CHAPTER 2 . . SERVICING

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PERIODIC MAINTENANCE

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

Cleanliness is vital, as the smallest particle of dirt in the oil may interfere with the correct operation of the hydraulic valves in the gearbox.

It is recommended that all work on the automatic gearbox whether it be periodic servicing or the rectification of a suspected defect, should follow the systematic procedure outlined below.

1. Check gearbox oil level
2. Check for oil leaks
3. Lubricate control joints
4. Ascertain that engine is correctly tuned and then test change points and for slip and noise

If any faults are discovered, further checks may be necessary to assist diagnosis. The checks to be made will depend on the symptoms but with the majority of faults, they should be made in the following order :—

1. Check control linkage
2. Check oil pressure
3. Check band adjustment
4. Partially dismantle to isolate faulty unit by air pressure check

WARNING

When running the engine to check the gearbox with the car stationary, the selector should never be moved from neutral unless the handbrake is fully on. This is particularly important if the engine is running faster than the correct ' hot ' idling r.p.m. Block the wheels and use the foot brake when using high engine r.p.m.

SERVICING PERIODS

MAINTENANCE	PERIOD
Adjust bands and control linkage	After first 1,000 miles
Check oil level Check for leaks Lubricate control linkage Road test to check gear changes	Every 5,000 miles
Drain transmission and refill with new fluid	After first 1,000 miles and then every 20,000 miles
Clean oil breather in top of dipstick	Every 10,000 miles or twice a year

CHECKING OIL LEVEL

The oil level can only be checked accurately when the engine is running and the gearbox has warmed up to its correct operating temperature, which takes approximately three minutes.

If the oil level is near or below the ' L ' mark, top up to the ' F ' mark while the engine is still running and check for oil leakage as described under ' Oil leaks.'

Only automatic transmission fluid, type ' A,' having an Armour qualification number prefixed by AQ ATF should be used. Any of the following brands may be used :—

		Type
Vacuum Oil Co.	Mobiloil fluid 200	AQ ATF.101
Shell	Donax T.6	AQ ATF.257
Wakefield	Castrol T.Q.	AQ ATF.156
General Motors	Hydra-Matic fluid	—
* Energol Automatic Transmission fluid		AQ/ATF 261

The recommended procedure is as follows :—

1. Select ' N,' ensure that the hand brake is on, then start and run at idling speed to warm up the transmission.
2. With the transmission warming up, remove the dipstick access cover and thoroughly clean around the dipstick *before* removing the dipstick.

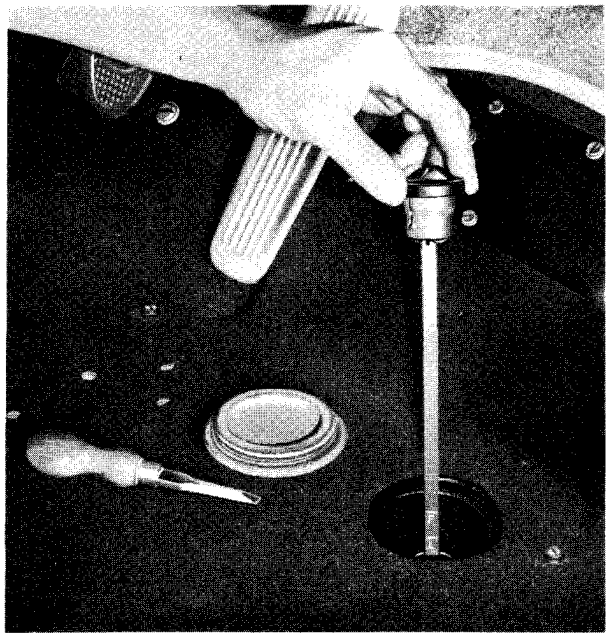

Fig. 1 Checking the oil level

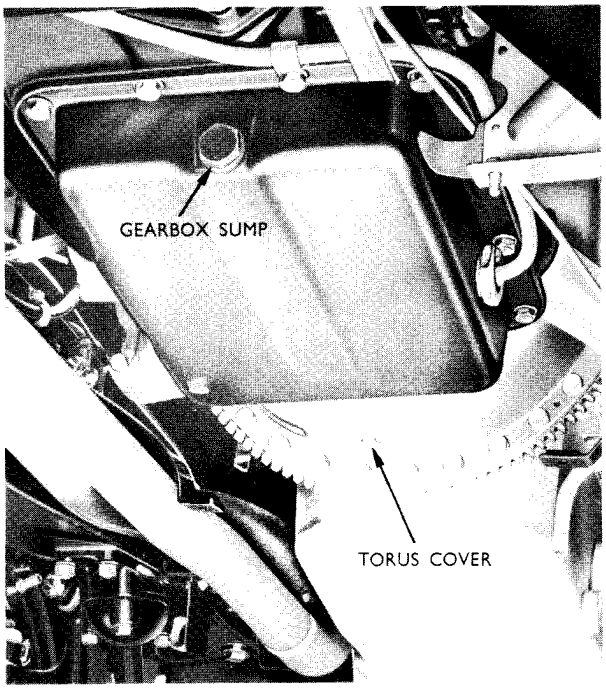

Fig. 2 Drain plugs

3. Remove and clean the dipstick before checking the level.
4. If topping up is necessary, pour in the correct oil in small quantities checking frequently to make sure that the level does not exceed the ' F ' mark.

Overfilling, which may itself result in oil loss through the breather due to excessive frothing, may also be indicated by a continuous ' patter ' noise when the car is moving.

DRAINING AND REFILLING

It is permissable to re-use the oil that has been drained after the initial 1,000 miles running, provided that it is filtered through a 30 mesh or finer gauze filter.

Efficient draining of the oil from the fluid coupling and sump is assisted by warming up prior to draining. Do not flush the transmission but ensure that it has drained thoroughly. Proceed as follows :—

1. Clean area round sump drain plug and remove plug.

* Amended January 1956

2. Remove lower bell housing cover, turn engine to bring the fluid coupling drain plug to the lowest point, remove plug and drain thoroughly. Do not use drained fluid again, but examine it carefully for evidence of wear.

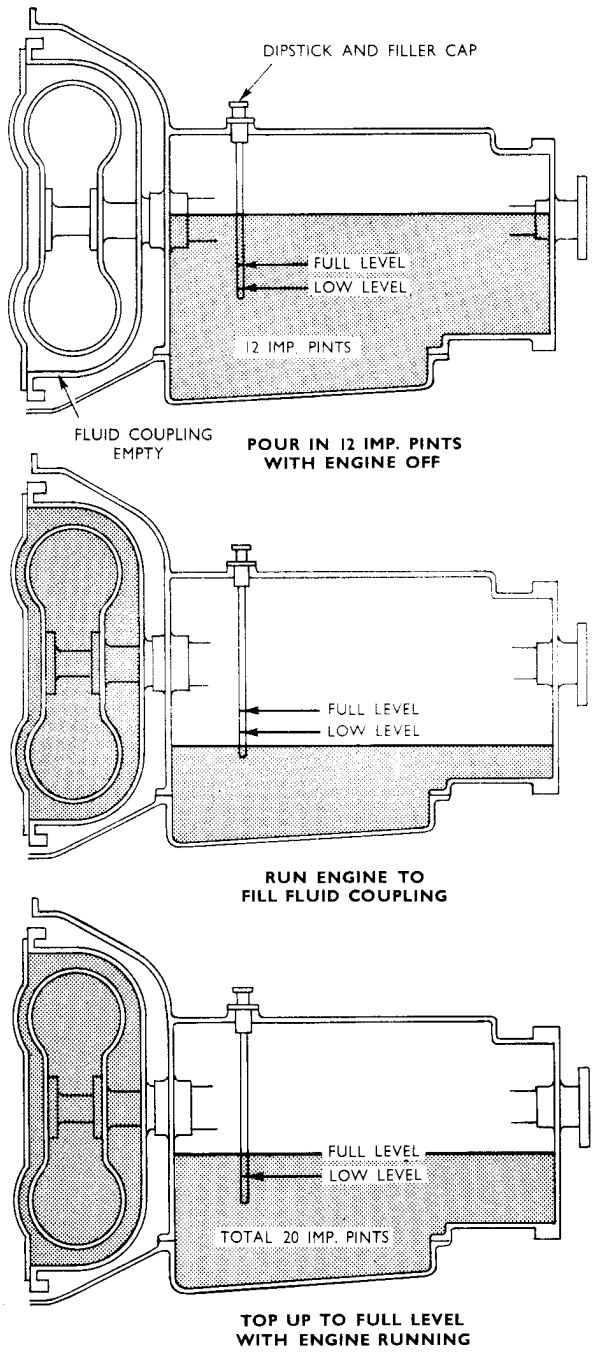

Fig. 3 Filling and topping up with oil

3. Replace both plugs, tightening the sump plug to 35 to 45 lb. ft. torque and using Permatex No. 3 sealing compound on the threads of the fluid coupling drain plug, which should be tightened to 6 to 7 lb. ft. torque.

