

Bob Bate's Technical Topics

Servicing the Borg Warner Model 35 automatic gearbox. Part 1

Some applicable models

Automatic versions of

3.4 Mk 2 chassis onwards

171615 RHD

181442 LHD

3.8 Mk 2 chassis onwards

235345 RHD

224747 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 chassis onwards

1B 8445 RHD

1B 26241 LHD

3.8 'S' Type chassis onwards

1B 59529 RHD

1B 80288 LHD

Daimler V8 2.5 litre

Daimler V8 250

240

340

2.8 XJ6

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 When identifying gearboxes confusion could occur if the original Model 35 has been replaced by a different automatic transmission. If in doubt about fitment reference to photographs of a Borg Warner Model 35 in figures 1, 2 and 3 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. 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.

SERVICE CONSIDERATIONS

SAFETY AND ENVIRONMENTAL 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.

Waste oil must be disposed off in a manner that conforms with applicable legislation.

Commencing 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.

Switch off the engine.

Engage PARK.

Remove the keys from the car.

After consideration of SAFETY NOTES raise the car if required to obtain access to the component being serviced.

Procedure for starting engine

A. Engage NEUTRAL or PARK.

B. Check that the handbrake is applied and effective.

C. Check that nothing can catch in rotating components.

D. Apply the footbrake.

E. Start engine and allow to idle.

F. Slowly release the footbrake whilst checking that there no tendency of the gearbox to drive the car. If the car does try to drive in PARK or NEUTRAL ascertain the reason and rectify, preferably before carrying out any other operation due to the possible danger involved.

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 thoughts may be of assistance.

A POSSIBLE SERVICING PROCEDURE

Check gearbox oil level

Road test vehicle

Change gearbox oil

Clean sump and filter(s)

Adjust brake bands

Carry out other adjustments if required

Road test vehicle

Let's think about each section individually.

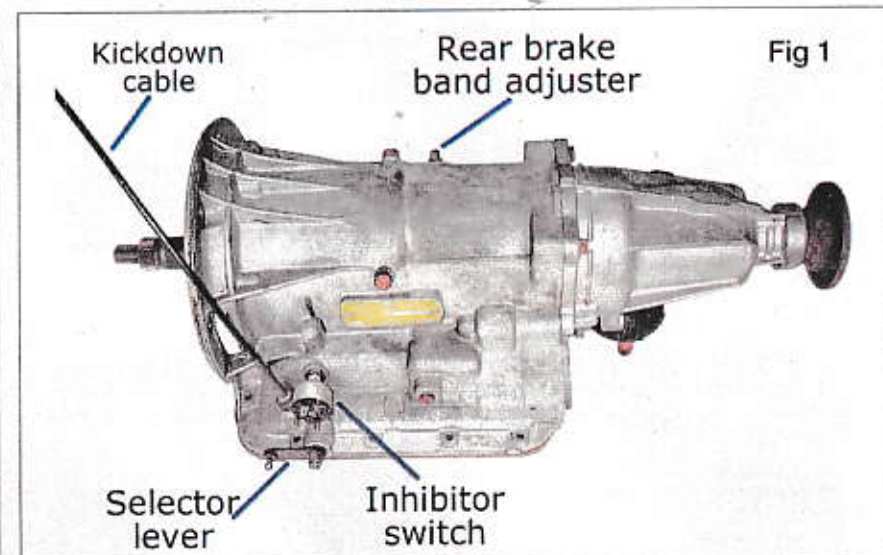


Fig 1

Fig 2

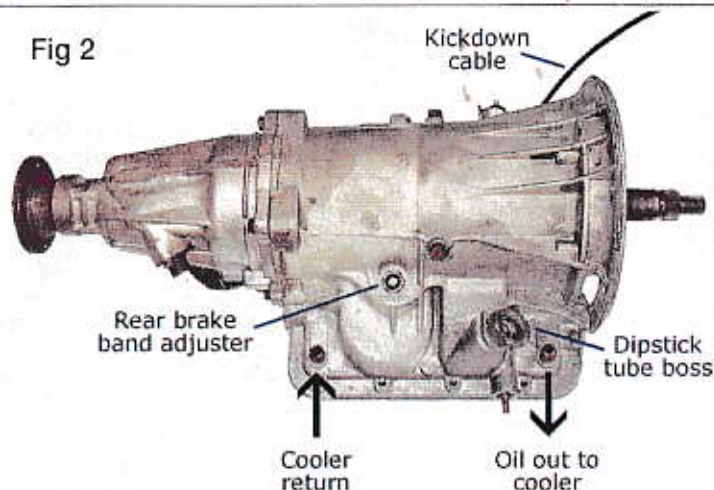
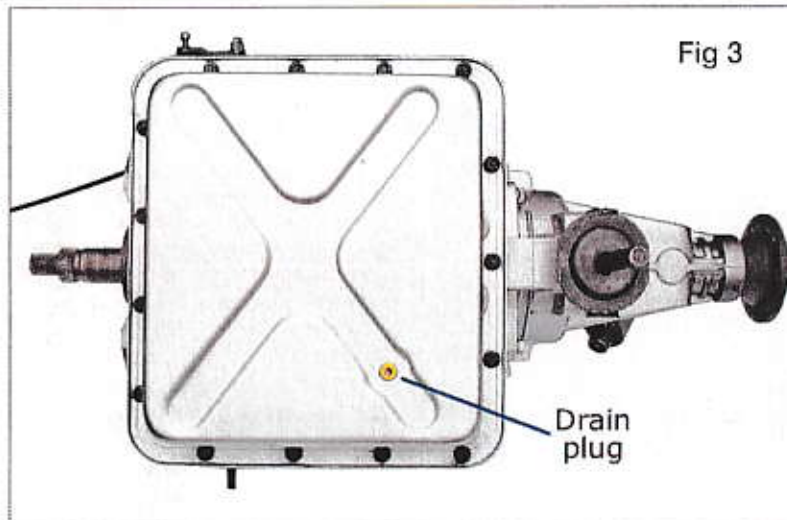


Fig 3



Gearbox oil level

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

Early manuals include reference to Transmission fluid Type A but this is now generally considered to be obsolete. The later specification of Automatic Transmission fluid Type F (Ford M2C-33F) has now been replaced by Type G (Ford M2C-33G).

CHECKING OIL LEVEL

The gearbox should ideally be at normal operating temperature when checking the oil level.

