

44 - AUTOMATIC GEARBOX

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ZF4HP22

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44 - AUTOMATIC GEARBOX

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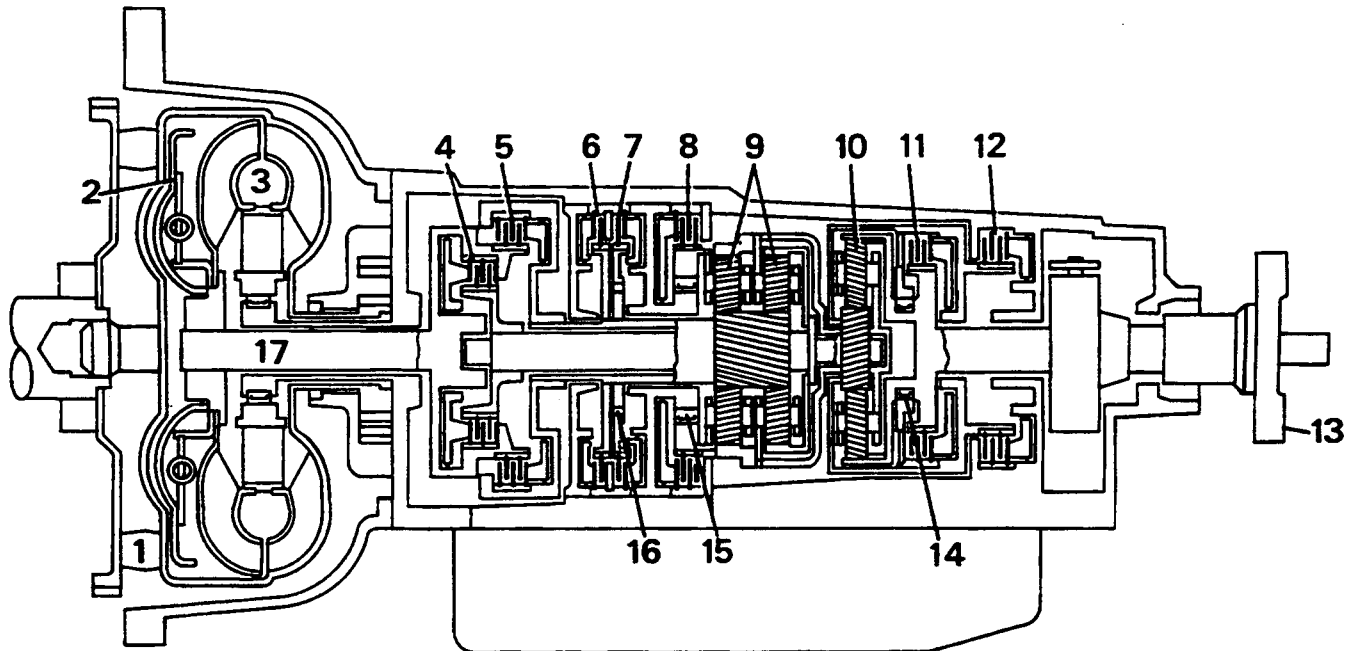
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DESCRIPTION

The automatic transmission is specially tailored version of the ZF4 HP22, used by many manufactures of high performance vehicles.

A three element torque converter delivers the power to a four speed epicyclic transmission. First, second and third gears are reduction ratios but fourth is an overdrive gear for high speed cruising. A direct drive clutch, integral with the torque converter operates to engage fourth gear.



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The gear selector has seven positions as follows:

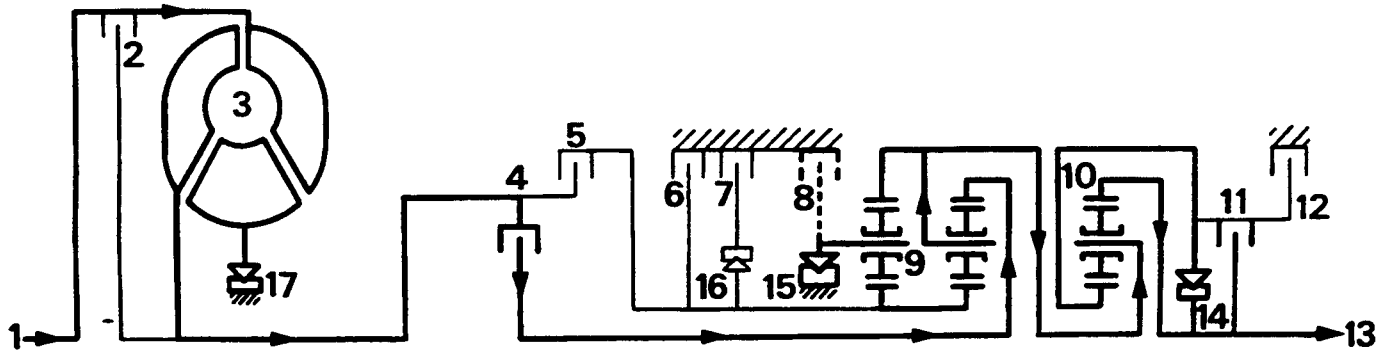
- P = Park provides a mechanical lock on the output shaft.
- R = Reverse gear.
- N = Neutral.
- D = Provides a 1st gear start and automatic shifts 1-2-3-4-3-2-1.
- 3 = Provides a 1st gear start and automatic shifts 1-2-3-2-1.
- 2 = Provides a 1st gear start and automatic shifts 1-2-1 or 3-2-1.
- 1 = Provides a 1st gear start with no up shifts, or 3-2-1.

All automatic shifts are automatically controlled by the valve block and an hydraulic governor driven by the output shaft.

Power flow

1st gear D selected

With D selected 1st gear engaged, clutches 4 and 11 are operative. The front planet gear carrier of gear set 9 is locked against the housing through freewheel 15 when the engine is pulling but freewheels when the vehicle is coasting. Epicyclic gear set 10 rotates as a solid unit with the front planet gear carrier. In selector position 1 with 1st gear engaged, clutch 8 operates to prevent the loss of drive on the overrun through freewheel 15, to provide engine braking.

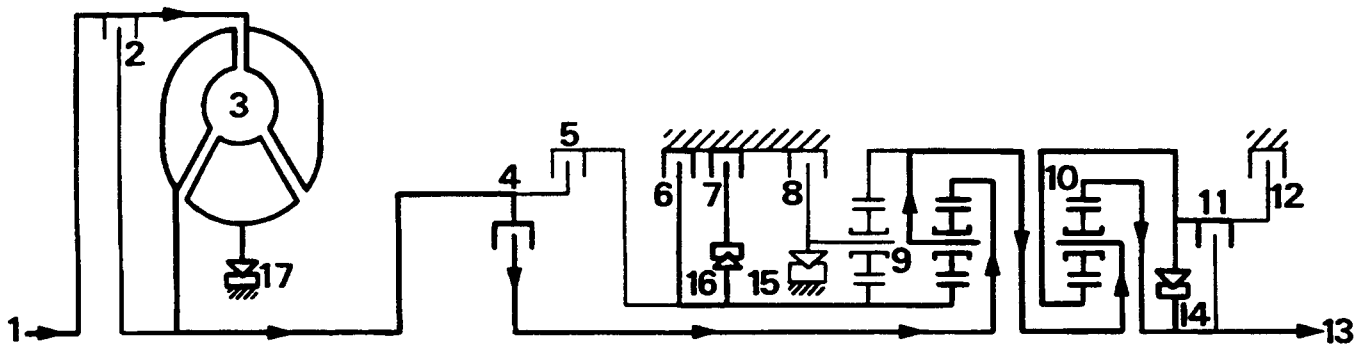


RR3561M

1st gear D selected

2nd gear D selected

Clutches 4, 6, 7 and 11 are engaged. Freewheel 15 overruns. the hollow shaft with the sun wheel of epicyclic gear set 9 is locked. Epicyclic gear set 10 also rotates as a solid unit.



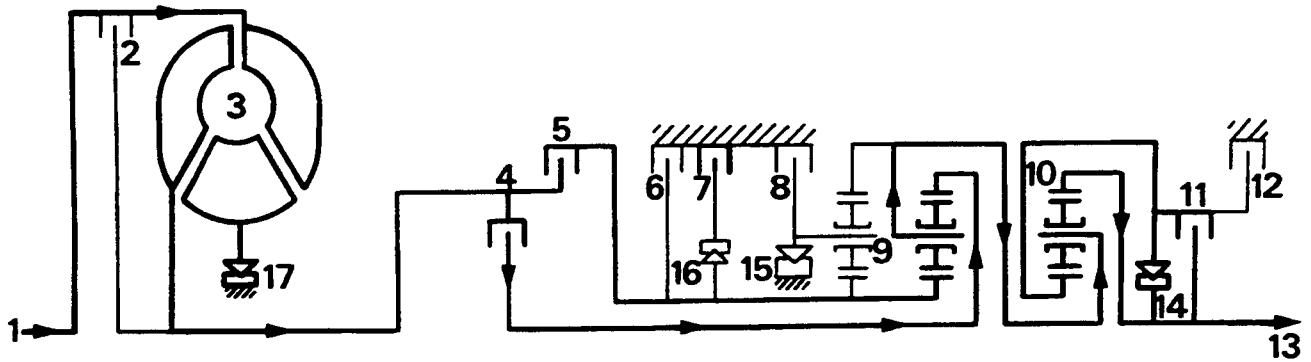
RR3562M



2nd gear D selected

3rd gear D selected

Clutches 4, 6, 7 and 11 are engaged. Freewheel 15 and 16 are overrun. Epicyclic gear set 9 and 10 rotate as a solid unit at a ratio of 1:1.



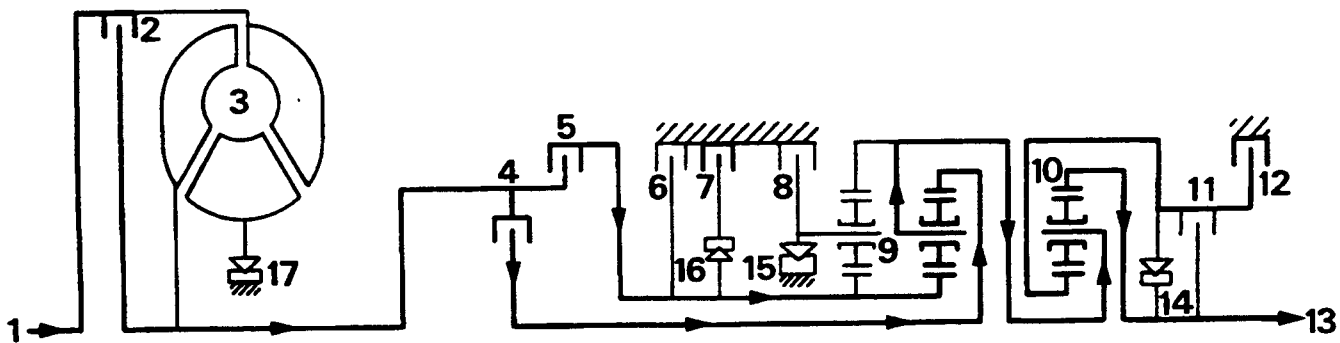
RR3563M

3rd gear D selected

4th gear D selected

Clutches 4, 6, 7 and 12 are engaged. Freewheel 14, 15 and 16 are overrun. Epicyclic gear set 9 rotates as a solid unit. The hollow shaft with the sun wheel of epicyclic gear set 10 is locked.

Above a predetermined road speed, clutch 2 locks the gearbox power input direct to the engine, by-passing the torque converter.



RR3564M

4th gear D selected

Reverse gear

Clutches 5, 8 and 11 are engaged. Since the front planet gear carrier of epicyclic gear set 9 is locked, the direction of output-shaft rotation is reversed. Epicyclic gear set 10 also rotates as a solid block.



ZF AUTOMATIC GEARBOX

Before referring to fault symptoms, carry out initial static checks first:

INITIAL STATIC CHECKS

Check start positions	'P' & 'N' only
Reverse lights	'R' only
Gear engagements	N-D,N-3,N-2,N-1,N-R
Full throttle	Engine switched off, check full travel at engine and at pedal.
Oil level	'N' selected, engine running at normal running temperature.

Pressure test

2000 rev/min	150 ± 5 p.s.i.
Idle pressure	100 ± 5 p.s.i. at 665 to 735 rev/min.

To fit pressure gauge

Service tools: See *Service tools, Automatic gearbox*

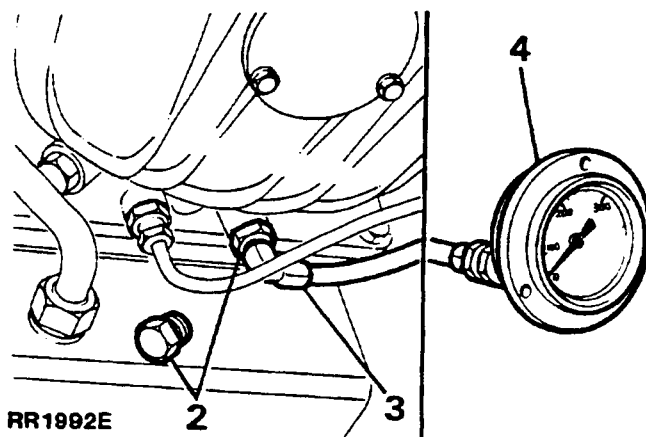
0 to 300 p.s.i. Pressure gauge.
Flexible hose adaptor.

1. Site vehicle on a ramp.
2. From under gearbox, remove socket head plug (located 10 cm from oil pipe) Fit hose adaptor LST502-1.
3. Fit hose to adaptor.
4. Fit gauge 18G502A to hose and route into vehicle, ensuring hose is clear of rotating parts and exhaust pipes.

5. Carry out road test. See *Road test procedure*.

Remove pressure gauge

6. Reverse removal procedure.





ROAD TEST PROCEDURE

Follow the procedure given commencing each test, from a standing start, on a level road, in good weather conditions.

ROADTEST 1 = CHECKS 1-2-3-4-5-6-7-8

D SELECTED KICKDOWN START FROM REST

CHECK 1

Check for clutch squeal and slip. Check pressure is 150 lbf/in²

CHECK 2

Check 1st to 2nd upshift speed and quality. Pressure should fall to 120 lbf/in².

CHECK 3

Check 2nd-3rd upshift speed and quality. Pressure should fall to 100 lbf/in²

CHECK 4

Release throttle to allow simultaneous engagement 4th + DDC. Check shift quality and engine rpm drop of approximately 500 rev/min.

CHECK 5

To proceed to Check 5 release throttle and check drop out speed of direct drive clutch to 4th.

CHECK 6

Check down shift speed and quality 4th to 3rd.



NOTE: This shift is usually very smooth and difficult to detect.

CHECK 7

Check downshift speed and quality 3rd to 2nd.

CHECK 8

Check downshift speed and quality 2nd to 1st. Also difficult to detect.

END OF ROADTEST 1

ROADTEST 2 CHECKS = 9-10-11

D SELECTED FROM REST

FULL THROTTLE START

CHECK 9

Check 1st-2nd upshift speed and quality.

CHECK 10

Check 2nd-3rd upshift speed and quality.

CHECK 11

Check 3rd-4th and direct drive clutch upshift speed and quality.



NOTE: 4th and the direct drive clutch engage simultaneously.

END OF ROADTEST 2

ROADTEST 3 = CHECKS

12-13-14-15-16-17-18-19-20-21-22-23

D SELECTED FROM REST**LIGHT THROTTLE START****CHECK 12**

Check 1st-2nd upshift speed and quality.

CHECK 13

Check 2nd-3rd upshift speed and quality.

CHECK 14

Check 3rd-4th upshift speed and quality.



NOTE: This shift is usually very difficult to detect but can be confirmed by a 200 rev/min drop in engine speed.

CHECK 15

Check speed and quality of shift into direct drive clutch, confirmed by 300 rev/min drop in engine speed.



NOTE: An intermediate throttle position engagement of 4th and the direct drive clutch, which is indicated by a fall of 500 rev/min in engine speed.

CHECK 16

At approximately 88 kph (55 mph) depress throttle to kickdown - gearbox should change down to 2nd - release throttle to re-engage 4th direct drive clutch continue to accelerate gently.

CHECK 17

At approximately 128 kph (80 mph) depress throttle to kickdown - gearbox should change down to 3rd - release throttle to re-engage 4th direct drive clutch and continue to accelerate gently.

CHECK 18

At approximately 138 kph (85 mph) select 3rd, gearbox should change immediately down to 3rd. Release throttle.

CHECK 19

Decelerate to approximately 47 kph (30 mph) depress throttle to kickdown - gearbox should downshift to 1st gear, continue accelerating at full throttle until 3rd gear is attained. To do this you will have repeated check 2 of Test 1.

CHECK 20

At 128 kph (80 mph) select 2nd no downshift should occur. Release throttle.

CHECK 21

At 104 kph (65 mph) an automatic downshift into 2nd gear should occur. Continue to decelerate.

CHECK 22

At 88 kph (55 mph) select 1st. No downshift should occur. Continue to decelerate.

