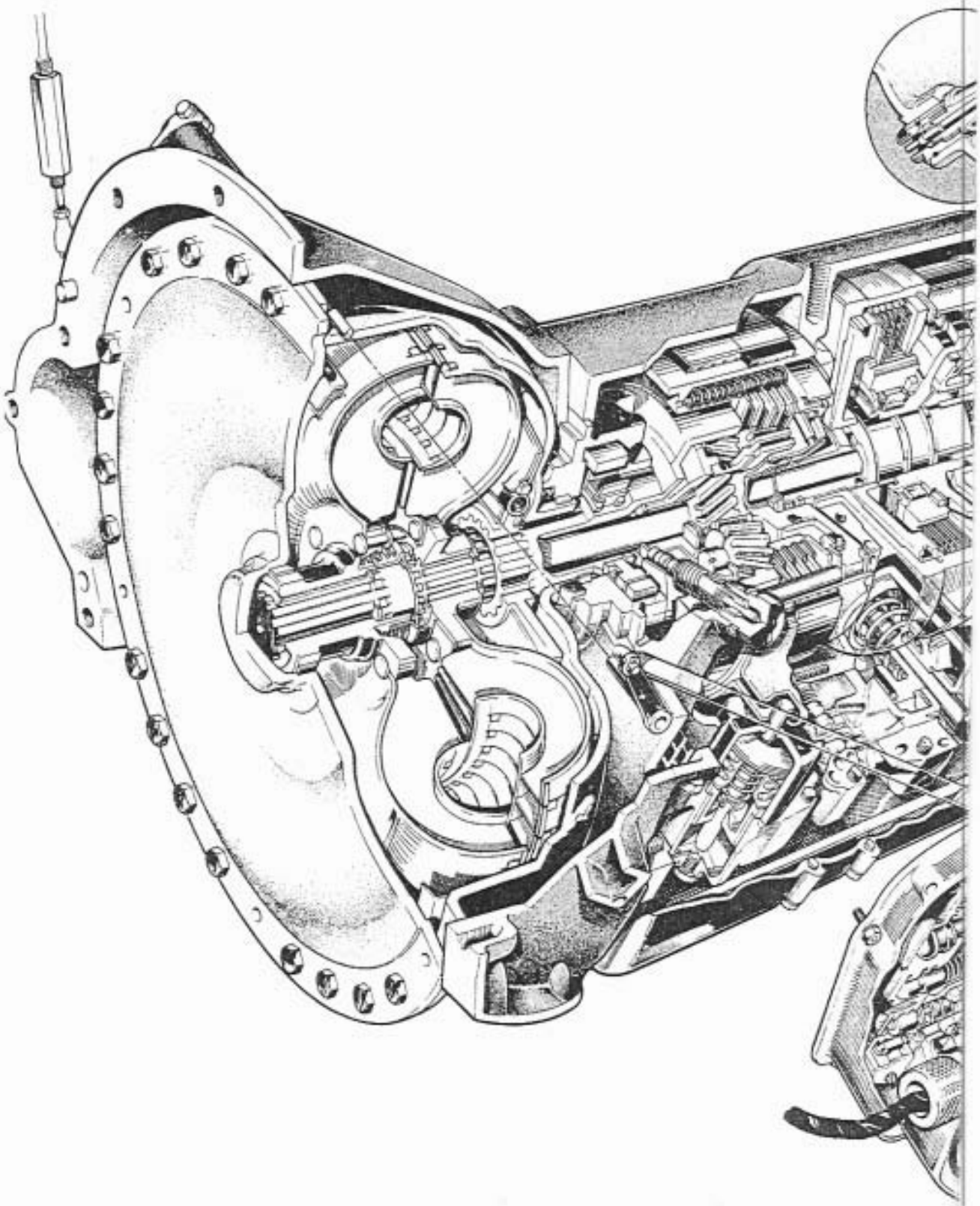
Chapter T
TRANSMISSION - PART 1
4-SPEED AUTOMATIC GEARBOX

FIG. T1 THE 4-SPEED AUTOMATIC GEARBOX AND GEARCHANGE ACTUATOR—CUTAWAY VIEW



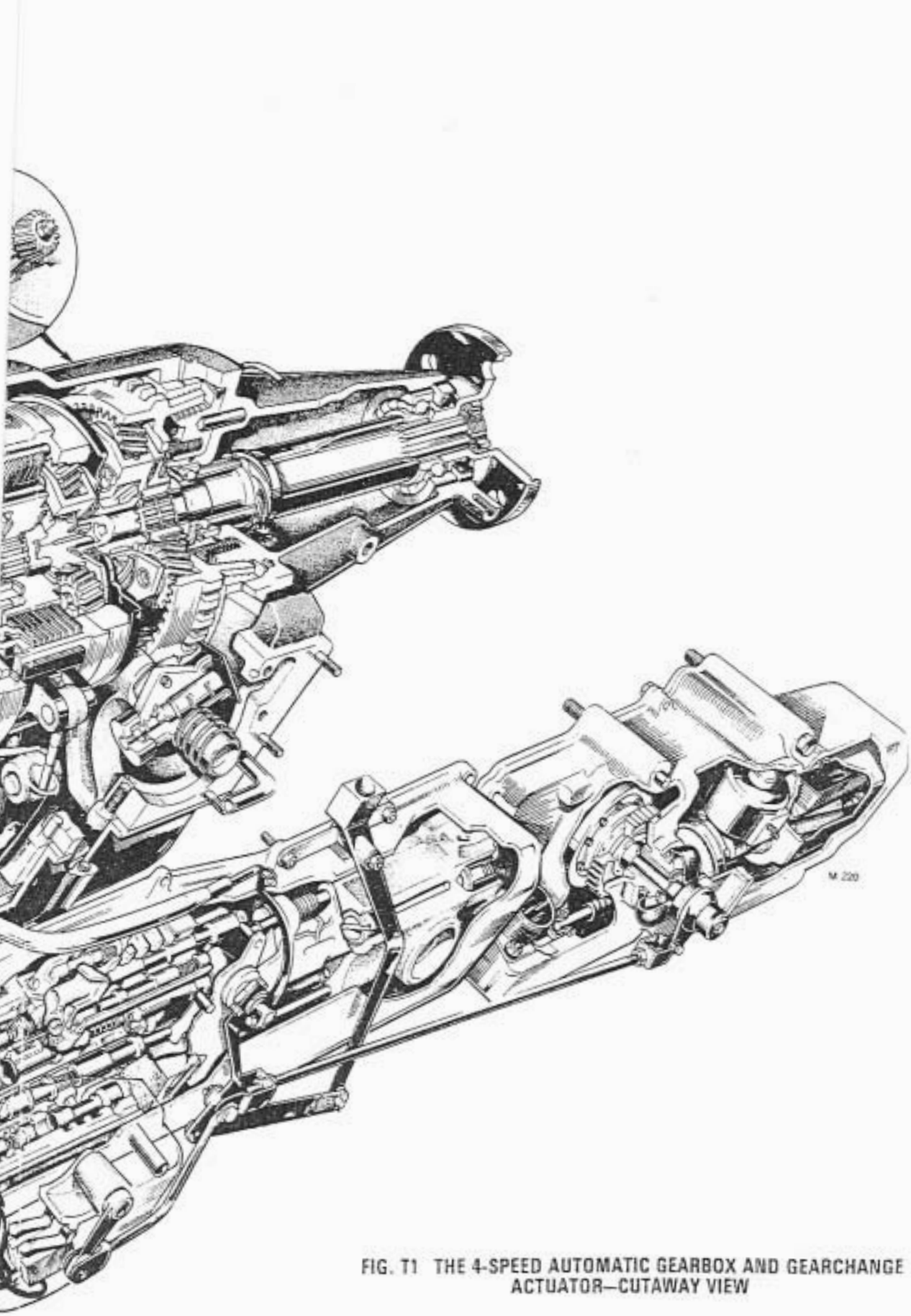


FIG. T1 THE 4-SPEED AUTOMATIC GEARBOX AND GEARCHANGE ACTUATOR—CUTAWAY VIEW

Printed in England

July 1971

T.S.D. 2476

Chapter T
TRANSMISSION — PART 1

Section T1
INTRODUCTION

Early Rolls-Royce Silver Shadow and Bentley T series motor cars were fitted with the 4-Speed Automatic Gearbox as follows:

All right-hand drive cars prior to Car Serial Number SRH 4033.

All right-hand drive cars destined for the United Kingdom prior to Car Serial Numbers SBH 4478, SRH 4488 (except SRH 4487).

The Automatic Gearbox (*see Fig. T1*) transmits tractive power from the engine to the propeller shaft in four forward ratios and in reverse. The gear changes are made automatically and are obtained through a fluid coupling and three hydraulically controlled epicyclic gear trains. In all forward ranges the driving torque is applied continuously to the road wheels during the changes from one ratio to another. Engine braking on overrun is obtained in 3rd and 4th gear; increased engine braking can be obtained by selecting Range 2 at speeds below 35 m.p.h. (56 k.p.h.).

A gear range selector lever is provided on the steering column of the car and can be used by the driver, within certain speed ranges, to overrule the automatic mechanism and to select the gear he considers most suitable for the road and traffic conditions. The selector lever, which is in the form of a switch, has five positions: 'R', 'N', '4', '3' and '2', representing Reverse, Neutral and three forward ranges. When the selector lever is moved from the neutral position, an electric actuator, fitted to the gearbox rear extension, will automatically select the required range. The gearbox will remain in the selected range until the steering column mounted lever is again moved.

In all ranges except Neutral, when the engine is running, the drive is engaged. At low throttle openings and with the handbrake applied the car will remain stationary due to slip in the fluid coupling; at higher engine speeds the car will move off whenever the brakes are released.

Range 4

For normal driving the selector lever should be placed in Range 4. The car will start from rest in first gear at low throttle openings and, when accelerated, will change progressively through second and third into fourth or 'top' gear. Greater throttle openings will cause the changes to be delayed progressively so that they occur at higher road speeds and provide more rapid acceleration of the car.

If, at any time, the accelerator is depressed beyond the full throttle position (kick-down), a full throttle down-change occurs (depending upon the speed of the car) which increases driving torque and so further increases the car's acceleration.

Range 3

Under normal driving conditions only first, second and third gears are obtainable in Range 3. A 'safety' up-change to fourth gear is provided however, to prevent the engine from being 'over-revved' in third gear. The 3-4 up-change is delayed in Range 3 until a speed of approximately 76 m.p.h. to 78 m.p.h. (122 k.p.h. to 125 k.p.h.) is reached. Thus, maximum acceleration can be obtained in third gear and for this reason Range 3 is often known as the performance range.

Chapter T

If, at any time, the driver requires a change from fourth to third gear under less than full throttle conditions, for example, to avoid the 4-3, 3-4 gear changes when driving in heavy traffic, he can promote the change from fourth gear to third gear by moving the selector gear lever to Range 3.

Range 2

In Range 2, under normal driving conditions, only second gear is obtainable. The car will start from rest in second gear and will remain in that gear until the selector lever is moved. **There is no safety up-change, therefore, a speed of 42 m.p.h. (70 k.p.h.) must never be exceeded in Range 2** otherwise serious damage to the engine may result.

First gear is temporarily obtainable by means of full throttle 'kick-down', or should extreme loading on the engine at low speeds demand it. Such circumstances are extremely rare and will probably never be met under normal driving conditions.

Range 2 may be used in extremely slow traffic conditions to avoid the continual gear changes. It can also be used when the engine is required to assist braking when descending steep or dangerous gradients.

Neutral

In Neutral the drive is disconnected, allowing the planet gears to idle without transmitting torque. The selector linkage is designed so that the electrical supply to the starter motor is broken except when in Neutral; this is a safeguard to prevent the engine from being started with the car in gear, where it would have a tendency to move forward, especially as the engine automatic choke system causes the engine to run at a fast-idle speed when starting from cold.

Reverse

It is possible to select Reverse while the car is moving forward below a speed of approximately 8 m.p.h. to 10 m.p.h. (13 k.p.h. to 16 k.p.h.). **This action places great stress upon the transmission and should not, therefore, be attempted.**

Reverse has an important secondary effect on the transmission. When the selector lever is moved to the Reverse position while the engine is stationary, a pawl engages with an annular gear on the reverse unit in the transmission and prevents the car from moving even when parked on the steepest of gradients. When the car is parked on a hill the handbrake must be firmly applied before the selector lever is moved to another range, as the parking lock will be released and the car will move if it is not held by the brakes.

Construction and mechanical arrangement

The gearbox main casing, bell housing, rear extension, side cover and sump are all manufactured from aluminium alloy castings and combine strength with lightness.

An underbonnet dipstick and filler tube is supplied to facilitate quick and easy servicing.

The torus cover is sealed so that no joints are required when fitting the gearbox to the engine. The T.V. may be adjusted by a micro adjuster which is in the T.V. control system and can be reached after lifting the bonnet. Gearbox breathing is effected in one of the following two ways, on early models by drillings which terminate in a fine mesh gauze opposite a further drilling in the rear of the bell housing and on later models by a pipe which runs from the top of the gearbox and terminates beyond a clip on the side of the casting.

The four forward gears are obtained through two sets of epicyclic gears of differing ratios. Reverse is obtained through another epicyclic gear train compounded with the rear train.

Gear ratios are varied by means of friction bands, multi-plate clutches and a sprag clutch. Both the servo actuated friction bands and the clutches are hydraulically operated. When the friction bands and sprag clutch hold the drums stationary the relevant clutches are disengaged and the epicyclic gears are in reduction. When the friction bands are released the clutches are engaged (*in the case of the rear clutch, the sprag allows one way rotation—see Section T21—Drum assemblies*), locking two elements of the epicyclic gear train together, thus providing a direct drive through the unit.

The gearbox fluid coupling is driven by a flexplate from the engine crankshaft. The torus cover drives the rear torus member, via the gear train of the front epicyclic unit, at a reduced speed. This speed reduction allows slip at higher engine speeds than would otherwise be possible, thus reducing the tendency of the car to creep forward.

Automatic control

The automatic gear changes are controlled by hydraulic pressure, which is regulated according to road speed and accelerator position. The pressure is directed by way of shift valves to the appropriate clutch and servo pistons. A pressure, dependent upon engine torque, is obtained by connecting a hydraulic valve to the engine throttle. An indication of road speed is given by a transmission driven governor which controls two hydraulic valves. The driver

Printed in England

July 1971

T.S.D. 2476

superimposes his requirements on the automatic control by means of selector valves.

Oil flow to the servos and clutch pistons is controlled by three shift valve assemblies (*see Fig. T2*), each one positioned by governor and throttle pressure to control a gear change. The 1-2 shift valve assembly controls the gear change between the first and second gear, the 2-3 shift valve assembly controls the change between second and third gear and the 3-4 shift valve assembly controls the three to four change. As each valve moves to change gear, ports are opened to permit main line oil pressure to act on the appropriate clutch and servo pistons until in fourth gear all the shift valves have moved across. The process is reversed for normal down-changes.

Oil pressure is generated by two oil pumps, one driven by the input shaft and the other by the output shaft, thus ensuring that oil pressure is available whenever the engine is running or the car is moving.

The two pumps draw oil from the gearbox sump through a common wire mesh scavenge filter and feed it at varying pressures between 70 lb/sq. in. and 170 lb/sq. in. (4,92 kg/sq. cm. and 11,95 kg/sq. cm.) approx. into a common outlet passage leading to the governor and to the manually controlled selector valves. A spring-loaded, non-return valve is interposed between the two pumps to prevent loss of oil when one pump is not operating. Oil is also delivered to the fluid coupling and provides lubrication for the gearbox bearings as explained under 'Oil circulation' later in this chapter.

The governor provides a signal of road speed in terms of oil pressure. Two pressures are indicated; the pressures increase at different rates to provide accurate control at high and low road speeds. Oil from the governor is prevented from passing to the control valve unit whilst the car is stationary, but when the car begins to move centrifugal force causes the valves to move and open the valve ports. Oil then flows through the open ports at pressures which progressively increase as the car gathers speed.

In addition to the selector valves and the automatic control valves, the control valve unit contains a throttle valve (T.V.) which is connected by rods and levers to the engine throttle; this provides a signal of engine torque in terms of oil pressure. When the main selector valve is in any of the drive positions, oil at pump pressure is directed to the throttle valve ports

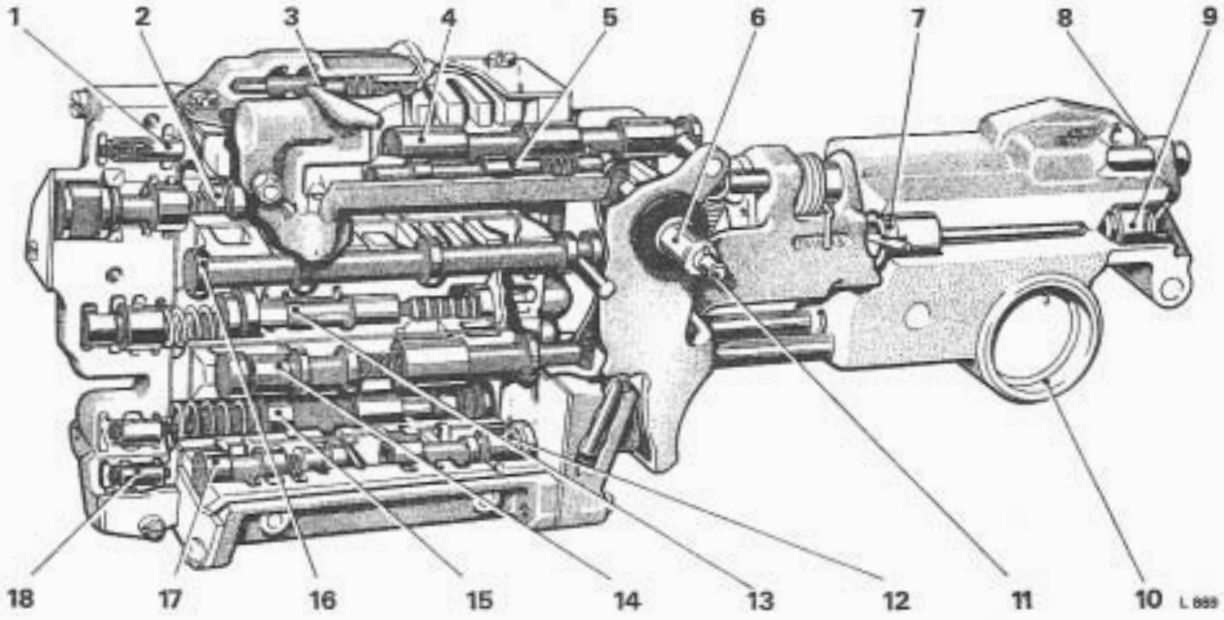


FIG. T2 CONTROL VALVE UNIT ASSEMBLY

1 T.V. regulator valve
2 2-3 Shift valve group
3 3-2 Timing valve
4 Neutral and rear servo manual valve
5 Rear band control valve
6 Selector shaft
7 Reverse blocker piston
8 Parking pawl crank
9 Parking blocker piston
10 Governor sleeve
11 T.V. operating shaft
12 Transition valve
13 1-2 Shift valve group
14 Throttle valve group
15 3-4 Shift valve group
16 Selector valve
17 Compensator valve
18 3-4 Shuttle valve

which are opened and closed with the throttle, thus providing an oil pressure which progressively increases with throttle opening.

