

BORG WARNER Transportation
Equipment

**MODEL 35
AUTOMATIC
TRANSMISSION
MANUAL**

Parts and Service Division

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SERVICE REQUIREMENTS

1. Fully road test and diagnose faults before dismantling an automatic gearbox. Use the road test procedure and diagnose chart and adjust as necessary. Re-test after rectification.
2. High standards of cleanliness are essential: Clean the outside of the casing with paraffin prior to the removal of any components. Rags and cloth must be clean and lint-free, preferably nylon.
3. Prior to assembly, clean all parts with an industrial solvent.
Renew all defective components.
Lubricate all components in Automatic Transmission Fluid. DO NOT assemble dry.
4. Use new joint washers.
5. Retain thrust washers and bearings with petroleum jelly; do not use grease.
6. Tighten screws, bolts and nuts to the recommended torque figure.
7. For all operations where access is required beneath the vehicle, it should be on a lift, over a pit or the front raised on stands.
8. Whenever a unit is overhauled due to component failure the oil cooler (if fitted) and connecting hoses should be flushed out.

EXAMINATION OF COMPONENTS

Transmission case and servo castings	.. .. .	Check for cracks and obstructions in passages.
Front and rear pump	.. .. .	Check for scoring and excessive wear.
Shafts	.. .. .	Check bearing and thrust faces for scoring.
Clutch plates	.. .. .	Check for warping, scoring, overheating and excessive wear.
Bands	.. .. .	Check for scoring, overheating and excessive wear.
Drums	.. .. .	Check for overheating and scoring.
Gears	.. .. .	Check teeth for chipping, scoring, wear and condition of thrust faces.
One way clutch and races	.. .. .	Check for scoring, overheating and wear.
Valve block and governor	.. .. .	Check for burrs, crossed or stripped threads, and scored sealing faces.
Impeller hub and front pump drive gear	.. .. .	Check for pitting and wear. Ensure good contact.
Thrust Washers	.. .. .	Check for burrs, scoring and wear.
White metal bushes	.. .. .	Check for scoring and loss of white metal.
Lip seals	.. .. .	Check for cuts, hardening of rubber, leakage past outer diameter.
Rubber 'O' rings and seals	.. .. .	Check for hardening, cracking, cuts or damage.
Sealing rings	.. .. .	Check fit in groove and wear (evident by lip overhanging the groove).

DESCRIPTION AND OPERATION

The model 35 three-speed automatic transmission is coupled to the engine by a three-element torque converter. Engine power is converted into hydrokinetic energy and this provides smooth application or driving torque.

Torque multiplication in all gear ratios is provided by the converter, which is infinitely variable between the ratio of 2:1 and 1:1. Extreme low-speed flexibility in third gear is the result. The speed range during which torque multiplication can be achieved is also variable, depending upon the position of the accelerator.

The Torque Converter

The torque converter consists of an impeller, connected to the engine crankshaft; a turbine connected to the transmission input shaft and a stator incorporating a sprag-type one-way clutch. This assembly is supported by a tube attached to the gearbox; it is co-axial with the input shaft.

The impeller, driven by the engine, causes fluid to flow from its vanes to the turbine vanes and to return to the impeller through the stator vanes.

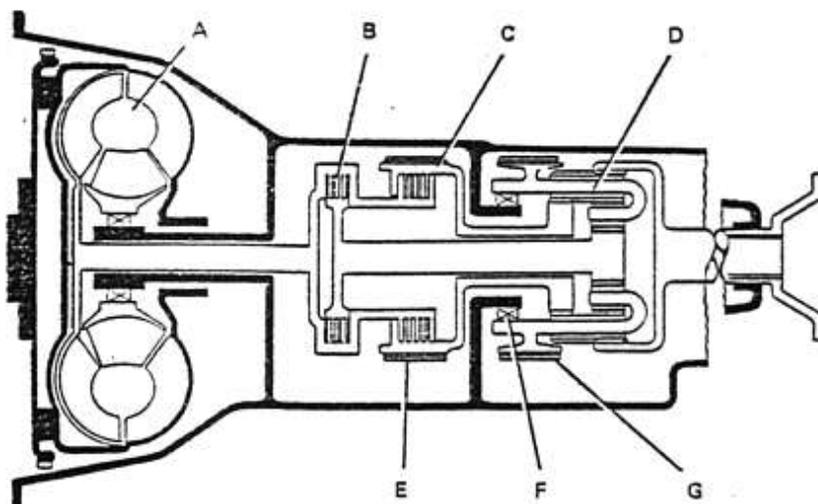
The vanes of the components are designed and curved to affect the angle of fluid flow when a speed differential exists between impeller and turbine. The angle of the fluid flow from the turbine is changed by the stator vanes in such a way that the fluid from the stator assists in driving the impeller; torque multiplication taking place.

This varies from 2:1 when the turbine is stalled* to 1:1 when the turbine speed reaches approximately 90 per cent of the impeller.

With the speed differential between impeller and turbine achieved the angle of fluid flow from the turbine drives the stator in the same direction as the turbine and impeller. In this state the converter acts as a fluid coupling and no torque multiplication takes place.

The Mechanical System

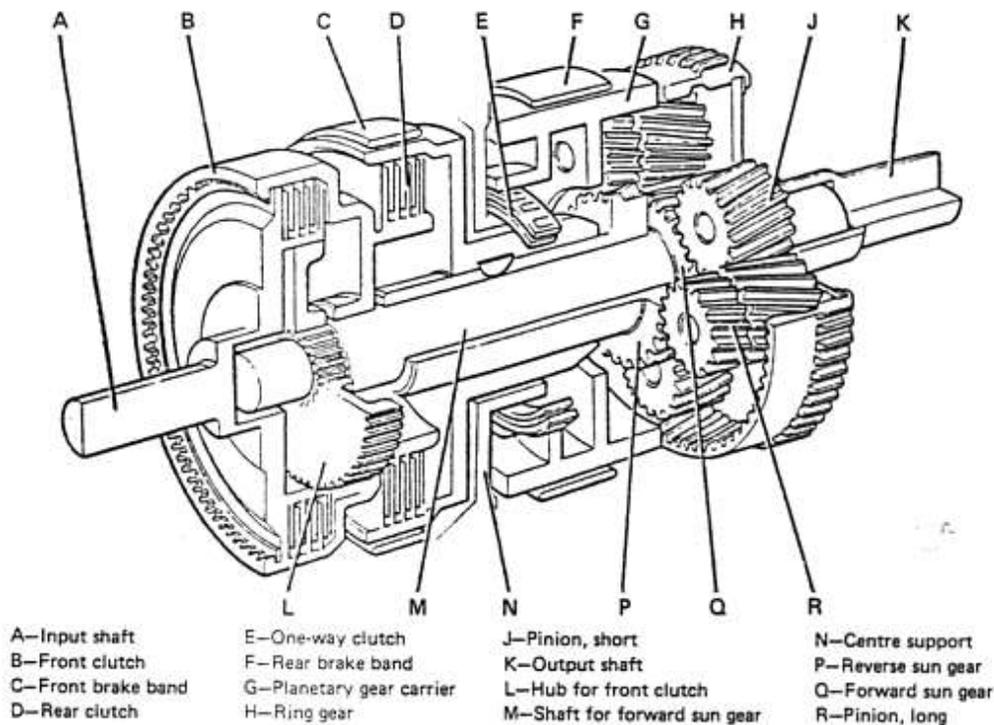
A planetary gear set, having helical involute tooth form throughout, provides three forward speeds and reverse. The planetary gear set comprises of two sun gears (forward and reverse); two sets of pinions located in a pinion carrier; and ring gear which is attached to the output shaft.



Mechanical Layout

- | | | | |
|--------------------|----------------------|------------------|-------------|
| A—Torque converter | C—Rear clutch | E—Front band | G—Rear band |
| B—Front clutch | D—Planetary gear set | F—One-way clutch | |

* When the car is held stationary with the engine operating at maximum throttle opening and any one of the driving ranges selected.



Power enters through one of the sun gears and leaves the gear set through the ring gear. In all forward gears, power enters through the forward sun gear and in reverse through the reverse sun gear.

A single set of pinions is engaged when reverse is selected, causing the ring gear to rotate in the opposite direction to the sun gear. A double set of pinions, engaged when forward gears are selected, cause the ring gear to rotate in the same direction as the sun gear.

The pinions are housed in a carrier which locates them in their respective position relative to the two sun gears and the ring gear. The carrier is in the form of a drum which may rotate or be held stationary by a brake band or the one-way clutch.

Gear ratios are engaged by hydraulically-operated clutches and brake bands, of which there are two of each.

The Clutches

These are operated by hydraulic pistons and connect the torque converter to the gear set.

In forward gears the front clutch connects the converter to the forward sun gear and in reverse the rear clutch connects the torque converter to the reverse sun gear.

Both clutches are of the multi-disc type.

The One-Way Clutch

This functions in place of the rear brake band when the selector is at the 'D'-Drive position. It prevents anti-clockwise rotation of the planetary gear carrier.

In first gear the gear set therefore freewheels, providing smooth changes first to second and vice versa.

The Brake Bands

There are two bands which hold elements of the gearing stationary to effect lower ratio output and increased torque. Both bands are hydraulically operated by servos.

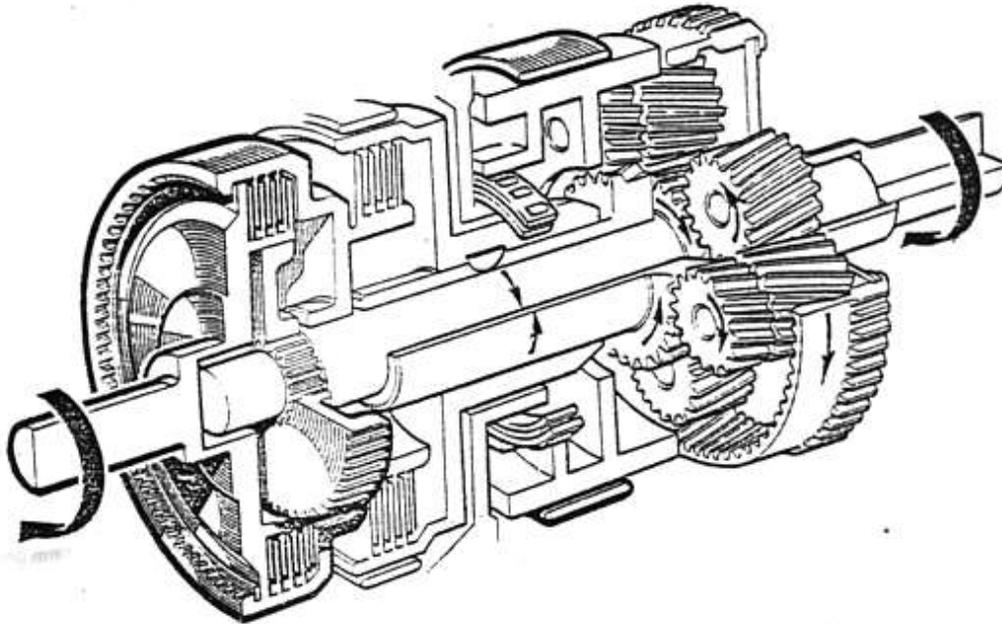
The front band holds the reverse sun gear stationary; the rear band holds the planetary gear carrier stationary.

In 'lock-up' on early selector pattern, or '1' on latest selector pattern, the pinion or planetary gear carrier is held stationary by the rear band and provides the first gear ratio of 2.39:1.

A double set of pinions are engaged so that the output shaft rotates in the same direction as the input shaft.

In reverse gear the planetary gear carrier is again held stationary, but a single set of pinions causes the driven shaft to rotate in the opposite direction.

For second gear ratio the front band holds the reverse sun gear stationary and the gearing produces a ratio of 1.45:1.



Application of bands and clutches – front clutch and rear band

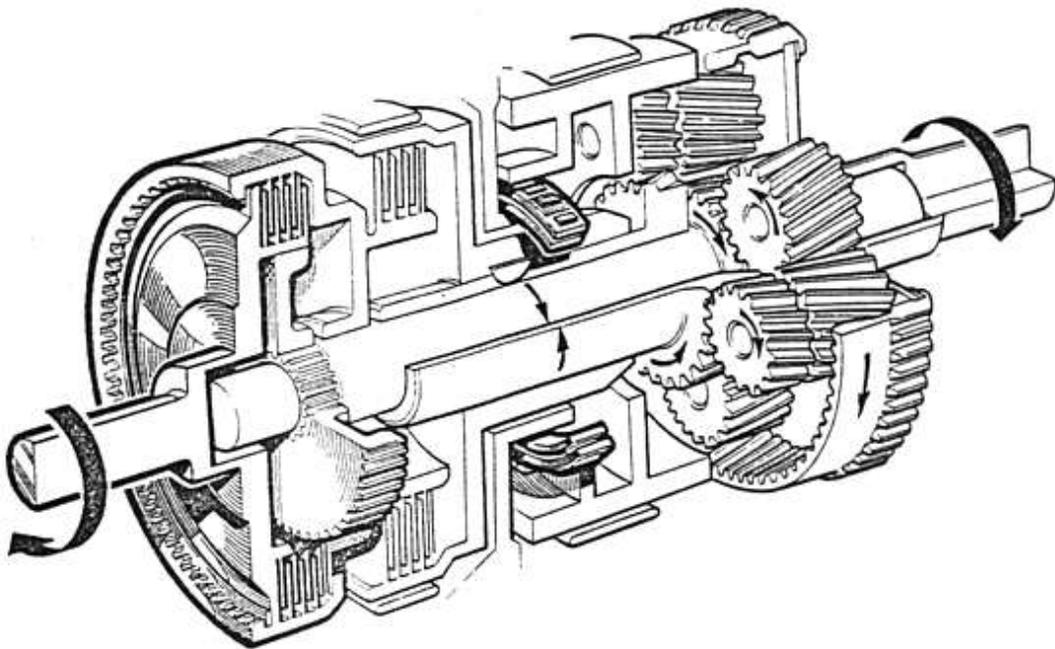
P R N D 2 1

L1

Power from the turbine of the torque converter is transmitted through the front clutch to the forward sun gear, which is in mesh with a double set of pinions in the planetary gear carrier.

Power leaves the planetary gear set by the ring gear, which is attached to the driven shaft. The carrier itself is held stationary by the rear brake band.

The reverse sun gear, which is also in mesh with a single set of pinions in the planetary set, rotates freely in the opposite direction to the forward sun gear.