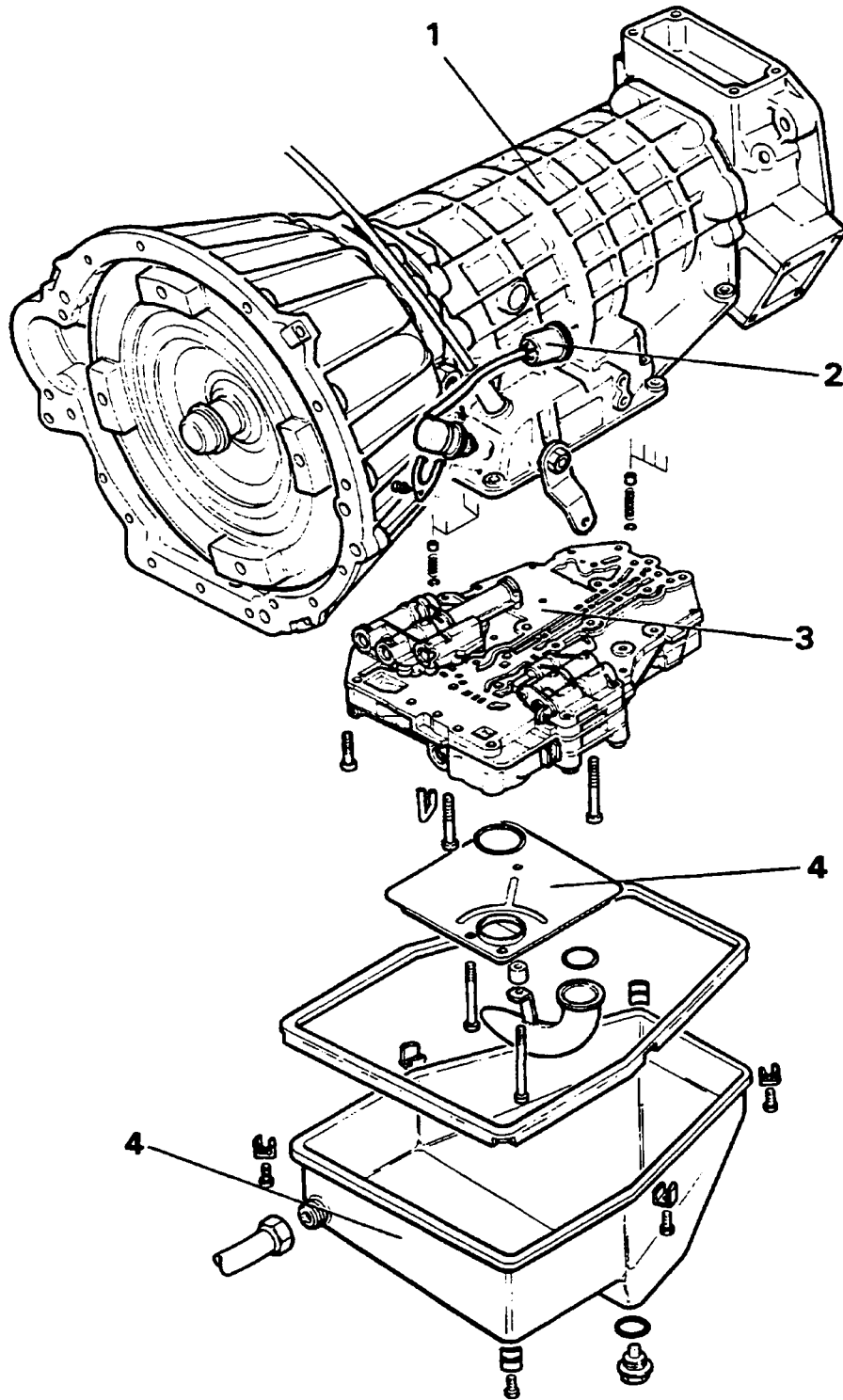
CHECK 23

With 1 selected 2nd gear engaged continue to decelerate and at 45 kph (28 mph) the box should automatically downshift to 1st gear after which no upshifts will occur in this selector position.

END OF ROADTEST



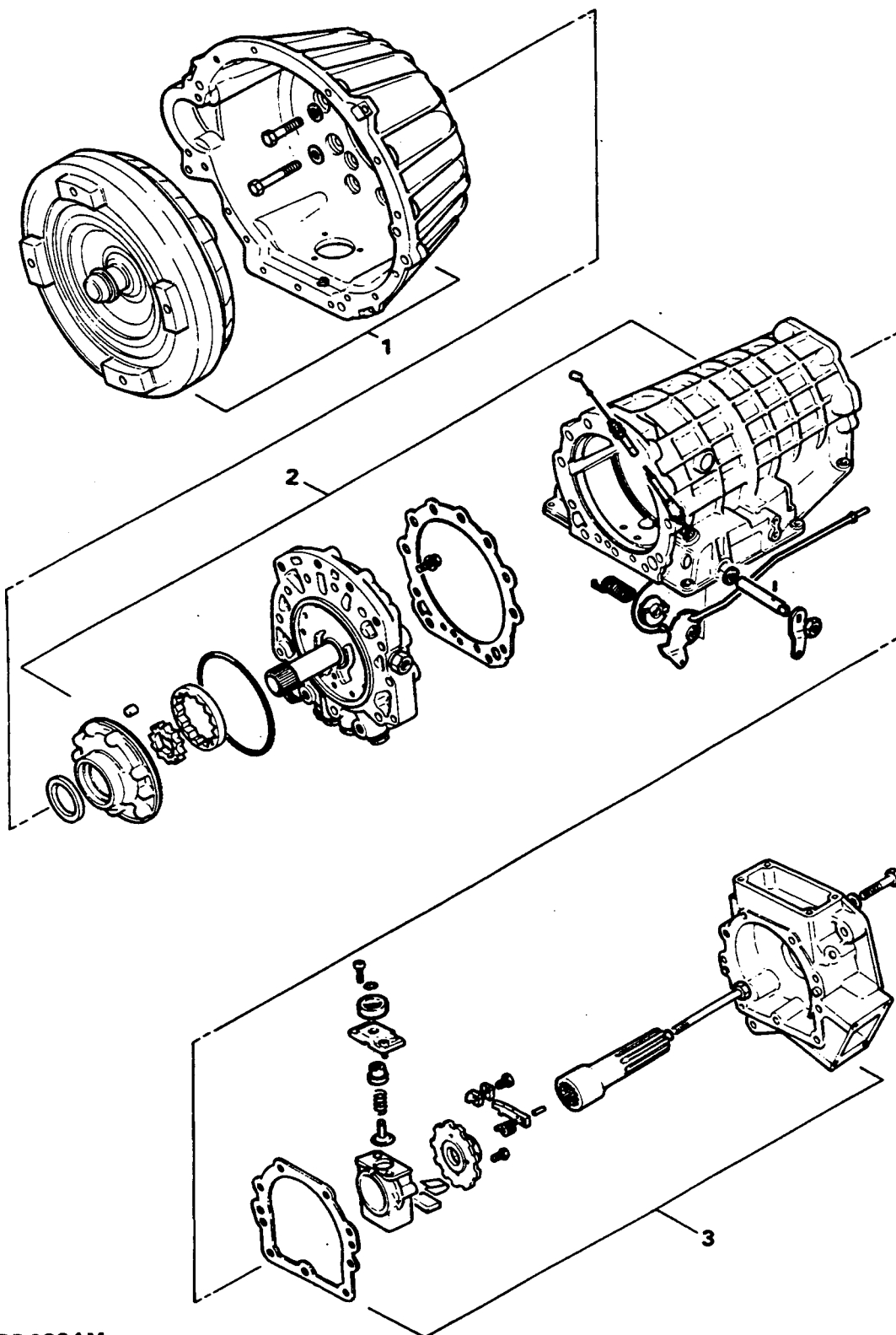
**AUTOMATIC GEARBOX ASSEMBLY
ILLUSTRATED**



RR524M

1. GEARBOX ASSEMBLY
2. INHIBITOR SWITCH ASSEMBLY
3. CONTROL UNIT ASSEMBLY
4. FILTER AND SUMP ASSEMBLY

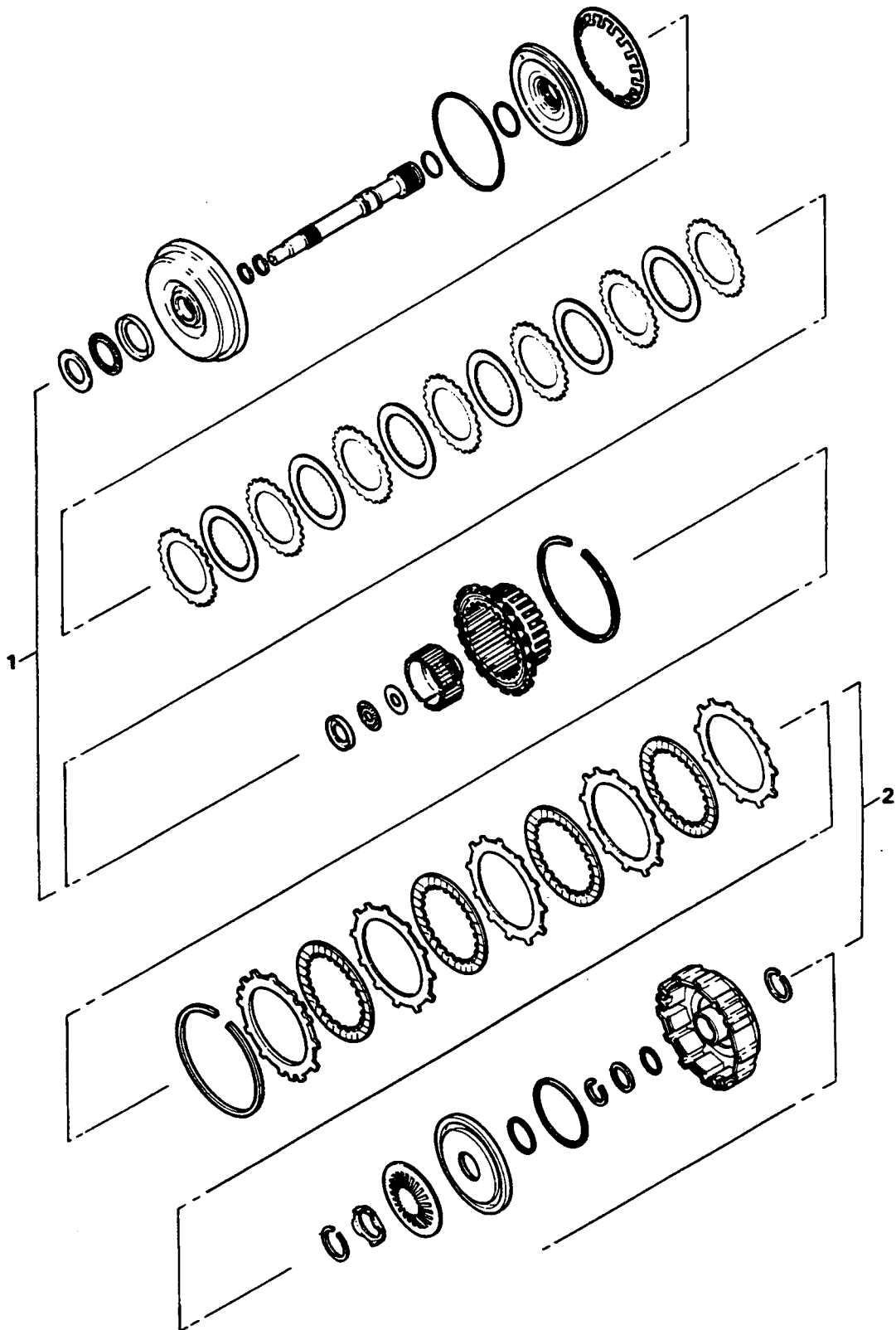
- 1. TORQUE CONVERTER HOUSING ASSEMBLY
- 2. GEARBOX PUMP AND CASING ASSEMBLY
- 3. GOVERNOR AND ADAPTOR HOUSING ASSEMBLY