This pressure is passed into the control valve unit to oppose the governor pressures acting on each of the shift valve assemblies. These valves are therefore positioned to direct oil pressure to apply the lowest gear ratio when the governor pressure is nil (road wheels not turning). As governor pressures increase and overcome the opposing throttle pressure, the shift valves move and select higher gear ratios. It will be seen also that lower gear ratios will be selected whenever increasing throttle opening causes throttle pressure to overcome governor pressure and move the shift valves the other way.

When selecting the gear ratios in the above manner, the shift valves are positioned to direct oil to the servos which apply or release the friction bands, and the clutches which engage or disengage in various combinations as shown in the following table.

These results are obtained by intermediate oil pressures which act on various relay, timing and locking valves and plugs, some of which are positioned solely by oil pressure and others by oil and spring pressure.

The function of the oil pressures may be summarised as follows.

Main pressure is applied through the shift valve ports to the clutch pistons and band servos.

Throttle pressures act upon the shift valves in opposition to governor pressures; the shift valves are therefore positioned to permit the main pressure to pass to the appropriate servo and clutch positions.

Bearings and thrust washers

The complete rotating assembly is carried in plain bearings at the front and centre and in ball bearings at the rear. Axial thrust is opposed by phosphor bronze thrust washers backed by steel washers.

The front plain bearings are positioned between the front of the intermediate shaft and the front pump drive gear, the pump drive gear and front pump and between the front pump and the torus cover. When in reduction the front drum rotates upon the intermediate shaft on two plain bearings.

The centre plain bearing is also an oil delivery sleeve and supports the intermediate shaft between the front and rear drums. The sleeve provides a bearing surface for the rear drum when in reduction.

A spigot bearing in the front end of the output shaft supports the rear end of the mainshaft; the front of the mainshaft is splined to the driven torus which is supported in a plain bearing in the torus end cover.

The output shaft revolves in two ball bearing races in the rear extension. A plain bearing supports the reverse sun gear at the forward end of the output shaft.

Thrust washers are positioned as follows.

A phosphor-bronze thrust washer and a steel backing washer between the driving torus hub and the front pump drive-shaft.

A phosphor-bronze thrust washer between the front pump drive-shaft and the hub of the front planet gear carrier.

A phosphor-bronze thrust washer and a steel backing washer between the hub of the front planet gear carrier and the front sun gear. These washers are retained when the planet gears are fitted and cannot be removed.

A phosphor-bronze thrust washer and a steel backing washer behind the front unit sun gear. These washers are secured on the intermediate shaft by a snap ring.

A phosphor-bronze thrust washer at the rear of the sprag outer race, between the race and the rear drum cover and a phosphor-bronze retainer at the front of the race. The retainer is an interference fit in the outer race.

A phosphor-bronze thrust washer on each side of the rear unit clutch hub.

A thin steel washer between the front face of the

TABLE OF CLUTCH AND BAND POSITIONS

	FRONT BAND	FRONT CLUTCH	CENTRE CLUTCH	SPRAG	REAR CLUTCH	REVERSE CLUTCH
NEUTRAL	OFF	OFF	OFF	—	OFF	OFF
1st GEAR	ON	OFF	ON	ENGAGED	OFF	OFF
2nd GEAR	OFF	ON	ON	ENGAGED	OFF	OFF
3rd GEAR	ON	OFF	ON	FREEWHEEL	ON	OFF
4th GEAR	OFF	ON	ON	FREEWHEEL	ON	OFF
REVERSE	ON	OFF	OFF	—	OFF	ON

Note The rear band is applied in Range 2 only.

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

Printed in England

July 1971

T.S.D. 2476

rear unit clutch hub and a snap ring on the intermediate shaft.

A phosphor-bronze adjusting washer between the rear face of the rear unit sun gear and the front face of the rear unit planet carrier. The thickness of this washer is to be selected to give the required end float for the mainshaft.

A phosphor-bronze thrust washer between the rear unit planet carrier and the reverse driving flange.

Oil circulation

Oil for the fluid coupling, the hydraulic servo system and gearbox lubrication is contained in the gearbox sump. The sump is filled through a filler tube which also houses the dipstick. Access to the filler tube is gained by lifting the car bonnet, then removing the dipstick from the tube. The oil is drawn through a gauze filter in the sump by the two pumps as previously described. Oil flow to the fluid coupling passes forward through the annular space between the front driveshaft and the pump body, then passes into the fluid coupling. When the coupling has filled with oil, a relief valve (check valve) opens to permit a flow between the main and intermediate shafts in order to lubricate the bearings, and through holes drilled in the shafts to lubricate the clutches, gears, splines and thrust washers of the rotating assemblies (*see Fig. T3*).

Pipes carry oil from both the pumps to the front servo unit from where it flows through drillings in the main casing to the control valve unit, then back to operate the servo and clutch pistons. Oil supply to the governor is conveyed through a pipe and drillings in the casing. Governor oil pressures pass from the governor sleeve to the control valve assembly through two oil pipes.

The annular spaces in the governor sleeve are sealed from each other by piston ring-type oil seals.

Oil flow from the control valve unit passes through drillings in the main casing to the front and rear servo units and to an oil delivery sleeve on the intermediate shaft between the front and rear drums. The delivery sleeve supplies oil to the front and rear clutches, the centre clutch being supplied with oil through a separate pipe from the control valve unit. Oil leakage from the delivery sleeve is prevented by piston ring-type oil seals.

A pipe from the control valve unit conveys reverse clutch supply oil to drillings in the casing, then to the rear extension from where it flows to the reverse clutch apply piston.

Control pressures

Main oil pressure, obtained direct from the two oil pumps, is used to operate the servo pistons and clutch pistons and to supply oil for conversion to lower controlling pressures by the governor and the valves in the control valve unit.

Compensator pressure is obtained by metering main line pressure through ports controlled by a compensator valve, spring and auxiliary valve. This pressure is lower than pump pressure and is directed to the front servo to increase the band holding force as torque increases.

Throttle valve (T.V.) pressure, obtained as already described under 'Automatic control', acts on the compensator valve to regulate the compensator pressure in accordance with throttle opening.

T.V. oil is metered past the T.V. regulator valve to act on the shift valves. It is also metered to the regulator plugs which control the ports permitting pressure to act on the shift valves. The regulator plugs lock the shift valves in gear after an up or down-change and so prevents 'hunting' between gears.

Accumulator pressure is obtained by allowing main line oil to meter past a valve in the accumulator control valve housing on the side of the rear servo. The valve is subject to T.V. pressure so that accumulator pressure varies according to T.V. pressure. Accumulator pressure is lower than main line pressure and is used to oppose rear clutch apply oil during the 2-3 up-change.

Governor pressure No. 1 (G1) is obtained by metering oil past the valve controlled by the large governor weight, and is directed to the 3-4 shift valve, overrun valve, 3-4 overspeed valve, 1-2 shift valve, 2-3 G1 plug, reverse blocker piston and the 4-3 timing valve in the front servo. The high rate of pressure increase caused by the large governor weight gives accurate control at low road speeds.

Governor pressure No. 2 (G2), obtained by metering oil past the lighter weighted valve, is directed to the 2-3 auxiliary valve, the 3-4 overspeed valve and the 3-4 governor plug. The rate of G2 pressure increase is greatest at high road speed, G1 pressure having reached its maximum.

Control linkage

The manual selection of gears is accomplished simply by operating the selector lever on the steering column. This lever is in effect a switch, and fingertip operation of the switch causes the gearbox electric actuator to select the desired gear immediately. The actuator motor is connected by a rod and levers to the selector shaft on the control valve unit. In the unlikely event of electrical or mechanical failure which may render the actuator inoperative, gear changes can be made manually by a separate lever which is connected to the gearchange actuator lever and can be operated from inside the car.

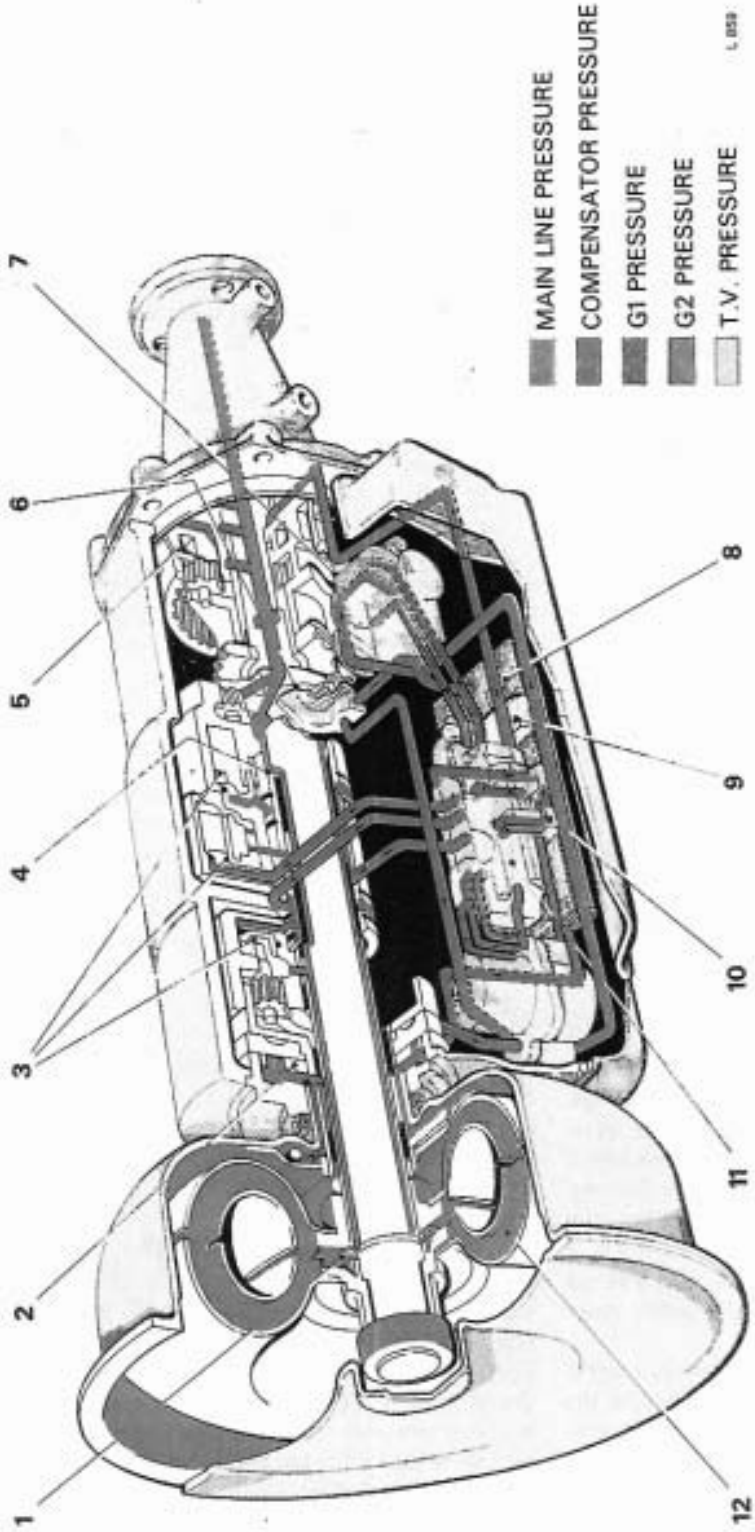


FIG. T3 OIL CIRCULATION DIAGRAM

1 Check valve
2 Front pump
3 Clutch pistons
4 Oil delivery sleeve
5 Reverse clutch piston
6 Rear pump
7 Governor
8 Oil screen
9 Rear servo
10 Junction body
11 Control valve unit
12 Fluid coupling

As the engine and gearbox unit is flexibly mounted and the accelerator pedal is body mounted, it is necessary to prevent relative movement interfering with throttle and T.V. controls.

A compensator mechanism comprising two bow-shaped links is attached, at the bottom, to a bracket on the right-hand side of the engine compartment. The top is secured to a tie rod, the inner end of which is located by the 'A' bank cylinder head control shaft.

Accelerator pedal movement is transmitted to the gearbox throttle valve via the compensator mechanism and the cylinder head control shaft. A cross-shaft in the bell housing transfers the movement to the left-hand side of the gearbox.

T.V. adjustment is effected by a simple micro adjuster which can be operated from the right-hand side of the engine compartment.

Gearbox control levers are mounted on concentric control shafts which pass through oil seals in the gearbox side cover and through a bearing integral with the control valve unit. The levers are splined to their respective shafts and can be fitted in one position only.

The outer shaft operates the selector valve and the neutral and rear servo manual valve by means of pins which engage with a radial groove in the end of each valve. Selector positions are determined by a spring-loaded plunger engaging with notches in a plate which is integral with the lever shaft. A solenoid operated brake in the electric actuator ensures accurate and positive braking of the actuator when a gear position has been reached.

The lever on the inner (T.V.) shaft varies the throttle pressure by acting on the stem of the 'T' valve, compressing the throttle valve spring in the control valve unit.

Printed in England

July 1971

T.S.D. 2476

Printed in England

July 1971

S.U. 29/9

Section T2
SERVICING

Careful and regular maintenance of the gearbox is necessary to ensure maximum reliability; the following table gives the recommended servicing periods.

SERVICING PERIODS

ESSENTIAL MAINTENANCE	PERIOD
Check oil level	After first 3 000 miles (4 828 km.) then every 6 000 miles (9 656 km.)
Check for leaks	
Drain transmission and fill with new fluid	Every 12 000 miles (19 312 km.)
PREVENTATIVE MAINTENANCE	**PERIOD**
Lubricate control linkage Road test to check gear changes	Every 6,000 miles (9 656 km.)

It is absolutely essential that great attention be paid to cleanliness whenever the interior of the gearbox is exposed and when work is being carried out on a particular unit belonging to the gearbox. The smallest particle of dirt in the oil may interfere with the correct operation of the valves, particularly in the control valve unit.

It is recommended that all work on the automatic gearbox, whether it be periodic servicing or the rectification of a fault, should be systematically carried out as follows.

1 Check gearbox oil level.
2 Check for oil leaks.
3 Lubricate control linkages.
4 Ensure that the engine is correctly tuned then test the gearbox change points; at the same time check for clutch slip and listen for noise.

If any faults are discovered, further checks may be necessary to assist in quick and accurate fault diagnosis. The checks to be made will, of course, vary with the symptoms but with the majority of faults the checks should be carried out in the following order.

