Bob Bate's Technical Topics

Servicing the Borg Warner DG automatic gearbox

Some applicable models

Automatic versions of
XK120, XK140, XK150
Mk VII, Mk VIII, Mk IX
Mk 10 3.8 litre
2.4 and 3.4 Mk 1
2.4 Mk 2
Most 3.4 Mk 2 cars up to chassis
171614 RHD
181441 LHD
Most 3.8 Mk 2 cars up to chassis
235344 RHD
224746 LHD
Several 3.4 and 3.8 Mk 2 cars before the chassis numbers quoted were fitted with the BW model 35 gearbox
3.4 'S' type up to chassis
1B 8444 RHD
1B 26240 LHD
3.8 S type up to Chassis
1B 59528 RHD
1B 80287 LHD

Chassis change points have been taken from Jaguar publications but cannot be guaranteed to be correct. When identifying gearboxes confusion could occur if the original DG has been replaced by a different automatic transmission. If in doubt about gearbox fitment reference to photographs of a DG gearbox in figures 1 and 2 should enable the query to be resolved.

A few thoughts

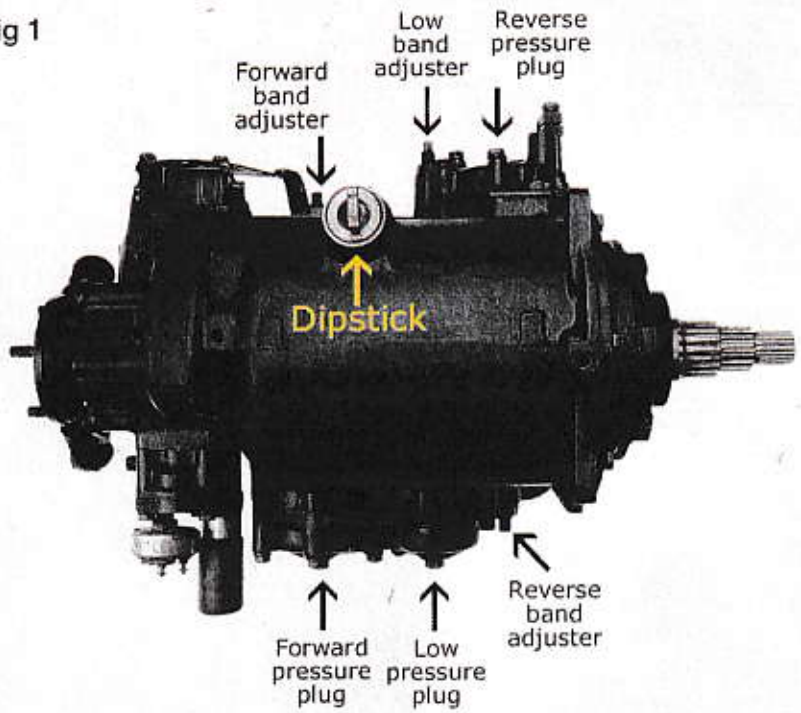
Servicing automatic gearboxes is often an emotive topic with discussions frequently driven by fear of the unknown and the spectre of spending money. Nonsensical mutterings such as "Don't fix what isn't broken" and "It's working so leave well alone" are often offered as excuses for neglecting these complex components that usually benefit from clean oil and a few adjustments. The servicing suggestions in this article are generalisations comprising information taken from Jaguar manuals and experience gained in the workshop but they may not apply to every situation. It is the responsibility of the person undertaking the work to ensure that the schedule adopted is suitable for the vehicle and individual circumstances.

A POSSIBLE SERVICING PROCEDURE

Check gearbox oil level
Road test vehicle
Change gearbox oil
Clean sump and filter
Adjust brake bands
Carry out other adjustments if required
Road test vehicle

Let's think about each section individually

Fig 1



Gearbox oil level - thoughts

Checking and if necessary adjusting the gearbox oil level before road testing is a good idea although it is possible that faults rectified by this operation may nullify some reasons for the test. Serious damage may be caused to an automatic gearbox if it is driven with an incorrect oil level.

Transmission fluid

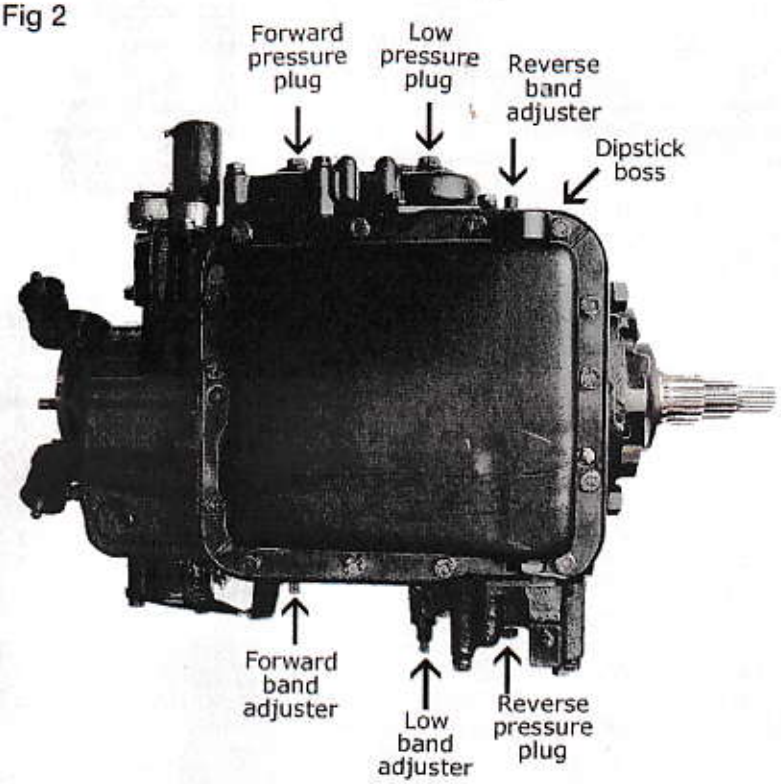
The original specification of transmission fluid for the DG gearbox (Type A Suffix A) is now obsolete. Some oil manufacturers supply modern oils that list this specification. Common recommendations after obsolescence of the original fluid have been Automatic Transmission fluid Types F or G which correspond to Ford Specifications M2C-33F and M2C-33G respectively.

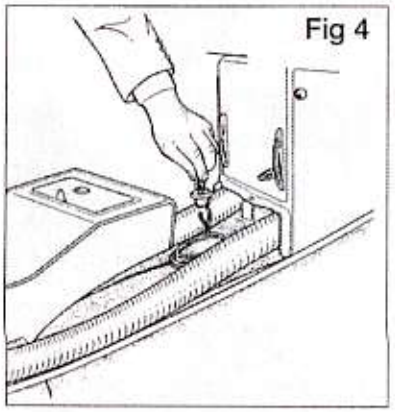
CHECKING OIL LEVEL

The procedure outlined is broadly as detailed in various Jaguar workshop manuals.

a. Place the vehicle on a level surface.
b. Switch off engine.
c. Apply the handbrake and check that it is effective.
d. Engage PARK.
e. Locate gearbox oil level dipstick and remove trim if necessary to obtain access. Early cars utilise a dipstick mounted directly on top of the gearbox (see fig 1) whereas later cars have a remote dipstick in the engine bay. To illustrate three examples – fig 3 shows the dipstick on a Mk 1 after removal of cover plate under the transmission housing carpet. Fig 4 shows the dipstick on a Mk 2 after removing front seat cushions and sliding the centre consol rearwards. Fig 5 shows the engine bay dipstick on a nineteen sixties 'S' type
f. Check that nothing can catch in rotating components.
g. Apply footbrake.
h. Start engine and allow to idle. If the engine and gearbox are at or close to normal operating temperature continue with operation m. If starting

Fig 2





the engine from cold or nearly so please proceed with i.

i. Engage LOW.

j. Run engine at approximately 800 rpm for two or three minutes to circulate gearbox oil and increase temperature.

k. Allow engine to idle.

l. Engage PARK

m. Slowly release footbrake and check that there is no tendency for the car to drive.