RR 3894M

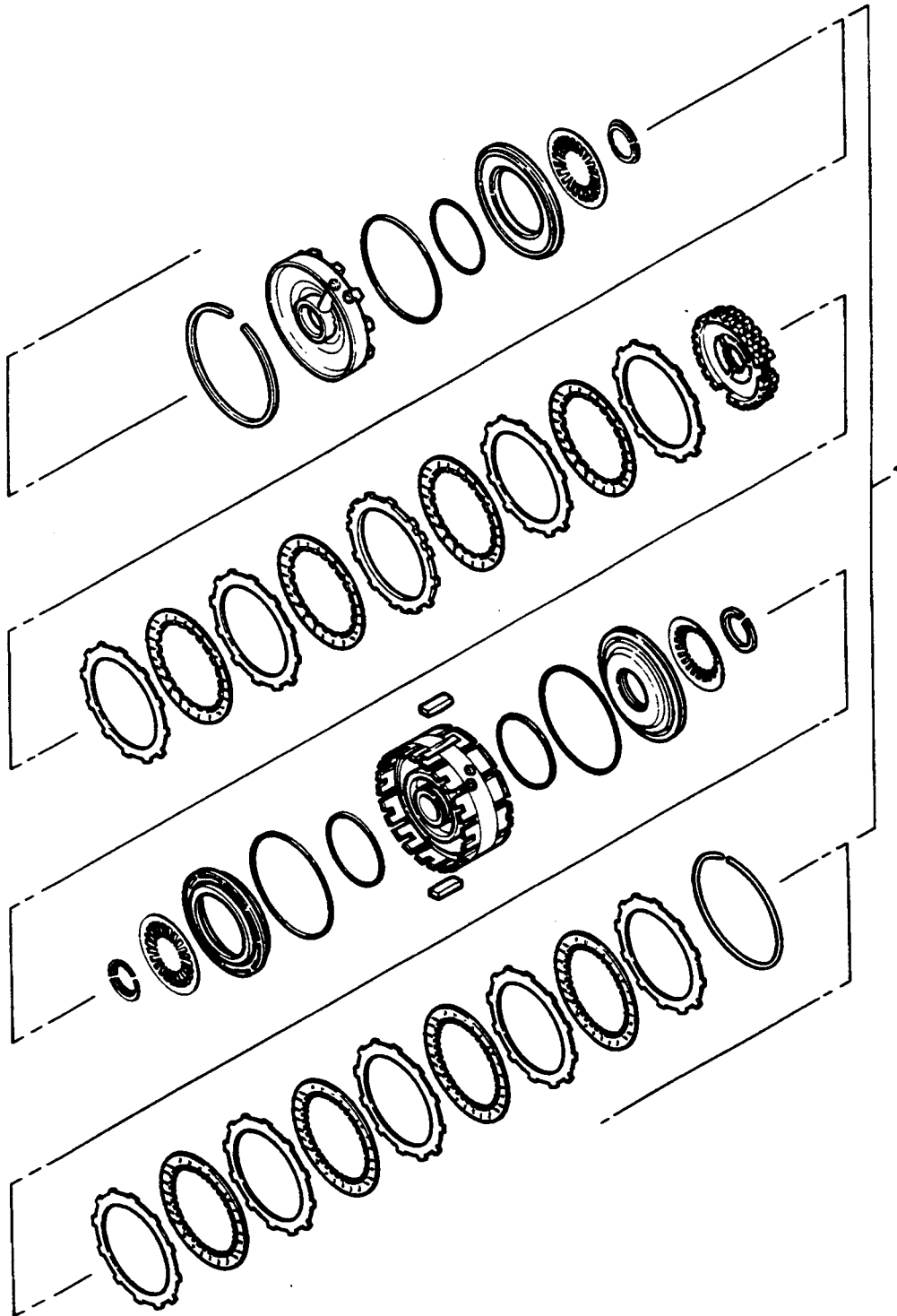


- 1. A CLUTCH ASSEMBLY
- 2. B CLUTCH ASSEMBLY



RR3895M

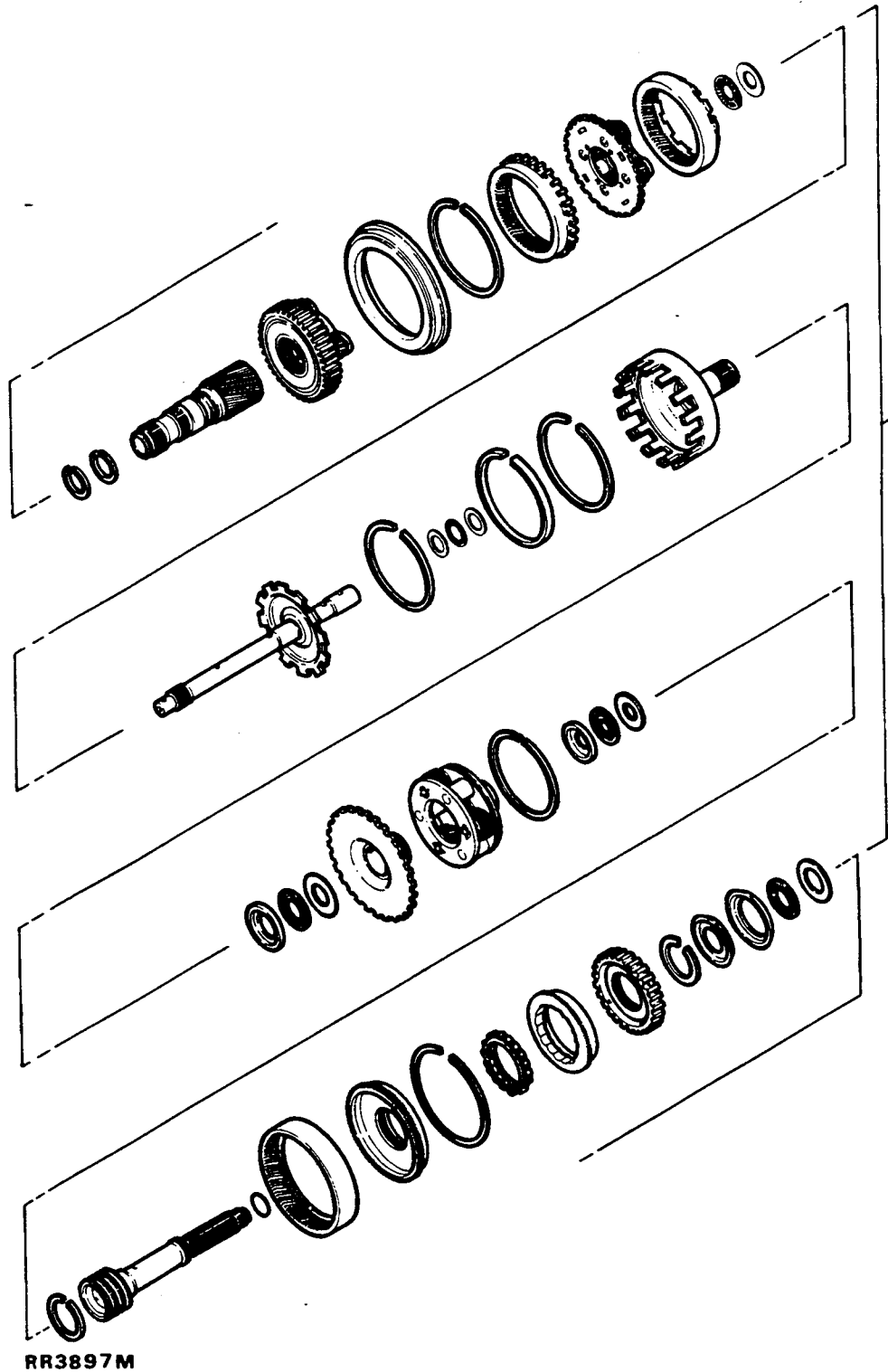
1. C,C AND D CLUTCH ASSEMBLY



RR3896M

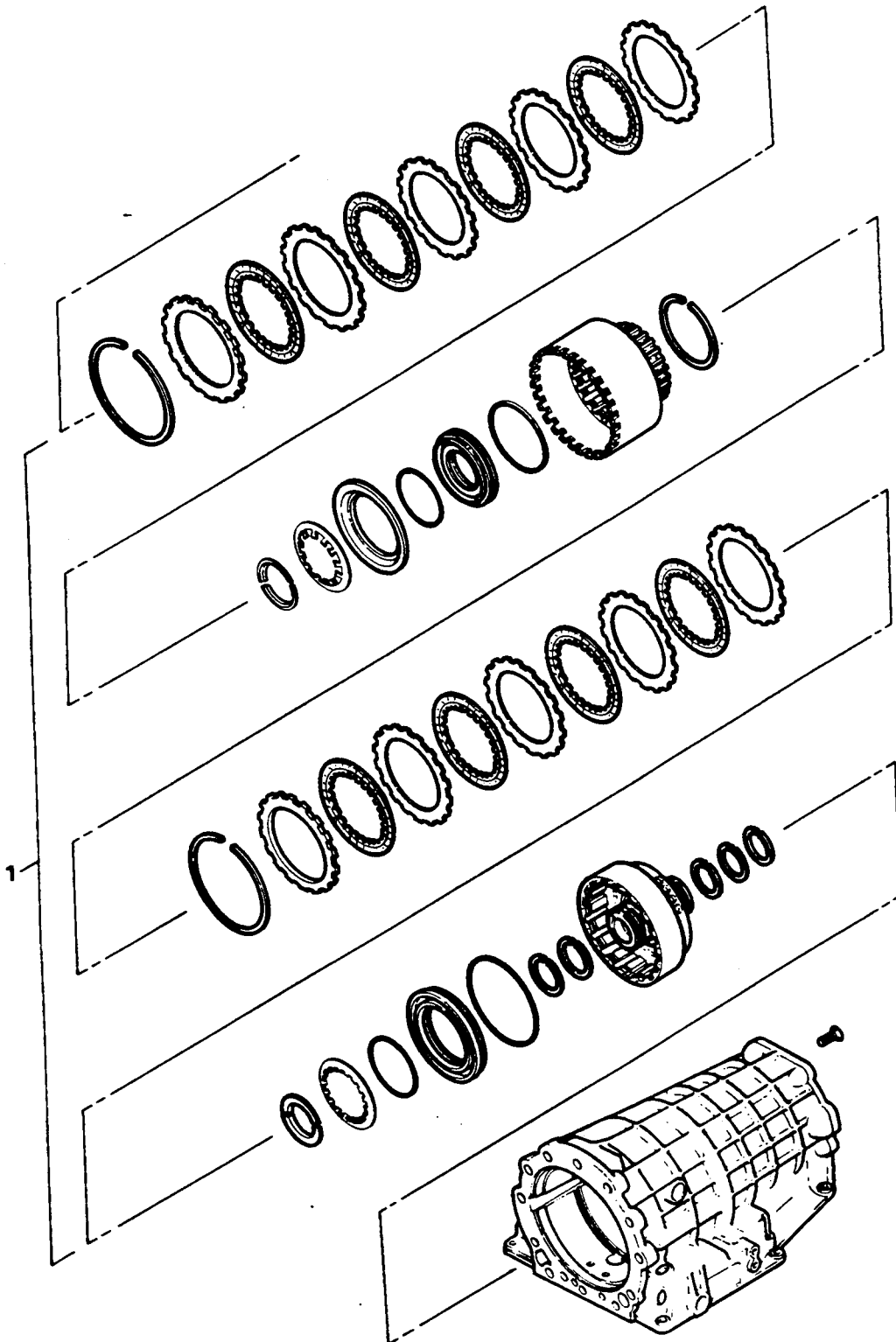


1. FREEWHEEL AND FOURTH GEAR ASSEMBLY



RR3897M

1. E AND F CLUTCH ASSEMBLY



RR3898M



FAULT SYMPTOMS

SYMPTOM 1 - Intermittent drive and high pitched noise

FAULT - Low fluid level or restricted filter

SYMPTOM 2 - No drive in reverse

Select 'D'

- No drive
FAULT - Continue with Symptom 3
- Drives forward
FAULT - Reverse gear interlock valve seized

Select '1'

- No engine braking
FAULT - Clutch brake 3

SYMPTOM 3 - No drive from rest with 'D' selected

Select '1'

- Vehicle drives
FAULT - No 2 freewheel
- No drive

Carry out main line pressure check

- Normal pressure
FAULT - Clutch A
- No pressure
FAULT - Blocked filter or pump failure
- Low pressure
FAULT - Restricted filter or sticking primary regulator

SYMPTOM 4 - Slip in all forward gears

Carry out main line pressure check

- No pressure
FAULT - Blocked filter or pump failure
- Low pressure
FAULT - Restricted filter or sticking primary regulator
- Normal pressure
FAULT - Clutch 'A'

SYMPTOM 5 - Harsh engagement 'N' to 'D'

Check engine idle speed

Carry out main line pressure check

- High pressure
FAULT - Primary regulator sTUCK
- Normal pressure
FAULT - Clutch 'A' or damper for clutch'A'

SYMPTOM 6 - Fierce shift or flare 1st to 2nd shift

Check engine idle speed

Carry out mainline pressure check

- High pressure
FAULT - Continue with symptom 5
- Normal pressure
FAULT - Modulator valve or dampers for clutch brake CB1 and/or clutch brake CB2
FAULT - Clutch brake CB1 and/or clutch brake CB2

SYMPTOM 7 - Fierce shift or flare 2nd to 3rd

Carry out mainline pressure check

- High pressure
FAULT - Continue with symptom 5
- Normal pressure
FAULT - Modulator valve or clutch 'B' damper
FAULT - Clutch 'B'

SYMPTOM 8 - No 3rd gear

FAULT - 2-3 shift valve
FAULT - Clutch 'B'

SYMPTOM 9 - No 4th gear 'D' selected

FAULT - 4th to 3rd downshift valve stuck or 3rd to 4th upshift valve stuck
FAULT - Clutch brake 4

SYMPTOM 10 - None or harsh engagement of direct drive clutch

NOTE: The direct drive clutch will only engage if 4th gear is engaged at 40 to 45 mph.

Carry out road test pressure check with gauge connected to torque converter.

- Normal pressure
 FAULT - Failed direct drive clutch
- Pressures correct but remains high
 FAULTS POSSIBLE -
 Direct drive clutch and torque converter control valve stuck
 Hysteresis valve stuck
 Direct drive clutch control valve stuck

SYMPTOM 11 - Direct drive clutch shift point incorrect or at low speed

NOTE: Direct drive clutch engagement at low speed will cause vibration in the torque converter

Carry out mainline and torque converter pressure check

- Normal pressure
 FAULT - Governor valve sticking
- Low or incorrect pressure
 FAULTS POSSIBLE -
 Direct drive clutch and torque converter control valve sticking.
 Hysteresis valve stuck.
 Direct drive clutch control valve stuck.

SYMPTOM 12 - Drives in 'D' but immediately upshifts to 3rd

FAULT - 2nd to 3rd shift valve stuck.

SYMPTOM 13 - With 'D' selected vehicle starts in 2nd

FAULTS POSSIBLE -
1st and 2nd shift valve stuck.
Governor sleeve sticking.

SYMPTOM 14 - With 'D' selected vehicle starts in 3rd

FAULTS POSSIBLE -
1st to 2nd and 2nd to 3rd shift valves stuck.
Governor sleeve sticking.

SYMPTOM 15 - No kickdown 4th to 3rd

FAULT - 4th to 3rd kickdown valve stuck.

SYMPTOM 16 - Upshifts/downshifts and kickdown shifts at incorrect road speeds

Check throttle kickdown cable adjustment
Carry out main line pressure check

- Normal pressure
 FAULT - Governor valve sticking
- Incorrect pressure
 FAULTS POSSIBLE -
 Incorrect throttle valve adjustment
 Primary regulator sticking

SYMPTOM 17 - No upshifts at light throttle

FAULTS POSSIBLE
Governor valve sticking
Shift valves sticking

SYMPTOM 18 - No engine braking '3' selected 3rd gear

FAULT - Clutch 'C'

SYMPTOM 19 - Delayed or no downshift occurs when making a manual selection from '3' to '2'

FAULTS POSSIBLE -
2nd and 3rd upshift valve sticking.
Governor valve sticking.
'2' Position interlock valve sticking.

SYMPTOM 20 - At speeds below 28 mph when making a manual selection from '2' to '1', downshift is delayed or does not occur

FAULTS POSSIBLE -
Governor sticking.
1st to 2nd shift valve sticking.
'1' Position interlock valve sticking.

SYMPTOM 21 - '1' Selected 1st gear no engine braking

FAULT - Clutch brake 3

SYMPTOM 22 - '2' Selected 2nd gear no engine braking

FAULT - Clutch brake 1

SYMPTOM 23 - Vehicle drives forward in 'N'

FAULT - Clutch 'A' stuck



ZF AUTO WITH BORG WARNER TRANSFER GEARBOX

Service repair no - 44.20.04.

Remove and refit

Remove

Under bonnet

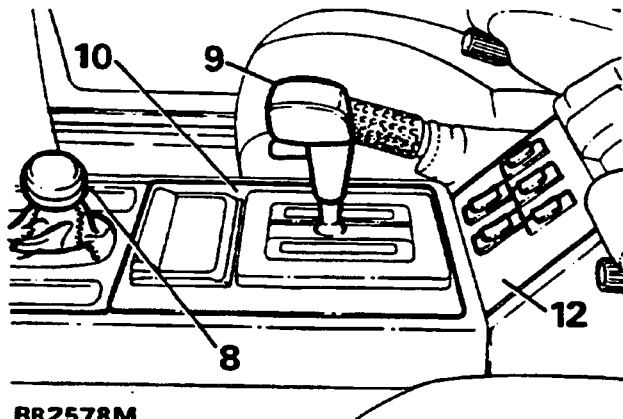


WARNING: When using transmission jack follow equipment manufacturers instructions to ensure safe and effective use of equipment.

1. Place vehicle on ramp, chock road wheels.
2. Disconnect the battery negative lead.
3. Remove fan blade assembly. Note assembly has a left hand thread.
4. Remove air intake hose from plenum chamber.
5. Disconnect kickdown cable from throttle linkage.
6. Release two gearbox breather pipes from lifting eye at rear of right hand cylinder head.
7. Remove gearbox dipstick.

Inside vehicle

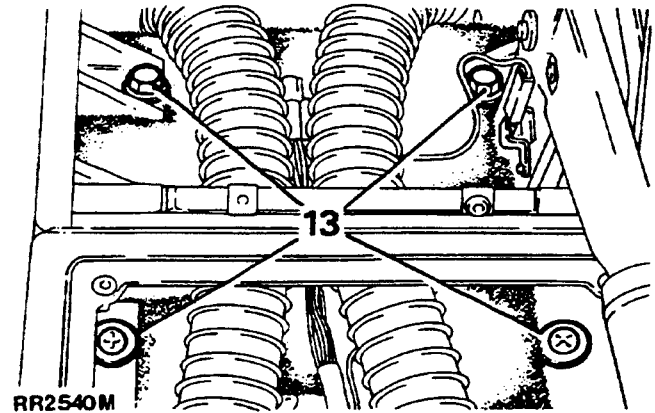
8. Select low range, unscrew and remove transfer gearbox knob.



RR2578M

9. Remove gear selector, *See ELECTRICAL, Repair, Automatic gear selector-panel illumination*
10. Pry inset panel out of floor mounted console. Disconnect multiplug to graphics panel and remove inset panel.

11. Remove glove box liner.
12. Remove window lift switch panel from glove box. Place panel aside on gearbox tunnel.
13. Release two bolts and two screws securing glove console assembly to gearbox tunnel.

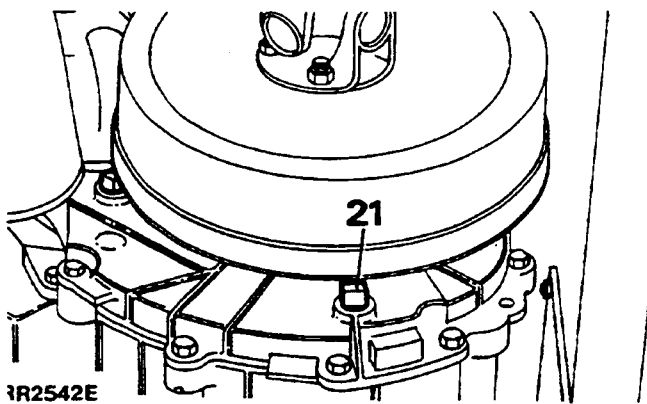
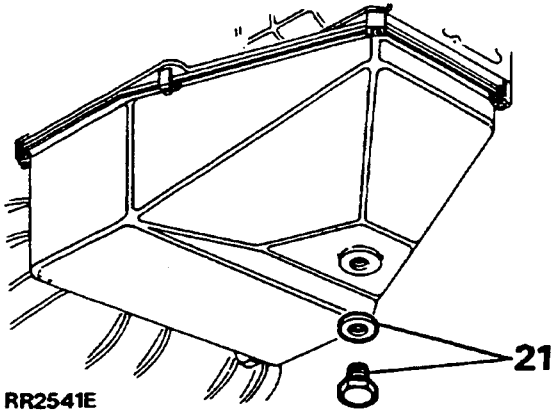


RR2540M

14. Detach relays from inner side of glove box.
15. Disconnect electrical leads to rear cigar lighter.
16. Disconnect parkbrake cable from parkbrake lever. Raise lever and remove console assembly from vehicle.
17. Remove retaining clip and pull parkbrake adjustment thumb wheel from outer sleeve. Push inner sleeve to underside of vehicle.
18. Remove sound deadening trim from top of gearbox tunnel.
19. Remove retaining plate from transfer gearbox lever.

Under vehicle

20. Raise ramp.
21. Drain oil from main and transfer gearbox.

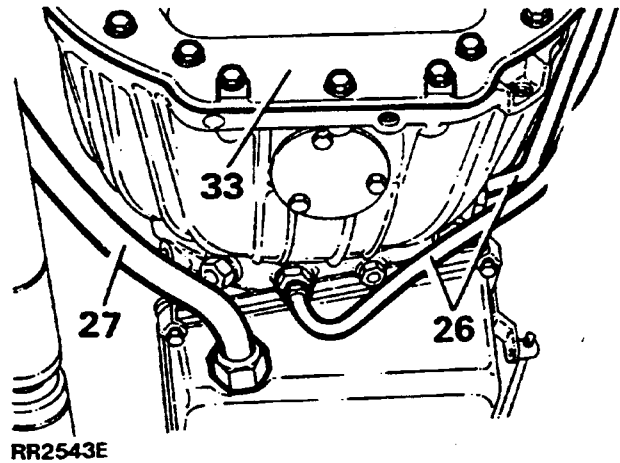


22. Disconnect multiplugs to Lambda sensors.
23. Remove front exhaust assembly.
24. Remove chassis crossmember.
25. Release two clamps securing gearbox oil cooler pipes.
26. Place a suitable container below gearbox, disconnect oil cooler return pipes from gearbox. Plug open ends of pipes.
27. Remove dipstick tube from gearbox sump.
28. Mark propeller shaft and transfer gearbox flanges for re-assembly. Disconnect propeller shafts at output flanges. Tie shafts to one side.
29. Disconnect speedometer cable from rear output housing, tie cable to one side.

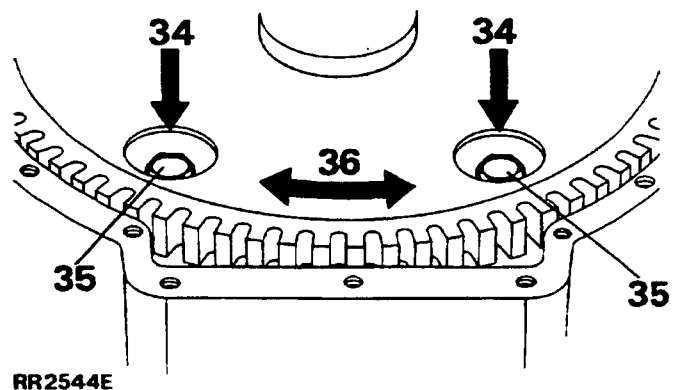
30. Disconnect main gearbox selector cable and rod from left side of gearbox. Lay cable aside.
31. Disconnect inhibitor switch.
32. Disconnect speed transducer multiplug.

Remove transmission assembly

33. Remove nine bolts from bottom of gearbox bellhousing, remove cover plate.



34. Rotate engine using crankshaft pulley until two access holes in drive plate are visible.
35. Remove two bolts securing drive plate to torque converter. Mark one access hole and one bolt hole with an identification line for accurate reassembly.
36. Rotate crankshaft 180°. Remove remaining two bolts.





37. Position transmission jack on brake drum to support weight of transmission assembly.
38. Remove bolts and withdraw transfer gearbox mountings.
39. Fit service tool adaptor plate to transmission hoist, raise and position hoist under transfer gearbox mounting points.
40. Secure adaptor plate to gearbox using gearbox mounting bolts.
41. Remove transmission jack from transmission assembly.
42. Carefully lower transmission until top of transfer gearbox clears rear passenger footwell.
43. Position transmission jack under engine to support weight while bellhousing bolts are removed.
44. Remove bellhousing bolts noting that one bolt secures gearbox dipstick tube.
45. Withdraw transmission assembly from engine, ensuring that torque converter is removed with gearbox.

Refit

46. Refitting gearbox is a reversal of removal procedure noting following points.
47. Coat drive plate to torque converter bolts with Loctite 270.
48. Tighten all bolts to specified torque. *See Specifications, torque, Torque values*
49. Fit new gaskets to exhaust flanges.
50. Refill gearboxes with correct grade and quantity of oil *See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids*

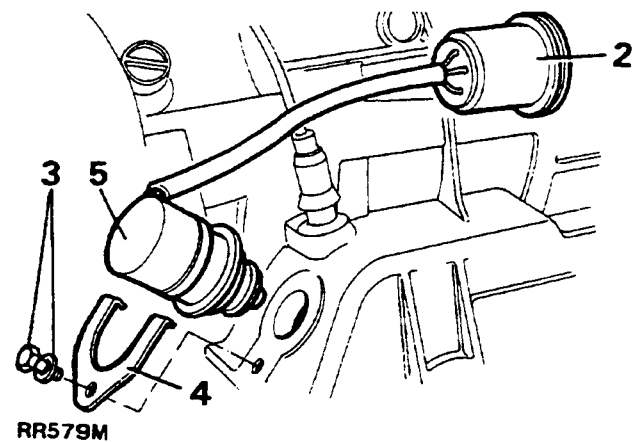
INHIBITOR SWITCH

Service repair no - 44.15.19.

Remove and refit

Remove

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Disconnect inhibitor lead.
3. Remove bolt and spring washer.
4. Remove retaining plate.
5. Remove inhibitor switch.



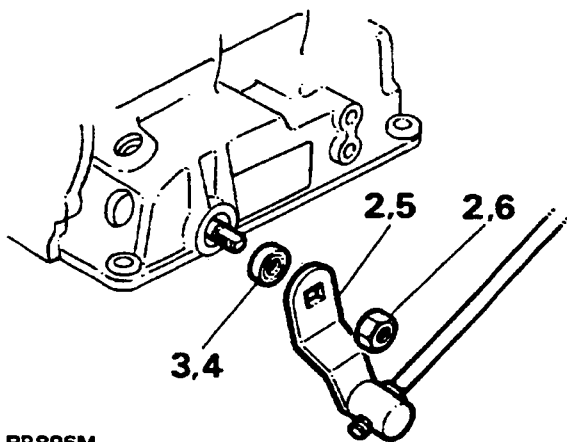
Refit

6. Fit new 'O' ring seal to inhibitor switch.
7. Fit switch and secure with retaining plate, spring washer and bolt.
8. Connect inhibitor lead.
9. Reconnect the battery negative lead.