1 Check control linkages.
2 Check main line oil pressure.
3 Check band adjustment.

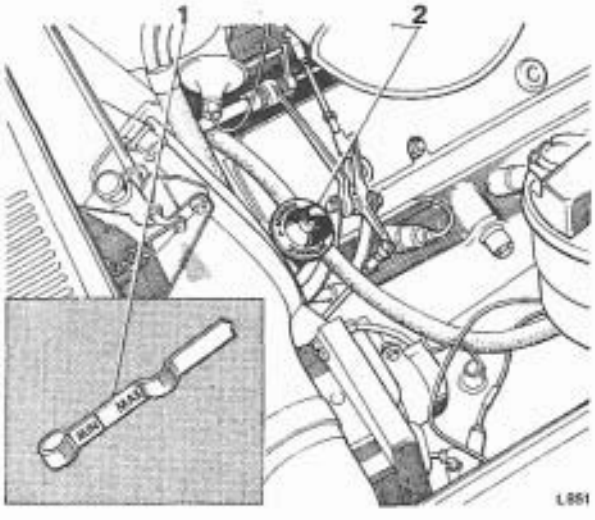


FIG. T4 CHECKING THE OIL LEVEL

1 MINIMUM and MAXIMUM oil level marks
2 Gearbox oil dipstick

Chapter T

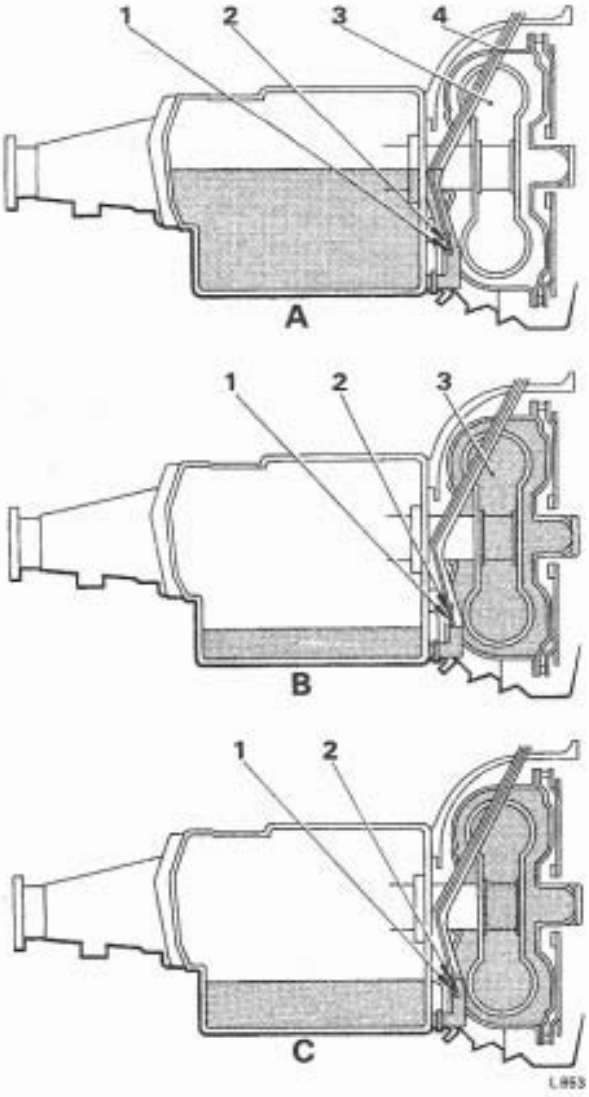


FIG. T5 FILLING AND TOPPING-UP THE GEARBOX

A Pour in 1·5 Imp. galls. (6,8 litres, 1·8 U.S. galls.) with engine stationary

B Run engine to fill fluid coupling

C Top-up to MAX. mark on dipstick with engine running

1 Low level on dipstick

2 Full level on dipstick

3 Fluid coupling

4 Dipstick and oil filler tube

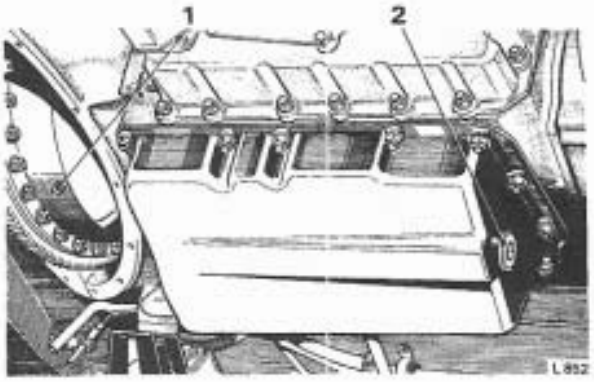


FIG. T6 DRAIN PLUGS
1 Torus cover drain plug
2 Gearbox sump drain plug

4 Partially dismantle the gearbox in order to isolate the suspect unit by means of an air pressure test.

Warning

To check the gearbox with the engine running and the car stationary, **do not** move the selector lever from the neutral position unless the hand brake is fully applied or the rear wheels are jacked clear of the ground. This is particularly important if the engine is running faster than the correct 'hot', slow idle speed. Chock the wheels and apply the foot brake when using high engine r.p.m.

Gearbox — To drain and fill

Efficient draining of the oil from the gearbox will be assisted by warming-up the gearbox prior to draining. Do not flush the gearbox but ensure that it has thoroughly drained.

Proceed as follows.

1 Place a clean container, capacity 3 gallons, under the sump drain plug.
2 Remove the plug and allow the oil to drain.
3 Remove the bell housing bottom cover.
4 Rotate the flywheel until the torus drain plug is in its lowermost position.
5 Place the container under the drain plug; remove the plug and drain the oil. Figure T6 shows the position of both drain plugs. If the car has covered only a low mileage since its last gearbox oil change and the oil is drained to facilitate some minor repair e.g. oil leak or sticking valve, the existing oil may be used again. The oil must be drained into a clean container

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

then passed through a fine mesh filter before being poured into the gearbox.

Note If there is any doubt about the suitability of the oil for further use it should be discarded and the gearbox should be filled with clean, fresh oil. Always examine the oil residue in the container for evidence of gearbox wear e.g. particles of clutch plate, band lining, etc.

6 Fit both drain plugs together with new sealing washers. Torque tighten the plugs to the following figures.

Fluid coupling drain plug — between 5 lb.ft. and 7 lb.ft. (0,691 kg.m. and 0,968 kg.m.).

Sump drain plug — between 40 lb.ft. and 45 lb.ft. (5,530 kg.m. and 6,222 kg.m.).

When filling the gearbox with transmission fluid ensure that the container is scrupulously clean. The fluid coupling and the sump are filled through the same orifice i.e. the dipstick and oil filler tube.

A new or overhauled gearbox requires approximately 24 Imperial pints (13,638 litres) of fluid. A gearbox which has only been drained of fluid will require approximately 2 Imperial pints (1,137 litres) less than this quantity to reach the MAX mark on the dipstick.

Fill the gearbox as follows (*see Fig. T5*).

1 Remove the dipstick then pour in 12 Imperial pints (6,819 litres) of fluid.

2 With the steering column lever in Neutral and the handbrake applied, start the engine and allow it to run at fast-idle for a few minutes.

3 Stop the engine then add a further 10 Imperial pints (5,683 litres).

4 Again start the engine and while it is running at slow-idle check the fluid level on the dipstick. If necessary, add sufficient oil to bring up the level to the MAX mark on the dipstick.
Do not overfill.

5 Road test the car, or run it until the gearbox has reached normal operating temperature, then finally check the gearbox oil level. Top-up to the MAX mark on the dipstick as required.

To check for leaks

If the level of oil is low when measured with the dipstick, examine the gearbox externally for signs of an oil leak.

Possible sources of leakage at the front of the gearbox are shown in Figure T7; the action to be taken when leakage is confirmed is given in the table on page T12.

If the action to be taken requires the removal of the gearbox, a road test should be made after topping-up and before removal.

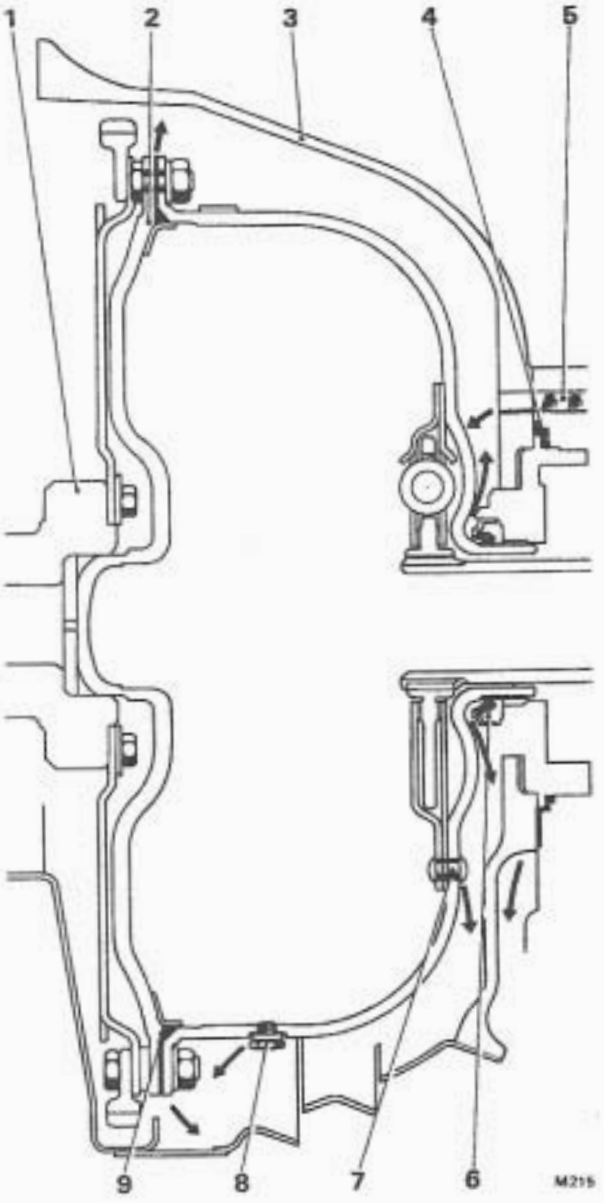


FIG. T7 SOURCES OF LEAKAGE

1 Crankshaft
2 End cover
3 Torus cover
4 Front pump to gearbox joint
5 Gearbox breather
6 Front pump oil seal
7 Damper rivets
8 Drain plug
9 Torus cover to end cover joint

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

Chapter T

Oil level — To check

The gearbox oil level can be accurately checked only when the engine is running and the gearbox has warmed up to 80°C. (176°F.), its correct operating temperature.

If the oil level is near or below the MIN mark on the dipstick, top-up to the MAX mark while the engine is still running and check for oil leakage as described under 'To check for leaks'.

The following transmission fluids are approved for use in the Rolls-Royce and Bentley 4-Speed Automatic Gearbox.

All lubricants listed are approved for world wide use.

B.P. ..	B.P. Autran DX (Dexron)
Castrol ..	Castrol TQ (Dexron ®)
Esso ..	Esso Automatic Transmission Fluid (Dexron)
Mobil ..	Mobil ATF 220 (Dexron)
Regent ..	Regent Texamatic (Dexron)
Shell ..	Shell Automatic Transmission Fluid (Dexron ®) or Shell Donax T6 (Dexron R)

Note Dexron is a registered trade name.

The lubricants listed supersede the Type A Suffix A automatic transmission fluids but as both types of fluid are miscible, Type A Suffix A automatic transmission fluids can still be used for topping-up purposes.

The procedure to be adopted for topping-up is as follows.

1 Select 'N', ensure that the handbrake is applied then start the engine and run it at idling speed to warm up the transmission fluid.
2 Remove the dipstick (*see Fig. T4*); clean the dipstick blade before checking the oil level.
3 If topping-up is necessary pour in the correct oil in small quantities, checking frequently to ensure that the level of oil does not rise above the MAX mark on the dipstick. Take care not to overfill as this may cause loss of oil through the gearbox breather.

Control joints — To lubricate

All control ball joints should be lubricated with Molytone 265 grease which should be worked into each ball socket with the fingers. If, during greasing, excessive end play is discovered, adjust the ball joint taking care not to disturb the control settings. If end play in the joints is excessive, it may be necessary to alter the controls as described under 'Controls — To adjust'.

Control rods which are retained in a lever by a split pin should be lubricated with a few drops of light oil.

The T.V. control cross-shaft which runs transversely in the bell housing and the 'Get You Home' lever are supported on oilite bushes and do not require lubrication.

OIL LEAKAGE SOURCES

LOCATION OF OIL	POSSIBLE SOURCE	ACTION TO TAKE
Outside of torus cover and inside of bell housing.	1 Front pump-to-torus cover oil seal.	Remove gearbox. Renew front pump oil seal.
	2 Torus cover drain plug.	Check tightness of plug. Renew joint washer.
	3 Torus cover-to-end cover joint.	Remove gearbox. Renew 'O' ring between torus cover and end cover.
	4 Torus cover damper rivets.	Remove gearbox. If rivets are loose, renew torus cover assembly.
Front of gearbox behind bell housing.	Front pump-to-gearbox 'O' ring.	Remove gearbox. Renew 'O' ring between front pump and gearbox. Ensure that the bell housing 'nips' the pump body.
Oil sump.	1 Sump drain plug.	Check tightness of plug. Renew joint washer.
	2 Sump-to-casing gasket.	Drain and remove sump. Check joint faces. Fit new gasket. Torque tighten nuts.
Side cover.	1 Main line blanking plug (oil pressure test point).	Check tightness of plug. Renew joint washer.
	2 Side cover-to-casing gasket.	Drain sump and remove side cover. Check joint faces. Fit new gasket.
	3 T.V. and selector shaft oil seal.	Check fit and condition of seal. Renew, if necessary.
Rear extension.	Rear extension oil seal.	Remove propeller shaft and coupling flange. Renew oil seal.

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

Printed in England

July 1971

T.S.D. 2476

Section T3
TESTING

There are two tests which can be made in order to check the functioning of the automatic gearbox. They are as follows.

1 A road test is necessary to ensure that the gear changes are occurring at the correct road speed and engine power.

2 The second test is to check the operating oil pressures to assist diagnosis of a suspected defect. This entails the fitting of a gauge to a pressure tapping in the gearbox top face then recording the operating pressures.

Change points — To check

The gearbox change points are given in the following table in the sequence in which the tests should be made. The gearbox oil level, engine tune and control settings should be correct before the test is made, otherwise subsequent analysis of the results will be very difficult.

The point at which the gear change occurs can be recognised by a tendency for the engine to speed up at the change point on the up-changes or a tendency for the car to lose road speed on the down-changes.

The speedometer readings at which each change point occurs should be noted, whether correct or incorrect, then the test should be continued until all the results are obtained. The test should not be terminated because of a defect unless damage to the transmission is likely to be caused by continued running.

Compare the noted change points with the table of change points and, if a defect exists, consult the fault diagnosis section which gives the action required for rectification, on the assumption that gearbox oil level, engine tune and engine idling speed are correct.

Although the symptoms for incorrect control settings are included in 'Fault Diagnosis', it will

CHANGE POINTS

	RANGE 4					
	UP-CHANGES m.p.h. (k.p.h.)			DOWN-CHANGES m.p.h. (k.p.h.)		
	1–2	2–3	3–4	4–3	3–2	2–1
Light throttle. Full throttle. Kick-down.	5–8 (8–13) 18–21 (29–34)	12–15 (19–24) 33–37 (53–59)	22–25 (35–40) 73–75 (117–121)	18–16 (29–26) 73–71 (117–114)	9–6 (14–10) 24–22 (39–35)	6–3 (10–5)
	RANGE 3					
	1–2	2–3	3–4	4–3	3–2	2–1
Light throttle. Full throttle. Kick-down.	5–8 (8–13) 18–21 (29–34)	12–15 (19–24) 33–37 (53–59)	75–77 (121–124)	77–75 (124–121)	9–6 (14–10) 24–22 (39–35)	6–3 (10–5)

simplify matters if the controls are checked before road testing the car. Many gearbox faults can be traced to incorrect setting of the controls.

The speedometer reading at which the change occurs will be dependent upon throttle position and increases progressively from light throttle to full throttle. Slight variation from the figures quoted in the table is permissible provided that the changes are smooth and that there are no other symptoms of incorrect operation.

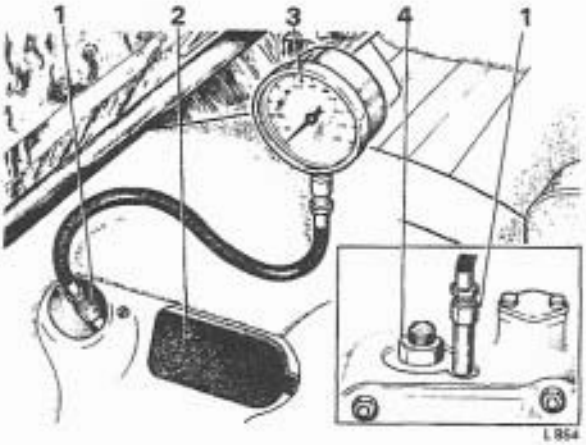


FIG. T8 CHECKING THE OIL PRESSURE

1 Adaptor
2 Rubber plug
3 Oil pressure gauge
4 Front band adjuster and lock-nut

Oil pressure — To check

If a road test is being made to test for a suspected defect, or if a defect has been found on a previous road-test, some of the possible causes listed in the Fault Diagnosis Section can be eliminated by jacking up the rear wheels then checking the operating oil pressures with the figures given in the following table.

For this test it is necessary to fit a tachometer in order to check engine r.p.m. Alsc fit a pressure gauge (R5244) to the pressure tapping between the band adjusting screws in such a manner that the gauge can be observed during the check. It will be necessary to partially remove the carpet from the front passenger's side, then lift out the forward rubber blank which is fitted in the left-hand side of the transmission tunnel (*see Fig. T8*).

Oil pressure tests should be carried out in the order given in the table after fitting the gauge and tachometer and running the engine for a few minutes to warm up the gearbox.

OIL PRESSURE TESTS

TEST CONDITION	RANGE	TACHOMETER OR SPEEDOMETER READING	OIL PRESSURE LB/SQ.IN
Engine running, car stationary.	N	1 200 r.p.m.	68 to 72 (4,781 kg/sq.cm. to 5,062 kg/sq.cm.)
Car reducing speed with throttle closed.	4	30 m.p.h. (48 k.p.h.)	68 to 72 (4,781 kg/sq.cm. to 5,062 kg/sq.cm.)
Car increasing speed at full throttle.	4	40 m.p.h. (64 k.p.h.)	105 to 110 (7,383 kg/sq.cm. to 7,734 kg/sq.cm.)
Car reducing speed with throttle closed.	3	30 m.p.h. (48 k.p.h.)	68 to 72 (4,781 kg/sq.cm. to 5,062 kg/sq.cm.)
Car reducing speed with throttle closed.	2	20 m.p.h. (32 k.p.h.)	68 to 72 (4,781 kg/sq.cm. to 5,062 kg/sq.cm.)
Car reducing speed with throttle closed.	R	10 m.p.h. (16 k.p.h.)	170 (11,953 kg/sq.cm.)
Coasting with engine stopped.	4	Not more than 25 m.p.h. (40 k.p.h.)	50 (min.) (3,515 kg/sq.cm.)

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

Printed in England

July 1971

T.S.D. 2476

Section T4
FAULT DIAGNOSIS

Reliable and accurate fault diagnosis and the rectification of faults, when discovered, will be made easier if servicing and testing are carried out in the correct order. The results of each test should be recorded before consulting the Fault Diagnosis Table in this Section.

The following sequence of tests may help to simplify the diagnosis of some obscure defects.

1 Check gearbox oil level then examine the outside of the gearbox for leaks.
2 Lubricate and check the setting of the control linkages.
3 Fit a pressure gauge to the gearbox then carry out a road test, recording oil pressures and gear change points.
4 Adjust the front band if necessary.

The following Fault Diagnosis Table is arranged in three columns. The first column gives the conditions under which the fault may occur. The second column lists the probable cause of the condition in the most likely order of occurrence whilst the third column gives the action to be taken in order to remedy the fault.