- 1) Place the vehicle on a level surface.
- 2) Apply the handbrake and check that it is effective.
- 3) Switch off engine.
- 4) Engage PARK.
- 5) Locate gearbox oil level dipstick in the

engine compartment. Fig 4 shows the dipstick (arrowed) on a 2.8 XJ6.

- 6) Check that nothing can catch in rotating components.
- 7) Apply the footbrake.
- 8) Start engine and allow to idle.
- 9) Slowly release the footbrake whilst checking that there is no tendency of the gearbox to drive the car. If the car does try to drive in PARK or NEUTRAL, ascertain the reason and rectify, preferably before carrying out any other operation due to the possible danger involved.
- 10) Insert dipstick fully.
- 11) Remove dipstick quickly and ascertain the oil level relating to engine/gearbox temperature. Checking the level with the gearbox at normal operating temperature tends to give the most reliable reading.
- 12) If the level is low, add oil of the correct specification SLOWLY down the dipstick tube until the correct level is attained. Filling rapidly can cause air locks which may cause oil to be expelled from the dipstick tube. Be careful not to over fill. Damage or

malfunction may be caused by running the gearbox with excessively high oil level.

- 13) After confirming that the oil level is correct refit dipstick.

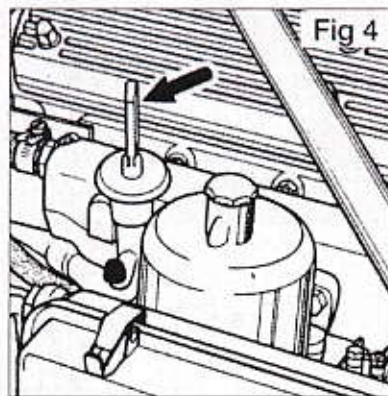
- 14) Switch off engine.

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.

A possible road test cycle

1. Place vehicle on a level surface with clear space at front and rear.
2. Apply the hand brake and check that it is effective.
3. Switch off engine.
4. Check adjustment of manual control linkage through all selector positions. i.e. The relationship between the gear lever in the car and the selector shaft in the gearbox – adjust if necessary.
5. Switch on ignition only.
6. Engage each gear in turn and check that the reverse lights will only operate in REVERSE.
7. Apply footbrake.
8. Engage each gear in turn and check that the starter will only operate in PARK and NEUTRAL.
9. Engage NEUTRAL.
10. Start engine.
11. Slowly release footbrake and check that there is no tendency for the car to drive either forwards or backwards.
12. Apply footbrake.
13. Engage PARK.
14. Slowly release footbrake and check that there is no tendency for the car to drive either forwards or backwards.



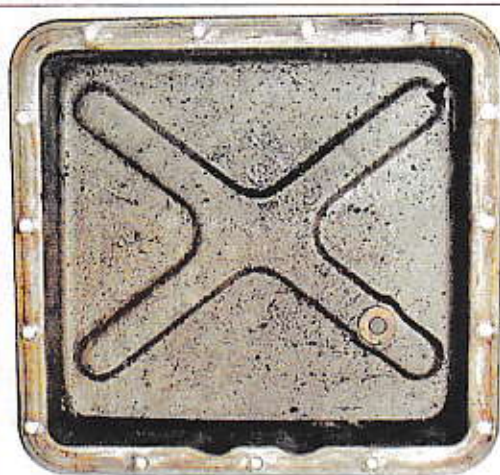


Fig 5

OBSERVATION

If the car does try to drive in PARK or NEUTRAL, ascertain the reason and rectify, preferably before carrying out any other operation due to the possible danger involved.

15. Allow engine to idle and check that rpm is within reasonable limits which for practical purposes could probably be considered as approximately 500 to 800 rpm.