Application of bands and clutches – front clutch and one-way clutch

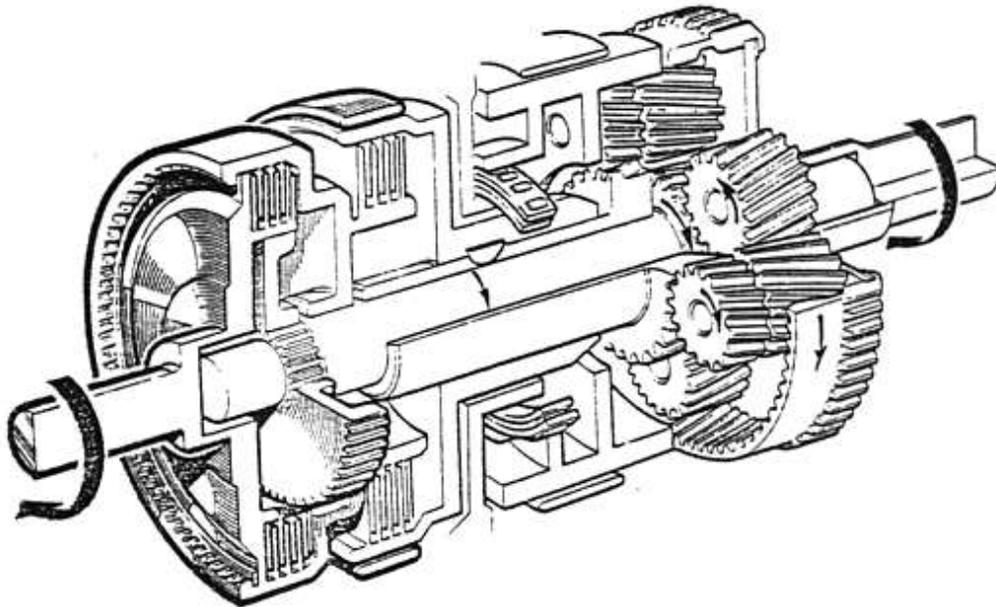
▼
P R N D 2 1

1ST GEAR

Power is again transmitted from the turbine of the torque converter to the forward sun gear through the front clutch. The forward sun gear is in mesh with a double set of pinions in the planetary gear set.

A one-way clutch, incorporated in the carrier of the planetary gears, prevents anti-clockwise rotation of the carrier and allows the gearbox to freewheel when on the overrun.

Power leaves the planet gear set by the ring gear and driven shaft.



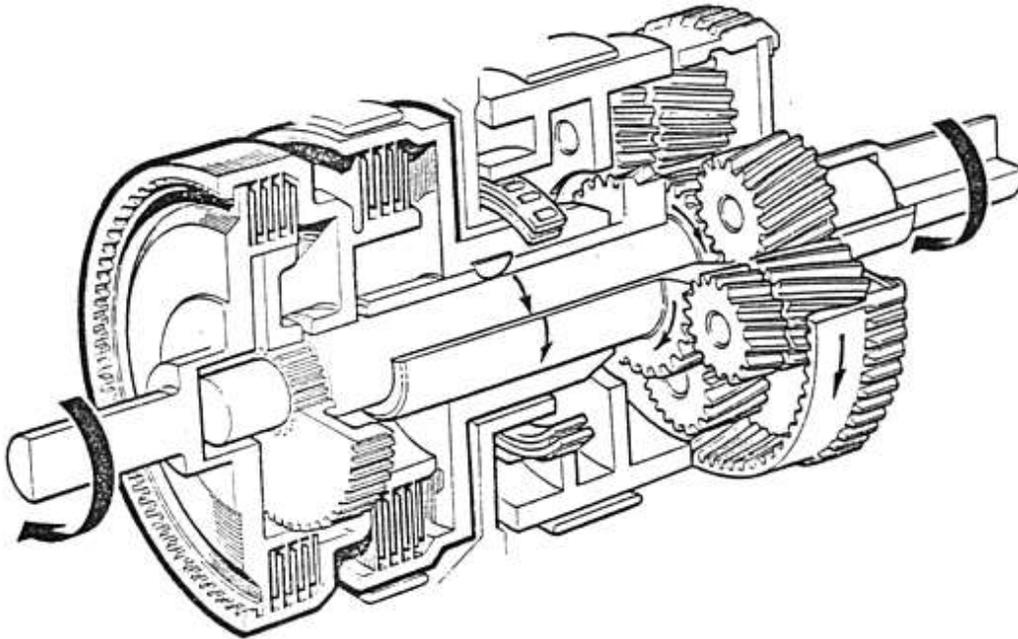
Application of bands and clutches – front clutch and front brake band

P R N D 2 1

2ND GEAR

The front clutch is applied, connecting the power from the converter to the forward sun gear and the planetary gear set. The front band is applied holding the reverse sun gear stationary; this allows the planetary gear carrier to be driven around the stationary reverse sun gear and provides the reduction of 1.45:1.

Power again leaves the gearbox by the ring gear and driven shaft.



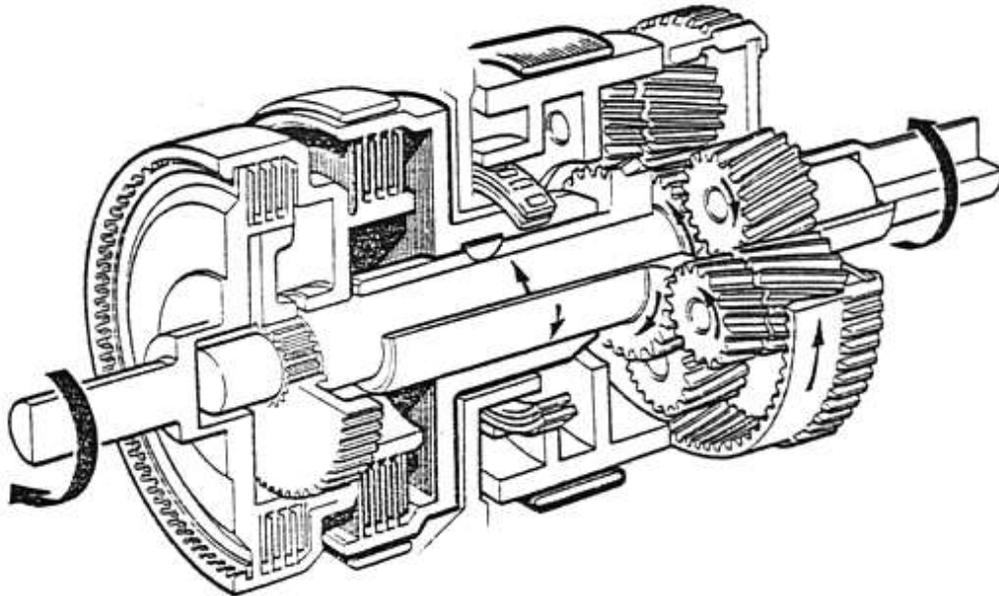
Application of bands and clutches – front clutch and rear clutch

P R N D 2 1

3RD GEAR

Power enters the gearbox from the torque converter through the front clutch, to the forward sun gear.

The rear clutch is applied which connects the power from the converter to the reverse sun gear; both sun gears being locked together, the gear set rotates as a unit providing a 1:1 ratio.



Application of bands and clutches – rear clutch and rear band

▼
P R N D 2 1

REVERSE

Power enters the gearbox from the converter and through the rear clutch to the reverse sun gear.

The rear band is applied which holds the planetary gear carrier stationary. A single set of pinions in the planetary set between the reverse sun gear and the ring gear of the driven shaft provides a reduction of 2.09:1 in the reverse direction to the input shaft.

Neutral and Park

The front and rear clutches are off and no power is transmitted from the converter to the gear set. The front and rear bands are also released, except in 'P', where for constructional reasons the rear band is applied as long as the engine is running.

THE HYDRAULIC SYSTEM

The hydraulic system contains a front and rear pump, both of the internal/external gear pattern, picking up fluid from the oil pan through separate strainers. Automatic control is provided by a centrifugally operated hydraulic governor on the transmission output shaft. This governor works in conjunction with valves in the valve bodies assembly located in the base of the transmission. These valves regulate fluid pressure and direct it to appropriate transmission components. The fluid passages in the actual transmission are shown in Fig. 1.

Front Pump

The front pump, driven by the converter impeller is in operation whenever the engine is running. This pump, through the primary and secondary regulator valves, supplies the hydraulic requirements of the transmission with the engine running when the vehicle is stationary, as well as at low vehicle speeds up to about 15 m.p.h. (24 k.p.h.) before the rear pump becomes effective. When the rear pump is effective, the front pump check valve closes but a by-pass permits the pump still to supply the converter and lubrication requirements in conjunction with the rear pump; it then operates at the reduced pressure regulated by the secondary regulator valve, excess flow exhausting to inlet thus minimising pumping losses.

Rear Pump

The rear pump is driven by the output shaft of the transmission. It is fully effective at speeds above 20 m.p.h. approximately and then supplies the hydraulic requirements of the transmission. If due to a dead engine the front pump is inoperative, the rear pump, above 20 m.p.h. (32 k.p.h.) can provide all hydraulic requirements thus enabling the engine to be started through the transmission by towing

Governor (See Fig.2 and 3)

The governor, revolving with the driven shaft is basically a pressure regulating valve which reduces line pressure to a value that varies with output shaft (i.e. vehicle) speed. This variable pressure, known as governor pressure, is utilized in the control system to effect up and down shifts through the 1-2 and 2-3 shift valves. Rotation of the governor at low speeds causes the governor weight and valve to produce a centrifugal force. This outward force is opposed by an equal and opposite hydraulic force produced by governor pressure acting upon a small area of the governor valve. Because the governor valve is a regulating valve, and will attempt to remain in equilibrium, governor pressure will rise in accordance with the increase in centrifugal force caused by increased rotational speed.

As speed increases, the governor weight moves outwards centrifugally to a stop in the governor body, when it can move no further. When this occurs, a spring located between the weight and the governor valve becomes effective. The constant force of this spring then combines with the centrifugal force of the governor valve, the total then being opposed by governor pressure, thus rendering this pressure less sensitive to output shaft speed variations.

Thus, the governor provides two distinct phases of regulation, the first being used for accurate control of the low speed shift points.

Illustrations of the governor appear on pages 47 and 48.

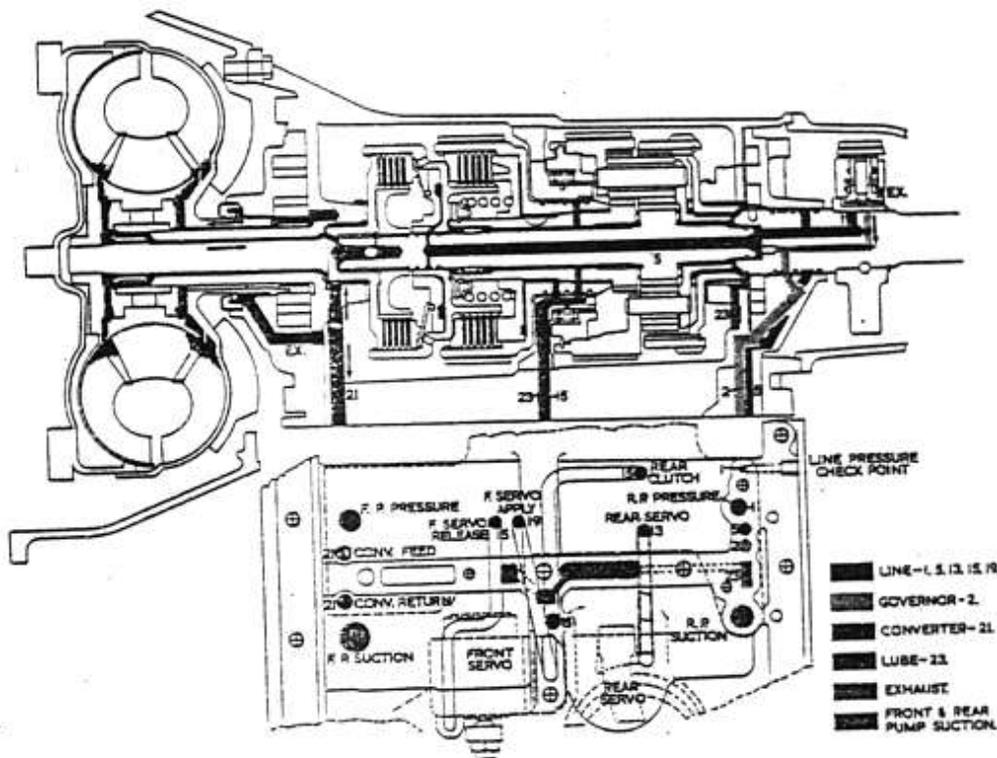


Fig. 1. Fluid passages in transmission and gearbox case

CONTROL SYSTEM

Hydraulic control of clutches, and brake bands, requires the application of correct pressures as well as correct timing. Too high a pressure will cause fierce gear changes and too low a pressure will cause transmission slip. The torque converter must be supplied with fluid at a correct pressure and fluid circulated to lubricate the transmission. These requirements are met by the hydraulic control system.

The hydraulic control system is shown in its various operating conditions in schematic form in Figs. 7 to 13. It is shown in another schematic form in Fig. 14 with all the valves accurately proportioned in length and diameter to their actual size.

The hydraulic control system is situated immediately below the transmission and can easily be renewed as a complete unit after removing the transmission oil pan. It is also illustrated on page 34 with all its valves, valve return springs, and retainers, removed from the valve bodies so that their exact position can be readily seen.

For ease of reference, all hydraulic circuits in the transmission are identified by numbers. A table of these numbers appear on page 26.

The control system utilizes these basic types of valves known as regulating valves, shuttle valves and manual valves. The principles on which these valves operate is shown in Figs. 4, 5 and 6, and are as follows:-

Regulating valves control fluid pressure by spring action, sometimes modified by hydraulic pressure acting with or against spring load. In this way a regulator valve can be made to give different regulated pressures to suit varying operating conditions.

Shuttle valves are hydraulically operated against their return spring and redirect or cut off fluid flow whenever they move. In action they resemble a two-way trap.

A manual valve acts as a multi-way tap and is manually operated.