Ensure when filling, that fluid and containers are scrupulously clean. The fluid coupling and sump are filled through the same filler, a new or overhauled gearbox requiring 20 Imperial pints or 24 U.S. pints of fluid. A gearbox that has just been drained will require approximately $\frac{3}{4}$ Imperial pints or 1 U.S. pint less to reach the *full mark*. Fill up as follows (fig. 3) :—

1. Remove the dipstick and pour in 12 Imperial pints (14 U.S. pints) of fluid.
2. With the control lever in Neutral and the hand brake on, start and run the engine at a fast idle for approximately 5 minutes.
3. Stop the engine and add a further 6 Imperial pints (7 U.S. pints).
4. Whilst running the engine at a slow idle, check the level with the dipstick, and add sufficient fluid to bring the level to the ' F ' mark. Take care not to overfill.

PRIMING THE RIDE CONTROL OIL PUMP

As some of the gearbox oil is pumped by the ride control oil pump into the rear dampers, the ride control oil system should always be bled to remove air whenever the gearbox has been drained and refilled. To do this proceed as follows :—

1. Jack up the back wheels.
2. Remove the blank from the four-way connection on the ride control oil delivery pipe (fig. 4).
3. Run the engine at a fast idling speed with the selector in range 4, or, alternatively, wind the back wheel in a forward direction to prime the ride control oil pump by forcing air and oil through the open connection.
4. When all the air has been forced out, refit the blank.

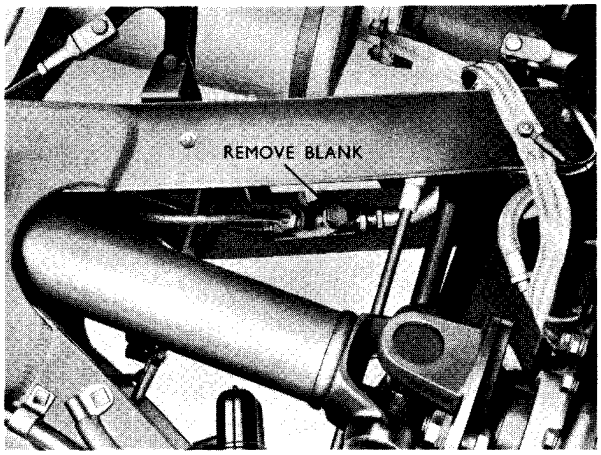

Fig. 4 Priming the ride control oil pump

If it is necessary to check the ride control oil system after this operation, a pressure gauge may be fitted in place of the blank and the engine run to give a speed of 20 m.p.h. with the selector lever in range 3 or 4.

The pressure should not be more than 3 lb. per sq. in. with the ride control in ' soft ' and should be between 30 and 35 lb. per sq. in. with the control in ' hard.' Remove the gauge and refit the blank.

If adjustment is required, shortening the ride control link rod near the gearbox will increase the pressure. If it is suspected that there is still air in the system, each rear damper should be bled by removing the bleed plug on each damper and running the engine as already described until all air is expelled.

Finally, top up the gearbox to the ' F ' mark again.

CHECKING FOR LEAKS

If the oil level is low at checking periods, check for evidence of oil leakage or foaming and loss of fluid from the breather in the top of the dipstick.

Possible sources of oil leakage are illustrated in fig. 5, and the action to be taken when leakage is confirmed is given in the table.

OIL LEAKAGE SOURCES

SOURCE	ACTION
Between flywheel and crankshaft flange	Remove gearbox and flywheel to re-make the flywheel to crankshaft joint.
Torus cover and flywheel	Check that torus cover plug is correctly fitted. Remove gearbox and torus cover to re-make torus cover to flywheel joint. Fit a new joint washer. Check front cover oil seals and damper rivets.
Front of transmission, behind bell housing	Remove gearbox. Remove front oil pump and re-make front cover joint with new joint washer. Check front oil seals.
Oil sump	Check drain plug for correct fitting. Remove sump and re-make joint with a new joint washer.
Side cover	Check that the pressure line blanking plug is correctly fitted. Remove side cover and re-make joint with a new joint washer ensuring that the lower studs are fitted with copper washers. Check throttle and selector shaft oil seals.
Rear of transmission	Remove gearbox, examine rear oil seal. Re-make housing joint face with a new joint washer.
Ride control unit and system. *Check pipes to rear dampers with engine running and ride control in ' Hard '*	Remove faulty unit or pipe and re-make joint or joints. Fitting instructions for the ride control pump are given in Chapter 3.

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

When rebuilding after leakage investigation, use of jointing compound should be restricted to a very light application to the threads of bolts which might allow external leakage. Jointing compound is unnecessary internally, and if used, may cause defective gearbox operation.

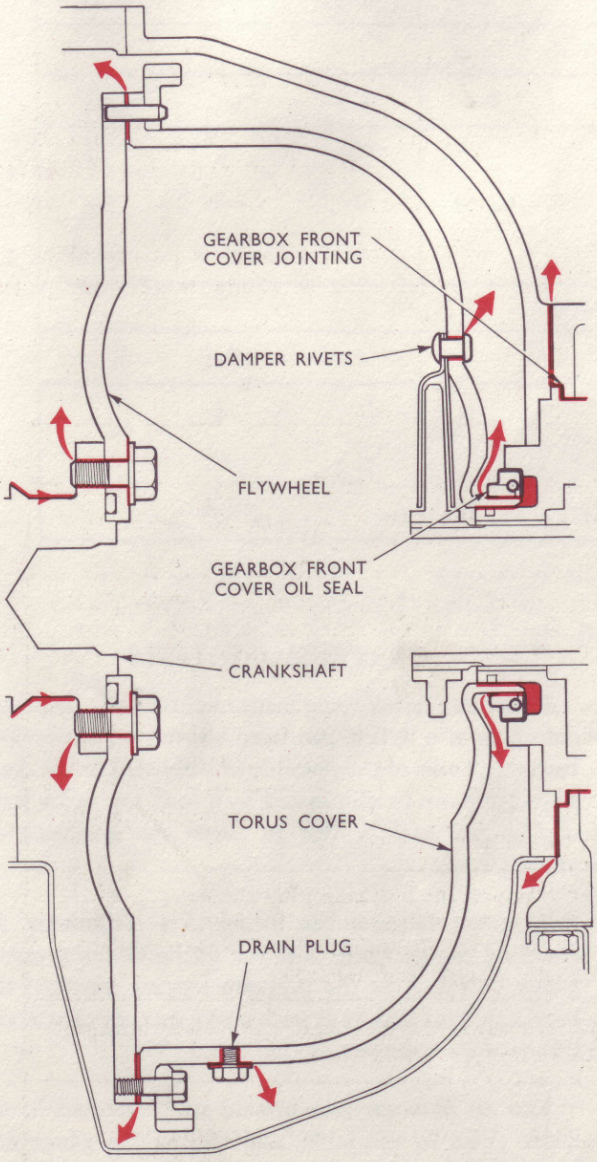

Fig. 5 Sources of leakage

LUBRICATING CONTROL JOINTS

All control joints should be lubricated with grease, which should be worked well into the working surface with the fingers. If excessive play of the joints is discovered during this operation the joint should be tightened, but care should be taken to avoid upsetting the adjustment. If play is very excessive it may be necessary to reset the linkage as described under ' Control adjustment.'