SELECTOR SHAFT OIL SEAL

Service repair no - 44.15.34.

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Remove gear change lever.
3. Remove oil seal.
4. Coat new oil seal with light grease. Fit seal using selector shaft oil seal replacer LST114.
5. Refit gearchange lever.
6. Fit nut. Tighten to **25 Nm**.

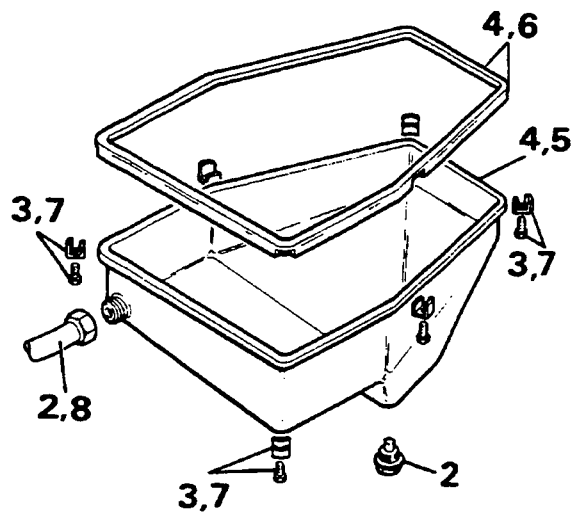


RR896M

OIL SUMP GASKET

Service repair no - 44.24.05.

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Drain gearbox oil. Remove oil level tube.
3. Remove six retaining plates and bolts.
4. Remove sump, discard gasket.
5. Inspect sump for damage. Replace if necessary.



RR903M

6. Fit new gasket to sump.
7. Refit sump. Fit six retaining plates tighten screws to **10Nm**.
8. Reconnect oil filler level tube. Tighten to **70Nm**. Fit sump plug with new seal. Tighten to **10Nm**.
9. Reconnect the battery negative lead.
10. Add correct oil through filler/level tube, See **LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids**
11. Ensure vehicle is on level ground with park brake applied. Check oil level with engine at idle, neutral selected after selecting each gear.



NOTE: If leak persists after fitting existing oil pan - fit new oil pan.



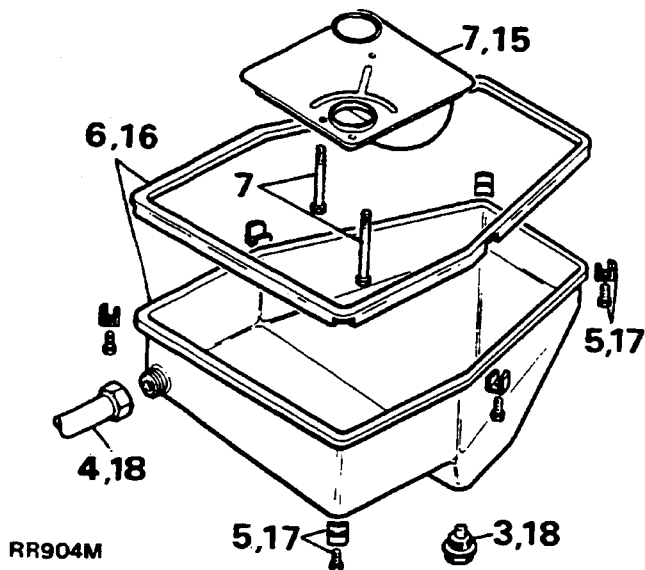
KICKDOWN CABLE LEAK

Service repair no - 44.15.01.

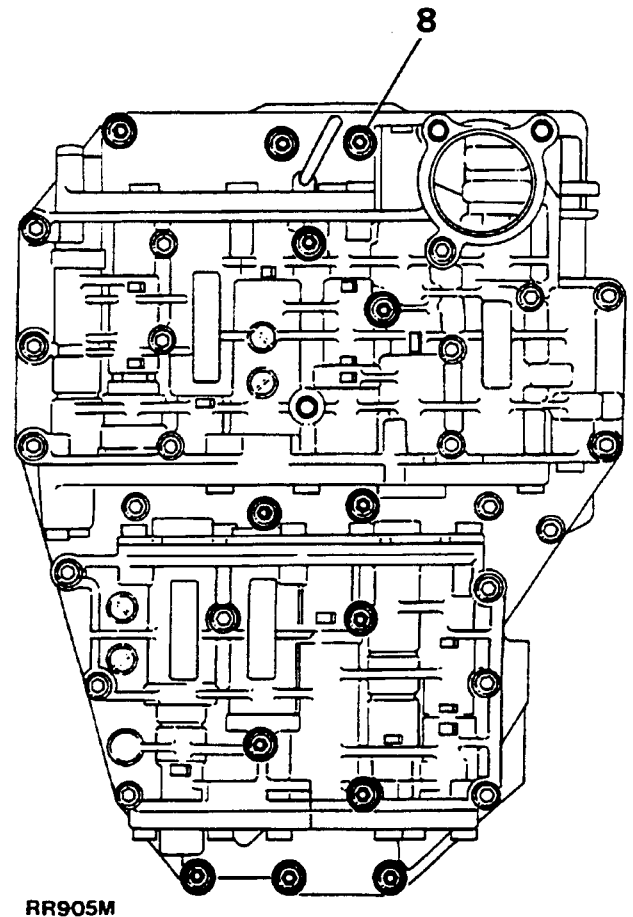
Remove and refit

Remove

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Disconnect kickdown cable from engine.
3. Drain gearbox oil. Remove front exhaust assembly and chassis crossmember.
4. Remove oil level tube.
5. Remove six retaining plates and bolts.
6. Remove sump, discard gasket.



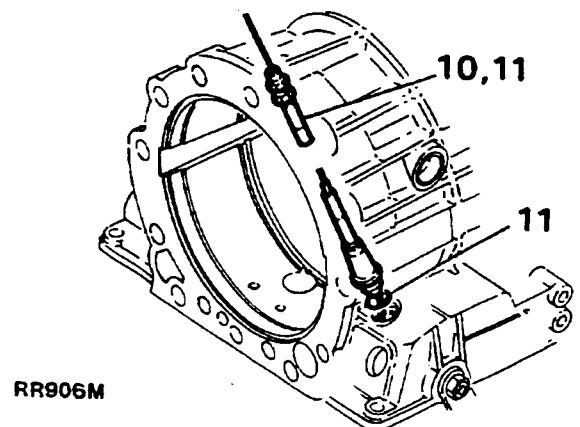
7. Loosen three bolts, remove oil screen.
8. Loosen thirteen remaining bolts, remove control unit.
9. Locate selector cam, remove nipple, holding kickdown cable from seat.



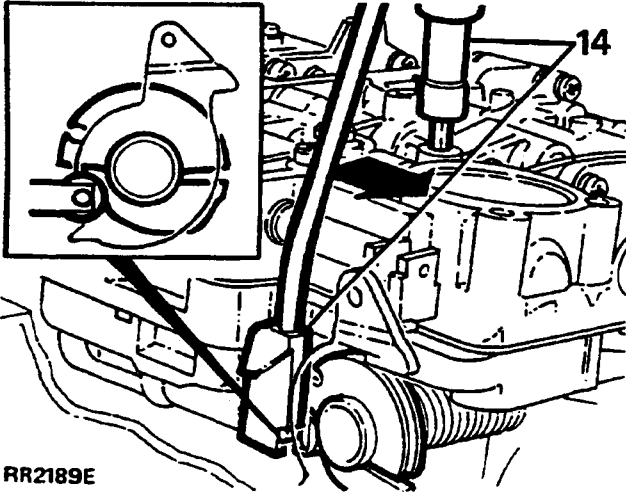
10. Using kickdown cable remover LST112, remove cable and its housing from casing and discard.

Refit

11. Fit new cable and new 'O' ring into casing.



12. Spring load cam by turning once before fitting. Fit nipple into cam seat.
13. Fit control unit after cleaning face with a lint free rag. Ensure selector shaft locates into gear shift fork. Fit thirteen bolts loosely.
14. Place selector linkage setting gauge LST109 in position, gently press control unit in direction shown. Tighten all thirteen bolts to **8Nm**.



RR2189E

15. Remove setting gauge. Fit oil screen, tighten fixings to **8Nm**.
16. Refit sump with new gasket.
17. Refit six retaining plates tighten screws to **8Nm**.
18. Reconnect oil filler tube. Tighten to **70Nm**. Fit sump plug with new seal. Tighten to **10Nm**.
19. Fit chassis crossmember
20. Fit front exhaust assembly
21. Reconnect the battery negative lead.
22. Add correct quantity and grade oil to gearbox. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids**
23. Connect kickdown cable to engine.

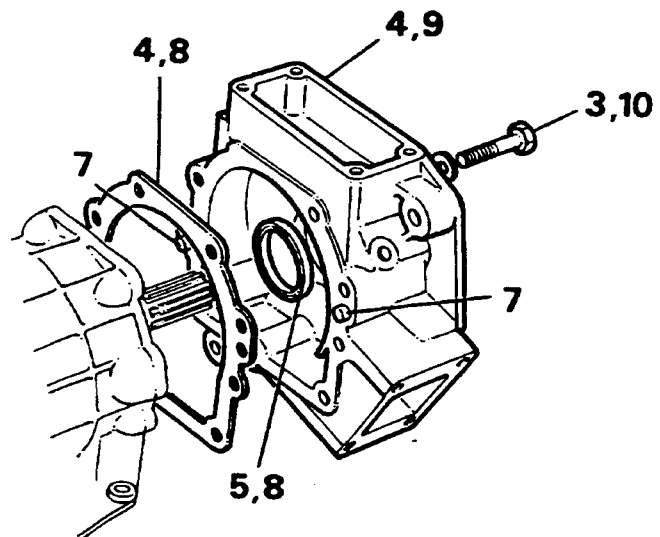
Adjust

24. Adjust cable sheath to achieve a crimp gap of 0.25 to 1.25 mm.
25. Hold cable sheath while tightening locknuts.
26. Ensuring vehicle is on level ground with park brake applied. Check oil level with engine at idle with neutral selected, after selecting each gear.

EXTENSION CASE

Service repair no - 44.20.18.

1. Remove transfer box, **See TRANSFER BOX, Repair, Borg Warner transfer gearbox**
2. Remove transfer gear selector.
3. Loosen nine bolts holding extension housing.
4. Remove extension housing, discard gasket.
5. Place extension housing on bench, remove oil seal.
6. Ensure that all surfaces are clean and case is free from damage.
7. If fitting new case, fit two dowels to case.
8. Fit a new gasket and oil seal using rear oil seal replacer LST108.



RR908M

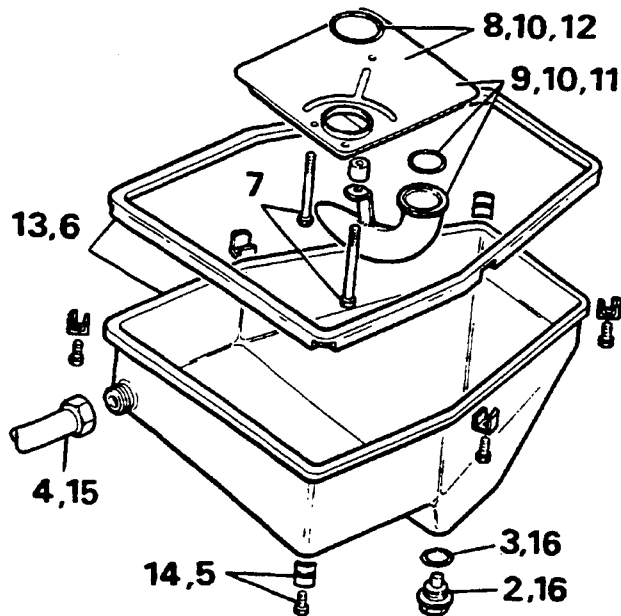
9. Fit extension case to gearbox, ensure oil seal is not damaged by extension shaft.
10. Fit and tighten nine bolts to **23 Nm**.
11. Refit transfer gear selector.
12. Tighten three bolts to **25 Nm**.
13. Refit transfer box.



OIL SCREEN

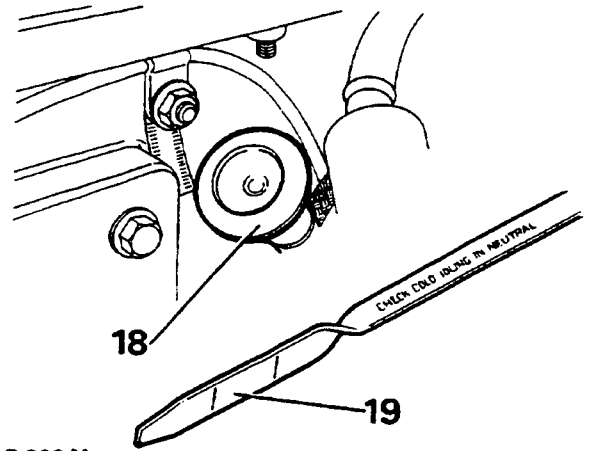
Service repair no - 44.24.07

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Drain gearbox oil.
3. Discard sump plug seal.
4. Remove level tube from sump.
5. Remove six retaining plates and bolts.
6. Remove sump, discard gasket.
7. Loosen three screws from oil screen.
8. Remove oil screen, discard 'O' rings.
9. Separate oil screen from suction tube, discard 'O' ring and oil screen.
10. Fit two new 'O' rings to oil screen.
11. Fit suction tube to oil screen.
12. Fit oil screen to control unit, tighten three bolts to **8 Nm**.



RR691M

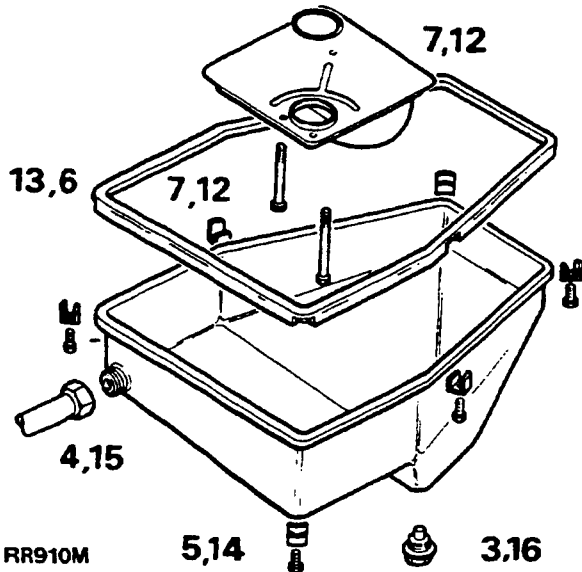
13. Refit sump using a new gasket.
14. Secure using six retaining plates and bolts. Tighten to **8Nm**.
15. Reconnect oil level/filler tube. Tighten to **70 Nm**.
16. Fit sump plug using a new seal. Tighten to **10 Nm**.
17. Connect battery lead.
18. Add correct oil to gearbox *See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids*
19. Ensuring vehicle is on level ground with park brake applied, check oil level with engine at idle, neutral selected, after selecting each gear.



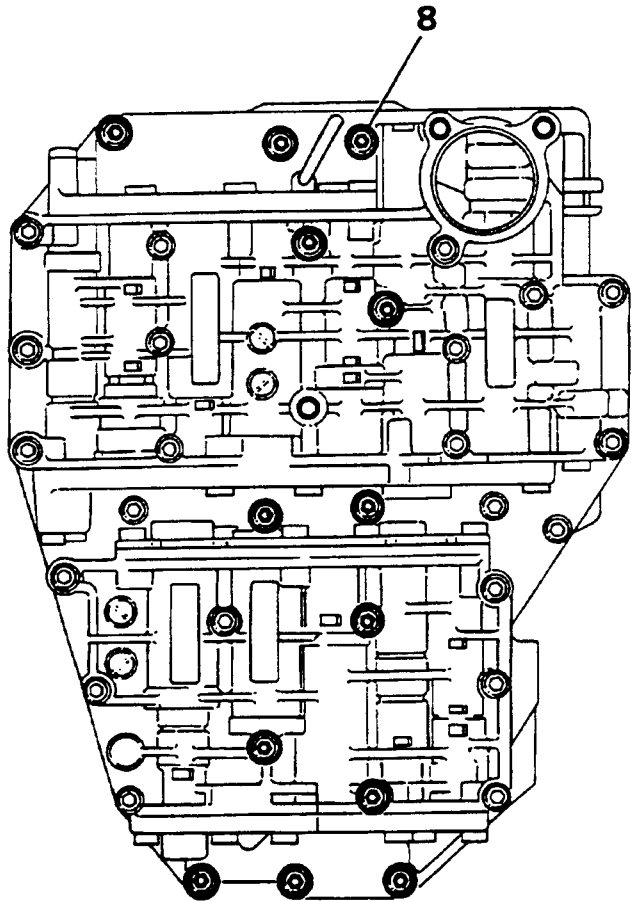
RR 922 M

CONTROL UNIT

1. Site vehicle on ramp, Disconnect the battery negative lead.
2. Drain gearbox oil into a container.
3. Discard sump plug seal.
4. Remove oil level tube from sump.



RR910M



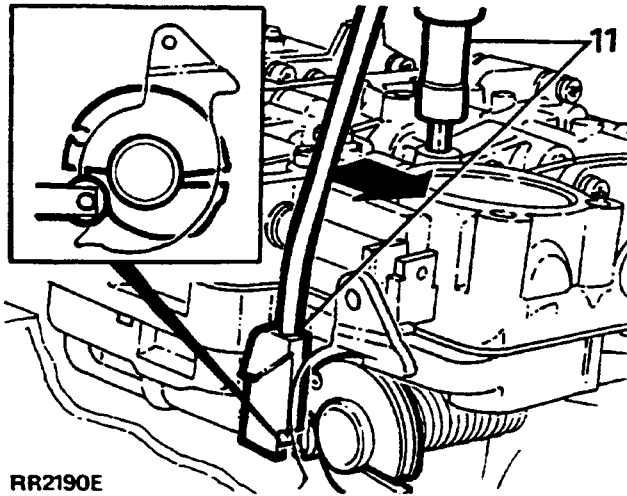
RR905M

5. Remove six retaining plates and bolts.
6. Remove sump, discard gasket.
7. Loosen three bolts and remove oil screen.
8. Loosen remaining thirteen bolts retaining control unit.

9. Clean surfaces using a lint-free rag. Ensure no damage has occurred to mounting face of case.
10. Fit control unit ensuring selector shaft locates into gear shift fork. Loosely fit thirteen bolts.



