Printed in England

July 1971

T.S.D. 2476

Section T15
REAR SERVO AND ACCUMULATOR

The rear servo and accumulator (*see Fig. T54*) comprises an assembly of pistons and valves, housed in aluminium alloy castings which are secured to the gearbox bottom face, adjoining the front servo. The rear servo is applied mechanically by a pair of coil springs and released hydraulically by main line oil pressure. A steel strap, bolted to the servo housing, retains the springs.

Operation

The rear servo actuates the rear band which holds the rear clutch drum when the selector lever is in Range 2, and is ustilised also to absorb an amount of rear clutch apply oil in Range 3 or 4.

Normally, when driving in Range 3 or 4 a sprag clutch assembly holds the rear drum during first and second gears thus giving the necessary gear reduction as required. When the car is on 'overrun', the rear wheels and propeller shaft attempt to drive the engine but the sprag clutch freewheels and makes this ineffective.

In Range 2 it is desirous to have engine braking, so in order to facilitate this, main line pressure to the rear servo is cut off. The coil springs then apply sufficient pressure to hold the friction band securely around the drum, thus holding it stationary. A small flap valve is fitted to the rear servo, in the hydraulic line. This has the effect of slowing down band application, or conversely speeding up band release.

The rear clutch accumulator (*see Fig. T54*) is a device which assists in the smooth application of the rear clutch under varying throttle conditions in Range 3 and 4. Due to the varying torque loads to which the rear clutch is subjected, some control over the application is desirable. For example, with light throttle conditions the rear clutch can be applied with a minimum of pressure, on the other hand, with higher throttle openings, the clutch can be applied with greater oil pressure.

Accumulator pressure is fed to the rear of the accumulator piston. The pressure is controlled by T.V. pressure acting on the primary and secondary valves and springs in the valve body.

When rear clutch apply oil is applied during the 2-3 shift, oil is fed to the clutch piston and to the accumulator. Initially, the clutch piston is forced against the clutch release springs and the accumulator piston remains stationary. During this period the rear clutch apply pressure is lower than the accumulator pressure. When the clutch piston reaches the end of its free travel (clutch plates not yet fully engaged) the rear clutch apply pressure rises until it is the same as the accumulator pressure and the equivalent accumulator spring pressure. This is the pressure required to give a smooth shift at that particular selected throttle opening.

The rear clutch apply pressure which, in attempting to build up above accumulator pressure, forces the accumulator piston back, causing the accumulator oil to exhaust. The rear clutch apply pressure cannot build up until the accumulator piston reaches the end of its travel. In this period the shift will have been completed and until the rear clutch apply pressure builds up to main line pressure it has no effect upon the shift.

Rear servo and accumulator — To remove

The rear servo can be removed independently of the front servo, but as removal necessitates slackening the

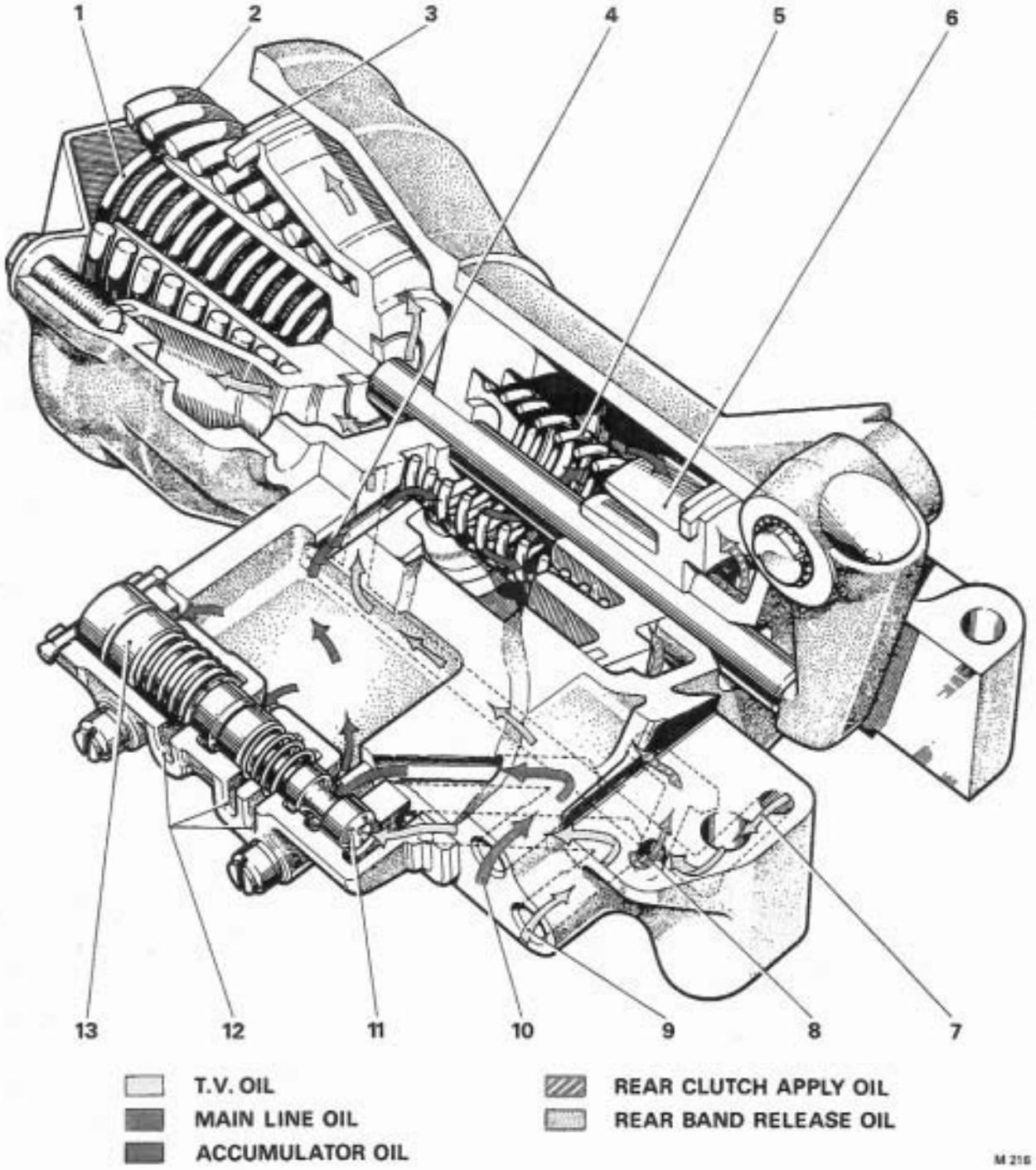

FIG. T54 REAR SERVO AND ACCUMULATOR—OPERATION

1 Accumulator oil
2 Rear servo spring
3 Rear servo inner spring
4 Rear servo piston
5 Accumulator piston spring
6 Accumulator piston
7 Rear band release oil inlet
8 Rear clutch apply oil inlet
9 T.V. oil inlet
10 Main line oil inlet
11 Primary valve
12 Exhaust ports
13 Plug

front servo securing screws it is advisable to remove both servos together as explained in Section T14—Front servo.

If fault diagnosis has indicated that the rear servo unit may be defective, it should be checked as described under 'Rear servo and accumulator — To test', in order to determine which part is at fault before dismantling and inspecting.

Rear servo and accumulator — To dismantle

Unscrew the four setscrews which secure the valve body to the accumulator body then lift off the valve body. The primary and secondary valves are held in position by a plug which is in turn secured by a crimped-ended pin. It is not necessary to dismantle the valve body.

Dismantling of the servo part of the servo and accumulator assembly is best carried out using special tool RH 7776 to compress and release the inner and outer servo apply springs. **Do not unscrew the two strap retaining setscrews until the springs are held captive by the tool.**

Secure the tool in an upright position in a vice.

Fit the assembled unit on to the base pegs of the tool (*see Fig. T55*) then screw down the centre screw until it abuts the strap.

Unscrew the strap retaining setscrews then slowly release the centre screw until the two servo springs are no longer under tension.

Remove the strap and springs then lift the assembly off the tool pegs.

If the special tool is not available, the assembly may be positioned upright under a hand press, then the press ram lowered until it just touches the retaining strap.

Note Do not exert any force on the strap, otherwise it may become distorted.

The servo may then be dismantled as previously described.

Push in the band actuating rod until the servo apply piston protrudes from its bore.

Remove the assembly piston and rod.

With the assembly again fitted on to the pegs of the special tool, remove the two setscrews which secure the accumulator body to the servo body; remove the accumulator body from the tool pegs.

Separate the two bodies and discard the gasket.

Note The bodies are a slight interference fit and should be carefully separated using a soft-headed mallet.

Remove the accumulator spring and piston from the accumulator body.

If the operating lever is to be removed, withdraw the split pin, slide out the clevis pin, remove the operating lever from the lugs then slide out the eighteen needle rollers.

Rear servo and accumulator — To inspect

Thoroughly clean all parts using a clean, filtered cleaning fluid and a brush, then dry off the parts using compressed air.

All oil passages must be washed and blown through with compressed air to ensure that particles of dirt do not remain which may eventually reach the control valve unit.

Do not remove the piston rings except when it is necessary to clean the ring grooves; careless handling of the rings can cause them to distort.

Check the permanent plug for security in the junction body.

Check that the primary and secondary valves are free to move in their bores.

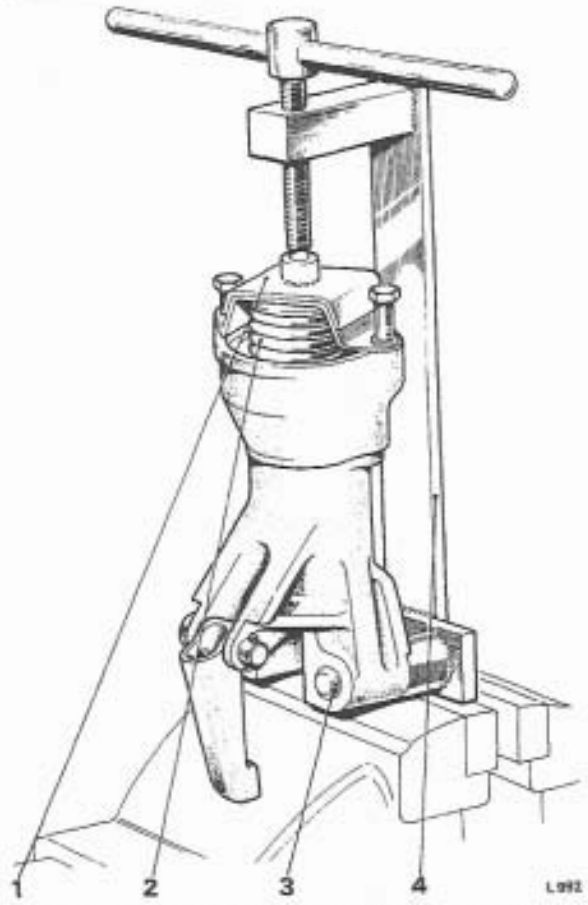

FIG. T55 DISMANTLING THE REAR SERVO

1 Retainer
2 Outer spring
3 Tool pin
4 Compressing tool

Printed in England
July 1971
T.S.D. 2476

Chapter T

If it is considered necessary to remove the valves and springs, file or saw off the head of the securing pin then withdraw the pin.

Remove the end plug, secondary valve and spring, then the primary valve and spring.

Inspect the valves and valve bores for scoring. Small marks may be removed from the valves with a hard Arkansas stone.

Do not attempt to remove score marks from the valve body bores; if either the valves or body bores are badly scored, a new valve body assembly should be fitted.

Examine all springs for distortion or broken coils.

Examine all tapped holes for damaged threads, particularly the ones which receive the strap securing setscrews; due consideration should be given to the load imposed on these threads when the servo is acting under oil pressure.

Examine the retaining strap for cracks, particularly at the bends.

Examine the piston rings for wear or breakage, also check for excessive side play in the piston ring grooves (*see Dimensional Data*).

Examine the servo and accumulator body bores for excessive wear or score marks. If either body is considered to be unserviceable, a new servo and accumulator unit assembly should be fitted. Check the fit of the servo body in the accumulator body; if the slight interference fit cannot be maintained a new servo and accumulator unit assembly should be fitted.

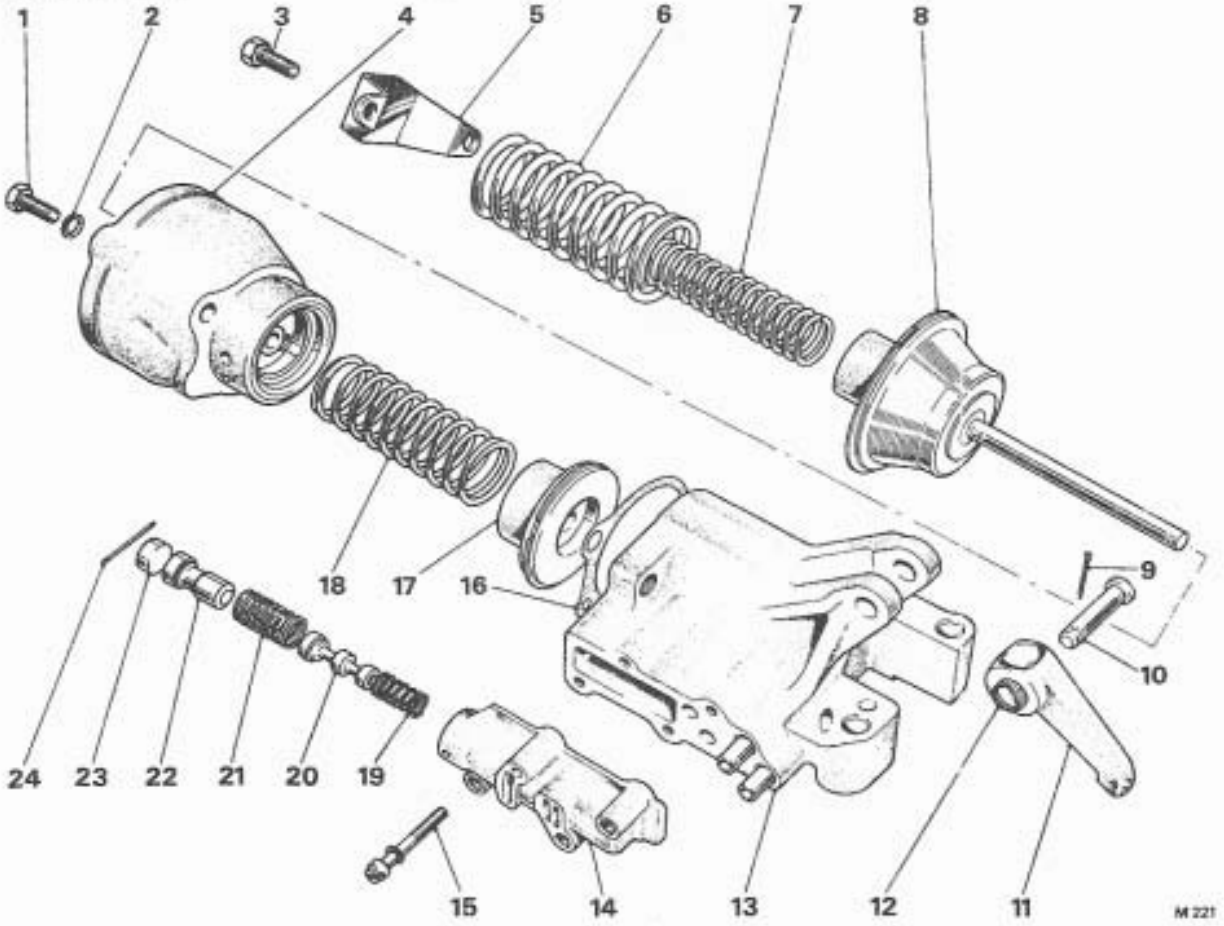

FIG. T56 REAR SERVO AND ACCUMULATOR—EXPLODED

1	Setscrew	9	Split pin	17	Accumulator piston
2	Plain washer	10	Clevis pin	18	Accumulator spring
3	Setscrew	11	Actuating lever	19	Primary valve spring
4	Rear servo body	12	Needle roller bearings	20	Primary valve
5	Spring retainer	13	Accumulator body	21	Secondary valve spring
6	Rear servo outer spring	14	Valve body	22	Secondary valve
7	Rear servo inner spring	15	Screw	23	Plug
8	Rear servo piston	16	Gasket	24	Retaining pin

T.S.D. 2476 July 1971 Printed in England

Examine the restrictor valve in the bottom of the servo release chamber for security.

Using a surface plate and engineer's blue, examine the mating faces of the accumulator body, valve body and junction body for warping.

Small burrs may be removed, particularly around the setscrew holes. If a component is sufficiently warped to allow excessive oil leaks, it should be renewed.

The clevis pin and the bore of the band operating lever should be examined for excessive wear.

Fit the clevis pin and needle rollers into the bore and check for excessive play. If wear is apparent, renew the parts.

Check the fit of the clevis pin in the lugs on the body.

Rear servo and accumulator — To assemble

Assemble the rear servo and accumulator as follows (*see Fig. T56*).

Fit the needle rollers into the bore of the operating lever, retaining them in position with petroleum jelly.

Fit the assembly of lever and rollers into the lugs on the body; fit the clevis pin.

Retain the clevis pin with a new split pin.

Lightly oil the accumulator body bore then fit the accumulator piston. Ensure that the piston enters the bore squarely, to avoid damaging the bore with the piston ring; push the piston to the bottom of the bore.

Using the piston rod, align the piston bore with the bore in the accumulator body.

Fit the accumulator piston spring.

Fit a new gasket on to the servo body mating face, ensuring that the gasket is correctly positioned relative to the band release hole.

Fit the servo body to the accumulator body, again positioning the oil hole, then fit the setscrews and the thin plain washers; torque tighten the setscrews (*see Dimensional Data*).

Lightly oil the bore of the servo body and the band actuating rod.

Enter the rod into the bore of the accumulator piston, then, ensuring that the servo release piston ring enters the servo body bore squarely, push the piston and rod assembly into the servo body.

Fit the inner and outer springs.

Fit the assembly onto the base pegs of the special tool.

Fit the strap onto the top of the springs.

Turn the tool centre screw clockwise until the springs are compressed sufficiently to allow the strap retaining setscrews to be fitted. Fit the setscrews and torque tighten them, then remove the assembly from the pegs of the special tool.

Note If the special tool is not available, a press may be used, reversing the procedure adopted when dismantling.

If the primary and secondary valves have been removed, they should be fitted into the valve body together with their return springs. Lightly oil the valves before entering them into the valve body; ensure that they return under spring pressure when pushed from the secondary valve end.

Fit the end plug and a new retaining pin; the end of the pin should be crimped to hold it in position.

Fit the valve body.

Fit the junction body.

Evenly tighten the setscrews then torque load them.

Note Do not use jointing compound between the accumulator body face and the valve housing and junction body faces.

Rear servo and accumulator — To test

The rear servo and accumulator can be tested functionally only by using a special test rig or by fitting the unit to the gearbox and carrying out a road test.

Movement of the pistons and freedom of the valves in their bores can be tested by applying an air pressure of approximately 70 lb/sq. in. (4,9 kg/sq. cm.) to specified oil ducts and observing the movement. However, internal leaks or sluggish valves will not be revealed by these tests.

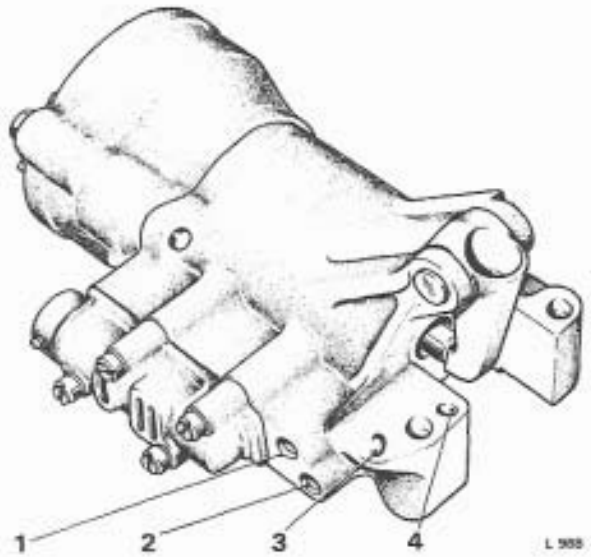

FIG. T57 REAR SERVO AND ACCUMULATOR AIR PRESSURE TEST POINTS

1 Main line oil port
2 T.V. oil port
3 Rear clutch apply oil port
4 Rear band release oil port

Printed in England
July 1971
T.S.D. 2476

Chapter T

Apply air pressure to the band release duct (*see Fig. T57*); the operating rod should move into the cylinder.

Apply air pressure to the rear clutch apply oil duct; the accumulator piston should be felt to move.

Apply air pressure to the main line oil duct; the primary and secondary valves should be heard to move in the valve body.

Rear servo and accumulator — To fit

If, as suggested under the heading 'Rear servo and accumulator — To remove', both servos were removed, at this point they should be fitted to the gearbox as described under 'Front and rear servos — To fit' in Section T14.

When the servos have been fitted to the gearbox, set the bands as described in Section T14.

Note If the front servo has been removed from the gearbox, the front band setting must still be checked after the servos have been secured to the gearbox casing.

DIMENSIONAL DATA FOR SECTION T15—REAR SERVO AND ACCUMULATOR

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Rear servo booster piston ring gap.	0·002 in. to 0·007 in. (0,05 mm. to 0,18 mm.)	—	—
Side clearance of rear servo booster piston ring in piston groove.	0·005 in. to 0·003 in. (0,13 mm. to 0,08 mm.)	0·005 in. (0,13 mm.)	—
Accumulator piston spring—free length.	3·625 in. (96,07 mm.)	—	—
Load required to compress spring length to 2·187 in. (55,56 mm.)	15 lb. (6,8 kg.)	—	—
Accumulator piston ring gap.	0·002 in. to 0·007 in. (0,05 mm. to 0,18 mm.)	—	—
Side clearance of accumulator piston ring in piston groove.	0·0005 in. to 0·0025 in. (0,013 mm. to 0,06 mm.)	0·0045 in. (0,115 mm.)	—
Compensator spring—free length.	3·921 in. (approx.) (99,62 mm.) (approx.)	—	—
Load required to compress spring length to 2·562 in. (65,09 mm.)	40 lb. to 80 lb. (18 kg. to 36 kg.)	—	—
Rear servo spring—free length.	4·343 in. (11,03 cm.)	—	—
Load required to compress spring length to 2·812 in. (71,44 mm.)	116 lb. 11 oz. to 130 lb. 11 oz. (52,9 kg. to 59,3 kg.)	—	—
Lever clevis pin clearance in needle roller bearings.	0·0002 in. to 0·0046 in. (0,005 mm. to 0,117 mm.)	0·006 in. (0,15 mm.)	—
Primary valve spring—free length	0·781 in. (19,84 mm.)	—	—
Load required to reduce spring length to 0·383 in. (9,73 mm.)	1 lb. 10½ oz. to 1 lb. 13½ oz. (0,75 kg. to 0,84 kg.)	—	—
Primary valve clearance in valve body.	0·0010 in. to 0·0018 in. (0,025 mm. to 0,045 mm.)	0·002 in. (0,05 mm.)	Renew assembly valve body if outside limit.
Secondary valve spring—free length.	1·086 in. (27,58 mm.)	—	—
Load required to reduce spring length to 0·620 in. (15,75 mm.)	6 lb. 1½ oz. to 6 lb. 11½ oz. (2,76 kg. to 3,05 kg.)	—	—
Secondary valve clearance in valve body.	0·0010 in. to 0·0018 in. (0,025 mm. to 0,045 mm.)	0·002 in. (0,05 mm.)	Renew assembly valve body if if outside limit.

T.S.D. 2476 July 1971 Printed in England

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Dimensional Data—*continued*			
Setscrews — accumulator body to rear servo body.	Torque tighten to between 16 lb.ft. and 18 lb.ft. (2,21 kgm. and 2,49 kgm.)	—	—
Setscrews — retainer to accumulator body.	Torque tighten to between 16 lb.ft. and 18 lb.ft. (2,21 kgm. and 2,49 kgm.)	—	—
Setscrews — valve body to rear servo body.	Torque tighten to between 3 lb.ft. and 4 lb.ft. (0,41 kgm. and 0,55 kgm.)	—	—
Setscrews — rear servo to gearbox case.	Torque tighten to between 29 lb.ft. and 32 lb.ft. (4,01 kgm. and 4,42 kgm.)	—	—
Setscrews — junction body to gearbox case.	Torque tighten to between 29 lb.ft. and 32 lb.ft. (4,01 kgm. and 4,42 kgm.)	—	—

Printed in England

July 1971

T.S.D. 2476

Printed in England

July 1971

T.S.D. 2476

Section T16
REAR OIL PUMP AND GOVERNOR

Rear pump

The rear pump (*see Fig. T58*); is a displacement gear type of pump, mounted on the lower face of the gear-box casing and driven by the transmission. The pump driving gear is mounted on a flexibly driven shaft and meshes with a larger annulus gear which itself rotates in the pump casing. The pump inlet and outlet ports are separated by a crescent shaped projection of the pump casing which also forms a seal between the periphery of both gears. A flat plate secured by four setscrews seals the chamber.

The governor is mounted on a flange which is secured to an extension of the pump driving shaft.