DIAGNOSIS

CONDITION	CAUSE	REMEDY
High up-shifts		
1 All up-shifts.	1 T.V. linkage too long.	1 Adjust T.V. linkage.
	2 Governor valves sticking.	2 Remove side cover, parking brake bracket and governor. Check governor valves.
	3 Broken or sticking governor oil sealing rings.	3 Remove side cover and parking brake bracket. Check governor rings.
Low up-shifts		
1 All up-shifts.	1 T.V. linkage too short.	1 Adjust T.V. linkage.
	2 Governor valves sticking.	2 Remove side cover, parking brake bracket and governor. Check governor valves.
	3 Leaking throttle pressure.	3 Remove side cover and control valve unit. Overhaul control valve unit. Check regulator plug. Check rear servo accumulator T.V. pipe.
Misses up-shifts		
1 No up-shift above 1st.	1 Shift valves sticking.	1 Remove side cover and control valve unit. Overhaul control valve unit.
	2 Governor valves sticking.	2 Remove side cover, parking brake bracket and governor. Check governor valves.
	3 Low oil pressure due to oil delivery sleeve rings broken or sticking.	3 Remove sump, side cover and control valve unit. Air test oil delivery sleeve for excessive leakage.

CONDITION	CAUSE	REMEDY
Misses up-shifts—*continued*		
2 Misses 1st and 3rd.	1 Front band incorrectly adjusted.	1 Drain and remove sump. Adjust front band.
	2 Broken front band.	2 Remove gearbox and renew front band.
	3 Front servo rings broken or sticking.	3 Drain and remove sump. Remove side cover and control valve unit. Air test front servo for operation and overhaul if necessary.
	4 Missing or loose plug in front servo.	4 Drain and remove sump to check. Fit and tighten plug as required.
	5 Front unit locked due to mechanical failure.	5 Remove gearbox, overhaul front unit.
3 Misses 2nd and 4th.	1 Excessive leakage from oil delivery sleeve.	1 Drain and remove sump. Remove side cover and control valve unit. Air test oil delivery sleeve for excessive leakage; check correct fitting of bearing cap.
Slips during up-shifts		
1 Slips — light throttle up-shifts.	1 T.V. linkage incorrectly adjusted.	1 Adjust T.V. linkage.
	2 Front band incorrectly adjusted.	2 Drain and remove sump; adjust front band.
	3 Low oil pressure.	3 Check oil pressure then see 'OIL PRESSURE DIAGNOSIS'.
	4 Throttle valve forced out of bore.	4 Remove side cover and control valve unit; overhaul control valve unit.
2 Slips—heavy throttle up-shifts.	1 T.V. linkage incorrectly adjusted.	1 Adjust T.V. linkage.
	2 T.V. pipe loose.	2 Remove side cover. Check fitting of T.V. pipe.
	3 Front band incorrectly adjusted.	3 Drain and remove sump; adjust front band.
	4 Low oil pressure.	4 Check oil pressure then see 'OIL PRESSURE DIAGNOSIS'.
	5 Throttle valve forced out of bore.	5 Remove side cover and control valve unit; overhaul control valve unit.
	6 Sticking T.V. plug in regulator valve.	6 Remove regulator valve and check T.V. pressure plug.
	7 Damaged oil seals in regulator valve.	7 Remove regulator valve and renew seals.
	8 Oil delivery sleeve rings broken or sticking. Heavy grooving in ring bore of clutch housing.	8 Drain and remove sump. Remove side cover and control valve unit. Air test oil delivery sleeve for excessive leakage. Remove gearbox and overhaul drum assemblies as required.
	9 Clutch plates worn or burned.	9 Remove gearbox. Overhaul front, centre and rear clutch packs.
3 Slips 1–2, 3–4.	1 Low oil pressure due to oil delivery sleeve rings sticking or broken.	1 Drain and remove sump. Remove side cover and control valve unit. Air test oil delivery sleeve for excessive leakage. Overhaul if necessary.
	2 Front servo rings sticking or broken.	2 Drain and remove sump. Remove side cover and control valve unit. Air test front servo for correct operation. Overhaul if necessary.
	3 Front unit clutch plates worn or burned.	3 Remove gearbox and overhaul front clutch pack.
	4 Broken or collapsed oil seal in front clutch piston.	4 Remove gearbox and overhaul front clutch pack.
4 Slips 2–3.	1 T.V. linkage incorrectly adjusted.	1 Adjust T.V. linkage.
	2 Front band incorrectly adjusted.	2 Drain and remove sump. Adjust front band.
	3 Restriction or heavy oil leak in oil circuit.	3 Drain and remove sump. Remove side cover and control valve unit. Air test oilways to check front servo and rear clutch. Remove unit or gearbox as required for overhaul.
	4 Rear servo accumulator valves sticking or broken piston rings.	4 With side cover and sump removed, air test servo to check valve and piston operation. Remove body and overhaul. If necessary, remove servo and overhaul.
	5 Sticking control valves.	5 Remove side cover and control valve unit. Overhaul control valve unit.
	6 Rear clutch plates worn or burned.	6 Remove gearbox. Overhaul rear clutch pack.

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

CONDITION	CAUSE	REMEDY
Intermittent slip		
1 All ranges.	1 Low oil level. 2 Incorrect oil pressure.	1 Check oil level and top-up as required. 2 Check oil pressure then see 'OIL PRESSURE DIAGNOSIS'.
Rough changes		
1 Rough up-shifts.	1 Throttle linkage incorrectly adjusted. 2 Front band incorrectly adjusted. 3 Incorrect oil pressure. 4 Control valves sticking.	1 Adjust throttle linkage. 2 Drain and remove sump; adjust front band. 3 Check oil pressure then see 'OIL PRESSURE DIAGNOSIS'. 4 Remove side cover, remove control valve unit. Overhaul control valve unit.
2 Rough 4–3 down-shift.	1 Throttle linkage incorrectly adjusted. 2 Incorrect oil pressure. 3 Front band incorrectly adjusted. 4 Control valves sticking.	1 Adjust throttle linkage. 2 Check oil pressure then see 'OIL PRESSURE DIAGNOSIS'. 3 Drain and remove sump. Adjust front band. 4 Remove side cover, remove control valve unit. Overhaul control valve unit.
3 Rough neutral to drive.	1 Engine slow running set too fast in closed throttle position. 2 Front band incorrectly adjusted.	1 Fit tachometer and correctly adjust engine slow running speed. 2 Drain and remove sump. Adjust front band.
4 Rough Range 3 to Range 2.	1 Sticking rear band control valve.	1 Remove side cover. Remove control valve unit. Overhaul valve assembly.
No engine braking		
1 No engine braking in Range 2.	1 Rear band incorrectly set.	1 Drain and remove sump. Adjust rear band.
No forced down-shift (Kick-down)		
1 No 4–3 and 3–2 forced down-shifts.	1 Throttle linkage incorrectly adjusted. 2 Full throttle stop incorrectly set. 3 Control valves sticking.	1 Adjust throttle linkage and accelerator pedal stop. 2 Adjust full throttle stop to obtain correct kick-down. 3 Remove side cover, remove control valve unit. Overhaul control valve unit.
Reverse malfunction		
1 Slips in Reverse.	1 Low oil pressure. 2 Damaged reverse piston oil seal. 3 Reverse piston oil supply restricted or leaking. 4 Front band incorrectly adjusted. 5 Stationary cone key missing.	1 Check oil pressure then see 'OIL PRESSURE DIAGNOSIS'. 2 Remove gearbox. Overhaul reverse unit. 3 Remove side cover. Check reverse oil feed pipe for correct fitting or obstruction. 4 Drain and remove sump. Adjust front band. 5 Remove gearbox. Remove rear extension and check fitting of stationary cone key.
2 Locks in Reverse.	1 Reverse piston sticking or reverse cone sticking to stationary cone. 2 Rear band incorrectly adjusted. 3 Reverse parking pawl incorrectly fitted.	1 Try to free clutch by burnishing as described in Section T6 —Reverse epicyclic unit. If this fails, remove gearbox and overhaul reverse unit. 2 Drain and remove sump. Adjust rear band. 3 Remove side cover and check correct operation of parking pawl.
3 Jumps out of Reverse.	1 Selector linkage incorrectly adjusted.	1 Adjust selector linkage on gearbox.
4 Cannot select Reverse.	1 Selector linkage incorrectly adjusted. 2 G1 valve sticking out allowing G1 oil to hold reverse blocker piston out. 3 Reverse blocker piston sticking out.	1 Adjust selector linkage on gearbox. 2 Remove side cover. If necessary remove governor to free valve. 3 Remove side cover. If necessary remove parking brake bracket to free piston.
5 Will go into Reverse above 8 to 10 m.p.h. (13 k.p.h. to 16 k.p.h.).	1 Reverse blocker piston sticking in.	1 Remove side cover. If necessary remove parking brake bracket to free piston.

Printed in England

July 1971

T.S.D. 2476

Chapter T

CONDITION	CAUSE	REMEDY
Reverse malfunction — *continued*		
6 Clashes when changing to Reverse.	1 Parking blocker piston sticking in allowing pawl to engage.	1 Remove side cover. If necessary remove parking brake bracket to free piston.
7 No forward drive after changing from Reverse.	1 Reverse piston sticking or reverse cone sticking to stationary cone.	1 Try to free clutch by burnishing as described in Section T6 – Reverse epicyclic unit. If this fails, remove gearbox then overhaul the reverse unit.
8 Inoperative parking brake.	1 Parking blocker piston sticking out or parking pawl binding.	1 Remove side cover and parking brake bracket. Check parking blocker piston and pawl then remove the parking brake bracket if necessary to free the piston.
Car fails to move		
1 No drive.	1 Selector linkage disconnected.	1 Connect and adjust selector linkage.
	2 No oil pressure.	2 Fit oil pressure gauge. Check oil level. Look for oil leaks. Drain and remove sump. Check correct fitting of oil pipes.
	3 Low oil level.	3 Check oil level and top-up as required. Look for oil leaks.
	4 Manual control valve operating pin not engaged with manual control valve.	4 Remove side cover. Correctly fit the manual control valve. Ensure also the correct fitting of the neutral and rear servo manual valve.
2 No drive when engine is first started.	1 Low oil pressure.	1 See 'OIL PRESSURE DIAGNOSIS'.
	2 Badly leaking torus check valve.	2 This will be revealed by an abnormally high level of oil in the gearbox due to the check valve failing to hold oil in the torus assembly. In such a case, remove the gearbox and overhaul the check valve in the driven torus.
	3 Reverse piston sticking or reverse cone sticking to stationary cone.	3 Try to free the reverse clutch by burnishing as described in Section T6 – Reverse epicyclic unit. If this fails, remove the gearbox then overhaul the reverse unit.
3 Car fails to move forward in Range 3 or 4 but moves in Range 2 and Reverse.	1 Centre clutch oil feed pipe blocked or badly leaking.	1 Remove side cover. Remove control valve unit. Examine pipe. Check clutch operation by air test.
	2 Sprag race 'turned over', allowing the rear drum to rotate.	2 Remove transmission. Overhaul sprag clutch.
4 Electric actuator will not select a gear.	1 Car battery is flat.	1 Renew car battery.
	2 Actuator motor thermal cut-out operated due to obstructed gearchange linkage.	2 Check and correctly adjust gearchange linkage. Re-set thermal cut-out.

It will be seen from reading the Fault Diagnosis Table that a considerable number of defects can be caused by oil pressure which is too high or too low.

The following list of causes of high and low oil pressure is useful when used in conjunction with the Fault Diagnosis Table.

OIL PRESSURE DIAGNOSIS

LOW OIL PRESSURE		HIGH OIL PRESSURE
1 Oil level low.	4 Blocked filter.	1 Pressure regulator valve sticking.
2 Boost plug sticking.	5 Oil foaming or air locks.	2 Boost plug sticking.
3 Pressure regulator or spring defects.	6 Internal leaks.	3 Pump relief valve sticking.
	7 Pump slide sticking.	4 Blocked oil passages.

Printed in England

July 1971

T.S.D. 2476

Section T5

CONTROL LINKAGE

It is recommended that the control linkage be checked before road testing the car to investigate a suspected defect. If the symptoms exhibited on a road test are shown by fault diagnosis to be attributable to the control linkage, another check should be made before proceeding any further.

Turning the micro adjuster clockwise (looking from the top) (*see Fig. T10*) will decrease T.V. pressure and may correct such defects as a high up-change or rough up and down-changes. Turning the adjuster anti-clockwise may correct such defects as low, heavy throttle up-changes, slipping or incorrect kick-down.

The selector linkage should be checked by disconnecting the selector rod on the side of the gearbox then checking the lever through its full range. The lever should click into each of its five positions. If the linkage is correctly adjusted it should be possible, with the actuator motor lever in the appropriate position, to connect the rod without springing the lever from any of its notches.

If necessary, adjust the controls to obtain the correct changes following the procedure given under 'Controls — To adjust'. If a fault still persists after road test, refer to the Fault Diagnosis Table for the next check.

Controls—To adjust

The following paragraphs explain the correct method of adjusting the throttle and selector controls, commencing with the throttle controls.

T.V. linkage—To adjust

Drive the car on to a ramp or over an inspection pit, then disconnect the T.V. rod at the gearbox end. Figure T9 shows the layout of the throttle controls, each component being numbered for easy reference.

Ensure that the engine choke is in the OFF position i.e. fast-idle cam inoperative.

Check that the operating lever on the 'A' bank manifold cross-shaft is vertical and that the lever which connects to the T.V. adjusting rod is horizontal. Slacken the lever pinch bolts and, if necessary, adjust the levers; tighten the pinch bolts.

Note Ensure that the choke has not moved on to fast-idle.

Set the micro adjuster to its midway position.

Check that the length of the micro adjuster and rod assembly is 3·812 in. (96,838 mm.) measured from the inside faces of the ball joint lock-nuts. If the rods do not conform to this length, slacken the ball joint pinch bolts, remove the screwed ends then equally adjust the rods to obtain the correct length. Ensure that a reasonable amount of thread remains in the threaded part of the ball joint i.e. a length at least one and a half times the rod diameter. Fit the rod to the levers, fit the screwed ends and pinch bolts; tighten the lock-nuts. The ball joints should be free without having end float.

Slacken the pinch bolts in the levers on each side of the bell housing cross-shaft.

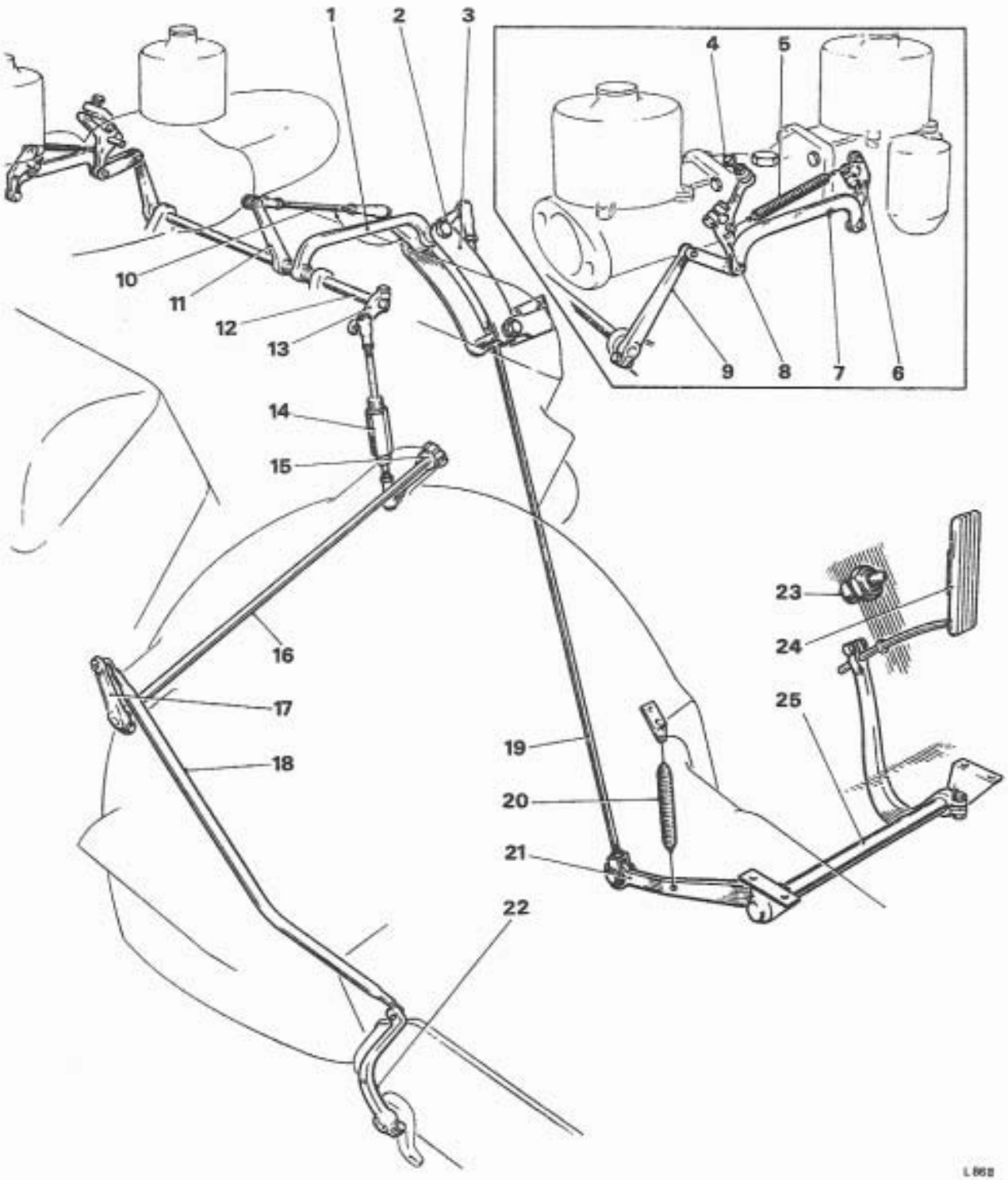


FIG. T9 THROTTLE AND T.V. CONTROLS

T.S.D. 2476

July 1971

Printed in England

Hold the T.V. lever fully forward in the 'no T.V.' position.