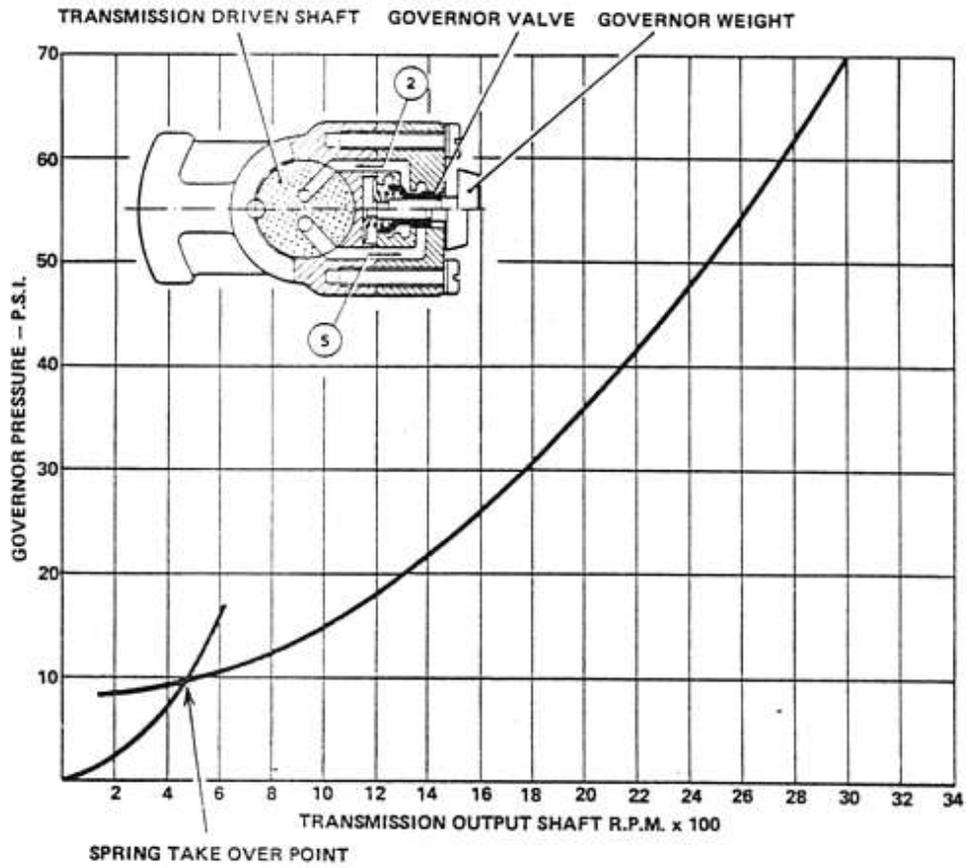


Fig.2. Governor pressure relation to driven shaft speed

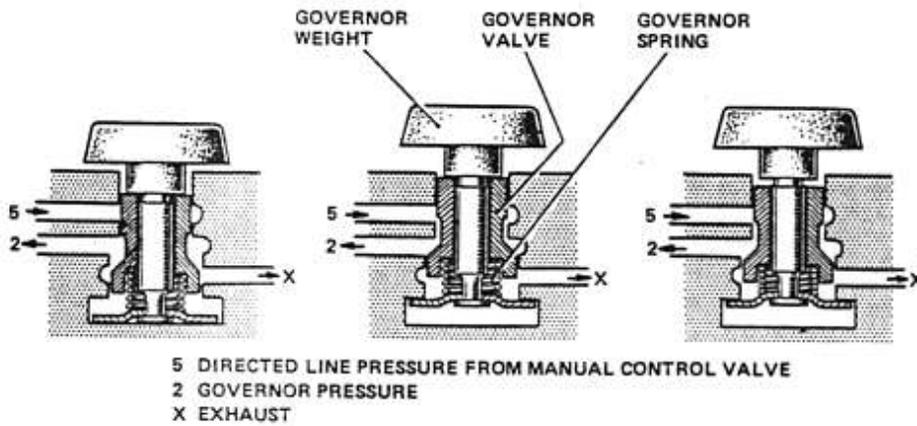
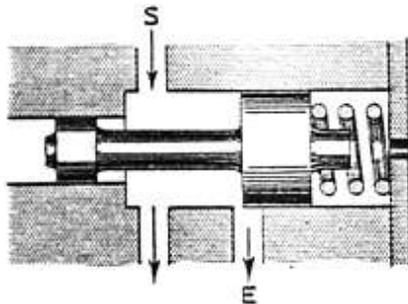
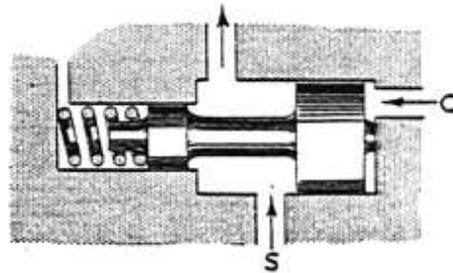


Fig.3. Governor — phases of operation



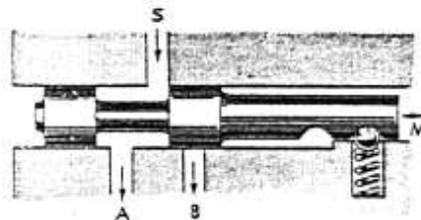
When supply pressure at S is high enough to compress piston return spring excess fluid is exhausted at E so that a steady pressure is maintained.

Fig. 4. Regulating valve operating principle



When controlling pressure at C is high enough to compress piston return spring, supply at S will be cut off by piston land covering port S.

Fig. 5. Shuttle valve operating principle



Valve is manually controlled by linkage connected to end M and in this case a selector spring and ball allows valve to occupy one of two positions thus allowing supply S to leave at ports A or B.

Fig. 6. Manual valve operating principle

Control System – Operation

Pressure control is provided by the primary and secondary regulator valves, the former operating in conjunction with throttle valve pressure acting on the spring end, and modulated (re-regulated) throttle pressure acting on the opposite end.

The accelerator pedal, through the throttle linkage, is connected by a flexible cable to the cam which operates the downshift and throttle valve shown in Figs. 7 to 13

Shift control is provided by the 1-2 and 2-3 shift

valves operated by governor pressure acting upon one end and throttle pressure acting upon the spring end. Line pressure acting upon differential areas provides shift speed hysteresis (difference between up shift and down shift speeds).

The selector lever operates the manual valve, which, according to the position of the selector, directs fluid to or provides an exhaust for the clutch and servo pistons.

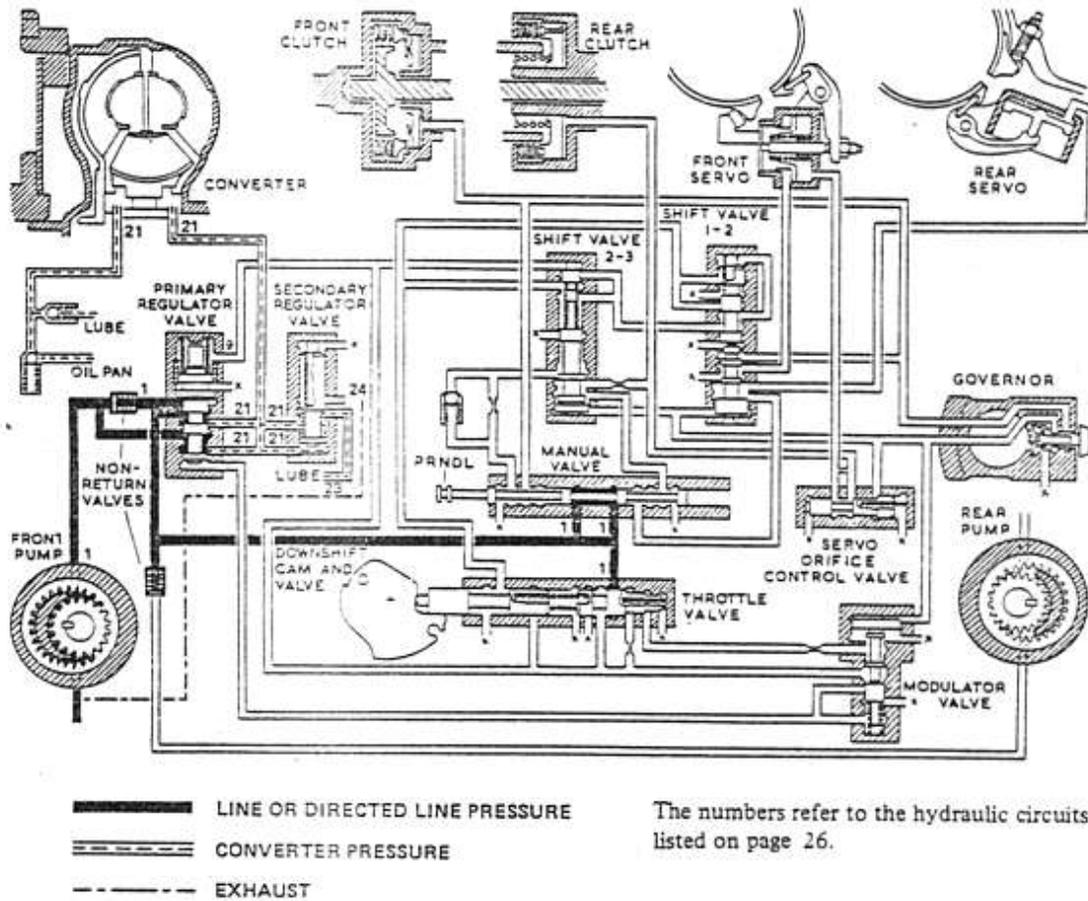


Fig. 7. Operation of hydraulic circuits in N—neutral

With the engine running, the front pump check valve is open and the rear pump check valve closes due to absence of rear pump pressure.

The primary regulator valve regulates line pressure (1) which is directed to the manual valve and throttle valve. It also permits fluid to reach the secondary regulator valve.

The secondary regulator valve regulates pressure to the converter and lubrication of the front end of the gear train (21). Identical pressure (23) is directed to the rear end of the gear train. The valve returns excess flow (24) to the oil pan through the front pump inlet, thus partially returning the front pump output.

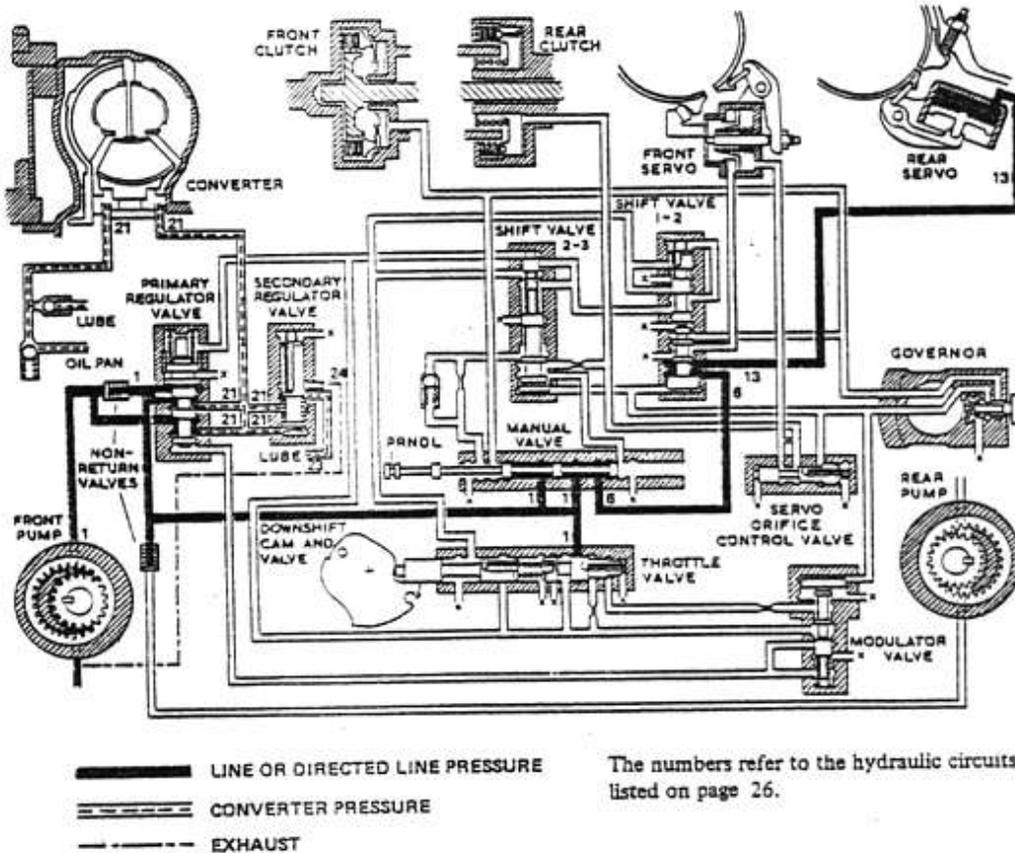
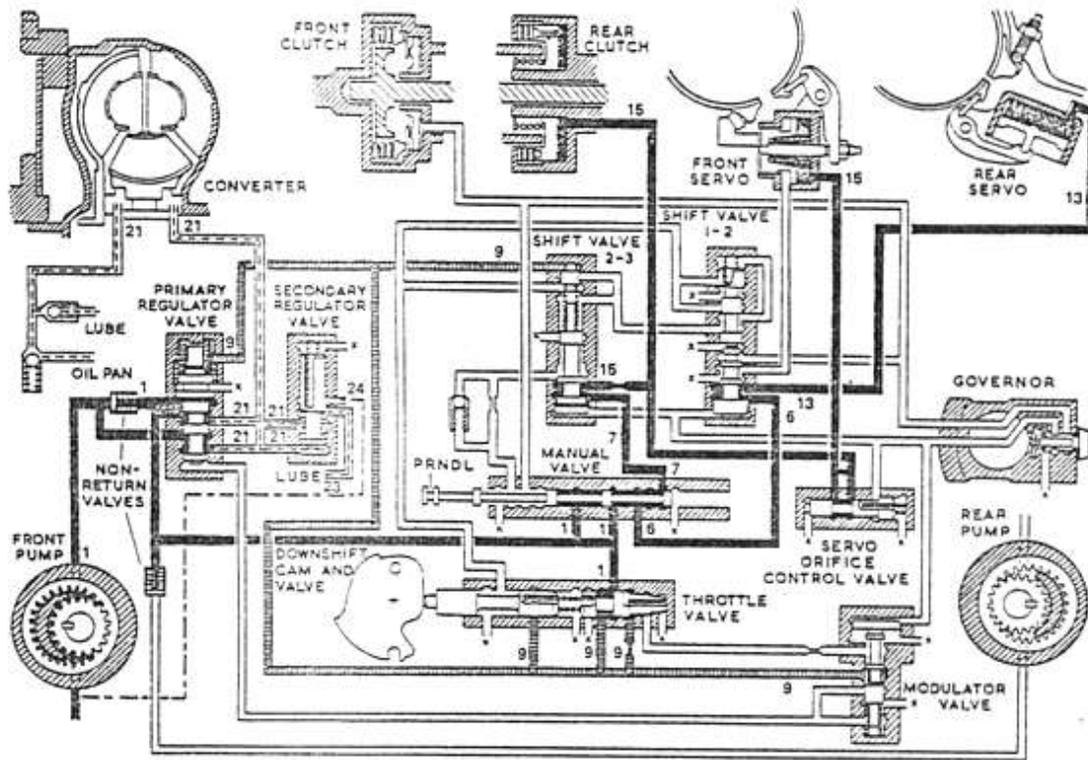


Fig. 8. Operation of hydraulic circuit in P—park

An internal linkage from the manual control valve detent lever engages the parking pawl with teeth formed on the outside of the driven shaft ring gear.