11. Place selector linkage setting gauge LST109 in position, gently press control unit against tool. Tighten to **8Nm**.



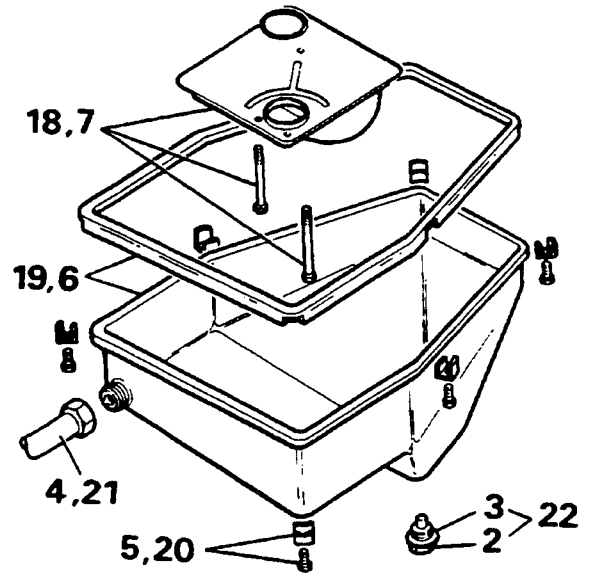
RR2190E

12. Remove setting gauge. Fit oil screen. Tighten to **8Nm**.
13. Refit sump using a new gasket.
14. Secure with six retaining plates and bolts. Tighten to **8 Nm**.
15. Reconnect oil level tube. Tighten to **70 Nm**.
16. Fit sump plug with new seal. Tighten to **10 Nm**.
17. Reconnect the battery negative lead.
18. Add correct quantity and grade of oil to gearbox, **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids**
19. Ensure vehicle is on level ground with park brake applied. Check oil level with engine at idle, neutral selected, after selecting each gear.

OIL INLET SEALING RINGS

Service repair no - 44.20.13.

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Drain gearbox oil into a container.



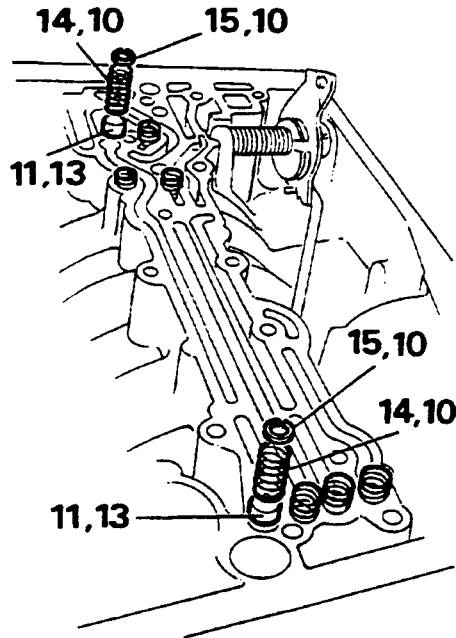
RR913M

3. Discard sump plug seal.
4. Remove oil level tube from sump.
5. Remove six retaining plates and bolts.
6. Remove sump, discard gasket.
7. Loosen three bolts and remove oil screen.
8. Loosen remaining thirteen bolts retaining control unit.
9. Clean surfaces using a lint-free rag. Ensure no damage has occurred to mounting face of case.
10. Remove eight circlips and springs from gearbox.
11. Using LST 113 remove eight oil seals.
12. Clean orifices, check for damage.



NOTE: If damage has occurred replace box, **See ZF Auto with Borg Warner Transfer Gearbox**

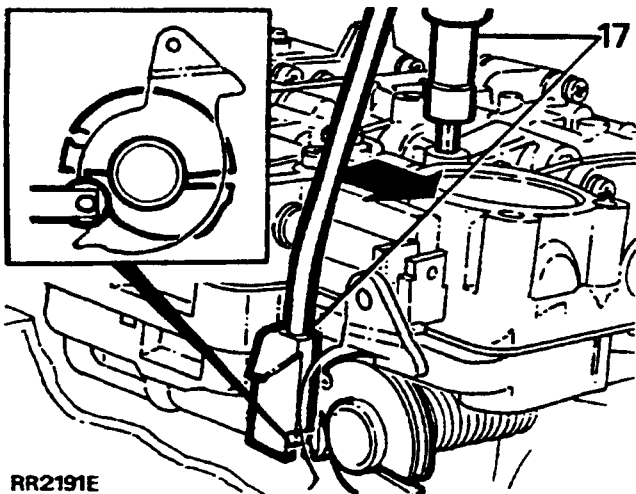
13. Using LST 113 fit new seals.
14. Fit eight compression springs, four short ones at front and four long ones at rear.



RR580M

18. Remove setting gauge. Fit oil screen, tighten fixings to **8 Nm**.
19. Refit oil pan with new gasket.
20. Secure with six retaining plates and bolt. Tighten to **8 Nm**.
21. Reconnect oil level tube. Tighten to **70 Nm**.
22. Fit sump plug with new seal. Tighten to **10 Nm**.
23. Reconnect the battery negative lead.
24. Add correct quantity and grade of oil to gearbox, **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids**
25. Ensure vehicle is on level ground with park brake applied. Check oil level with engine at idle, neutral selected, after selecting each gear.

15. Fit eight circlips to retain compression springs.
16. Fit control unit locating selector shaft into gear shift fork. Fit thirteen bolts loosely.
17. Place setting gauge LST 109 in position. Press control unit against tool, tighten thirteen bolts to **8Nm**.



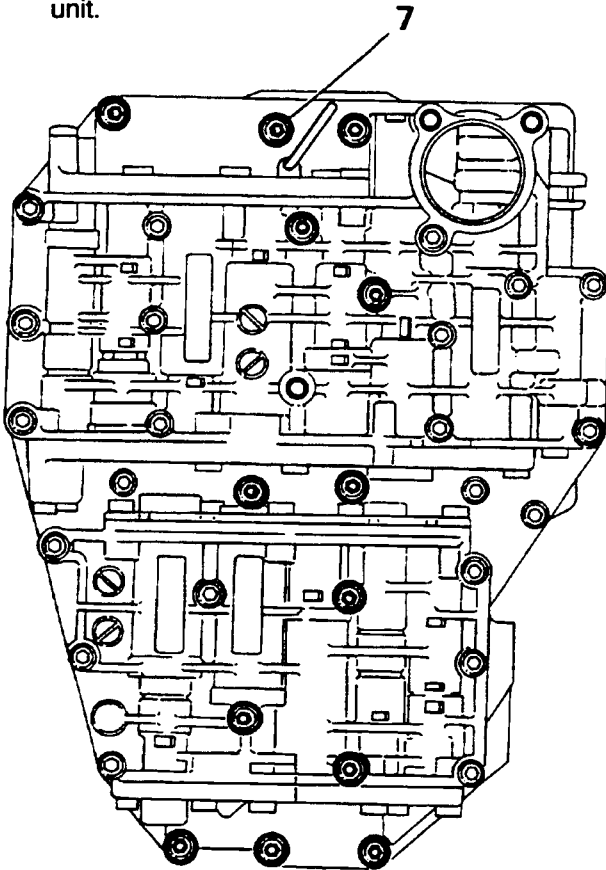
RR2191E



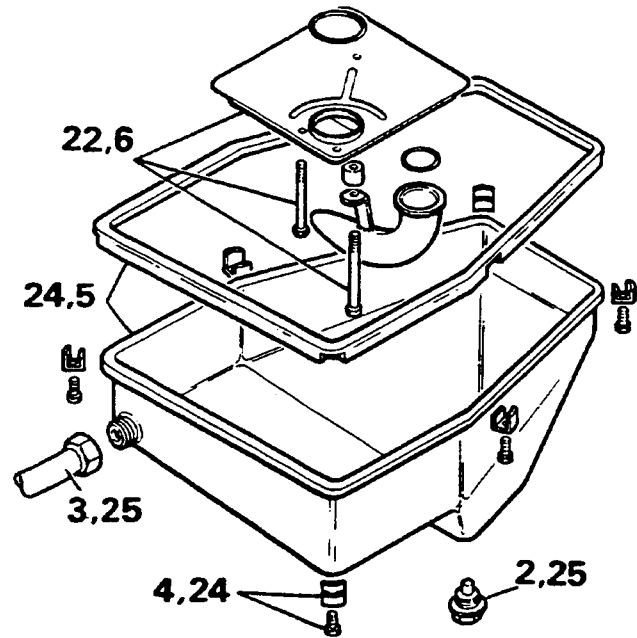
MANUAL VALVE OPERATING MECHANISM

Service repair no - 44.40.01.

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Drain gearbox oil into a container. Discard sump plug seal.
3. Remove oil level tube from sump.
4. Remove six retaining plates and bolts.
5. Remove sump, discard gasket.
6. Loosen three bolts and remove oil screen.
7. Loosen remaining thirteen bolts retaining control unit.

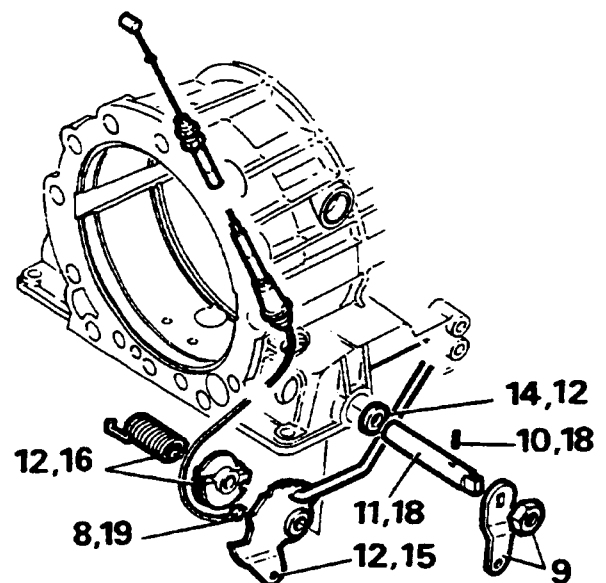


RR914M



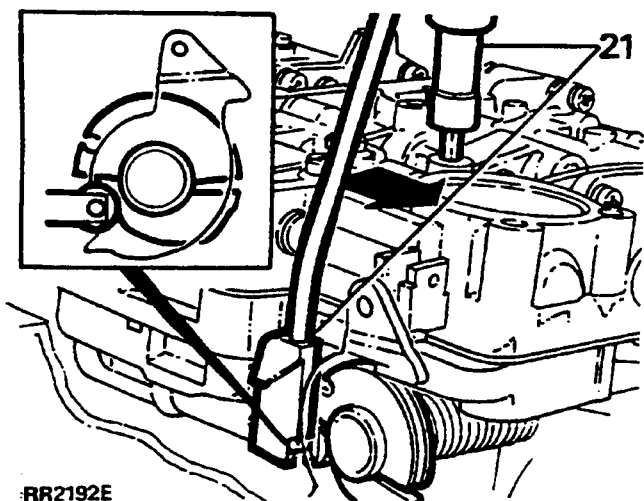
RR582M

8. Locate selector cam, remove kickdown cable nipple from its seat.
9. Remove gear change lever.
10. Drift out roll pin from selector shaft, discard pin.
11. Remove selector shaft from box, note position of detent plate for reassembly.
12. Remove connecting rod with detent plate, accelerator cam, and spring. Remove and discard oil seal.
13. Check all parts for wear or damage, replace as necessary.



RR581M

14. Using LST114, fit oil seal use petroleum jelly to aid assembly.
15. Fit connecting rod to detent plate, locate in box by pushing selector shaft through from outside of casing.
16. Fit accelerator cam with spring.
17. Fit assembly into box and secure by pushing selector shaft through.
18. Align hole in selector shaft with hole in detent plate. Secure with a new roll pin.
19. Spring load cam by turning once. Fit kickdown cable nipple into cam seat.
20. Fit control unit ensuring selector shaft locates into gear shift fork. Fit thirteen bolts loosely.
21. Position setting gauge LST 109. Press control unit against tool. Tighten thirteen bolts to **8 Nm**.



22. Remove setting gauge, fit oil screen, tighten fixings to **8 Nm**.
23. Refit oil pan with new gasket.
24. Secure with six retaining plates and bolt. Tighten to **8 Nm**.
25. Reconnect oil level tube. Tighten to **70 Nm**.
26. Fit sump plug with new seal. Tighten to **10 Nm**.
27. Reconnect the battery negative lead.
28. Add correct quantity and grade of oil to gearbox, **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids**
29. Ensure vehicle is on level ground with park brake applied. Check oil level with engine at idle, neutral selected, after selecting each gear.



GOVERNOR HOUSING

Service repair no - 44.22.01.

Remove and refit

Remove

1. Remove transfer box, *See TRANSFER BOX, Repair, Borg Warner transfer gearbox*
2. Remove transfer gear selector housing.
3. Loosen nine bolts holding extension housing.
4. Remove extension housing ensuring that seal is not damaged, discard gasket.
5. Remove extension shaft and retaining bolt with 'O' ring.
6. Remove governor assembly with parking wheel.
7. Remove two screws holding governor housing.
8. Remove governor housing complete and discard.
9. Inspect governor hub and parking wheel for damage.

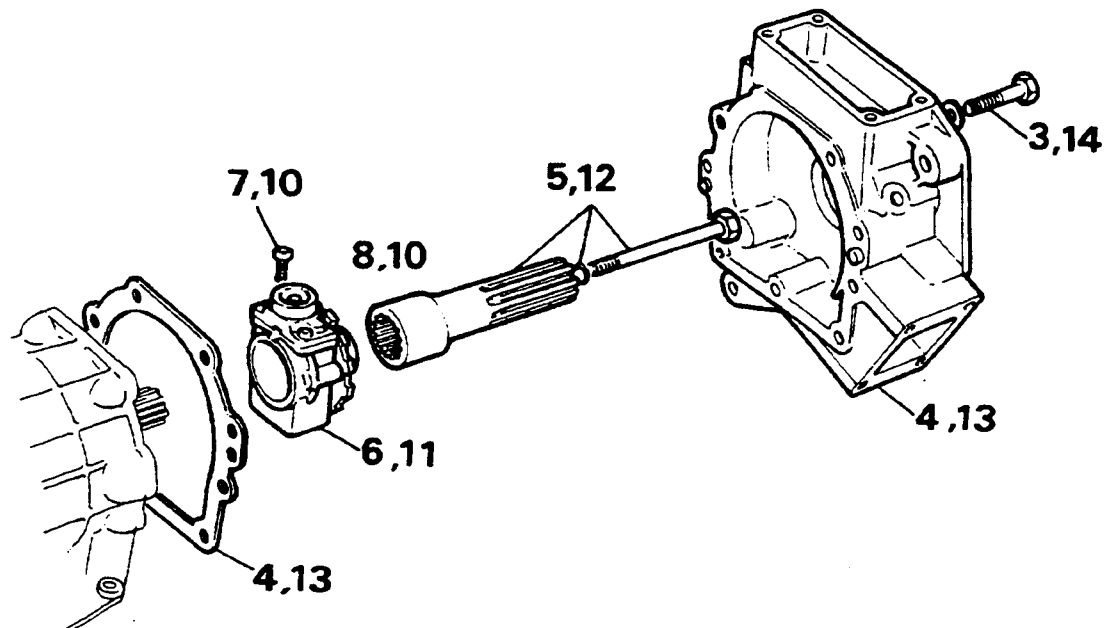
Refit

10. Fit new governor housing complete to governor hub and parking wheel. Tighten to **10 Nm**.
11. Push governor assembly with parking wheel onto output shaft until fully seated.



NOTE: Apply petroleum jelly to 'O' ring. Ensure seal rings are snapped together and seated.

12. Fit extension shaft, apply Loctite 270 to retaining bolt. Using a new 'O' ring. Tighten to **42 Nm**.
13. Fit new gasket to rear of gearbox. Fit extension housing, avoid damage to seal.
14. Tighten nine extension housing nine bolts to **23 Nm**.
15. Fit transfer gear selector housing.
16. Tighten three bolts to **25Nm**.
17. Refit transfer box.



RR586M

GOVERNOR HUB**Remove and refit****Remove**

1. Remove transfer box, *See TRANSFER BOX, Repair, Borg Warner transfer gearbox*
2. Remove transfer gear selector housing.
3. Loosen nine bolts holding extension housing.
4. Remove extension housing ensuring that seal is not damaged, discard gasket.
5. Remove extension shaft and retaining bolt with 'O' ring.
6. Remove governor assembly with parking wheel.
7. Remove two screws holding governor housing.
8. Remove two bolts, remove parking wheel. Discard governor hub.
9. Remove security clip and counter-weight.
10. Remove 'O' ring from output shaft and discard.
11. Remove three seal rings from 'F' clutch housing shaft.
12. Inspect all parts for damage or wear, replace if necessary.

Refit

13. Fit counterweight and security clip into new governor hub.

14. Secure governor housing to governor hub. Tighten to **10Nm**.
15. Fit parking wheel to governor hub. Tighten to **10 Nm**.
16. Fit three new seal rings onto F clutch housing shaft, fit 'O' ring onto output shaft.



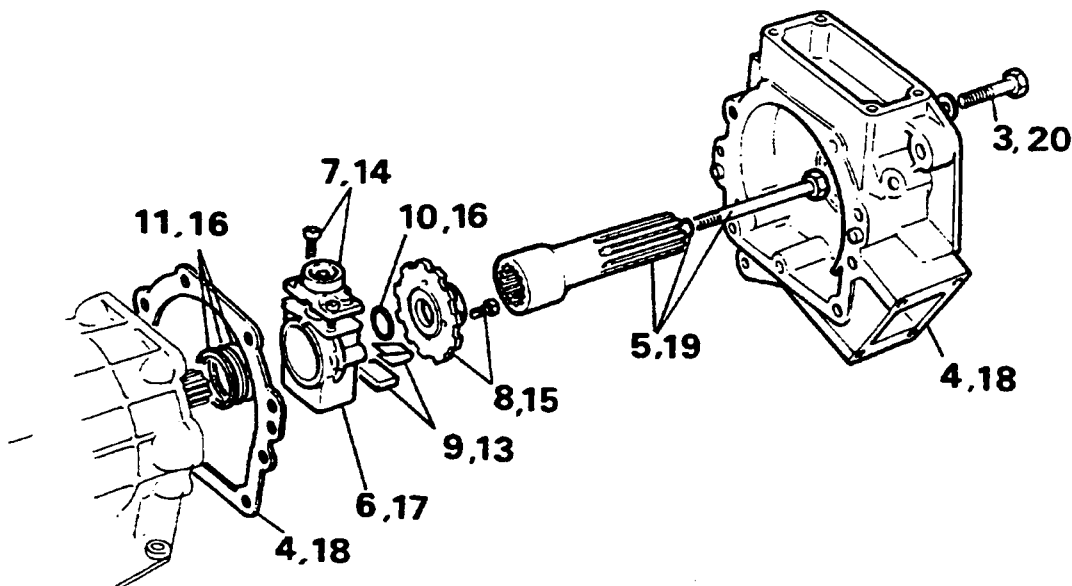
NOTE: To aid fitment of 'O' ring apply petroleum jelly.