TIME TO THINK

Now we come to a slightly tricky part of the operation. Our Jaguar workshop manuals advise that the oil level should be checked with the gearbox in LOW and engine idling. This procedure would appear to be in order if the following conditions (i to v)are satisfied:

i. The handbrake will hold the car against the driving tendency of the gearbox.

ii. The gearbox anti creep device is functioning and will hold the car against the driving tendency of the gearbox. This is a circuit that retains fluid pressure in the rear brakes to prevent the car driving whilst stationary with the throttle closed.

iii. Engine idle speed must not be so high that the gearbox will drive against resistance of the handbrake and anti creep brake.

iv The gearbox must not be defective in such a way that it will drive against resistance of the handbrake and anti creep brake. NOTE Under certain conditions it is possible for a faulty gearbox and/or torque converter to cause the car to drive when the gearbox or selector lever is in neutral or park. "Faulty" in this context includes the relationship between the manual gear selector lever and the gearbox.

v. The footbrake is applied when the gearbox is in LOW if the handbrake and anti creep brake cannot hold the car against the driving tendency of the transmission.

OBSERVATION

Quite honestly, the thought of working on a car, leaning into the passenger compartment or over the engine bay with the engine running and gearbox in LOW gives me nightmares. Jaguar owners are not generally renowned for diligent maintenance of the hand brake and a DG with an operational anti creep circuit is very rare. In the interests of safety two personal recommendations when the engine is idling and the gearbox is in LOW are:

A). If using a dipstick inside the car keep the footbrake applied.

B).When using a dipstick in the engine compartment, either ask an assistant to keep the footbrake applied or engage PARK. When using a dipstick in the engine compartment the oil level in LOW or PARK with the engine running is virtually the same for practical purposes.

n. After consideration of the foregoing notes and with all safety considerations observed either engage LOW if you are certain that the car will not drive or if there is any doubt as to the holding ability of the brakes engage PARK.

o. Remove dipstick and wipe clean.

p. Insert dipstick fully.

q. Remove dipstick quickly and ascertain the oil level.

r. If the oil level is low, add oil of the correct specification either directly into the gearbox or down the dipstick tube until the correct level is attained. Adding small quantities at a time is better than over filling. If the oil level is too high it will be necessary to switch off the engine, drain oil and then repeat the checking routine.

s. After confirming that the oil level is correct refit dipstick.

t. Switch off engine.

u. Engage PARK if not already selected.

v. Release footbrake if applied.

w. Assemble vehicle as required.

ROAD TESTING

These notes apply only to the operation of the gearbox and not the legality of driving the car or relationship to other road users. It is surely prudent to carry out a road test before servicing the gearbox so that existing problems may be noted. Ideally, the schedule will enable as many of the gearbox functions as possible to be checked. The test should be discontinued if the gearbox malfunctions, slips or makes unusual noises. Attempting to drive a faulty automatic gearbox could result in further damage being caused.

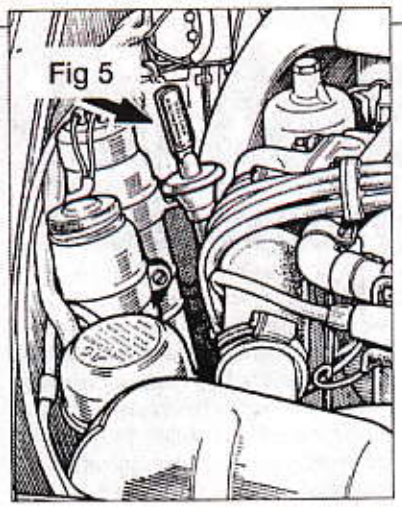


Fig 6

A possible road test procedure

1. Place the vehicle on a level surface with clear space at front and rear.
2. Switch off engine.
3. Engage PARK.
4. Apply the hand brake and check that it is effective.
5. Check adjustment of manual control linkage. i.e. The relationship between the gear selector lever in the car and the selector shaft in the gearbox – adjust if necessary as suggested in SERVICE OPERATIONS.
6. Engage each gear in turn and check that the starter will only operate in PARK and NEUTRAL.
7. Engage each gear in turn and check that the reverse lights will only operate in REVERSE.
8. Start the engine.
9. Check that the engine is running well on all cylinders. If necessary wait until normal operating temperature has been reached before making a decision as many power units do not run satisfactorily on choke. As engine torque command is transmitted to the gearbox it follows that if the engine is malfunctioning, so may the gearbox. If the engine has a problem that affects power output the road test should be cancelled as it will be of little benefit.
10. Listen for unusual sounds emitting from the gearbox or bell housing and cancel the road test if any are audible.
11. Allow the engine to idle and check that the rpm is within reasonable limits which for practical purposes could probably be considered as approximately 500 to 600 rpm.
12. Slowly release footbrake and check that there is no tendency for the car to drive either forwards or backwards.
13. Apply footbrake.
14. Engage NEUTRAL.
15. Slowly release the footbrake and check that there is no tendency for the car to drive either forwards or backwards.
16. Apply the footbrake.
17. Engage each drive range in turn and check the quality of engagement which should be positive yet cushioned without squealing, grating or other incorrect mechanical noises. Light ticking, clicking or similar sounds as play in drive train components is taken up is usually acceptable.
18. Engage a drive range.
19. Slowly release the footbrake. The car should not drive because the handbrake is applied and the gearbox incorporates an anti creep circuit which maintains pressure on the rear brakes whilst the throttle is closed.
20. Slowly release the handbrake and check that the car does not drive – anti creep brake should be holding.
21. Slowly open the throttle and confirm that the rear brakes release after a small movement of the accelerator pedal.
22. Drive the car in all forward ranges with a variety of throttle openings through all gears and check that the gearbox operates correctly. Early cars start from rest with D engaged in second gear whereas later models start in first gear. Do not allow the engine to exceed maximum recommended rpm at any time during the test.
23. If the gearbox is functioning correctly kickdown can be checked by pushing the accelerator pedal to the floor when the transmission should down shift to a lower ratio provided that a suitable gear is operative and road speed is within limits. It is normally inadvisable to operate kickdown if there is any suspicion of a gearbox malfunction because of the additional loading to which components will be subjected.
24. Having brought the car to a standstill keep the foot brake applied.
25. Engage REVERSE.
26. Release the footbrake and check that the car drives backwards without problems.
27. Bring the car to a standstill.
28. Engage PARK.
29. Switch off the engine.