TESTING

There are three kinds of test which can be made to check the functioning of the automatic gearbox. A road test is necessary to check that the gear changes are occurring at the correct road speed and engine power, while a more stringent test, called the Stall Test, is necessary to check the bands and the operation of the units in the gearbox. The third test is a check of 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 and testing to record the operating pressures at a set speedometer or r.p.m. reading with low and high throttle openings.

TESTING THE CHANGE POINTS

The change points are given in the table in the order in which the tests should be made. The forced-throttle downshift may be obtained on a steep hill or by light continuous application of the brakes. The oil level, engine tune and control settings should be correct before the test is made, or subsequent analysis of the results will be very difficult.

The point at which the gear change occurs can be recognised by a slight change in note of the engine and gearbox. The change should be smooth at low throttle openings but will be more noticeable at the higher engine torques. Slipping 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 recorded, whether correct or faulty, and the test continued until all results are obtained. The tests should not be terminated because of a defect unless damage to the transmission can be caused by continued running.

CHANGE POINTS

4 RANGE						
	UP CHANGES (m.p.h.)			DOWN CHANGES (m.p.h.)		
	1–2	2–3	3–4	4–3	3–2	2–1
Light throttle	6	12	20	12	7	3
Full throttle	20	30	62–64	—	—	—
Forced	—	—	—	55–23	25–13	10–4
3 RANGE						
	1–2	2–3	3–4	4–3	3–2	2–1
Light throttle	6	11	—	55–60	8	4
Full throttle	20	30	62–64	—	—	—
Forced	—	—	—	—	25–13	10–4
2 RANGE						
	1–2			2–1		
Light throttle	6			4		
Full throttle	20			—		
Forced	—			10–4		

Compare the results with the table of change points and, if a defect exists, with the fault diagnosis table which gives the action required for rectification in order of probability, on the assumption that oil level, engine tune and idling speed are correct. Although the symptoms for faulty control settings are included in the fault diagnosis table, it will simplify diagnosis if they are checked before the road test, because many of the possible faults can be caused by incorrect control settings.

The speedometer reading at which the gear change occurs will be dependent on throttle position, increasing progressively from light throttle to the full throttle position; slight variation from the figures quoted in the table is permissible providing the changes are smooth and there are no other symptoms of incorrect operation.

OIL PRESSURE TESTS

If the road test is being made to check for a suspected defect, or if a defect has been proved on a previous road test, some of the possible causes listed in the diagnosis table can be eliminated by a road test or by jacking up the back wheels to check the operating oil pressures.

This test requires the fitting of a tachometer for checking engine r.p.m. and the fitting of the pressure gauge J-2450-A to the pressure tapping between the band adjusting screws in such a way that the gauges can be observed while testing (fig. 6 and 7).

The oil pressure tests should be performed 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.

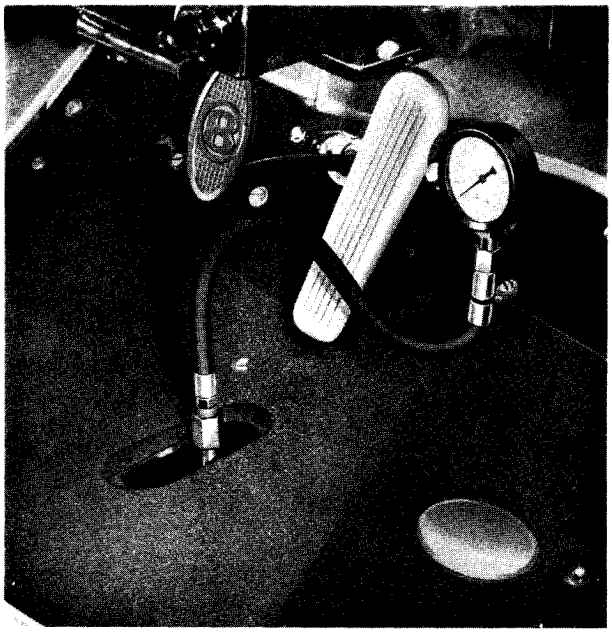

Fig. 6 Checking oil pressure

STALL TEST

The stall test is a method of ascertaining that the automatic gearbox will transmit the full engine torque without slip of the bands. It is made after running the engine to warm up the gearbox, by applying the brakes fully, placing the selector lever in range 4 and applying full throttle. The torque is absorbed by slip in the fluid coupling and the resultant engine speed, read off a tachometer fitted for the purpose, is a measure of the torque being absorbed. It should be ascertained that the engine is performing satisfactorily before making this check, as low engine power will result in a low reading of r.p.m. and prevent an accurate check of the gearbox. Do not run the engine at full throttle for longer than 30 seconds and if the engine speeds up above the r.p.m. quoted, close the throttle immediately. After the stall test, run the engine for a few minutes with the selector in Neutral to circulate the oil and cool the fluid coupling.

OIL PRESSURE TESTS

TEST CONDITION	SELECTOR RANGE	SPEEDOMETER or TACHOMETER READING 1952 gearbox	1953 gearbox	PRESSURE lb. per sq. in.
Engine running, car stationary	4	350 r.p.m.	375 r.p.m.	50 (min.)
Engine running, car stationary	3	350 r.p.m.	375 r.p.m.	50 (min.)
Engine running, car stationary	2	350 r.p.m.	375 r.p.m.	50 (min.)
Engine running, car stationary	R	350 r.p.m.	375 r.p.m.	130 (min.)
Car reducing speed with closed throttle	4	19 to 22 m.p.h.		60 (min.)
Car increasing speed with full throttle (not forced)	4	19 to 22 m.p.h.		85 to 93
Brakes on fully, half throttle	R	—		135 (min.)
Coasting with engine stopped	4	not more than 25 m.p.h.		50 (min.)

An r.p.m. of between 1,700 and 1,800 will indicate that engine and transmission are performing satisfactorily. If the engine power is satisfactory, a low r.p.m. will indicate faulty gearbox such as can be caused by sticking governor valves or a faulty control valve unit. A higher r.p.m. will indicate slip, the source of which can be traced by reference to the road and oil pressure test results. If the degree of slip is such that a road test cannot be made, check the adjustment of the bands.

CHECKING AND ADJUSTING THE BANDS

This check enables small adjustments to be made to the bands without dismantling any part of the gearbox and is therefore very suitable for elimination of possible defects during fault diagnosis. If it is found that slip is excessive after this check and adjustment, an internal examination of the bands and drums is necessary and the band setting gauges must be used to adjust the bands as for a new or overhauled gearbox (Chap. 3).

The internal method of adjusting the bands will also be necessary on 1953 gearboxes, because the front band cannot be checked accurately by the external method.

Before making the external check, the gearbox oil level should be correct and a tachometer should be fitted to the engine, which should be started and run for a few minutes to warm up the gearbox.

Keep the engine running and after applying the brakes and blocking the wheels, proceed with the check on the front band as follows :—

1. Selector either 4 or 3 range.
2. Increase the engine idling speed to 700 r.p.m. by adjusting the carburettor idling stop.
3. Position the band adjusting tool J.2681-A on the front band adjusting screw (fig. 7).
4. Loosen adjusting screw locknut ; screw back the adjusting screw with the tool until the engine speeds up to 900-1000 r.p.m. (front drum now spinning freely). If the engine does not speed up the front band is slipping under normal driving conditions and the band and drum must be examined.
5. If speed increases satisfactorily, screw back the band adjuster slowly until the engine speed returns to 700 r.p.m. (Front drum has now stopped).
6. Carefully repeat items 4 and 5 to locate the exact point at which the drum stops spinning, then wait 30 seconds. If the engine speed increases slightly, tighten the adjuster one-tenth of a turn and wait a further 30 seconds. Repeat this procedure until engine speed remains constant at 700 r.p.m.
7. Set the tool revolution counter to ' 00.'
8. Hold the locknut stationary and tighten the adjusting screw 7.7 turns as shown on the counter.
9. Hold the adjusting screw stationary while tightening the locknut. Finally, torque load the locknut to 40 to 50 lb. ft. torque.