With the engine running, the operation of the hydraulic system is identical to N except that the manual valve directs line pressure (6) to the rear servo (13).

This arrangement originates in the design of the manual control valve on which, for simplicity, three of the lands serve to control both the L and P selector positions, without the rear servo or band performing any function in P.



- LINE OR DIRECTED LINE PRESSURE
- CONVERTER PRESSURE
- THROTTLE PRESSURE
- EXHAUST

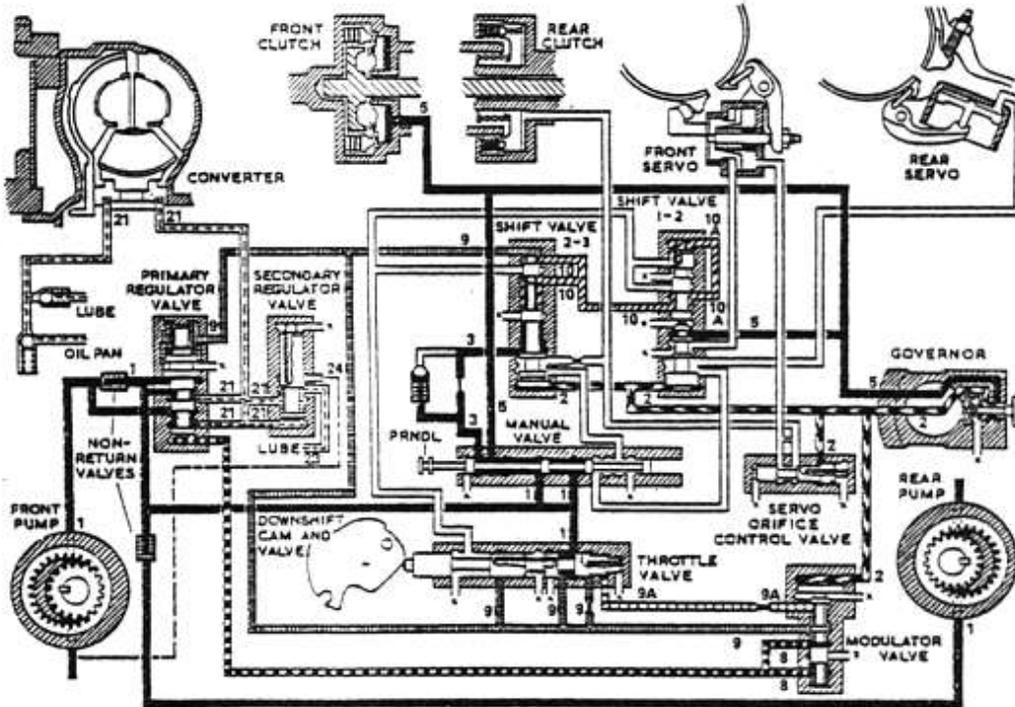
The numbers refer to the hydraulic circuits listed on page 26.

Fig.9. Operation of hydraulic circuit in R-reverse

Pressure control of the front pump is as in P or N but in accordance with accelerator pedal depression, throttle pressure (9) is directed to the spring end of the primary regulating valve thus increasing line pressure (1) in accordance with torque capacity requirements.

The manual valve directs line pressure (6) through the 1-2 shift valve to the rear servo (13) and line

pressure (7) through the 2-3 shift valve to the rear clutch and front servo release (15). Due to absence of governor pressure the shift valves and servo orifice control valve perform no function in this selector position. The fluid passages 13 and 15 of other manual valve positions are utilized in R to simplify the hydraulic circuit.



- LINE OR DIRECTED LINE PRESSURE
- CONVERTER PRESSURE
- GOVERNOR PRESSURE
- THROTTLE PRESSURE
- MODULATED THROTTLE PRESSURE
- THROTTLE PRESSURE CONTROLLED BY MODULATOR VALVE
- SHIFT VALVE PLUNGER PRESSURE
- EXHAUST

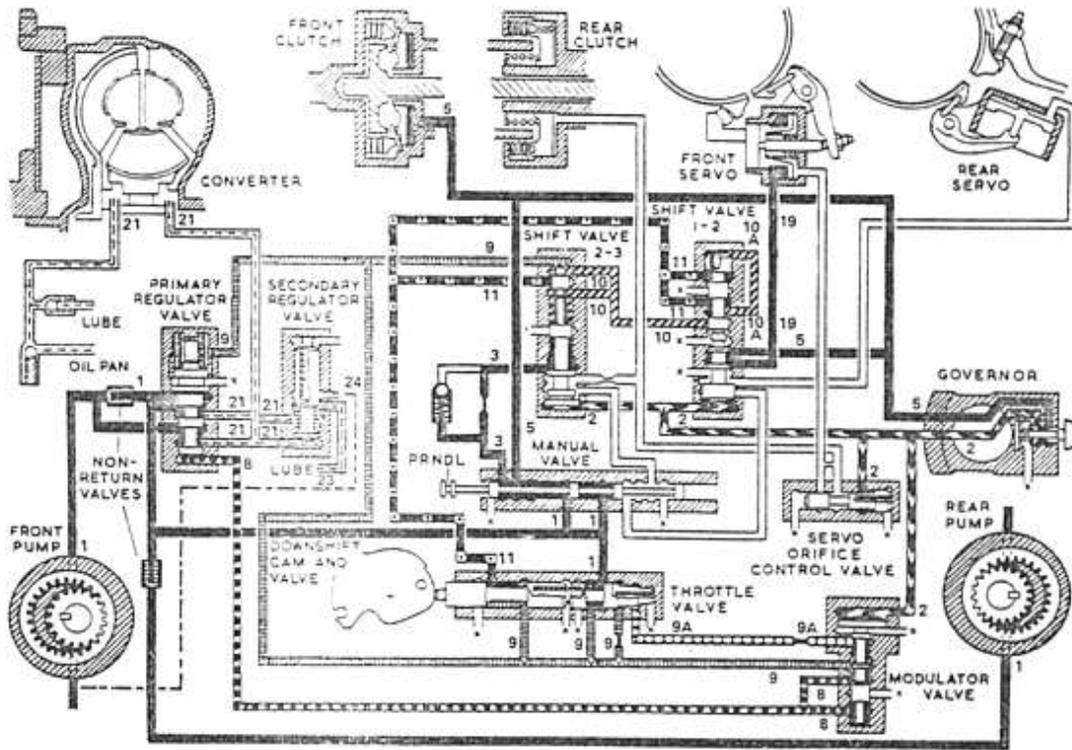
The numbers refer to the hydraulic circuits listed on page 26.

Fig.10. Operation of hydraulic circuit in D1

Pressure control of the front and/or rear pump will be as in R but with the throttle valve in the full throttle position as illustrated, throttle pressure (9) regulated by the modulator valve plunger (8) acts upon the primary regulator valve opposing throttle pressure (9), thus modulating (re-regulating) line pressure in the interest of gear shift quality.

The manual valve directs line pressure (5) to the front clutch, governor feed and 1-2 shift valve for the subsequent 1-2 shift. Line pressure (3) reaches the 2-3 shift valve for the subsequent 2-3 shift.

The front clutch applied in conjunction with the one-way clutch, permits the car to move off from rest, in first gear.



- LINE OR DIRECTED LINE PRESSURE
- CONVERTER PRESSURE
- GOVERNOR PRESSURE
- THROTTLE PRESSURE
- FORCED THROTTLE PRESSURE
- MODULATED THROTTLE PRESSURE
- THROTTLE PRESSURE CONTROLLED BY MODULATOR VALVE
- SHIFT VALVE PLUNGER PRESSURE
- EXHAUST

The numbers refer to the hydraulic circuits listed on page 26.

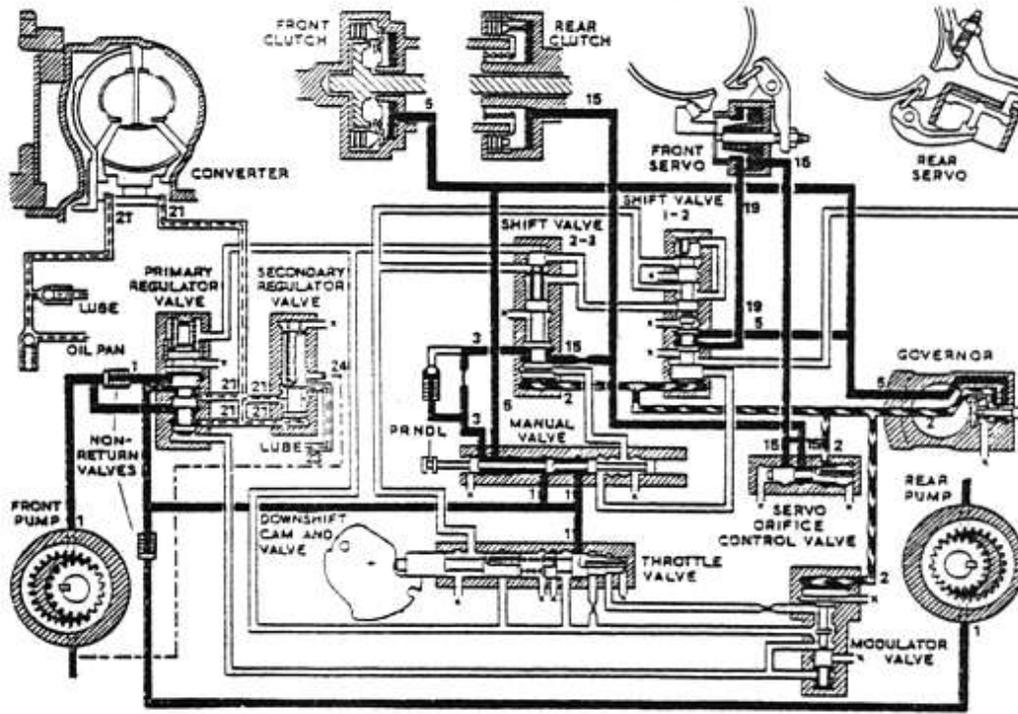
Fig.11. Operation of hydraulic circuit in D2—intermediate

Pressure control by the primary regulator valve will be of the rear pump output, the front pump providing torque converter and front lubrication requirements (21) as well as rear lubrication (23). Throttle pressure (8-9) acts upon the primary regulator valve as in D1.

Shift control is provided by the 1-2 shift valve moving under influence of governor pressure (2) opposed by spring force and throttle pressure (11). This permits line pressure (5) to reach the apply

side of the front servo (19). The front band thus applied, in conjunction with the front clutch, provides 2nd gear. With the downshift valve in the forced throttle position as illustrated, forced throttle pressure (11) acts upon the 1-2 and 2-3 shift valves, thus further delaying upshifts or providing a 2-1 downshift at speeds when there is little governor pressure (2).

Note: Fig. 11 shows front pump supplying line pressure which it does at quite low road speeds.



- LINE OR DIRECTED LINE PRESSURE
- CONVERTER PRESSURE
- GOVERNOR PRESSURE
- EXHAUST

The numbers refer to the hydraulic circuits listed on page 26.

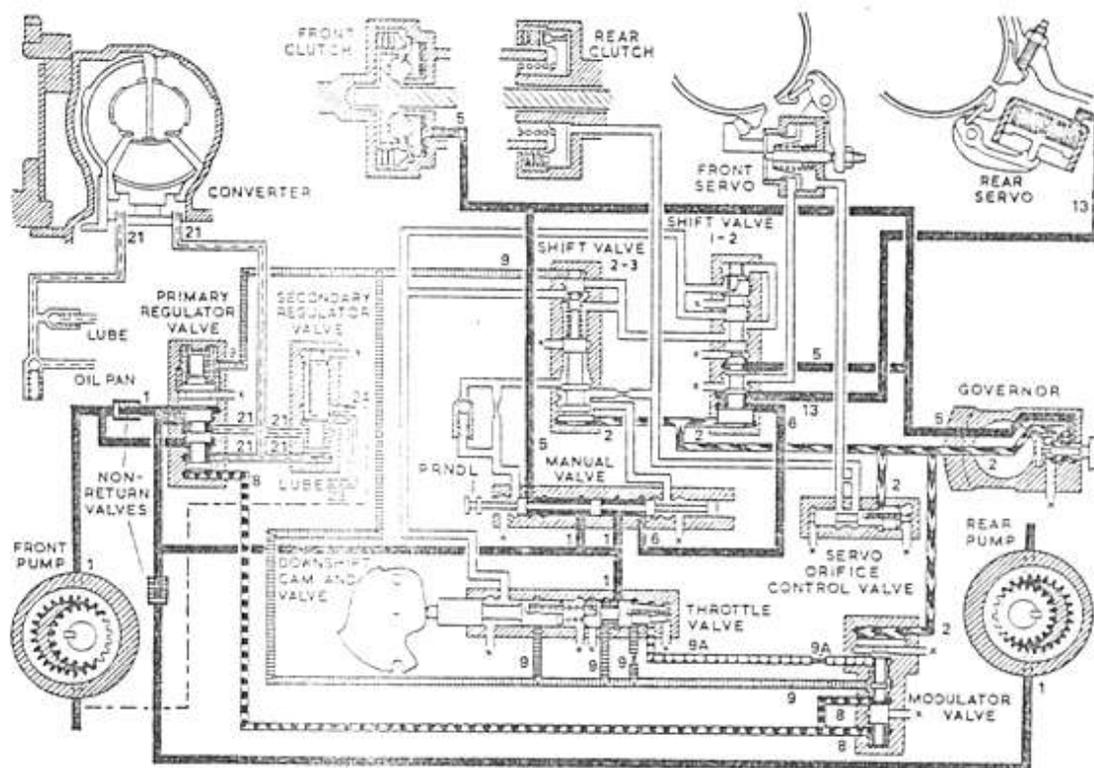
Fig. 12 Operation of hydraulic circuit in D3—High

Pressure control is as in D2 except that in the throttle valve position shown (minimum throttle) no throttle pressure or modulated throttle pressure acts upon the two ends of the primary regulator valve.

Shift control is provided by the 2-3 shift valve moving against spring force under influence of governor pressure (2). This permits line pressure (3) to reach the rear clutch (15) and the release side of the front servo through the servo orifice control valve. When governor pressure (2) is apparent, the servo orifice control valve closes, forcing line pressure through an orifice which thus effects the relationship between rear clutch apply and front

servo release in accordance with road speed. Because the release side of the front servo has a larger area than the apply side, the front servo will disengage the band. The rear clutch now engaged in conjunction with the front clutch provides 3rd gear. The absence of throttle pressure as mentioned above will cause the 2-3 shift valve to move early under influence of governor pressure, thus providing a low-speed 2-3 shift.

Note: Above approximately 15 m.p.h. (24 k.p.h.) the front pump will only supply converter and lubrication requirements. Fig. 12 shows condition below this speed.