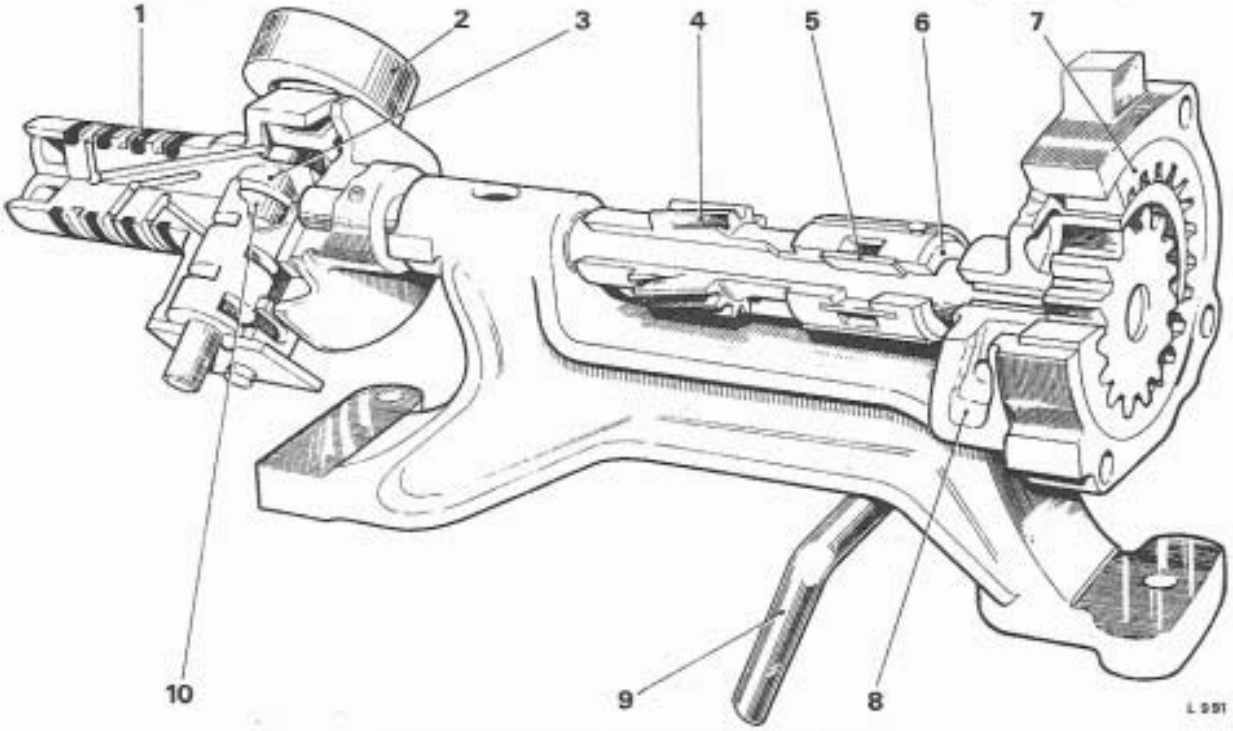

FIG. T58 REAR PUMP AND GOVERNOR

1	Piston ring type seals	4	Driven gear	8	Delivery port
2	G1 Weight	5	Driven vane	9	Intake pipe
3	G1 Valve	6	Driving dog	10	G2 Valve
		7	Annulus gear		

Chapter T

Operation — Rear pump

Oil is drawn through an inlet pipe which projects into the sump filter. Upon entering the inlet side of the pump, the oil is carried in sealed pockets between the gear teeth then discharged through the outlet port from where it flows, via a pipe, to the front servo.

Governor

The governor (*see Fig. T58*); comprises a small iron casting bolted to a flange which in turn is pinned to the oil pump drive-shaft. The casting houses two steel valves, the G1 valve and the G2 valve. The G2 valve works in a sleeve which is retained in the casting by a plate and two setscrews; the G1 valve operates directly in its bore in the casting and has a weight secured to its outer end.

Operation — Governor

Oil is fed to the casting through a stationary sleeve which is a close fit around three annular grooves, these are sealed from each other by four hooked ring seals.

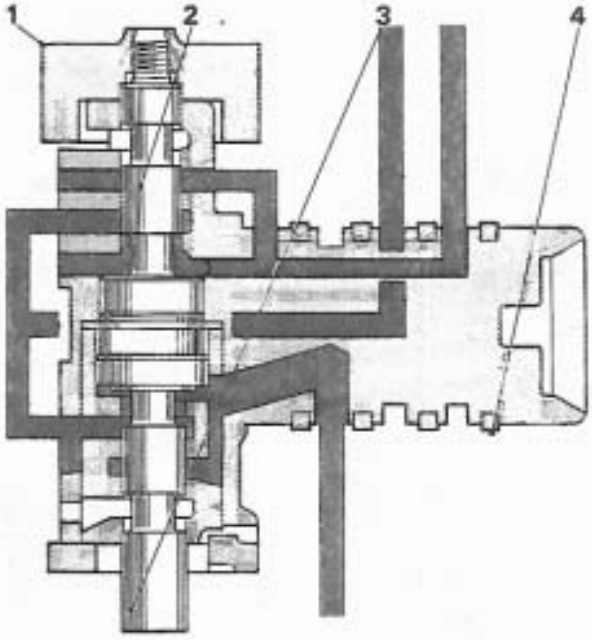

FIG. T59 GOVERNOR OPERATION

1 G1 Weight
2 G1 Valve
3 G2 Valve
4 Oil sealing ring

From the annular grooves the oil flows through drillings to ports which are controlled by the two valves, (*see Fig. T59*).

The valves are balanced by metered oil pressure which tends to hold them in, and centrifugal force which tries to move them out. Each valve attains equilibrium when the centrifugal force equals the opposing oil pressure, and as one governor weight is heavier than the other, the governor delivers two pressures, both of which are functions of road speed. Oil at these pressures, termed G1 pressure and G2 pressure, flows through drillings in the sleeve to pipes leading to the control valve unit. G1 pressure builds up quicker than G2 pressure because the G1 governor valve and weight is heavier than the G2 valve.

Rear pump and governor removal

When removing the rear pump and governor, it is unnecessary to remove the gearbox from the car. Drain the oil from the gearbox as described in Section T2— 'Servicing' then remove the following units.

Sump and side cover (*see Section T11*).

Control valve unit and parking brake bracket (*see Section T12*).

Front servo unit (*see Section T14*).

Rear servo and accumulator (*see Section T15*).

If only the governor is to be removed, it is not necessary to remove the servo units.

Governor — To remove

Scribe correlation marks on the edge of the governor drive flange and the governor body to ensure correct assembly, then unscrew the two retaining setscrews and separate the governor assembly from its driving flange.

If the gearbox has been removed from the car, hold the output flange to prevent the governor from turning whilst the two setscrews are removed.

Rear pump and governor — To remove

Withdraw the pump-to-front servo oil pipe.

Rotate the output shaft until the large governor weight faces toward the front of the gearbox. Unscrew the two retaining setscrews then withdraw the pump and governor assembly from the gearbox as shown in Figure T60.

Rear pump and governor — To dismantle

Dismantling of the rear pump, and governor is limited to the procedure described in the following paragraphs. If wear or damage should necessitate the renewal of a part not covered by these dismantling instructions, either the pump or governor must be renewed as a unit.

Printed in England

July 1971

T.S.D. 2476

When renewing a pump, the bronze driving gear on the output shaft must be examined for wear; if wear is considered excessive or the gears are noisy on a subsequent road test, renew the gear (*see Section T20—Reverse assembly*).

Governor — To dismantle

The only parts which can be removed from the governor assembly are the oil sealing rings, the G2 valve and sleeve and the hardened steel washer which is situated at the bottom of the G2 valve sleeve bore.

The G2 valve can be drawn from its sleeve after removing the retaining plate as shown in Figure T61, but the oil sealing rings need not be removed unless they are worn or damaged.

If the G2 valve is unserviceable, a new G2 valve and sleeve assembly may be fitted, but if a G1 valve is unserviceable a new governor assembly must be fitted as the G1 weight should not be removed.

Rear pump — To dismantle

Unscrew the four setscrews which retain the cover.

Lift off the cover then remove the annulus gear.

Rear pump and governor — To inspect

Thoroughly clean all the components, flush out the oilways with clean paraffin and blow through them with compressed air. Examine all parts for cracks, burrs and other damage.

Governor — To inspect

Check the mating faces of the governor and driving flange with engineer's blue; if either face is distorted, renew the complete assembly as the surfaces must not be scraped or lapped.

Wear of the governor tower is unlikely, but if signs of rubbing are evident, it should be inspected in conjunction with the bore of the parking brake bracket. Wear of this nature is usually caused by the tower running eccentrically. Details of the run-out check and methods of rectification are given under 'Governor — To fit'.

Check the oil sealing rings for freedom or excessive clearance in their grooves.

Ensure that the G1 and G2 valves operate freely; they should be heard to move as the governor assembly is gently shaken from side to side.

Rear pump — To inspect

Check the governor driving flange pin and the flexible drive retaining pin for security.

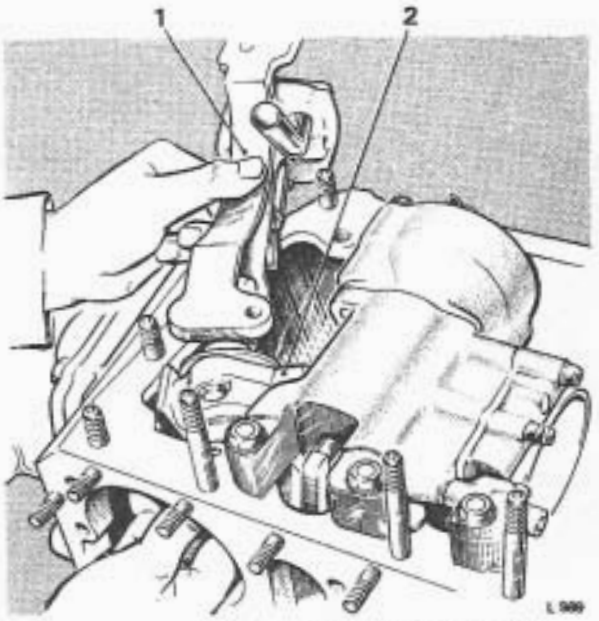

FIG. T60 REMOVING THE REAR PUMP AND GOVERNOR

1 Rear pump and governor assembly
2 G1 Weight

Failure of the flexible drive is most unlikely, therefore the considerable amount of axial movement and the small radial movement between the steel driven gear and the flexible drive can be considered normal.

Check the mating faces of the pump cover and body

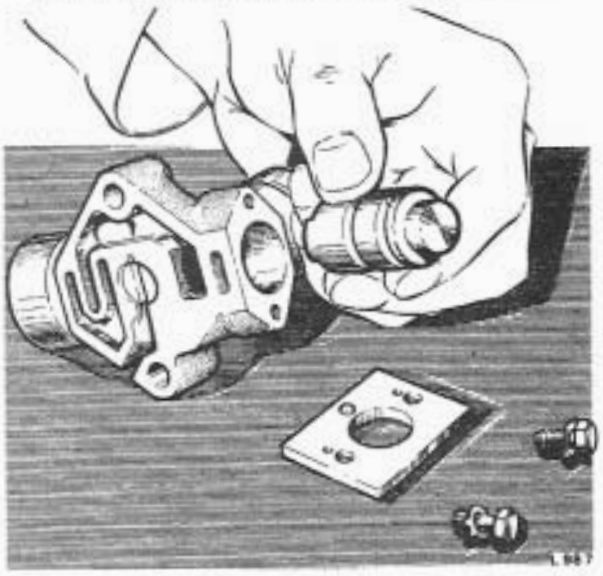

FIG. T61 REMOVING THE G2 VALVE AND SLEEVE

FIG. T62 FITTING THE GOVERNOR OIL SEALING RINGS

with engineer's blue. Small burrs may be removed but the joint faces must not be scraped or lapped otherwise the machining marks, which help to make an oil tight joint, may easily be eliminated.

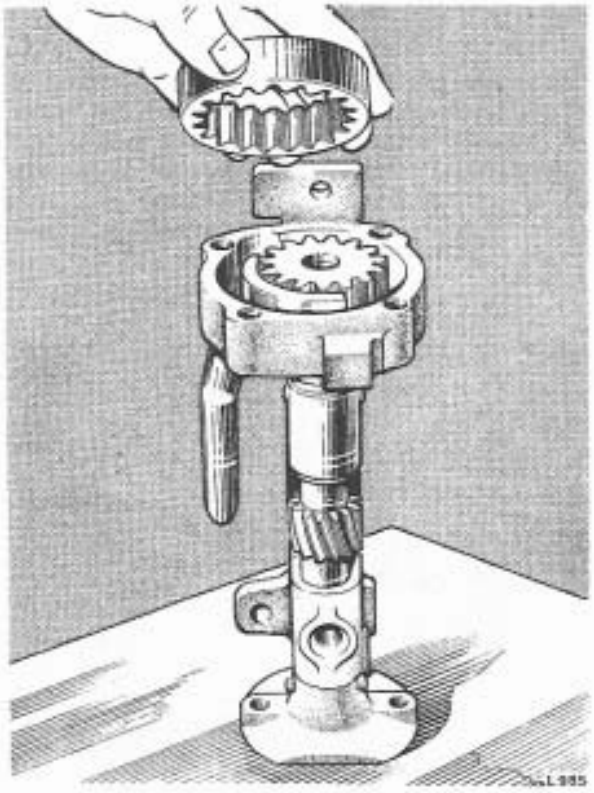

FIG. T63 FITTING THE OIL PUMP ANNULAR GEAR

Examine the annulus gear pocket and pump cover for wear. If the scoring in the pocket is severe and likely to affect the pump performance, renew the pump. If the oil pressure is found to be low during fault diagnosis tests, this should be used as a guide when assessing score damage.

Inspect the gears for worn or damaged teeth and check the oil inlet pipe for security in the pump body.

Check the inside face of the crescent shaped segment for signs of fouling by the inner gear teeth. If scoring is heavy this is an indication of excessive wear in the drive-shaft bushes; in each case the pump should be renewed.

Rear pump and governor — To assemble

Lubricate all working parts with clean gearbox oil prior to assembly.

The importance of cleanliness is emphasized, but cloth should not be used for cleaning purposes owing to the danger of fluff entering the control system and fouling the valves.

When assembling the rear oil pump and governor, attention should be given to the torque tightening figures and fits and clearances given in 'Dimensional Data' at the end of this Section.

Governor — To assemble

Fit the oil sealing rings to the governor tower using the special tool (Part No. 25937/T1002-5) as shown in Figure T62.

Interlock the ends of the rings.

Fit the steel washer into the governor body, then the G2 valve and sleeve. Ensure that the small recess in the sleeve aligns with the slightly larger recess in the governor body.

Fit the retaining plate, ensuring that the dowel in the plate lines up with the two recesses previously described. Fit the two setscrews with new tab washers.

Torque tighten the screws then lock them with the tab washers.

Rear pump — To assemble

Fit the annular gear to the pump body, noting that the chamfered edge of the gear is to be fitted toward the bottom of the annulus gear pocket (*see Fig. T63*).

Fit the pump cover and four setscrews; torque tighten the screws.

Check that the drive-shaft end float is within the limits given in 'Dimensional Data'.

The pump should be free to rotate smoothly and easily.

If rig testing facilities are available, the pump should

T.S.D. 2476 July 1971 Printed in England

Printed in England

July 1971

T.S.D. 2476

be checked for flow and pressure (*see Dimensional Data*).

Before fitting the governor to the pump flange, the flange face must be checked for swash, using a dial test indicator. Rotate the pump shaft several times and check that the amount of swash, if any, is within the limits given in 'Dimensional Data'. If it is outside these limits, renew the pump.

Governor — To fit

Mount the governor onto the driving flange and if neither of the units have been renewed, ensure that the correlation marks coincide; if a new unit is being fitted, it should be marked after the run-out check described in the following paragraphs. Fit the two setscrews and washers; torque tighten the setscrews.

Using a dial test indicator as shown in Figure T64, check the run-out of the governor tower as follows.

With the stem of the indicator contacting the tower approximately ¼ in. (6 mm.) from its outer end, rotate the shaft several times. If the total run-out exceeds the limits given in 'Dimensional Data', remove the governor from the drive flange, turn it through 180 degrees and fit, then again check the run-out. If the run-out is still excessive, fit a new governor. If this does not bring the run-out within the limits, the rear pump and the governor must be renewed.

After satisfactorily completing the check, again scribe the correlation marks on the governor and pump flange.

Fit the remainder of the units by reversing the procedure given for their removal (*see Sections T11, T12 and T14*).

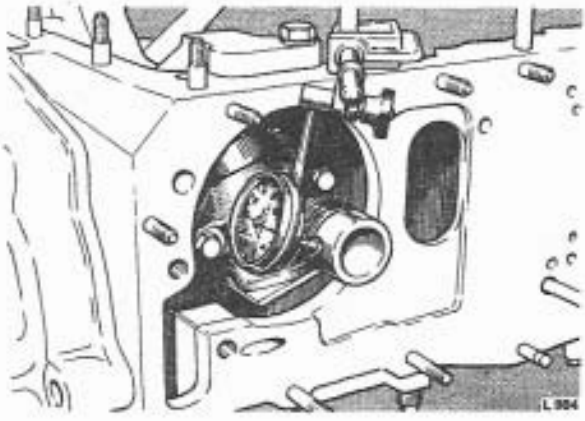

FIG. T64 CHECKING GOVERNOR TOWER RUN-OUT

Rear pump and governor — To fit

When both the rear pump and governor have been removed from the gearbox, the assembling and checking procedure is similar to that given under 'Governor — To fit'. It is, however, easier to check for swash and run-out before installing the combined assembly into the gearbox; in such a case the dial test indicator should be mounted onto the pump body (*see Fig. T65*).

After completing the check, ensure that the mating surfaces of the gearbox and oil pump are free from burrs, especially around the setscrew holes, then, with the G1 weight facing the front of the gearbox, fit the assembly, at the same time slightly rotating the governor to mesh the gears.

Fit the two retaining setscrews and flat washers; torque tighten the screws.

Fit the remainder of the units reversing the pro-

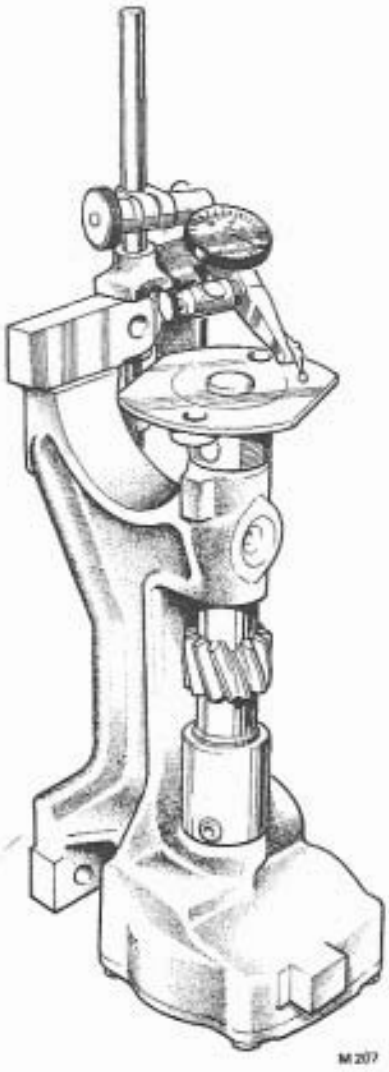

FIG. T65 CHECKING THE PUMP FLANGE FOR SWASH

cedure given for their removal (*see Sections T11, T12, T14 and T15*).

Serviceability check

After overhaul or fault rectification, replenish the gearbox with oil then carry out a road test. Pay particular attention to that part of the test which led to the diagnosis of the original fault. Details of the tests are given in Section T2—'Servicing'.

DIMENSIONAL DATA FOR SECTION T16—REAR PUMP AND GOVERNOR

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Oil sealing rings side clearance in governor tower grooves.	0·0005 in. to 0·0016 in. (0,013 mm. to 0,040 mm.)	0·003 in. (0,08 mm.)	——
Rings closed gap (butt clearance).	0·005 in. to 0·025 in. (0,13 mm. to 0,64 mm.)	0·020 in. (0,51 mm.)	Check in 1·1875 in. (30,16 mm.) diameter minimum bore.
Governor tower run-out.	0·005 in. maximum (0,13 mm. maximum).	——	——
Governor drive flange swash.	0·001 in. maximum (0,025 mm. maximum).	——	Renew pump if outside limit.
Pump drive — shaft end float.	0·0005 in. to 0·0025 in. (0,013 mm. to 0,064 mm.)	0·0045 in. (0,115 mm.)	——
Oil pump gear backlash.	0·004 in. to 0·008 in. 0,10 mm. to 0,20 mm.)	0·012 in. (0,30 mm.)	——
Setscrews — rear pump to gearbox casing.	Torque tighten to between 16 lb.ft. and 18 lb.ft. (2,21 kgm. and 2,49 kgm.)	——	——
Setscrews — rear pump cover to rear pump body.	Torque tighten to between 8 lb.ft. and 10 lb.ft. (1,11 kgm. and 1,38 kgm.)	——	——
Setscrews — governor body to pump drive flange.	Torque tighten to between 8 lb.ft. and 10 lb.ft. (1,11 kgm. and 1,38 kgm.)	——	——
Setscrews — G2 valve retaining plate to governor body.	Torque tighten to between 3 lb.ft. and 4 lb.ft. (0,41 kgm. and 0,55 kgm.)	——	——
Backlash — rear pump driven gear and bronze driving gear.	0·011 in. to 0·015 in. (0,28 mm. to 0,38 mm.)	0·019 in. (0,48 mm.)	——

REAR OIL PUMP RIG TEST PERFORMANCE

PUMP R.P.M.	LINE PRESSURE	LINE FLOW
600	60 lb/sq. in. (4,22 kg/sq.cm.)	½ gallon (2,273 litres) in 70 seconds (minimum)
Use WA —389 oil at 93° C. (199° F.)		

T.S.D. 2476

July 1971

Printed in England

Printed in England

July 1971

T.S.D. 2476

Section T17
PRESSURE CONTROL VALVE

The pressure control valve comprises an assembly of valve and springs and is located at the front end of the gearbox, adjacent to the front pump.

The valve itself fits into a bore in the front pump body and is attached to the end coil of a return spring. A projection on the hexagon headed plug locates the other end of the spring (*see Fig. T66*).

Operation

The pressure control valve controls the oil delivery from the front pump, according to the demands of the hydraulic system. Pressurized oil is directed, via the control valve, to the outer surface of the front pump slide, thus moving it to the required delivery position.

The controlling forces in the pressure control valve are the pump output (main) pressure and the throttle pressure. Main oil pressure, acting on the spring-loaded valve, tends to reduce pump delivery, whilst throttle valve (T.V.) pressure acting on the T.V. oil regulator plug assists the spring in opposing main pressure and increases pump delivery. T.V. pressure thus causes the pump output to increase with increased throttle opening.

When Reverse is selected, additional oil pressure is required to hold the reverse cone clutch in the engaged position. This pressure is directed to act on the reverse booster plug (*see Fig. T66*) and as this pressure is greater than T.V. pressure, pump delivery is boosted to a pressure sufficient to hold the reverse clutch firmly in engagement.

Pressure control valve — To remove

The pressure control valve can be removed with the gearbox fitted to the car and without disturbing any other parts.

To ensure that the inner parts do not fall out during removal, proceed as follows.

Unscrew the blanking plug, taking care to retain it

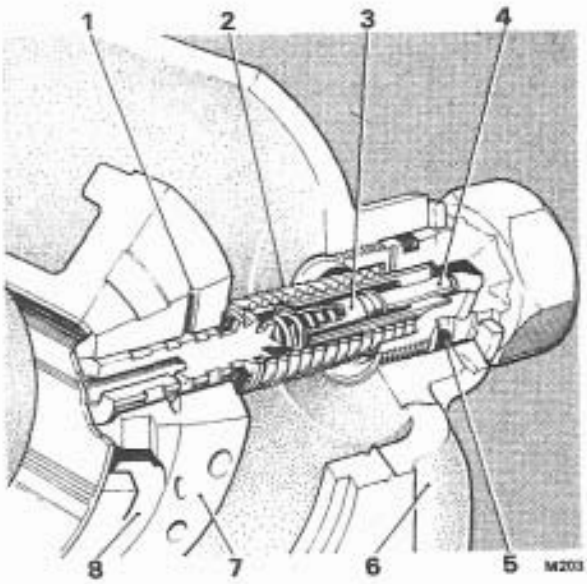

FIG. T66 PRESSURE CONTROL VALVE IN POSITION

1 Oil passage to pump slide
2 Pressure regulator spring
3 Reverse booster plug
4 T.V. or regulator plug
5 Sealing ring
6 Gearbox casing
7 Pump casing
8 Oil delivery duct

against the force of the pressure regulator spring. Before lifting out the blanking plug place a finger on the regulator spring and lift out the complete unit.

Separate the spring and valve from the plug; the damper spring, reverse booster plug and T.V. regulator plug can then be shaken from their bores.

Pressure control valve — To inspect

Thoroughly clean all metal parts using a cleaning fluid such as Trichlorethylene.

Examine the condition of the inner and outer rubber cushions and, if they show any signs of deterioration or damage, they should be renewed. Lubricate the new rubber cushions with clean gearbox oil before fitting them.

Remove the 'O' ring and joint washer from the blanking plug, then examine the threads for signs of damage; also examine for damage the threads in the aluminium gearbox casing. Screw the blanking plug into the casing to ensure that the plug enters smoothly and easily; remove the plug.

Pressure control valve — To fit

Fit a new 'O' ring and joint washer, then assemble the unit (*see Fig. T67*) using petroleum jelly to retain the plugs and damper spring in position whilst the unit is fitted to the gearbox.

Tighten the plug to the correct torque loading.