The rear band adjustment is similar to that of the front band, except that item 6 is deleted and in item 8 ' Neutral ' must be selected while screwing in the adjuster 2.0 turns instead of 7.7 turns. After tightening and torque loading the locknut the selector lever should be returned to the 4 or 3 range position to check that the engine remains constant at 700 r.p.m.

Finally, reset the idling r.p.m. back to 350 for 1952 models or 375 for 1953 models and remove the tachometer from the engine.

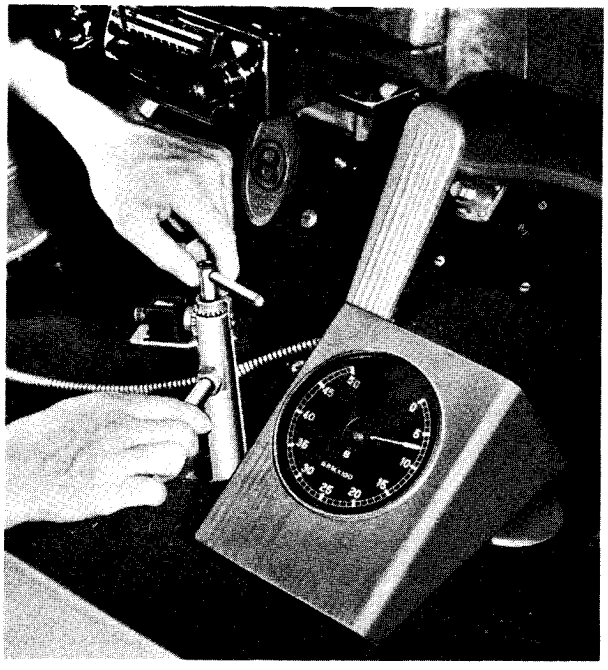

Fig. 7 Checking and adjusting bands externally

FAULT DIAGNOSIS TABLE

	Throttle linkage	Selector linkage	Oil pressure	Servo bands	Control valve unit	Parking bracket	Governor	Front servo	Rear servo	Reverse unit	Fluid coupling	Front unit	Rear unit	
High or low up-changes	★				★		★							
Rough up-changes	★		★	★	★									
Slips—light throttle up-changes	★			★										
Slips—heavy throttle up-changes	★		★	★	★			★	★					
Slips 1–2 and 3–4			★	★				★	★				★	
Slips 2–3	★		★	★	★			★	★					★
Up-change to 3rd in 2 range		★			★		★							
Early 4th to 3 range		★			★		★							
Rough 3–2 closed throttle down-change	★		★	★	★				★					
No 4–3 forced down-change	★				★								★	
No 3–2 forced down-change	★				★									
Rough 4–3 down-change			★	★	★			★						
Rough down-change after stopping	★				★									
No up-change above 1st			★		★	★	★						★	★
Misses 2nd and 4th								★	★					
Misses 1st and 3rd				★				★					★	
No reserve—slips		★	★	★	★		★	★						
Locks in R (light throttle or coast)		★	★						★					
Jumps out of R		★												
Cannot select R						★	★							
Will go into reverse above 10 m.p.h.						★								
Clashes when changed to R			★			★								
No forward drive after changing from R										★				
No drive		★	★		★									
No drive when engine is first started			★								★			
Slips in range 3—not in 2			★			★	★	★						
Slips in range 3 on coast								★						
Intermittent slip—all ranges			★					★						
Rough changing—N to Drive				★					★					
Slow band apply—N to Drive								★	★					
Inoperative parking brake						★								
	Diagnosis without dismantling					*Partially dismantle and air test*					*Remove gearbox*			

FAULT DIAGNOSIS

Reliable fault diagnosis and rectification necessitates following the correct order of servicing and testing, recording the results of each test and then consulting the fault diagnosis table.

The table is divided into three sections, the first one consisting of the defects which can be diagnosed without dismantling, the second giving the faults which can be diagnosed by air test and removing units separately, and the third those faults which will entail removal of the gearbox from the car.

The recommended sequence of tests to simplify diagnosis of obscure defects is as follows :—

1. Check oil level and for leaks.
2. Lubricate and check control linkage.
3. Having checked engine tune and idling speed and fitted a tachometer, perform ' stall test ' ; record results.
4. Fit pressure gauge and carry out road test, recording oil pressure and change points ; adjust bands if necessary.
5. Consult fault diagnosis table and take appropriate action, referring to the following paragraphs for additional information.

CONTROL LINKAGE

It is recommended that the control linkage should be checked *before* testing to investigate a suspected defect, but if the symptoms exhibited on test are shown by the fault diagnosis table to be attributable to control linkage, a further check should be made before proceeding further.

Shortening the rod attached to the gearbox throttle lever may correct such defects as high up-change, and ' rough up and down changes.' Lengthening the rod may correct such defects as ' low heavy throttle up-changes ', ' slips on 2nd to 3rd up-change,' incorrect heavy throttle down-changes and ' slips in all forward positions.' A sticking throttle linkage will give inconsistent oil pressures and may cause a ' rough down-change ' as the car comes to a stop.

Incorrect selector control linkage may cause an early change to 4th gear in 3 range, a change to 3rd gear in 2 range or incorrect performance in reverse. The linkage can be checked by disconnecting the rod from the lower selector lever on the steering column, and checking selector lever movement through its full range ; the gearbox lever should click into each of its positions N, 4, 3, 2 and R. If the linkage is adjusted correctly, it should be possible, with the steering column lever in the appropriate position, to couple the rod without springing the gearbox lever from any of the notches. If necessary adjust the controls to attain this condition following the procedure given under ' Control adjustment.' If the fault still persists after road test, refer to the fault diagnosis table for the next check.

CONTROL ADJUSTMENT (1952 cars)

A quick check of the controls is given under ' Control linkage.' If the settings are still suspect after this check, the linkage should be checked in the sequence given in the following paragraphs.

Check that the quadrant stops and gate are not preventing accurate engagement of the control notches in the gearbox. If doubt exists disconnect the rod from the lower lever on the steering column and check that it engages in each position without springing the controls. In range 4, slight ' spring ' towards the neutral stop is permissible to prevent vibration of the quadrant lever.

Check that the swinging link is at right angles to the steering column. The position of the link is controlled by the length of the two equal length parallel rods connecting the gearbox selector lever to the swinging link.

Check with the throttle in the closed position (slow running stop screwed back) that the cross-shaft right hand lever is $1\frac{3}{4}$ inches from the bulkhead to the clevis pin centre.

Check that the link rod from the cross-shaft lever to the counter-shaft lever is $2\frac{7}{8}$ inches between clevis pin centres.

Check that the counter-shaft lever is just below the horizontal (approx. 2 deg.) with the throttle closed.

Check that the rod to the carburettor throttles is $4\frac{1}{2}$ inches between ball joint centres.

When all the above points are correct the gearbox

throttle lever should be against or near its forward stop when the throttle is fully closed (throttle stop screwed back), and against its rearward stop when the throttle is fully opened. The selector lever should be in the correct position in its quadrant when each of the selector notches in the gearbox are engaged.

If any discrepancy is noted during the checks outlined, or if the controls have been disturbed, it will be necessary to reset the controls completely as follows (fig. 8) :—

1. Disconnect the accelerator to cross-shaft control rod at its upper end.
2. Select range 3 and adjust the two parallel rods to bring the swinging link to a position at right angles to the steering column, maintaining the rods at equal lengths.