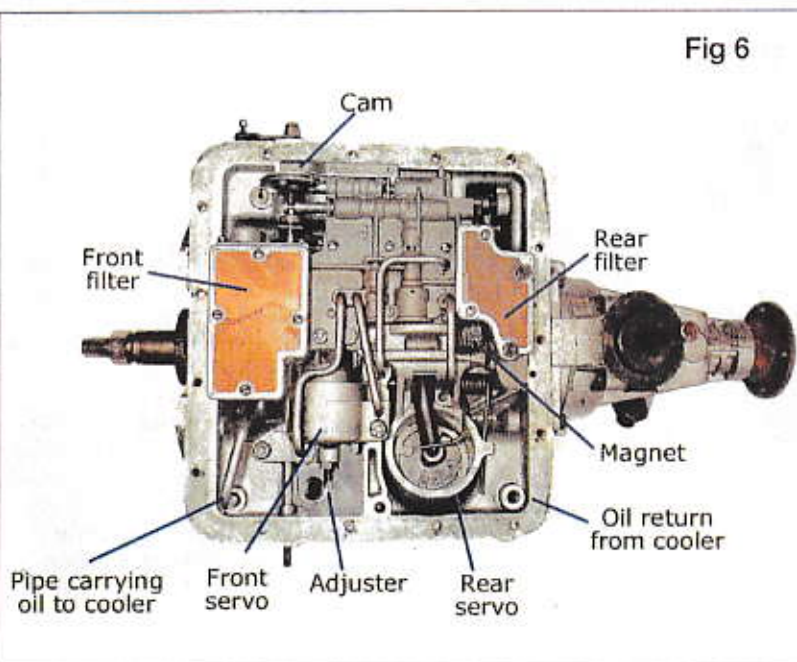


Fig 6

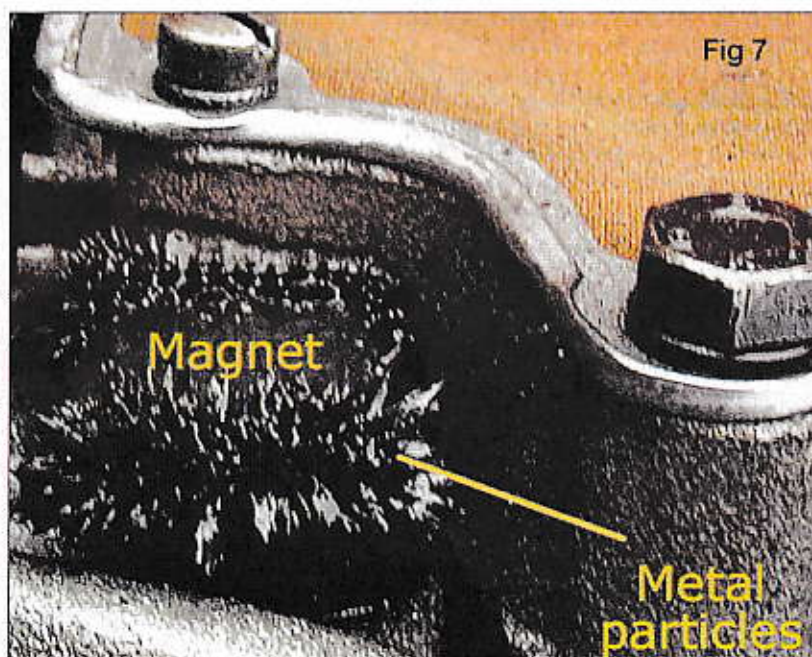


Fig 7

16. 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.
17. Listen for unusual sounds emitting from the gearbox or bell housing and cancel the road test if any are audible.
18. Apply footbrake.
19. 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.
20. Engage a forwards drive range.
21. After releasing the footbrake drive the car in all forward ranges with a variety of throttle openings through all gears and check that the gearbox operates correctly. Do not allow the engine to exceed maximum recommended rpm at any time during the test.
22. If the gearbox is functioning normally 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 engaged and road speed is within limits. It is generally inadvisable to operate kickdown if there is any suspicion of a gearbox malfunction because of the additional loading to which components will be subjected.
23. Having brought the car to a standstill keep the foot brake applied.
24. Engage REVERSE.
25. Release the footbrake and check that the car drives backwards without problems.
26. Bring the car to a standstill.
27. Apply handbrake.
28. Engage PARK.
29. Release footbrake.
30. Switch off the engine.

Changing gearbox oil Cleaning sump and filter

NOTE

Some sumps are fitted with a drain plug, others are not. The dipstick tube is usually fitted into the gearbox casing as in fig 2. Jaguar manuals refer to dipstick fitment in the sump although we have never seen this on Jaguar/Daimler cars in the workshop.

A few suggestions

- 1) If fitted - arrange for the drain plug or dipstick tube boss 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. Automatic transmission fluid may cause scalding when at normal operating temperature.
- 3) Remove or displace components as required to enable removal of the sump.
- 4) Place a tray in position to catch oil when the sump, drain plug or dipstick tube is removed. Caution - oil may spurt sideways.
- 5) If fitted - remove the drain plug and catch oil that will drain. Drain plugs with a recessed hexagonal head are frequently cracked and need to be replaced.
- 6) If fitted - detach the dipstick tube from the sump.
- 7) Without a drain plug or dipstick tube the oil will have to be drained by slackening and removing the sump. Wouldn't you just love to watch the people who design (design?) these things getting covered in transmission fluid when removing a full sump. If the oil has already been drained then simply remove the sump.
- 8) Inspect the sump. If the gearbox is in good condition the oil and sump will be clean with very little contamination. Unfortunately components do wear in service thus meaning that a small amount of debris is often visible and usually acceptable. The difficulty is deciding when "acceptable" changes to "unacceptable". Figure 5 shows large quantities of fibre and metal particles indicating that wear has taken place to such an extent that the vehicle should not be driven to reduce the possibility of further damage. An additional clue to the condition of the gearbox can be gleaned by the amount of metal clinging to the magnet - identified in figure 6 and shown in greater detail in fig 7. When in good condition the oil is red and fairly translucent. Check for discolouration caused by burnt gearbox components and water contamination, usually from the oil cooler. When mixed with water the oil becomes emulsified, is thicker and has a whitish pinky colour.
- 9) Remove magnet, clean and refit.
- 10) Remove four screws and detach the front filter, the flat mesh type is identified in figure 6 with figure 8 showing debris in the mesh. The later snorkel filter is illustrated in figure 9.
- 11) Clean the filter if it is of the flat screen type, check the mesh for integrity and if broken obtain a replacement. Snorkel type filters are difficult to clean and probably better replaced if

- there is any sign of contamination.
- 12) Fit front filter.
 - 13) If fitted - The rear filter (identified in fig 6) can be detached after removing two bolts and screws. The bolts also secure the valve chest but it should remain in place because there is another retaining bolt close to the front servo.
 - 14) Clean filter, check the mesh for integrity and replace if broken.
 - 15) Fit rear filter.
 - 16) Clean sump and remove all traces of gasket.
 - 17) Remove all traces of gasket from gearbox case.
 - 18) Fit sump, preferably with a new gasket.
 - 19) Fit dipstick tube - if applicable.
 - 20) Fit drain plug - if applicable.
 - 21) Slowly pour transmission fluid down the dipstick tube until the correct level is reached. Unfortunately this means continually dipping to guard against overfilling.
 - 22) Check that handbrake is applied.
 - 23) Check that the transmission is in

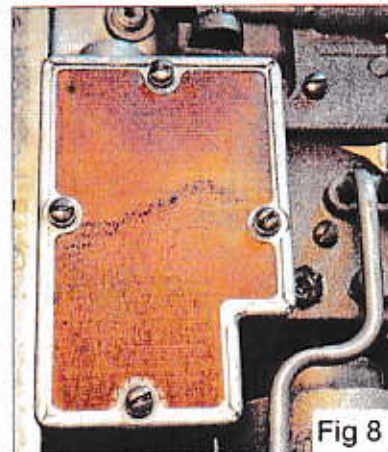


Fig 8

PARK.

- 24) Check that nothing can catch in rotating components.
- 25) Apply footbrake.
- 26) Start engine and allow to idle.
- 27) Move gear lever through all drive ranges to circulate the oil and fill the torque converter.
- 28) Engage PARK.
- 29) Release footbrake.