SERVICE OPERATIONS SAFETY NOTES

Observe all safety precautions.
All equipment must be in good condition, suitable for the purpose for which it will be used and operated correctly.
Place the car on a firm level surface if using a jack or drive on wheel ramps.
If using a pit check that the vehicle is correctly positioned.
A jack alone must never be used to support the vehicle.
Suitable blocks or stands must be placed in correct positions underneath a raised vehicle.
Front and rear of wheels remaining on the ground should be chocked if others are raised.
When using a vehicle lift check that safety mechanisms are fitted and functional.
If the car is to be supported or lifted by the body check that axle or subframe mountings are in good condition and that they will not separate when the vehicle is raised.

When undertaking any service operation

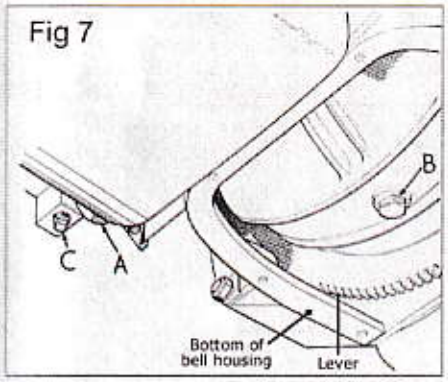
Place the car on a firm level surface, over a pit or on a vehicle lift.
Apply the hand brake and check that it is effective.
Engage PARK.
Switch off the engine and remove the keys from the car.
After consideration of SAFETY NOTES raise the car if required to obtain access to the component being serviced.
The way in which servicing tasks will be approached depends upon many factors, some of which are vehicle model, personal preferences, available equipment, individual requirements, etc. Whilst it is virtually impossible to write a procedure that will be applicable to every situation the following notes may be of assistance.

Changing gearbox oil

Cleaning sump and filter

1) If possible arrange for the gearbox drain plug (see fig 6) to be at the lowest point of the sump.
2) Carefully check that the gearbox sump is at a suitable temperature for work to be undertaken. N.B. Automatic transmission fluid may cause scalding when at normal operating temperature.
3) Remove or displace components as required to enable the gearbox sump (fig 6) and torque converter cover plate attached to the bottom of the bell housing (fig 7) to be removed.
4) Place a tray in position to catch oil when the gearbox sump plug (fig 6 and A in fig 7) is removed. Caution – oil may spurt sideways.
5) Carefully and slowly remove the sump drain plug and catch oil that will drain.
6) Remove the torque converter cover plate from the bottom of the bell housing.

Fig 7



7) Rotate the engine by hand until the torque converter drain plug (B in fig 7) is at its lowest position as in the illustration. The engine can be rotated by careful use of a suitable lever against the starter ring gear teeth as shown in fig 7.

identified in fig 2.
13) If fitted – detach dipstick tube from the sump and catch oil that will drain.
14) Remove bolts with washers and lower sump from gearbox.
15) Slacken filter bracket screw identified in fig 8.
16) Support filter, twist bracket to one side and remove filter. Take care to miss the oil that may drain out of the filter locating sockets.
17) Clean sump and remove all traces of gasket.
18) Remove all traces of gasket from gearbox case.
19) Clean filter (fig 9) and check mesh screen for integrity. If the mesh is broken replace the filter.
20) Offer filter to gearbox and rotate bracket into retaining position.
21) Tighten bracket securing screw.

Fig 8

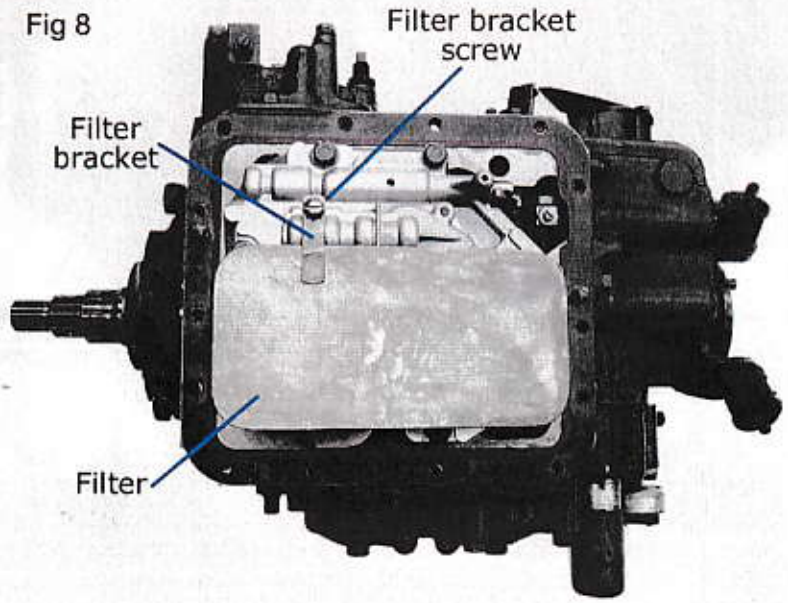


Fig 9

8) Place a tray in position to catch oil when the converter drain plug is removed.
9) Place a tray underneath the torque converter pressure take-off plug (C in fig 7).
10) Remove converter drain plug and catch oil that will drain.
11) Remove the pressure take-off plug and catch oil that will drain.
12) Place a tray in position to catch oil when it drains from the dipstick tube – if fitted. The dipstick boss is

22) Fit sump with a new gasket.
23) Fit dipstick tube – if applicable.
24) Fit sump drain plug.
25) Fit converter drain plug.
26) Fit converter pressure take-off plug.
27) Fit converter cover plate.
28) Slowly pour approximately 5.8 litres of transmission fluid either into top of the gearbox or down the dipstick tube.
29) Check that handbrake is applied.
30) Check that transmission is in PARK.
31) Apply footbrake.
32) Start engine and allow to idle.
33) Move gear lever through drive ranges to circulate oil and fill the torque converter.
34) Check and top up oil level as suggested from operation (i) onwards in Checking oil level earlier in the article. The gearbox will probably need approximately 2 more litres of fluid to top up to the full mark on the dipstick.
35) Refit components that were removed or displaced to facilitate access.
36) Observing all safety precautions lower the car or drive off pit and restore to normal running condition.
37) Carefully take the car for a test drive.
38) Bring car to a standstill.
39) Apply handbrake.
40) Check and if necessary top up gearbox oil in accordance with previous notes.
41) Engage PARK if not already selected.
42) Switch off engine.

BRAKE BANDS

Locations

The gearbox has three brake bands, which, from front to rear are REVERSE, LOW and FORWARD as indicated on figures 1 and 2.

Adjusting

The method detailed in our Jaguar manuals is with the use of a special tool illustrated in figures 10, 11 and 12. When the threaded boss is screwed fully into the gearbox with a correctly adjust brake band the spring loaded plunger pushes the sliding indicator outwards until it is flush with the face of the tool body as in figure 12. Perhaps we should think about adjusting brake bands with and without the tool. The procedure is the same for all bands.