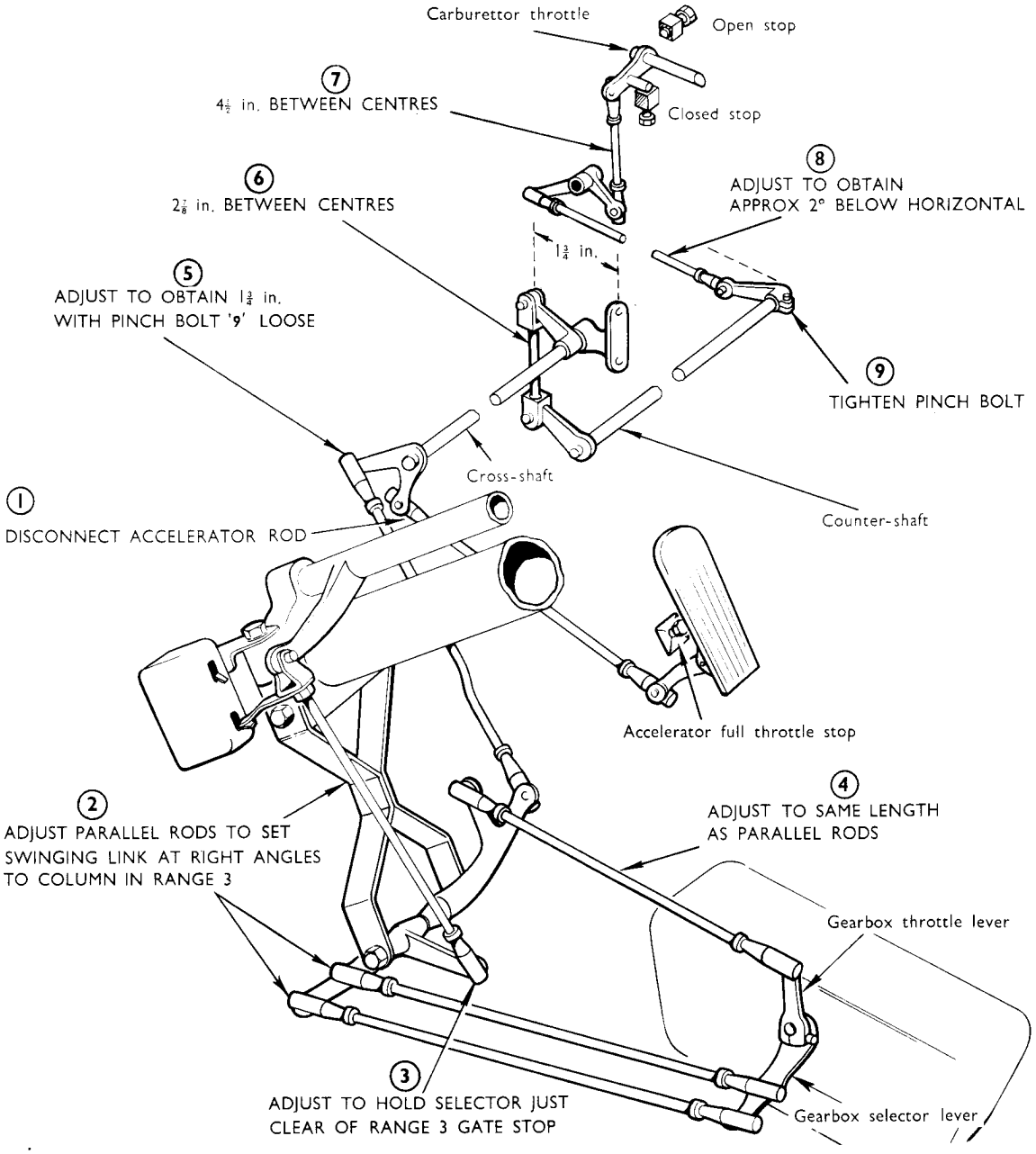

Fig. 8 Checking the controls (1952 cars)

3. If necessary adjust the rod connecting the swinging link to the selector lever on the steering column to maintain the steering column control in its central position in its quadrant (range 3). This completes the setting of the selector linkage.

4. Adjust the rod connecting the gearbox throttle lever and the swinging link to the same length as the two parallel rods.

5. Holding the gearbox throttle lever on its forward stop, adjust the rod connecting the swinging link and the cross-shaft to position the lever on the right hand end of the cross-shaft $1\frac{3}{4}$ inches from the bulkhead, measured at right angles from the bulkhead to the clevis pin centre. It may be necessary to slacken the pinch bolt on the outer end of the counter-shaft to permit this adjustment.

6. Check the length of the rod connecting the cross-shaft to the counter-shaft and if necessary adjust it to $2\frac{7}{8}$ inches between clevis pin centres.

7. Check the length of the rod connected to the carburettor throttle and if necessary adjust it to $4\frac{1}{2}$ inches between ball joint centres.

8. Adjust the rod connected to the lever on the outer end of the counter-shaft to bring the lever approximately 2 deg. below the horizontal maintaining the throttle fully closed and the gearbox lever against its forward stop. The slackened pinch bolt will allow the shaft to turn inside the lever to maintain these positions.

9. Tighten the pinch bolt and move the linkage to the throttle open position. The gearbox lever should touch its rearward stop when the throttles touch their open stop.

If the throttle touches its open stop, check that the gearbox lever has touched its stop by slackening the pinch bolt and pressing the gearbox lever towards its rearward stop. If movement is felt, correct the controls by raising the counter-shaft outer lever nearer towards horizontal and shortening the counter-shaft to induction manifold rod to maintain the closed throttle settings.

If the gearbox lever touches its rearward stop and prevents the throttles from reaching the open stop, correct by moving the counter-shaft outer lever further below horizontal, lengthening the counter-shaft to induction manifold rod to maintain the closed throttle settings. Ensure that the pinch bolt is tightened securely and lock all control joints, ensuring that no play or binding is felt when moving the controls through the full range in both directions.

Finally, after setting the idling stop to give 350 r.p.m. hot, reconnect the accelerator to cross-shaft control rod, adjusting its length to depress the accelerator pedal slightly. Set the accelerator pedal maximum stop to contact the pedal in the full throttle position. Set the starter micro switch to contact when Neutral is selected and the reverse light switch to light when Reverse is selected. The car should now be road tested as previously described and the throttle control adjusted if necessary by altering the length of the gearbox throttle lever rod one turn at a time.

CONTROL ADJUSTMENT (1953 cars)

The arrangement of the controls for the 1953 gearbox differs from that of the 1952 model in that the cross-shaft is not mounted on the bulkhead, but runs through the gearbox bell housing. This has eliminated the swinging link on the steering column and is fitted on both left and right hand drive cars.

With all throttle controls, the initial check should be to ensure that the gearbox throttle lever reaches its full throttle stop coincidentally with the carburettor lever reaching its open stop. At the other end of the range the gearbox lever should be against or close to its forward stop when the throttle is closed.

To correct a faulty setting, it is only necessary, after eliminating possible interference from the accelerator, to adjust two rods. Proceed as described in the following paragraphs (fig. 9).

On right hand drive cars disconnect the rod coupling the accelerator lever to the bulkhead relay lever.

On left hand drive cars disconnect the rod coupling the accelerator arm to the bell-crank lever on the engine.

Before disconnecting any other rods and levers, move the controls from the throttle closed position (idling stop screwed back) to the throttle open position. If the limits of travel are not coincident with both stops, lengthen the rod connected to the lever which fails to