- LINE OR DIRECTED LINE PRESSURE
- CONVERTER PRESSURE
- GOVERNOR PRESSURE
- THROTTLE PRESSURE
- MODULATED THROTTLE PRESSURE
- THROTTLE PRESSURE CONTROLLED BY MODULATOR VALVE
- EXHAUST

The numbers refer to the hydraulic circuits listed on page 26.

Fig. 13. Operation of hydraulic circuit in L1—first Lock-up

Pressure control of the front and/or rear pump will be as in D1 as the same position of throttle valve (full throttle) is illustrated.

The manual valve directs line pressure (5) to the front clutch, governor feed and 1-2 shift valve. It also directs line pressure (6) to the 1-2 shift valve. In the first gear position illustrated, the 1-2 shift valve is latched hydraulically by line pressure (6) opposing governor pressure (2). The result is that line pressure (6) is open to the rear servo (13) and

no upshift can occur. For L the manual control valve opens to exhaust the rear clutch and front servo release circuit (7) and (15) from the 2-3 shift valve. This causes a downshift from the 3rd gear whenever L is selected at speed. In this condition governor pressure (2) will have moved the 1-2 shift valve; the result is that line pressure (6) is then blocked from the rear servo (13) but opens (5) to the apply side of the front servo (19) as in D2.

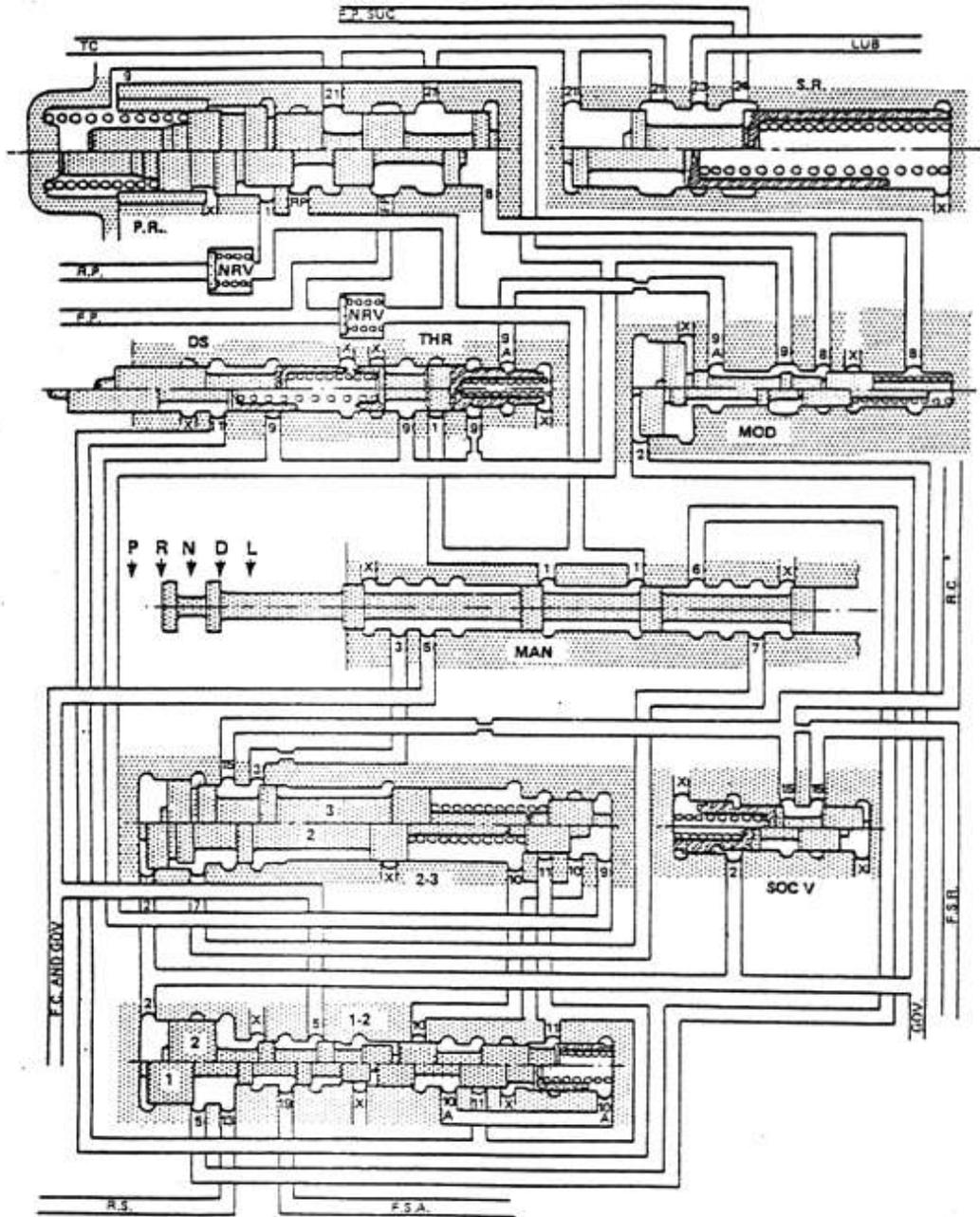


Fig. 14. Control System: passages in valve bodies assembly – schematic

Key to Fig.14.

TC	= TO CONVERTER
FP Suc	= FRONT PUMP SUCTION
LUB	= LUBRICATION
PR	= PRIMARY REGULATOR VALVE
SR	= SECONDARY REGULATOR VALVE
X	= EXHAUST
RP	= REAR PUMP FEED
FP	= FRONT PUMP FEED
NRV	= NON RETURN VALVES
DS	= DOWNSHIFT VALVE
THR	= THROTTLE VALVE
MOD.	= MODULATOR VALVE

P.R.N.D.L.	= SELECTOR LEVER POSITIONS, PARK—REVERSE—NEUTRAL—DRIVE—LOCK-UP
MAN.	= MANUAL VALVE
2-3	= 2-3 SHIFT VALVE, 2nd GEAR POSITION TO LEFT 3rd GEAR POSITION TO RIGHT
SOCV	= SERVO ORIFICE CONTROL VALVE
R.C.	= REAR CLUTCH
F.S.R.	= FRONT SERVO RELEASE
GOV.	= GOVERNOR
FC and GOV.	= FRONT CLUTCH AND GOVERNOR FEED
1-2	= 1-2 SHIFT VALVE, 1st GEAR POSITION TO LEFT, 2nd GEAR POSITION TO RIGHT
RS	= REAR SERVO
F.S.A.	= FRONT SERVO APPLY

VALVE BODY ASSEMBLY (See Fig.14)

For a more complete understanding of the hydraulic system, a functional description of all valves in the valve body assembly is given in the following pages. In Fig.14 all the valves are illustrated proportional to their actual size.

Primary Regulator Valve

This valve regulates front pump pressures during idling, reversing and at low vehicle speeds, and rear pump pressure when, as a result of increased vehicle speed, the rear pump becomes effective. Rear pump regulation occurs when rear pump pressure exceeds front pump regulated pressure. This pressure differential opens the rear pump check valve allowing rear pump fluid to flow to the primary regulator valve and supply the line pressure requirements. Front pump pressure is then no longer regulated by the primary regulator valve but flows through this valve to the secondary regulator valve.

Line pressure (1), operating on a small area of the valve can be decreased by modulated throttle pressure (8) (described later) operating on one end of the valve. These forces are opposed by the primary regulator valve spring and throttle pressure (9) (described later) operating on the spring end of the valve. The line pressure thus produced varies with accelerator position as well as vehicle speed and provides the correct clutch and brake band capacity under all operating conditions. This line pressure (1) is directed to the manual valve and throttle valve.

Secondary Regulator Valve

This is a regulating valve which controls the values of converter pressure (21) and lubrication (23) for the components in the rear of the transmission case. Converter pressure operating on one

end of the valve is opposed by spring force on the other end. When the front pump capacity increases due to increased engine speed, the valve moves to open a port that directs fluid (24) to the suction side of the front pump. Thus, at high speed, excess front pump output is directed back to minimise pumping losses.

Downshift Valve and Throttle Valve

The downshift valve is connected to the carburettor linkage via a cable-actuated cam. Movement of the downshift valve compresses the throttle valve spring located between the downshift valve and the throttle valve. This spring is opposed by the throttle return spring, combined with throttle pressure (9) acting (at low vehicle speed) on one area of this regulating valve, and at high vehicle speed on two areas (9 and 9a). Thus a throttle pressure is produced that is related to both engine torque and vehicle speed. This pressure (9) is directed to the spring end of the primary regulator valve to vary the basic line pressure (1) accordingly, thus providing correct clutch and brake band capacities and appropriate shift quality under all operating conditions.

Full movement of the downshift valve, which is a shuttle valve, directs throttle pressure (11-9) to the shift valves to further delay upshifts or effect 3-2 or 3-1 downshifts at present maximum vehicle speeds.

Throttle pressure (9) is directed also to the 2-3 shift plunger which at part throttle openings reduces the value of throttle pressure by a fixed amount. This reduced pressure (10), is directed to the 1-2 and 2-3 shift valves to render the low speed shift points less sensitive to throttle pressure and, therefore, accelerator position.

Modulator Plug and Valve

The modulator plug is a regulating valve that reduces throttle pressure (9) by a fixed amount. This modulated pressure (8) operating on one end of the plug, assisted by the modulator valve spring, is opposed by throttle pressure (9) operating on the opposite end. Modulated throttle pressure (8) is directed to the primary regulator valve to vary the rate of increase of line pressure (1) relative to throttle pressure.

The modulator valve is a shuttle valve. Governor pressure (2) operating on the large end is opposed by the modulator valve spring. As governor pressure rises, the valve moves, preventing the plug from regulating and modulated throttle pressure (8) then becomes equal to throttle pressure (9). Moreover this movement directs throttle pressure (9 and 9a) to a second area of the throttle valve opposing throttle valve spring force. This arrangement permits high throttle and line pressure under stall (and part-throttle) conditions with a reduction in these pressures after "cut-back".

Servo Orifice Control Valve

A common line (15) supplies fluid to, or exhausts fluid from, the rear clutch and the release area of the front servo to effect the 2-3 and 3-2 shift.

The servo orifice control valve is a shuttle valve interposed in the front servo release circuit. Governor pressure (2) operating on an area of the valve is opposed by the valve spring. At a 2-3 shift with low governor pressure (i.e. low vehicle speed), fluid goes without restriction to the release side of the front servo piston. At a 2-3 shift with higher governor pressure, however, the valve moves and fluid is directed through an orifice to this side of the piston.

During upshifts, with the servo orifice in circuit, the front band does not release too quickly relative to rear clutch engagement, thus avoiding "run-up" during the transition from 2 to 3. During downshifts, the orifice in circuit ensures that the front band does not engage before the rear clutch releases thus avoiding "tie-up" on the 3-2 shift.

The servo orifice control valve, therefore, affects the relationship between the rear clutch and front servo to provide correct shift timing under all operating conditions.

1-2 Shift Valve and Plunger

Both are shuttle valves and operate in unison in the Drive (D) selector position. In 1st gear governor pressure (2), operating on the large end of the valve, is opposed by line pressure (5) operating on an area of this valve, the 1-2 shift valve spring and reduced throttle pressure, called shift valve plunger pressure

(10-10a) operating on the opposite end of the plunger. When the governor pressure exceeds these opposing forces, the valve moves to the 2nd gear position and line pressure (5) is directed to the apply side of the front servo piston (19). The movement also results in an area of the valve being no longer subjected to line pressure (5). This allows the 2-1 downshift to occur at a lower speed than the 1-2 upshift. The difference between the upshift and downshift speed is known as "shift speed hysteresis". When the governor pressure is less than the spring force combined with the reduced throttle pressure force, the valve moves to the 1st gear position and the apply side of the front servo (19) is opened to exhaust (X).

In Lock-up, with low governor pressure (2) the valve also moves to the 1st gear position; line pressure (6) thus directed to the rear servo (13) latches the valve hydraulically in the 1st gear position, preventing an upshift.

2-3 Shift Valve Plunger and Valve

The 2-3 shift valve plunger is a regulating valve that reduces the value of throttle pressure (9) by a fixed amount and therefore is inoperative when throttle pressure is below this fixed amount. Throttle pressure (9), operating on one end of the plunger, is opposed by this reduced throttle pressure (10) and the 2-3 shift valve spring located between the plunger and valve. This reduced pressure is directed to the 2-3 shift valve and the 1-2 shift plunger as described under "Downshift and throttle valve".

The 2-3 shift valve is a shuttle valve. In the 2nd gear position, and before the plunger begins regulating, governor pressure (2), operating on the large end of the valve, is opposed by line pressure (3) operating on an area of this valve, as well as the 2-3 shift valve spring. Once the plunger begins regulating, the spring no longer exerts a force on the valve but relays the force of the plunger to the valve. Under these conditions, governor pressure (2), operating on the large end of the valve, is opposed by line pressure (3) operating on an area of the valve, reduced throttle pressure (10) operating on the small end of the valve, and throttle pressure (9) operating on the end of the plunger. This last force is relayed to the 2-3 shift valve by the valve spring.

Movement of the shift valve to the 3rd gear position directs fluid via the common line (15) to the rear clutch and, via the servo orifice control valve, to the release side of the front servo. This pressure causes the rear clutch to be applied. Moreover, because the release area (R) of the front servo is larger than the apply area (A) as shown in Fig. 15, it causes the front band to be released. The movement also results in an area of the valve being no longer subjected to line pressure (3); this movement

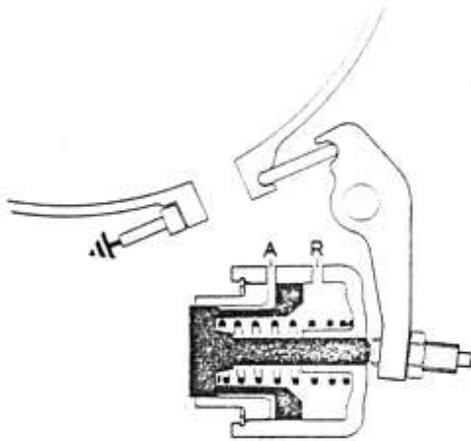


Fig. 15. Front servo operation

prevents regulation of the plunger forced to the end of the valve bore. Thus reduced throttle pressure (10) is replaced by throttle pressure (9). This change in forces affects the shift point hysteresis and causes the 3-2 shift point to occur at a lower governor pressure (i.e. vehicle speed) than the 2-3 shift.

When the manual valve is moved to the Lock-up position, line pressure (15) which was directed to the 2-3 shift valve and consequently to the rear clutch and front servo release, is exhausted through (7) to a port (X) at the opposite end of the manual valve collar. This inevitably results in an immediate downshift to 2nd gear regardless of the position of the 2-3 shift valve and no third gear is possible.