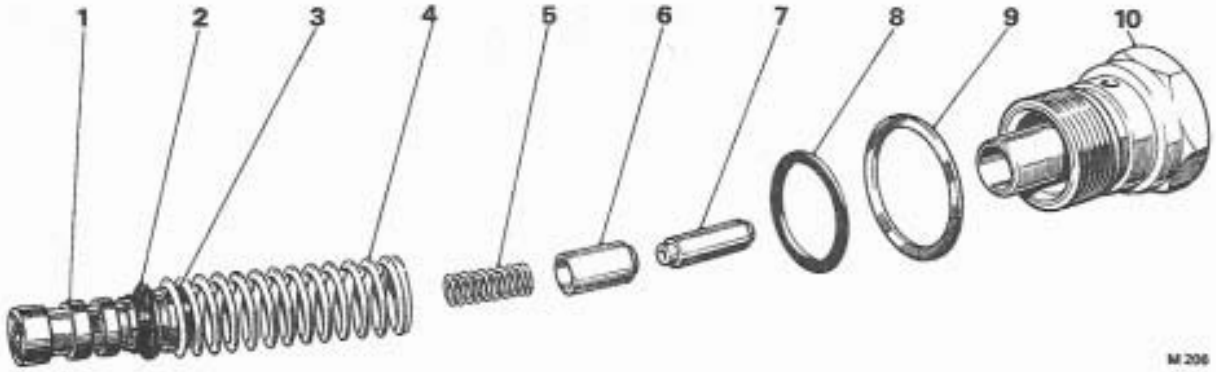

FIG. T67 PRESSURE CONTROL VALVE

1 Regulator valve
2 Inner cushion
3 Outer cushion
4 Pressure regulator spring
5 Damper spring
6 Reverse booster plug
7 T.V. regulator plug
8 Sealing ring
9 Joint washer
10 Blanking plug

DIMENSIONAL DATA FOR SECTION T17— PRESSURE CONTROL VALVE

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Return spring— free length.	2·235 in. (approx). (56,8 mm.) (approx.)	—	—
Load required to compress spring length to 1·328 in. (33,73 mm.)	14 lb. 4 oz. to 14 lb. 12 oz. (6,5 kg. to 6,7 kg.)	14 lb. (6,4 kg.)	—
Damper spring— free length.	0·771 in. (19,57 mm.)	—	—
Load required to compress spring length to 0·609 in. (16,47 mm.)	21 lb. 9 oz. to 24 lb. 7 oz. (9,7 kg. to 11,1 kg.)	21 lb. (9,5 kg.)	—
Blanking plug.	Torque tighten to between 45 lb.ft. and 50 lb.ft. (6,2 kgm. and 6,9 kgm.)	—	—

T.S.D. 2476 July 1971 Printed in England

Printed in England

July 1971

T.S.D. 2476

Section T18
FRONT PUMP AND DRIVE-SHAFT

The gearbox front pump (*see Fig. T68*) is a variable capacity, engine driven unit which is secured to the front face of the gearbox. A cast iron cover contains a steel slide, a rotor and seven vanes. The vanes are positioned in slots in the rotor, the outer edges running against the inside of the slide and the inner edges against two vane rings. A bronze bush in the cover accepts the neck of the torus cover, and a lip-type seal, pressed into the cover in front of the bush, prevents the escape of oil between the pump and the torus cover. Another iron casting forms the pump body. This body bolts onto the cover and contains a bush which supports the pump drive-shaft; the body also houses the pump relief valve.

Operation

When the engine starts, the pump rotor is caused to rotate and to lift filtered oil from the gearbox sump. The slide can move from a position of maximum tion, to an eccentric position diametrically opposite to the maximum stroke position. This varies the oil displacement space between the rotor and the slide and causes the oil which is carried round between the vanes to be forced out at the position of minimum clearance (*see Fig. T69*). A position of maximum eccentricity will enable the pump to supply maximum delivery; opposite

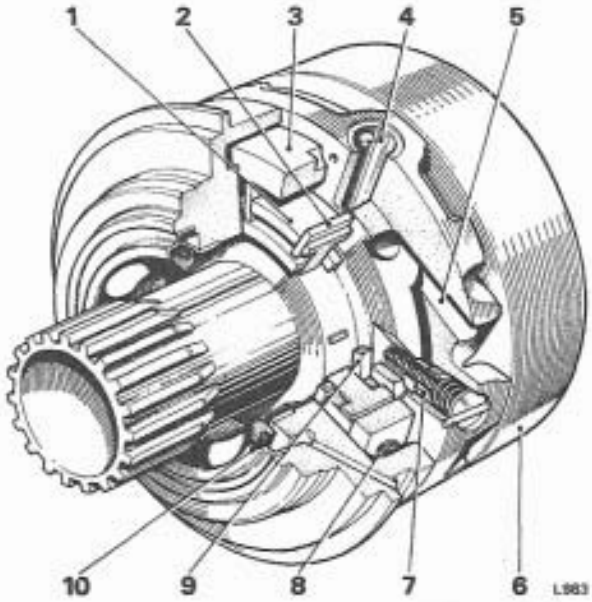

FIG. T68 FRONT PUMP AND DRIVE-SHAFT

1 Rotor
2 Vane
3 Slide
4 Pressure control valve port
5 Outlet
6 Drive-shaft and front annulus gear
7 Relief valve
8 Priming springs
9 Vane rings
10 Oil seal

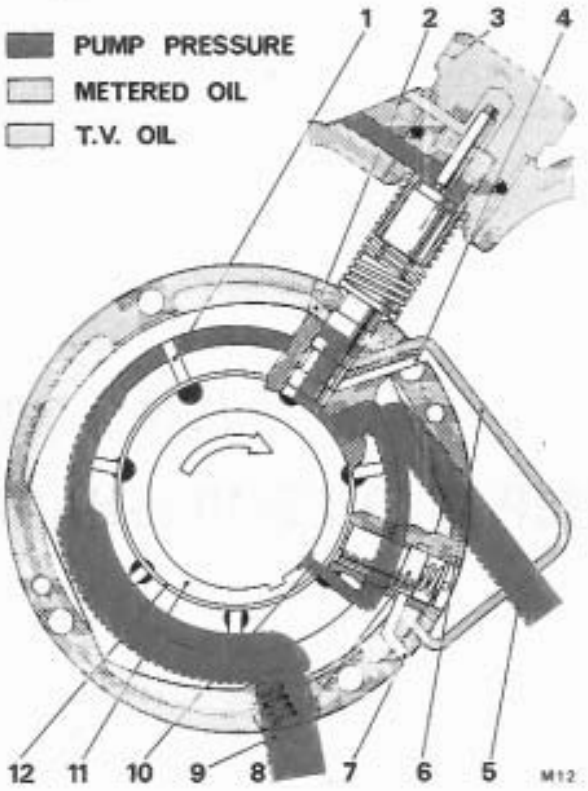

FIG. T69 OIL FLOW DIAGRAM—FRONT PUMP

1 Vane
2 Decreased delivery
3 Pressure control valve
4 Exhaust
5 Pressure oil to front servo
6 Increased delivery
7 Exhaust
8 Relief valve
9 Inlet
10 Feed to coupling
11 Rotor
12 Vane ring

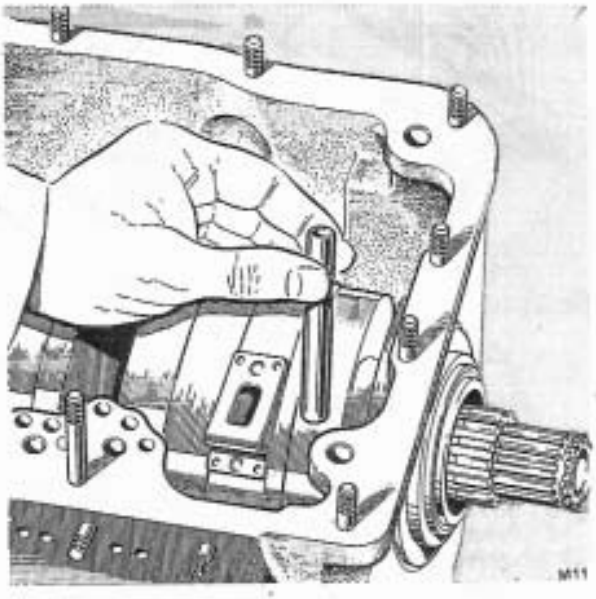

FIG. T70 WITHDRAWING THE PUMP FEED PIPE

eccentricity will enable the pump to return excess oil from the rear pump to the sump. This arrangement enables the front pump to control delivery from both pumps.

A concentric pair of coil springs hold the slide in the maximum delivery position in order to prime the pump rapidly when starting.

The slide position and therefore pump delivery is varied to maintain the required output in accordance with the demands of the gearbox hydraulic system. A pressure control valve (*see Section T17*) is positioned by pump output pressure to vary oil flow through a port permitting oil pressure to act on the outside of the slide in opposition to the oil pressure on the inside.

Although the front pump absorbs excessive oil from the rear pump, a relief valve is fitted in the front pump body to limit the maximum pressure in the system.

Oil under pressure is delivered by the pump to the front servo unit. At this point it is joined by the supply from the rear pump. Rear pump oil passes through a non-return valve which prevents the front pump from discharging into the rear pump. A small oil bleed is allowed to by-pass the relief valve in order to supply oil to the rear pump when the car is stationary or moving in reverse gear.

Front pump — To remove

To remove the front pump and drive-shaft, it is necessary to remove the gearbox from the car, then remove the following units.

Fluid coupling (*see Section T10*).
Side cover, sump and filter (*see Section T11*).
Front servo (*see Section T14*).
Rear servo and accumulator (*see Section T15*).
Pressure control valve (*see Section T17*).

If necessary, the front pump may be removed from the gearbox without disturbing the drive-shaft, but, if the gearbox is to be overhauled it is easier to remove the drive-shaft at this stage.

Withdraw the pump-to-front servo oil feed pipe (*see Fig. T70*), then withdraw the filter-to-pump pipe.

Using snap ring pliers (*see T.S.D. 2331—Workshop Tools*) remove the snap ring from the intermediate shaft as shown in Figure T71. Remove the steel backing washer and bronze thrust washer; these washers should be kept together and labelled for easy identification on assembly.

Remove the two setscrews which secure the front pump to the gearbox casing then using the snap ring pliers, extract the pump locating washer from its counterbore (*see Fig. T72*).

Printed in England

July 1971

T.S.D. 2476

Taking care not to damage the drive-shaft bushes on the intermediate shaft splines, withdraw the pump, together with the drive-shaft, from the gearbox (*see Fig. T73*). It may be necessary to tap the rear face of the pump to free it initially, in which case a soft drift should be used; discard the pump-to-gearbox 'O' ring seal.

Remove the bronze thrust washer from the intermediate shaft and attach a label to the washer for identification.

The front pump should be dismantled only if it is faulty or requires cleaning. If rig testing facilities are not available, it is recommended that a replacement pump be fitted rather than to attempt rectification.

Front pump — To dismantle

Separate the pump from the drive-shaft by sliding one from the other.

Remove the four setscrews and washers which secure the halves of the pump together, then lift off the pump body (*see Fig. T74*). If the halves of the pump are held tight by the two dowels, tap the pump cover with a soft-headed mallet. Ensure that the cover is lowermost (i.e. oil seal at the bottom) otherwise the pump internal parts will fall out and may be damaged.

Before lifting out any of the parts, mark the exposed face of the rotor to ensure that it is fitted with the same side up during assembly. Do not use a scriber or punch for marking; an indelible pencil is recommended.

Remove the top inner vane ring, the rotor, the seven vanes and the bottom inner vane ring, then lift out the slide after pushing it toward the priming springs as shown in Figure T75.

Remove the priming springs.

Remove the relief valve from the pump body as follows.

Depress the spring guide then withdraw the retaining pin.

Relax the pressure on the spring guide, then remove the guide and springs; remove the valve (*see Fig. T76*).

Remove and discard the 'O' ring from the bore of the oil intake pipe in the pump body.

The lip-type seal in the pump cover should not be removed unless it is to be renewed, in which case it should be carefully knocked out with a hammer and chisel; take care not to damage the bore in the pump cover.

Front pump — To inspect

Wash all the parts in clean paraffin, ensuring that all the oil passages and bleed holes are clear, then blow them through with compressed air.

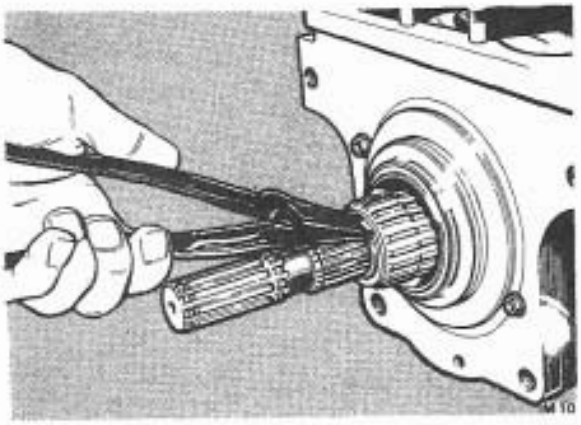

FIG. T71 REMOVING THE SNAP RING

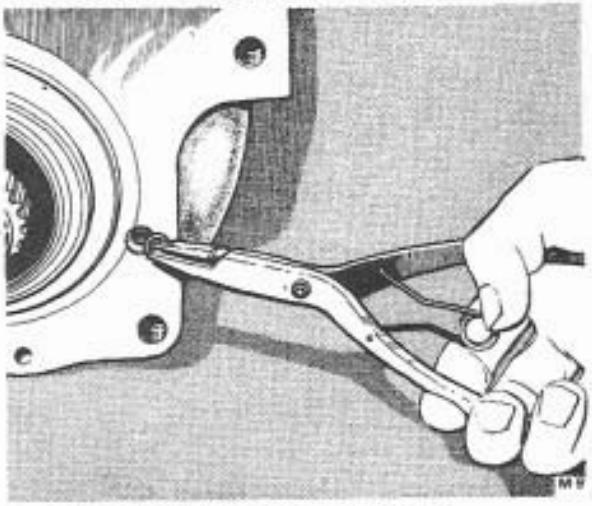

FIG. T72 REMOVING THE PUMP LOCATING WASHER

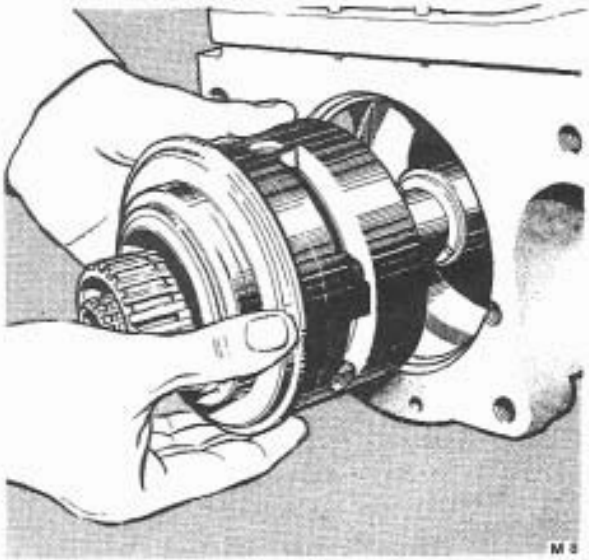

FIG. T73 REMOVING THE PUMP AND DRIVE-SHAFT

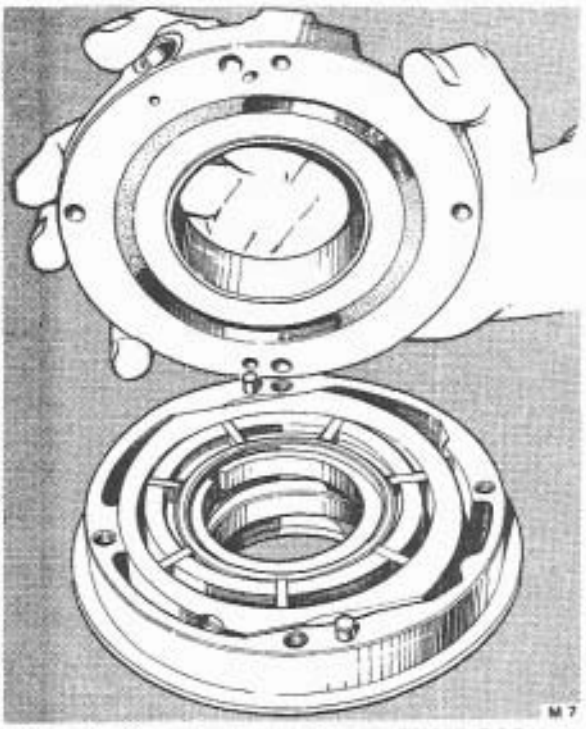

FIG. T74 REMOVING THE PUMP BODY

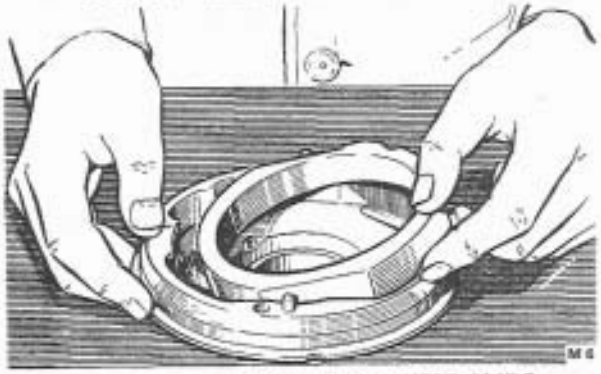

FIG. T75 REMOVING THE PUMP SLIDE

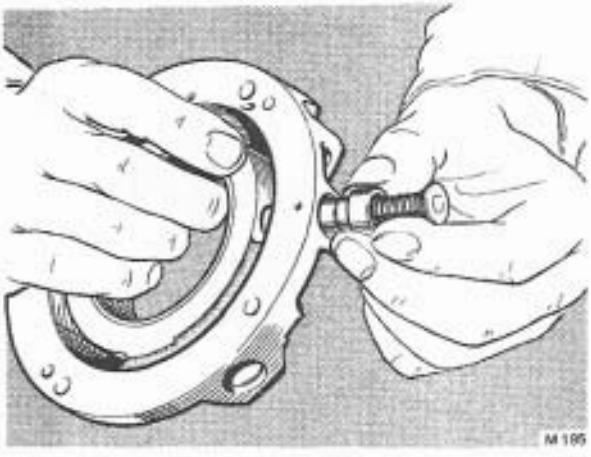

FIG. T76 REMOVING THE RELIEF VALVE

Cloths should not be used for cleaning purposes owing to the danger of fluff entering the control system and fouling the various valves.

Examine all parts for cracks or damage and check all moving parts for scores, burrs and roughness. If the pump cover or body is deeply scored, the pump should be renewed.

Check that the halves of the pump mate without a gap. Small burrs may be stoned off but the joint faces must not be scraped or lapped.

Reference should be made to the Parts List before renewing any parts as many of the components are selectively assembled and must not be renewed separately.

Check that the dowels are secure in the pump cover.

Ensure that the pump slide moves freely in the pump cover and that the relief valve and regulator valve are free to move in their respective bores.

Examine the relief valve spring and priming springs for damage and general condition; slight polishing of the coil outer diameter is permissible.

Check that the pump vanes are free in their slots.

Inspect the drive-shaft bush in the pump body and the torus cover bush in the pump cover for scoring or heavy uneven wear. Slight wear of the bushes is normal but, if wear or damage is excessive, the complete pump should be renewed as it is not advisable to fit a separate body or cover.

Ensure that the rotor driving key is a good fit in the drive-shaft; check the rotor keyway for wear and burrs.

Examine the drive-shaft splines and the gear teeth for wear; also the journal surface for scoring.

Check that the two bronze bushes in the shaft are secure; inspect the bushes for scoring and uneven wear.

Examine the steel backing washer and bronze thrust washers for ridges or heavy scoring.

Fit the pump slide into the pump cover without fitting the priming springs.

Using a dial test indicator, as shown in Figure T77, check the end clearance between the slide and cover. The initial reading should be taken from the cover joint face, then the assembly should be moved so that the tip of the indicator moves onto the slide.

The difference between the two readings should comply with the figures given in 'Dimensional Data' at the end of this Section.

Check the end clearance of the rotor in a similar manner; again the difference in indicator readings should comply with the figures given in 'Dimensional Data'.

Remove the slide and rotor.

T.S.D. 2476

July 1971

Printed in England

Printed in England

July 1971

T.S.D. 2476

Front pump — To assemble

When all parts have been carefully inspected, cleaned and dried, lubricate all moving parts with clean gearbox oil then assemble the pump in the following order.

If necessary, fit a new oil seal with the seal lip facing toward the centre of the pump (*see Fig. T78*). Lightly smear the seal shell with Wellseal before fitting.

Fit a new intake pipe oil seal ring into the bore of the pump body as shown in Figure T79. Ensure that the end of the intake pipe has no sharp edges then lightly smear it with gearbox oil. Check that the ring is correctly fitted by entering and withdrawing the pipe.

Fit the relief valve with its spring guide and retaining pin.

Fit the two priming springs and the slide into the pump cover. Ensure that the outer spring is correctly located in the recesses in the cover and the slide. Check that the slide will move freely through its full stroke and will return under spring pressure.

Fit one of the vane rings, then fit the rotor with its marked face uppermost.

Fit the seven vanes, positioning them according to the wear pattern on the radiused ends; the edge polished along its whole length should contact the inner circumference of the slide, the inside edge being polished only where contact is made with the vane rings.

Fit the second vane ring, ensuring that the vanes are correctly positioned between the vane rings and the slide. Rotate the rotor several times to ensure freedom of movement.

If any one of the vanes appears excessively loose, its diametrical clearance should be checked in the manner illustrated in Figure T81 to ascertain if it is within the limits given in 'Dimensional Data'.

Fit the pump body over the dowels in the cover and secure the body with the four setscrews and washers; tighten the setscrews evenly to the correct torque figure given in 'Dimensional Data'. Turn the rotor several times to check for freedom of movement, then, by pushing against the internal bore of the rotor, ensure that the slide is free and that the priming springs return it to the maximum delivery position.

Pour a little clean gearbox oil into the pump intake bore then rotate the rotor several times to ensure thorough internal lubrication.

If rig testing facilities are available the pump should be checked for flow and pressure (*see Dimensional Data*). If these facilities are not available, fit the pump to the gearbox and check the oil pressure as described under 'Oil pressure—To check' in Section T3—Testing.

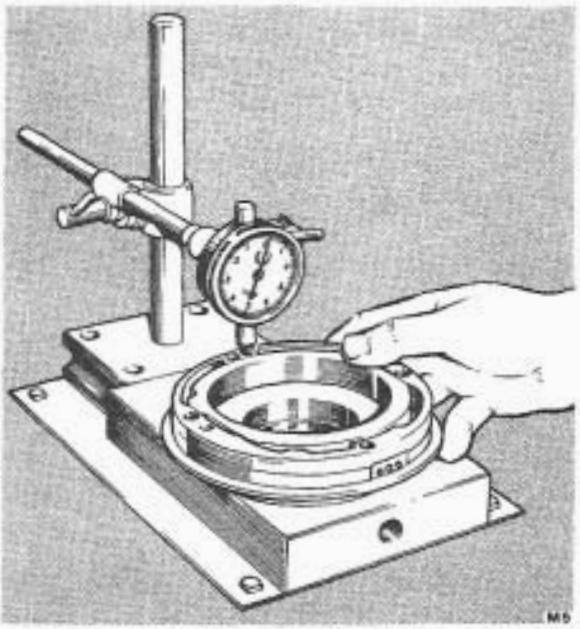

FIG. T77 CHECKING THE SLIDE END CLEARANCE

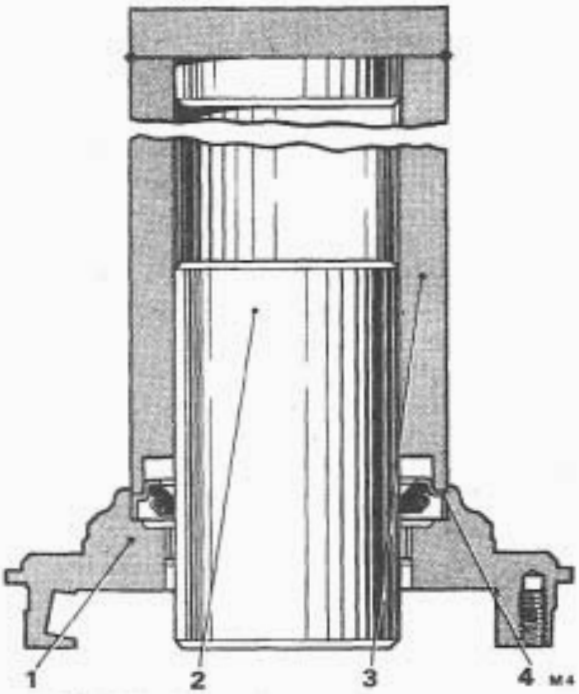

FIG. T78 FITTING THE PUMP OIL SEAL

1 Pump cover
2 Guide tool
3 Press tool
4 Oil seal

FIG. T79 FITTING THE INTAKE PIPE SEALING RING

Front pump — To fit

Fit the bronze thrust washer over the intermediate shaft so that it is in position against the shoulder of the front planet carrier. Apply a liberal amount of clean gearbox oil to the front drive gear then slide it over the intermediate shaft into the main casing, turning it slightly to mesh with the planet gears. During this operation care must be exercised to avoid damaging the bushes on the intermediate shaft splines.

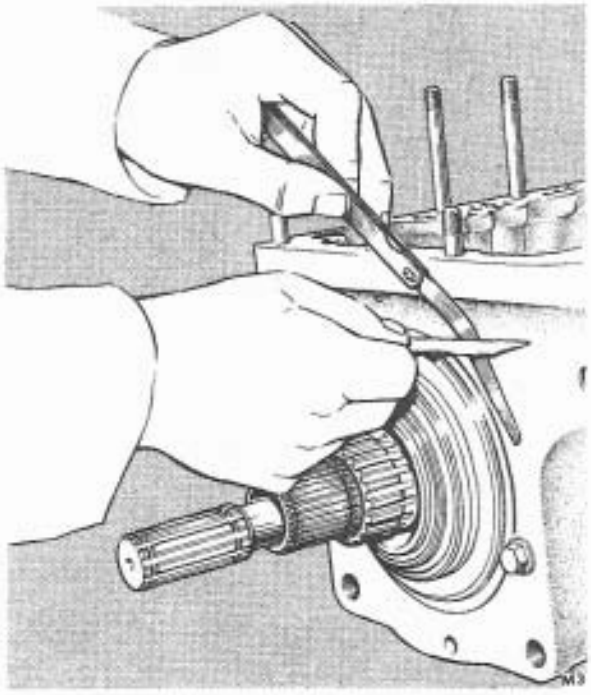

FIG. T80 CHECKING THE FRONT PUMP NIP

Fit the bronze thrust washer and the steel backing washer over the intermediate shaft, then fit the snap ring.

Using a dial test indicator, or feeler gauges inserted between the thrust washer and the end of the drive-shaft, check the drive-shaft end float in relation to the intermediate shaft. Movement of the drive-shaft should be between 0·002 in. and 0·004 in. (0,05 mm. and 0,10 mm.).