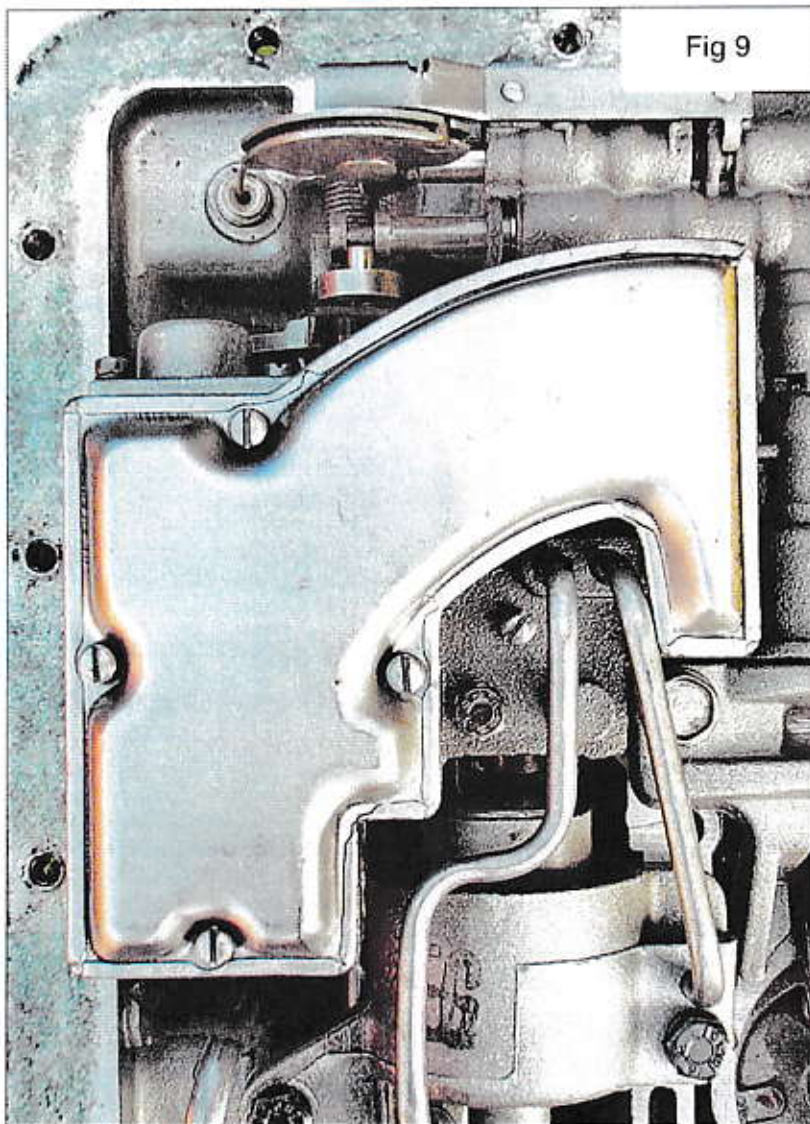
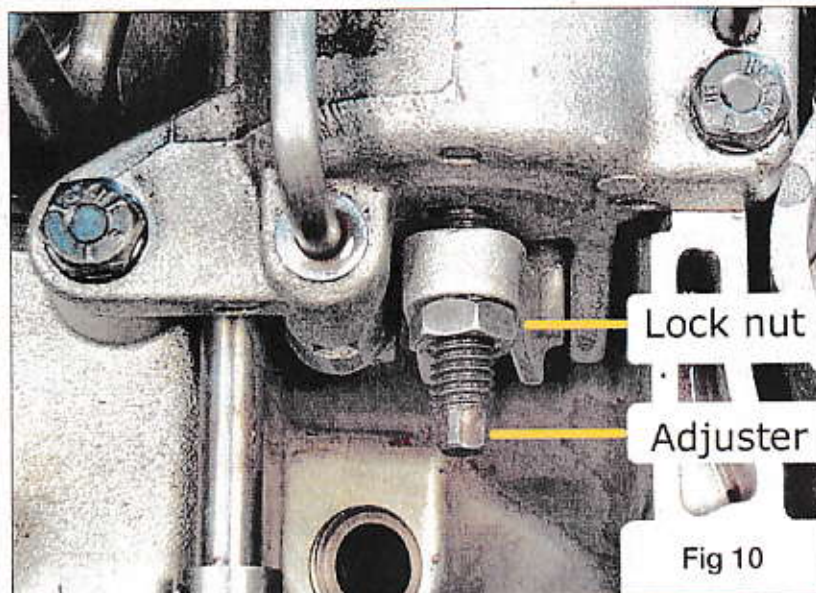


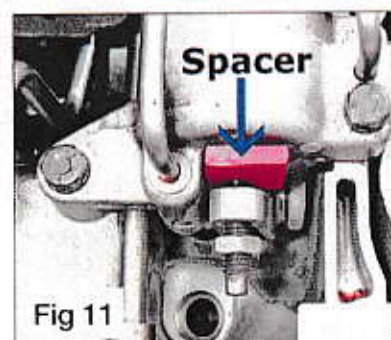
Fig 9



Lock nut

Adjuster

Fig 10



Spacer

Fig 11

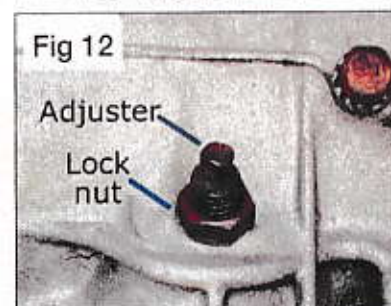


Fig 12

Adjuster

Lock nut

- 30) Check and top up oil level as suggested in **Checking oil level** from operation 9 onwards.
- 31) Refit components that were removed or displaced to facilitate access.
- 32) Observing all safety precautions lower the car or drive off pit and restore to normal running condition.
- 33) Carefully take the car for a test drive.
- 34) Bring car to a standstill.
- 35) Apply handbrake.
- 36) Engage PARK.
- 37) Release footbrake.
- 37) Check and if necessary top up gearbox oil in accordance with previous notes.
- 38) Switch off engine.

Flushing torque converter

The converter is not drained during routing oil changes as a drain plug is not fitted. Oil can be flushed through the

converter by disconnecting one of the oil pipes, running the engine and expelling oil until it becomes clear, signifying that new oil has filled the converter. To undertake this operation.

- A) Ensure that the gearbox is full of new oil.
- B) Disconnect one of the oil cooler pipes and lead into a suitable container for catching expelled oil. The direction of oil flow is indicated on figure 2. Unfortunately, the direction of flow is incorrect in many of the Jaguar manuals. For the avoidance of doubt, the oil outlet pipe and open return orifice can be seen in figure 6.
- C) Check that the handbrake is applied.
- D) Engage PARK.
- E) Apply footbrake.
- F) Run engine at idle speed until the oil flowing oil clear.
- G) Switch off engine.
- H) Release footbrake.
- I) Connect the cooler pipe.
- J) Top up gearbox oil level as previously described.

