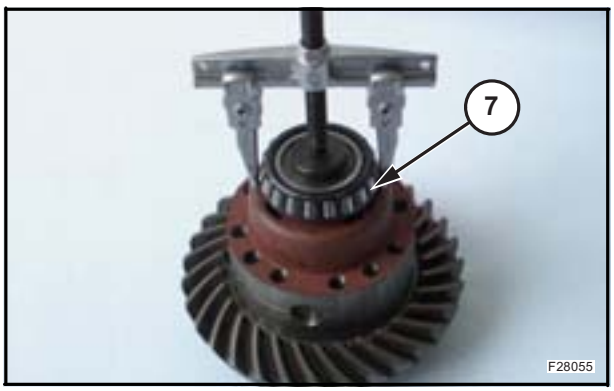
Support the differential box assy (2) with a rod and remove it.



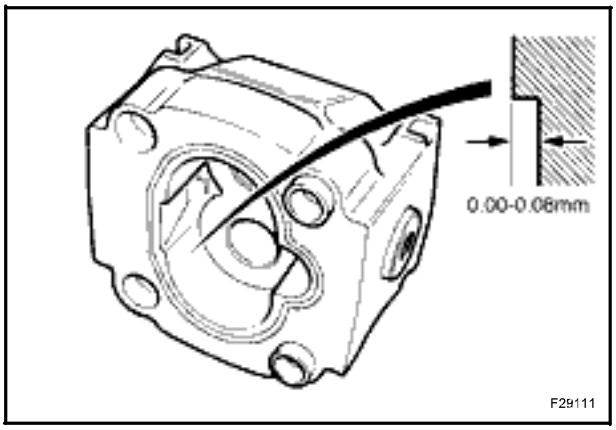
Use an extractor to remove the bearing (18) from the differential unit.



Use an extractor to remove the bearing (7) from the differential unit.



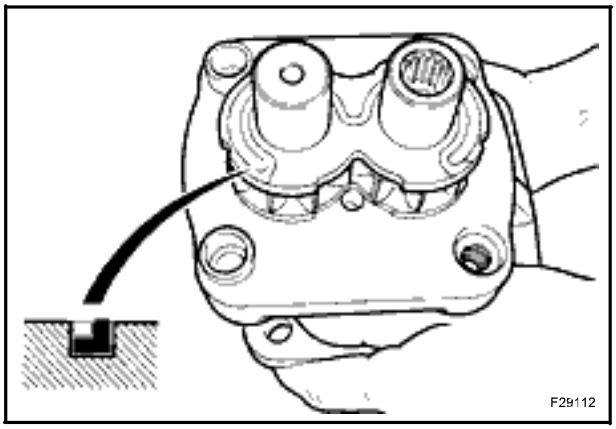
Inspect the wear track cut by the gears in pump body. The body can be reused if the track is bright and polished and does not exceed 0.08 - 0.076 mm (0.0031 - 0.0030 in) in depth.
Examine bearing block faces for scoring and flatness paying particular attention to the face which abuts the gears.
Examine bearing block bushes for scoring.
Examine pump gears for scored or worn side faces, journals and damaged teeth.



If pump block, gears or bearing blocks are worn and require replacement the pump assembly must be replaced.

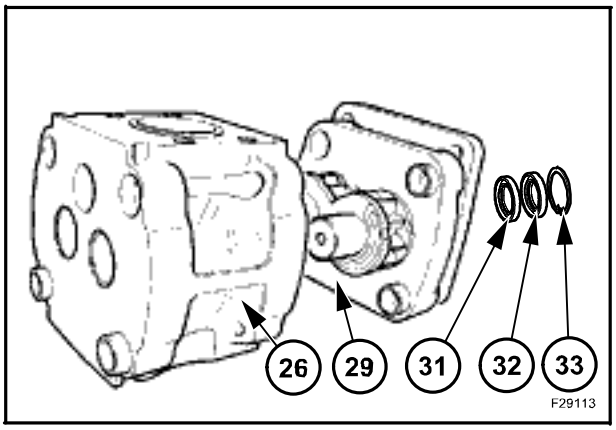
Reassembly follows the disassembly procedure in reverse whilst observing the following:

- Ensure all parts are perfectly clean and lubricate bushes and gears with clean hydraulic fluid.
- Replace all seals and O-rings.
- Install the bearing blocks into the same positions from which they were removed using identification letters scribed during disassembly.
- Ensure plastic back-up seals are correctly positioned in the rubber seal.