If necessary, adjust the end float by selecting the correct size of backing washer to give the required figure.

Fit a new 'O' ring under the pump cover flange.

Before fitting the pump, lubricate the drive-shaft bush in the pump body with a liberal amount of clean gearbox oil. Align the drive-shaft key with the keyway in the pump then slide the pump into position; the key should enter the keyway smoothly and easily.

Align the pump flange with the dowel washer location in the gearbox front face then insert the dowel washer. Fit the two retaining setscrews and tighten to the correct torque loading (*see Dimensional Data*).

Note The pump must be pushed in until the 'O' ring abuts the counterbore in the gearbox. Do not attempt to push in the pump by tightening the setscrews, except for the latter part when nipping the 'O' ring.

If a replacement pump has been fitted, the following check should be made to ensure the correct nip of the pump flange by the bell housing.

Check that the projection of the pump flange from the front face of the gearbox is within the limits given in 'Dimensional Data'.

This check can be made using a straight-edge and feeler gauges (*see Fig. T80*). If the clearance is incorrect, renew the 'O' ring seal.

Fit the remaining assemblies in the reverse order to that given for their removal.

Oil pressure — To check

If rig testing facilities are available, the front pump should be checked for flow and pressure (*see Dimensional Data*).

If the pump has not been checked in this manner, and the gearbox has been fitted to the car, replenish the

T.S.D. 2476

July 1971

Printed in England

the gearbox has been fitted to the car, replenish the gearbox with oil and check the oil pressure in the following manner.

Fit an oil pressure gauge as described under 'Oil pressure—To check' in Section T3—Testing, then run the engine at a speed of 1 200 r.p.m. and check the oil pressure when the gearbox is warm. Select Reverse and again note the pressure. If the pump is working satisfactorily the pressure should be approximately 70 lb/sq. in. (4,9 kg/sq.cm.).

Reverse pressure should not be less than that obtained in Neutral; it is normally slightly higher.

Finally, carry out a road test to ensure that all components are functioning correctly. Details of change points and testing procedure are given in Section T3—Testing.

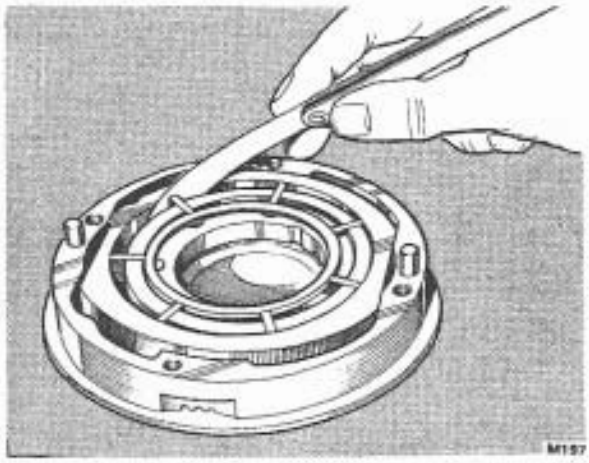

FIG. T81 CHECKING THE VANE DIAMETRICAL CLEARANCE

DIMENSIONAL DATA FOR SECTION T18—FRONT PUMP AND DRIVE-SHAFT

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Vanes diametrical clearance.	0·0012 in. to 0·0042 in. (0,031 mm. to 0,107 mm.)	0·005 in. (0,13 mm.)	——
Vanes end clearance.	0·0008 in. to 0·0015 in. (0,020 mm. to 0,038 mm.)	0·00175 in. (0,0045 mm.)	Selectively assembled.
Rotor end clearance.	0·0008 in. to 0·0015 in. (0,020 mm. to 0,038 mm.)	0·00175 in. (0,0045 mm.)	Selectively assembled.
Slide end clearance.	0.0008 in. to 0.0015 in. (0,020 mm. to 0,038 mm.)	0·00175 in. (0,0045 mm.)	Selectively assembled.
Vanes clearance in rotor.	0·0012 in. to 0·0042 in. (0,031 mm. to 0,107 mm.)	0·005 in. (0,13 mm.)	A vane with excess clearance will cause oil fluctuation.
Drive-shaft end float.	0·002 in. to 0·004 in. (0,05 mm. to 0,10 mm.)	0·006 in. (0,15 mm.)	Select backing washer to give the correct end float.
Bell housing to gearbox casing nip.	0·003 in. to 0·013 in. (0,08 mm. to 0,33 mm.)	——	Renew 'O' ring to obtain correct nip.
Priming spring — outer — free length.	0·679 in. (17,25 mm.)	——	——
Load required to compress spring length to 0·375 in. (9,53 mm.)	6 lb. 8 oz. to 7 lb. 8 oz. (2,95 kg. to 3,40 kg.)	5 lb. 8 oz. (2,5 kg.)	——
Priming spring — inner — free length.	0·405 in. (10,3 mm.)	——	——
Load required to compress spring length to 0·350 in. (8,89 mm.)	18 lb. to 26 lb. (8,17 kg. to 11,79 kg.)	17 lb. (7,71 kg.)	——
Relief valve spring — free length.	1·718 in. (43,66 mm.)	——	——
Load required to compress spring length to 1·057 in. (26,85 mm.)	13 lb. to 15 lb. (5,90 kg. to 6,80 kg.)	12 lb. (5,44 kg.)	——
Setscrews — pump body to cover.	Torque tighten to between 12 lb.ft. and 15 lb.ft. (1,66 kgm. and 2,07 kgm.)	——	——
Setscrews — pump to gearbox casing.	Torque tighten to between 10 lb.ft. and 13 lb.ft. (1,38 kgm. and 1,80 kgm.)	——	——

Printed in England

July 1971

T.S.D. 2476

FRONT OIL PUMP RIG TEST PERFORMANCE

PUMP R.P.M	LINE PRESSURE	LINE FLOW	TORUS PRESSURE
350	50 lb/sq. in. (3,5 kg/sq. cm.)	1 gallon (4,55 litres) in 55 seconds (minimum).	10 lb/sq. in. to 40 lb/sq. in. (0,70 kg/sq. cm. to 2,8 kg/sq. cm.)
Use an approved lubricant at 121° C. (250° F)			

T.S.D. 2476

July 1971

Printed in England

Printed in England

July 1971

T.S.D. 2476

Section T19
SPEEDOMETER DRIVE

The speedometer drive (*see Fig. T82*) is secured by a setscrew and lock plate to the gearbox rear extension; it can be readily removed without disturbing any other gearbox units.

Speedometer drive — To remove

Disconnect the speedometer cable by unscrewing the knurled nut at the gearbox end then withdrawing the cable. If the speedometer drive is to be removed for any length of time, mask the open end of the drive cable to prevent the ingress of dust and dirt.

Remove the retaining setscrew and lock plate then withdraw the speedometer drive.

Discard the rubber 'O' ring.

Speedometer drive — To dismantle

Hold the gear between soft jaws in a vice.

Remove the split pin then unscrew the nut which secures the gear to the drive shaft; remove the nut and washer.

Tap the gear off the shaft using a soft-faced mallet.

Utilizing the two flats on the speedometer drive body, clamp the body between soft jaws in a vice then unscrew the halves of the assembly.

Speedometer drive — To inspect

Wash all dismantled parts in clean paraffin.

Examine the gear teeth for damage and signs of excessive wear.

Examine the squared end of the shaft for cracks.

Examine the threads on the housing for damage.

If the oil seal is to be renewed it should be pressed out of its housing using a suitable dolly.

Examine the shaft for any sharp edges which may damage the oil-seal during assembly.

Speedometer drive — To assemble

To assemble the speedometer drive reverse the procedure given for its dismantling noting the following points.

Do not overtighten the castellated nut when fitting the gear to the shaft. A new split plin should be fitted.

Ensure that the halves of the assembly are tight; do not overtighten.

A light application of clean oil on the drive-shaft will assist its passage through the oil seal.

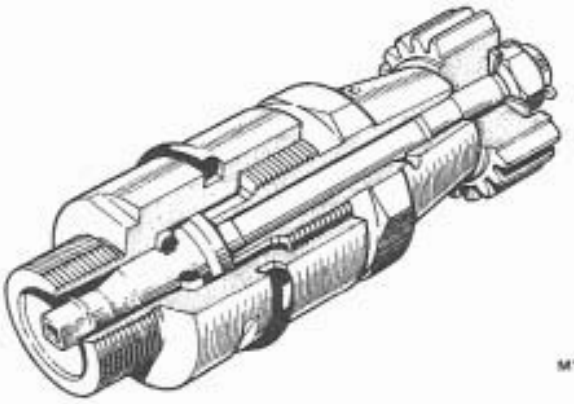

FIG. T82 SPEEDOMETER DRIVE

Speedometer drive — To fit

Fit a new rubber 'O' ring to the groove in the speedometer drive housing.

Apply a thin smear of clean oil around the 'O' ring when fitting the speedometer drive into the gearbox rear extension.

Locate the locking plate in its groove, then fit and tighten the setscrew to the correct torque loading.

Ensure that the end float and backlash of the driveshaft and gear are within the limits given in 'Dimensional Data' at the end of this Chapter.

Connect the speedometer drive cable

DIMENSIONAL DATA FOR SECTION T19—SPEEDOMETER DRIVE

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Drive-shaft end float.	0·015 in. (0,38 mm.) (minimum).	——	——
Drive gear backlash.	0·002 in. to 0·004 in. (0,05 mm. to 0,10 mm.)	0·006 in. (0,15 mm.)	——
Castellated nut — gear to shaft.	Torque tighten to 8 lb.ft. (1,11 kgm.)	——	Take nut to next split pin hole.
Setscrew — speedometer housing to rear extension.	Torque tighten to between 8 lb.ft. and 10 lb.ft. (1,11 kgm. and 1,38 kgm.)	——	——

T.S.D. 2476

July 1971

Printed in England

Printed in England

July 1971

T.S.D. 2476

Section T20
REVERSE ASSEMBLY

The reverse assembly (*see Fig. T83*) comprises the reverse epicyclic gears and output shaft, an aluminium rear extension casing and, for dismantling and assembly purposes, the mainshaft.

The reverse planet carrier has three planet gears which rotate on needle roller bearings around hardened steel pins; the carrier is splined to the output shaft. Also fitted to the reverse planet carrier is the bronze skew gear which drives the rear pump and governor.

The reverse annulus gear, which rotates on the output shaft, is an integral part of the reverse cone clutch. The cone surfaces run between an outer friction cone which is held stationary in the gearbox casing and an inner cone which forms part of the clutch piston; the clutch piston moves axially on four guide pins which prevent its rotation, oil leakage being prevented by annular seals.

Two ball bearings, one at each end of the rear extension carry the output shaft; the front bearing is captive, being retained by a circlip. On the output shaft itself is the gear wheel which drives the speedometer drive-shaft gear. The gear wheel is located by two distance tubes, between the ball bearings, and is secured by the clamping load when the coupling flange is fitted to the output shaft and tightened in position.

Oil sealing is effected by a lip-type seal which fits into a bore in the rear of the extension, the lip of the seal bearing on the coupling flange.

The gearbox electric actuator is conveniently mounted on the rear extension casing. Two tapped bosses on the left-hand side of the casing, and a boss and bracket underneath, accept the actuator securing setscrews.

Operation

When Reverse is selected, reverse oil pressure pushes the reverse clutch piston forward to trap the reverse cone between the inner and outer cones, thus holding the reverse annulus gear stationary. At the same time the rear band and the centre clutch are released, allowing the rear drum to rotate freely.

As driving torque is applied to the rear sun gear, the planet gears are forced to revolve and drive the rear drum and reverse sun gear in the reverse direction to the applied torque. Thus, the reverse planet gears are forced to revolve around the stationary annulus to follow the rotating sun gear, the reverse epicyclic unit is in reduction and the entire assembly of reverse and rear planet carriers is driven in Reverse.

When oil pressure to the reverse clutch is cut off, the reverse cone clutch is released by six coil springs.

Reverse assembly — To remove

Before attempting to remove the reverse assembly,

Chapter T

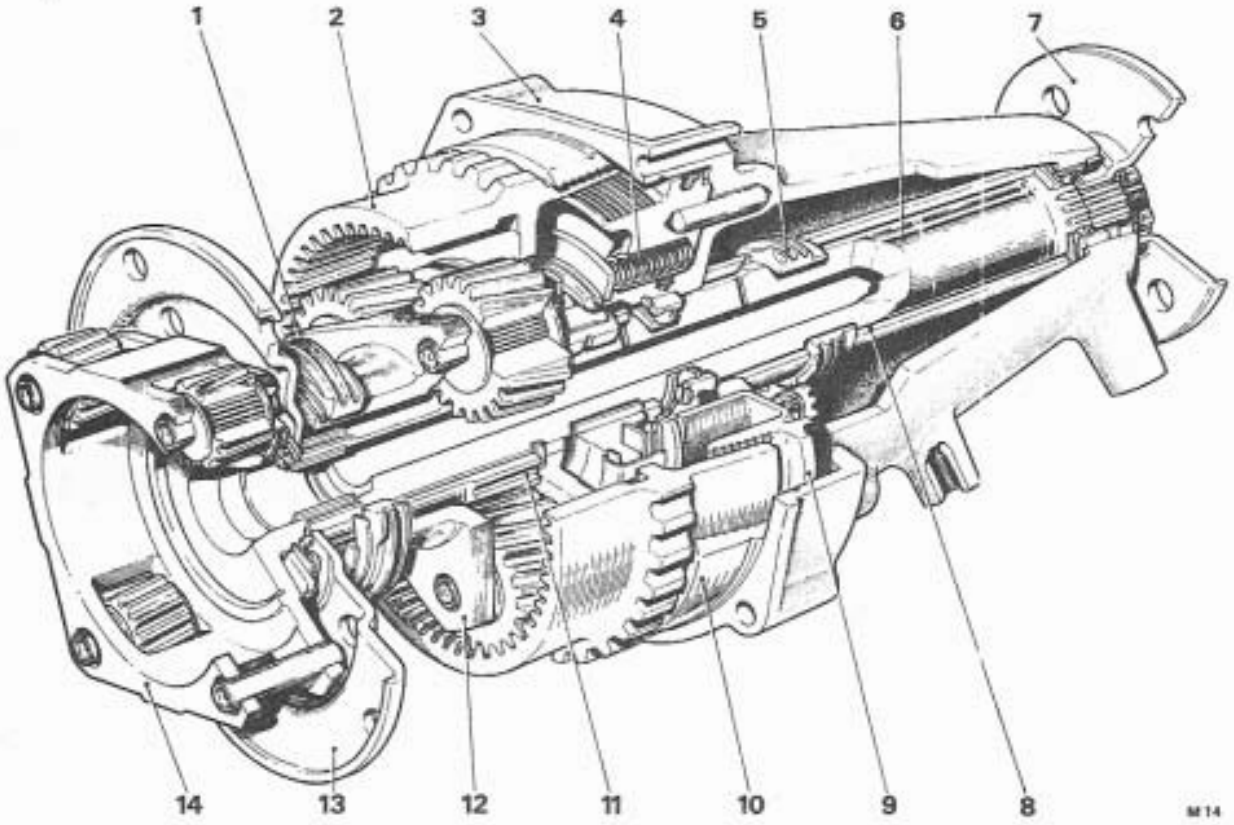

FIG. T83 REVERSE ASSEMBLY—CUTAWAY VIEW

1 Oil pump drive gear
2 Reverse annulus gear
3 Rear extension casing
4 Reverse clutch return spring
5 Speedometer drive gear wheel
6 Distance tube
7 Coupling flange
8 Output shaft
9 Reverse clutch piston
10 Stationary cone
11 Reverse sun gear
12 Reverse planet carrier
13 Drive flange
14 Rear unit planet carrier

the gearbox should be taken out of the car (*see Section T9*) and the following units removed.

Fluid coupling (*see Section T10*).

Side cover, sump and filter (*see Section T11*).

Control valve unit and parking brake bracket (*see Section T12*).

Front servo unit (*see Section T14*).

Rear servo and accumulator (*see Section T15*).

Rear pump and governor (*see Section T16*).

Speedometer drive (*see Section T19*).

During removal of the reverse assembly from the gearbox and also during subsequent dismantling, all the thrust and adjusting washers should be labelled for easy identification when assembling.

After removal of the units previously mentioned, check the end float of the mainshaft as follows.

Remove the snap ring from the mainshaft.

Fit the centralising tool RH 7771 to the mainshaft and intermediate shaft.

Mount a dial test indicator so that the gauge plunger rests on the end of the mainshaft (see Fig. T84).

Fit the wedge tool (*see T.S.D. 2331—Workshop Tools*) in position between the forward end of the oil delivery sleeve cap and the front drum, then lightly tap it down to take up front drum assembly end float.

Push the mainshaft in toward the rear extension then set the gauge to zero.

Pull the mainshaft forward and note the gauge reading.

Repeat the operation to ensure that a correct reading has been obtained. If the reading is within the limits given in 'Dimensional Data' the existing thrust washer may be retained, provided that it is otherwise serviceable; remove the wedge tool and the centralising tool.

If the end float is incorrect, measure the thickness of the adjusting washer then select a new one to give the correct end float.

T.S.D. 2476 July 1971 Printed in England

Printed in England

July 1971

T.S.D. 2476

Unlock the tab washer which secures the coupling flange nut.

Fit a holding bar to the coupling flange then slacken the nut, using serrated spanner No. RH 7772 (*see T.S.D. 2331—Workshop Tools*). Remove the nut, tab washer, key washer, clamping washer and end nip adjusting washer.

Hold the rear drum by applying the rear band with a suitable lever, then remove the six setscrews and spring washers which secure the driving flange to the rear drum.

Remove the five nuts and plain washers which secure the rear extension to the gearbox casing.

Withdraw the reverse assembly from the gearbox casing, taking care to retain the stationary cone key, then remove the mainshaft and washers (*see Fig. T85*). If the reverse assembly sticks in the gearbox casing, tap the front of the mainshaft with a soft-headed mallet to initiate movement.

Remove and discard the gasket.

If the gearbox drum assembly is to be removed, fit the rear clutch hub retainer.

Reverse assembly — To dismantle

Remove the output shaft and epicyclic gear train from the rear extension casing as described in the following paragraphs. Refer to the cutaway view shown in Figure T83 when dismantling the reverse assembly.

Place the extension casing on the bed of a press, ensuring that there is sufficient room below the press bed to allow the shaft to emerge fully from the extension casing. Ensure that the bed of the press is clean and will not damage the joint face of the aluminium casing.

Protect the threads on the end of the output shaft then press the shaft out of the bearings.

After approximately 0·750 in. (19,05 mm.) of movement the shaft will fall freely until the land upon which the speedometer drive gear wheel fits encounters the front bearing.

Obtain a bar of suitable length and diameter that will pass through the rear bearing and assist in pushing out the shaft.

Continue pressing the shaft downward until the gear wheel land passes beyond the front bearing inner race.

The shaft should again fall until the third land, upon which the rear bearing fits, encounters the front bearing inner race.

Push the shaft through the front bearing then remove the shaft and the press bar.

Remove the epicyclic gears from the output shaft as follows.

Remove the thrust washer from the reverse annulus gear.

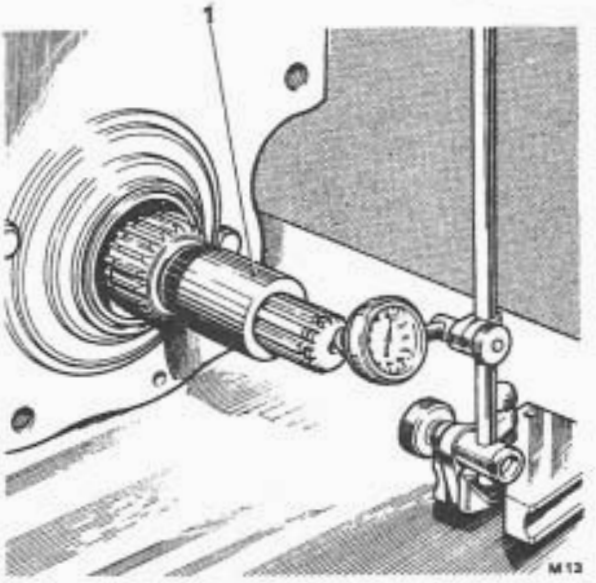

FIG. T84 CHECKING MAINSHAFT END FLOAT

1 Spacer

Remove the annulus gear, spacer and the reverse planet carrier from the output shaft, taking care not to damage the soft metal bush in the annulus gear.

Remove the snap ring from the output shaft then lift off the reverse sun gear and driving flange, thrust washer and backing washer.

To dismantle the reverse clutch, lay the annulus gear on the bench with the stationary cone uppermost.

Expand and remove the stationary cone as shown in Figure T86. Avoid over expanding the cone as this may lead to permanent distortion.

Turn over the annulus gear then remove the retainer and cushioning ring by slightly turning the retainer and withdrawing the lugs from their holes.

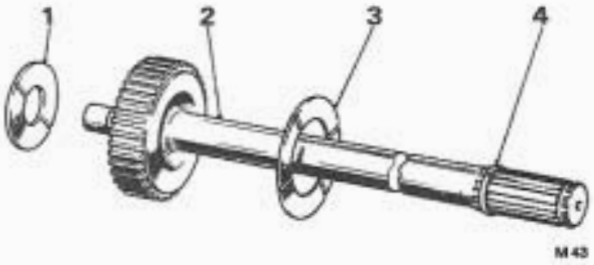

FIG. T85 MAINSHAFT AND WASHERS

1 End float adjusting washer
2 Mainshaft
3 Thrust washer
4 Snap ring

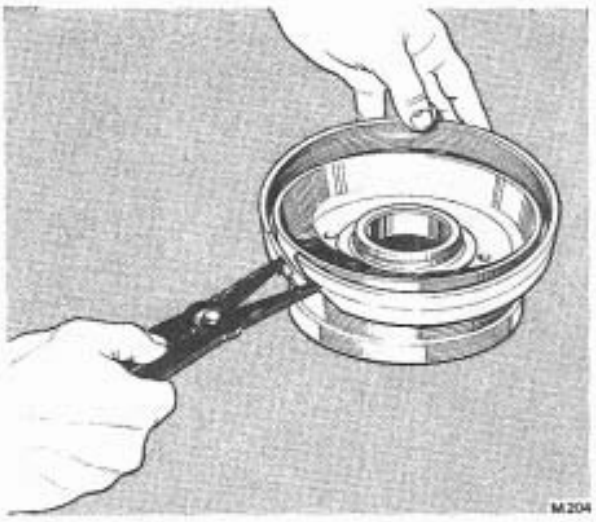

FIG. T86 REMOVING THE STATIONARY CONE

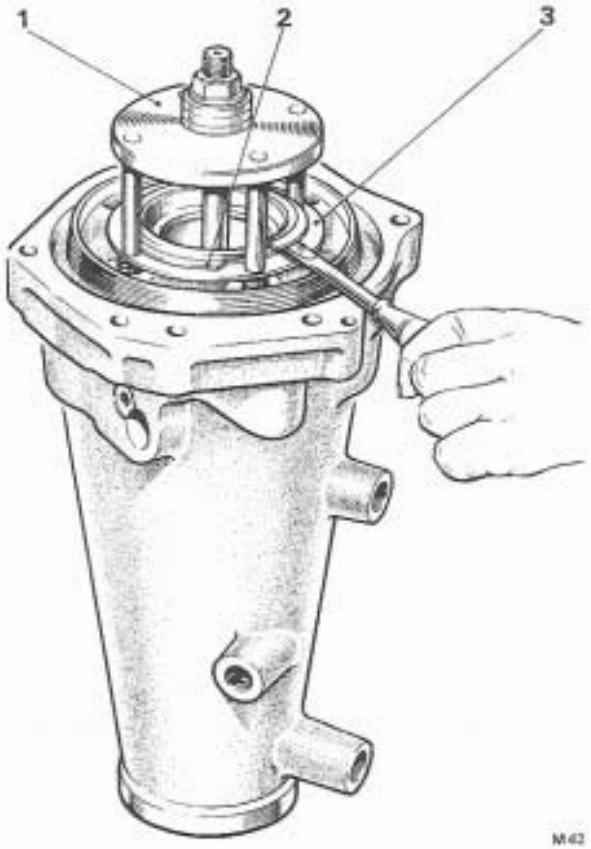

FIG. T87 CLUTCH SPRING COMPRESSING TOOL IN POSITION

1 Tool 2 Retainer 3 Snap ring

Fit the clutch spring compressing tool to the extension as shown in Figure T87, ensuring that the gap in the spring ring is situated between two of the tool legs to facilitate removal.

Centralise the tool in the extension housing. Screw down the tool nut until the clutch spring retaining washer is clear of the spring ring; remove the ring from the groove. Remove the tool and withdraw the retaining plate and six clutch springs.

Withdraw the inner cone clutch from the extension casing.

If difficulty is experienced in removing the clutch cone, place a hand over the extension casing to retain the piston, then intermittently apply air pressure of approximately 70 lb/sq.in. (4,9 kg/sq.cm.) to the clutch apply duct as shown in Figure T88. This will lift the cone sufficiently to allow withdrawal from the casing; do not attempt to rotate the cone as it is located by dowels. Remove the clutch piston sealing rings.

To remove the bearings and speedometer drive gear wheel proceed as follows.

Remove the snap ring which secures the front bearing in position in the extension casing.

Push out the front bearing then remove the short distance tube, speedometer drive gear wheel and the long distance tube.

Push out the rear bearing and the oil seal; the seal may be retained if the shell is undamaged and the rubber lip is in good condition.

Reverse assembly — To inspect

Before inspection, all parts must be cleaned thoroughly using clean paraffin, a brush and compressed air.

Examine the following for residual sludge. Gear teeth, external and internal splines, bores and sealing ring grooves and the mainshaft bearing housing at the front end of the output shaft.

The clutch apply duct in the extension casing and the oil passages at the rear end of the mainshaft must be blown through with compressed air to ensure that they are free from obstruction.

Screw threads — To inspect

Examine all screw threads, particularly any which were tight on removal; if necessary clean the threads.

Gears — To inspect

Examine all gear teeth for damage and wear. Examine the general condition of the end thrust washers of the planet pinions.