With the engine still in the 'off choke' position, lock the cross-shaft levers to the cross-shaft.

Turn the T.V. adjuster 6 notches (clicks) anti-clockwise, looking from the top (*see Fig. T10*), to take up free play in the T.V. linkage.

Ensure that the linkage moves freely and that the fully closed and fully open positions on the carburetter are obtainable.

Accelerator pedal linkage—To adjust

Check the length of the rod which connects the vertical lever on 'A' bank head cross-shaft to the fulcrum lever. Initially it should be set at 1·937 in. (49,312 mm.) between the inside faces of the ball joint lock-nuts.

Disconnect the rod between the fulcrum lever and the accelerator cross-shaft lever.

Check that the included angle made by the rod and the fulcrum lever is approximately 165° with the engine throttle in the closed position. Adjust rod, if necessary to obtain this angle.

Allow the accelerator pedal return spring to hold the pedal in the fully returned position. Under these conditions the pedal movement is limited by the rubber boot under the toe board.

Check that the length of the fulcrum lever-to-pedal cross-shaft lever rod is approximately 0·187 in. (4.763 mm.) longer than the actual length required with the accelerator pedal fully-back, as previously described, and with the throttle closed. Connect the ball joint and lock the pinch bolt.

Check to ensure that full throttle is obtainable. If necessary, adjust the kick-down stop so that full throttle is just obtainable (*see Kick-down stop—To adjust*).

Ensure that the fulcrum lever and the rod cannot toggle over when the accelerator pedal is quickly released. Shorten the rod if necessary, to cure this condition.

Finally, check that all linkages and levers operate freely.

T.V.—Final adjustment

After the throttle and T.V. controls have been adjusted as described, the final setting, to adjust the T.V. micro adjuster and alter the kick-down stop to suit, should be carried out during road test.

The T.V. should be adjusted as follows, assuming that the engine throttle controls have been correctly set.

If the gearbox slips when gear changes occur, or if kick-down is unobtainable, T.V. pressure should be increased by turning the micro adjuster anti-clockwise, looking from the top.

If the gear changes are jerky, or the gear changes are delayed on light throttle up-changes, T.V. pressure should be decreased by turning the adjuster in the opposite direction. Turn the adjuster two or three 'clicks' at a time until the desired conditions are obtained.

When T.V. has been satisfactorily adjusted, set the kick-down stop (accelerator pedal stop) so that kick-down is unobtainable unless the button is depressed.

FIG. T9 THROTTLE AND T.V. CONTROLS

1 Tie rod
2 Fulcrum rod
3 Compensator link
4 Slow running throttle stop
5 Return spring
6 Throttle lever—'B' bank
7 Coupling link
8 Throttle lever—'A' bank
9 Lever—manifold to carburetter
10 Control rod—'A' bank
11 Lever—'A' bank control shaft to control rod
12 'A' bank control shaft
13 Lever—'A' bank control shaft to T.V. micro adjuster
14 T.V. micro adjuster
15 Lever—bell housing to T.V. micro adjuster
16 Bell housing cross-shaft
17 Lever—bell housing to T.V. rod
18 Control rod—bell housing to T.V. lever
19 Control rod—accelerator to compensator linkage
20 Pull-off spring
21 Lever—accelerator pedal cross-shaft
22 T.V. lever
23 Kick-down stop
24 Accelerator pedal
25 Cross-shaft—accelerator pedal

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

Chapter T

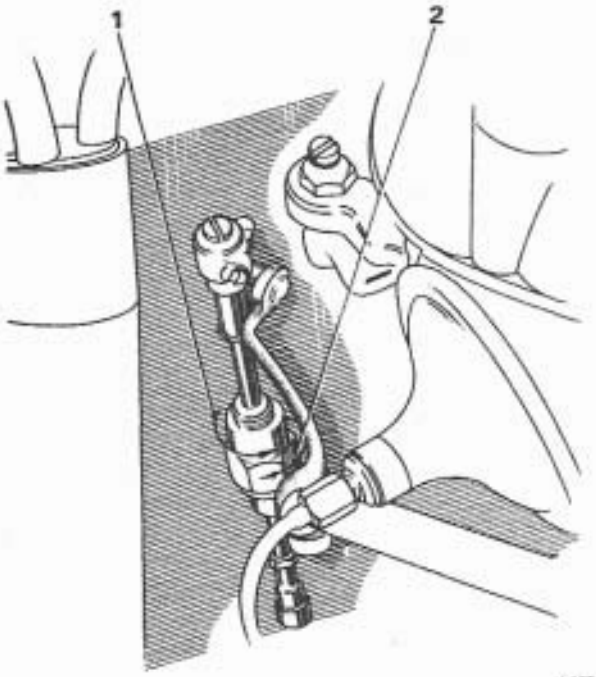


FIG. T10 T.V. MICRO ADJUSTER
1 Increase T.V. 2 Decrease T.V.

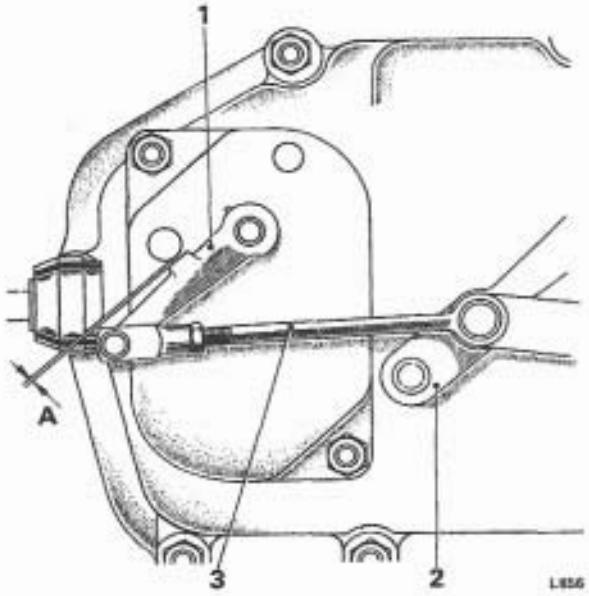


FIG. T11 SETTING THE NEUTRAL START AND HEIGHT CONTROL SWITCHES

A 0·050 in. + 0·010 in. (1,27 mm + 0,25 mm)
1 Neutral start and height control switch actuating lever
2 Gearbox lever
3 Operating rod

The button is spring-loaded so that the driver may feel the difference between the full throttle position and the kick-down position.

Kick-down stop — To adjust

To adjust the kick-down stop proceed as follows.

Remove the floor covering from the toe board on the driver's side of the car; the kick-down stop can be seen under the accelerator pedal.

Slacken the large lock-nut, then adjust the body by screwing it up or down as required; tighten the lock-nut. When setting the kick-down stop care must be taken not to confuse a forced down-change (kick-down) with a normal top gear down-change which occurs below 35 m.p.h. (56 k.p.h.) (*see Change points in Section T3*).

If, when adjusting the kick-down stop, its position is such that it is in danger of being hidden by the carpet, an improvement can be made by shortening the length of the long operating rod. This operation will throw the accelerator pedal further up (away from the toe board) thus allowing the kick-down stop to be raised.

Check that the closed throttle condition is still obtainable.

Selector linkage — To adjust

Selector linkage setting is comparatively simple and one rod only need be adjusted.

Select 'R' on the steering column control. When the actuator has moved the selector lever on the gearbox to the reverse position it should be possible to move the gearbox lever a small amount in a rearward direction.

Select 'N', then, when the actuator has moved the gearbox lever to the neutral position, it should be possible to move the gearbox lever a small amount in a forward direction.

Note When fitting an actuating rod on which the lock nuts are released and which is not adjusted to the correct length, ensure that the actuator and the gearbox lever are both in the same gear position when the rod is connected (*see Section T7—Gearbox electric actuator*).

Neutral start and height control switches — To set

If the gear change control levers and rods have been removed for any reason, the setting of the neutral

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

start and height control switches must be checked.

To set the switches proceed as follows.

Select Neutral on the steering column control.

Using feeler gauges, check the gap that exists between the forward edge of the switch actuating lever and the stop on the switch cover (*see Fig. T11*).

If necessary, adjust the operating rod until a 0·050 in. plus 0·010 in. (1,270 mm. plus 0,254 mm.) gauge will just pass between the lever and the stop.

This gap sets both the neutral start and the height control micro switches.

When all the controls have been finally adjusted ensure that all locking nuts, pinch bolts and split pins are secured and that the linkage operates freely.

Ensure that the engine throttle reaches the fully open and the fully closed positions.

Printed in England

July 1971

T.S.D. 2476

Printed in England

July 1971

T.S.D. 2476

Section T6
AIR PRESSURE CHECK AND INVESTIGATION

The air pressure test assists fault diagnosis by indicating which unit is leaking excessively and in some instances it can be used to check for unit functioning.

The tests can be made only after removal of the gearbox sump, the side cover, the control valve unit and the parking brake bracket. After removing the control valve unit and parking brake bracket, the oil holes that lead to the various units will be revealed. Using tool (R 5280) or a similar adaptor connected to a compressed air supply of approximately 80 lb/sq. in. (5,625 kg/sq. cm.) apply air pressure to the oil passages; refer to Figure T12 for identification of the oil passages. Excess oil should be blown out onto a cloth before examination.

Front servo

The front servo will apply the front band when air pressure is applied to the front band apply passage. Small air leaks are permissible only — through the servo-to-casing joint face — from the 4-3 timing valve exhaust hole — and from the front band release passage; no other leaks are permissible. Excessive leakage from the front band apply passage or from the compensator passage may cause slipping on the 2-3 up-change or when starting from rest. As the front servo is returned by spring pressure to the released position, application of air to the front band release passage will not actuate the servo or band but it will indicate excessive leakage. Slight leakage past the piston ring gaps is permissible. Excessive leakage will cause slipping on the 3-4 up-change and if it is very excessive will cause missing of second and fourth gears.

Air pressure applied to the G1 to 4-3 timing valve passage should give a slight leak only from the front band apply passage. A sticking 4-3 timing valve may cause a rough 4-3 down-change.

Rear servo and accumulator

The rear servo will operate when air is applied to the rear band release passage. The accumulator piston can be felt to move when air is applied to the rear clutch apply port. Air will escape through the piston ring gaps but leakage should not be sufficient to impair operation.

The primary valve will be seen to move if air is applied to the main line oil-to-primary valve port. The valve will not move when air is applied to the T.V. passage but air leakage from both sources should be confined to a slight leak from the valve body joint face.

A sticking primary valve may give a 'slippy' 2-3 up-change.

Front epicyclic unit

The front unit contains the front clutch which can be felt or heard to operate when air pressure is

applied to the front clutch apply passage. Excessive air leakage will indicate either faulty clutch piston seals or a faulty oil delivery sleeve; the latter can be more accurately checked by removing the servos to enable a closer examination to be made of the source of leakage.

The operation of both front and rear units can be affected by leakage from the oil delivery sleeve.

It may be possible to rectify leakage from the oil delivery sleeve if it is due to loose bearing cap set-screws or incorrect fitting of the cap to the sleeve, but any other fault will require the removal of the gearbox to permit removal and investigation of the front epicyclic unit or oil delivery sleeve.

A loss of oil pressure or any other fault which causes the clutch to slip will cause slipping on the 1-2 and 2-3 up-changes. If excessive, second and fourth gears will be missed.

A locked front unit, due to faulty gears, will prevent a forced 4-3 down-change and missing of first and third gears; this, of course, will not be shown up by the air pressure check.

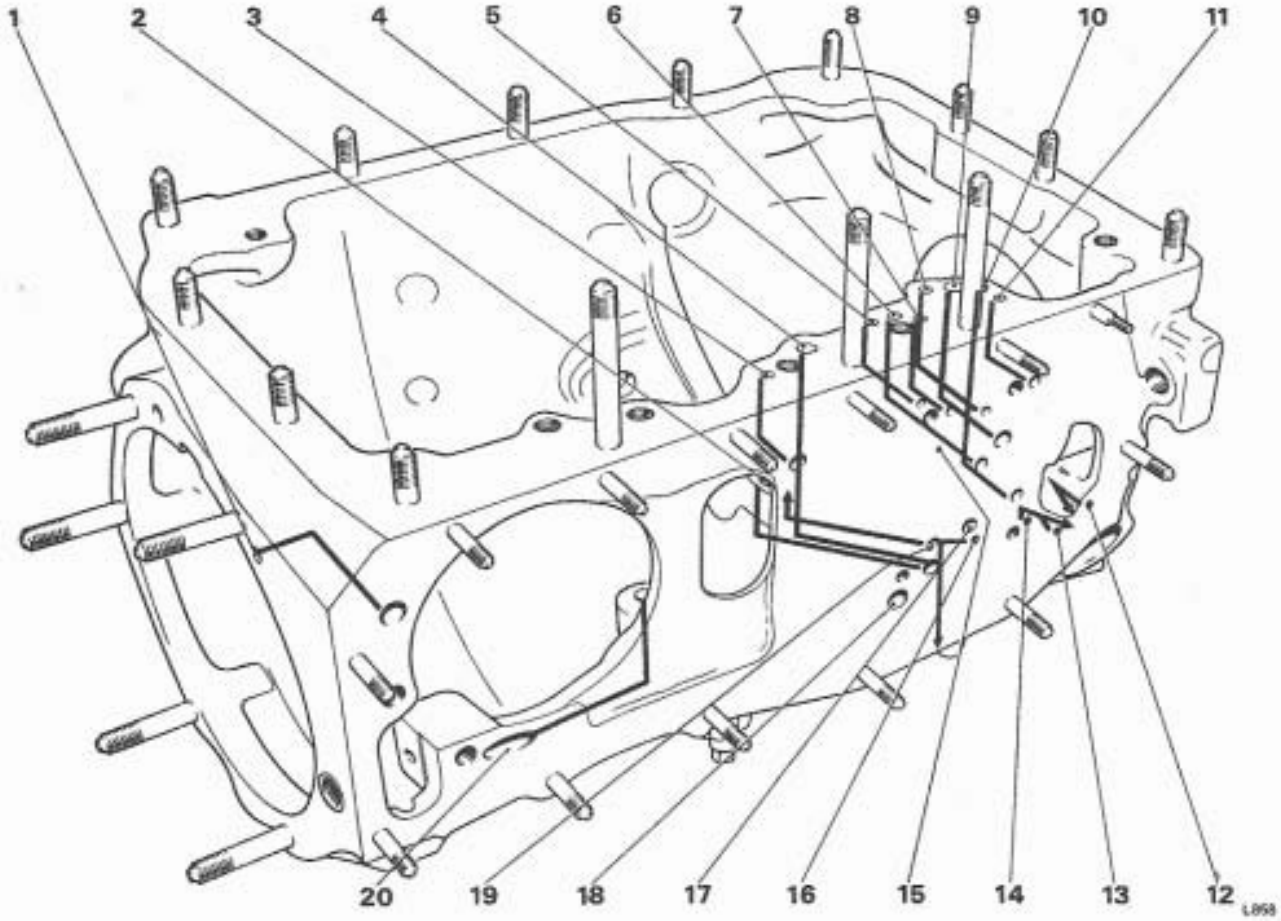


FIG. T12 OIL PASSAGE IDENTIFICATION

1 Reverse clutch apply
2 Rear clutch apply
3 Rear band release
4 Main line oil to accumulator piston
5 T.V. oil to modulating valve
6 Main line to modulating valve
7 Compensator
8 G1 Pressure
9 Main line
10 Front band release
11 Front band apply
12 Reverse booster
13 T.V. oil
14 T.V. oil
15 Exhaust
16 Main line pressure tapping
17 Exhaust
18 Main line oil to centre clutch
19 Front clutch apply
20 Governor feed

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

Printed in England

July 1971

T.S.D. 2476

Centre clutch

When air is applied to the centre clutch apply hole the clutch should be felt and heard to operate. Excessive air leakage will indicate faulty oil seals.

A slipping centre clutch will render the sprag inoperable, allowing the rear drum to rotate. This can cause such symptoms as slip during up-shifts or if the leak is excessive, loss of forward drive.

Rear epicyclic unit

The rear unit and its clutch can be checked in the same manner as the front clutch by applying air pressure to the rear clutch apply passage. A slipping rear clutch will result in slipping on the 2-3 up-change and, if both front and rear clutches are slipping as a result of leakage from the oil delivery sleeve, there may be no up-change above first gear.

Reverse epicyclic unit

The reverse unit clutch test is the same as for the other clutches, the pressure being applied through the reverse clutch apply passage after the removal of the reverse clutch oil pipe. Excessive leakage from around the clutch piston indicates faulty piston seals; this may cause slipping or 'loss of drive' in Reverse. This can be rectified only by removing and dismantling the gearbox to overhaul the reverse clutch.

A tendency for the reverse clutch to stick in engagement after moving the selector lever from Reverse will prevent forward drive as the transmission will lock. It may be possible to rectify such a fault, before detailed investigation, by operating the transmission and by burnishing the clutch surfaces as described in the following paragraphs.

Free the reverse clutch by selecting Reverse and increasing engine speed then select Range 4. When the change occurs reduce engine speed to idling. Repeat this operation until the transmission is free.

If, after five attempts, the transmission is still not free, do not continue the procedure as a more detailed investigation will be necessary to cure the fault.

If the transmission can be freed by the foregoing method the clutch should be burnished by driving the car forward at 1 m.p.h. to 2 m.p.h. (1,61 k.p.h. to 3,22 k.p.h.) selecting Reverse then, when the change is nearly complete, again select forward drive.

Repeat this procedure five or six times then select Range 4 and drive the car at approximately 20 m.p.h. (32 k.p.h.) for a few minutes to cool the gearbox. Repeat this cycle five or six times then road test the car.

Governor and parking brake bracket

checked together for excessive leakage after removing the governor feed pipe and then fitting it so that the servo end of the pipe is swung clear of the gearbox. Air pressure can then be applied to the open end of the pipe.

With the governor weights pressed inward manually to close the ports there will be some leakage past the piston rings where the ring ends interlock; air will escape from the governor sleeve, the G1 passage, G2 passage and the valves but this should not be excessive. There may be slight leakage from the parking and reverse blocker pistons.