17. Push governor assembly and parking wheel onto output shaft until seated.



NOTE: Apply petroleum jelly to 'O' ring. Ensure seal rings are snapped together and seated.

18. Fit new gasket to rear of gearbox. Fit extension housing, avoid damaging seal.
19. Fit extension shaft, apply Loctite 270 to retaining bolt. Using a new 'O' ring. Tighten to **42 Nm**.
20. Tighten nine extension housing nine bolts to **23 Nm**.
21. Fit transfer gear selector housing, tighten three bolts to **25 Nm**.
22. Refit transfer box.



RR919M



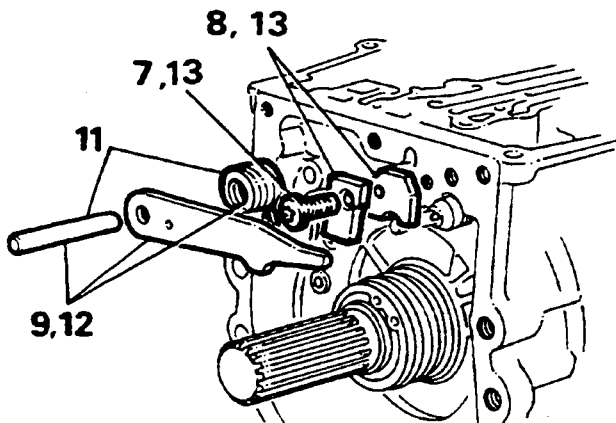
PARKING PAWL MECHANISM

Service repair no - 44.28.07.

Remove and refit

Remove

1. Remove transfer box, *See TRANSFER BOX, Repair, Borg Warner transfer box*
2. Remove transfer gear selector housing.
3. Loosen nine bolts holding extension housing.
4. Remove extension housing ensuring that seal is not damaged, discard gasket.
5. Remove extension shaft and retaining bolt with 'O' ring.
6. Remove governor assembly with parking wheel.



RR584 M

7. Remove guide plate bolt.
8. Remove plate and guide plate from gearbox case.
9. Remove pin, pawl and spring.



CAUTION: When removing assembly. Avoid damaging parts which could weaken spring tension.

10. Inspect all parts for wear or damage. Replace if necessary.

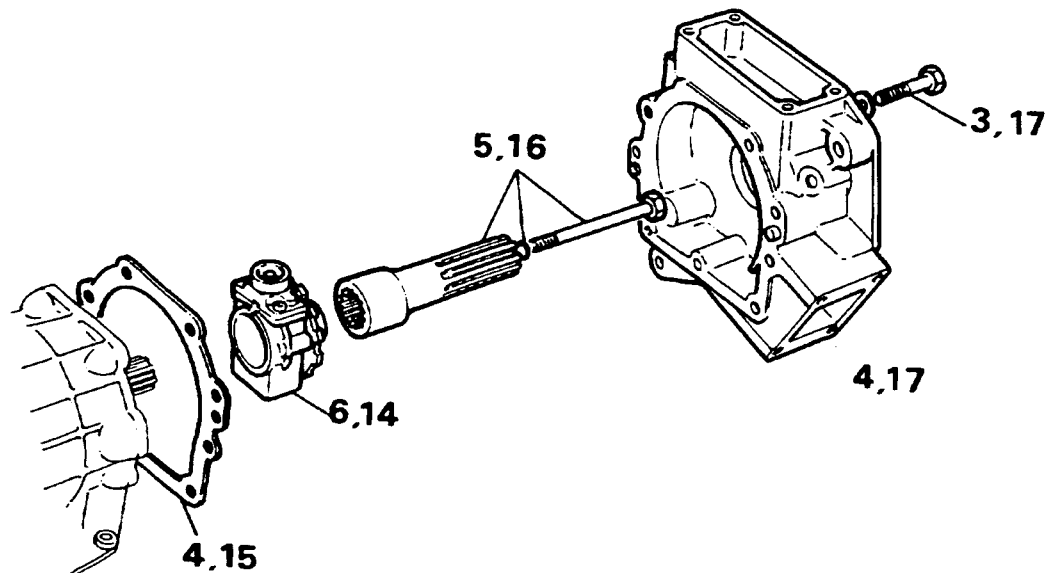
Refit

11. Fit pin and leg spring, locate spring correctly.
12. Fit pawl to pin. Locate spring leg into hole in pawl to create tension in spring.
13. Fit plate and guide plate. Tighten to **10 Nm**.
14. Push governor assembly with parking wheel onto output shaft until seated.



NOTE: Apply petroleum jelly to 'O' ring. Ensure seal rings are snapped together and seated.

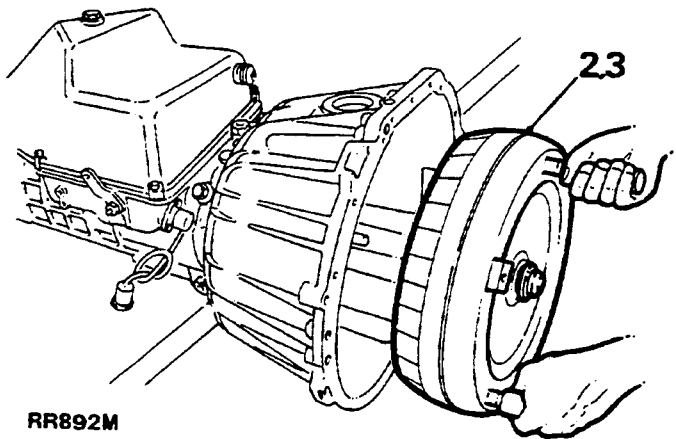
15. Fit new gasket to rear of gearbox. Fit extension housing, taking care not to damage seal or assembly.
16. Fit extension shaft and retaining bolt with new 'O' ring.
17. Fit extension housing, tighten nine bolts to **23Nm**.
18. Fit transfer gear selector housing, tighten three bolts to **25 Nm**.
19. Refit transfer box.



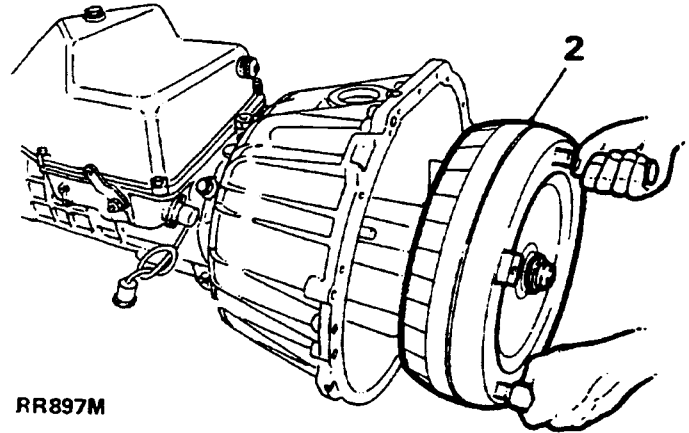
RR920M

REPLACING TORQUE CONVERTER

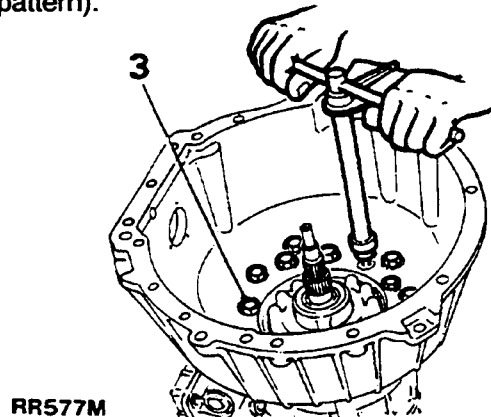
1. Remove gearbox and transfer box assembly, *See ZF Auto with Borg Warner transfer gearbox*
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.
3. Fit new torque converter using torque converter handles 18G1501. Check dimension from converter fixing boss to converter housing face is 50 mm. This shows converter is correctly seated in housing.
4. Refit gearbox and transfer box assembly. *See ZF Auto with Borg Warner transfer gearbox*

**ELIMINATING LEAKS ON PUMP HOUSING**

1. Remove gearbox and transfer box assembly, *See ZF Auto with Borg Warner transfer gearbox*
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.



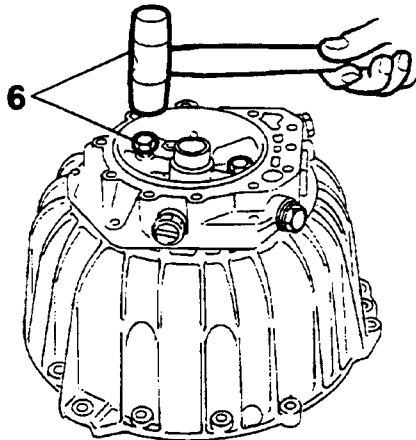
3. Remove twelve hexagonal bolts (inner ring pattern).



4. Remove bellhousing and pump assembly, discard gasket.
5. Remove eight hexagonal bolts on rear of pump.

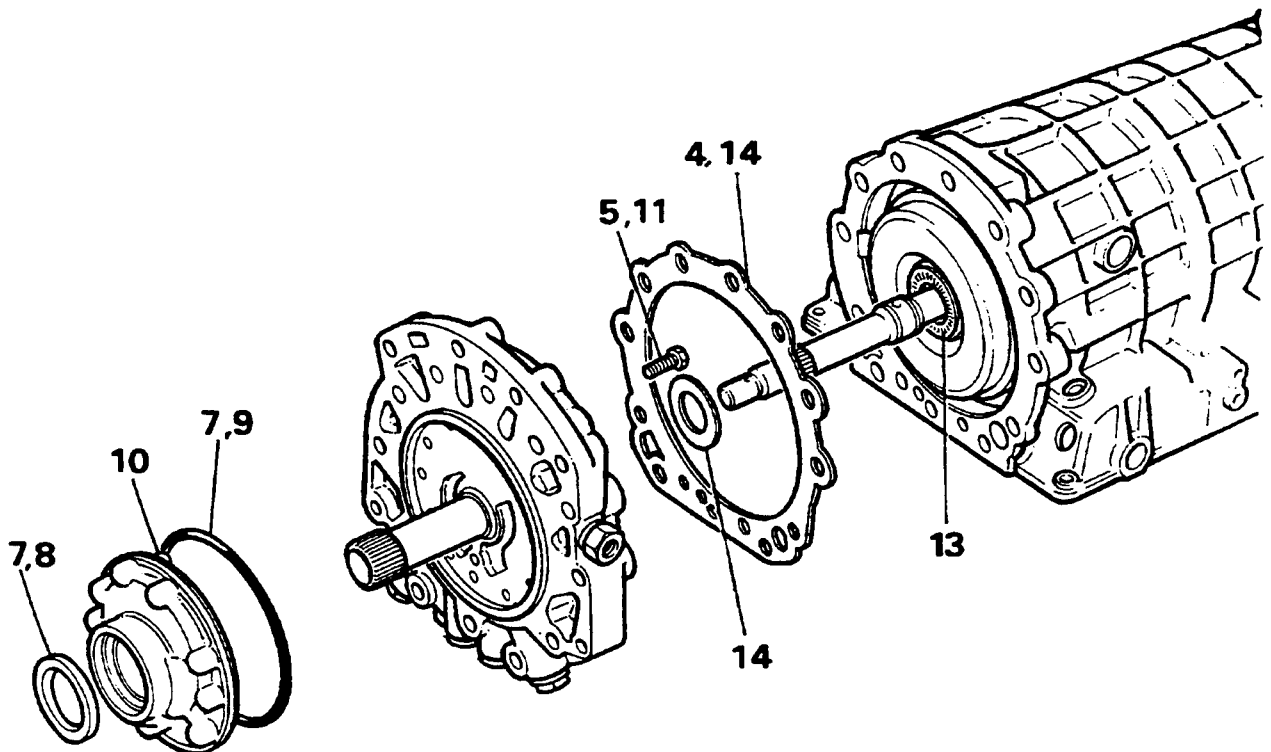


6. Screw in two bolts, diagonally opposite each other. Tap lightly using a soft headed mallet to remove pump assembly from intermediate plate.



RR578M

7. Remove shaft sealing ring and 'O' ring from pump housing and discard.
8. Using oil seal replacer LST108 fit shaft seal ring into pump housing.
9. Fit 'O' ring onto circumference of pump housing.
10. Align dowel with hole in intermediate plate and press pump housing home.

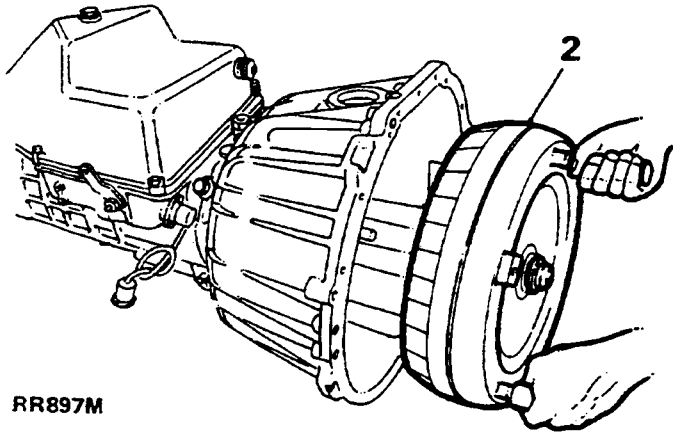


RR878M

11. Fit pump housing to intermediate plate, tighten eight bolts to **10 Nm**.
12. Place bellhousing and intermediate plate assembly on bench, front face up. Using oil pump rotation sleeve LST111, check that pump gears rotate freely.
13. Before fitting intermediate plate and bellhousing assembly, check that thrust washer and axial cage are seated on A clutch housing.
14. Place gasket and disc washer onto bellhousing and intermediate plate assembly using Petroleum Jelly.
15. Fit bellhousing and intermediate plate assembly to gearcase. Tighten twelve bolts to **46 Nm**.
16. Place end float gauge LST111 onto pump housing and check that axial play is between 0.2-0.4 mm. Replace existing washer, situated at rear of intermediate plate, with a suitable washer to give required end float.
17. Refit torque converter into housing using torque converter handles 18G1501, checking that dimension from converter fixing bolt boss to converter housing face is 50 mm. This shows converter is properly seated in housing.
18. Refit gearbox/transfer box assembly. **See ZF Auto with Borg Warner transfer gearbox**

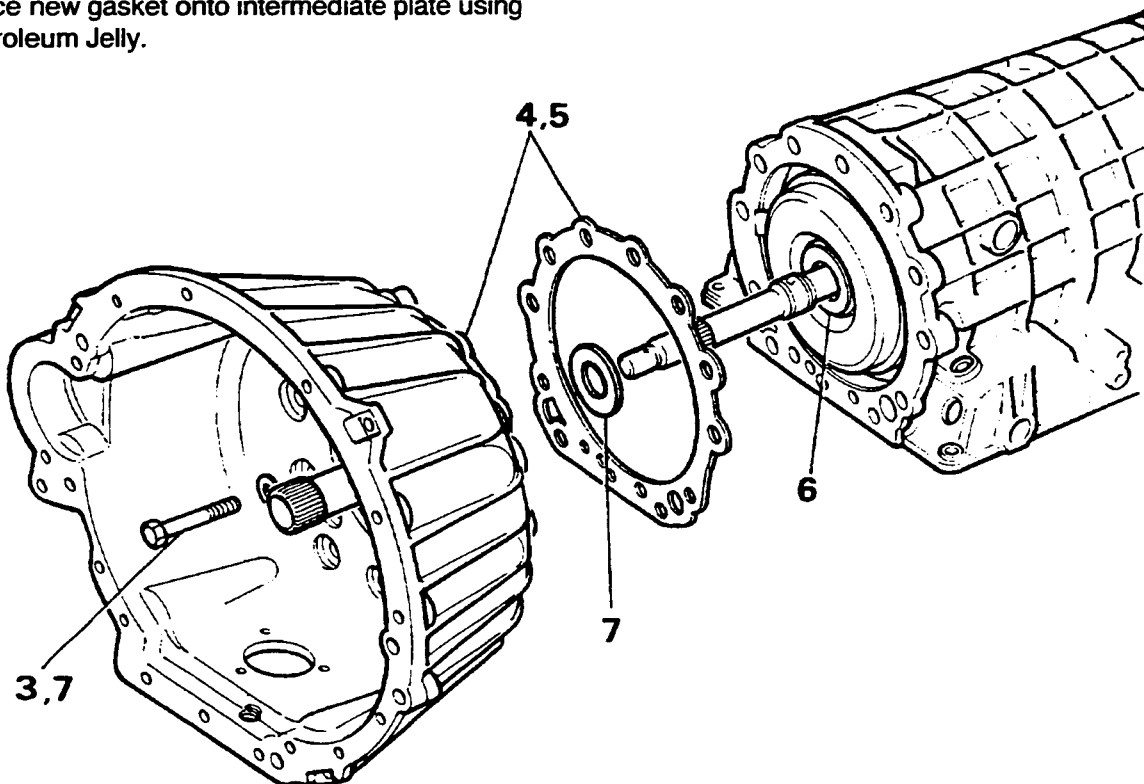
ELIMINATING LEAKS BETWEEN GEARBOX HOUSING AND INTERMEDIATE PLATE

1. Remove gearbox and transfer box assembly, *See ZF Auto with Borg Warner transfer gearbox*
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.

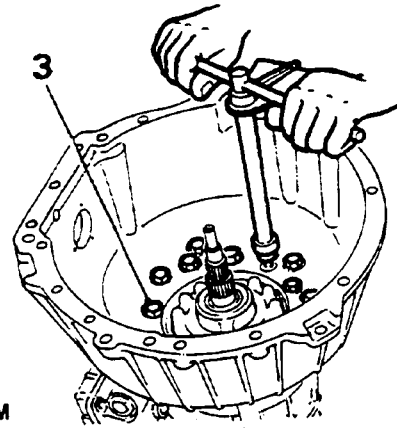


RR897M

3. Remove twelve hexagonal bolts (inner ring pattern).
4. Remove bellhousing/intermediate plate assembly from gearbox case and discard gasket.
5. Place new gasket onto intermediate plate using Petroleum Jelly.