Examine the planet pinion carriers around the pin bores for radial cracking, particularly across the

T.S.D. 2476

July 1971

Printed in England

narrowest sections, also check the pins for tightness in the bores; the pins are initially a press fit and should remain tight.

If any part of a planet pinion assembly is found to be unserviceable the complete assembly concerned must be renewed.

If any part of the reverse planet carrier is unserviceable, the complete assembly, including the rear pump driving gear, must be renewed; the pump driving gear is retained by a ball and snap ring and any attempt to remove it will render it unserviceable. The rear pump must be renewed complete with the reverse planet carrier; a worn gear must not be mated with a new gear in this instance.

The output shaft planet gear assembly, reverse sun gear and the reverse planet gear assembly may be changed independently of their mating gears.

Output shaft — To inspect

Examine the bearing faces of the planet carrier, the shaft and the thrust and backing washers for scoring and for signs of uneven wear.

Examine the mainshaft bronze bearing in the hollow end of the output shaft.

Check the splines for fretting and twisting which may indicate incipient failure.

Check that the plug in the end of the shaft is secure.

If any part of the output shaft is found to be unserviceable, it must be changed as an assembly. The thrust and backing washers can, of course, be renewed independently if any doubt exists as to their serviceability.

Reverse sun gear and driving flange assembly — To inspect

Check the driving flange and the thrust washer retainer for distortion; the retainer should be tight on the splines.

Examine the bronze bearing in the bore of the sun gear for scoring and uneven wear.

Any part which is unserviceable will necessitate renewing the complete assembly.

The thrust washer retainer under the driving flange should not be disturbed as this is a press fit and is jig-assembled.

Reverse planet carrier — To inspect

Check that the rear pump driving gear is tight on its mounting and examine the gear for excessive wear.

Examine the bearing surfaces of the extension and the cushioning ring for scoring and uneven wear.

If any part of the reverse planet carrier is unserviceable the complete assembly and the rear pump must be renewed, as described under 'Gears — To inspect'.

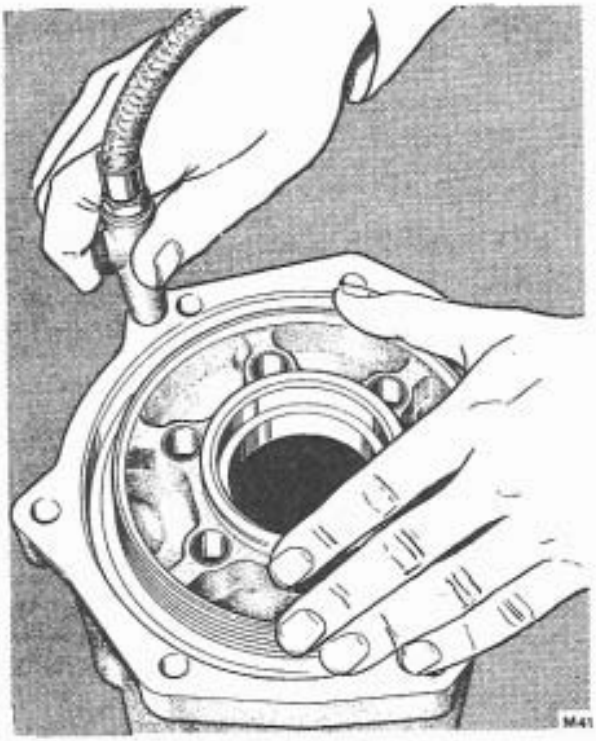

FIG. T88 REMOVING THE REVERSE CLUTCH PISTON

FIG. T89 CHECKING THE REVERSE PLANET CARRIER END FLOAT

Printed in England

July 1971

T.S.D. 2476

Chapter T

Reverse clutch assembly — To inspect

Examine the following parts for scoring, rough surfaces, signs of overheating and uneven contact. The mating faces of the outer stationary clutch cone, the reverse annulus gear and the inner stationary clutch cone.

Examine the thrust washer and the bearing surface in the reverse annulus gear for scoring and uneven wear; also examine the soft metal lining in the annulus gear bore for scoring, cracking and for poor adhesion to the shell.

Examine the clutch spring retainer for damage or distortion and check the springs for collapsed coils. Check that all the springs are of the same length.

Examine the stationary clutch cone for cracking in the vicinity of the keyway.

Examine the cushioning ring retainer for excessive wear on its bearing surface and for cracking at the bends of the lugs. Check that the cushioning ring has not lost its spring tension and become flattened during service.

Examine the reverse clutch piston seals for loss of resilience and cracking. If any parts of the reverse annulus gear, the stationary clutch cone or the inner clutch cone are unserviceable it will necessitate renewal of these parts as a comple assembly.

Other parts of the assembly can be renewed independently, but clutch springs should be renewed as a set.

Bearings and housing — To inspect

Examine the front and rear ball bearings for wear and the outer races and their housings for signs of spinning: the outer race should be a light, tap fit in the housing.

The bearings can be renewed independently of the shaft or extension casing providing that due regard is given to the condition of the housing and mountings.

Rear extension and coupling — To inspect

Examine the extension for cracks and other damage.

Examine the internal splines of the coupling for signs of fretting or other damage; also examine the bore of the distance sleeves for burrs which might become detached during assembly.

Examine the coupling bolt holes for elongation.

Examine the oil seal rubbing diameter for signs of grooving or burrs.

Examine the oil seal for loss of resilience and any damage to the sealing lip which would account for a leaking seal.

All items in this assembly may be renewed independently.

Reverse assembly — To assemble

Before assembling, all parts must be thoroughly cleaned then lightly oiled with clean gearbox oil.

New gaskets, oil seals and snap rings should be fitted where applicable; jointing compound must not be used.

Stand the output shaft on its end and assemble the thrust washer, the backing washer and the driving flange and reverse sun gear, taking care not to damage the bronze bearing in the sun gear bore as it passes over the shaft splines.

Check that the washers are in the retainer on the underside of the driving flange, then fit the snap ring to the groove in the shaft. Rotate the sun gear assembly to ensure that it is free on the shaft. Fit the reverse planet carrier ensuring that the gears mesh correctly with the sun gear and check that it rotates freely.

Slide the distance piece into position on the shaft; check the end float of the reverse planet carrier by holding the distance piece against the shoulder on the shaft and inserting a feeler gauge between the distance piece and the planet carrier as shown in Figure T89. If the end float is not within the limits quoted in 'Dimensional Data' the output shaft, or the reverse planet carrier, or both, must be renewed by selective fitting.

Mobilgrease M3 and gently expand the seal into its groove with the seal lip facing away from the conical end of the clutch cone. Grease the inner seal and fit it to the groove in the neck of the extension casing with the lip facing the bottom of the apply chamber. Ensure that both seals are fitted snugly into their grooves.

With the extension casing on the bench and the apply chamber uppermost, fit the outer seal guide tool (*see T.S.D. 2331—Workshop Tools*) in position (*see Fig. T90*) ensuring that it is seated on the shoulder in the apply chamber. If a guide tool is not available, a narrow flexible strip of metal approximately 1·00 in. (25,4 mm.) wide, of the correct length and free from burrs and jagged edges, should be inserted in the same manner as the tool.

Lower the inner cone squarely into the guide tool, seal first, then turn it to engage the four dowels. Push the cone into the chamber until it reaches the bottom, then remove the guide tool.

Do not try to force the piston into its chamber without the aid of a suitable guide, otherwise the piston outer seal will almost certainly be damaged.

Fit the extension casing in position over the base of the clutch spring compressing tool and fit the six clutch springs into the sockets. Lay the clutch spring retainer plate and the spring ring in position on top of the springs and assemble the top portion of the tool ensuring that it is in a central position. Depress the

T.S.D. 2476 July 1971 Printed in England

retainer until the spring ring can be fitted into the groove. When the spring ring is in position, tap it into the groove to make sure it will not fly out when under spring pressure. Release the pressure and remove the tool.

Check the freedom of the piston in the apply chamber by applying an air pressure of approximately 70 lb/sq. in. (4,9 kg/sq. cm.) to the clutch apply duct.

Hold the cone out by air pressure and check the seal for leakage which will be indicated by the presence of grease bubbles. If a leakage occurs fit a new seal.

Lubricate the stationary clutch cone and expand it into position on the reverse annulus gear, using snap ring pliers.

Care must be taken to ensure the inner face on the edge of the annulus gear is not damaged during this operation. Do not over expand the cone due to the risk of distorion and the subsequent loss of contact area.

Turn the reverse annulus gear over and fit the cushioning ring and retainer; rotate the retainer to lock the lugs in their holes.

Rear extension — To assemble

The reverse assembly can be completely assembled before being fitted to the gearbox if a bench fixture is available to hold the assembly. If a fixture is not available, assessment of the thickness of the coupling flange end nip washer and the final tightening and locking of the securing nut should be left until the assembly is secured to the gearbox casing

With the output shaft standing on its gear end, lower the reverse annulus gear over the shaft (cushioning ring retainer downward), until it meshes with the reverse planet carrier. Spin the reverse annulus gear several times to check for freedom of rotation.

Position the thrust washer in the reverse annulus gear and retain it with a smear of petroleum jelly.

Press the front bearing into its bore in the rear extension; fit the snap ring.

Lower the bearing and casing over the output shaft then press down the bearing, using a suitable tube on the bearing inner race, until the race abuts the collar. During this operation the stationary cone must be guided into its spigot in the rear extension casing, at the same time align the keyway so that it is between the bottom two stud holes in the casing.

Fit the short distance tube with the oil supply slots uppermost.

Fit the speedometer drive gear with the shoulder uppermost then fit the long distance tube.

Fit the rear bearing, pushing it down the rear extension bore until the inner race abuts the long distance tube.

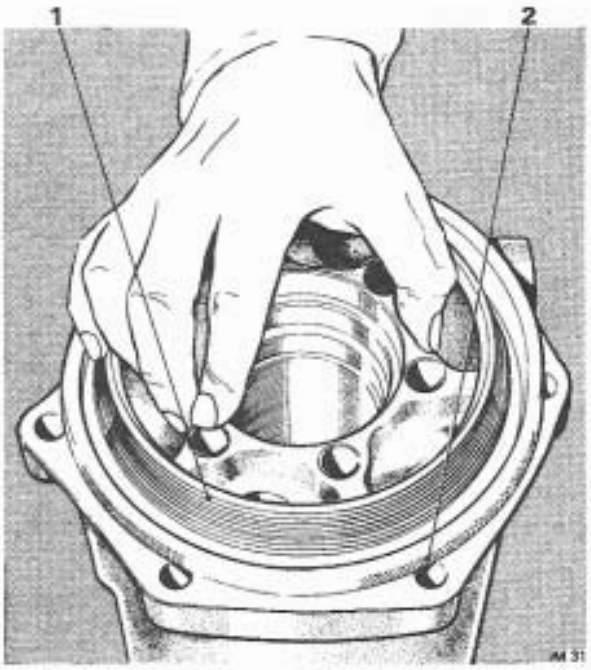

FIG. T90 FITTING THE REVERSE CLUTCH PISTON

1 Piston
2 Guide tool

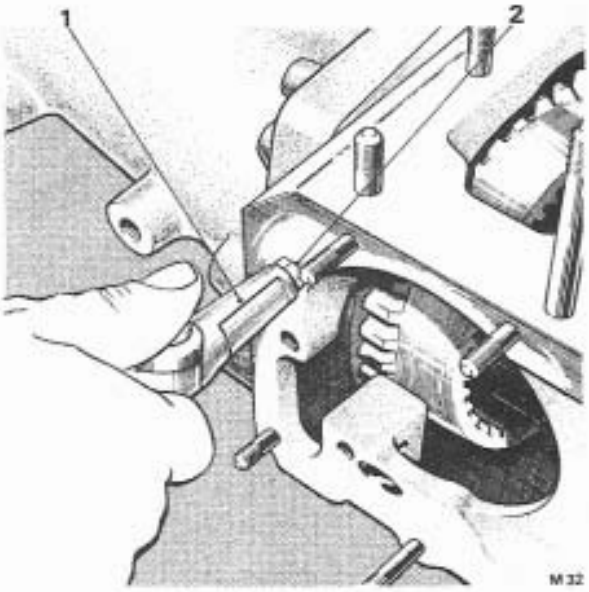

FIG. T91 CENTRALISING THE REVERSE CLUTCH CONE

1 Air line adaptor

2 Reverse clutch apply port

Printed in England
July 1971
T.S.D. 2476

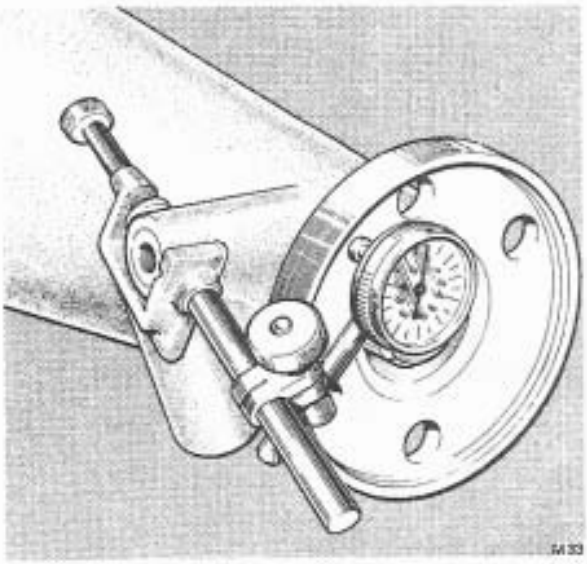

FIG. T92 ASSESSING THICKNESS OF END NIP WASHER

Fit the oil seal with the lip of the seal facing toward the bearing. The seal casing should lie flush with the end of the rear extension.

Apply a smear of clean gearbox oil to the seal lip then fit the coupling flange, nip washer, abutment washer, key washer, tab washer and nut; do not tighten the nut yet unless a bench fixture is available to hold the rear extension assembly.

Reverse assembly — To fit

Remove the clutch hub retainer; ensure that the hub is correctly engaged in all the driving plates as described in Section T21.

Fit a new gasket to the gearbox rear face and retain it with a smear of petroleum jelly.

Fit the bronze adjusting washer to the recess in the front face of the output shaft and retain it with a smear of petroleum jelly.

Fit the mainshaft into the bearing in the output shaft. Ensure that the bronze thrust washer is in position in the rear clutch hub, then fit the mainshaft and reverse assembly to the gearbox. Check that the stationary cone keyway is aligned with the keyway in the gearbox casing.

Fit the key then push the reverse assembly firmly against the rear face of the gearbox.

Fit the parking pawl setscrews to align the rear extension then fit the plain washers and nuts; finger tighten the nuts.

Apply air pressure of approximately 70 lb/sq.in. (4,9 kg/sq.cm.) to the reverse clutch apply port in the gearbox side (*see Fig. T91*). This will apply and centralise the reverse clutch assembly.

With the air pressure still applied, evenly tighten the nuts. Cut off the air supply then torque tighten the nuts to the correct torque figure; remove the parking pawl setscrew.

Align the driving flange holes with the rear drum holes then fit the setscrews and washers; check the output shaft for freedom of rotation and the mainshaft for freedom of movement whilst the setscrews are being progressively tightened.

If the output shaft becomes stiff to turn, or locks, or the mainshaft cannot be moved, remove the rear extension and ensure that the rear clutch hub is home in the rear drum; also ensure that the mainshaft adjusting and thrust washers have not slipped from their respective recesses. If either of these washers has slipped and become trapped, it must be checked for damage or distortion and, if necessary, renewed.

If new clutch plates have been fitted to any of the drums, a certain amount of stiffness may be encountered but it should still be possible to rotate the output shaft by hand.

Check the end float of the mainshaft as described under 'Reverse assembly — To remove'. This is a routine assembly operation but it may have to be carried out during investigations of stiffness as described in the previous paragraphs.

Fit the rearmost snap ring to the mainshaft.

Output shaft end nip — To adjust

The output shaft end nip is set to ensure that certain components which are fitted to the output shaft are locked in position.

Output shaft end nip should be adjusted as follows.

Remove the nut, lock tab, key washer, clamping washer and adjusting washer from the output shaft.

Select a thick adjusting washer; washer range 0·090 in. to 0·125 in. (2,29 mm. to 3,18 mm.), fit the washer to the output shaft; the washer should stand proud of the shaft shoulder.

Fit the clamping washer, key washer and nut, then tighten the nut until all end clearance between the bearing, gear and spacers has been taken up.

Remove the nut and washers then fit a slave adjusting washer, between 0·040 in. and 0·060 in. (1,02 mm. and 1,52 mm.) thick, onto the output shaft; the shaft shoulder should stand proud of the washer.

Fit the clamping washer, key washer and nut; tighten the nut.

Mount a dial test indicator to read off the coupling flange as shown in Figure T 92.

Push the coupling flange along the output shaft then set the dial to zero. Pull back the coupling flange and note the reading. The thickness of the required adjust-

T.S.D. 2476 July 1971

ing washer is: the thickness of the slave (thin) adjusting washer, plus the dial test indicator reading, plus between 0·004 in. and 0·010 in. (0,10 mm. and 0,25 mm.). *0·008 in.(0,20 mm.) is obtained on initial build*).

Measure the thickness of the existing washer and, if suitable, and otherwise serviceable, it may be fitted. If it is unsuitable, select another washer to give the required end nip.

Remove the nut and washers then fit the selected adjusting washer, clamping washer, key washer, new

Fit a holding tool to the coupling flange, tighten the tab washer and the nut.

nut to the correct torque figure then bend over the tabs on the washer.

Remove the holding tool and build up the gearbox as described in the Sections which are listed at the commencement of this Section.

The reverse unit can be tested for correct functioning, apart from reverse clutch operation, only by fitting the gearbox to the car and carrving out reverse and forward selection of the gears as explained in Section T6—'Air pressure check and investigation'.

DIMENSIONAL DATA FOR SECTION T20—REVERSE ASSEMBLY

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Output shaft bush i/d.	0·687 in. to 0·689 in. (17,46 mm. to 17,51 mm.)	—	—
Mainshaft — bearing diameter.	0·685 in. to 0·684 in. (17,39 mm. to 17,37 mm.)	—	—
Clearance.	0·002 in. to 0·005 in. (0,05 mm. to 0,13 mm.)	—	—
Reverse sun gear bush i/d.	1·4995 in. to 1·5005 in. (38,08 mm. to 38,113 mm.)	—	—
Output shaft diameter.	1·498 in. to 1·497 in. (38,05 mm. to 38,02 mm.)	—	—
Clearance.	0·0015 in. to 0·0035 in. (0,038 mm. to 0,089 mm.)	—	—
Reverse planet carrier end float.	0·004 in. to 0·015 in. (0,10 mm. to 0,40 mm.)	—	—
Mainshaft end float.	0·004 in. to 0·015 in. (0,10 mm. to 0,40 mm.)	—	—
Reverse annulus gear bush i/d.	1·9995 in. to 2·0005 in. (50,799 mm. to 50,801 mm)	—	—
Reverse planet carrier bearing diameter.	1·9965 in. to 1·9955 in. (50,711 mm. to 50,686 mm.)	—	—
Clearance.	0·003 in. to 0·005 in. (0,08 mm. to 0,13 mm.)	—	—
Output shaft front bearing inner race i/d.	1·3775 in. to 1·3780 in. (34,99 mm. to 35,00 mm.)	—	—
Output shaft bearing diameter.	1·3782 in. to 1·3777 in. (35,006 mm. to 34,994 mm.)	—	—
Interference.	0·0002 in. to 0·0007 in. (0,005 mm. to 0,018 mm.)	—	—
Speedometer drive gear wheel i/d.	1·3782 in. to 1·3792 in. (35,006 mm. to 35,057 mm.)	—	—
Output shaft—bearing diameter.	1·3782 in. to 1·3777 in. (35,006 mm. to 34,994 mm.)	—	—
Clearance.	0·0000 in. to 0·0015 in. (0,000 mm. to 0,038 mm.)	—	—
Output shaft rear bearing inner race i/d.	1·37795 in. (34,977 mm.)	—	—
Output shaft—bearing diameter.	1·3782 in. to 1·3777 in. (35,006 mm. to 34,994 mm.)	—	—

Printed in England

July 1971

T.S.D. 2476

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Dimensional Data—*continued*			
Interference or clearance.	+ or — 0·00025 in. (+ or — 0,0063 mm.)	—	—
Rear extension front bearing bore i/d.	2·4408 in. to 2·4416 in. (61,996 mm. to 62,016 mm.)	—	—
Front bearing outer race o/d.	2·4409 in. to 2·4404 in. (62,018 mm. to 61,986 mm.)	—	—
Interference or clearance.	—0·0001 in. tight to +0·0012 in. clear (— 0,0025 mm. to + 0,030 mm.)	—	—
Rear extension rear bearing bore i/d.	2·8343 in. to 2·8348 in. (71,992 mm. to 72,004 mm.)	—	—
Rear bearing outer race o/d.	2·8346 in. (71,999 mm.)	—	—
Interference or clearance.	—0·003 in. tight to +0·0002 in. clear (— 0,008 mm. to + 0,005 mm.)	—	—
Output shaft end nip.	0·004 in. to 0·010 in. (0,10 mm. to 0,25mm.)	—	—
End nip adjusting washer range.	0·090 in. to 0·125 in. (2,29 mm. to 3,18 mm.)	—	Select adjusting washer to give correct end nip.
Output shaft pinions end clearance.	0·005 in. to 0·026 in. (0,13 mm. to 0,66 mm.)	—	—
Nuts — rear extension to gearbox casing.	Torque tighten to between 29 lb.ft. and 32 lb.ft. (4,01 kgm. and 4,42 kgm.)	—	—
Nut — coupling flange.	Torque tighten to between 150 lb.ft. and 180 lb.ft. (20,74 kgm. and 24,89 kgm.)	—	—
Setscrews — driving flange to rear drum.	Torque tighten to between 16 lb.ft. and 18 lb.ft. (2,21 kgm. and 2,49 kgm.)	—	—
Reverse clutch release spring—free length.	1·344 in. (approx.) (33,12 mm.) (approx.)	—	—
Load required to compress spring length to 1·031 in. (26,19 mm.)	30 lb. 1 oz. to 35 lb. 1 oz. (13,64 kg. to 15,90 kg.)	—	—

T.S.D. 2476

July 1971

Printed in England

Printed in England

July 1971

T.S.D. 2476

Section T21
DRUM ASSEMBLIES

The drum assemblies (*see Fig. T93*) comprise three drums, referred to as front drum, centre drum and rear drum. Both the front and rear drums contain clutch plates, as well as an epicyclic gear train and are free to rotate. The centre drum contains a clutch pack and a sprag clutch; this drum is an interference fit on the oil delivery sleeve. It is also located in the gearbox casing by means of a steel key. The drum and oil delivery sleeve are held captive in the gearbox casing. The inner race of the sprag clutch is splined to the rear drum. When the centre clutch is applied, the sprag outer race is held and the rear drum will be held stationary by the action of the sprag. The sprag takes the torque reaction of the rear train as soon as the rear drum is released by the rear clutch and the rear epicyclic unit goes into reduction.

The four forward gears are obtained by using the two epicyclic gear trains which are of different ratios. The reverse gear idles when the forward Ranges are selected, but when engaged, it revolves in a reverse direction and provides a further slight gear reduction (*see Section T20—Reverse assembly*).

Four forward gears are obtained as follows.

First gear — both front and rear epicyclic units are in reduction.

Second gear — the front unit is in direct drive and the rear unit is in reduction.

Third gear — the front unit is in reduction and the rear unit is in direct drive.

Fourth gear — both units are in direct drive.

The centre clutch is applied during all forward Ranges but is not applied in Reverse.

Operation

The line of drive through each epicyclic unit is dependent upon a hydraulically controlled friction band (two bands in Range 2) and three clutches. When the friction bands, or sprag clutch, hold the drums stationary, the front and rear clutches are in the disengaged state and the units are in reduction. When the front band is released, and the front clutch engaged, locking together two elements of the gear train, a direct drive is provided through the unit. As soon as the rear clutch is applied, the action of the sprag clutch is such that it allows this drum also to rotate.

The clutch in the front unit locks together the sun gear and the planet gear carrier, thus preventing rotation of the planet gears and locking the unit in direct drive.

The clutch in the rear unit locks the annulus gear to the intermediate shaft. If there were no slip in the fluid coupling this would be equivalent to locking the annulus and sun gears together, so preventing rotation of the planet gears and enforcing direct drive through the unit. However, slight slip is always present in the

Chapter T

fluid coupling, therefore, the planet gears revolve slowly around the annulus to accommodate it, the action being similar in principle to that of a differential. The subsequent result nevertheless, is direct drive through the unit with slight loss in the fluid coupling.

In Reverse, both the rear clutch and the centre clutch are released, permitting all the gears in the rear unit to rotate. The rear unit annulus and the reverse unit sun gear are splined together, and rotate in the opposite direction to that of the input torque. The reverse unit annulus gear is held by the reverse cone clutch (*see Section T20—Reverse assembly*) and the reverse unit planet gears therefore revolve inside it, transmitting the reverse torque through the planet gear carrier to the output shaft.

A point of interest in gear arrangement is the fact that the fluid coupling is not directly driven by the engine drive-plate; the torus cover is secured to the crankshaft driven drive-plate and drives the rear torus member at a reduced speed, in first gear, through the gear train of the front epicyclic unit. This speed reduction allows the fluid coupling to rotate at a lower speed than if it were directly connected to the engine. Since the coupling is inefficient at very low speeds this reduces the tendency for the car to creep forward when a forward Range is selected at idle.

Gear ratios

The line of drive through from the engine crankshaft, follows.

First gear

The drive is transferred from the engine crankshaft, via the torus cover to the front gear train which is in reduction. From the front gear train the drive passes to the fluid coupling by way of the intermediate shaft. The fluid coupling drives the mainshaft which in turn transfers the drive through the rear train, which is in reduction, to the output shaft. With both gear trains in reduction the gearbox will be in bottom or first gear, ratio 3.82 : 1 (*see Fig. T94*).