There should be little or no leakage from the bracket-to-casing face joint. Excessive leakage would prevent any up-change.

If the reverse blocker piston sticks in, due to insufficient governor pressure or for any other reason, reverse engagement above the maximum speed of 10 m.p.h. (16 k.p.h.) will be possible.

If the reverse blocker piston sticks out due to leakage of main pressure oil into the governor passage (broken piston ring), it will prevent the selection of Reverse below 10 m.p.h. (16 k.p.h.).

If the parking blocker piston sticks out it will prevent the engagement of the parking pawl when Reverse is selected for parking purposes.

Clashing when Reverse is engaged may be caused by incorrect operation of the parking pawl.

The governor valves should not have a tendency to stick and if they are moved outward during the air pressure check, there should be an increase in the air flow from the G1 and G2 passages and governor valve exhaust ports. Sticking valves or excessive leakage in the governor will cause defective operation such as high or low up-changes, slipping in Range 4 and Range 3 or slipping with failure to drive in Reverse.

Other passages which may be checked during this diagnosis procedure are the pump main feed passages, the exhaust ports for the control valve unit and the passage to the pressure gauge blank.

Air pressure applied to the main line passage will result in a large escape of air from between the front drum and the front pump; this is normal and comes from the rear side of the front pump.

The exhaust ports for the control valve unit should allow unrestricted flow into the inside of the main casing.

Chapter T

Pressure control valve

When removing the pressure control valve care must be taken to retain the damper spring, reverse booster plug and the throttle regulator plug.

After thorough cleaning, blow out the passages to the regulator plug and the reverse booster plug; the plugs should move freely in their bores. The plugs and springs should be assembled using petroleum jelly to retain them in position.

Before fitting the regulator valve into its bore, it is recommended that oil is flushed through the bore by motoring over the engine by means of the starter motor. **Do not** introduce cleaning fluid into the bore.

Control valve unit

The control valve unit cannot be satisfactorily checked in position, therefore, if the foregoing checks indicate that the control valve unit is faulty it should be removed, dismantled and overhauled as described in Section T12. Before removing the unit, check that the securing setscrews are tight as leakage between the joint faces may seriously affect valve operation.

Fluid coupling

Slipping or faulty gearchanges are unlikely to be caused by the fluid coupling, except in the event of damaged torus members which may cause slipping and overheating at all speeds. Damage to these members is most improbable.

Temporary slipping on starting the car, without the recommended three minutes warming-up period can be the result of a leaking torus check valve. This is because there is insufficient oil in the fluid coupling due to excessive flow through the check valve. Such a defect raises the level of oil on the dipstick which can therefore be used to check for the fault.

Check the oil level as previously described then wait for approximately ten minutes with the engine stationary; note the oil level on the dipstick without running the engine. If the level of oil has increased by more than half an inch, excessive leakage is confirmed and rectification is necessary.

Any fault associated with the fluid coupling will require removal of the gearbox before the fault can be rectified.

Noise

The source of any noise that occurs in the gearbox should be traced by the phase of operation associated with the faulty unit. Before examining the gearbox for noisy units ensure that the noise is not caused by the engine, the final drive or other moving parts. Also ensure that gearbox noise is not being transmitted by adjacent components which may contact the gearbox. All gearboxes are checked for noise during testing at the factory. Any slight gear noises which are emitted by the gearbox should not be audible to the driver or passengers. The following paragraphs may help in locating noise which may become apparent at varying road speeds and gear positions.

Planet gear noise will be heard as a low growl, rising to a high pitched whine as speed is increased. Front unit noise will be at a higher pitch than that of the rear unit, while reverse gear noise can be heard only when accelerating in Reverse.

Tests should be made by accelerating through the gears in Range 4 and noting the characteristics of the noise at the change points. Noise in both first and second gears is caused by the rear unit.

Noise in both first and third gears is caused by the front unit.

Rear unit noise may also be heard when slowing down in Reverse.

Slight gear noise in Neutral, which disappears when drive is selected is usually attributable to the rear unit.

Oil pump noise may be more pronounced at a certain engine or road speed. As the gearbox front pump is operating only when the engine is running, and the rear pump only when the output shaft is rotating, it is possible to detect which pump is defective by static and road tests.

The test should be started in Neutral and the throttle gradually opened whilst noting the engine speed at which noise, if any, is most pronounced. Select Range 4 and drive the car on the road until the noise is most pronounced then quickly switch off the engine and select Neutral to stop the rotation of the front pump.

If the noise still persists and was not noticeable when the car was stationary, the rear pump is suspect.

There are two possible faults which can cause noise in the rear pump.

Noise caused by the rear pump driving gear is a whine similar to axle noise and will usually be most noticeable above 20 m.p.h. (32 k.p.h.). If doubt exists, axle noise can be eliminated by disconnecting the gearbox coupling flange then, with the selector in Range 4, run the engine up to the speed at which the noise was most noticeable.

The other possible cause of noise in the rear pump is inner gear noise, which is usually a low growl occurring at speeds above 35 m.p.h. (56 k.p.h.).

Printed in England

July 1971

T.S.D. 2476

Important In the tests for suspected noise in the rear pump, coasting with the engine switched off should not exceed 25 m.p.h. (40 k.p.h.) and should be kept to the minimum necessary to confirm or eliminate the fault. The possible low oil pressure from a faulty rear pump may cause incorrect operation or inadequate lubrication with possible damage to other units in the gearbox.

The fluid coupling is unlikely to cause noise or slipping unless it is damaged or incorrectly fitted. A metallic scraping noise would result from fouling of the rotating parts. Worn torus member splines may result in increased gear noise in Neutral.

'Get You Home' lever

The 'Get You Home' lever is fitted to a bracket which is secured to the left-hand side of the gearbox by two side cover securing nuts. A link connects this lever to the gearchange lever on the manual control shaft.

In the unlikely event of failure of the gearbox electric actuator it is possible, by using the 'Get You Home' lever, to effect a manual gear change so enabling the car to be driven to a Service Station where the faulty actuator can be serviced or replaced.

Access to the 'Get You Home' lever is obtained by moving back the front passenger seat, lifting the carpet flap to expose the rubber blanking plug, then removing the plug (*see Fig. T13*).

To actuate the lever, fit the tommy bar from the car tool kit into the hole in the top of the lever, then push the lever backward or forward as required.

Pushing the lever fully back will select Neutral. One notch forward from this position will select Range 4. Range 3 and Range 2 follow progressively. Reverse can be obtained by pushing the lever fully forward.

By selecting Range 4 the driver should be able to drive the car normally until he has reached his destination. If he then requires Reverse the lever will have to be moved.

It should be noted that, as this control is on the passenger side of the car, it should not be operated as a normal manual gearchange but only as an emergency feature.

Rectification of units

Units which can be removed and fitted without removing the gearbox from the car are as follows.

1 Pressure control valve.
2 Control valve unit (requires removal of side cover and parking brake bracket).

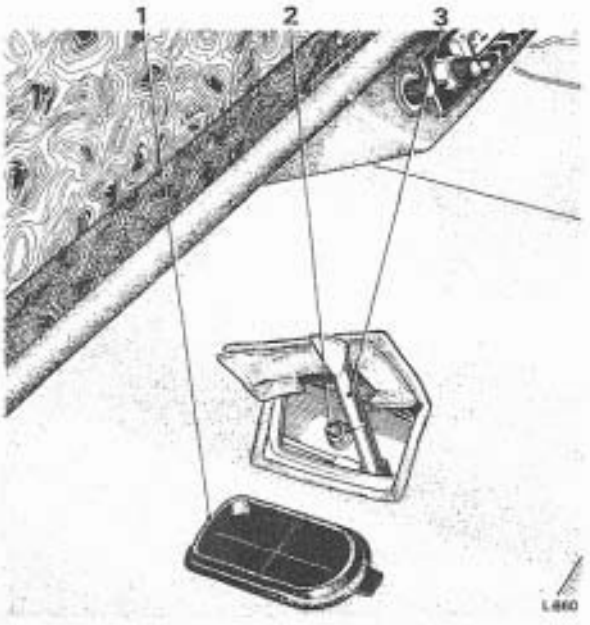


FIG. T13 ACCESS TO GET-YOU-HOME LEVER

1 Rubber seal
2 Rear band adjusting screw
3 Tyre lever

3 Parking brake bracket (requires removal of side cover and control valve unit).
4 Rear oil pump and governor (requires removal of side cover, sump, control valve unit and parking brake bracket and both servos).
5 Both servos (requires removal of sump and re-adjustment of bands).
6 Speedometer drive.
7 Electric gearchange actuator.

The units which necessitate the removal of the gearbox before they can be rectified are as follows.

1 Fluid coupling.
2 Front oil pump.
3 Front epicyclic unit.
4 Sprag clutch assembly.
5 Rear epicyclic unit.
6 Reverse epicyclic unit.

Towing

Towing or coasting with the engine switched off should be confined to as short a distance as possible and to a speed not greater than 25 m.p.h. (40 k.p.h.).

Before attempting to tow, examine the gearbox for mechanical damage and leaks then check the oil level. The car should not be towed if there is mechanical damage or if the oil level is low unless the propeller

shaft is removed.

The gearbox should be prepared for towing by slackening the rear band adjusting screw four and a half turns then locking the adjusting screw.

When towing, the selector lever should always be in the neutral position and, where possible, the towing speed maintained between 15 m.p.h. and 20 m.p.h. (24 k.p.h. and 32 k.p.h.).

T.S.D. 2476

July 1971

Printed in England

Printed in England

July 1971

T.S.D. 2476

Section T7

GEARCHANGE ACTUATOR, NEUTRAL AND HEIGHT CONTROL SWITCHES

The electric gearchange actuator (*see Fig. T14*) is mounted on the gearbox rear extension and is connected by levers and rods to the gearchange lever on the gearbox, and to the neutral start and height control switches on the gearbox side cover.

A 12 volt, series wound motor is secured to the rearmost part of the actuator casing and is enclosed by a cover. Both the cover and the actuator casing are magnesium castings.

The motor is able to rotate in both directions, reversal being obtained by employing a double-wound field coil. The windings are of equal resistance, and one winding or the other is energised according to the gearchange selector position. A reset button which neutralises a thermal cut-out is located in the main fuse box on the bulkhead.

The drive from the motor is transmitted to a worm shaft via a flexible coupling. The worm shaft drives a worm gear which is rivetted to a shaft onto which the operating lever is fitted.

A drum is pinned onto the worm shaft, the drum itself forming part of the flexible drive. A solenoid operated brake acts on the drum periphery to arrest lever travel when a particular gear has been obtained.

Seven phosphor-bronze spring contacts are rivetted to a laminated bakelite base plate which is secured to the actuator casing. The spring contacts operate against a silver plated slip ring assembly which is screwed to the worm wheel. Also secured to the base plate is a dual relay arrangement, the contacts of which are normally open.

The actuator casing is vented to atmosphere but all joints and electrical connections on the casing are fully waterproofed.

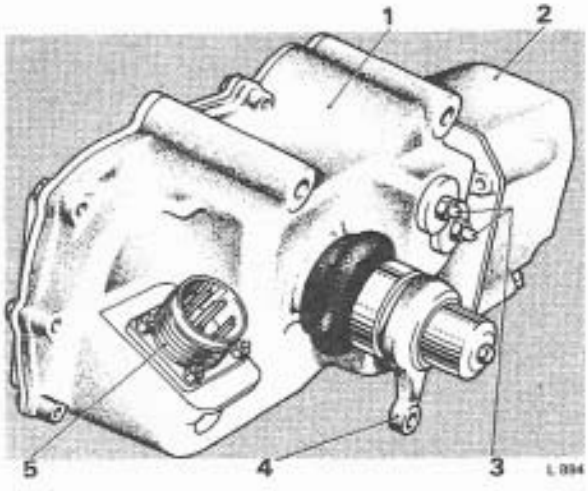


FIG. T14 ELECTRIC GEARCHANGE ACTUATOR

1 Actuator casing
2 Motor cover
3 Solenoid securing nuts
4 Actuating lever
5 Plug socket

Chapter T

A rod, which extends forward from the gear change linkage, is connected to a lever which is pinned to the neutral start and height control switch operating shaft. A cam is brazed onto the inner end of the shaft and actuates two micro switches, which are secured to the switch housing. The housing and wire connections are fully waterproofed and the whole assembly can easily be removed from the side cover without disconnecting the wires.

Operation

When the ignition is switched on and the selector lever on the steering column is moved to one of the gear positions, current is allowed to flow to the actuator motor via a relay.

The motor rotates and turns the worm shaft through the flexible coupling. As the worm gear rotates, the slip ring which is secured to the worm gear also rotates until an insulated slot in the slip ring is aligned with the live contact. When this position is reached, the current is cut off and the motor ceases to rotate. Immediately the current ceases to flow, the brake, which is held off by the energised solenoid, is applied to the drum thus positively holding the shaft and lever in the required position.

As soon as the lever on the steering column is moved to another position, the solenoid is again energised, the brake is released and the motor will turn the actuating lever to the selected position.

The electric actuator is so wired that should the driver stop the car in a gear position other than Reverse then switch off the ignition, he can still lock the transmission by moving the selector lever on the steering column to the reverse gear position.

Having done this, if he now moves the lever out of this position, or the lever is accidentally moved to a drive position, the actuator will not respond until the ignition is switched on.

The neutral start switch is actuated only when the gearbox is in Neutral, and the engine cannot be started until the micro switch is in its operating position. Also actuated when in Neutral is the height control switch which selects fast levelling whilst the car is stationary (*for information concerning the operation of the levelling switch see Chapter G—Section G9—Solenoid valve—T.S.D. 2476 Workshop Manual*).

Actuator—To test

The two tests described are designed to prove if a fault lies within the gearbox actuator or elsewhere in the gearchange electrical circuit.

The first test is designed to discover whether the pins of the actuator loom socket receive the correct electrical signal in sequence, as dictated by the position of the gear range selector lever.

1. Ensure that the gearchange thermal cut-out switch on the distribution board (fuse panel) has not cut-out. This can be done by depressing the Red button. The position of the button will not change whether the switch has tripped or not, however a

TEST CHART—ACTUATOR SOCKET

Socket Pin No.	Gear Range Lever Position					General Notes
	R	N	4	2	3	
A	N	Pos	N	N	N	
B	N	N	N	N	N	
C	N	N	Pos	N	N	
D	N	N	N	Pos	N	
E	N	N	N	N	Pos	
F	Pos	N	N	N	N	
G	Neg	Neg	Neg	Neg	Neg	This pin is Negative when the ignition is ON, and Neutral when the ignition is OFF.
H	Pos	Pos	Pos	Pos	Pos	This pin is directly connected to the thermal cut-out switch.
I	Neg	Neg	Neg	Neg	Neg	This pin is fixed to the valance earth point.

Key

Pos. Common with the battery positive terminal
Neg. Common with the battery negative terminal
N Neutral—no connection to either battery terminal

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

tripped switch will click on pressing the button.

2. Ensure that fuse number 12 is intact.

3. Disconnect the low tension wire from the distributor and turn the ignition switch to the 'on' position.

4. Slightly loosen the actuator loom socket and check the actuator function. This will reveal any poor contact which may exist between the plug and socket.

5. Unscrew and withdraw the loom socket from the plug of the gearchange actuator.

6. Connect the negative side of a suitable voltmeter to a good earth point. The positive side should be connected in turn to the various pins of the loom socket (*see Test Chart—Actuator Socket*).

7. Move the gear range selector lever to the 'Reverse' position and check that all the pins of the loom socket are of the correct polarity or are neutral, as indicated in the 'Test Chart'.

Note Each pin in the socket is identified by a letter which is moulded in the rubber body adjacent to each pin.

8. Carry out the above operation in each of the gear range selector lever positions, checking each pin in turn with the information given in the 'Test Chart'.

9. Switch off the ignition and ensure that pin number G of the actuator socket is now neutral.

10. Reconnect the socket to the actuator and refit the distributor low tension cable.

Note If an incorrect reading is obtained during any of the above tests, this will indicate that the gear-change circuit is probably at fault and not the actuator.

It should be noted that the voltage readings obtained must not be more than 0·25 Volts less than the battery voltage. However, if the test sequence does not reveal a discrepancy, then the fault may be either inside the gearbox actuator or in the gearbox and neutral start switch linkage.

Before removing the actuator the gearbox linkage should be disconnected from the actuator output lever and checked for excessive stiffness.

The gearbox linkage should move into any gear when a load of approximately 10 lb. (4,53 kg.) is applied to the disconnected rod. When selecting 'Reverse' however, this load will be increased to 20 lb. (9,07 kg.).

If the linkage operation is satisfactory then it will be necessary to remove, recondition and test the actuator as described later in this Section.

After fitting the reconditioned actuator to the car, it should be finally tested as follows.

1. Disconnect the earth cable from the battery negative terminal, or from the boot quick release terminal when fitted.

2. Connect an ammeter capable of reading at least 20 Amps. between the battery negative terminal and the loose end of the earth cable.

3. Ensure that all accessories such as the rear window demister and blower motors are switched off and then switch on the ignition. Note the reading shown on the ammeter.

4. Move the gear lever between 'Neutral' and 'Reverse' gear positions and check that the extra reading on the ammeter caused by the operation of the actuator does not exceed 10 Amps.

5. Check that the actuator moves smoothly and quietly to each position selected and that the output lever stops in the correct position and does not 'hunt' about that position more than once before finally stopping.

6. Remove the ammeter and connect the battery negative cable.

Gearbox electric actuator — To remove

Should the electric gearchange actuator fail to operate it should be noted that the system includes a thermal cut-out. This device prevents the motor from being overloaded should the gearchange linkage become obstructed and, as a result, will give the impression of actuator failure.

Before removing the actuator, ensure that the controls are free and adequately lubricated and that the actuator electrical system is cool enough for the thermal cut-out to permit the motor to operate. Press the reset button in the main fuse box to reset the cut-out.