BRAKE BANDS

Locations

There are two brake bands which for simplicity we can call front and rear. The adjuster for the front band (see figures 6 and 10) is accessible after removing the sump. The rear brake band adjuster is situated on the outside of the gearbox case as shown in figures 1, 2 and 12. Adjustment may be referred to as either "adjusting the brake band" or "adjusting the servo". The reason being that adjustment takes up free play on the band and servo (which operates the band) – and then introduces the required amount of clearance or free play so that when not applied the band is clear of its rotating component.

Front servo – adjusting

- A) Drain gearbox oil and remove sump as described in operations 1 to 7 in the section **changing gearbox oil**.
- B) Slacken adjuster lock nut (see figures 6 and 10).
- C) Adjust the clearance of the servo operating arm. A $\frac{1}{4}$ inch thick spacer is used to adjust the servo as described in Jaguar manuals. Without the spacer an alternative method has to be used. If the rear servo is removed do not be tempted to use the band apply strut (usually 0.215" thick) as a spacer for adjustment of the front servo.

WITH $\frac{1}{4}$ " SPACER

- a) Undo the adjuster sufficiently to allow the spacer to fit between the bolt and the servo as in figure 11.
- b) Tighten the adjuster to 10 lbs ins. That is ten pounds inches – NOT TEN POUNDS FEET. Without a torque wrench a reasonable approximation can usually be obtained by using light figure pressure on an open ended spanner.
- c) Hold the adjuster to prevent it rotating and tighten the lock nut.
- d) Remove spacer.

WITHOUT SPACER

- a) Back off adjuster lock nut by approximately 5 turns provided that there is sufficient length of thread on the adjuster.
- b) Tighten the adjuster to 10 lbs ins. That is ten pounds inches – NOT TEN POUNDS FEET. Without a torque wrench a reasonable approximation can usually be obtained by using light figure pressure on an open ended spanner. In some instances the nut may have to be removed to allow full movement of the adjuster.
- c) Undo the adjuster 4 turns. As the adjuster is 16 threads per inch, 4 turns represents $\frac{1}{4}$ inch of travel which gives the same result as having the spacer fitted.
- d) Hold the adjuster to prevent it rotating and tighten the lock nut.

ZX

- D) Refit sump, fill with oil and check level as described from operation 18 onwards in the section **changing gearbox oil**.

Rear servo – adjusting

- i) Slacken adjuster lock (see figures 1, 2 and 12).
- ii) Tighten adjuster to 10 lbs feet. (Yes, TEN POUNDS FEET). Without a torque wrench a reasonable approximation can usually be obtained by hand pressure on an open ended spanner.
- iii) Undo adjuster by $\frac{1}{4}$ to 1 turn.
- iv) Hold the adjuster to prevent it rotating.
- v) Tighten lock nut.

Continued next month.

Bob Bate's Technical Topics

Servicing the Borg Warner Model 35 automatic gearbox. Part 2

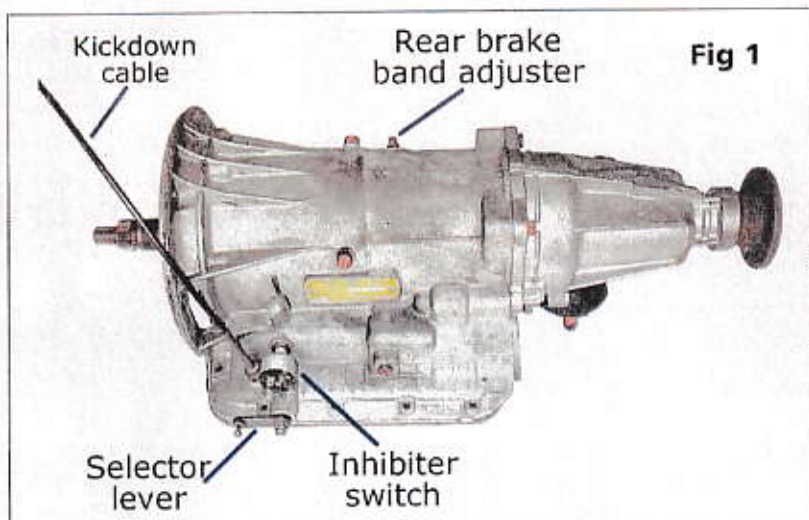
When identifying gearboxes confusion could occur if the original Model 35 has been replaced by a different automatic transmission. If in doubt about fitment reference to the photograph of a Borg Warner Model 35 in figure 1 should enable the query to be resolved.

Waste oil must be disposed off in a manner that conforms with applicable legislation.

When commencing any service operation

Place the car on a firm level surface, over a pit or on a vehicle lift.

F. Slowly release the footbrake whilst checking that there no tendency of the gearbox to drive the car. If the car does try to drive in PARK or NEUTRAL ascertain the reason and rectify, preferably before carrying out any other operation due to the possible danger involved.



This month's text is a continuation of and should be read in conjunction with the article relating to servicing the BW35 gearbox printed in the October issue.

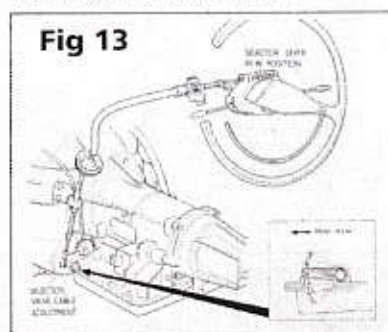
SERVICE CONSIDERATIONS SAFETY AND OPERATING NOTES

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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.

Apply the hand brake and check that it is effective.
Switch off the engine.
Engage PARK.
Remove the keys from the car.
After consideration of SAFETY AND OPERATING NOTES raise the car if required to obtain access to the component being serviced.

Starting engine

- Engage NEUTRAL or PARK.
- Check that the handbrake is applied and effective.
- Check that nothing can catch in rotating components.
- Apply the footbrake.
- Start engine and allow to idle.