Second gear

The drive is transferred from the engine crankshaft, via the torus cover, to the front gear train which is in

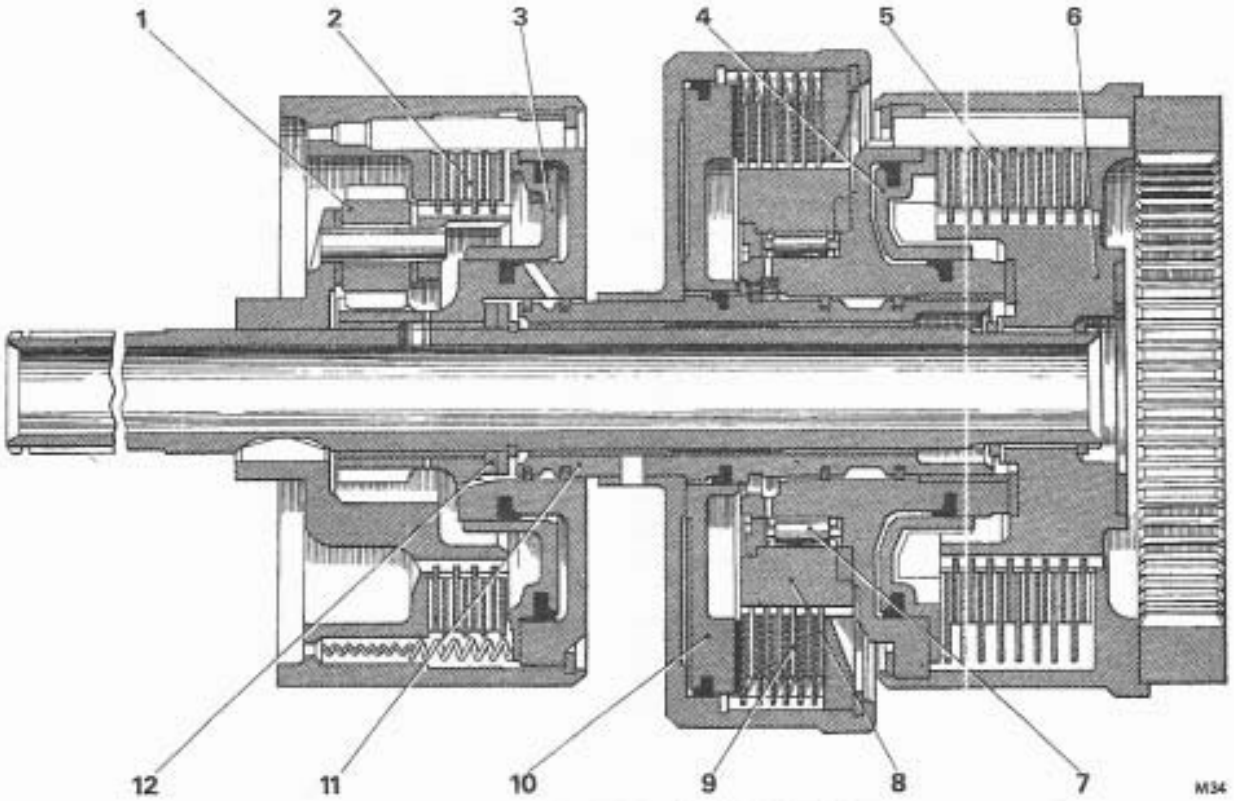

FIG. T93 DRUM ASSEMBLIES—SECTIONED VIEW

1 Front planet gear
2 Front clutch
3 Front clutch piston
4 Rear clutch piston
5 Rear clutch
6 Rear clutch hub
7 Sprag race
8 Sprag outer race
9 Centre clutch
10 Centre clutch piston
11 Oil delivery sleeve
12 Thrust washer

T.S.D. 2476 July 1971 Printed in England

direct drive. From the front gear train the drive passes to the fluid coupling by way of the intermediate shaft. The fluid coupling drives the mainshaft which in turn transfers the drive through the rear train, which is in reduction, to the output shaft. Only the rear train is in reduction so the gearbox will be in second gear, ratio 2.63 : 1 (*see Fig. T95*).

Third gear

The drive is transferred from the engine crankshaft, via the torus cover, to the front gear train which is in reduction. Here the drive is divided, passing to the fluid coupling via the intermediate shaft, also passing directly to the rear train, again by way of the intermediate shaft. The rear train is in direct drive; hence, torque is applied to the output shaft from the fluid coupling, via the mainshaft, also from the intermediate shaft. As only the front train is in reduction the gearbox will be in third gear, ratio 1.45 : 1 (*see Fig. T96*).

Fourth gear

The drive is transferred from the engine crankshaft, via the torus cover, to the front gear train which is in direct drive. Here again the drive is divided, passing forward to the fluid coupling and rearward to the rear gear train. The rear gear train is in direct drive also, therefore the gearbox transmits torque through a 1 : 1 ratio and is in top gear (*see Fig. T97*).

Reverse

The drive is transferred from the engine crankshaft, via the torus cover, to the front gear train which is in reduction. From the front gear train the drive passes to the fluid coupling by way of the intermediate shaft. The fluid coupling drives the mainshaft and rear unit sun gear. The rear unit sun gear transmits the drive, via the output shaft planet gears, to the rear unit annulus gear which is splined to the reverse unit sun gear. The reverse unit is in reduction and drive is transmitted by the reverse unit planet carrier to the output shaft in a reverse direction (*see Section T20—Reverse assembly*). With the front, rear and reverse trains in reduction, the ratio is 4.30 : 1 (*see Fig. T98*).

Neutral

The drive is transferred from the engine crankshaft, via the torus cover to the front train. The front band and clutch are off, the gears idle therefore no torque is transmitted to the output shaft (*see Fig. T99*).

Drum assemblies — To overhaul

The following paragraphs describe the procedure to be adopted when overhauling the drum assembly. This assembly comprises the front, centre and rear clutch units, the intermediate shaft, the oil delivery sleeve, the sprag clutch and the front and rear bands. Before the assembly can be removed from the gearbox, the gearbox must be taken out of the car and the following units removed.

Fluid coupling (*see Section T10*).

Side cover, sump and filter (*see Section T11*).

Control valve unit and parking brake bracket (*see Sections T12 and T13*).

Servo units (*see Sections T14 and T15*).

Rear pump and governor (*see Section T16*).

Pressure control valve (*see Section T17*).

Front pump and drive-shaft (*see Section T18*).

Reverse assembly (*see Section T20*).

Drum assemblies — To remove

Unscrew the two setscrews which secure the centre drum locating key plate to the gearbox casing; remove the plate, run a 5/16 in. dia. U.N.F. setscrew into the tapped hole in the key then lift out the key (*see Fig. T100*).

Turn back the tabs of the centre bearing cap lock plate, unscrew the two retaining setscrews then lift off the cap. Remove the oil feed pipe from the centre drum and casing.

Rotate both bands so that they are clear of their respective anchor pins.

Lift the rear end of the intermediate shaft and support the front of the shaft with the other hand; gently ease the oil delivery sleeve out of its support.

Hold the rear band on the rear drum then lift the assembly out of the gearbox casing, leaving the front band in the casing.

Fit the assembled drums and shaft into the holding stand (*see T.S.D. 2331—Workshop Tools*), then remove the front band from the casing.

Drum assemblies — To dismantle

Remove the snap ring which retains the rear drum hub to the intermediate shaft (*see Fig. T101*). Remove the hub.

Lift the rear drum assembly off the shaft. As the sprag clutch inner race is retained by a snap ring to the rear drum, the inner race will be removed as well as the sprag race and the outer race.

Remove the thin steel thrust washer from above the snap ring. Remove the snap ring which locates the rear

Printed in England

July 1971

T.S.D. 2476

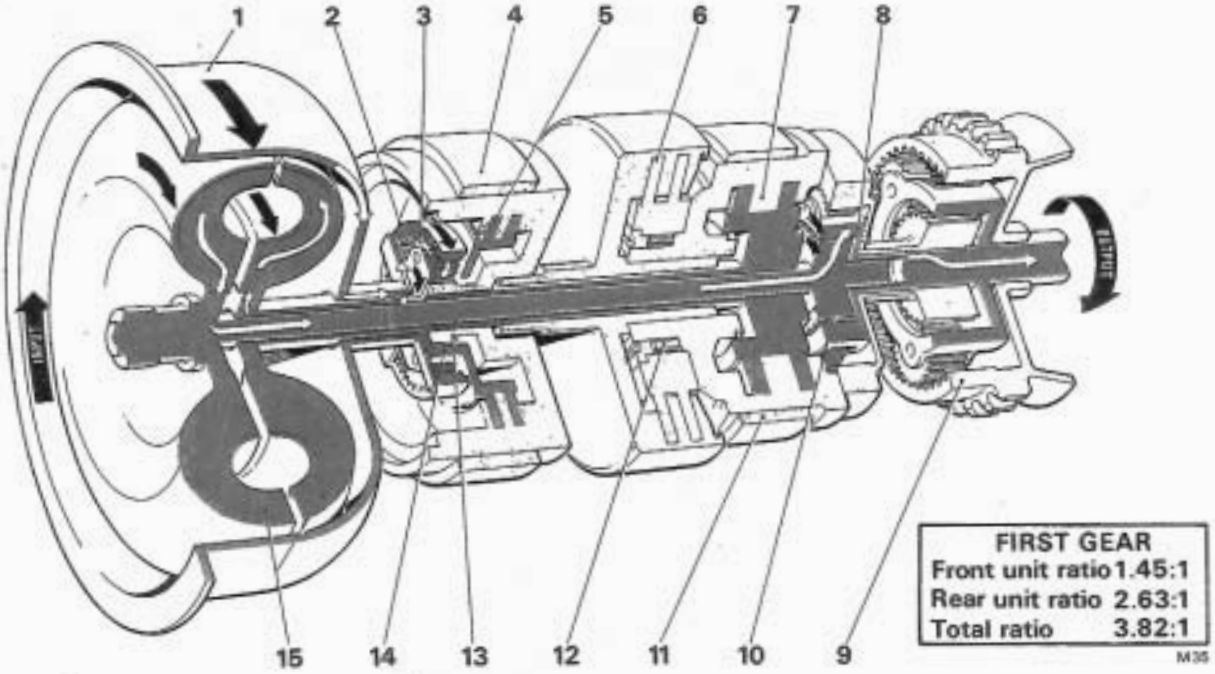

FIG. T94 LINE OF DRIVE IN 1st GEAR

1 Torus cover *driving*
2 Annulus gear *driving*
3 Planet gears *rotating*
4 Front band *holding*
5 Front clutch *released*
6 Centre clutch *holding*
7 Rear clutch *released*
8 Planet carrier *driving*
9 Reverse unit *idling*
10 Sun gear *driving*
11 Rear band *released*
12 Sprag clutch *holding*
13 Sun gear *stationary*
14 Planet carrier *rotating*
15 Tori *driving*

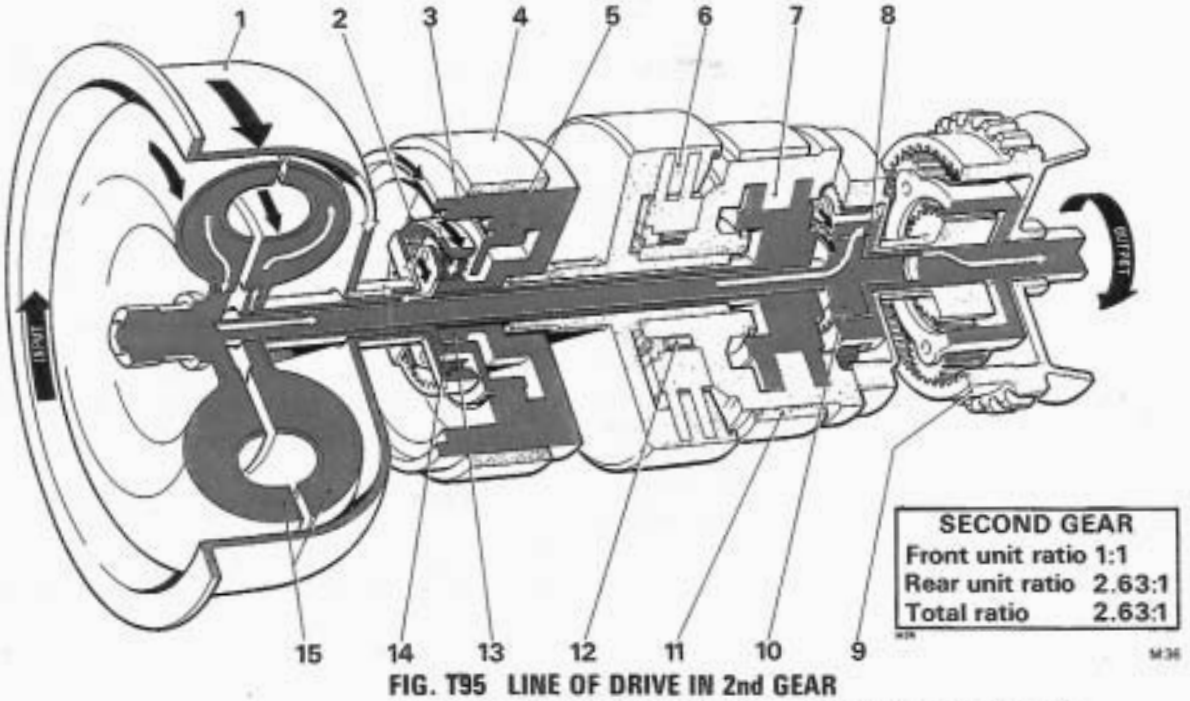

FIG. T95 LINE OF DRIVE IN 2nd GEAR

1 Torus cover *driving*
2 Annulus gear *driving*
3 Front drum *rotating*
4 Front band *released*
5 Front clutch *applied*
6 Centre clutch *applied*
7 Rear clutch *released*
8 Planet carrier *driving*
9 Reverse unit *idling*
10 Sun gear *driving*
11 Rear band *released*
12 Sprag clutch *holding*
13 Sun gear *rotating*
14 Planet carrier *rotating*
15 Tori *driving*

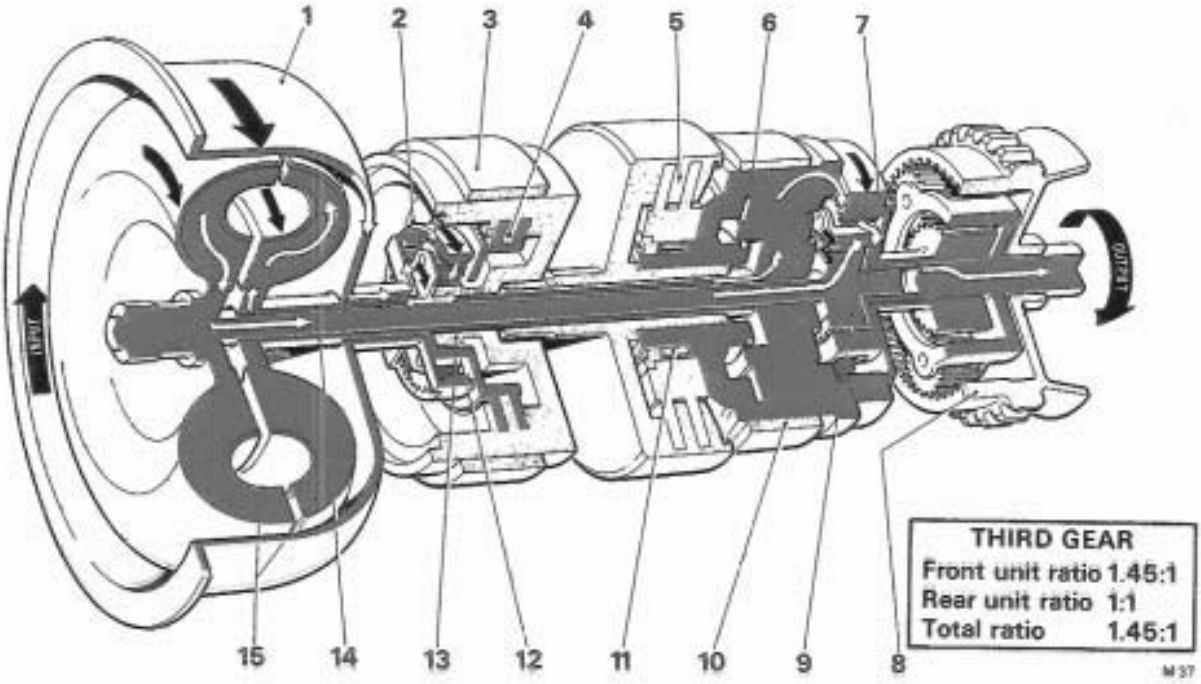

FIG. T96 LINE OF DRIVE IN 3rd GEAR

1 Torus cover *driving*
2 Annulus gear *driving*
3 Planet gears *rotating*
4 Front band *holding*
5 Front clutch *released*
6 Centre clutch *holding*
7 Rear clutch *released*
8 Planet carrier *driving*
9 Reverse unit *idling*
10 Sun gear *driving*
11 Rear band *released*
12 Sprag clutch *holding*
13 Sun gear *stationary*
14 Planet carrier *rotating*
15 Tori *driving*

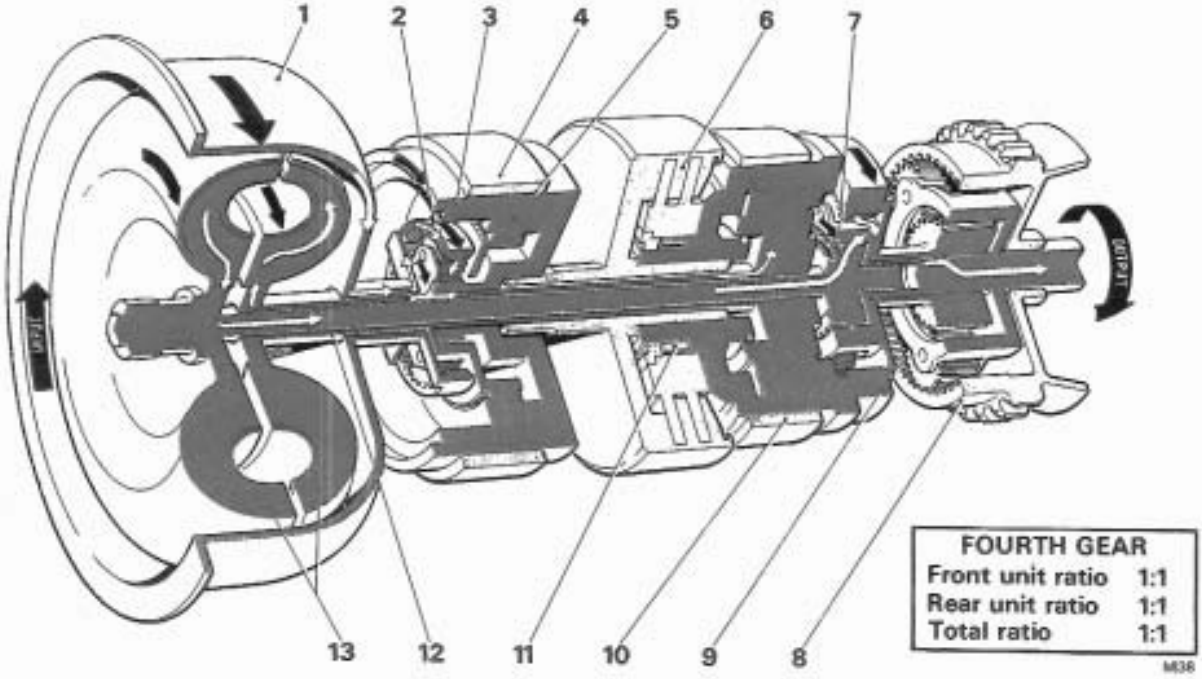

FIG. T97 LINE OF DRIVE IN 4th GEAR

1 Torus cover *driving*
2 Annulus gear *driving*
3 Front drum *rotating*
4 Front band *released*
5 Front clutch *applied*
6 Centre clutch *applied*
7 Sun gear *driving*
8 Reverse unit *idling*
9 Annulus gear *driving*
10 Rear band *releasing*
11 Sprag clutch *freewheeling*
12 Intermediate shaft *driving*
13 Tori *driving*

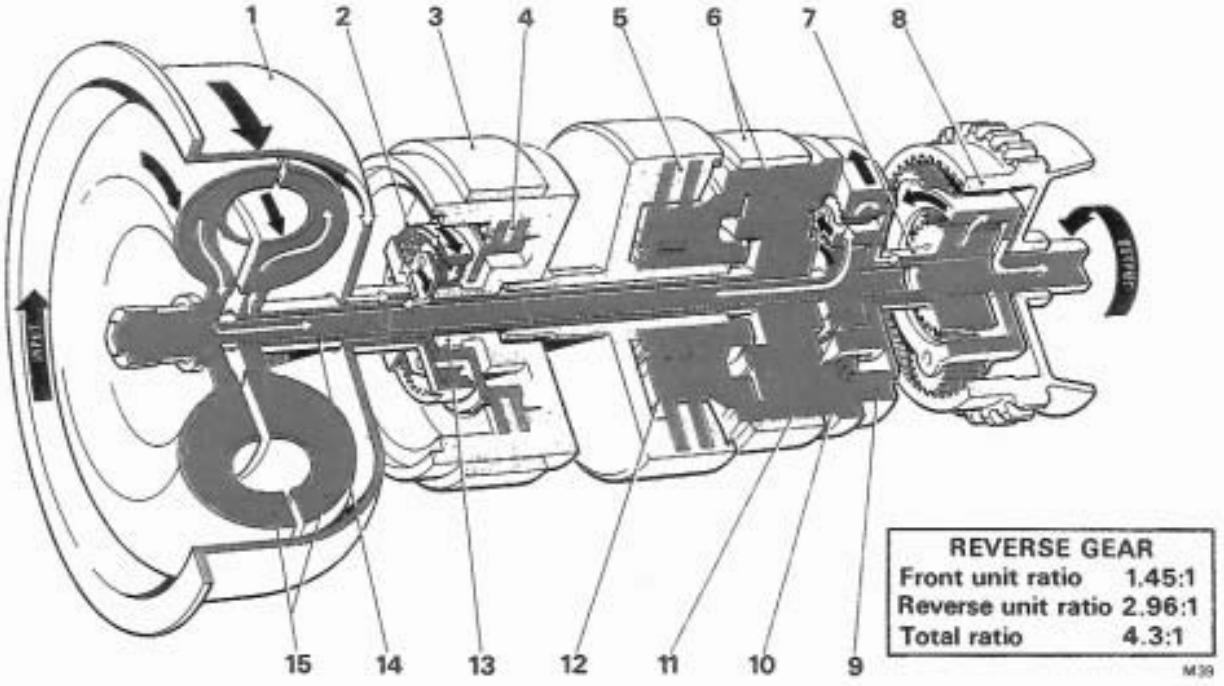

FIG. T98 LINE OF DRIVE IN REVERSE GEAR

1 Torus cover *driving*
2 Annulus gear *driving*
3 Front band *holding*
4 Front clutch *released*
5 Centre clutch *released*
6 Band and clutch *released*
7 Sun gear *driving*
8 Annulus gear *stationary*
9 Annulus gear *opposite rotation*
10 Planet gears *rotating*
11 Sun gear *driving*
12 Sprag clutch *rotating*
13 Sun gear *stationary*
14 Intermediate shaft *driving*
15 Tori *driving*

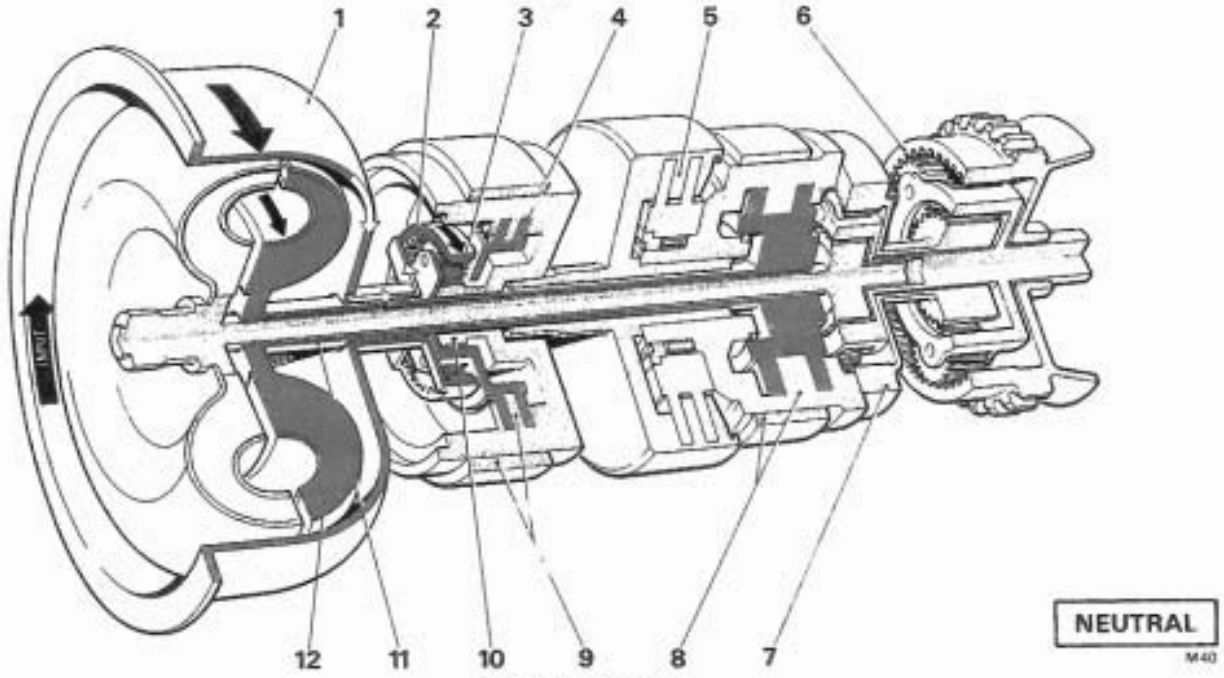

FIG. T99 NEUTRAL

1 Torus cover *driving*
2 Annulus gear *driving*
3 Planet gears *rotating*
4 Planet carrier *idling*
5 Centre clutch *released*
6 Reverse unit *idle*
7 Annulus gear *idle*
8 Rear clutch and band *released*
9 Front clutch and band *released*
10 Sun gear *idling*
11 Intermediate shaft *idling*
12 Rear torus *idling*

Printed in England

July 1971

T.S.D. 2476

clutch hub and which now prevents the removal of the oil delivery sleeve (*see Fig. T102*).