In Reverse, line pressure (7) is directed to the rear clutch and front servo release (15).

Manual Control Valve

This valve, actuated by movement of the selector, directs line pressure to, or exhausts from, the appropriate valves or components in accordance with control requirements.

P. Movement of the valve mechanically engages the parking pawl with the externally toothed ring gear on the driven shaft, effectively immobilising the vehicle. No fluid is directed to the front clutch or 2-3 shift valve for the rear clutch, therefore the gear set is disconnected from the converter and no engine power is transmitted to the rear wheels. Because of the arrangement of the manual control valve ports for other selector positions, line pressure (6) is directed to the rear servo (13).

R. Line pressure (6) is directed to the rear servo (13) entering at (A) as shown in Fig. 16 via the 1-2 shift valve and also (7) to the rear clutch (15) via the 2-3 shift valve. No pressure is directed to the governor.

N. The clutches and servos are not pressurized and are exhausted, because circuits 3 and 5 are open to a port (X) nearest to the manual valve collar. Therefore the gear set is disconnected from the converter and no engine power is transmitted to the rear wheels.

D. Line pressure (5) is directed to the front clutch, governor and 1-2 shift valve. Line pressure is directed also to the 2-3 shift valve (3).

L. Line pressure (5) is directed to the front clutch, governor and 1-2 shift valve, so that 2nd gear is available. No line pressure is directed to the 2-3 shift valve; therefore upshifts to 3rd gear cannot occur. When in 1st gear, line pressure (6) is directed to a differential area of the 1-2 shift valve to lock it in position, and hence to the rear servo (13).

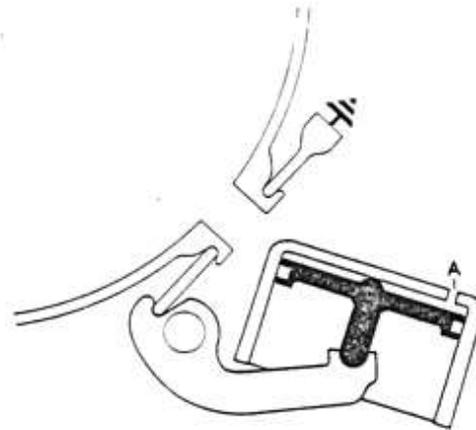


Fig. 16. Rear servo operation

TABLE OF HYDRAULIC CIRCUITS

- Note:** 1. Where a pressure range consists of three figures, the first figure is at idling speed, the second "forced" throttle before "cut back", i.e., from rest and at low speed in first gear, and the third at "forced throttle" after "cut back", i.e., at higher speeds in 1st, 2nd and 3rd.
 "Cut back" indicates the condition when, due to governor pressure, modulated throttle pressure (8) is directed to the piston end of the primary regulator valve to oppose its spring loads. Thus, at low road speeds, line pressure is reduced to approximately half of the maximum value in the interest of smooth gear changes. It also reduces pumping losses.
2. The pressure take off point on this transmission only gives line pressure readings.
3. Circuits 4, 14, 16, 17, 18 and 20 are not used on this particular "35" assembly.

Circuit No.	Name of Pressure	From	To	Remarks
1	Line pressure	Front and rear pump*	Primary regulator valve Manual control valve Throttle valve	
2	Governor pressure	Governor	Modulator valve 1-2 shift valve 2-3 shift valve Servo orifice control valve	According to road speed
3	Directed line pressure	Manual control valve	2-3 shift valve	In D
5	Directed line pressure	Manual control valve	Front clutch and governor feed 1-2 shift valve	In L and D or in 1-2 and D
6	Directed line pressure	Manual control valve	1-2 shift valve	In L, D, R and P or in 1-2-D-R and P
7	Directed line pressure	Manual control valve	2-3 shift valve	In R and P
8	Modulated throttle pressure	Modulator valve	Primary regulator valve (piston end)	
9	Throttle pressure	Throttle valve	Modulator valve Primary regulator valve (spring end) 2-3 shift valve Shift valve plunger	
9a	Throttle pressure controlled by modulator valve	Modulator valve	Throttle valve	Doubles throttle pressure before cut-back and increases line pressure under part throttle acceleration.
10	Shift valve plunger pressure	Shift valve plunger	2-3 shift valve 1-2 shift valve	

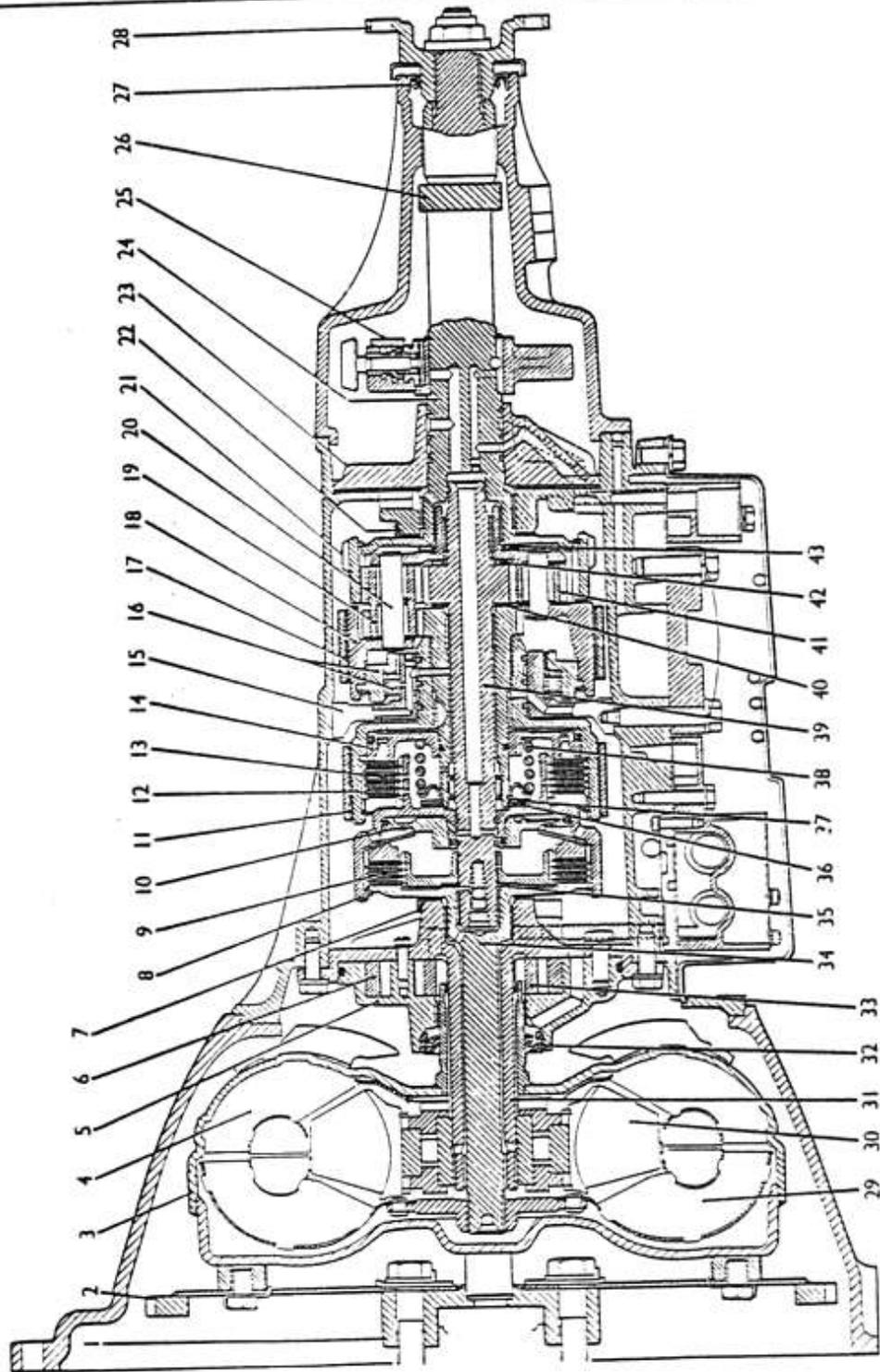
* Rear pump is not fitted on transmissions with 1-2-D-N-R-P selector lever positions



GEARBOX—AUTOMATIC

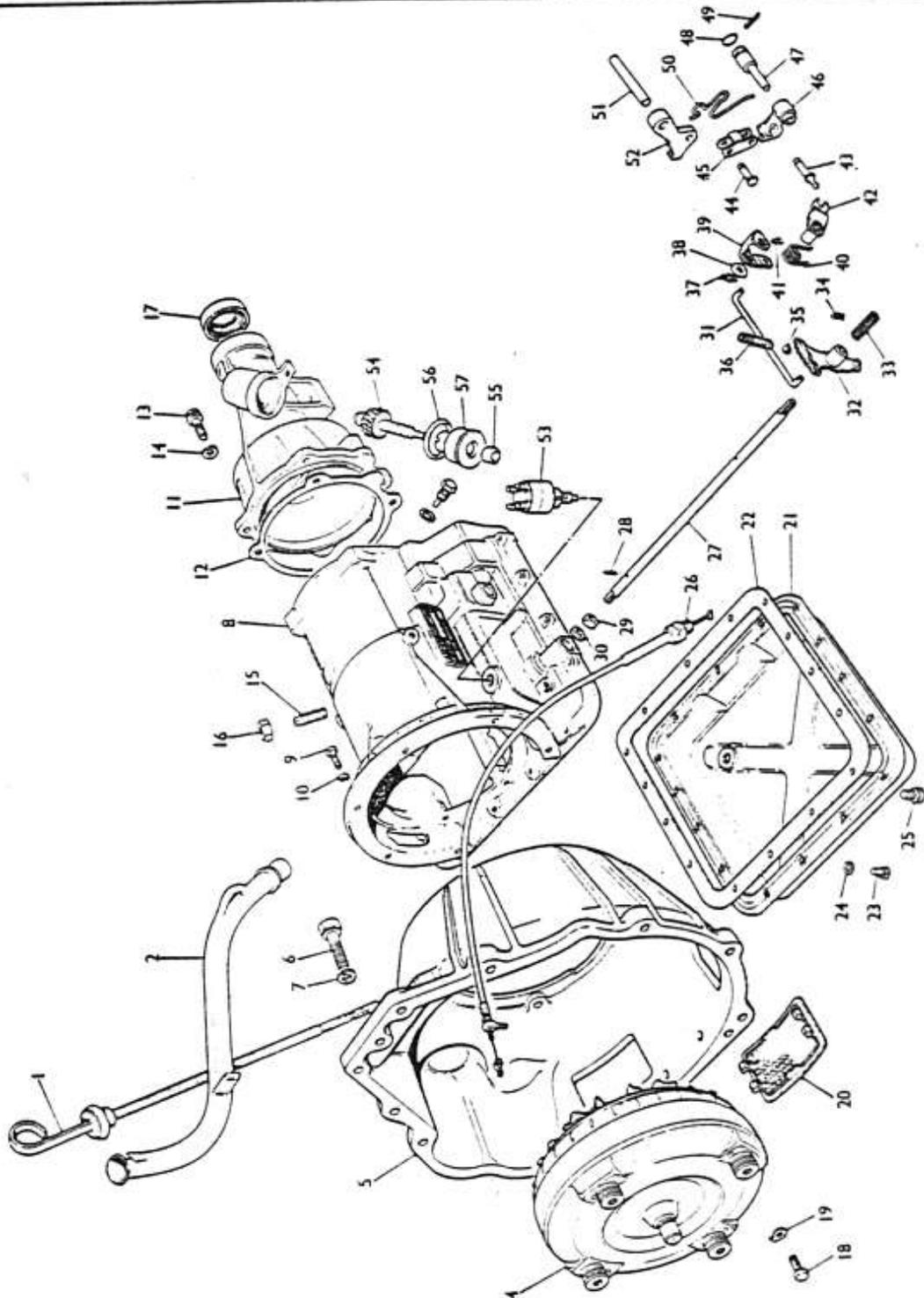
Circuit No.	Name of Pressure	From	To	Remarks
10a	Shift valve plunger pressure	Shift valve plunger	1-2 shift valve	In first gear only
11	Forced throttle pressure	Downshift valve	1-2 shift valve 2-3 shift valve	
13	Line pressure	1-2 shift valve	Rear servo apply	
15	Line pressure	2-3 shift valve	Rear clutch and front servo release	
19	Line pressure	1-2 shift valve	Front servo apply	Front servo release through servo orifice or valve
21	Converter pressure	Primary regulator valve	Secondary regulator valve and converter	
23	Lubrication pressure	Secondary regulator valve		
24	Exhaust	Secondary regulator valve	Front pump suction	