Fig 10

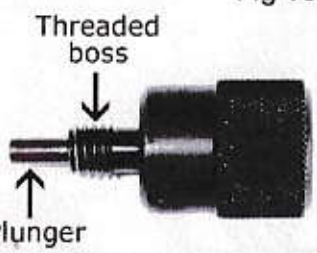
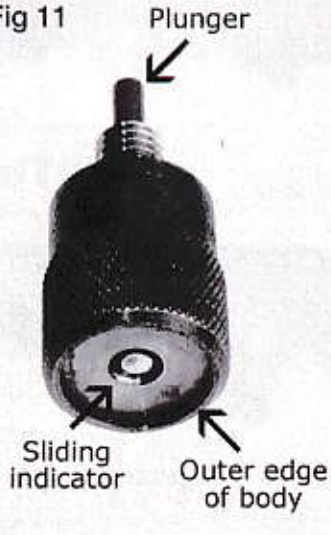


Fig 11



With special tool

1) Locate brake band adjusters shown in figures 1, 2, 14 and 15.
2) Wire brush adjuster threads to remove surface corrosion and apply light oil to assist rotation.
3) Slacken by approximately 1/4 turn one of the brake band adjuster lock nuts (3/4" A.F.). One adjuster and lock nut is shown in greater detail in figure 13.
4) Hold adjuster by the square (5/16" A.F.) to prevent it rotating.
5) Slacken the lock nut until it is clear of the gearbox case.
6) Remove from opposite side of gearbox the relative servo piston pressure take off plug and washer (shown in figures 1, 2, 14 and 15).
7) Carefully screw the adjusting tool by hand in to the pressure take off plug location until it is fully seated or the indictor is flush with the end of the body as in figure 12. The tool may be damaged if the indicator is pushed beyond the end of the body. If the indicator is flush before the tool is seated, brake band adjustment is too tight. If the band is too tight undo the adjuster by small increments whilst checking indicator position and screwing the tool into the servo housing until is fully seated. Do not undo the adjuster sufficiently to disengage it from the brake band operating strut. Provided that the adjuster is slackened by no more than one turn each time disengagement should not occur.
8) Check that the tool is seated against the servo housing.
9) Hold the adjuster lock nut to prevent it rotating.
10) Rotate the brake band adjuster until the tool indicator is flush with the end of the body as in figure 12.

Fig 12

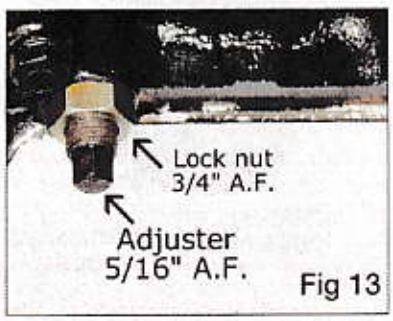


Fig 13

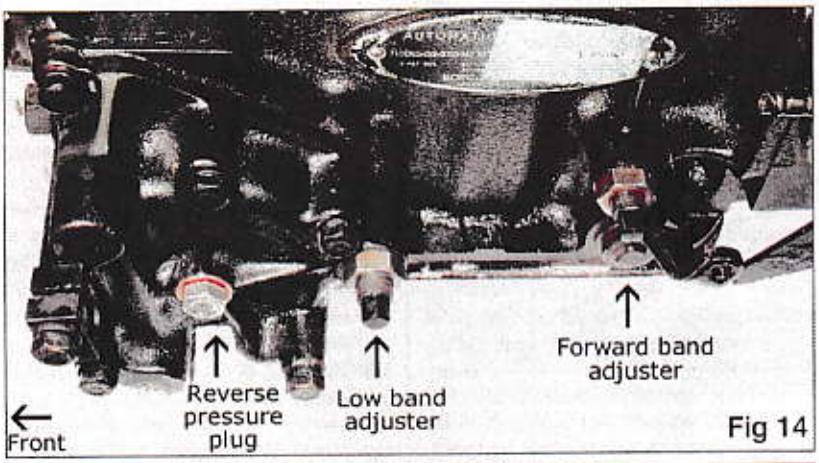


Fig 14

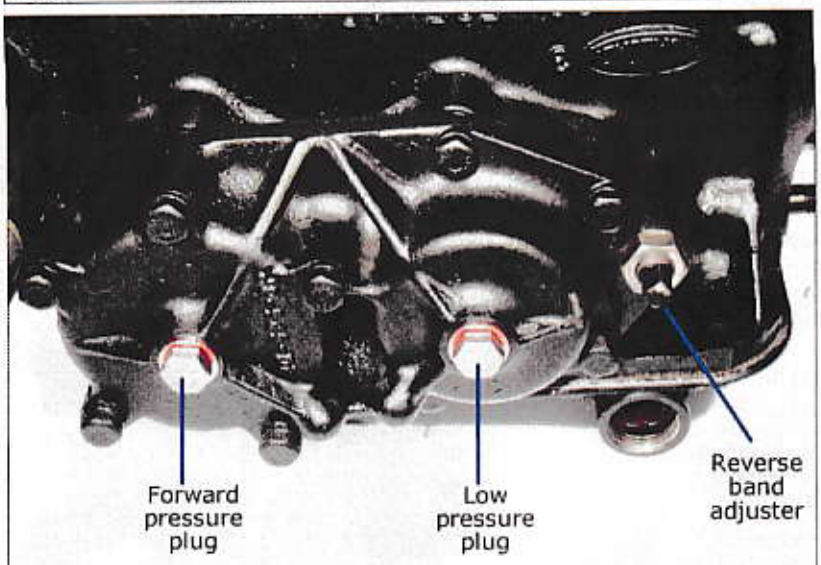


Fig 15

11) Hold the adjuster so that it cannot rotate and tighten the lock nut.
12) Check that band adjustment is correct and if so remove the tool from the servo housing.
13) Refit pressure take off plug with copper washer.
14) Repeat operations 1 to 13 for the other brake bands.

Without special tool

This procedure is not listed in any of our Jaguar manuals. It has been derived in the workshop and given brake band clearances which for practical purposes have been similar to those obtained when using the special tool.

1) Locate brake band adjusters shown in figures 1, 2, 14 and 15
2) Wire brush adjuster threads to remove surface corrosion and apply light oil to assist rotation.
3) Slacken by approximately 1/4 turn one of the brake band adjuster lock nuts (3/4" A.F.). One adjuster and lock nut is shown in greater detail in figure 13.
4) Hold adjuster by the square (5/16" A.F.) to prevent it rotating.
5) Slacken lock nut until it is clear of the gearbox case and check that it is free to rotate on the adjuster.
6) Hold the lock nut to prevent it rotating.
7) Carefully tighten the adjuster with a small spanner and light finger pressure only until positive resistance to rotation is felt due to the brake band servo piston having been pushed to the limit of its travel. Check that resistance of the adjuster is not caused by friction in the lock nut.
8) Undo the adjuster by approximately 1/4 turns.
9) Hold the adjuster to prevent it rotating.
10) Tighten the lock nut.
11) Repeat operations 1 to 10 for the other brake bands.

Acknowledgement

Figures 3, 4, 5 and 7 have been reproduced by kind permission of Jaguar Cars.

Next month Bob will cover other service operations like adjustment of manual linkage and governor lever.

Bob Bate's Technical Topics

Servicing the Borg Warner DG automatic gearbox. Part 2

This month's text is a continuation of and intended to be read in conjunction with the article relating to servicing the DG gearbox printed in the July issue.

SERVICE OPERATIONS
SAFETY NOTES

Observe all safety precautions.
All equipment must be in good condition, suitable for the purpose for which it will be used and operated correctly.
Place the car on a firm level surface if using a jack or drive on wheel ramps.
If using a pit check that the vehicle is correctly positioned.
A jack alone must never be used to support the vehicle.
Suitable blocks or stands must be placed in correct positions underneath a raised vehicle.
Front and rear of wheels remaining on the ground should be chocked if others are raised.
When using a vehicle lift check that safety mechanisms are fitted and functional.
If the car is to be supported or lifted by the body check that axle or subframe mountings are in good condition and that they will not separate when the vehicle is raised.