OTHER SERVICE OPERATIONS

Adjustment of manual linkage

The linkage should be adjusted so that the gear lever in the car aligns with its location plate and indicator when the gearbox selector is in the corresponding position. Two suggestions:

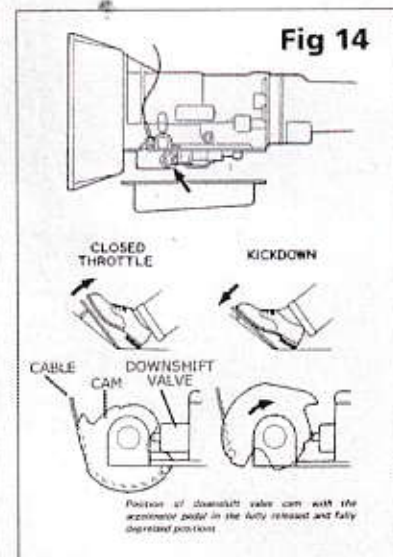
- Check for excessive free play in the connections between the gear lever and the arm that is attached to the gearbox.
- Check tightness of the nut that secures the lever to the gearbox selector shaft. Looseness at this point can permit an unbelievable amount of free play as the unsecured lever rotates on the shaft.

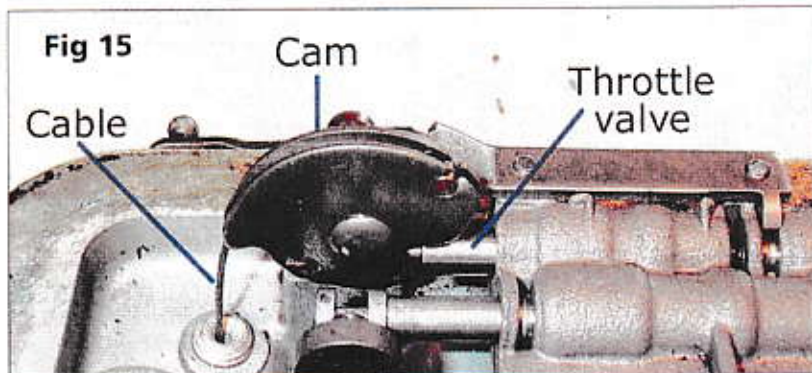
Figure 13 shows the gearbox selector lever, cable and connection to gearbox on a Jaguar 240.

Kickdown cable

Principle of operation

The cable communicates engine load from the throttle linkage to the gearbox. When the throttle and thus kickdown cable is released the engine will be producing minimum power. At full throttle with the kickdown cable pulled





to it's full extension the engine will be providing maximum power. Yes, it's obvious but a principle that is often forgotten when tracing gearbox faults. Figures 14, 15 and 16 shows the relationship between accelerator pedal, cable and a typical valve chest.

The kickdown cable has two main functions

1. Transmits engine torque requirement to the gearbox valve chest which adjusts hydraulic line pressure accordingly. LINE PRESSURE can probably be considered as the main hydraulic control pressure in the gearbox which amongst other functions has an effect on the speed at which gearshifts occur and the force with which drive components such as clutches and brake bands are applied.
2. Signals the valve chest to operate kickdown, the activation of which depends upon other factors such as selected drive range, current gear engaged and road speed.

CLOSED THROTTLE

At closed throttle the cable should be relaxed so that the cam is in the "at rest" position with the heel of the cam resting on the downshift valve which is at it's furthest position out of the valve chest. With the accelerator released, both when the vehicle is stationary and on the over run, the valve chest will be supplying the transmission with relatively low line pressure so that operation of gearbox drive ranges will be soft and virtually unobtrusive.

LIGHT THROTTLE

If the car is drive with light throttle the cable will be pulled a small amount and the cam rotated slightly so that the valve combination is pushed into the chest to

produce a small increase in line pressure. In this condition automatic gear shifts will be relatively soft and at low road speeds.

INCREASED THROTTLE

As the throttle is opened further line pressure is increased to accommodate the additional torque transmitted and automatic gearshifts become more positive at higher road speeds.

KICKDOWN

At almost full throttle a raised portion on the cam that can felt by the driver through the accelerator pedal pushes the downshift valve further into the valve chest to operate kickdown which will only become operative if a correct range is selected and the road speed is within acceptable limits. Kickdown position of the cam can be seen in figure 14.

Kickdown cable

Adjustment

Preliminary considerations

"Check" means check and adjust or rectify as necessary

1. Check that the engine is running well on all cylinders and that settings such as tappets, ignition timing, carburation etc. are correct. It follows that if the engine is not running correctly increased throttle opening will be required for a given road speed or acceleration, therefore effecting operation of the gearbox including automatic gearshift and kickdown speeds.
2. Check that the linkages open the throttle valves (butterflies) fully at the point where the accelerator pedal reaches maximum travel and that the kickdown cable is pulled just past kickdown position.
3. Check that there is minimum free play between movement of the accelerator linkages and the kickdown cable. When the accelerator is opened the kickdown cable and the throttle valves should move almost simultaneously so that engine torque demand is transmitted accurately to the gearbox.
4. Check that when the accelerator is released the kickdown cable is not under tension and the cam attached to the valve chest is resting on the back of the valve as shown in figures 14 to 16. Figure 17 shows the kickdown cable and its attachment to the throttle

linkages on a Jaguar 240. Although the linkage design is different on other models the principle is similar. When the throttle is closed there should be a small gap between the crimped stop on the cable and the end of the adjuster. By pulling the inner cable against spring tension of the cam return spring and then releasing, it should be possible to hear the cam contacting the valve at the same time as the cable becomes slack, thus confirming correct setting with a closed throttle. It is not unusual to find that the crimped stop has been positioned incorrectly or the cable has stretched so that the relationship between the inner and outer cables has changed.

MALADJUSTMENT

If the kickdown cable is pulled before the butterflies open there will be a corresponding increase in gearbox line pressure before an increase in engine torque so that automatic gearshifts will be harsh and late. Conversely, opening the throttle valves before the cable is pulled will mean that gearbox line pressure will not have been increased to accommodate the additional torque with the possible result of transmission slip and early automatic gearshifts in relationship to throttle opening and road speed. Automatic downshifts, particularly from second into first can be harsh if the cable is adjusted so that the cable is pulled when the throttle is closed.

The generally recommended method of adjusting the cable is with the use of a pressure gauge attached to the gearbox. Without this equipment the cable can usually be adjusted within acceptable limits by assessing the response of the gearbox whilst stationary and during road testing. Should we think about both procedures?

Kickdown cable adjustment

Utilising pressure gauge

Tools required on our gearboxes have been:

3/16 inch AF male hexagon wrench or Allen key.