GEARBOX-AUTOMATIC



KEY TO THE AUTOMATIC GEARBOX

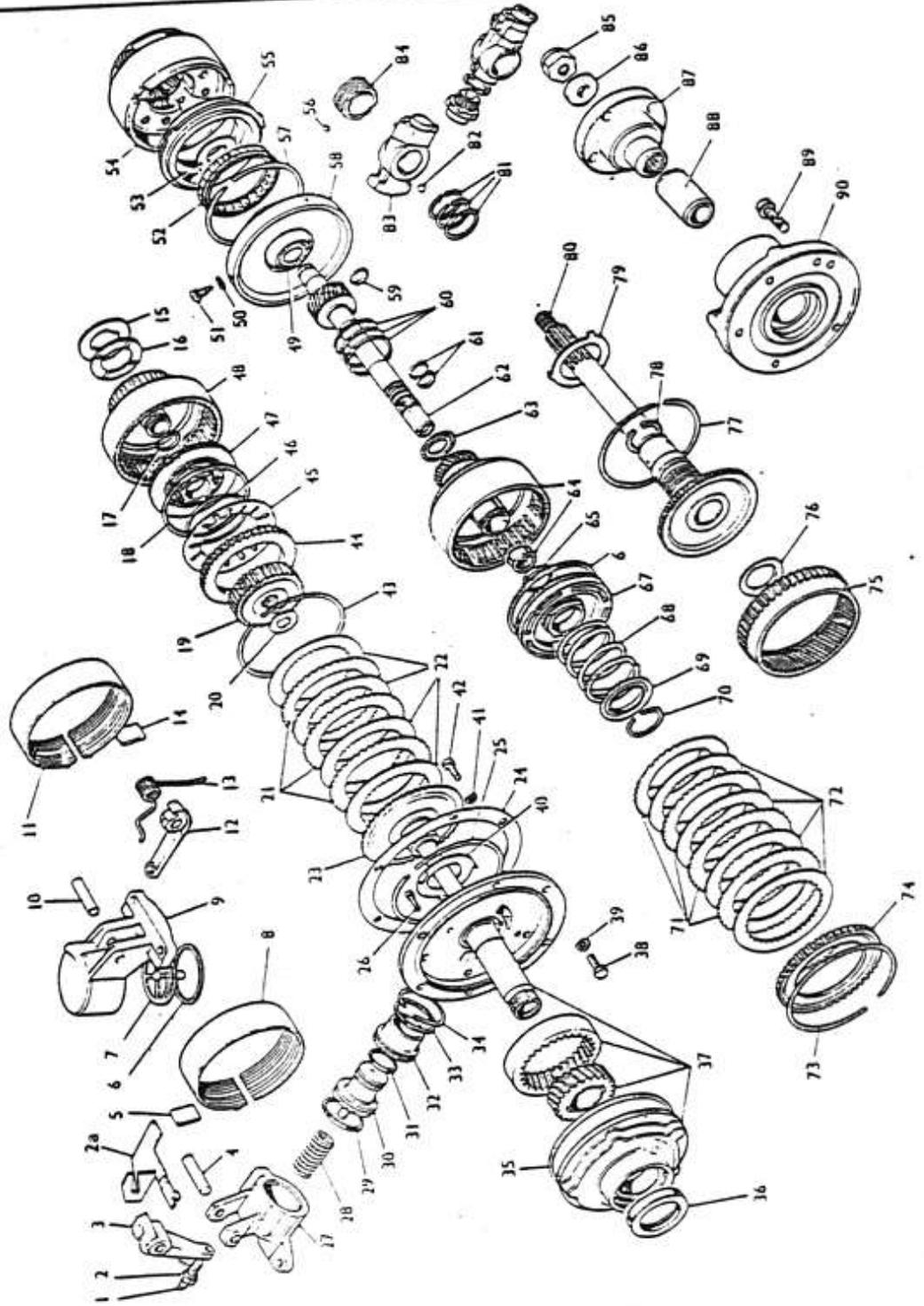
No.	Description	No.	Description	No.	Description
1.	Engine crankshaft	16.	One-way clutch	30.	Stator
2.	Converter drive plate	17.	Rear brake band	31.	Converter support
3.	Converter	18.	Planet carrier	32.	Front oil seal
4.	Impeller	19.	Planet pinion — long	33.	Pump inner member
5.	Pump housing	20.	Pinion shaft	34.	Input shaft
6.	Pump outer member	21.	Ring gear	35.	Thrust washer
7.	Thrust washer	22.	Thrust washer	36.	Thrust washer (bronze)
8.	Front clutch housing	23.	Rear plate adaptor	37.	Thrust washer (steel)
9.	Front clutch plates	24.	Driven shaft	38.	Rear clutch spring
10.	Front clutch piston	25.	Governor assembly	39.	Forward sun gear
11.	Front brake band	26.	Speedometer drive gear	40.	Needle thrust washer
12.	Front drum assembly	27.	Rear oil seal	41.	Planet pinion — short
13.	Rear clutch plates	28.	Driving flange	42.	Needle thrust washer
14.	Rear clutch piston	29.	Turbine	43.	Needle thrust washer
15.	Centre support				



KEY TO THE AUTOMATIC GEARBOX EXTERNAL COMPONENTS

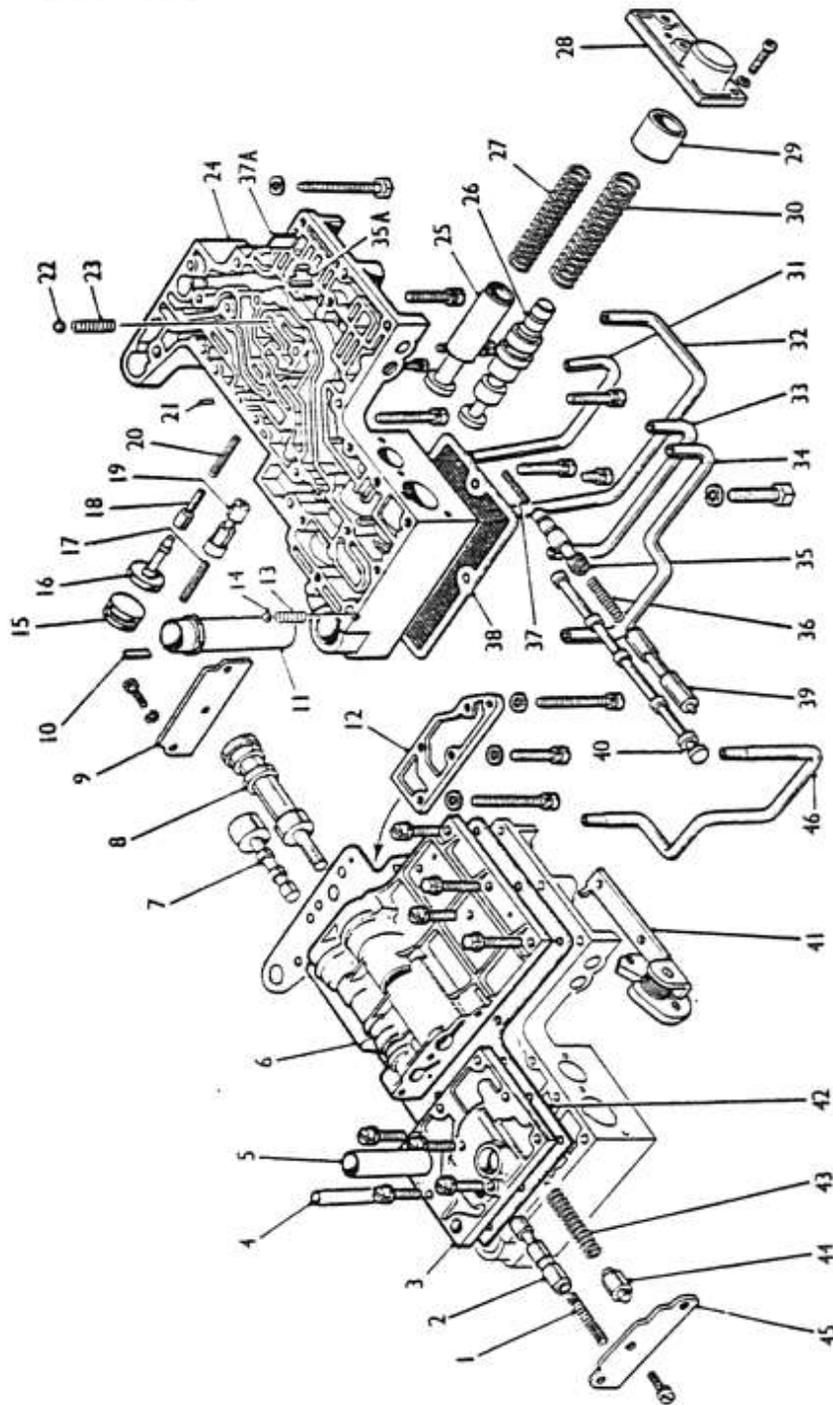
No.	Description	No.	Description	No.	Description
1.	Dipstick	20.	Stoneguard	39.	Torsion lever
2.	Oil filler and gearbox breather	21.	Oil pan assembly	40.	Spring
3.	Adaptor for filler tube	22.	Gasket for oil pan	41.	Clip
4.	Converter assembly	23.	Bolt for oil pan	42.	Toggle arm assembly
5.	Converter housing	24.	Spring washer for bolt	43.	Toggle pin
6.	Bolt for housing	25.	Drain plug	44.	Toggle link pin
7.	Spring washer for bolt	26.	Down-shift cable assembly	45.	Toggle link
8.	Case assembly	27.	Manual control shaft	46.	Toggle lever
9.	Bolt for case	28.	Roll-pin	47.	Toggle pin
10.	Spring washer for bolt	29.	Collar	48.	'O' ring for pin
11.	Rear extension housing	30.	Oil seal	49.	Slotted pin
12.	Gasket for extension housing	31.	Manual linkage rod	50.	Parking brake release spring
13.	Bolt for extension housing	32.	Manual detent lever	51.	Parking brake anchor pin
14.	Spring washer for bolt	33.	Spring	52.	Parking brake pawl
15.	Rear brake band adjusting screw	34.	Clip	53.	Inhibitor switch
16.	Locknut for adjusting screw	35.	Ball	54.	Speedometer pinion
17.	Rear oil seal	36.	Spring	55.	Oil seal for pinion
18.	Bolt for converter	37.	Clip	56.	Gasket for pinion bush
19.	Lock washer for bolt	38.	Washer	57.	Speedometer pinion bush

GEARBOX-AUTOMATIC



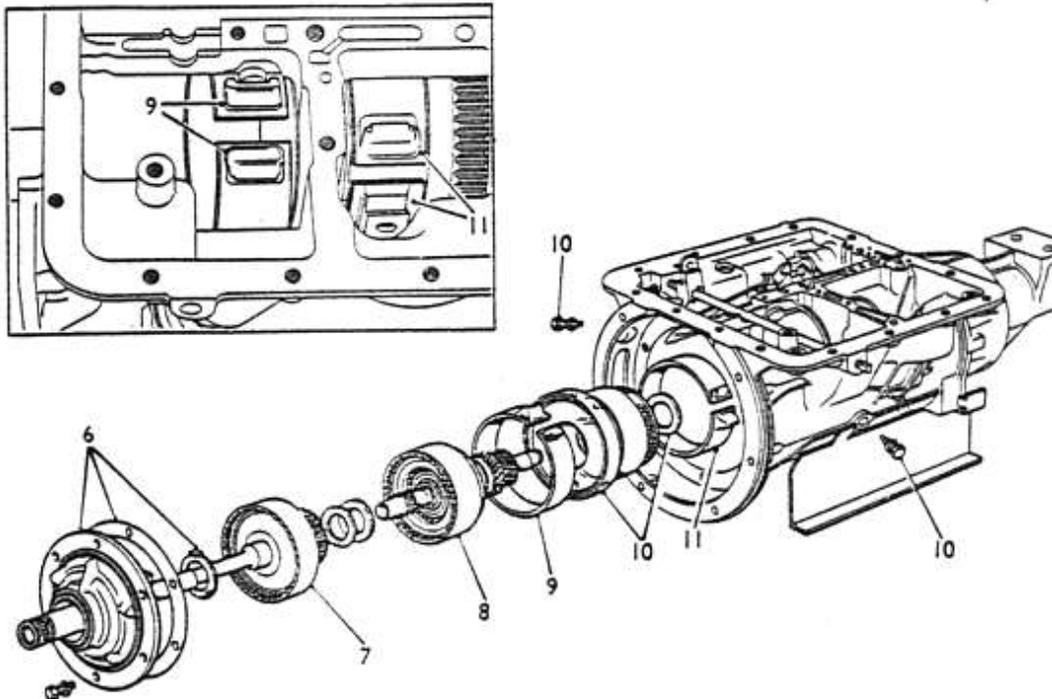
KEY TO THE AUTOMATIC GEARBOX INTERNAL COMPONENTS

No.	Description	No.	Description	No.	Description
1.	Front servo adjuster	31.	Piston seal	61.	Sun gear oil sealing rings
2.	Locknut or self adjuster spring	32.	Front servo sleeve	62.	Forward sun gear
2a.	Cam plate	33.	Oil sealing ring	63.	Needle thrust bearing
3.	Front servo lever	34.	Circlip	64.	Front drum and reverse sun gear assy.
4.	Pivot pin for lever	35.	'O' ring	65.	Rear clutch piston seal - inner
5.	Strut for front servo	36.	Front oil seal	66.	Rear clutch piston seal - outer
6.	'O' ring for rear servo piston	37.	Pump assembly	67.	Rear clutch piston
7.	Rear servo piston	38.	Bolt for pump	68.	Spring for rear clutch
8.	Front brake band	39.	Washer for bolt	69.	Seat for spring
9.	Rear servo body	40.	Input shaft thrust washer	70.	Snap-ring
10.	Pivot pin for rear servo lever	41.	Washer for bolt	71.	Rear clutch plates - outer
11.	Rear brake band	42.	Bolt for pump	72.	Rear clutch plates - inner
12.	Rear servo lever	43.	Front clutch snap-ring	73.	Snap-ring
13.	Rear servo spring	44.	Distance piece for front clutch	74.	Pressure plate for rear clutch
14.	Strut for rear servo	45.	Spring for front clutch	75.	Ring gear
15.	Front clutch thrust washer	46.	Bearing ring for spring	76.	Needle thrust bearing and plate
16.	Front clutch thrust washer	47.	Piston for front clutch	77.	Snap-ring
17.	'O' ring	48.	Front clutch housing	78.	Governor oil sealing ring
18.	Front clutch sealing ring	49.	Needle thrust bearing	79.	Driven shaft thrust washer
19.	Front clutch hub	50.	Lock washer for bolt	80.	Driven shaft
20.	Thrust washer	51.	Centre support bolt	81.	Adaptor oil sealing rings
21.	Front clutch plates - outer	52.	One-way clutch assembly	82.	Governor drive ball
22.	Front clutch plates - inner	53.	Needle thrust bearing plate	83.	Governor assembly
23.	Input shaft assembly	54.	Planet gear and rear drum assy.	84.	Speedometer drive gear
24.	Gasket for converter support	55.	One-way clutch outer race	85.	Locknut
25.	Circlip	56.	Speedometer gear drive ball	86.	Plain washer
26.	Screw	57.	Snap-ring	87.	Drive flange
27.	Front servo body	58.	Centre support	88.	Spacer
28.	Spring	59.	Output shaft oil sealing ring	89.	Screw with spring washer
29.	Piston seal	60.	Rear clutch sealing rings	90.	Rear adaptor plate
30.	Front servo piston				



KEY TO THE AUTOMATIC GEARBOX VALVE BODIES COMPONENTS

No.	Description	No.	Description	No.	Description
1.	Spring — 1-2 shift valve	17.	Spring — servo orifice control valve	33.	Front servo apply tube
2.	Plunger — 1-2 shift valve	18.	Modulator valve plug	34.	Front servo release tube
3.	Oil tube collector	19.	Servo orifice control valve	35.	Throttle valve
4.	Converter inlet oil tube	20.	Spring — modulator valve	35A.	Stop plate — throttle valve
5.	Pump outlet tube	21.	Modulator valve retainer dowel	36.	Spring — throttle valve
6.	Upper valve body	22.	3-2 shift restrictor ball	37.	Spring — throttle valve return
7.	Valve — 1-2 shift	23.	3-2 shift restrictor spring	37A.	Stop — throttle valve
8.	Valve — 2-3 shift	24.	Lower valve body	38.	Oil strainer
9.	Rear end plate	25.	Secondary regulator valve	39.	Down-shift valve
10.	Servo orifice control valve stop	26.	Primary regulator valve	40.	Manual control valve
11.	Pump inlet tube	27.	Spring — secondary regulator valve	41.	Down-shift and throttle valve cam assy.
12.	Governor line plate	28.	Lower body end plate	42.	Separating plate
13.	Check valve spring	29.	Primary regulator valve sleeve	43.	Spring — 2-3 shift valve
14.	Check valve ball	30.	Spring — primary regulator valve	44.	Plunger — 2-3 shift valve
15.	Modulator valve retainer	31.	Rear servo tube	45.	Front end plate
16.	Modulator valve	32.	Rear clutch tube	46.	Oil cooler inlet tube (when fitted)



BRAKE BANDS

— Remove and refit

Front brake band 1 to 9, 16 and 17
 Rear brake band 1 to 11 and 12 to 17

Service Tool
 CBW 35B

Removing

1. Remove the gearbox
2. Remove the oil pan.
3. Remove the valve block.
4. Remove the front servo.
5. Remove the rear servo.
6. Remove the front pump.
7. Remove the front clutch.
8. Remove the rear clutch.
9. Squeeze the ends of the front brake band together and remove it from the casing.
10. Remove the planet gears and centre support.
11. Squeeze the ends of the rear brake band together and remove it from the casing.