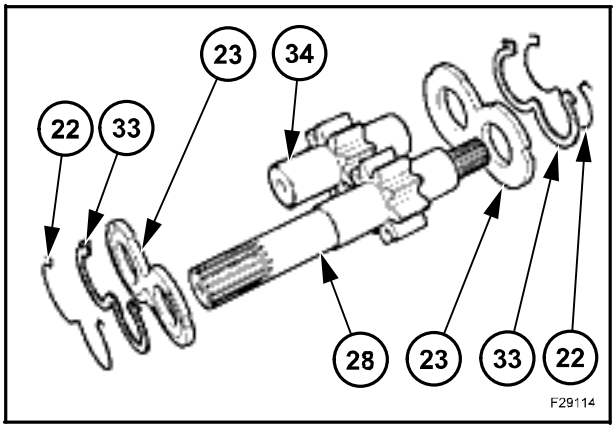


DISASSEMBLY FRONT PUMP

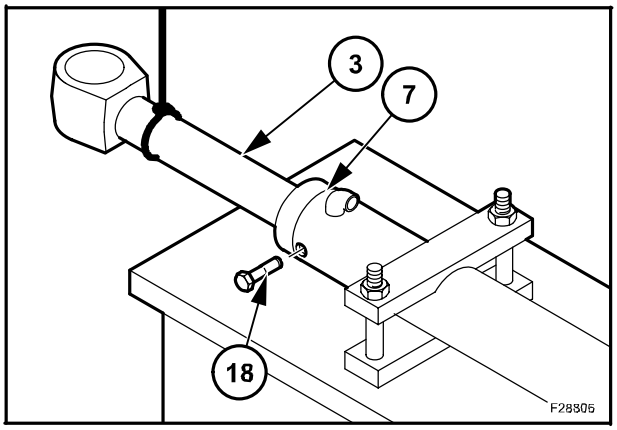
To remove from the pump assembly (26) from the flange (29) it's necessary to remove the snap ring (33).
Remove and replace the flange seals (31) and (32).



Identify and note the position of each bearing block to ensure correct reassembly.
Disassemble the gears (28) and (34), the seals (22) and (33) and the bearings (23).
Wash all components in approved degreasant.

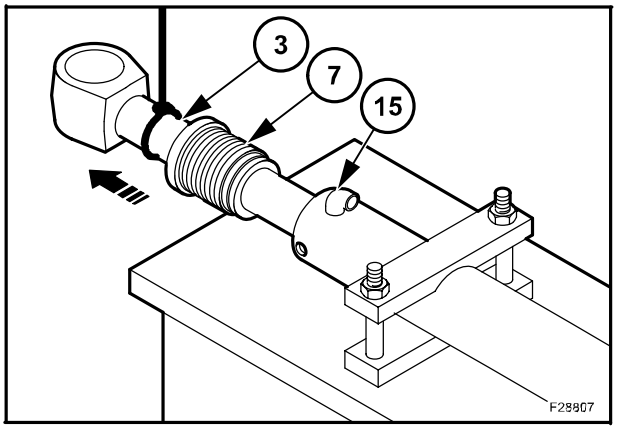


Fully extend the cylinder rod (3).
Remove the safety screw (19). Use the wrench **380000724** to loose the cylinder head (7).
If necessary gently heat the gland carrier to soften the thread sealant applied during manufacture.

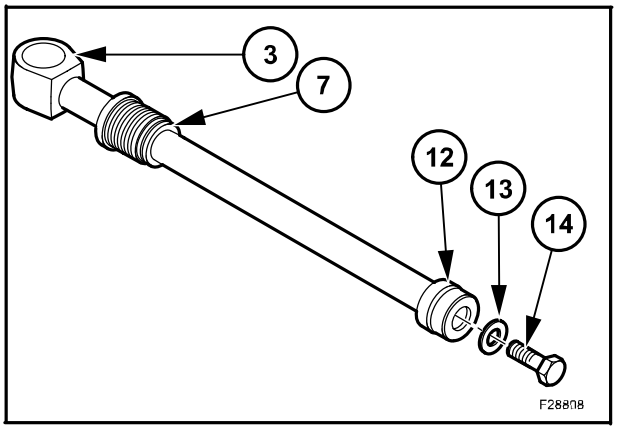


Pull out the cylinder head (7) from the cylinder tube (15) by tapping with a rubber hammer. Remove the cylinder rod (3) and the cylinder head (7).