It is recommended that the easiest and quickest method of dealing with actuator failure, should it occur, is by substituting the faulty actuator for a service exchange unit. If, however, a service exchange unit is not available but adequate repair facilities are, the following procedure should be observed.

Disconnect the negative lead from the battery.

Remove the split pin and clevis pin from the actuating lever on the electric actuator; disconnect the rod from the lever.

Unscrew and remove the 'multi-pin' plug.

Disconnect the breather pipe from the rear extension and the actuator side cover.

Remove the three bolts which secure the actuator to the rear extension then remove the actuator.

Neutral start and height control switches — To remove

Remove the split pin and clevis pin which secures the link rod to the switch actuating lever; disconnect the link rod.

Remove the two nuts and washers which secure the

Printed in England

July 1971

T.S.D. 2476

switch cover to the gearbox side cover; remove the cover.

Note Before the switches can be removed from the car, the switch assembly must be partially dismantled and the wires disconnected (*see Neutral start and height control switches — To dismantle*).

Gearbox electric actuator — To dismantle

Unscrew the setscrew in the centre of the actuating lever cover then remove the cover.

Using spring compressing tool RH 7843 compress the coil spring sufficiently to enable the hardened steel pin to be removed; drive out the pin.

Remove the spring compressing tool then withdraw the operating lever, spring and spring retaining cup from the shaft.

Remove the nuts and washers which secure the side cover to the main casing; remove the cover.

Note The cover gasket is initially sealed on both sides with jointing compound and, as a result, the cover may not be easily removable. Do not use a screwdriver between the joint faces in an effort to remove the cover as this may cause damage to the joint faces and destroy the waterproofing effect. Discard the gasket.

Disconnect the motor feed to the relays.

Disconnect the motor earth and solenoid feed wires.

Remove the four nuts which secure the motor cover to the main casing; remove the cover.

The gasket is sealed with jointing compound and care should be exercised when removing the cover.

Discard the gasket.

Withdraw the motor from the four long studs. The motor is secured to a mounting plate and this will be removed with the motor. Remove the rubber grommet and withdraw the wires.

Discard the gasket.

Remove the coupling dog from the motor output shaft.

Remove the flexible rubber coupling from the brake drum.

Remove the nuts and washers which secure the motor to its mounting plate. Remove the motor from the mounting plate, withdraw the wires out from the grommet and through the hole in the plate.

Remove the nuts and washers which secure the plug wires to the connection on the insulated base plate; detach the wires from the connections.

Unscrew the nuts and washers which secure the plug assembly to the actuator casing. Remove the plug and withdraw the wires from the casing; retain the rubber gasket which fits between the casing and the plug.

Remove the nuts and washers which secure the insulated base plate to the main casing. Carefully lift the base plate from the studs.

Note Care should be exercised when handling the base plate assembly to avoid damaging the relays and contacts.

Using tool RH 7841 remove the roll pin which secures the brake drum to the worm shaft.

Push the pin through the drum and shaft until it can be removed; discard the pin.

Remove the drum from the worm shaft. It will be necessary to hold the brake shoe away from the drum whilst the drum is being removed.

Mark the top of the brake shoe in pencil to facilitate correct assembly.

Unscrew the dome nuts which secure the brake solenoid assembly to the main casing; remove the cup washers and the rubber washers. Remove the assembly from the casing. Secure the brake shoe assembly and spring to the solenoid with adhesive tape to retain them as a unit.

Remove the circlip and washers from the outer side of the seal which fits over the actuator casing and around the output shaft; remove the seal.

Remove the circlip which locates the output shaft and slip ring assembly in the main casing then remove the washer.

Withdraw the slip ring and shaft from the bush in the actuator casing; remove the washer from the shoulder behind the slip ring.

Remove the circlip which locates the worm shaft and bearings in the actuator casing. Remove the adjusting washer and label it to ensure the correct washer is fitted during assembly.

Gently tap the worm shaft and the bearings from the casing. The bearings are a push fit in the casing bores and no difficulty should be experienced when removing them.

This last operation will have dismantled the actuator into its main assemblies. It is recommended that no further dismantling be attempted. The base plate assembly, plug assembly, brake shoe assembly, solenoid assembly, brake solenoid assembly and the output shaft and slip ring assembly should be renewed, if necessary, as separate assemblies. The motor should also be removed as an assembly although it may be dismantled for inspection as follows.

Gearchange actuator motor — To dismantle

Unscrew and withdraw the two through-bolts.

Remove the end covers.

Withdraw the armature from the drive end. Retain the shim washers which fit between the shoulder on the drive end of the armature shaft and the drive end bush.

Note the side and the position of each brush to ensure correct assembly then remove the brushes, taking

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

Printed in England

July 1971

T.S.D. 2476

care not to stretch the brush tension spring excessively.

Should the pole piece require removal, mark the pole piece and the two retaining screws so that they can be fitted in their original position.

Neutral start and height control switches — To dismantle

If the gearbox has been removed from the car, the switch cover will have been removed from the gearbox side cover but it will still be connected to the car by wires. The procedure for dismantling the switches will therefore be the same as that for dismantling the switches when the gearbox is in position in the car.

To dismantle the neutral start and height control switches, proceed as follows.

Remove the four screws which secure the cover to the casing.

Remove the cover and discard the joint. The gasket is sealed with jointing compound on both sides during initial assembly and this may make separation of the cover and casing difficult. Do not use a screwdriver blade between the joint faces otherwise the waterproofing may be impaired.

Unscrew the knurled nut at the front of the cover.

Unscrew the two 6 B.A. screws which secure the micro switches to the casing.

Remove the switches and separator, disconnect the wires, then remove the wires and rubber grommet from the casing.

It should not be necessary to remove the operating cam and shaft which is secured in the casing by the lever. The lever is positioned and secured on the shaft by a roll pin.

Gearbox electric actuator — To inspect

Examine the magnesium casing for cracks or other damage. Ensure that the joint faces are clean and free from burrs.

Wash the gearchange operating lever, spring and covers in clean paraffin then examine them for general wear.

Ensure that the breather pipe is clear and free from damage.

Examine the driving dog slot for excessive wear, also the mating shaft on the drive end of the motor armature shaft. The dog should be an easy sliding fit on the shaft but without excessive side play.

Examine the rubber coupling for signs of deterioration.

Examine the general condition of the plug assembly. Ensure that no strands of wire are broken where they enter the pins. It is recommended that, in the event of the plug being considered unserviceable, the whole assembly be renewed, rather than an individual connection. Special crimping tools and 'Cannon' insert tools are required for assembly purposes and unless these are available the work should not be attempted.

Examine the seven spring contacts for security on the insulated base.

Care must be exercised when handling the assembled base plate so that the contacts and the relays are not damaged in any way.

Check the height of the contacts from the base plate. The contact point should be approximately 0·485 in (12,3 mm.) from the contact (lower) side of the base. If excessive wear has occurred on the contact points the base assembly should be renewed.

Should the dual relay assembly be unserviceable, it is recommended that the assembly be renewed rather than attempt rectification. The relays are precision units and are accurately set to give the correct operating times. The spring-loaded adjusting screw is set during the initial build of the relay and the setting should not be altered.

Ensure that the terminals and the terminal blocks are secure on the insulated base.

Examine the brake drum for scoring or damage. Ensure that the brake drum is a push fit on the worm shaft. If the drum is slack on the shaft, examine the drum bore and the shaft for signs of fretting.

Remove the adhesive tape from the brake shoe and solenoid assembly.

Ensure that the assembled plunger and brake shoe will slide freely into the solenoid.

If either the brake shoe assembly or the solenoid become unserviceable they should not be renewed separately. The components are tested as one complete assembly during initial build and must remain as such, unless equipment is available that will enable separate assemblies to be tested and 'paired' (*see Dimensional Data*).

Examine the brake linings for wear.

Examine the general condition of the wiring.

If the components are satisfactory, retain them with adhesive tape until they are required for final assembly.

Check the tightness of the four 5 B.A. screws which secure the slip ring assembly to the shaft.

Ensure that a 0·025 in. (0,64 mm.) air gap exists on each side of the silver plated segments which are secured to the slip ring.

Ensure that the edges of the slip ring around the air gap are free from burrs.

Examine the slip ring face for signs of tracking. This should not normally occur but, if signs of tracking are found, the slip ring assembly must be renewed.

Examine the teeth on the worm gear and the worm for damage or uneven wear.

Examine the ball bearing bores in the main casing for signs of fretting. The bearing should be a light push fit in the casing. Reject the casing if the bearings

have worked loose.

Examine for wear the bush which supports the output shaft. The shaft should be a running fit in the bush without excessive clearance i.e. the shaft should not rock in the bush (*see Dimensional Data*).

Gearchange actuator motor — To inspect

Under normal operating conditions the gearchange actuator motor should need no attention. The porous bronze bearings are impregnated with oil and the brushes are carbon copper.

Details of motor tests and performance are given in Dimensional Data at the end of this Section.

Neutral start and height control switches — To inspect

Examine the switch casing for damage to the joint faces.

Ensure that between 0·005 in. and 0·010 in. (0,13 mm. and 0,25 mm.) end float exists between the casing and the operating cam.

Gearchange actuator motor — To assemble

Assemble the gearchange actuator motor as follows (*see Fig. T15*).

Fit the pole pieces and the two self-tapping screws, ensuring that the marks made during dismantling are aligned.

Fit the brushgear assembly, ensuring that the brushes are fitted in their original position. Take care not to overstretch the brush tension springs. Ensure that the brush arms pivot freely on their terminal plate locations.

Fit the armature.

Fit the shim(s) to the drive end of the armature shaft.

Fit the end covers, securing them with the through-bolts.

Check the end float of the armature. This should measure between 0·002 in. and 0·012 in. (0,05 mm. and 0,30 mm.). If the end float does not conform to these figures remove the drive end bracket and adjust the shim(s) to suit.

Gearbox electric actuator — To assemble

Wash the bearings and shaft assembly in clean paraffin then dry them with compressed air.

Lightly lubricate the bearings with Esso Beacon grease.

Ensure that the actuator casing is clean and dry, then fit the shaft and bearings. Do not use force to fit the bearings to the casing.

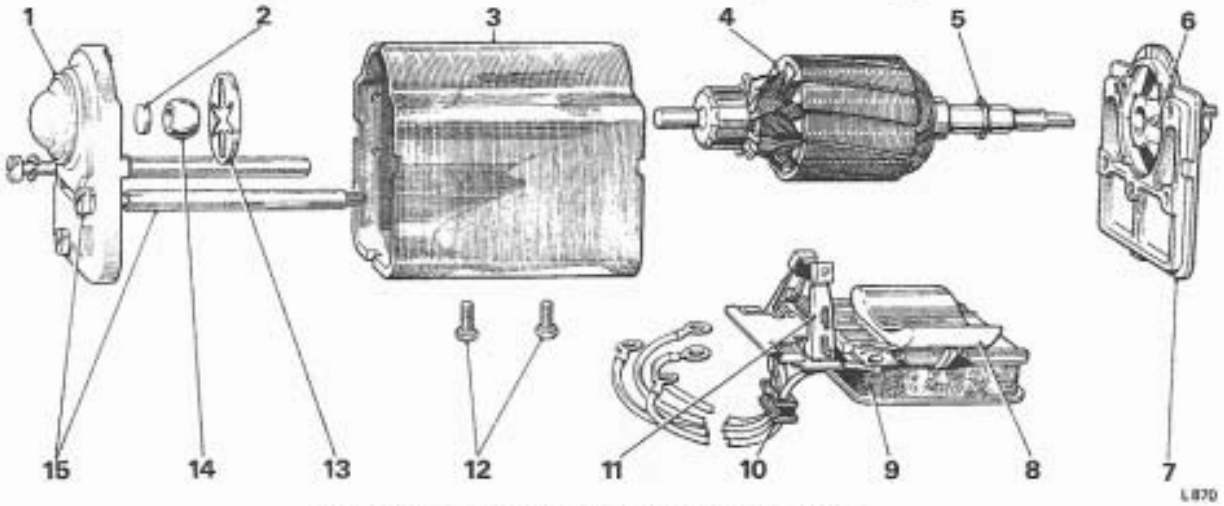


FIG. T15 GEARCHANGE ACTUATOR MOTOR

1 Commutator end bracket
2 Thrust pad
3 Yoke
4 Armature
5 Shim
6 Bearing retainer
7 Drive end bracket
8 Pole piece
9 Field coil
10 Grommet
11 Brushgear
12 Pole piece securing setscrew
13 Bearing retainer
14 Self-aligning bearing
15 Through-bolts and

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

Printed in England

July 1971

T.S.D. 2476

Fit the adjusting washer and the circlip.

Mount a dial test indicator so that the plunger rests on the end of the worm shaft (see Fig. 17).

Using a slave output shaft and gear, move the worm shaft backward and forward, noting the clock reading. If necessary, adjust the washer to give an end float of between 0·002 in. and 0·005 in. (0,05 mm. and 0,13 mm.). It will be appreciated that the bearings must be no more than a light push fit in the casing to achieve this (*see Dimensional Data*).

Ensure that the output shaft and the porous bronze bush are both clean; **do not wipe the bush with a degreasing agent.**

Lightly lubricate the shaft with Shell Tonna E oil.

Fit a washer over the shaft then fit the shaft into the bush in the casing.

Fit a washer over the end of the output shaft then fit the circlip.

Lightly lubricate the nylon worm gear with Esso Beacon grease.

Fit the rubber seal to the casing. A light smear of Esso Beacon grease applied to the inside of the seal will make this operation easier.

Fit the remaining washer and circlip to the shaft.

Ensure that the worm shaft will turn freely.

Rotate the output shaft until the open circuit sections are parallel with the worm shaft.

Note If the open circuits are at 90° to the worm shaft, the actuator will not operate when switched on initially.

Ensure that the pencil mark on the brake shoe is at the top.

Remove the adhesive tape from the brake shoe and solenoid assembly.

Fit the assembly into the actuator casing.

Fit the seal washers, cup washers and dome nuts. **Do not** tighten the nuts at this stage.

Push the brake drum down onto the worm shaft until the pin holes are aligned. If either the drum or the shaft are new components, ensure that the fit is such that the drum can be pushed onto the shaft, otherwise it will be difficult to align the holes. It will be necessary to hold the brake shoe in against spring pressure whilst the drum is fitted.

Fit a new roll pin to the shaft and drum using tool RH 7841 as shown in Figure T17.

Remove the tool, ensuring that the pin protrudes equally on each side.

The brake should be set in relation to the brake drum and solenoid as follows.

Obtain a smooth strip of soft metal e.g. aluminium, 0·048 in. (1,22 mm.) thick, 0·750 in. (19,0 mm.) wide and bend it into 1 in. (25,4 mm.) radius semicircle.

Slide the metal onto the outside of the drum.

Push the solenoid assembly in the direction of the brake drum until the brake shoe abuts the metal strip

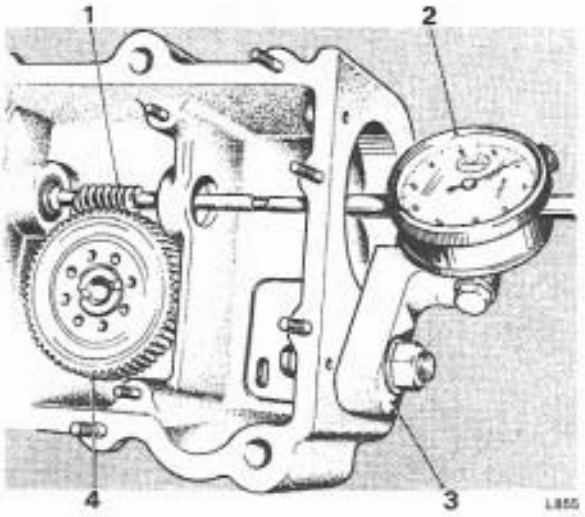


FIG. T16 CHECKING WORM SHAFT END FLOAT

1 Worm shaft
2 Dial indicator gauge
3 Gauge arm
4 Slave gear

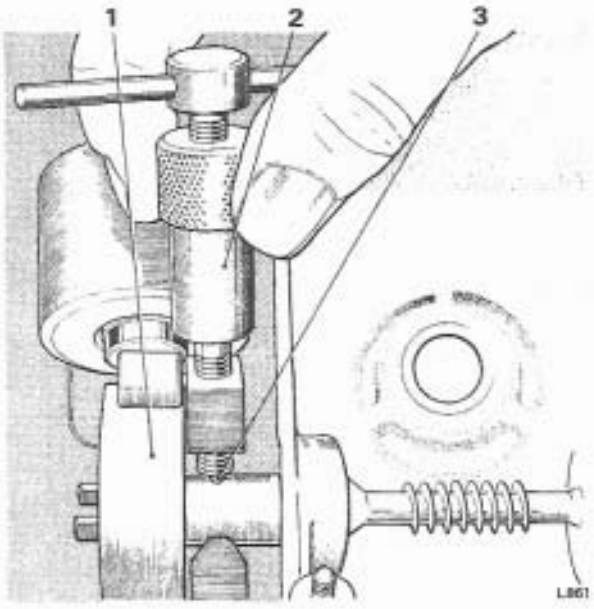


FIG. T17 FITTING THE BRAKE DRUM ROLL PIN

1 Brake drum
2 Tool
3 Roll pin

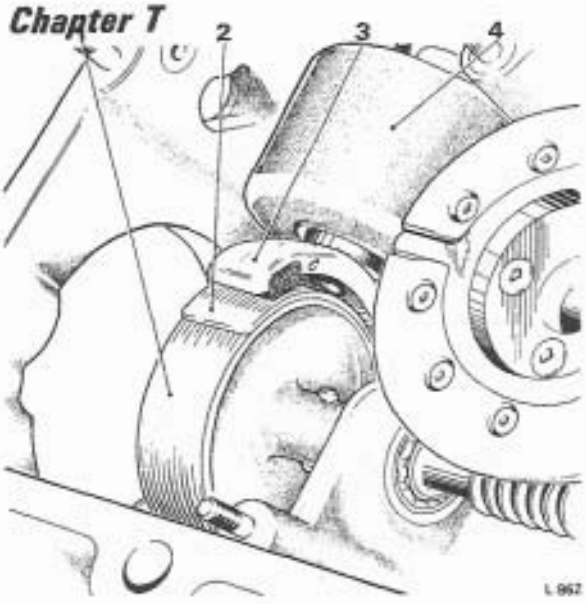


FIG. T18 SETTING THE SOLENOID BRAKE

1 Brake drum
2 Spacer
3 Brake shoe
4 Solenoid

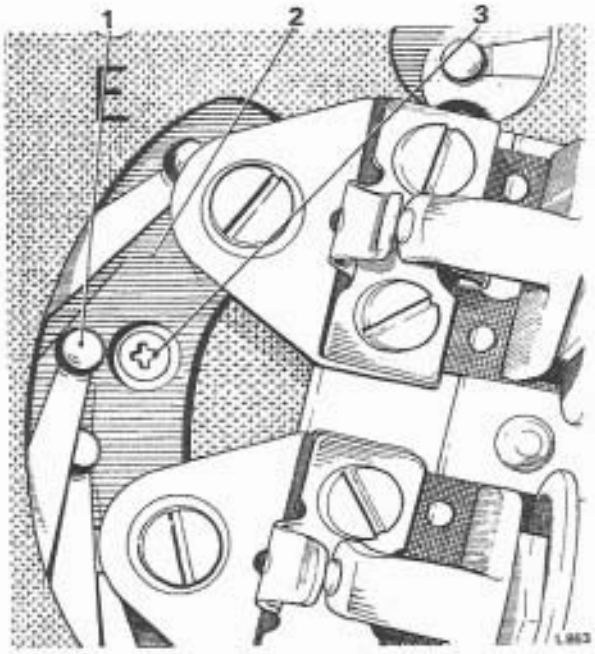


FIG. T19 CHECKING CONTACT POSITION

1 Contact
2 Slip ring
3 Securing screw

(*see Fig. T18*). Tighten the two dome nuts. Remove the metal strip. When the solenoid is operated, the plunger will then travel a distance of 0·035 in. (0,89 mm.).