RR576M



RR577M

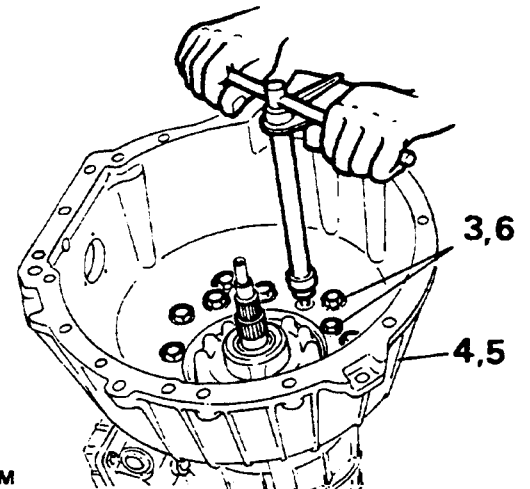
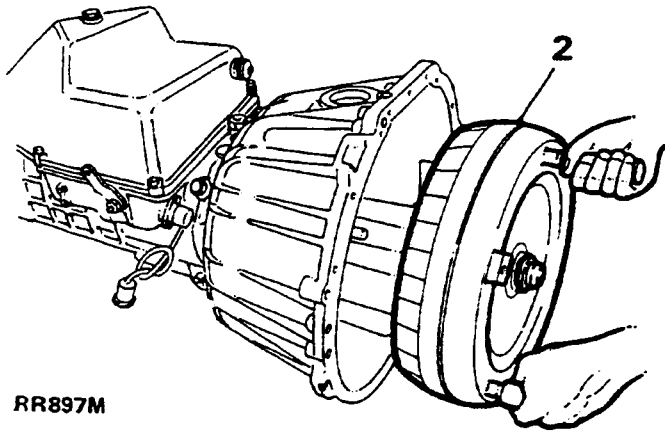
6. Before fitting bellhousing assembly check that thrust washer and axial cage are seated on A clutch housing.
7. Fit bellhousing assembly with disc washer to gearcase. Tighten twelve bolts to **46Nm**.
8. Place end-float gauge LST111 onto pump housing and check that axial play is between 0.2-0.4 mm. Replace existing washer, situated at rear of intermediate plate, with a suitable washer to give required end-float.
9. Refit torque converter using torque converter handles 18G1501. Checking that dimension from converter fixing boss to converter housing case is 50mm. This dimension shows converter is properly seated.
10. Refit gearbox/transfer box assembly. *See ZF Auto with Borg Warner transfer gearbox*



REPLACING BELLHOUSING

Service repair no - 44.17.01

1. Remove gearbox and transfer box assembly, *See ZF Auto with Borg Warner transfer gearbox*
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.



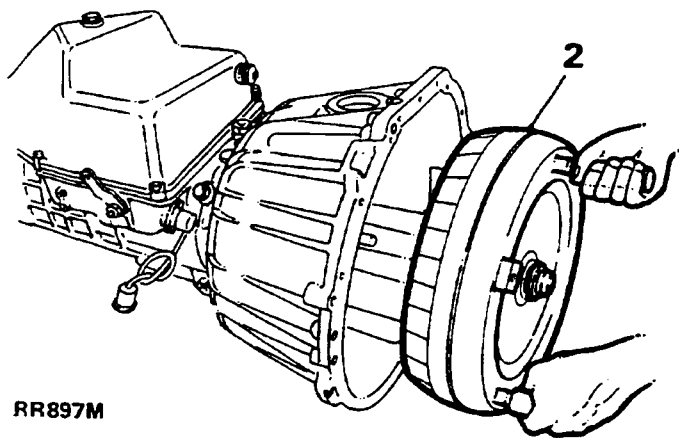
7. Refit torque converter using torque converter handles 18G1501. Check that dimension from converter fixing boss to converter housing face is 50 mm. This dimension shows converter is properly seated in housing.
8. Refit gearbox/transfer assembly. *See ZF Auto with Borg Warner transfer gearbox*

3. Remove eighteen hexagonal bolts.
4. Remove bellhousing.
5. Fit new bellhousing.
6. Secure bellhousing, tighten eighteen bolts to **46 Nm**.

REPLACING PUMP

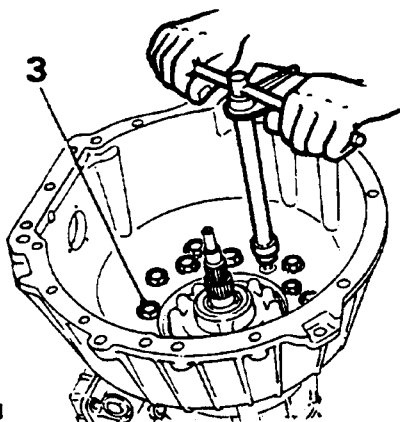
Service repair no - 44.32.01.

1. Remove gearbox and transfer box assembly, *See ZF Auto with Borg Warner transfer gearbox*
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.



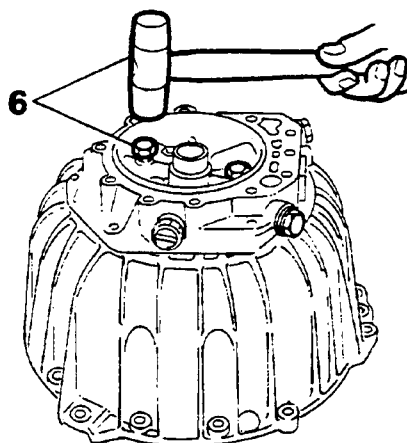
RR897M

3. Remove twelve bolts (inner ring pattern).



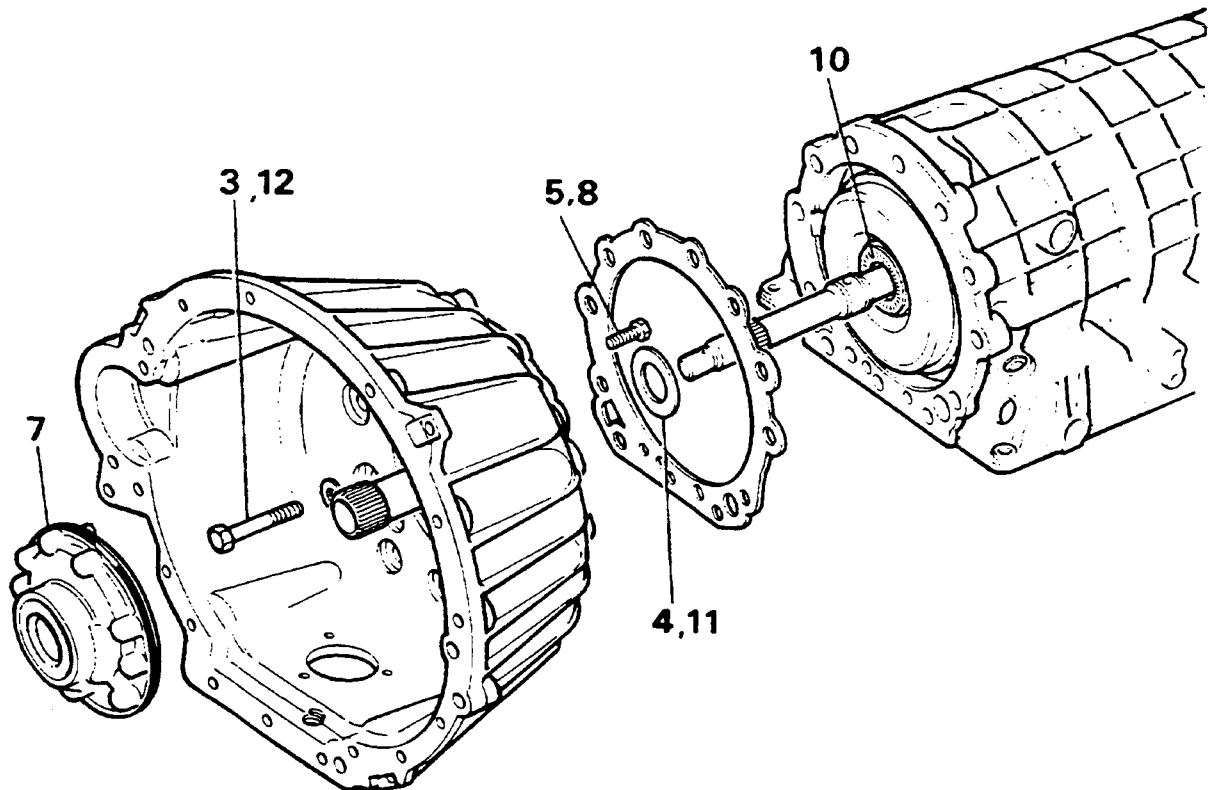
RR577M

4. Remove bellhousing and pump assembly from gearbox case, discard gasket.
5. Remove eight bolts on rear of pump.
6. Screw in two bolts, diagonally opposite each other, tap lightly using a soft headed mallet to free pump assembly from intermediate plate.



RR578M

7. Fit new pump assembly, aligning dowel with hole in intermediate plate, press pump housing home.
8. Secure pump housing to intermediate plate using eight hexagonal bolts and. Tighten to **10 Nm**.
9. Place bellhousing and intermediate plate assembly on bench, front face up. Using oil pump rotation sleeve LST111, check that pump gears rotate freely.
10. Before replacing intermediate plate/bellhousing assembly check that thrust washer and axial cage are seated on A clutch housing.
11. Place new gasket and disc washer onto bellhousing and intermediate plate assembly using a Petroleum Jelly.
12. Fit bellhousing and intermediate plate assembly, tighten twelve bolts to **46 Nm**.



RR891M

13. Place end-float gauge LST111 onto pump housing and check that axial play is between 0.2-0.4 mm. Replace existing washer, situated at rear of intermediate plate, with suitable washer to give required end-float.



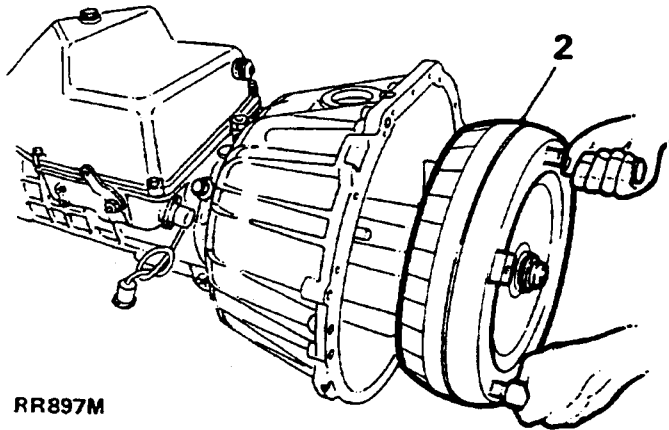
NOTE: If damage is apparent to bolts they should be replaced.

14. Refit torque converter into housing using torque converter handles 18G1501. Check dimension converter fixing boss to converter housing face is 50 mm. This shows converter is properly seated in housing.
15. Refit gearbox/transfer box assembly. *See ZF Auto with Borg Warner transfer gearbox*

REPLACING INTERMEDIATE PLATE

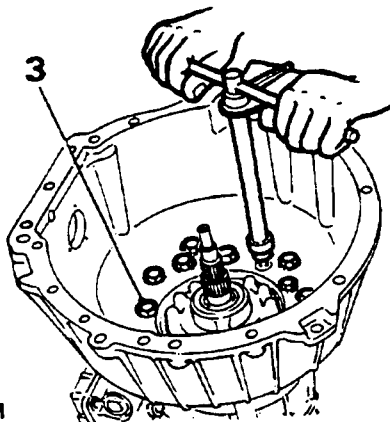
Service repair no - 44.20.11.

1. Remove gearbox and transfer box assembly,
See ZF Auto with Borg Warner transfer gearbox
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501.



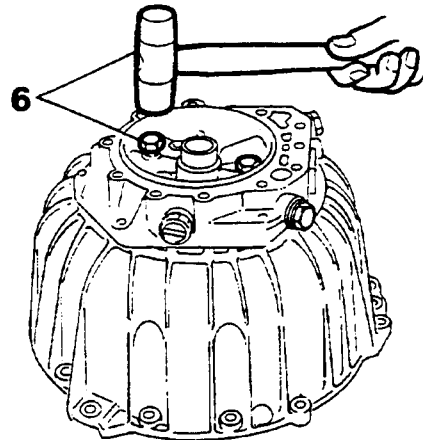
RR897M

3. Remove twelve bolts (inner ring pattern).



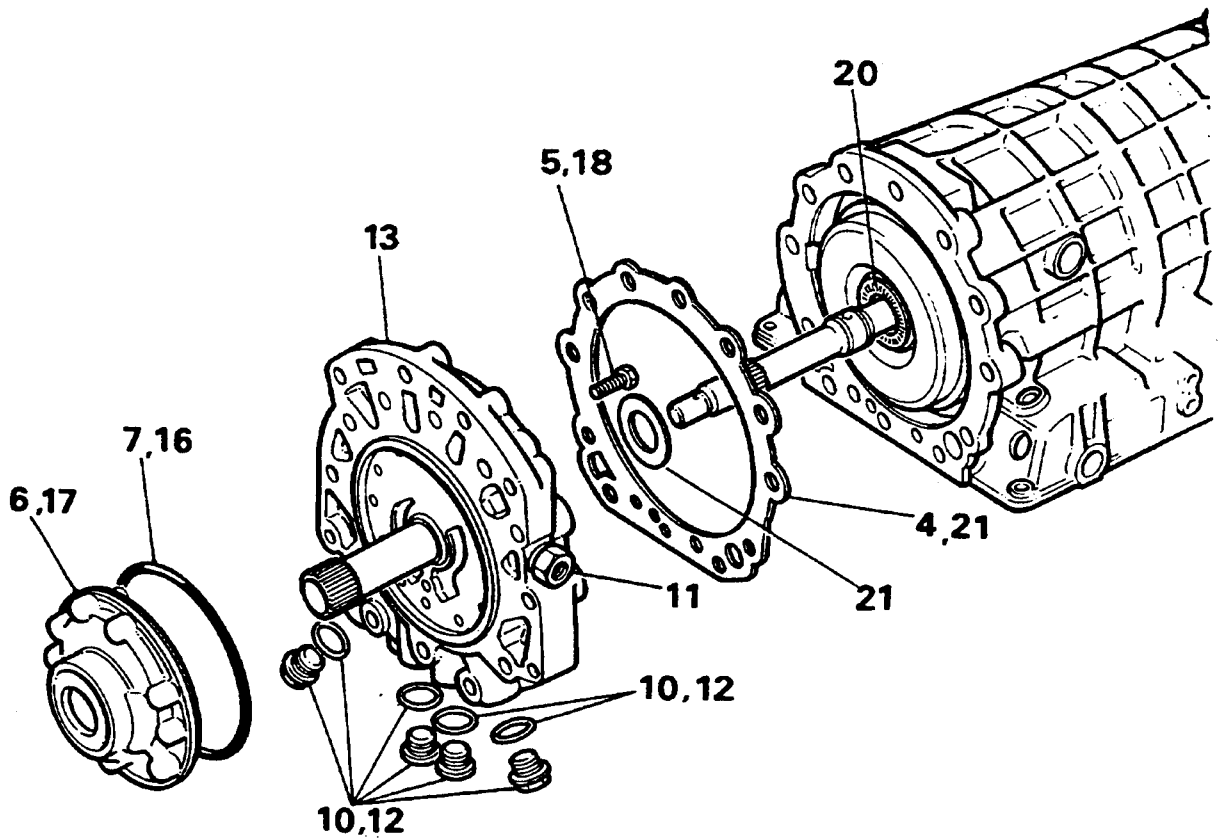
RR577M

4. Remove bellhousing and pump assembly from gearbox case, discard gasket.
5. Remove eight bolts from rear of pump.
6. Screw in two bolts, diagonally opposite each other, tap pump to free pump assembly from intermediate plate.



RR578M

7. Remove 'O' ring from pump housing and discard.
8. Place bellhousing and intermediate plate assembly on bench.



RR876M

9. Remove six bolts and remove bellhousing from intermediate plate assembly.
10. Remove four screw plugs and seal rings from intermediate plate, discard seal rings.
11. Remove oil cooler pipe adaptors, fit them into new intermediate plate.
12. Fit plugs and new seal rings into new intermediate plate.
13. Fit intermediate plate assembly onto bellhousing.
14. Secure with six hexagonal bolts (outer ring pattern). Tighten to **46 Nm**.
15. Place intermediate plate and bellhousing assembly on bench, front face up.
16. Fit 'O' ring onto circumference of pump housing.
17. Align dowel with hole in intermediate plate, press pump housing home.
18. Secure pump housing to intermediate plate, tighten eight bolts to **10Nm**.
19. Place bellhousing and intermediate plate assembly on bench. Using oil pump rotation sleeve LST111, check that pump gears rotate freely.
20. Before replacing intermediate plate and bellhousing assembly check that thrust washer and axial cage are seated on 'A' clutch housing.
21. Place gasket and disc washer onto bellhousing and intermediate plate assembly using Petroleum Jelly.
22. Fit bellhousing and intermediate plate assembly onto gearcase, tighten twelve bolts to **46 Nm**.
23. Place end-float gauge LST111 on pump housing and check that axial play is between 0,2-0,4 mm. Renew existing washer, at rear of intermediate plate, to give required end-float.
24. Refit torque converter into housing using torque converter handles 18G1501. Check dimension from converter fixing boss to converter housing face is 50 mm. This shows converter is properly seated in housing.
25. Refit gearbox/transfer box assembly. *See ZF Auto with Borg Warner transfer gearbox*



TORQUE VALUES



NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
Coupling shaft to mainshaft	42*
Filler tube to sump	70
Gear change lever to gearbox	25
Cooler pipe adaptor to gearbox	42
Securing screws - clutch F	10
Securing screw - parking pawl	10
Securing screws - pump	10
Intermediate plate plugs (M20)	50
Intermediate plate plugs (M14)	40
Bell housing mounting bolts	46
Governor mounting screws	10
Extension housing bolts	23
Control unit mounting bolts	8
Sump plug	10
Mounting screws for sump	8
Drive plate to converter	39*
Gearbox to engine	42
Strut (threaded end)	42
Bottom cover to converter housing	9
Cover - converter housing	9
Drive plates to crankshaft adaptor	40*
Adaptor to crankshaft	84



NOTE: * These bolts must have threads coated with Loctite 270 prior to assembly.

Torque values below are for all screws and bolts used except for those that are specified otherwise.

	Nm
METRIC	
M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180
UNC / UNF	
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

ZF GEARBOX DATA

Axial end float 0.2 to 0.4 mm.