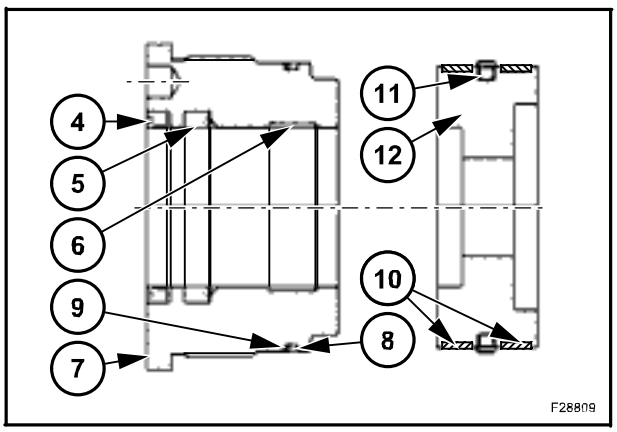
IMPORTANT: be sure to pull out the cylinder rod (3) straight so as not to damage the sliding surfaces.



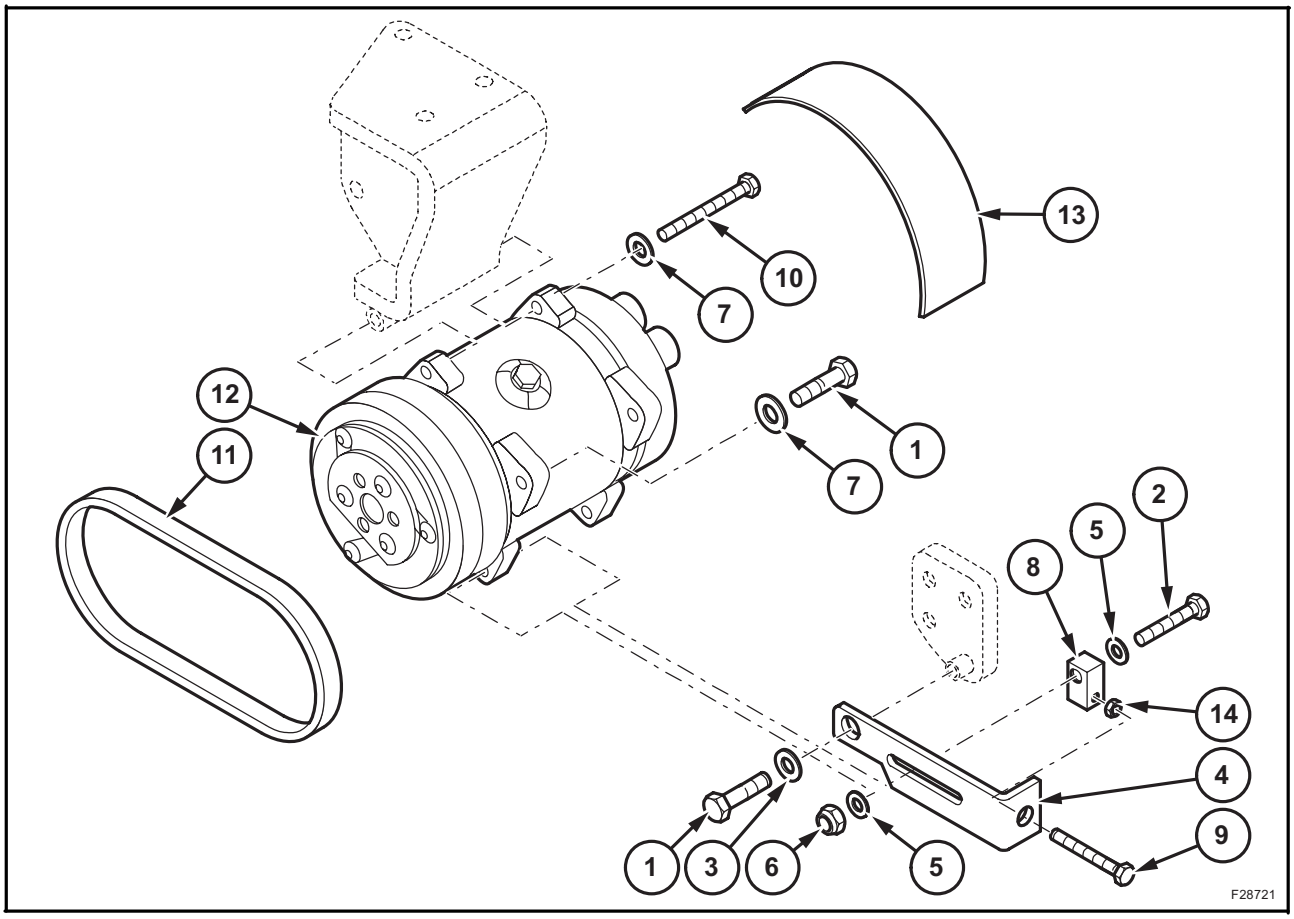
Untighten and remove the screw (15) with the washer (13). Disassembly the cylinder rod (3) and the piston assy (12) and the cylinder head assy (7).



