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SECTION 16 — VALVE OPERATION

The position of the shift valves in range four—first gear, and the different oil passages used to obtain this gear are shown in Figure 20. A detailed description of the operation of the valves in selecting each gear is described in the following paragraphs.

FIRST GEAR

Range 4 part throttle

When the manual selector is in '4' range position, oil at main line pressure is allowed to flow directly to the front servo to apply the front friction band.

Road speed would be low, therefore governor pressure would be low.

The T valve would be slightly open and consequently the throttle valve would be slightly open, allowing main pressure to bleed past the throttle valve to form T.V. pressure. This pressure is regulated by the T.V. regulator valve.

T.V. pressure lifts the T.V. regulator valve against its spring and bleeds past the valve to assist the springs in holding closed the shift valves. T.V. pressure acting on the regulator plug assists the pressure control valve in regulating the front pump capacity to maintain the pump pressure at a controlled amount above T.V. pressure. Acting on the compensator valve, T.V. pressure moves it against its spring so that it opens to allow main oil pressure to bleed past to form compensator pressure.

Compensator pressure assists main pressure in the front servo in holding the front band 'on'; it also assists the rear servo springs to hold the rear band 'on'. Compensator pressure also moves the transition valve, but this is not important in first gear, as front clutch 'apply' oil is fed past the compensator valve and this is not applied until second gear. Both gear trains are then in reduction and the gearbox transmits torque in first gear ratio 3·82:1.

SECOND GEAR

Range 4 part throttle

If the manual selector valve remains in '4' range position, main oil pressure would still be fed to the front servo 'apply' chambers. However, as will be seen later, main pressure is also fed to the front servo 'release' chambers and acting over the larger area of the 'release' pistons, forces main 'apply' oil to exhaust.

The throttle valve remains slightly open and so the throttle pressures remain low.

When the road speed increases, G1 pressure becomes important, and G1 pressure acting on the 1–2 shift valve eventually overcomes the T.V. pressure and moves the 1–2 shift valve group into the second gear position. T.V. pressure on this group is then cut off by the 1–2 regulator valve and the existing T.V. oil forced to exhaust.

Compensator oil would remain high enough to keep the transition valve open. This was unimportant in first gear, but the movement of the 1–2 shift valve opens a port which allows main pressure to flow past the open transition valve to engage the front clutch and to release the front band.

The rear servo remains applied, assisted by compensator pressure, therefore the rear gear train will be in reduction. As the front gear train would then be in direct drive (clutch on, band off), the gearbox transmits torque in the ratio 2·63:1 i.e.—has changed to second gear.

Down-change

The 2–1 down-change occurs automatically only at extremely low road speeds. When G1 pressure falls below a minimum value the action of T.V. pressure on the 1–2 regulator valve and the action of the coil spring on the 1–2 shift valve moves the 1–2 shift valve back against the reduced G1 pressure and holds the

valve group in the first gear position.

The main pressure feed is then cut off, therefore the front clutch is released by its springs and the front band is applied by the main pressure feed from the manual selector valve. The gearbox thus changes down to first gear.

THIRD GEAR

Range 4 part throttle

With the main selector still in '4' range position, main oil will still flow directly to the front servo and if band release pressure is exhausted from the servo, the front band will be applied.

With the throttle valve remaining only slightly open, throttle and compensator pressures remain low.

Road speed will increase in second gear, and as a result G1 pressure will approach its maximum value whilst G2 pressure becomes more effective.

When the speed, and thus the governor pressures become high enough, the combined action of T1 and G2 pressures on the 2–3 shift valve group overcomes the opposing spring and T.V. pressure and the shift valve group is forced to move.

As the 2–3 shift valve moves, a port is opened which allows main pressure to flow past the 3–2 timing valve to engage the rear clutch and release the rear friction band.

Main pressure is also tapped from the rear clutch line to close the transition valve against compensator pressure.

When the transition valve closes, the port, which supplied pressure for front clutch 'apply' and front band 'release', is sealed. As a result, the front clutch is released by its springs and the front band is applied by the main line feed from the manual selector valve. The front gear train is then in reduction (band on, clutch off), and the rear train is in direct drive (band off, clutch on).

The gearbox will therefore transmit torque in the ratio 1·45:1, i.e.—has changed to third gear.

Down-change

If road speed is allowed to fall, governor pressure will decrease accordingly. G2 pressure is particularly sensitive to changes in speed and if it is allowed to fall below a minimum value, the combined action of coil spring and T.V. pressure will force the 2–3 shift valve back into the second gear position.

When this occurs, the main pressure ports to the transition valve and rear servo release chambers are sealed. As compensator pressure forces the transition valve open, main pressure flows past it to engage the front clutch and release the front band. The gearbox then reverts to second gear.

Note: The 3–2 timing valve is effective only during full throttle down-changes as described on Page 41.