When undertaking any service operation

Place the car on a firm level surface, over a pit or on a vehicle lift.
Apply the hand brake and check that it is effective.
Engage PARK.
Switch off the engine and remove the keys from the car.
After consideration of SAFETY NOTES raise the car if required to obtain access to the component being serviced.

OTHER SERVICE OPERATIONS

Adjustment of manual linkage

The linkage should be adjusted so that the gear lever in the car aligns with its location ident and indicator panel when the gearbox manual control lever is in the corresponding position. Care must be taken to ensure that free play, maladjustment or other faults in the linkages can not allow the gearbox to be in a range that is not indicated by the gear lever inside the car.

It is often considered that the car will not roll when the gear lever is in PARK. This assumption only holds good when the gearbox selector mechanism is in PARK, the parking pawl has engaged with the gear on the output shaft and all components are in a serviceable condition. If the pawl is not securely engaged with the gear, PARK may not prevent the vehicle from moving. PARK alone should not be relied upon to prevent the vehicle from rolling. The handbrake should be applied when a motor vehicle is left unattended and if possible when work is being undertaken. If the nature of work being carried out prevents engagement of PARK or if the mechanism is defective, alternate measures must be implemented to ensure that the vehicle is in a safe condition and cannot roll.

A similar consideration obtains with regard to the engine being inhibited from starting when the gearbox is in NEUTRAL or PARK. Once again, the assumption is only valid if the gearbox selector mechanism is in the range corresponding to that selected by the gear lever inside the car and the inhibitor switch is functioning.

It is not uncommon to see misaligned manual control linkages that do not engage PARK correctly and/or permit the engine to start when the gearbox is in a drive range. Faults such as these are dangerous and should be rectified immediately they become apparent.

Adjustment of manual linkage stop plate

At the extremity of travel in REVERSE the gearbox selector lever should be just touching the stop plate as shown in figure 16. If adjustment is required:

1) Slacken bolts A and B in figure 16 by approximately ¼ turn each which is normally sufficient to allow movement of the stop plate. Slackening of these bolts should be kept to a minimum because they secure the speedometer gear housing to the extension case.

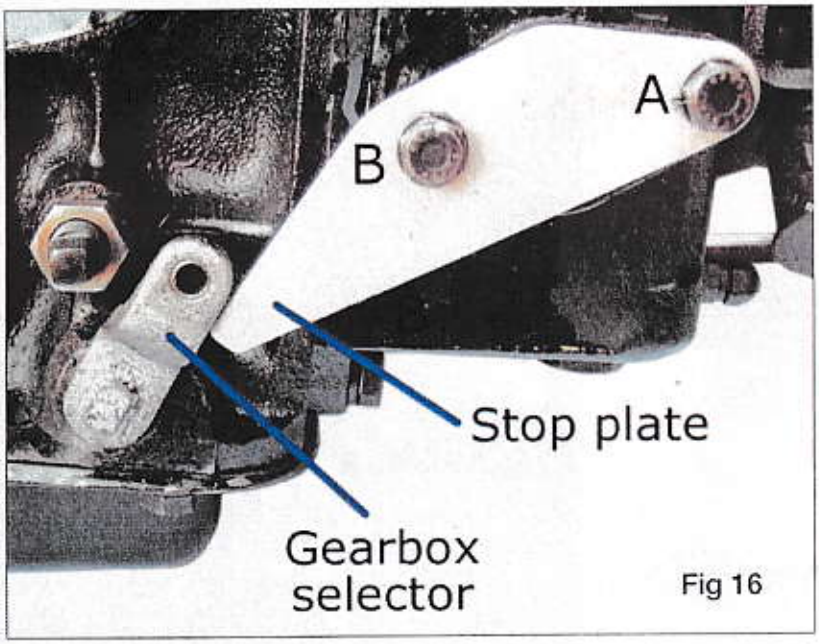


Fig 16

Fig 17

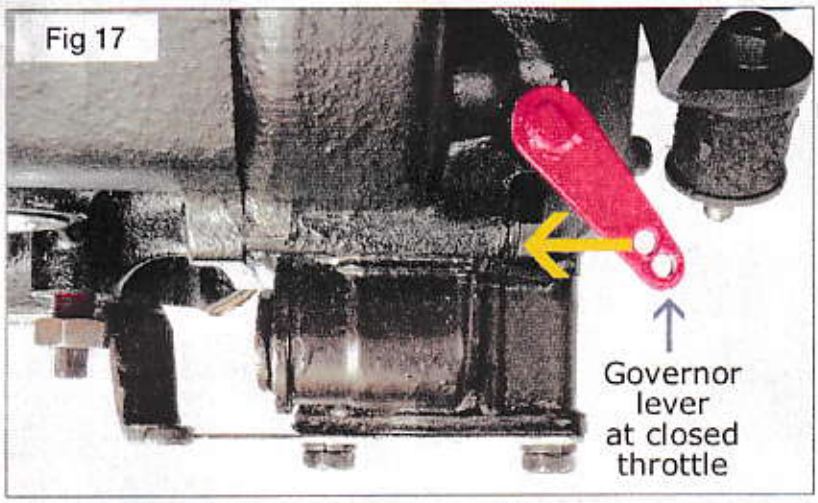


Fig 18

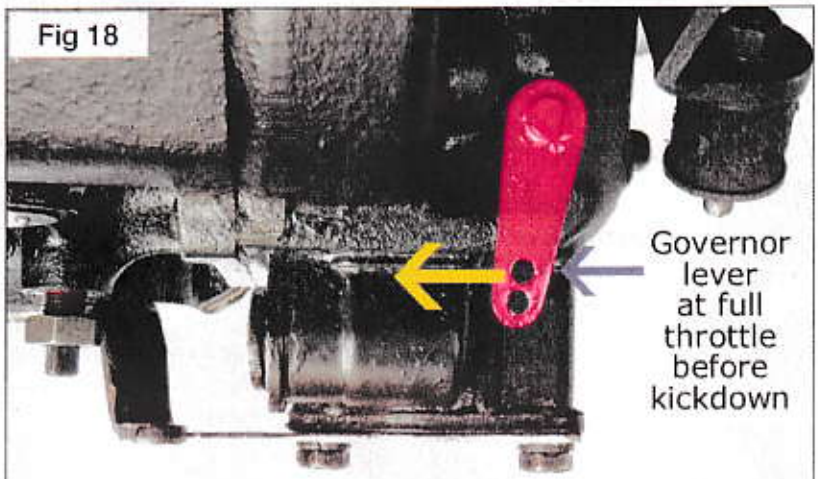
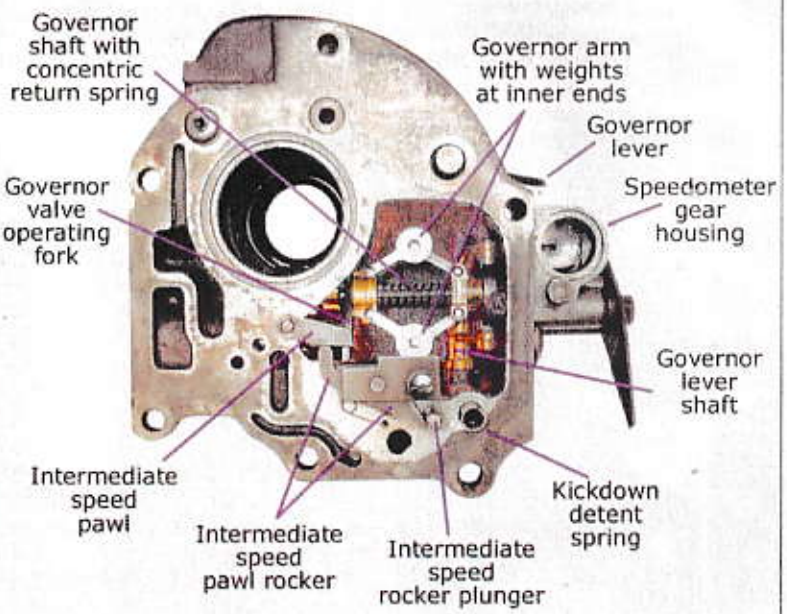


Fig 19



2) Pivot the stop plate about bolt A. The hole in the plate under bolt B is slotted.
3) Tighten the bolts.
4) Operate the gear lever and check adjustment of the stop plate.