Fit the insulated base plate with the seven contacts and the relays. Care should be exercised when performing this operation so that the settings of the relays and the position of the contacts are not disturbed. Evenly tighten the four 3 B.A. nuts.

Ensure that a gap of approximately 0·050 in. (1,3 mm.) exists between each contact. The slip ring and contacts can be seen through the motor mounting orifice.

View the contacts through the gaps in the contact plate and ensure that the contacts touch the slip ring centrally between the outside diameter of the slip ring and the outer perimeter of the rivet countersunk holes. There should be a clearance of approximately 0·062 in. (1,6 mm.) on each side (*see Fig. T19*).

Fit the rubber gasket to the plug assembly mounting face on the actuator casing.

Fit the plug assembly, ensuring that the two largest pins are lowermost. It will be advantageous to contain the wires with adhesive tape before attempting to thread them through the casing and the contact assembly.

Remove the tape, then run all the wires to their respective connections (*see Fig. T20*).

Fit the nuts and washers then tighten them, starting at the one furthest away from the plug and progressing toward the plug.

Do not fit any nuts which are tight on the threads of the studs in the terminal blocks. If a tight nut is fitted there is a danger that the terminal screw will turn and the terminal block will become loose, thus, a loose connection will be formed between contact and screw. If doubt exists about the firmness of a contact, the base plate must be removed and the terminal screw tightened.

Fit the actuator motor to its mounting plate studs. Fit and tighten the three 2 B.A. half nuts and spring washers.

Feed the motor supply wires through the mounting plate bore, then through the grommet. The longer end of the grommet fits into the casing.

Ensure that the rear face of the actuator casing and the front face of the mounting plate are clean and free from burrs, then apply a thin coat of Wellseal to the faces.

Fit a new gasket to the rear face.

Fit the flexible coupling onto the brake drum.

Fit the coupling dog onto the drive end of the motor armature shaft.

Fit the motor onto the four long studs.

Feed the wires through to the actuator casing, at the same time position the grommet.

Push the motor forward, align the driving dog with

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

Printed in England

July 1971

T.S.D. 2476

the rubber coupling, then push the motor fully home. Ensure that the rubber grommet fits correctly into its recess in the casing and has not become trapped.

Ensure that the rear face of the mounting plate and the joint face of the motor cover are clean and free from burrs.

Apply a thin smear of Wellseal to the faces, fit a new gasket to the mounting plate then fit the motor cover. Fit and tighten the four 2 B.A. nuts and washers.

Connect the motor feed and the solenoid feed wires (*see Fig. T20*).Fit the solenoid wires first with the wires to the eyelets lowermost.

Fit the motor earth and the solenoid connection with the wire to the eyelet uppermost.

Fit the motor feed wires to the relays.

Visually examine all connections to ensure that they are all correctly connected.

Ensure that the slip ring is positioned with the open circuit sections parallel with the worm shaft as described earlier.

Ensure that the joint faces of the actuator casing and the cover are clean and free from burrs.

Apply a thin smear of Wellseal to both faces then fit a new gasket to the casing.

Fit the cover and secure it with the eight 2 B.A. nuts and washers.

Fit the spring retaining cup onto the output shaft.

Liberally apply Rocol M 204 G Ragosine to the inside of the cup and to the output shaft.

Smear both ends of the spring with the same lubricant then fit the spring over the shaft and into the cup.

Lubricate the spring housing in the lever then fit the lever to the shaft with the lever pointing downward.

Smear the detent face of the lever, again using Rocol M 204 G Ragosine.

Using tool No. RH 7843 compress the spring then fit the hardened steel pin.

Coat the inside of the cover with the same lubricant. Fit the cover, securing it with the setscrew.

The lever should now be tested to ensure that the torque required to make the lever slip is correct. Proceed as follows.

Operate the lever at least three times in each direction to relieve any initial stiffness.

Fit a spring balance to the lever, with one end of the spring balance located in the clevis pin hole in the end of the lever.

Move the lever forward until it slips; note the reading on the spring balance.

Move the lever in the opposite direction, again noting the reading. The lever should slip at a load of between 60 lb. and 75 lb. (27,2 kg. and 34 kg.).

If the load required to move the lever is greater or less than the figures quoted check the spring poundage (*see Dimensional Data*) then renew either the spring or the lever to obtain the correct slipping load.

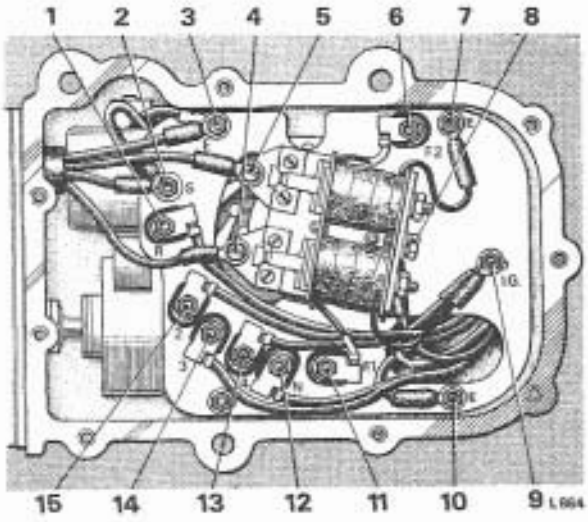


FIG. T20 WIRE CONNECTIONS

1 Black/Red, from plug terminal R
2 Green,from both solenoid and motor to terminalS
3 Black, from solenoid and Black/Green, from motor to terminal E
4 Red/Green, from motor to F1 relay terminal
5 Blue/Green, from motor to F2 relay terminal
6 Black, from relay coil motor end to terminal F2
7 Black, from relay coil plug end to terminal E
8 Brown/Black, from plug to relay positive feed terminal
9 Red, from relay coil plug end and Green/Black, from plug to terminal 1G
10 Black, from plug to terminal E
11 Red, from relay coil motor end to terminal F1
12 Black/Blue, from plug to terminal N
13 Black/Green, from plug to terminal 4
14 Black/Yellow, from plug to terminal 3
15 Black/White, from plug to terminal 2

Fit the breather pipe loose to the rear extension prior to fitting the acuator to the gearbox.

If rig testing facilities are available, the actuator should be tested to the specification given in Dimensional Data at the end of this Section.

Neutral start and height control switches — To assemble

Ensure that the lever and cam assembly is free to rotate.

Ensure that the cork seal is in good condition. Should the seal require renewal, press out the roll pin using tool No. RH 7841 , remove the lever and washer, then renew the seal. Fit the lever using a new roll pin.

Chapter T

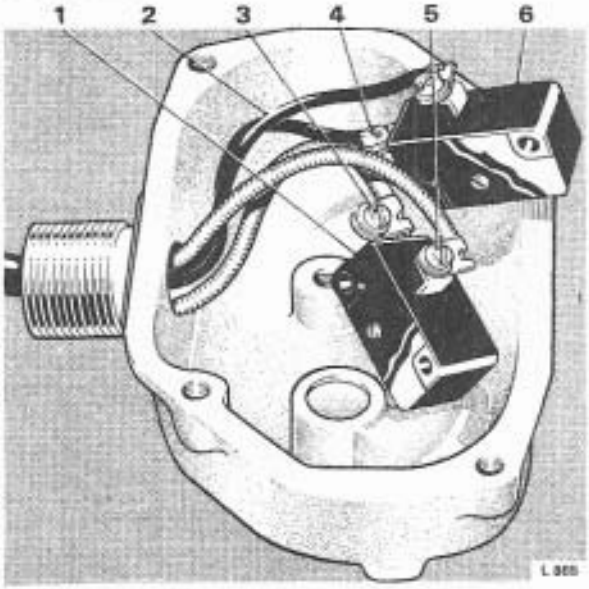


FIG. T21 MICRO SWITCH CONNECTIONS

1 Neutral start switch
2 Green lead
3 Red/White lead
4 Green/Black lead
5 White/Black lead
6 Height control switch

If the cam and shaft assembly has been removed from the casing, lubricate the shaft with Rocol M 204 G Ragosine when fitting the shaft to the casing.

Feed the wires into the casing then connect them to the micro switches as shown in Figure T21.

Fit the micro switches and separator to the casing. The insulated separator fits between the two switches.

Ensure that a gap of 0·050 in. (1,27 mm.) exists between the flat on the lever and the stop on the cover when the cam actuates the switches.

Pull the rubber sealing plug down the loom until it fits into the tapered bore in the casing. Tighten the knurled nut.

Ensure that the joint faces of the casing and cover are clean and free from burrs then apply a thin smear of Wellseal to both faces.

Fit a new gasket to the casing then fit the cover, using four 3 B.A. screws.

Gearbox electric actuator — To fit

Fit the gearbox actuator to the gearbox rear extension. Torque tighten the setscrews.

Fit the 'multi-pin' plug and tighten the knurled nut.

Fit the breather pipe to the actuator cover and to the rear extension.

On early cars, where the actuator breather system terminates by the gearbox rear extension casing, a flexible tube should be attached to the open end of the metal pipe and routed rearwards to terminate inside the centre cross-member.

On later cars (i.e. cars produced after SRX 3254—Standard cars and CRH 3399—Coachbuilt cars), a breather system incorporating the flexible tube is fitted.

It is essential that upon completion of work involving the actuator breather, an inspection be carried out to ensure that both the breather flexible pipe and centre cross-member adaptor are fitted and connected.

Neutral start and height control switches— To fit

Fit the switch to the gearbox side cover. Torque tighten the nuts.

Connect the control rods to both the units then adjust the controls as described in Section T5—Control Linkage.

DIMENSIONAL DATA FOR SECTION T7—GEARCHANGE ACTUATOR AND NEUTRAL START AND HEIGHT CONTROL SWITCHES

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Output shaft bearing bush i/d.	0·6273 in. — 0·001 in. (15,932 mm. — 0,025 mm.)	—	The bush is oil impregnated phosphor bronze and should not be cleaned with a degreasing agent.
Output shaft o/d.	0·6245 in. — 0·0005 in. (15,863 mm. — 0,013 mm.)	—	—

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

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Dimensional Data— *continued*			
Clearance.	0·0018 in. to 0·0033 in. (0,045 mm. to 0,083 mm.)	—	—
Front bearing bore—actuator casing.	0·7480 in. + 0·0005 in. (19,0 mm. + 0,013 mm.)	—	—
Front bearing o/d.	0·7480 in. − 0·0004 in. (19,0 mm. − 0,010 mm.)	—	—
Clearance.	0·000 in. to 0·0009 in. (0,00 mm. to 0,023 mm.)	—	—
Rear bearing bore — actuator casing.	0·7497 in. + 0·0005 in. (19,041 mm. + 0,013 mm.)	—	—
Rear bearing o/d.	0·7497 in. − 0,0004 in. (19,041 mm. − 0,010 mm.)	—	—
Clearance.	0·000 in. to 0·0009 in. (0,00 mm. to 0,023 mm.)	—	—
Front bearing i/d.	0·2362 in. − 0·0004 in. (6 mm. − 0,010 mm.)	—	—
Worm shaft front bearing diameter.	0·2363 in. − 0·0005 in. (6,001 mm. − 0,013 mm.)	—	—
Interference or clearance.	0·0005 in. tight to 0·0004 in. clear (0,013 mm. tight to 0,010 mm. clear)	—	—
Rear bearing i/d.	0·250 in. ± 0·0002 in. (6,35 mm. ± 0,005 mm.)	—	—
Worm shaft rear bearing diameter.	0·250 in. − 0·0005 in. (6,35 mm. − 0,013 mm.)	—	—
Interference or clearance.	0·0002 in. tight to 0·0007 in. clear (0,005 mm. tight to 0,018 mm. clear)	—	—
Brake drum — shaft diameter.	0·2485 in. + 0·0005 in. (6,312 mm. + 0,013 mm.)	—	—
Worm shaft—drum diameter.	0·2485 in. − 0·0005 in. (6,312 mm. − 0,013 mm.)	—	—
Interference or clearance.	0·000 in. tight to 0·001 in. clear (0,000 mm. tight to 0,025 mm. clear)	—	—
Worm gears backlash.	0·002 in. to 0·007 in. (0,05 mm. to 0,18 mm.)	—	—
Worm shaft end float.	0·002 in. to 0·005 in. (0,05 mm. to 0,13 mm)	0·005 in. (0,13 mm.)	Adjust end float by selecting suitable adjusting washer.
Motor armature end float.	0·002 in. to 0·012 in. (0,05 mm. to 0,30 mm.)	0·012 in. (0,30 mm.)	Adjust end float by selecting suitable adjusting washer.
Pressure of brushes on commutator.	4·4 oz. to 5·6 oz. (125 g. to 160 g.)		Renew spring or brushes to maintain pressure.
Solenoid brake spring—free length.	1·287 in. (approx.) (32,69 mm.) (approx.)	—	—
Load required to compress spring to a length of 1·045 in. (26,55 mm.).	6 lb. 8 oz. to 7 lb. (2,95 kg. to 3,18 kg.)	—	—
Operating spring free length.	1·00 in. (approx.) (25,4 mm.) (approx.)	—	—
Load required to compress spring to a length of 0·70 in. (17,8 mm.).	100 lb. (45,4 kg.)	—	—
2 B.A. half nuts—motor to mounting plate.	Torque tighten to between 30 lb. in. and 36 lb. in. (0,34 kgm. and 0,41 kgm.).	—	—

Printed in England

July 1971

T.S.D. 2476

DESCRIPTION	DIMENSION	PERMISSIBLE WORN DIMENSION	REMARKS
Dimensional Data— *continued*			
Remainder of 2 B.A. nuts.	Torque tighten to between 48 lb.in. and 60 lb.in. (0,55 kgm. and 0,69 kgm.)	——	——
Pole piece screws.	Torque tighten to between 6 lb.ft. and 8 lb.ft. (0,83 kgm. and 1,11 kgm.)	——	——
Setscrews — actuator extension.	Torque tighten to between 16 lb.ft. and 18 lb.ft. (2,21 kgm. and 2,49 kgm.)	——	——

ACTUATOR MOTOR TEST DATA

Nominal operating voltage	12.
Torque developed in either direction of armature rotation at 20°C. (68°F.) with a 0.9 ohm solenoid brake load connected in shunt with the armature	40 oz.in. at 200 r.p.m. (min.) at 16·5 amp. (max.) and 20 oz.in. at 700 r.p.m. (min.) at 14·5 amp. (max.)
Test voltage must be measured at the motor flags lead terminals. Motor must be mounted with the field pole mounting screws uppermost for all performance tests.	
Field coil resistance per winding	0·26 ohm. to 0.3 ohm.
Resistance of armature winding (measured between adjacent commutator bars)	0·16 ohm. to 0·19 ohm.

SOLENOID TEST DATA

Voltage required to withdraw plunger against spring loading from a set distance of 0·075 in. (1,91 mm.)	5·0 volts (max.)
Voltage required to hold plunger back against spring pressure	1·0 volts (min.)
Note When the plunger and solenoid assembly has been satisfactorily tested the components should be kept together and fitted as a complete unit.	

ACTUATOR TEST DATA

Voltage required to operate actuator—temperature range 70°C. (158°F.) to minus 17.8°C. (0°F.)	9 volts (min.)
Time taken to rotate a 2 in. (50,8 mm.) lever through 80° 15' with a torque of 15·0 lb.in. (0,17 kgm.) applied to the lever	1·5 seconds (max.)
With 9 volts applied at the motor and an ambient temperature of 20°C. (68°F.) the stall torque on the end of the lever must be 40 lb.in. (0,46 kgm.)	
With 12 volts applied at the motor and an ambient temperature of 20°C. (68°F.) the stall torque on the end of the lever must be 70 lb.in. (0,81 kgm.).	
With 12 volts applied at the motor and 10 lb.in. (0,12 kgm.) load applied to the lever, the actuator must select to within 3° of the correct position.	
With 14 volts applied at the motor and no load on the lever, the actuator must not 'hunt' between selector positions. It is permissible for the lever to move slightly past a selected position then return to that position before halting. It is not permissible for the actuator lever to move forward and backward past the selected position before finally halting in the position required.	

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