Lift the assembled delivery sleeve and centre drum from the intermediate shaft.

Remove the front drum retaining snap ring (*see Fig. T103*), taking care not to scratch the surface of the intermediate shaft, then lift off the drum assembly.

Withdraw the steel and the bronze thrust washers from the recess in the front drum and label them for dentification.

Front drum — To dismantle

Position the front drum assembly in a suitable press then apply sufficient pressure on the clutch cover to enable the large snap ring to be prised from its groove.

Remove the drum assembly from the press and separate the clutch cover from the drum by tapping the end of the sun gear with a soft-headed mallet.

Remove the six inner and six outer clutch return springs, then lift out the complete pack of clutch plates and spacer plate(s). It is important that the clutch plates are not separated prior to examination.

Remove the clutch apply piston from its annular housing in the clutch cover by sharply tapping the sun gear with a soft-headed mallet to shock it out of position.

Using a blunt screwdriver or similar tool, prise the oil seal rings and expanders from their respective grooves in the clutch piston and clutch cover, discard the seals and expanders.

Centre drum — To dismantle

Place the centre drum on a suitable press so that the drum, and not the oil delivery sleeve, rests on the press.

Press down the clutch retaining ring just sufficiently to enable the snap ring to be removed; remove the snap ring then remove the drum from the press.

Lift out the pack of clutch plates, clutch release springs and spacer plate(s); do not separate the plates prior to examination.

Remove the clutch apply piston then remove the rubber oil sealing rings from the piston and the oil delivery sleeve; discard the seals.

Rear drum — To dismantle

Remove the rear clutch hub retainer (if fitted) then withdraw the hub and bronze thrust washer.

Place the drum on the bench with the sprag clutch uppermost. Remove the Spirolox snap ring by winding it out of its groove in the sprag inner race (*see Fig. T104*).

Pull the sprag outer race until the bronze retainer, outer race and thrust washer can be removed; remove

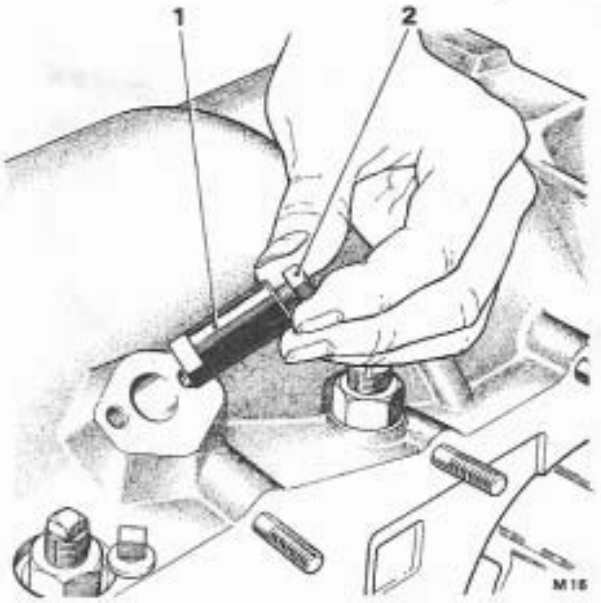

FIG. T100 REMOVING THE CENTRE CLUTCH KEY

1 Key 2 Setscrew

the assembled retainer and the outer race then remove the sprag race.

Note The sprag race and the outer race should be removed smoothly and easily. **Do not** attempt to force either one when removing them from or fitting them to the inner race.

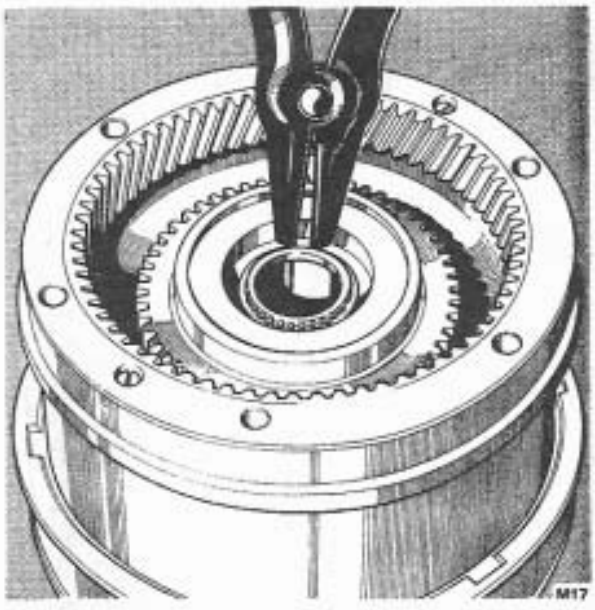

FIG. T101 REMOVING THE REAR DRUM RETAINING RING

Chapter T

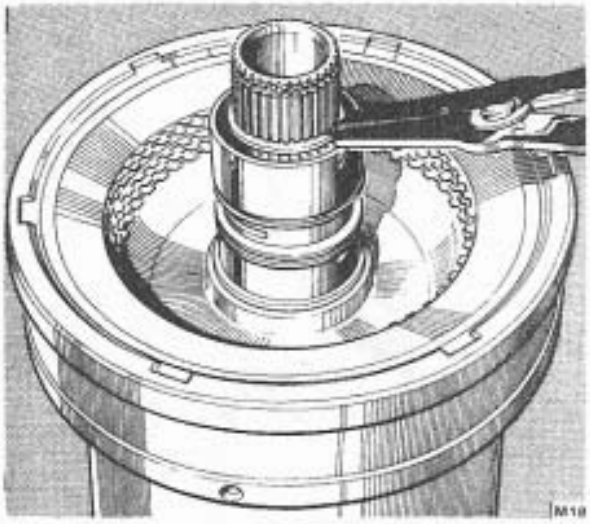

FIG. T102 REMOVING THE DELIVERY SLEEVE RETAINING RING

Place the rear drum on the bed of a press with the sprag inner race uppermost.

Press down the inner race just sufficiently to enable the large snap ring to be removed.

Place the rear drum of the bench then remove the inner race, which is part of the rear clutch drum.

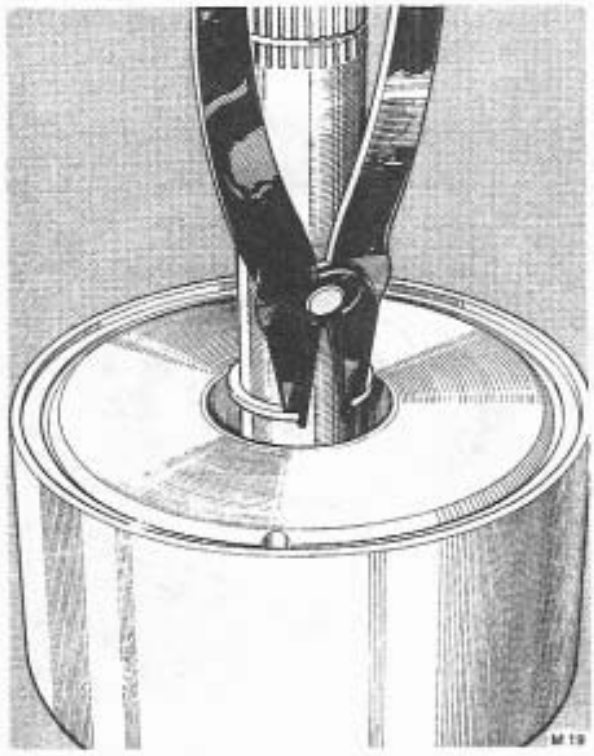

FIG. T103 REMOVING THE FRONT DRUM RETAINING RING

Remove the rear clutch piston, then remove and discard the inner and outer seals and expanders.

Remove the clutch pack and return springs in a similar manner to that described for the front drum.

Note The clutch release springs are fitted with guide pins which should be removed with the springs.

The annulus gear is secured to the rear drum by two setscrews and should be removed only for renewal purposes.

Drum assemblies — To inspect

With the exception of the three clutch packs, thoroughly wash all parts in clean paraffin. The clutch plates must first be examined as explained later in this Section.

Examine all surfaces of the clutch drums for scoring and grooves; only slight damage, which should be removed by stoning, is permissible. Check the front and rear clutch driving pins for security; if loose, renew the drums.

Examine the gear teeth of the rear drum annulus gear and the intermediate shaft pinions. If damaged, check the gears with which they mesh and, if they are unserviceable, renew the particular unit or assembly.

Examine the internal and external splines of the clutch hubs and the intermediate shaft for damage marks, burrs and excessive uneven wear; only damage which can be rectified by light stoning should be accepted. If any splines are chipped, that particular unit should be renewed.

Examine the snap ring grooves in the intermediate shaft for burrs and ridges. Examine the bearing surfaces for scores and scratches; if necessary, remove with a stone. Examine the planet carrier and the outer diameter of the pinion thrust washer for cracks. Spin each planet gear to check for smooth running; also check for side play which may indicate worn needle rollers or loose planet gear retaining pins. The front planet and intermediate shaft assembly must be renewed as a unit should any of the components become unserviceable; dismantling of the unit is not permitted.

Examine the clutch return springs for distortion and collapsed coils.

The springs should be of the same height (*see Dimensional Data*). If one spring is weak, it is recommended that all the springs be changed, as a reduction in spring length, or distortion, indicates that the clutch has, at some stage, been overheated. This will have weakened all the springs and will cause the clutch to slip under heavy loading. Slight wear indicated by brightness of the outer coil diameter is acceptable. Examine the centre clutch return springs for cracks or distortion; polishing of the tops of the spring 'waves'

T.S.D. 2476 July 1971 Printed in England

Printed in England

July 1971

T.S.D. 2476

is acceptable (*see Dimensional Data for approximate spring height*). Examine the guide pins of the rear clutch springs for distortion and burred ends; ensure that they are all of equal length.

Examine the clutch pistons for scores, cracks or distortion and ensure that the seal grooves are perfectly clean.

Examine the piston bore in the front clutch cover for scores and the bushes for security, signs of picking up or heavy wear. Check the seal groove for cleanliness.

Examine the rear clutch drum for scoring of the piston bore; examine the bush for scores and grooves. Ensure that the seal groove is clean. Examine the delivery sleeve ring bores in the clutch drums for grooving; the bores will have a clean finish where the rings have run, but should not be scored or grooved. If signs of scoring or grooving is evident, renew the drums. Examine the sprag inner race diameter for scores and indentations; ensure that the oil holes are clean. Examine the sprag race to ensure that there are no cracks in the sprag cage and that the sprags are free to move in the cage. Examine the sprag outer race for scores and indentations. Examine the thrust washer in the outer race for scores; this washer is an integral part of the outer race and no attempt should be made to remove it. Examine the sprag retainer for scores; the retainer is initially a light interference fit — 0·000 in. to 0·001 in. (0,00 mm. to 0,025 mm.) — in the outer race, but slackness is permissible, providing that the retainer is otherwise serviceable. The tracks on which the sprag operates may appear — owing to its normal wear pattern — to be slightly worn or indented. In such a case, polish the tracks with Crocus paper then inspect the surfaces for irregularities, using a dial test indicator, in order to prevent possible rejection of a serviceable component (*see Dimensional Data for sprag clutch inner and outer race diameters*).

Examine the assembled oil delivery sleeve and centre drum for scores; damage which can be removed by light stoning only is acceptable. Check that the drum is secure on its sleeve.

Note On early models, check that the three guide pins are secure in the drum and that the centre clutch piston will move freely on the pins.

Examine the bush in the oil delivery sleeve for heavy scoring.

Ensure that the oil delivery sleeve sealing rings are free in their grooves and that the grooves are clean. It is not necessary to remove the rings unless damage necessitates renewal.

Examine the centre bearing cap and dowel pin for burrs; light damage may be removed by stoning or polishing. If the dowel pin is loose or damaged it should be renewed.

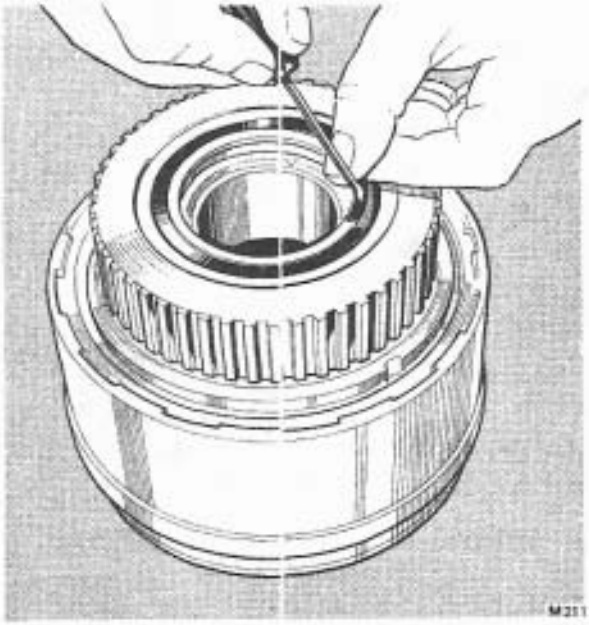

FIG. T104 REMOVING THE SPRAG RETAINING RING

Clutch plates — To inspect

Having retained the clutch plates in the order in which they were fitted, it is now possible to examine the surfaces of each plate in relation to that with which it mates. This is important, as a rough surface on a driven plate may easily be the cause of excessive wear on the mating face of the composition drive plate.

It is possible that at the clutch cover end of the front and rear clutch packs, and at the piston end of the centre clutch pack, one or two extra steel plates may be found. These 'spacing' plates should be labelled and

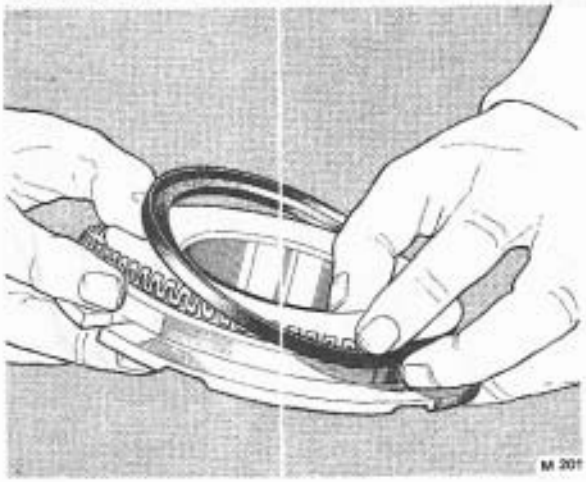

FIG. T105 FITTING EXPANDER AND SEAL TO CLUTCH PISTON

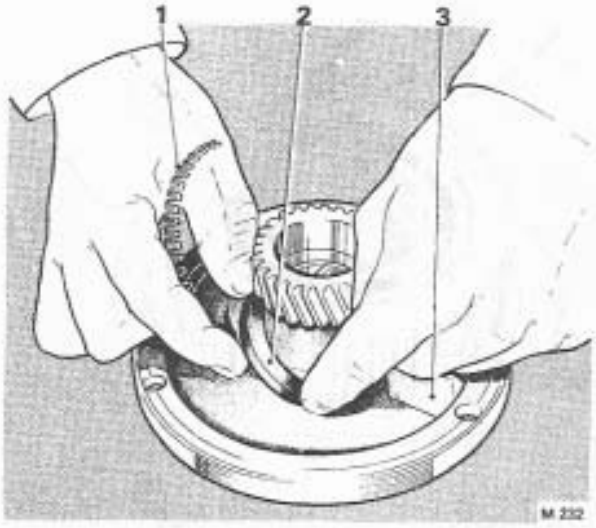

FIG. T106 FITTING EXPANDER AND SEAL TO CLUTCH COVER

1 Expander

2 Seal

3 Spacing block

kept separate from the other plates, as they are not hardened and vary in thickness.

Slight discolouration of the steel plates is acceptable, but heavy discolouration caused by overheating may have affected the heat treatment of the plates and they should be discarded. Check the driven plates in the front and rear clutches for distortion, using a surface plate; also ensure that the surface finish is smooth and polished. The centre clutch outer plates (steel plates) should also have a smooth polished finish but instead of being flat, should be slightly waved — between 0·008 in. and 0·012 in. (0,20 mm. and 0,31 mm.).

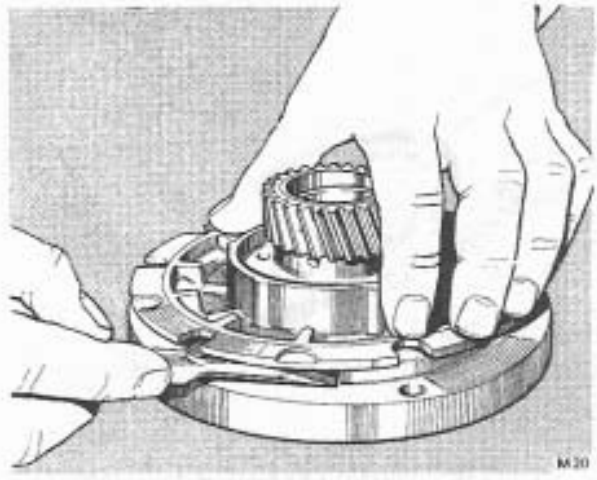

FIG. T107 FITTING THE PISTON TO THE CLUTCH COVER

The composition surfaces of the drive plates should be carefully inspected for lifting, flaking or excessive wear. The thickness of the composition plates should not be less than 0·090 in. (2,29 mm.). A plate will normally darken with use, but should it be almost black, or have a glazed look, indicating signs of burning, it must be renewed. If more than one plate is badly burnt, the complete set of plates must be renewed.

The surface contour of the front and rear clutch drive plates is undulated; each plate should have six 'waves' which should not be less than 0·015 in. (0,40 mm). deep. This can be checked on a surface table by sliding a feeler gauge into the spaces so formed; if there is evidence of any other distortion the plate must be renewed.

Examine the drive plate serrations and the driven plate slots for burrs or signs of excessive wear; ensure that the plates slide smoothly over their respective splines or driving pins.

Oil delivery sleeve — To check

It is possible to check for oil leakage between the oil delivery sleeve and gearbox casing as follows.

Pour clean gearbox oil over the portion of the centre drum that contains the dowel and oil feed holes.

Fit the drum and oil delivery sleeve to the gearbox casing, locating the cap dowel pin in one of the two holes in the sleeve instead of its correct location; this blanks off the casing oilways.

The cap must be fitted with the machined chamfer toward the front of the case and the setscrews evenly tightened to the correct torque loading.

Note If the sleeve and drum assembly can be rocked they should be renewed.

Apply air pressure to the front and rear clutch passages, as shown for clutch testing in Figure T116; there should be no leakage between the drum, the case and the cap. When a new oil delivery sleeve and drum assembly has been fitted, slight leakage may be rectified by carefully dressing the cap where it abuts the casing. Should this prove unsuccessful, the cap and casing must be renewed.

When the foregoing checks are satisfactory, remove the sleeve in readiness for gearbox assembly.

Bands — To inspect

Examine the band for loose or worn linings. If the face of a lining is worn to the bottom of the grooves, or has started to lift from the steel band, the particular band assembly must be renewed. When inspecting bands, care must be taken not to distort them in any way which might destroy the good circumferential fit which

T.S.D. 2476 July 1971 Printed in England

Printed in England

July 1971

T.S.D. 2476

exists between drum and band. If a lining is found to be badly impregnated with foreign matter such as bronze, caused by a bush failure, it should be renewed.

Check the steel bands for distortion and cracks and check the anchor ends for broken welds and worn sockets.

Check the rear band operating strut locating pin for security and the strut for play on the pin. If play is excessive or the pin is loose, renew the complete band assembly.

Thrust washers and snap rings — To inspect

Examine all thrust washers for cracks; if any washer is cracked, badly scored or excessively worn, it should be renewed. Examine the washer mating faces for burrs, scoring and sharp edges. Check the snap rings for correct fitting in their grooves. If they are loose when in position on the intermediate shaft they should be renewed.

Checking the fittings of the large snap rings in the clutch drums. The rings must be a snug fit in their grooves; slight distortion necessitates the renewal of the rings.

Front clutch — To assemble

Fit a new seal and expander to the piston in the manner illustrated in Figure T105. Take care to ensure that the rubber is well bedded into its groove and that the expander does not protrude beyond the bottom edge of the rubber seal.

In a similar manner fit a new seal and expander to the clutch cover. After initially inserting the expander and seal into the groove, a small wooden block should be fitted between the seal and the inner circumference of the cover (*see Fig. T106*). This will prevent the tendency for the seal and the expander to creep out of the groove during fitting. Remove the wooden block then check that the expander does not protrude below the seal.

The direction in which the protruding lip of the seal faces is important and must be fitted as shown in the respective illustrations (*see Fig. T105 and Fig. T106*).

With the seal correctly in position the piston may then be inserted into the cover after first smearing the rubber with 'Mobilgrease MP'. The lip of the outer seal should be initially introduced into the cover using the side of a blunt screwdriver drawn over the seal edge as shown in Figure T107. The two components can then be pressed together manually.

Line up the square notches in the piston with the three holes in the cover.

Fit the intermediate shaft into the holding fixture, clutch hub uppermost.

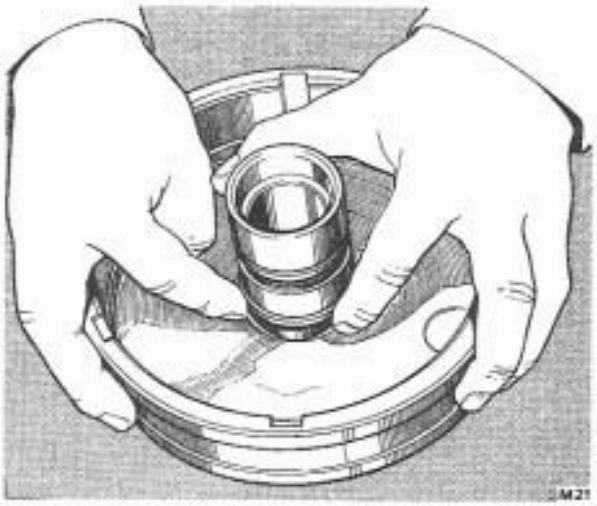

FIG. T108 FITTING THE OIL SEAL TO THE CENTRE CLUTCH DRUM ASSEMBLY

Fit the front drum over the shaft so that it rests on the planet gears with its driving pins pointing upward.

Lubricate the surfaces of the clutch plates with clean gearbox fluid, then fit them alternately commencing with a composition drive plate, then a steel driven plate, until the complete pack is fitted. New composition plates should be thoroughly soaked in hot gearbox oil before fitting. Ensure that each composition plate slides freely over the clutch hub splines and that the steel plates are fitted with the square notches over the driving pins.

It should be noted that previously labelled spacing plates must be fitted last, but the thickness may have to be re-assessed as described later.

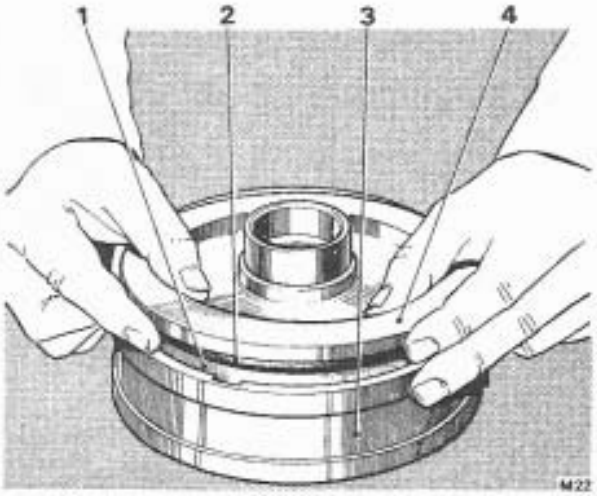

FIG. T109 FITTING THE CENTRE CLUTCH PISTON

1 Guide tool
2 Seal
3 Centre drum
4 Piston

Chapter T

Fit the size pairs of clutch release springs into the locating holes formed by the plates, then fit the cover into the drum, sun gear first, making sure that the springs engage with the pockets in the clutch piston.

Remove the complete assembly from the intermediate shaft.

Using a suitable press, apply sufficient pressure to the clutch cover to enable the snap ring to be fitted into its groove. Ensure that the ring snaps firmly into its groove then release the pressure.

After removing the drum assembly from the press, ensure that the outer shoulder of the clutch cover protrudes evenly through the inner circumference of the snap ring; if necessary, lightly tap the cover into its correct position, using a soft-headed mallet.

The assembly of the clutch plates should now be checked. This is best accomplished by placing the fingers on the teeth of the drive plates then lifting and turning the plates. When correct, the clearance should be just sufficient to allow free rotation of the plates without binding.

If the clutch plates are too free and end float can be felt, or if the plates are binding or are solid, it will be necessary to alter the thickness of the spacing plates accordingly.

These plates are supplied in various thicknesses (*see Parts List*) and can be fitted singly or paired in any combination to give the correct clearance. The total number of spacing plates fitted must not exceed two and they must not be fitted in any position other than between the clutch cover and the first steel driven plate.

Centre clutch — To assemble

Fit a new seal to the piston.

In a similar manner, fit a new seal to the oil delivery sleeve; the seal lip should point toward the base of the drum (*see Fig. T108*). If the oil sealing rings have not been removed take care not to damage the seal. Ensure that the seals are well bedded in their grooves.

Smear the seals with 'Mobilgrease MP'.

Fit the piston guide tool RH 7777 (*see T.S.D. 2331 —Workshop Tools*) into the drum then fit the piston as shown in Figure T109.

Note On early models, turn the piston to align the holes with the guide pins.

Push the piston to the bottom of the bore; remove the guide tool.

Fit the existing spacer plate(s) next to the piston then lubricate the faces of the clutch plates with clean gearbox oil. New plates should be thoroughly soaked in hot gearbox oil before fitting.

Fit alternately a steel outer plate, a composition inner plate and a 'waved' spring (*see Fig. T110*) until six steel plates and five composition plates and springs have been fitted. Ensure that the open ends of the springs face toward the piston and that the gaps in the springs are aligned.