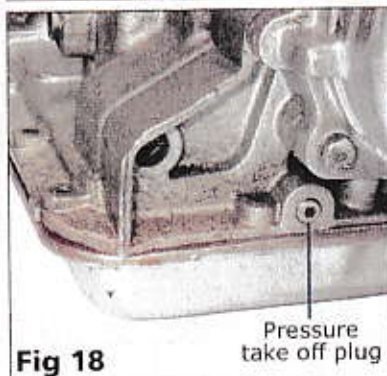
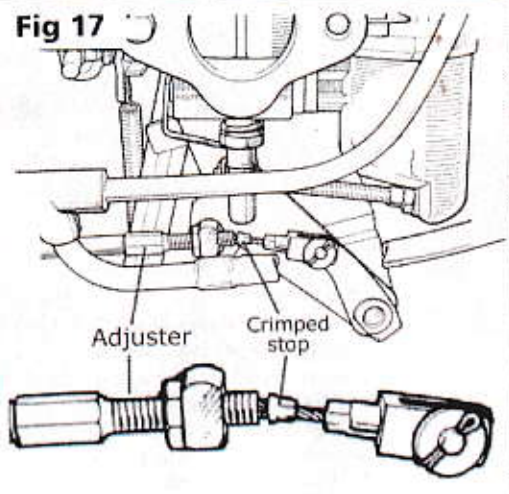
1/8 inch x 27 tpi NPTF male adaptor to screw into the gearbox.

Pressure gauge reading up to 200 psi and hose for attachment to the adaptor.

Unless the hose is long enough for the gauge to be seen from the driving seat a second person will be required for this operation.

Our procedure

- 1) Carefully check that the gearbox sump and other components are at a suitable temperature for work to be undertaken. Automatic transmission fluid may cause scalding when at normal operating temperature.
- 2) Displace components as required to enable removal of the pressure adaptor from the rear of the gearbox (see figure 18).

Fig 17**Fig 18**

- 3) Place a tray in position to catch oil that may drain when the plug is removed.
- 4) Remove all debris from the female hexagon of the plug to ensure that the wrench or Allen key has the deepest possible engagement. The plug is often very tight.
- 5) Remove the plug and catch oil that will drain.
- 6) Fit the adaptor and pressure gauge to the gearbox.
- 7) If necessary, refit components that are required to enable the engine to run.
- 8) Check that PARK is engaged.
- 9) Observing all safety procedures start the engine.
- 10) If a significant quantity of oil has drained from the gearbox, check and if necessary top up the level. Usually, such a small amount of oil drains that this operation is unnecessary.
- 11) APPLY THE FOOTBRAKE.**
- 12) CHECK THAT THE HANDBRAKE IS FIRMLY APPLIED.**
- 13) Engage D1 or D2 on early transmissions, D or 2 on later models.
- 14) Whilst keeping pressure on the footbrake to prevent the car driving increase engine speed to 1,000 rpm.
- 15) Note reading on the pressure gauge which according to our manuals should be 95 to 100 psi.
- 16) Allow engine to idle.
- 17) Switch off engine.
- 18) Release footbrake.
- 19) Adjust kickdown cable if required and

repeat the test sequence. Undoing the cable adjuster so that effectively the inner cable is pulled further out of the gearbox for a given throttle position increases line pressure and vice versa. Do not forget to tighten the lock nut.

- 20) When the line pressure is correct and with engine switched off carefully check that the gearbox sump and other items are at a suitable temperature for work to be undertaken.
- 21) Displace components if necessary and remove the pressure gauge.

- 22) Refit the sealing plug.
- 23) Refit other components if required.
- 24) Observing all safety precautions lower the vehicle if applicable and restore to normal running condition.
- 25) Check and if necessary top up gearbox oil level.
- 26) Road test the car to confirm that line pressure setting is correct in accordance with assessment of the gearshift quality and speeds. It is not unusual to find that a minor adjustment of the cable is required to modify line pressure in accordance with personal preference. If considerable adjustment is required it suggests that something is amiss and in need of attention. Driving an automatic gearbox with significantly incorrect line pressure can cause serious damage.

Kickdown cable adjustment

Without pressure gauge

If the cable has been adjusted and linkage relationships checked in accordance with preliminary considerations gearbox line pressure should in theory be correct and in practice is usually found to be within reasonable limits. Road test evaluation should indicate whether or not gearshifts are late and harsh or early and soft. A few suggestions:

- A) Drive the car from rest with light throttle. Check that gearshifts are smooth and occur at speeds in accordance with data in the owner's handbook or workshop manual. Without this information the best that can be accomplished is to "feel" when you expect upshifts to take place.
- B) At approximately 30 mph release the throttle, allow the car to decelerate and bring it slowly to a standstill. Downshifts should be smooth and almost imperceptible.
- C) Check operation of kickdown. Do not confuse FORCED THROTTLE DOWNSHIFT which kickdown.

FORCED THROTTLE DOWNSHIFT
After upshifting, increased throttle

opening short of kickdown will force the gearbox to downshift provided that the road speed is within the required range. To establish the feeling of forced throttle downshifts drive the car at approximately 30 mph in third gear and slowly push down the accelerator. The gearbox should downshift to second before kickdown position is reached.

KICKDOWN

As road speed increases the amount of throttle opening and road speed for forced downshift increase to a point where it will not occur. From this speed onwards up to maximum allowable for kickdown a downshift will only take place when the accelerator is pushed sufficiently far to pull the control cam to the kickdown position. Maximum engine revolutions should never be exceeded.

- D) Adjust kickdown cable if considered necessary. Undoing the cable adjuster so that effectively the inner cable is pulled further out of the gearbox for a given throttle position increases line pressure and vice versa. Do not forget to tighten the lock nut.

Inhibiter switch

Operation and adjustment

The inhibitor switch(s) prevent the engine from starting when a drive range is selected and operate the reverse lights when reverse is selected. Switches attached to linkages inside the car are relatively easy to adjust and probably do not need explanation. Adjustment of the gearbox mounted inhibitor switch (see figures 1, 19 and 20) may be easier if a few suggestions are included.

NOTE

Early switches as shown in figures 1, 19 and 20 are adjustable and can be identified by the lock nut and visible threaded section that screws into the gearbox. Later switches that do not have a visible thread are self adjusting upon fitment. Unfortunately, procedures for identifying cables, terminals and adjusting depend upon individual vehicles and the problem that is being experienced.