Adjustment of governor lever

The governor in the gearbox extension case is part of the mechanism that controls the speed at which the transmission changes gear when in D or DRIVE range.

Applicable transmissions

This description relates to the latest and probably most common DG gearbox (commencing serial number J2426) that starts from rest with D selected in LOW gear and is fitted with an INTERMEDIATE speed pawl (explained later). Gear ratios in automatic DRIVE are referred to as LOW (first), INTERMEDIATE (second) and DIRECT (third) to maintain consistency with many of the Jaguar manuals. To reduce clutter on the photographs only one of multiple items is usually identified.

Transmission variations

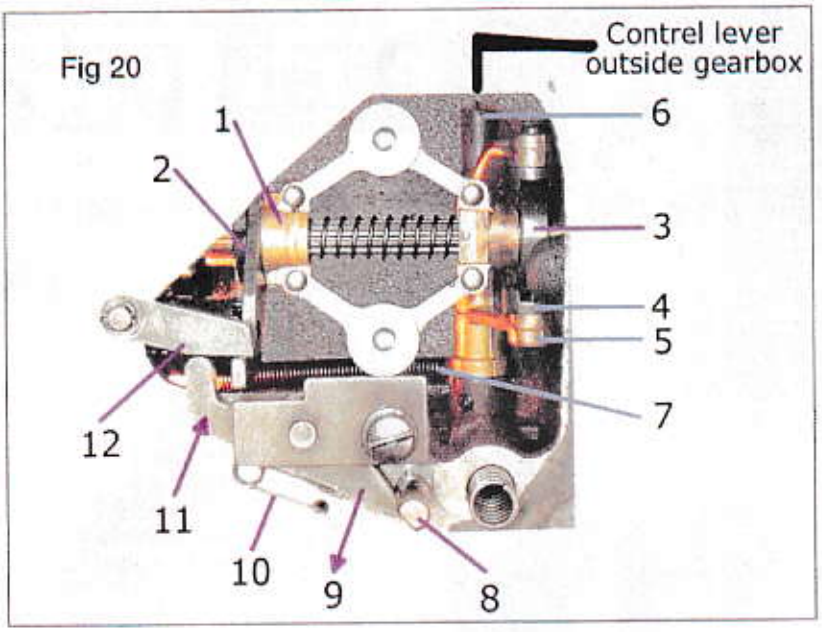
The earliest DG gearbox starts from rest with D selected in intermediate and whilst the governor mechanism is not identical the principle of operation is similar. These units are fitted with a direct drive pawl that is longer than the intermediate pawl. Operation and release of the pawl is slightly different to that described for the first speed start transmissions with kickdown being available from direct drive to intermediate. According to our information the direct drive pawl was eliminated from second speed start gearboxes at Mark VII chassis number 736871.

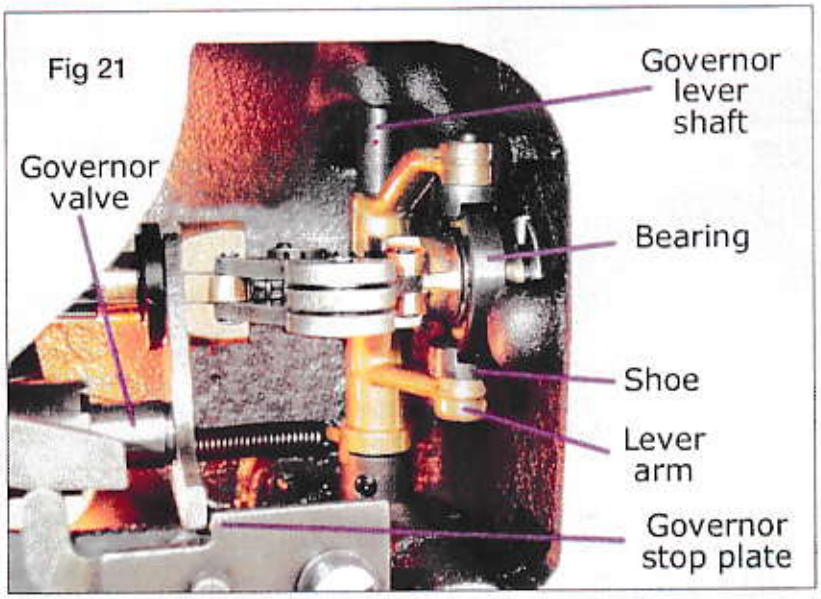
Preliminary considerations

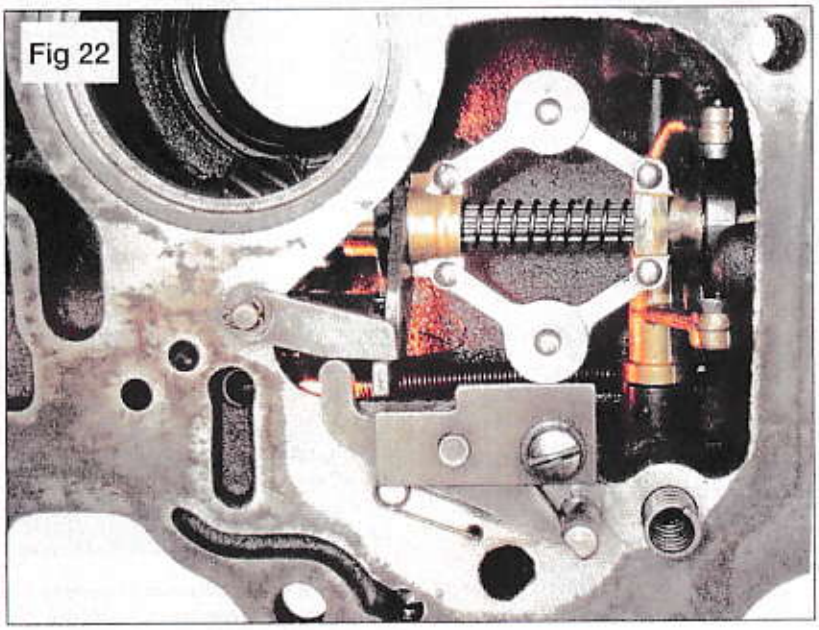
As the governor control lever is connected to and operated by the accelerator linkages the engine must be in good condition, running well and producing normal performance for a given throttle opening before any adjustment is attempted. If the engine is not running correctly increased throttle opening will be required for a specific road speed or acceleration, thereby increasing the speed at which the transmission changes gear. It is therefore essential that carburetter linkages are in good order and all engine settings such as tappets, carburation and ignition timing are correct before adjusting the governor linkage. Carburetter linkages must open the throttle valves (butterflies) fully and then push through the spring loaded over travel which operates kickdown.