Fit the retaining plate next to the upper steel plate

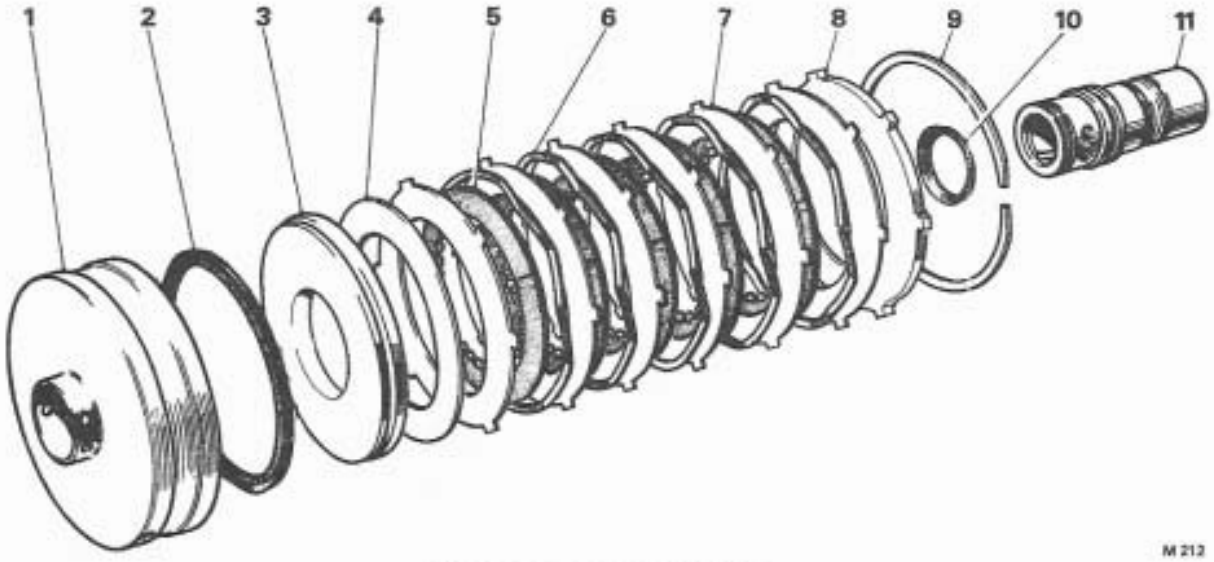

FIG. T110 CENTRE CLUTCH

1 Drum
2 Outer seal
3 Piston
4 Spacer plate
5 Inner clutch plate (composition)
6 Clutch release spring
7 Outer clutch plate (waved)
8 Retainer
9 Snap ring
10 Inner seal
11 Oil delivery sleeve

T.S.D. 2476
July 1971
Printed in England

Printed in England

July 1971

T.S.D. 2476

Fit the retaining plate next to the upper steel plate with the chamfered side uppermost.

Place the drum under a press with the drum itself resting on the press.

Press down the retainer until it is possible to fit the snap ring; fit the snap ring then remove the drum assembly from the press.

It is necessary to check the piston movement before proceeding further; this should be done as follows.

Measure the depth from the top of the drum to the top of the piston.

Apply an air pressure of approximately 70 lb/sq.in. (4,9 kg/sq.cm.) to the clutch apply port in the drum periphery (*see Fig. T111*).

When the clutch has moved through its full travel and compressed the plates, again measure the depth from drum top to piston top with the air pressure still applied. By subtracting one from the other, the amount of piston travel can be obtained. Piston travel should be between 0·100 in. and 0·120 in. (2,54 mm. and 3,048 mm.).

If the piston travel is greater or less than the figures quoted, dismantle the drum assembly then adjust the spacer plate(s) to obtain the correct piston travel.

The spacer plates are supplied in various thicknesses (*see Parts List*) and can be fitted singly or paired in any combination to give the correct travel. The total number of spacing plates fitted must not exceed two and they must not be fitted in any position other than between the piston and the first steel plate.

Rear clutch — To assemble

If previously removed, fit the annulus gear and evenly tighten the screws. Before final tightening, tap the end face of the gear with a soft-headed mallet to ensure correct location.

Fit new oil seals and expanders to the piston and the rear clutch drum in a similar manner to that described for the front clutch.

Lubricate the clutch plates with clean gearbox oil (thoroughly soak new plates) then fit the eight composition plates and eight steel plates to the drum, commencing with a composition plate and ending with a steel plate; note that the squared holes in the driven plates fit over the driving pins. It is advisable to fit temporarily the clutch hub to ensure that the drive plates slide freely on the splines.

Fit the clutch return springs and guide pins.

Fit the spacer plate(s) between the top steel plate and the piston then fit the rear clutch drum; fit the snap ring.

plate and the piston then fit the rear clutch drum; fit the snap ring.

Check and adjust the rear clutch clearance in a similar manner to that described for the front clutch.

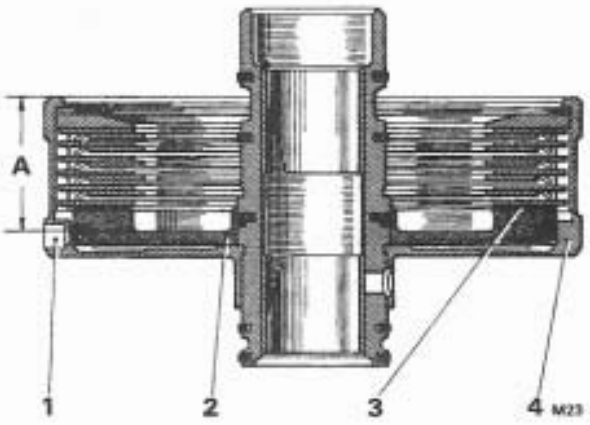

FIG. T111 CHECKING CENTRE CLUTCH PISTON TRAVEL

A Piston travel 0·100 in. to 0·120 in. (2,54 mm to 3,048 mm)
1 Clutch apply port
2 Clutch piston
3 Spacer plate
4 Clutch drum

Remove the hub.

Fit the large bronze thrust washer to the hub, retaining the washer on the hub with petroleum jelly.

Fit the hub and washer, rotating the hub to engage the drive plate splines. When correctly fitted the hub should be flush or just slightly below the counterbore of the drum.

Fit and secure the hub retaining bracket.

Stand the drum assembly on the bench, clutch drum uppermost.

Lubricate the sprag race with clean gearbox oil then fit the sprag race to the outer race with the flanged end of the sprag race uppermost (*see Fig. T112*). The

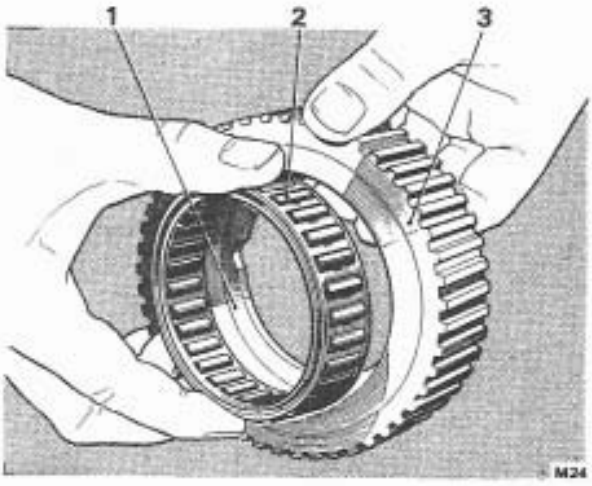

FIG. T112 FITTING THE SPRAG

1 Retainer 2 Sprag 3 Outer race

Chapter T

FIG. T113 FITTING THE SPRAG CLUTCH ASSEMBLY

1 Retainer 2 Sprag 3 Outer race

sprag race should slide into the outer race smoothly and easily whilst being pushed in.

Note It is essential that the outer race and sprag is fitted so that it 'freewheels' when turned anti-clockwise and locks when turned clockwise.

Lubricate the thrust washer and the retainer on the outer race then fit the assembly to the clutch drum turning it in a similar manner to that previously described (*see Fig. T113*).

Fit the Spirolox snap ring.

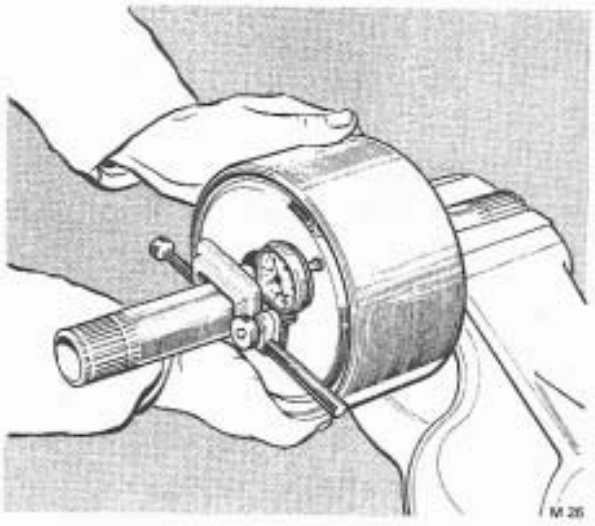

FIG. T114 CHECKING FRONT DRUM END FLOAT

Drum assemblies — To assemble

Fit the drum assemblies to the intermediate shaft in the following manner, using liberal quantities of clean gearbox oil during the procedure.

Fit the front drum onto the shaft, over the hub, rotating the drum so as to locate all the drive plates on the hub.

Fit the bronze thrust washer, steel (by selection) backing washer and the snap ring. The steel washer may have to be changed if, as a result of the following end float check, the end clearance is found to be outside the limits.

Hold the shaft in soft jaws in a vice.

Mount a dial test indicator on the shaft as shown in Figure T114 then measure the drum end float. If the end float reading is outside the limits given in 'Dimensional Data', replace the steel washer with one of suitable thickness, details of which are given in the Parts List.

Remove the assembly from the vice then fit the assembly to a holding fixture.

Ensure that the oil sealing rings on the oil delivery sleeve are locked, then carefully lower the assembled sleeve and centre drum over the intermediate shaft. Carefully enter the two sealing rings into the front drum cover, lowering the sleeve and drum until it comes to rest against the lower snap ring on the shaft.

Fit the snap ring above the sleeve then fit the thin steel washer.

Align the splines of the five drive plates in the centre clutch. This is best accomplished using a slave sprag outer race.

Ensure that the oil sealing rings on the intermediate shaft are locked.

Fit the rear drum assembly onto the oil delivery sleeve. Ease the drum carefully over the sealing rings, at the same time slightly turning the assembly to enable the splines on the sprag outer race to engage the clutch teeth. Also position the rear clutch hub so that the internal splines will engage with the mating splines on the end of the intermediate shaft. It may be necessary to remove the hub, fit the drum assembly and then fit the hub again. In such a case, ensure that the large bronze thrust washer is retained in its recess in the hub, otherwise, damage will occur and end float will be unobtainable.

Fit the hub retaining snap ring and the hub retaining bracket.

Drum assemblies — To fit

Fit the bearing cap in position on the centre drum — chamfer to the front — making sure that the dowel locates positively in its correct hole.

T.S.D. 2476 July 1971 Printed in England

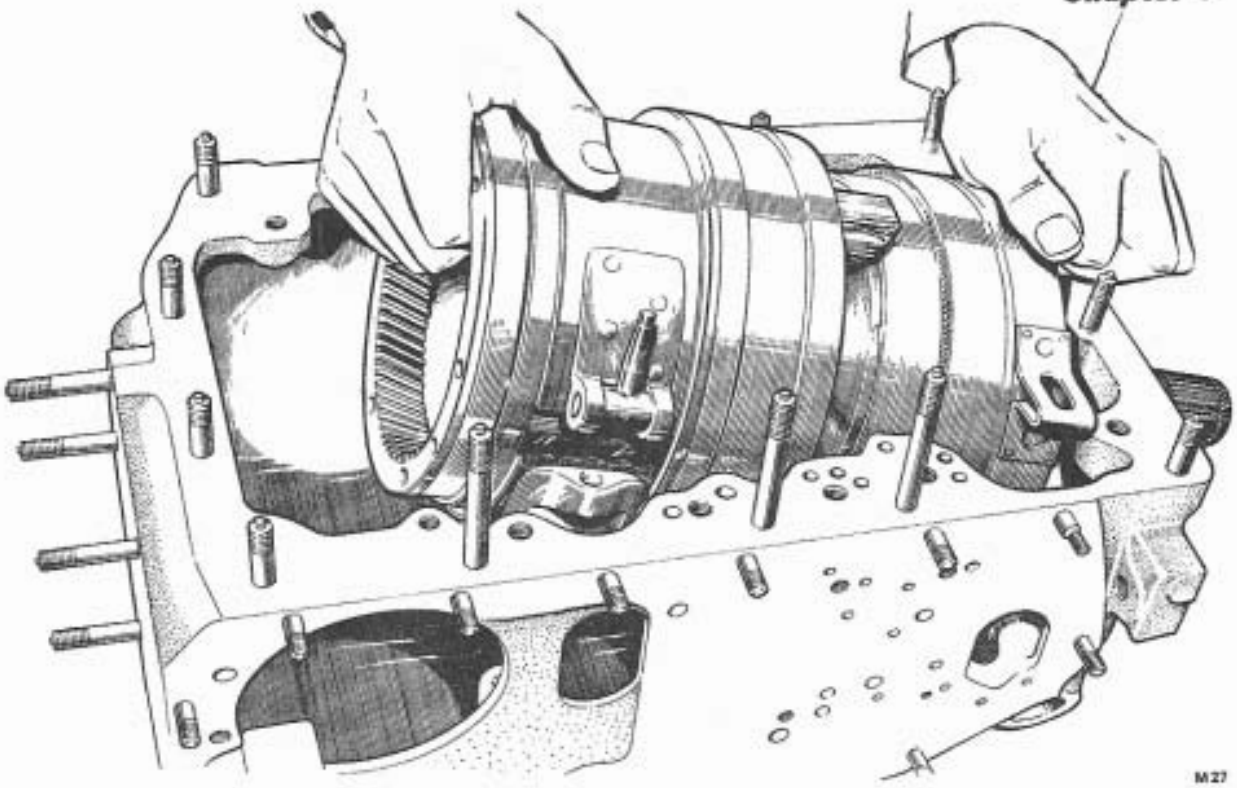

FIG. T115 FITTING THE DRUM ASSEMBLIES

Fit the front band into position in the gearbox casing.

Place a small block of wood approximately 1·00 in. (25,4 mm.) wide between the front and centre drums. This will hold them apart as the drum assemblies are lowered into the gearbox casing and onto the bearing.

Insert the front of the intermediate shaft through the front band then, while the assembly is tilted, fit the rear band to the rear drum. Lower the complete assembly into position in the gearbox casing (*see Fig. T115*).

Remove the wooden spacer block.

Ensure that the anchor point on each band is located on its respective adjusting screw.

Fit the bearing cap setscrews together with a new lock-plate; do not tighten the screws.

Ensure that the key locating hole in the centre drum aligns with the corresponding hole in the case; similarly ensure that the centre clutch oil feed pipe holes align.

Fit the key.

Note Ensure that the flats on the key align with the slot in the drum. Do not use force to fit the key.

Fit the key retaining plate and setscrews; tighten the screws.

Torque tighten the bearing cap setscrews then lock them with locking plate tabs.

Ensure that the front and rear drums revolve smoothly on the intermediate shaft.

Check the action of the clutches by means of compressed air applied through the passages shown in Figure T116. Correct operation can be both heard and felt. Thoroughly check for air leaks during this test.

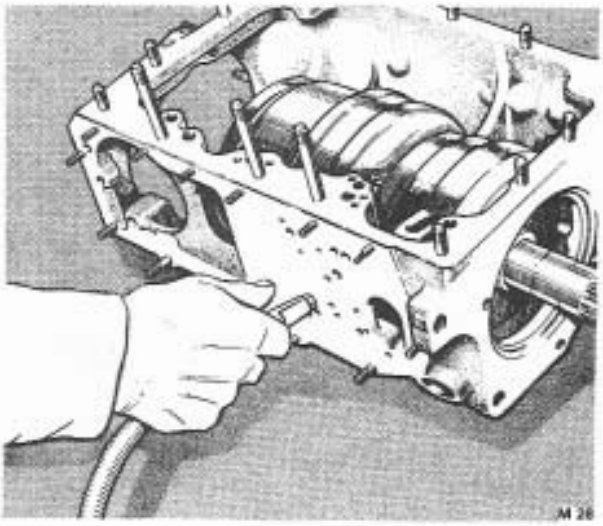

FIG. T116 CHECKING CLUTCH OPERATION

Assemble the gearbox, fitting the remaining assemblies as explained in their relevant Sections.

Printed in England

July 1971

T.S.D. 2476

Chapter T

DIMENSIONAL DATA FOR SECTION T21—DRUM ASSEMBLIES

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Front drum end float on intermediate shaft.	0·002 in. to 0·004 in. (0,05 mm. to 0,10 mm.)	0·006 in. (0,15 mm.)	Correct by changing the steel adjusting washer.
Intermediate shaft planet gears end float.	0·002 in. to 0·004 in. (0,05 mm. to 0,10 mm.)	——	Renew assembly shaft if gear pins or rollers are badly worn.
Front drum bush i/d.	1·3750 in. to 1·3755 in. (34,93 mm. to 34,943 mm.)	——	——
Intermediate shaft bearing diameter.	1·372 in. to 1·373 in. (34,80 mm. to 34,81 mm.)	——	——
Clearance.	0·002 in. to 0·0035 in. (0,05 mm. to 0,089 mm.)	——	——
Oil delivery sleeve bush i/d.	1·330 in. to 1·331 in. (33,78 mm. to 33,81 mm.)	——	——
Intermediate shaft bearing diameter.	1·3265 in. to 1·3275 in. (33,693 mm. to 33,718 mm.)	——	——
Clearance.	0·0025 in. to 0·0045 in. (0,064 mm. to 0,115 mm.)	——	——
Centre clutch piston travel.	0·100 in. to 0·130 in. (2,54 mm. to 3,30 mm.)	——	Apply air pressure of 70 lb/sq.in. (4,92 kg/sq.cm.) to clutch apply port.
Sprag outer race i/d.	3·4990 in. to 3·4995 in. (88,875 mm. to 88,888 mm.)	——	——
Sprag inner race o/d.	2·84325 in. to 2·8435 in. (72,218 mm. to 72,225 mm.)	——	——
Rear clutch drum bush i/d.	1·9705 in. to 1·9715 in. (50,05 mm. to 50,08 mm.)	——	——
Oil delivery sleeve o/d.	1·967 in. to 1·968 in. (49,96 mm. to 50,12 mm.)	——	——
Clearance.	0·0025 in. to 0·0045 in. (0,063 mm. to 0,114 mm.)	——	——
Clutch inner release spring—free length.	2·234 in. (approx.) (56,74 mm.) (approx.)	——	——
Load required to compress spring length to 1·812 in. (46,03 mm.)	14 lb. to 16 lb. (6,35 kg. to 7,26 kg.)	——	——
Clutch outer release spring—free length.	2·484 in. (approx.) (63,09 mm.) (approx.)	——	——
Load required to compress spring length to 1·812 in. (43,03 mm.)	22 lb. 8 oz. to 25 lb. 8 oz. (10,21 kg. to 11,57 kg.)	——	——
Centre clutch release spring—free height.	0·162 in. (approx.) (4,12 mm.) (approx.)	——	——
Setscrews — centre bearing cap to gearbox casing.	Torque tighten to between 29 lb.ft. and 32 lb.ft. (4,01 kgm. and 4,42 kgm.)	——	——
Setscrews — rear planet pinion annulus gear to rear drum.	Torque tighten to between 3 lb.ft. and 4 lb.ft. (0,41 kgm. and 0,55 kgm.)	——	——
Setscrews — centre drum key plate to gearbox casing.	Torque tighten to between 8 lb.ft. and 10 lb.ft. (1,11 kgm. and 1,38 kgm.)	——	——
Oil delivery sleeve sealing ring gap.	0·005 in. to 0·015 in. (0,13 mm. to 0,40 mm.)	——	Check ring gaps in unworn part of relevant bores.

T.S.D. 2476 July 1971 Printed in England

Printed in England

July 1971

T.S.D. 2476

Section T22
GEARBOX CASING

When all the units have been removed from the gearbox, as described in the foregoing Sections, the only removable parts which remain are the two band adjusting screws, the oil pressure test point blanking plug, the breather filter and, if necessary, the studs.

Removal of the adjusting screws and the blanking plug is straightforward. The filter should be carefully removed to prevent altering its shape and consequently its fit in the gearbox casing.

Thoroughly wash the casing in clean paraffin then dry off with compressed air. Ensure that all the oilways are clear.

Gearbox casing — To inspect

Check all joint faces for burrs; slight damage can be removed by careful scraping.

Note Extreme care should be taken when removing burrs or damage marks from the control valve unit face on the casing. The surface finish on this face is the only sealing medium between the two units and should not be marked.

Similarly examine the spigot bores in the front and rear ends of the casing.

Inspect the screw threads of all tapped holes, making sure that the top threads have not been pulled or damaged to an extent which might upset a joint face.

Heli-Coil inserts are fitted to the gearbox casing in the following holes.

Parking brake bracket securing setscrew holes.

Control valve unit securing setscrew holes.

Band anchor screw holes.

If a Heli-Coil insert becomes damaged, it should be removed and discarded, then a new one fitted.

Section A3—General Information—gives a detailed description of the procedure to be followed, and the tools required when removing or fitting a Heli-Coil insert.

Examine the gearbox casing for cracks and other damage.

Check the fit of the centre bearing cap together with the centre drum and oil delivery sleeve as explained in Section T21.

Check the continuity and interconnection of the oil passages using compressed air, and referring to Figure T13 as a guide.

Strong wire may be used to clear a blocked passage but care must be taken not to damage the mouth of the holes.

Screw the band adjusting screws into the casing, fit the oil pressure blanking plug; torque tighten the plug.

Fit the breather filter.

Chapter T

DIMENSIONAL DATA FOR SECTION T22—GEARBOX CASING

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Oil pressure check point plug.	Torque tighten to between 16 lb.ft. and 18 lb.ft. (2,21 kgm. and 2,49 kgm.)	——	——

T.S.D. 2476

July 1971

Printed in England

Printed in England

July 1971

T.S.D. 2476

Section T23
WORKSHOP TOOLS

The following is a list of special tools to be used when servicing or overhauling the Automatic Gearbox. General tools are not included as it is felt that these will be available locally. For a complete list of all the necessary tools refer to T.S.D. 2331 — Workshop Tools Manual.

Tool No.	Title	Description
R 5244 ..	Oil pressure gauge	The gauge adaptor fits into the main line oil pressure take-off orifice to enable main line pressure to be checked.
RH 412 ..	Square holed spanner – blanking plug ..	This spanner can be used to remove and fit the oil pressure orifice blanking plug.
R 5280 ..	Adaptor – air checking	This is a rubber nosed adaptor for applying air pressure to the various oil holes in the gearbox so that components can be tested for correct operation.
RH 7843 ..	Compressor – actuating lever spring ..	This tool fits onto the actuator output shaft and will compress the actuating lever spring to facilitate removal of the retaining pin.
RH 7841 ..	Insertion and extraction tool – roll pin ..	The roll pin can be easily fitted to and removed from the brake drum and worm shaft with the aid of this tool.
RH 7674 ..	Circlip and snap ring pliers	By utilising the various nose pieces, this tool can be used for the removal and fitting of circlips and snap rings in the gearbox.
RH 329 ..	Alignment gauge – governor sleeve ..	The bore of the parking brake bracket must fit concentrically over the governor tower. The gauge is essential for correct alignment.
UR 3144 ..	Tool – front band adjusting	The tool screws into the blanking plug orifice in the bottom of the front servo and is used to accurately adjust the front friction band.
RH 7838 ..	Gauge – rear band adjusting	The gauge is used in conjunction with spanner RH 131 to correctly adjust the rear friction band.
RH 131 ..	Spanner – band adjusting screw	This spanner enables both bands to be adjusted whilst the gearbox is in the car.
RH 7776 ..	Compressor – rear servo springs	Before dismantling the rear servo, the springs must be held captive by the compressor until the spring retaining setscrews have been removed.
25937/ T 1002-5 ..	Assembly sleeve – oil sealing rings ..	The four sleeves of the tool are designed to assist in the fitting of the oil sealing rings to the governor tower.
STD 6007 ..	Holding tool – front oil pump	This tool, designed to fit over a lug cast on the body of the front pump, enables the pump to be held secure whilst the body securing screws are slackened or tightened.

Chapter T

Workshop Tools–*continued*

Tool No.	Title	Description
26225/ T 1002 ..	Adaptor – torque spanner	The adaptor has been designed to enable a standard torque spanner to be used to tighten the front oil pump socket head screws.
RH 7770 ..	Oil seal insertion tool	This tool has been designed to facilitate the fitting of the front pump oil seal, whether the pump is fitted to the gearbox or has been removed.
RH 7771 ..	Centralising sleeve – mainshaft end float check	This sleeve fits over the mainshaft and the intermediate shaft, centralising the mainshaft, to enable the existing end float to be checked.
STD 6010 ..	Spacing wedge – front drum	This tool is used when checking mainshaft end float.
RH 7772 ..	Serrated spanner	This spanner is designed to remove and fit the coupling flange securing nut.
RH 7773 ..	Compressing tool – reverse clutch springs	The reverse clutch return springs are compressed by this tool to facilitate fitting of the reverse piston retaining ring.
23789/ F 1002 ..	Installing tool – reverse piston	This tool ensures that the lip of the piston oil seal is not damaged during fitting.
RH 584 ..	Holding fixture – intermediate shaft ..	The task of assembling the clutches to the intermediate shaft is made considerably easier if the shaft is held in this fixture.
RH 7777 ..	Installing tool – centre clutch piston ..	This tool facilitates the fitting of the centre clutch piston to the centre drum.
RH 7853 ..	Compressing tool – oil delivery sleeve rings	The piston ring type seals on the oil delivery sleeve have inter-locking ends, but they may be compressed further by using this tool before the rings enter the front drum.
23789/ T 1001 ..	Hub retainer	The rear clutch hub is held in position by this retainer to facilitate assembly to the intermediate shaft.

T.S.D. 2476

July 1971

Printed in England