Cables are attached in opposite pairs as indicated on figure 19 which has been taken from the gearbox manual for the Jaguar 240 and 240. Reverse light terminals should be at 45 degrees to the switch end plate as in the diagram but may not have remained this way in service. The colours may not apply to all of these cars and probably differ on other models.

Safety warnings

All safety procedures must be observed with handbrake applied and PARK selected before undertaking any of these operations.

Ensure that cables cannot short

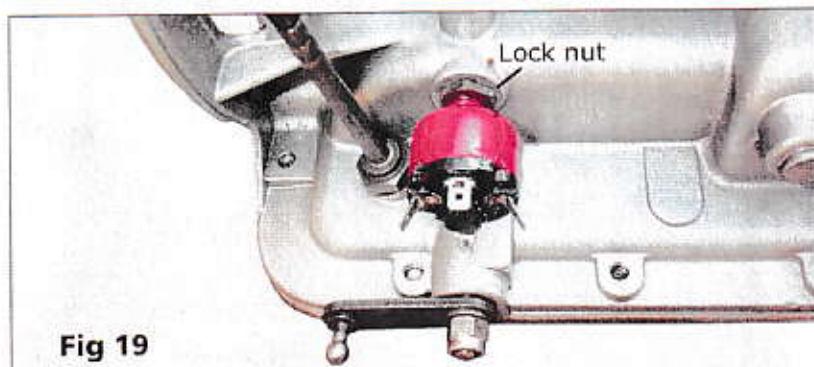


Fig 19

when disconnected from the switch.

CHECKING OPERATION OF CIRCUITS
SWITCH SUSPECTED AS BEING FAULTY
SWITCH FUNCTIONING PREVIOUSLY
TERMINAL ANGLES INDETERMINATE
TEST METER NOT AVAILABLE

1. Note cable colours that are in opposing pairs on the switch.
2. Try to identify cables from figure 19 or vehicle wiring diagram. If this cannot be accomplished proceed with operation.
3. Disconnect the ignition coil primary winding so that the engine cannot start.
4. Detach both pairs of wires from the switch.
5. Switch on ignition.
6. Join together one pair of wires whilst watching to see if the reverse lights operate. If they do not illuminate repeat the test for other pair of cables. If the reverse lights are still inoperative there must be a fault in the circuit rather than the inhibitor switch.
7. Join together one pair of wires.
8. Operate the starter motor and check that it engages. If it does not repeat the test for the other pair of cables.
9. Connect ignition coil when it is desired to start the engine.

IDENTIFYING CABLES
ALL CABLES DISCONNECTED
NO FUNCTIONS KNOWN
UTILISING VOLT METER

- 1) Disconnect the ignition coil primary winding so that the engine cannot start.
- 2) Select a meter range to measure 13 volts.
- 3) Connect the meter probe that corresponds to the earth polarity of the vehicle to earth.
- 4) Switch on ignition.
- 5) Connect the voltmeter measuring probe to each cable in turn. The one that reads battery voltage should be the supply cable for the reverse lights.
- 6) Connect the voltmeter measuring probe to each of the other three cables in turn whilst trying to operate the starter motor which will not engage because the inhibitor switch is disconnected. The cable which

registers battery voltage should be for energising the starter.

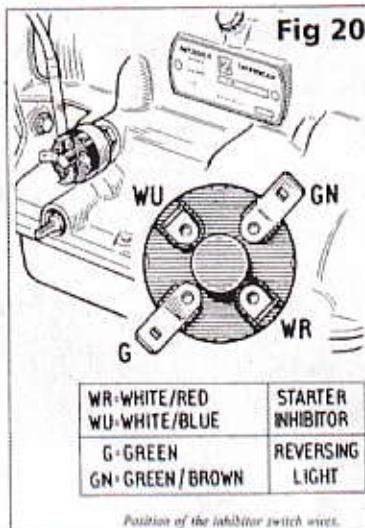
- 7) Touch the reverse light supply cable to each of the two remaining cables in turn and identify which is for reverse lights and starter motor.
- 8) Connect ignition coil when it is desired to start the engine.

UTILISING A 12V TEST BULB

The procedure is virtually identical except that a bulb is used between earth and the cables as a means of determining when voltage is evident.

INHIBITOR SWITCH ADJUSTING ORIGINAL and FITTING REPLACEMENT UTILISING AN OHMMETER

- A. Disconnect the ignition coil primary winding so that the engine cannot start. This is vital because the starter may energise accidentally with the transmission in a drive range if a mistake is made when the switch is adjusted.
- B. Engage a forward drive range. Figure 13 shows the gear selector positions on the Jaguar 240 and 340 cars. Cars with different forward drive ranges will still have P, R and N in the same positions.
- C. Identify switch cables and make suitable notes to assist refitting. Do not trust to memory.
- D. Detach cables from the switch.
- E. Slacken the adjuster lock nut.
- F. Remove switch from the gearbox.
- G. Set ohmmeter to continuity or a low range and set zero if applicable.
- H. Connect the meter to each pair of terminals in turn and locate those for reverse which should be connected when the switch is removed from the gearbox. The starter terminals are not connected when the switch is removed from the gearbox. Identify terminals to avoid confusion later.
- I. Connect the ohmmeter to the reverse terminals.
- J. Screw the switch into the gearbox until the terminal connection is broken.
- K. Note position of the switch.
- L. Transfer the ohmmeter to the other terminals which are for the starter motor.



- M. Screw the switch into the gearbox until the terminals become connected.
- N. Note position of the switch.
- O. Unscrew the switch until it is midway between the two positions noted.
- P. Hold the switch to prevent it rotating and tighten the lock nut to a torque of 4 - 6 pounds feet if a torque wrench and adaptor is available. Be careful not to over tighten the nut.
- Q. Connect the ohmmeter to the reverse light terminals and check that they are only connected when REVERSE is selected.
- R. Connect the ohmmeter to the starter terminals and check that they are only connected when PARK or NEUTRAL is selected.
- S. Connect the switch.
- T. Switch on ignition.
- U. Check that the reverse lights only illuminate when REVERSE is selected.
- V. Check that the starter only operates when PARK or NEUTRAL is selected.
- W. Switch off ignition.
- X. If all is in order connect the ignition coil.

ADDITIONAL CHECKS

Fluid leaks

Inspect the gearbox and cooler pipes for 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.

Acknowledgement

Figures 13, 14, 17 AND 20 have been reproduced by kind permission of Jaguar Cars.