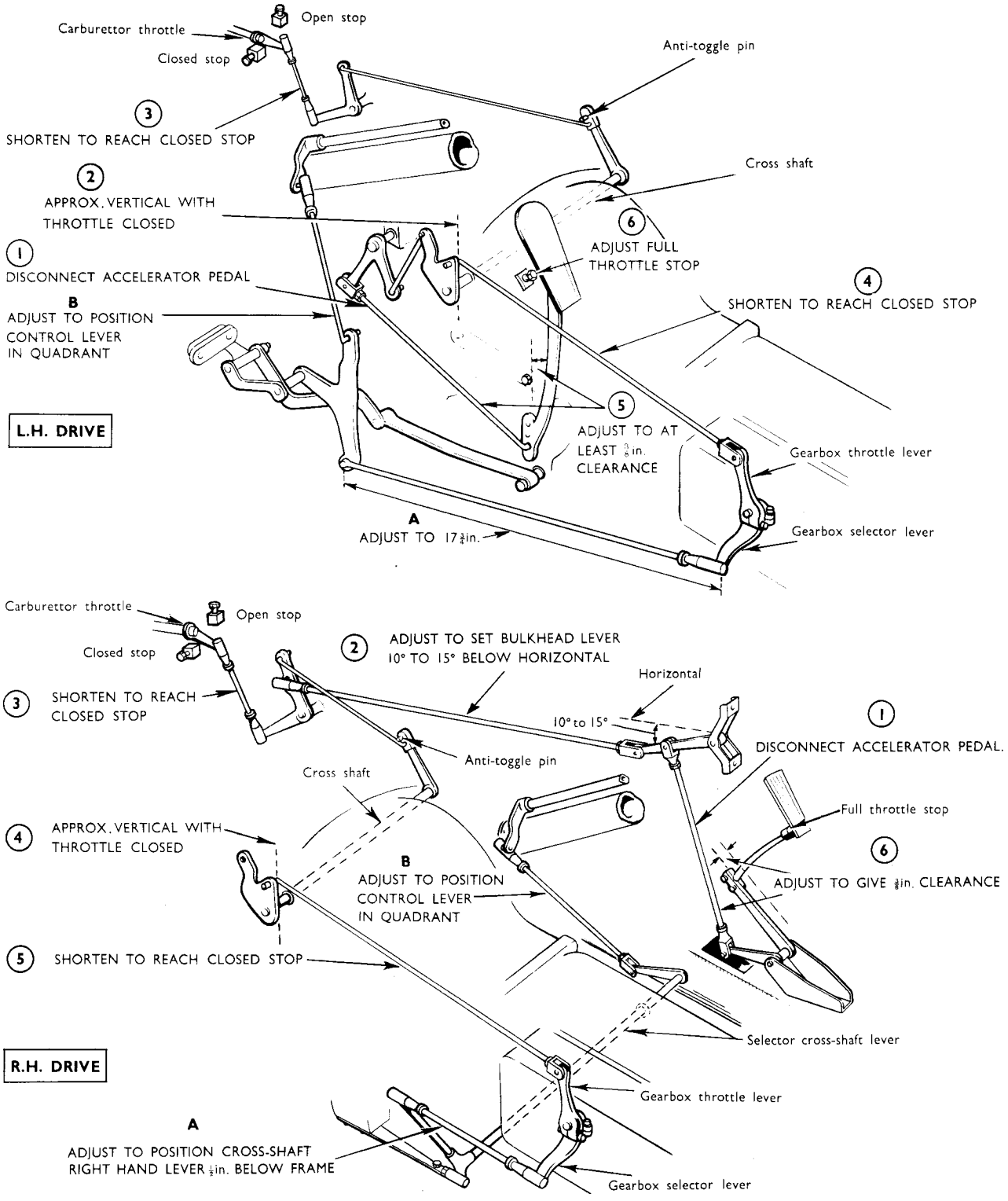

Fig. 9 Checking the controls (1953 cars)

reach its full throttle stop, or shorten the rod connected to the lever which fails to reach the closed stop. If lever movement is arrested by both the carburettor stops,and the gearbox lever does not reach its stops, the gearbox lever travel must be increased.

To *increase* the movement of the gearbox lever relative to the carburettor throttle lever, *shorten* both the horizontal rod connected to the gearbox throttle lever and the vertical rod connected to the carburettor throttle lever. This applies to both left and right hand drive cars and *lengthening* the rods will, of course, *reduce* the movement of the gearbox throttle lever.

Correct lengths of the rods should position the cross-shaft so that, in the closed throttle position, the rearward edge of the lever on the left hand end of the cross-shaft is approximately vertical, or the long lever on the carburettor end of the cross-shaft is at an angle which holds the rod clear of the anti-toggle pin on the lever.

Before re-connecting the accelerator rod, check it for freedom through its full travel, pushing it firmly downwards and pulling it firmly back to the limit of travel. On right hand drive cars adjust the rod to a length which permits the stop under the pedal head to just clear the floor boards in the full throttle position, while giving at least $\frac{3}{8}$ in. clearance between the pedal arm and the floorboard in the throttle closed position.

If pedal travel is insufficient to permit this, remove a rubber stop washer from beneath the pedal head and re-adjust the rod again.

On left-hand drive cars adjust the length of the rod so that, when coupled to the lowest of the three holes in the accelerator pedal arm, the arm clears the adjacent setscrew by at least $\frac{3}{8}$ in. in the throttle closed position. After adjusting the engine idling speed to 375 r.p.m. adjust the full throttle pedal stop to give a slight clearance in the full throttle position.

Finally, check the gearbox operation by road test. If the changes (particularly the 2–3 change) occur with an excessive amount of slip or if forced down-change cannot be obtained, lengthen the rod connected to the gearbox throttle lever. If forced down-changes are obtained before the full throttle position, shorten the rod.

The method of checking the selector linkage is the same on all cars but an incorrect setting on the 1953 cars can be rectified without interfering with the throttle controls.

The notches in the gearbox should retain the controls in each selector position, the quadrant lever being just clear of the Neutral and gate stops in positions 4 and 3 respectively. Slightly springing the selector lever towards the Neutral stop in the 4 range position is permissible if there is any tendency for the lever to vibrate during running.

The setting of the intermediate linkage is controlled by the length of the rod connected to the control tube lever, which on left hand drive cars should be $17\frac{3}{4}$ inches between ball and pin centres, and on right hand drive cars should permit the lever on the right hand end of the cross-shaft to project half an inch below the level of the chassis frame when the gearbox is in Neutral.

When the intermediate linkage is correct it should only be necessary to adjust the length of the rod connected to the control tube lever to reset the position of the selector lever relative to the gearbox lever. If there is any tendency for the selector lever to vibrate when in range 4, lengthen the rod by one or two half-turns as necessary.

It may be necessary, after re-setting the selector controls, to reset the starter and reverse light micro switches.

On left hand drive cars, set the selector in range 2 and, after pivoting the rocking lever to take up the free movement in the reversing light switch, adjust the lever pivot to give approximately 0.075 in. between the lever and the starter switch button, then with the rocking lever still in this position adjust the operating fork to give 0.125 in. between the lever and the operating tab on the engine side of the rocking lever.

On right hand drive cars set the selector in range 3 and adjust the position of the starter switch to give approximately 0.150 in. between the operating peg and the switch button.

Set the selector lever in range 2 and adjust the position of the reversing light switch to give approximately 0.125 in. between the operating peg and the switch button.

OIL PRESSURE

It will be seen from the fault diagnosis table that incorrect oil pressure can produce a large variety of symptoms of incorrect performance, but once the oil pressure check has proved incorrect oil pressure, it is a comparatively simple job to track down the cause by a process of elimination.

A consistently incorrect pressure in all gears and selector positions can be caused by a fault in any of the following which should be checked in the order given.

Control linkage can cause either high pressure at low throttle openings or low pressure at high throttle openings and should be checked as described under ' Control linkage.'

The pressure control valve which can cause either high, inconsistent or low pressure can be rectified by removing for examination and cleaning as described under ' Pressure control valve.'

Low pressure caused by leakage from oil pipes or joint faces can be traced, after removal of the side cover and sump, by careful examination before removal of any unit. An examination should also be made of the pump inlet pipes and filters for possible restriction.

Restrictions in the oil feed pipe to either pump can cause low oil pressure. Front pump restriction may cause faulty gearbox operation when the car is stationary or moving slowly, but the effect of rear pump restriction can only be diagnosed by coasting with the engine switched off. For this check the road speed must be kept below 25 m.p.h. for the minimum time necessary to confirm correct or defective operation. Restrictions on the pressure side of the system caused by kinked pipes, or obstruction in the oil passages, may cause sluggish operation of control valves in the control valve unit, front or rear servo, or the governor.

The control valve unit can cause either high or low oil pressure and should be dealt with as described under ' Control valve unit.'

The parking brake bracket may cause low oil pressure and should be checked by removing the gearbox side cover and applying the ' Air pressure test.'