FOURTH GEAR

Range 4 part throttle

The manual selector valve remains in '4' range position and so main pressure is still fed to the front servo 'apply' chambers. However, as was seen in second gear, main pressure will also be fed to the 'release' chambers of the servo, and, acting over the larger piston areas, will cause the front band to release.

The throttle valve remains only slightly open and so throttle and compensator pressures remain low.

Due to increasing road speed in third gear, G1 pressure will reach a maximum, and G2 pressure assume a greater importance. When sufficiently high, the combined action of G1 and G2 pressures on the 3–4 shift valve group overcomes the opposing spring tension and T.V. pressure, and the shift group is forced to move.

As the 3–4 shift valve moves, it opens a port which allows main pressure to flow past the **closed** transition valve to engage the front clutch and to release the front band.

The front gear train will then be in direct drive (clutch on, band off), therefore as the rear train has remained in direct drive from third gear, the gearbox transmits torque directly, ratio 1:1, i.e.—has changed to fourth gear.

Down-change

When road speed, in fourth gear, is allowed to fall, G2 pressure is reduced accordingly. G1 pressure is not affected until the car speed is considerably reduced.

When G2 pressure is sufficiently low, the combined action of T.V. pressure on the 3–4 regulator valve and coil spring tension on the 3–4 shift valve forces the 3–4 shift valve group to move. As soon as the regulator valve moves, a port is opened which allows T.V. pressure to act directly on the 3–4 shift valve, forcing the valve into the third gear position.

The flow of main pressure past the shift valve is thus stopped, removing the pressure from the front clutch

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and servo. The front clutch is then released by its springs and the front servo is applied by main pressure from the selector valve. As the rear clutch and band remain unaffected, the gearbox reverts to third gear.

4-3 Timing valve

To prevent the front band from slipping when high torque is transmitted during the 4–3 down-change, the 4–3 timing valve in the front servo closes one main band 'apply' port and forces band 'apply' oil to meter through a restricted by-pass channel. This has the effect of delaying front band application until the front clutch has released.

Forced down-change

A forced down-change can be obtained by fully opening the throttle and then exerting slightly greater force on the accelerator pedal. This forces the throttle valve assembly to the end of its travel where the T valve uncovers a port, permitting oil at main pressure to flow through a non-return valve and bleed past the T.V. regulator valve to increase T.V. pressure to approximately the same value as main pressure, and to act in opposition to governor pressures on the lock valves. Oil at main pressure acts on the 2–3 detent plug and also passes through a port partially covered by the 3–4 regulator valve which is forced over to cut off T.V. pressure and substitute main pressure on the 3–4 shift valve. The cushion of resistance felt on the accelerator pedal is provided by T.V. pressure acting on the end of the throttle valve assembly.

Subsequent valve operation will depend on the road speed; if this is below 72 m.p.h. the 3–4 shift valve will change down to third gear and maintain it until approximately 78 m.p.h. to 80 m.p.h. when an up-change will occur through the action of the overspeed valve in increasing the pressure acting on the 3–4 governor plug. This action is achieved by the increased G2 pressure acting on the overspeed valve and moving it against its spring to uncover a port which allows G1 pressure to substitute for G2 pressure and so increase the pressure on the 3–4 governor plug and move the 3–4 shift valve assembly over. If the road speed is below 38 m.p.h. the 3–2 detent plug is moved against its spring pressure towards the 2–3 shift valve and uncovers a port which permits main pressure to act on the transition valve and the 3–2 timing valve; the 3–2 detent plug and 2–3 shift valve will then move to change down into second gear.

If below 20 m.p.h. a change to first gear will occur.

A feature of the 3–2 change is the operation of the 3–2 timing valve which delays the application of the rear band and disengagement of the rear clutch until the front clutch is applied. The main pressure acting on the end of the 3–2 timing valve moves it to close the unrestricted passage; the discharge to exhaust of the rear servo must, therefore, pass through the restriction, thus delaying rear band application and rear clutch release, until movement of the transition valve permits main pressure to act on the front servo release piston and the front clutch engage piston. This pressure is also passed to the 3–2 timing valve to uncover the unrestricted passage thus speeding up the final application of the rear band. Up-change to third gear will not occur until approximately 35 m.p.h. because of main pressure on the 3–2 detent plug instead of T.V. pressure acting on the 2–3 shift valve.

If the road speed is below 20 m.p.h. the 1–2 shift valve assembly will operate to change down, and the subsequent up-change will occur at a slightly higher speed than normal due to pump pressure acting on the 1–2 detent plug and the higher T.V. pressure acting on the 1–2 regulator plug.

The change points given in the above paragraphs are for S3 cars. Earlier models have slightly different change points, as does the Bentley Continental range. A chart showing the variations between the different models is given in 'Chapter 2—Servicing'.