Governor construction and operation

When the accelerator is released the







governor lever should be pushed rearwards so that it is just clear of the governor mechanism as shown approximately in figure 17. Upon opening the throttle the linkage is pulled forwards in direction of the yellow arrow so that the governor lever acts against operation of the governor in the gearbox. The further the throttle is opened the greater is the resistance to travel of the governor and hence the later the gearshift in relationship to road speed. At full throttle without kickdown in operation the governor lever should have been pulled to approximately the position as shown in figure 18. When the accelerator linkages are pushed through the spring loaded over travel the governor linkage is pulled further forwards against a spring loaded cam detent in the gearbox extension case to operate kickdown.

Unfortunately the previous paragraph is not easy to understand without knowledge of the governor components. The obvious answer seemed to be "Remove the extension case and have a look inside" as in figures 19, 20 and 21. Observant readers will have noticed that to save space inapplicable sections of the case have been deleted from the photographs. Sorry about the yellow tinge in some of the pictures which is caused by the light bulb hidden behind the governor valve.

All items in this section refer to figure 20 unless stated otherwise. The governor comprises four arms which are pivoted in pairs and attached by pivots at their outer ends to brackets which slide on the splined governor shaft. When the governor is stationary the return spring concentric with the shaft (see figures 19 and 20) pushes the brackets outwards to the extremities of their travel. The innermost bracket (1) is engaged with a fork (2) fastened to the governor valve which can be seen in figure 21. The outer bracket carries a ball bearing race (3) which is attached through shoes (4) to arms (5) fastened to the vertical governor control shaft (6), on top of which outside the gearbox is the control lever. The control shaft return spring (7) tries to rotate the shaft against the action of the control lever. When the throttle is closed and the governor lever arm is in the "at rest" position the bearing and outer bracket are held at their outermost location as in figure 20 by the combined actions of the governor and control shaft return springs. When stationary the governor return spring pushes the inner bracket to the extremity of its travel and hence the governor valve fully into its housing which is the position for operation of low gear. Another action of the governor control lever when "at rest" is to push the plunger (8) forwards (out of the casing towards the reader) so that a

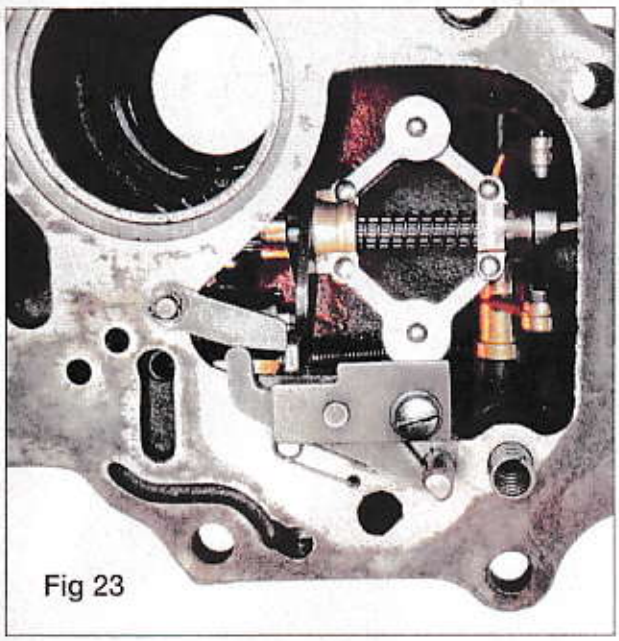


Fig 23

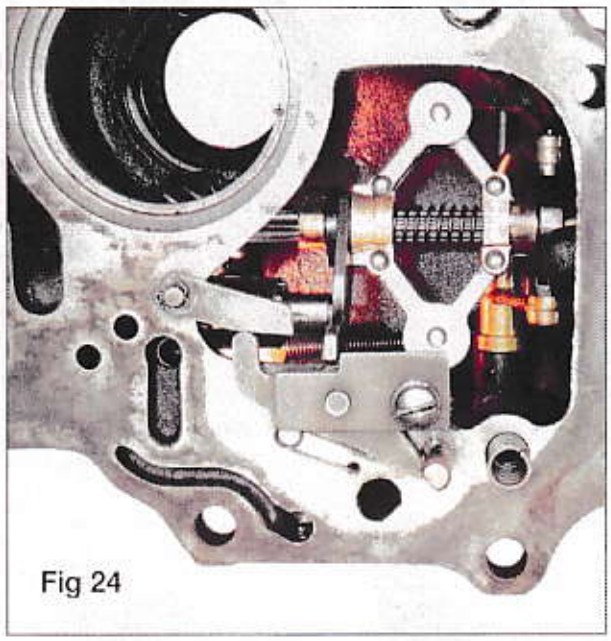


Fig 24

ramp on the shaft pushes the end of rocker (9) downwards in the direction of the arrow against the action of spring (10), thereby lifting the opposite end of rocker (11 arrowed) and intermediate pawl (12) so that the governor valve fork can return to the low gear position. This mechanism is explained in more detail during operation of the governor whilst driving.

Figure 21 shows the assembly from a different angle with the governor rotated through ninety degrees and the governor valve pulled to direct drive position.

Driving

From standstill to intermediate gear

Light throttle

When starting from rest the governor valve should be pushed fully into its housing so that the transmission will engage low gear. In this condition the intermediate gear pawl will be resting by action of gravity on top of the governor valve fork as in figures 19, 20 and 22. When the vehicle moves forward the governor shaft is turned by gearing from the gearbox output shaft so that the centrifugal force applied to the rotating governor weights causes them to move outwards, thus bringing the two end brackets closer together. The higher the road speed the greater the centrifugal force and vice versa. With minimum throttle opening and hence little movement of the governor control lever the outer governor bracket will be held almost at the end of its travel by the control lever return spring as in figure 22. In this condition the inner bracket will withdraw the governor fork and valve sufficiently to cause an upshift into intermediate gear at a low road speed as in figure 23. Coincident with the gearshift the intermediate gear pawl will disengage from the governor valve fork and fall downwards, thus preventing the governor fork from pushing the valve back into low gear position if road speed decreases whilst the governor control lever is not fully released. Figure 23 shows the governor valve in intermediate gear with the pawl behind the fork.

Upshift from intermediate to direct drive

Light throttle

As road speed increases so does the rotational speed of the governor and hence the centrifugal force on the weights so they move further outwards, bringing the end brackets closer together. With minimum throttle opening and hence little movement of the governor control lever the outer governor bracket will be held almost at the end of its travel by the control lever return spring. In this condition the inner bracket will retract the governor fork and valve sufficiently to cause an upshift into direct drive at a relatively low road speed as in figure 24. Governor valve travel is limited in direct drive by contact of the governor fork with the stop plate identified in figure 21.

Downshift from direct to intermediate

Light throttle

When road speed and as a consequence governor speed reduces the governor brackets are moved apart by the return spring so that the governor valve is pushed into its housing, effecting a downshift into intermediate when the right point is reached. As road speed reduces further the centrifugal force on the governor weights also reduces but whilst the throttle is partly open the intermediate pawl prevents the governor valve from moving to the low position.