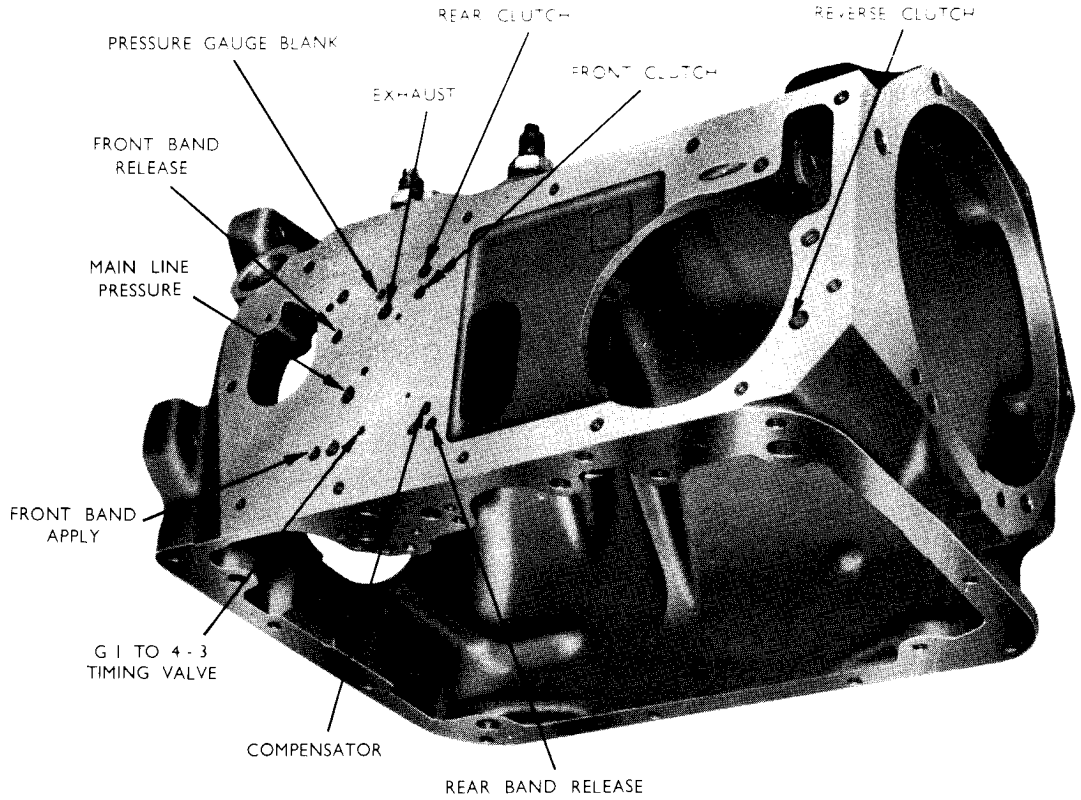

Fig. 10 Oil passage identification

The rear pump and governor unit, which can cause low pressure, should be checked by applying the air pressure test.

The main exhaust valve can cause low oil pressure and should be removed for examination and cleaning. (See Chapter 3).

The front pump can cause either high or low oil pressure and can only be rectified by removing and partially dismantling the gearbox. A sticking front pump relief valve will allow a rapid drain of oil from the fluid coupling when the engine is stopped. This should be checked as described under ' Fluid coupling.'

AIR PRESSURE CHECK AND INVESTIGATION

The air pressure test can assist diagnosis by indicating which unit is exhibiting excessive oil leakage and in some cases can be used to check unit functioning. The tests can only be made after removal of the gearbox sump, side cover and control valve unit, which should follow investigation of the possible causes listed in the first four columns of the fault diagnosis table.

Removal of the control valve unit and reverse clutch oil pipe reveals the drillings to which the air pressure should be applied in sequence, using the tool J-4353-1 connected to a compressed air supply of approximately 80 lb. per sq. in. Refer to fig. 10 for identification of the oil passages. Excess oil should be blown out into a cloth before close 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 through the servo to casing joint face, from the 4–3 timing valve exhaust hole and from the front band release passage are permissible but there should be no other leaks. Excessive leakage from the front band apply passage or from the compensator passage may cause slipping on 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 pressure to the front band release passage will not actuate the servo or band, but it will indicate undue leakage. Slight leakage is permissible past the piston ring gaps. Excessive leakage will cause slipping on 3–4 up-change and if it is very excessive will cause missing of second and fourth gears. A sticking quick-release valve may cause slipping in range 3.

Air pressure applied to the G1 to 4–3 timing valve passage should give only slight leakage from the valve retainer clip and from the front band apply passage. If the valve is sticking or if the valve retainer clip is not retaining the valve in its correct position, slipping may occur on the 2–3 up-change, 4–3 down-change, or intermittently in all ranges. In some instances a rough 4–3 down-change may occur.

Rear servo

The rear servo will actuate the rear band when air pressure is applied intermittently to the rear band release passage. Air will escape through the piston ring gaps but leakage should not be enough to impair operation. A small amount of air may escape from the compensator passage and from the servo to casing face joint but there should be no other leakage. Excessive leakage will cause slipping on 2–3 up-change or a rough 3–2 closed-throttle down-change.

When air pressure is directed into the compensator passage a feed into both front and rear servos, tending to tighten the bands, should be indicated by slight leakage past the piston ring gaps of both servos. Excessive leakage will cause slipping on heavy throttle up-changes.

Other possible rear servo defects are faulty restrictor valve, exhaust valve sticking open or servo piston sticking when applying ; these cannot be diagnosed by the air pressure check but will give such incorrect operation as rough 3–2 closed-throttle down-change, or slow band apply when selecting drive from Neutral.

Front epicyclic unit

The front unit contains the front clutch which can be felt or heard to operate when air pressure is applied intermittently to the front clutch apply passage. Excessive air leakage will indicate either faulty clutch piston seals, or a faulty oil delivery sleeve which can be checked more accurately by removing the servos to enable a closer inspection of the source of leakage. Leakage from the oil delivery sleeve may affect front or rear unit operation, or both.

It may be possible to rectify leakage from the oil delivery sleeve if it is due to loose bearing cap bolts or

bad fitting of the cap to the sleeve, but any other fault will require removal of the gearbox to permit removal and investigation of the front unit or oil delivery sleeve. A sufficient loss of oil pressure or other fault which causes the clutch to slip will cause slipping on 1–2 and 3–4 up-changes ; if very 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, and will not be shown up by the air pressure check.

Rear epicyclic unit

The rear unit and its clutch can be checked in the same way 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.

Reverse epicyclic unit

The reverse unit clutch test is the same as for the front and rear clutches, the pressure being applied through the reverse clutch apply passage after removal of the reverse clutch oil pipe. Excessive leakage from around the clutch piston indicates faulty piston seals, which may cause slipping or ' no drive ' in reverse, and can only be rectified by removing and dismantling the gearbox to rectify the reverse unit.

A tendency for the reverse clutch to stick in engagement after moving the selector lever from reverse will prevent forward drive because the transmission will lock. It may be possible to rectify such a fault before detailed investigation by operating the transmission to free it and burnish the clutch surfaces.

Free the reverse clutch by running the engine with the brakes applied firmly ; select reverse and increase engine speed ; then select range 2. 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 eliminate the fault. When the transmission has been freed satisfactorily by running the engine, the clutch should be burnished by driving the car forward at 1 to 2 m.p.h., selecting reverse and when the change is nearly complete, selecting forward drive again. Repeat this procedure five or six times and then select range 4 and drive at about 20 m.p.h. for a few minutes to cool the gearbox. Repeat this cycle five times and then road test.

Governor and parking bracket

The governor and parking brake bracket can be checked together for excessive leakage after removing the governor feed pipe and refitting 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 inwards to close the ports, there will be some leakage past the piston ring gaps in the governor sleeve ; air will escape from the sleeve and from the G1 and G2 passages and valves, but this should not be excessive. There may also be slight leakage from the parking and reverse blocker pistons. There should be little or no leakage from the bracket to casing face joint. Very 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. will be possible. If it sticks out, due to leakage of main pressure into the governor passage (broken piston ring) it will prevent selection of reverse below 10 m.p.h. If the parking blocker piston sticks out it will prevent engagement of the parking pawl when reverse is selected for parking. Clashing when reverse is engaged may be caused by incorrect operation of the parking pawl.

The governor valves should have no tendency to stick and if they are moved outwards 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 such defective operation as high or low up-changes, slipping in 4 and 3 ranges or slipping with failure to drive in reverse.