From torque converter boss to torque converter housing face 50 mm

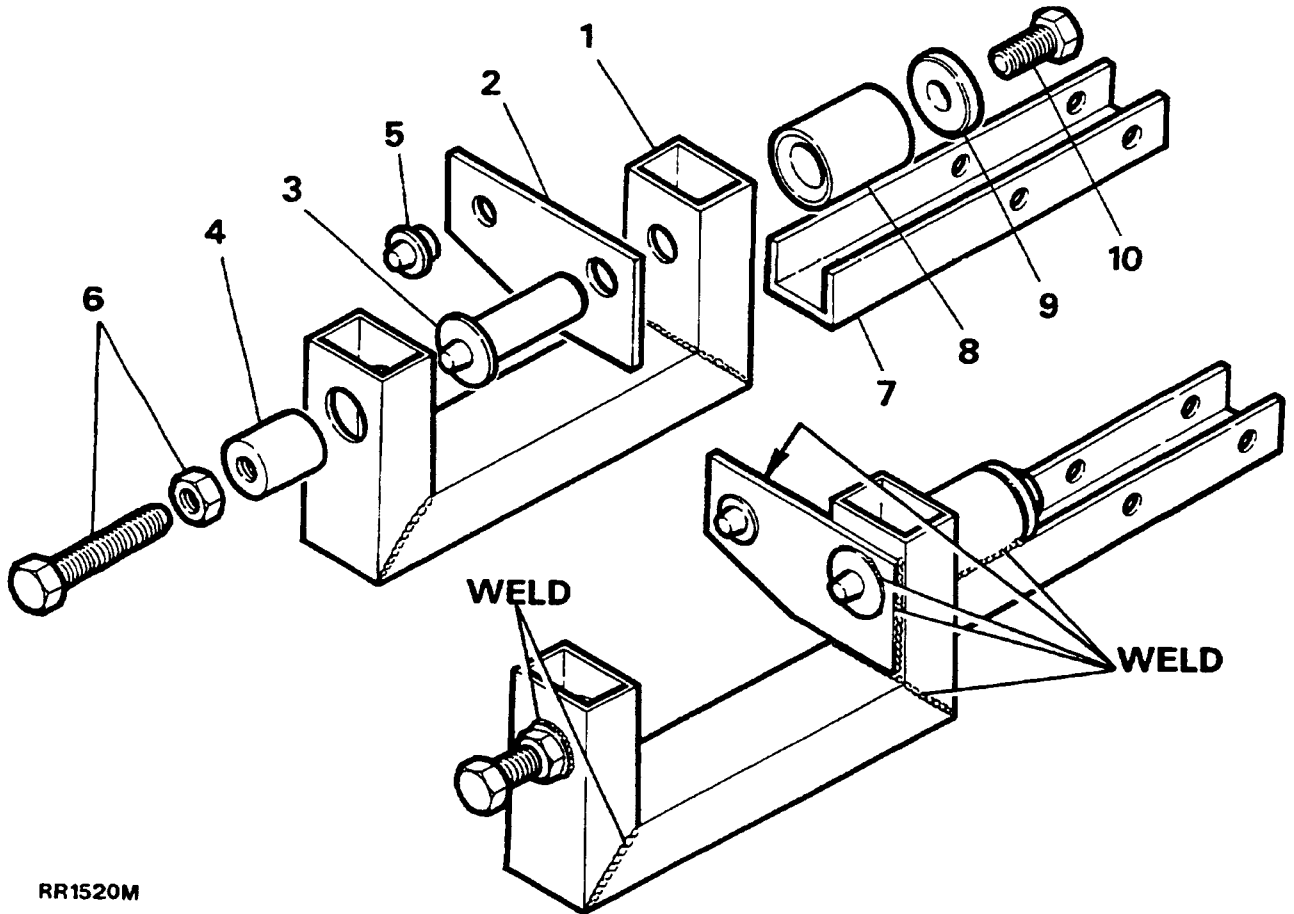
Freewheel cage assembly to ring gear; minimum clearance 0.1 mm

Output shaft above cylinder F assembly; dimension 10.00 mm

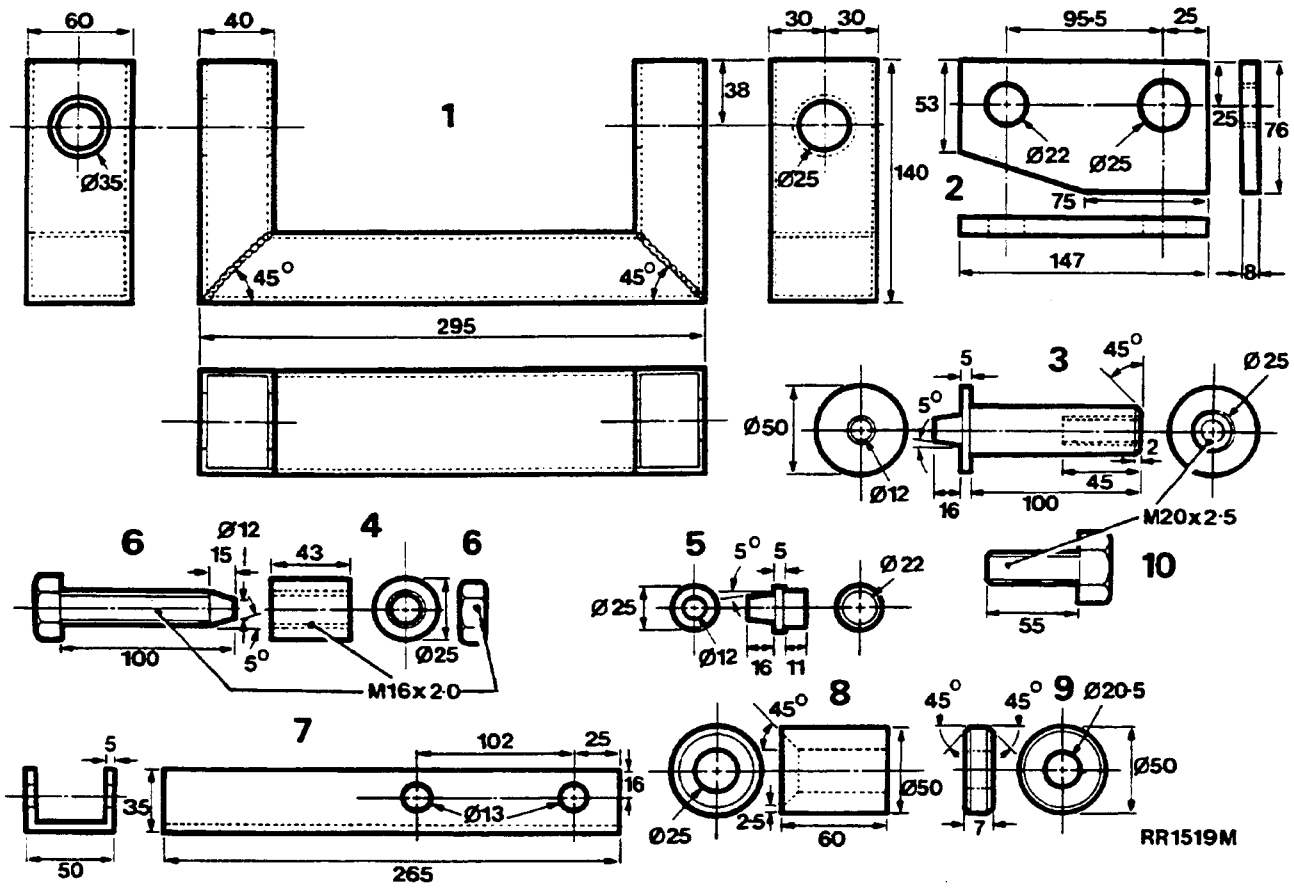
A cylinder protrusion above gearbox front face not more than 8.5 mm

**AUTOMATIC GEARBOX HOLDING FIXTURE**

NOTE: This fixture enables ZF gearbox to be held securely during bench sited repairs. It can be manufactured to details given, or purchased under service tool number LST 118.



RR1520M



RR1519M

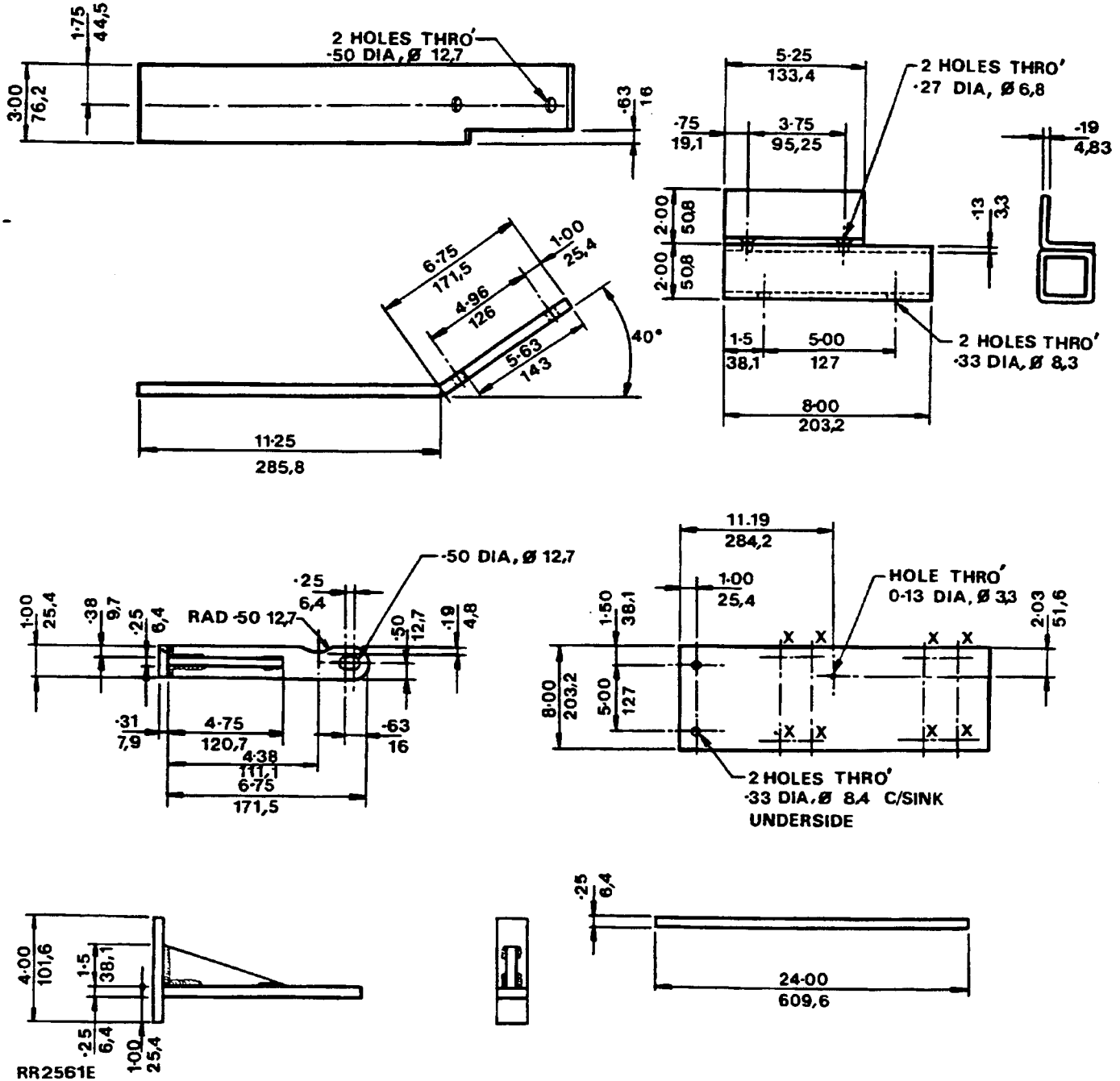


**AUTOMATIC GEARBOX AND BORG WARNER
TRANSFER GEARBOX**

Adaptor plate

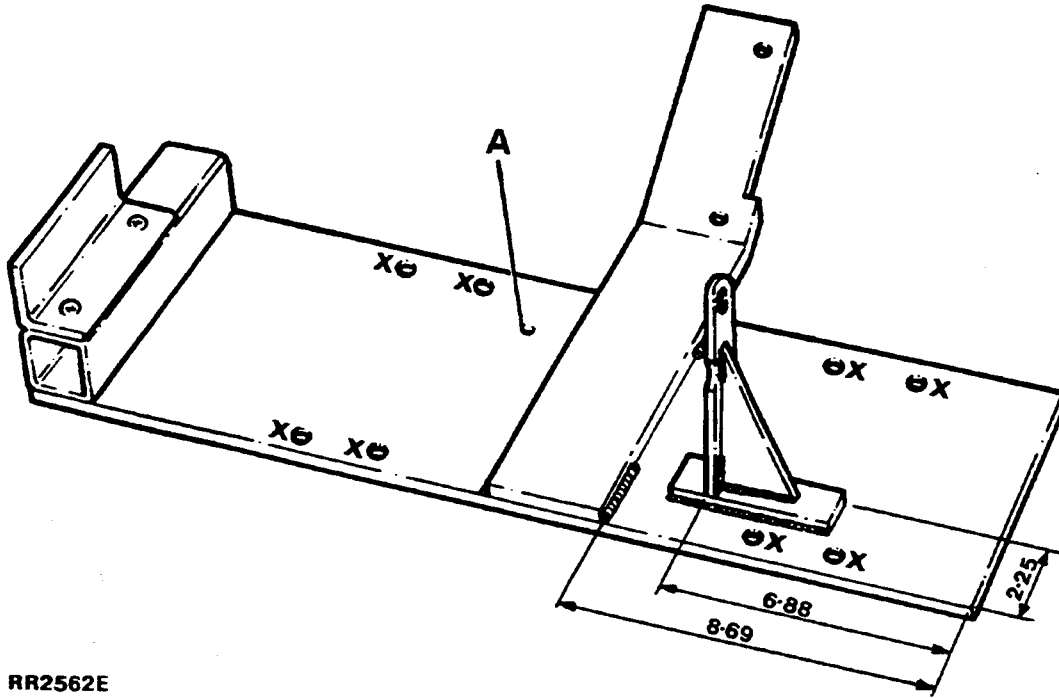
To remove transmission assembly from vehicle it is necessary to manufacture an adaptor plate to use with transmission hoist.

NOTE: Four holes (A) to be countersunk on underside to suit hoist.



- A: Centre of the lifting hoist
- X: Drill fixing holes to suit hoist table

Material: Mild Steel plate BS 1449, 14SWG

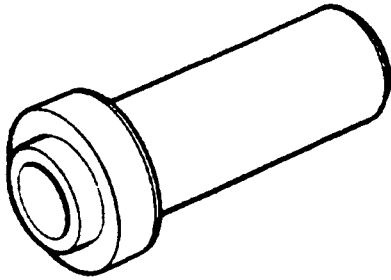


RR2562E



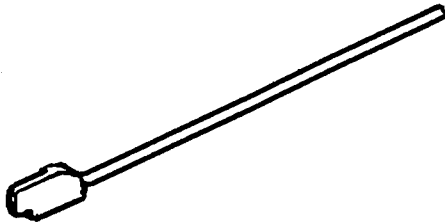
AUTOMATIC GEARBOX

LRT-44-001 Front and rear oil seal replacer.
LST 108



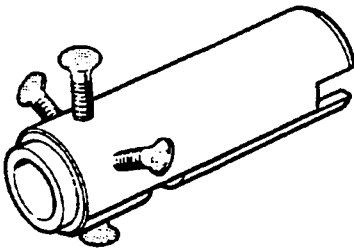
LST108

LRT-44-002 Selector linkage setting gauge.
LST 109



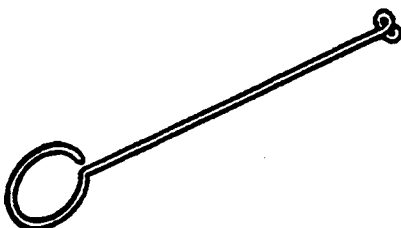
LST109

LRT-44-003 Oil pump rotation sleeve and end float gauge.
LST 111

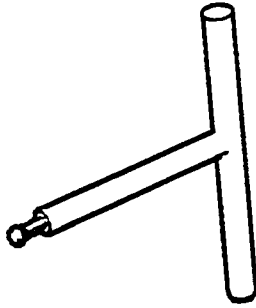


LST111

LRT-44-004 Kickdown cable remover.
LST 112



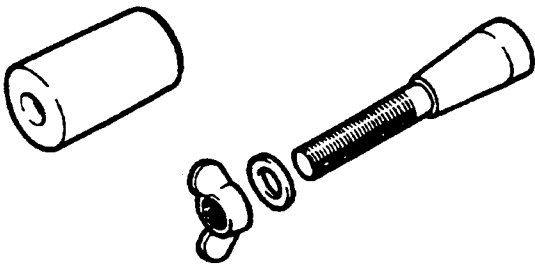
LST112



LRT-44-005
LST 113

Control unit oil seal remover/replacer.

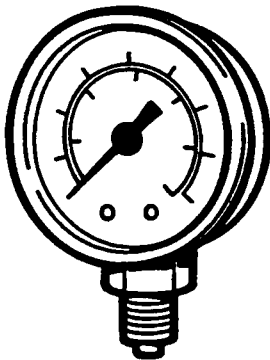
LST113



LRT-44-006
LST 114

Selector shaft oil seal replacer.

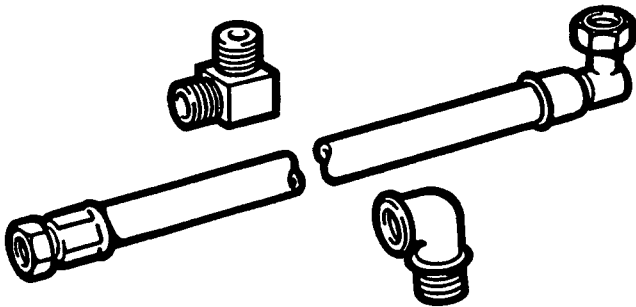
LST114



LRT-44-007
18G.502A

Line pressure test gauge.

18G502A



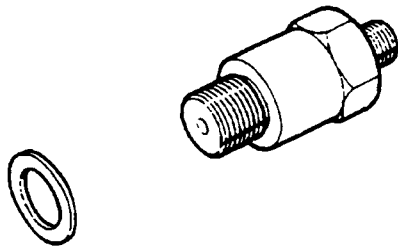
LRT-44-008
18G.502K

Hose and adaptor.

18G502K

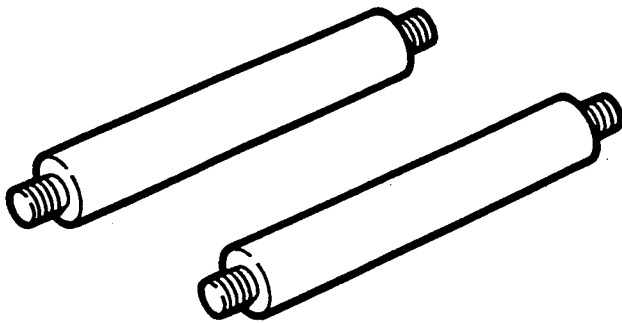


LRT-44-009 Adaptor pressure take off.
LST 502-1



LST502-1

LRT-44-010 Converter lifting handles.
18G.1501



18G1501