Downshift from intermediate to low

Closed throttle

When the throttle is released the intermediate pawl is lifted as described previously so that the governor valve can move into low position at the correct road speed. The gearbox will not change down into low if the governor linkage is adjusted incorrectly so that the intermediate pawl is not lifted.

From rest to intermediate

Wider throttle opening

The general principle of the gearshift with light throttle applies except that the increased throttle travel will cause the control rod to be rotated so that the outer governor bracket will be pushed inwards, thus increasing the load on the concentric return spring. It follows that a higher road speed will be required to increase the governor speed and centrifugal force on the weights to overcome the increased loading of the governor return spring and move the governor valve into intermediate position. Figure 25 shows the governor valve in low with a wider throttle opening and therefore increased governor return spring load compared with that shown in figure 22.

From intermediate to direct

Wider throttle opening

The principles already discussed apply to the upshift into direct drive.

Kickdown

When the governor control lever moves beyond the full throttle position the governor control lever is rotated further against the action of a spring loaded plunger riding over a cam detent to give what is known as KICKDOWN. The extra travel of the governor outer bracket increases the compression of the concen-

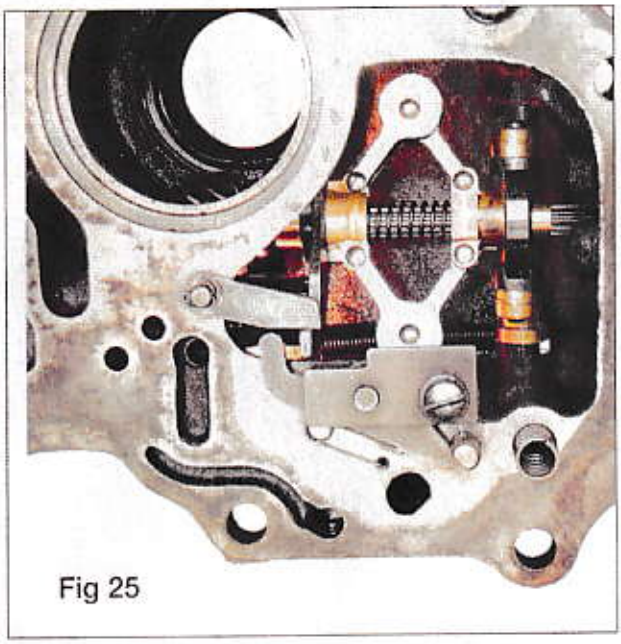


Fig 25

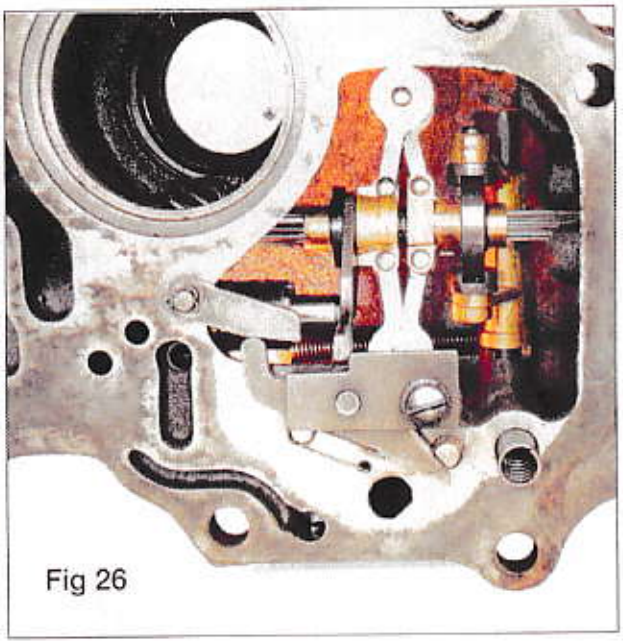


Fig 26

tric return spring and consequently the speed at which the governor has to rotate to withdraw the governor valve to a specific position. The effect of kickdown is to force a downshift from direct to intermediate provided that the road speed is within acceptable limits as determined by the valve chest or increase the speed at which all upshifts occur. Kickdown from intermediate into low is not possible due to the action of the intermediate pawl. Figure 26 shows the governor valve in direct with the governor lever pulled to kickdown position. The kickdown detent spring is identified in figure 19.

ADDITIONAL CHECKS

Fluid leaks

Inspect the gearbox for signs of serious fluid leaks. Minor seepage from gaskets and joints may be acceptable but larger leaks are not and should be rectified at the earliest opportunity. A serious leak could cause loss of drive and damage to the gearbox.

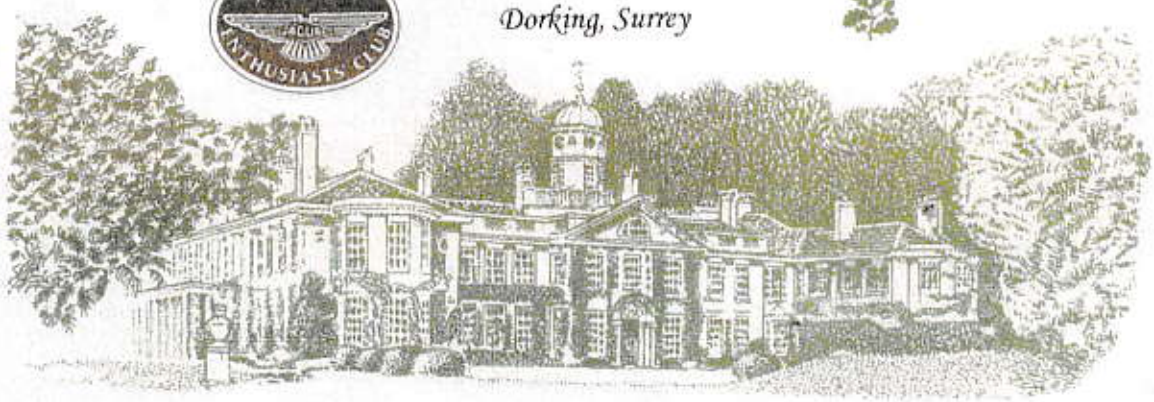
Mounting

Inspect the gearbox mountings for general condition and security. Check the tightness of nuts, bolts, linkages, etc if considered necessary.

SURREY JAGUAR DAY - SUNDAY 5 SEPTEMBER 2004

Polesden Lacey

Dorking, Surrey



The theme for his year's event will be **"Powered by Jaguar"**. Jaguar engines have provided the motive force for numerous military vehicles and powerboats, as well as many kitcars and replicas. Any vehicle or vessel using a Jaguar engine will be welcome to this event, and special parking areas for groups of similar vehicles can be provided by prior arrangement with Peter G. Clarke.

The Polesden Lacey estate is situated on the North Downs near Dorking and extends to some 30 acres. There are elegant grass terraces and a magnificent walled garden commanding some of the finest views in Surrey.

Event attractions include informal concours, raffle, static displays, and live jazz band.

Admission £6.00 per adult, children free, which includes entry to the garden, grounds, restaurant and gift shop.

This event will have its own entrance, which should be approached from the A24 at West Humble; direct access from the A246 (Bookham) will not be possible. Gates open at 10.30 a.m.

Further information from **Peter Clark: 01737 832367** or **Peter G. Clarke: 01372 450908.**