Other passages which may be checked during this diagnosis procedure are the main pump feed passage, the exhaust port 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

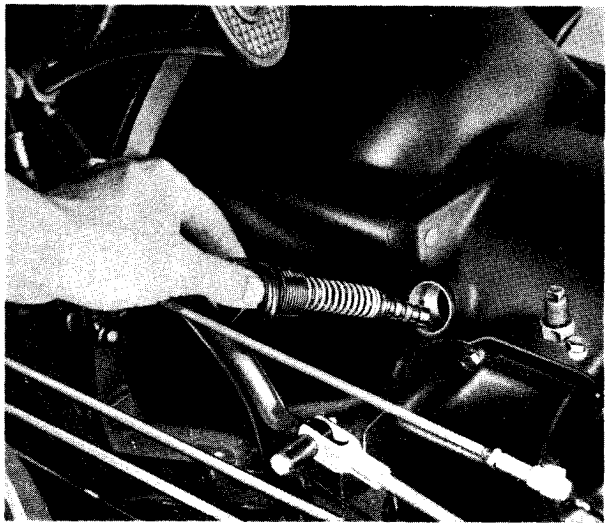

Fig. 11 Removing pressure control valve

drum and front pump ; this is normal and comes from the rear side of the front pump.

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

PRESSURE CONTROL VALVE

Take care during removal of the pressure control valve, which is spring-loaded and must be restrained during removal, that the damper spring, reverse booster plug and throttle regulator plug do not fall out. After thorough cleaning, an air blast into the passages of the regulator and reverse booster plugs should remove stickiness. The plugs should move freely in their bores and the plugs and damper springer should be assembled with vaseline to retain them in position during assembly. Before trying the control valve in the piston valve bore, it is recommended that oil is flushed through the bore by motoring the engine over by the starter. Do not introduce cleaning solution into the bore. The piston valve should be tried for free movement in its bore before being refitted.

CONTROL VALVE UNIT

The control valve unit cannot be checked satisfactorily in position, therefore if the foregoing checks indicate satisfactory functioning of other units in the gearbox and the fault is shown by the diagnosis table to be attributable to the control valve unit it should be dismantled and overhauled as described in Chapter 3. It should be noted when removing that screws are tight, as leakage between the face joints may seriously affect valve operation.

FLUID COUPLING

Slipping or faulty gear changes are unlikely to be caused by the fluid coupling, except in the unlikely event of damaged torus members, which might cause slipping and overheating at all speeds. Temporary slipping on starting the car without the recommended three minutes warming-up period can result from a leaking torus check valve. This is because there is insufficient oil in the fluid coupling, as a result of excessive drainage through the relief valve into the sump. Such a defect raises the oil level on the dipstick, which can therefore be used to check for the fault.

Check the oil level as previously described and wait ten minutes with the engine stopped. Note the level on the dipstick without running the engine ; it if has increased 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 it can be rectified.

NOISE

The source of any noise that occurs in the gearbox should be traced by reference to the phase of operation associated with the faulty unit. The method of testing to ensure this is described in the following paragraphs.

Planet gear noise will be heard as a low growl at idling, 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 4 range and noting the character of the noise at the change points. Noise in both first and second gear is caused by the front unit, and in both first and third is caused by the rear 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 most pronounced at a certain engine or road speed. As the front pump is operating

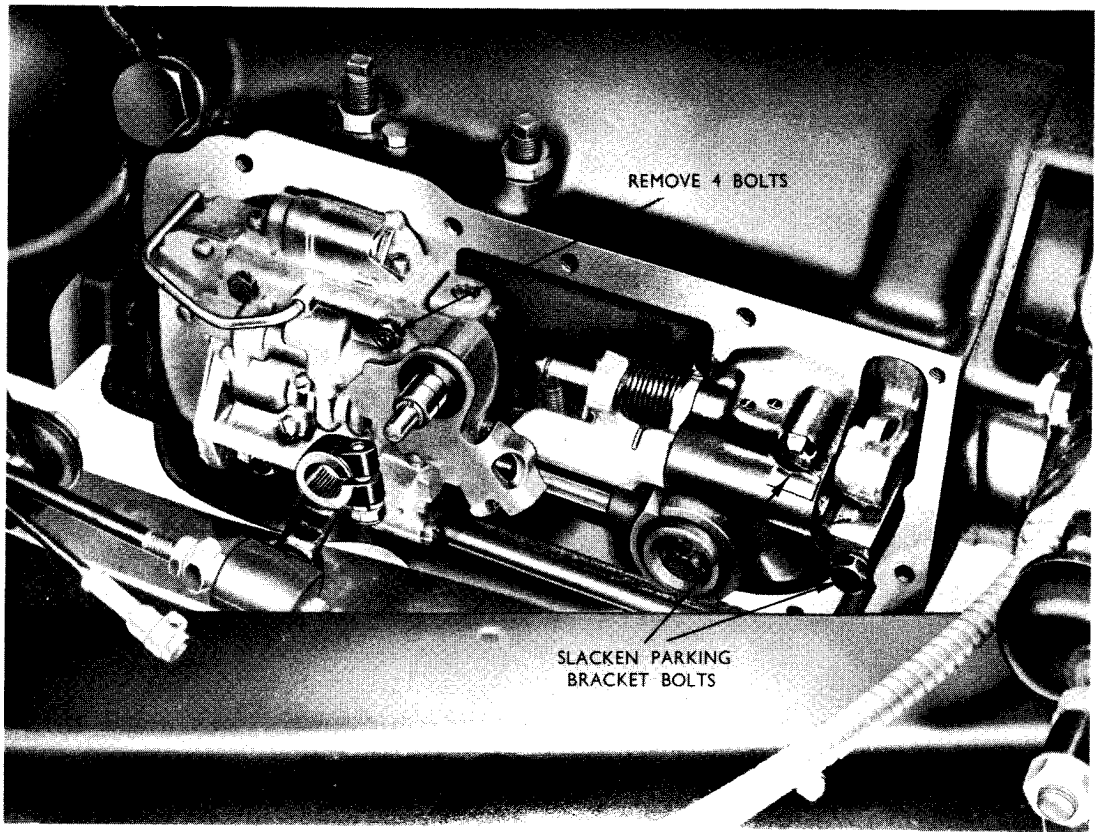

Fig. 12 Removing control valve unit

only when the engine is running and the rear pump only when the output shaft is turning, it is possible to diagnose which pump is defective by static and road tests.

The test should be started in Neutral and the throttle opened gradually while 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 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. If doubt exists, axle noise can be eliminated by disconnecting the gearbox output shaft and, with the selector in range 4, running the engine up to the speed at which 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.

An important point to remember is that, in the tests for suspected noise in the rear pump, coasting with engine switched off should not exceed 25 m.p.h. and should be kept to the minimum necessary to confirm or eliminate the fault, as the low oil pressure possible with 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.

RECTIFICATION OF UNITS

Removal, overhaul and replacement of all units is described in Chapter 3.

The units which can be removed and replaced without removal of the gearbox are as follows :—

1. Pressure control valve
2. Control valve unit (Requires removal of side cover)
3. Parking brake bracket (Requires removal of side cover and control valve unit)
4. Governor and rear oil pump (Requires removal of side cover, sump, control valve unit, parking brake bracket and both servos)
5. Front and rear servos (Requires removal of sump and re-adjustment of bands)
6. Ride control oil pump and road wheel brake servo drive

The units which require removal of the gearbox before they can be rectified are as follows :—

1. Fluid coupling
2. Front oil pump
3. Front epicyclic unit
4. Rear epicyclic unit
5. Reverse epicyclic unit

TOWING

Coasting with the engine switched off, or towing should be confined to as short a distance as possible and to a speed not greater than 25 m.p.h.

Before attempting to tow, examine the gearbox for mechanical damage and leaks, and check the oil level. The car should not be towed if there is mechanical damage or if the oil level is low, but if satisfactory, the gearbox should be prepared for towing by slackening the rear band adjusting screw $4\frac{1}{2}$ turns and relocking the adjusting screw. When towing, the selector lever should always be in Neutral and, where possible, the towing speed maintained between 15 and 25 m.p.h.

An alternative method of preparing the car for towing is to disconnect and remove the rear half of the propeller shaft. This method is permissible if the gearbox is faulty and facilities for transporting the car are not available.