Only if necessary:
- remove from the cylinder head (7), the wiper ring (4), O-ring (5), the guide bush (6), and the back-up ring (8) with O-ring (9);
- remove from the piston (12) the piston ring guides (10) and the piston gasket (11).

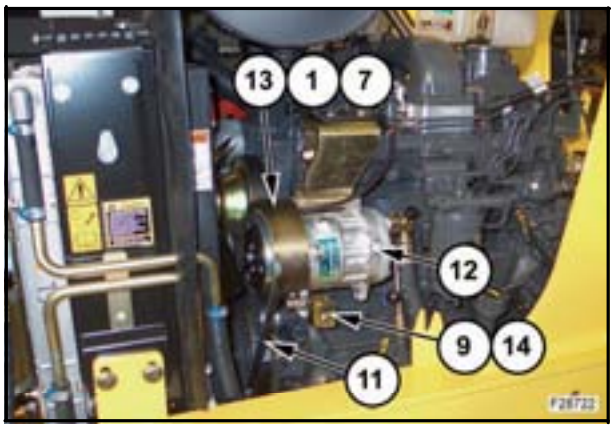


REMOVAL AND INSTALLATION



Removal

Discharge the air conditioning system. Disconnect the electrical harness of the compressor (12) from the electrical harness of the engine. Disconnect tubing to compressor. Remove the washer (7) and the screw (1). Remove the protective guard (13). Remove the bolt (11). Remove the nut (14) and the screw (9).



4.11 WARNING MESSAGES

Function	Fault lamp	Alarm	Lamp	Display lamp	Condition	DTC	SA	Description	Priority	Color
Engine coolant too high		Continuous			Coolant above 112 °C (233.6 °F) for 5 seconds	1002	VCM	Coolant temperature signal - Above normal	1	Red
Engine oil pressure too low		Continuous			Pressure < 26 bar (37.7 psi) rpm>500	3028	ECU	Oil pressure sensor - pressure too low	1	Red
Transmission oil pressure too low		Continuous			Switch closed to ground for 25 seconds	1008	VCM	The engine must be running with switch closed for 25 seconds	1	Red
Malfunction		Continuous			5 seconds without message	1051	ECU	Timeout of message	1	Red
Malfunction		Continuous			25 seconds without message	1053	ECU	Timeout of message	1	Red
Malfunction		Continuous			5 seconds without message	1054	VCM	Timeout of message engine temperature	1	Red
Malfunction		Continuous			5 seconds without message	1055	VCM	Timeout of message inlet/ exhaust	1	Red
Malfunction		Continuous			5 seconds without message	1056	VCM	Timeout of message engine fluid	1	Red
Malfunction		Continuous			5 seconds without message	1057	VCM	Timeout of message vehicle electrical	1	Red
Malfunction		Continuous			5 seconds without message	1059	VCM	Timeout of message display	1	Red
Transmission oil temperature too high		Continuous			Transmission oil above 115 °C (239 °F) for 5 seconds	1009	VCM	Transmission oil temperature limit reached	1	Red