Reassembling

12. Place the rear band in the casing and locate it in the correct position.
13. Retain the needle thrust washer, backing plate to planet carrier, using petroleum jelly.
14. Install the centre support and planet gear carrier assembly, ensuring that the oil feed holes are uppermost (with gearbox inverted) and the locating holes are aligned with those in the casing.
15. Fit and tighten the two locating bolts with washers to 10 to 15 lbf ft (1.4 to 2.5 kgf m). The washers act as a seal and must be fitted with their flat face against the casing.
16. Reverse procedures in 1 to 9, noting:
 - a. Retain thrust washers using petroleum jelly.
 - b. Use a new joint washer and tighten the front pump bolts to 9 to 12 lbf ft (1.1 to 2.5 kgf m).
 - c. Tighten the rear servo bolts to 13 to 18 lbf ft (1.8 to 3.7 kgf m).
 - d. Tighten the front servo bolts to 9 to 12 lbf ft (1.1 to 1.8 kgf m).
 - e. Adjust the front and rear brake bands.
17. Refill the gearbox with Automatic Transmission Fluid and check the level.

FRONT CLUTCH

— Remove and refit

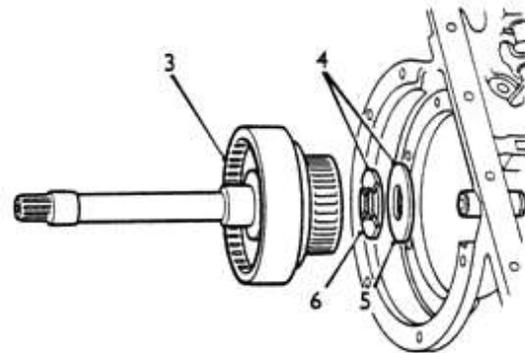
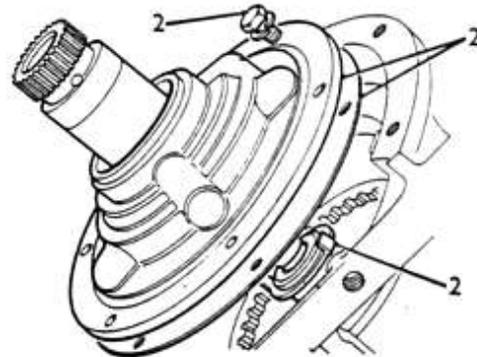
Service Tool
CBW 35B

Removing

1. Remove the gearbox.
2. Remove the front pump and the input shaft thrust washer.
3. Withdraw the input shaft and front clutch assembly.
4. Remove the bronze and steel thrust washers.

Refitting

5. Position the steel thrust washer on the rear clutch hub, ensuring that the hub and washer locating flats engage. Retain in position using petroleum jelly.
6. Fit the bronze thrust washer, and retain in position using petroleum jelly.
7. Refit the input shaft and front clutch assembly.
8. Refit the front pump with thrust washer; use a new joint washer and tighten bolts to 9 to 12 lbf ft (1:1 to 2.5 kgf m).
9. Refit the gearbox.
10. Refill the gearbox with Automatic Transmission Fluid and check the level.



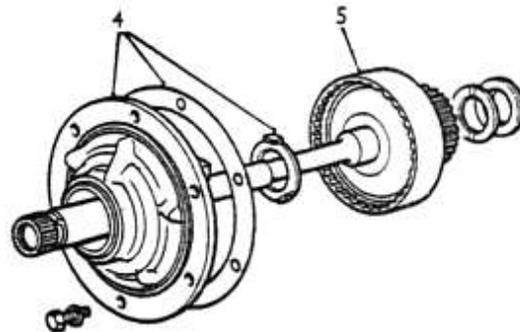
REAR CLUTCH

— Remove and refit

Service Tool
CBW 35B

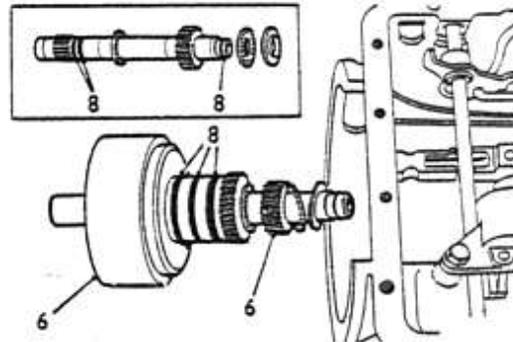
Removing

1. Remove the gearbox.
2. Remove the oil pan.
3. Remove the valve block.
4. Remove the front pump.
5. Remove the front clutch.
6. Withdraw the rear clutch and forward sun gear assembly.
7. Withdraw the forward sun gear from the rear clutch.



Refitting

8. Fit new oil sealing rings to the sun gear shaft, front clutch and governor feeds.
9. Position the two needle thrust washers on the forward sun gear and retain in position using petroleum jelly.
10. Position the backing washer into planet carrier using Petroleum Jelly.
11. Reverse the procedure in 1 to 7.
12. Refill the gearbox with Automatic Transmission Fluid and check the level.



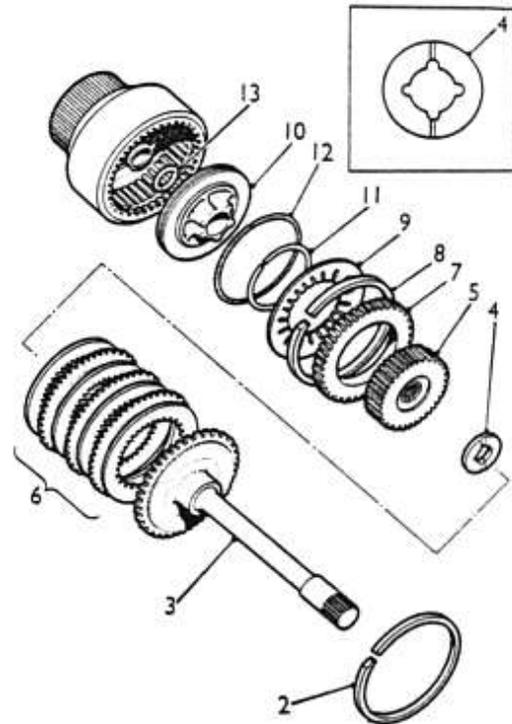
FRONT CLUTCH

– Overhaul

 Service Tool
 CBW 42A

Dismantling

1. Remove the front clutch.
2. Lever out the snap-ring.
3. Withdraw the input shaft assembly.
4. Remove the clutch hub thrust washer.
5. Withdraw the clutch hub.
6. Remove the inner friction and outer steel plates; retain the plates in their removal order.
7. Remove the clutch distance piece.
8. Lever out the circlip retaining the dished piston spring.
9. Remove the dished piston spring.
10. Withdraw the piston, apply air pressure to one feed orifice on the internal bore whilst the second is blanked off.
11. Remove the bearing ring for the piston if worn.
12. Remove the piston sealing ring.
13. Remove the 'O' ring from the clutch housing boss.

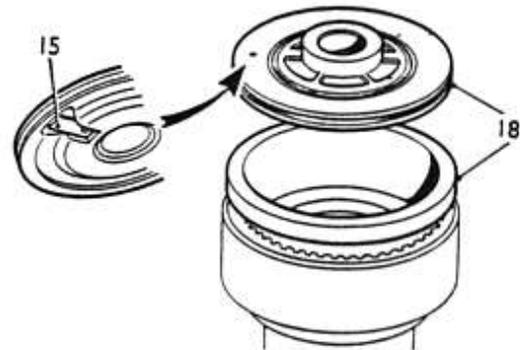


Inspection

14. Renew the rubber oil seals.
NOTE: If the rear clutch is not being overhauled, check the sealing rings on the forward sun gear shaft for wear, and renew if necessary.
15. Blow gently through the piston one-way ball valve (early models reed) and ensure that air will pass one way only.
16. Check the friction plates for wear and burning. Renew as a set.
17. Check the steel plates for distortion; if the distortion exceeds 0.005 in (0.12 mm) the plates must be renewed as a set.

Reassembling

18. Reverse procedure in 1 to 13, noting:
 - a. Lubricate the piston using Automatic Transmission Fluid and refit into the drum, using CBW 42A.
 - b. Refit the inner and outer clutch plates in alternate sequence.



REAR CLUTCH

(And Forward Sun Gear Shaft)

— Overhaul

Service Tools

CBW 41A, 7066, 7066J, CWG 37.

Dismantling

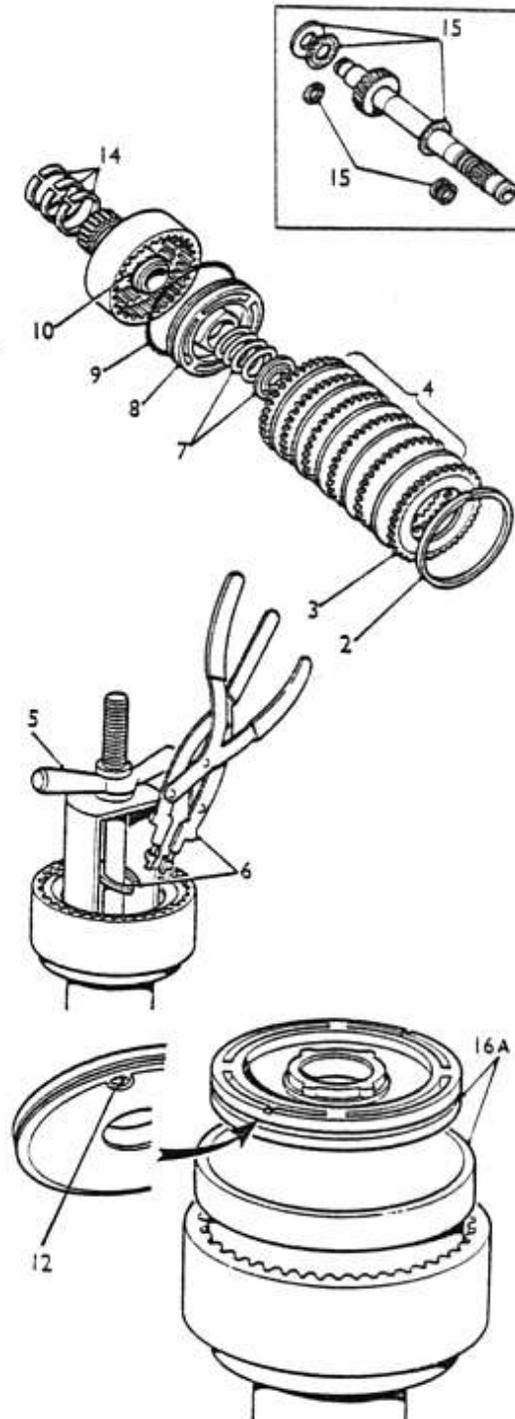
1. Remove the rear clutch and forward sun gear assembly.
2. Lever the snap-ring from the front of the clutch drum.
3. Withdraw the pressure plate.
4. Remove the inner friction and outer steel plates, and retain the plates in their removal order for reassembly.
5. Compress the piston spring; use CWG 37.
6. Remove the spring retaining circlip; use 7066 and 7066J.
7. Withdraw the seat and spring.
8. Remove the piston by shocking the drum on a soft surface or apply air pressure to the hole between the two inner oil rings at the rear of the housing.
9. Remove the piston seal.
10. Remove the 'O' ring from the reverse sun gear hub.

Inspection

11. Renew rubber oil seals.
12. Blow gently through the piston one-way ball valve (early models need) and ensure that air will pass one way only.
13. Check the friction plates for wear; the plates are coned 0-010 to 0-020 in (0-03 to 0-05 mm). Renew as a set.
14. Check the ring seals and the drum bearing for wear or damage.
15. Forward sun gear shaft: Check the needle thrust washers and ring seals for wear or damage.

Reassembling

16. Reverse procedure in 1 to 10, noting:
 - a. Lubricate the piston using Automatic Transmission Fluid and refit into the drum, using CBW 41A.
 - b. Refit the inner and outer clutch plates in alternate sequence and with the coning in the same direction.



DOWN-SHIFT CABLE

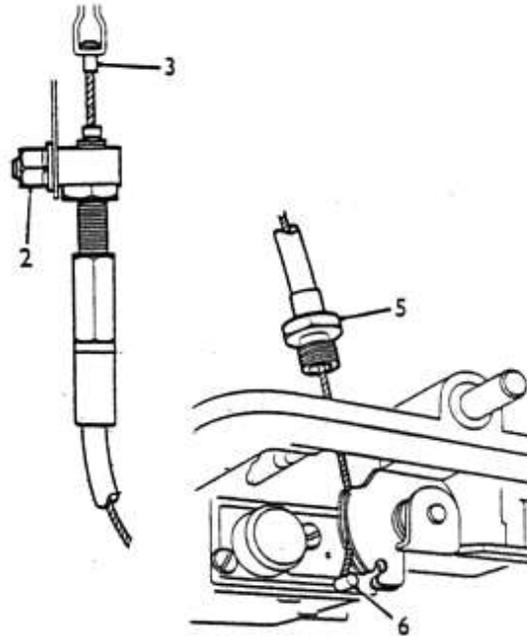
– Remove and refit

Removing

1. Chock the wheels, apply the hand brake, select 'N'.
2. Remove the nut and washer retaining the cable end steady.
3. Disconnect the down-shift cable nipple from its throttle linkage clip.
4. Remove the oil pan.
5. Unscrew the cable end connector from the gearbox case.
6. Pull the cable to rotate the down-shift cam, disconnect the cable end nipple and release the cam.

Refitting

7. Reverse the procedure in 2, 3, 5 and 6.
8. With the carburettor linkage in the idling position, check that the face of the down-shift cam is against the body of the manual control valve.
9. Open the throttle fully and check that the down-shift valve enters the kick-down position on the cam. Adjust the cable if necessary.
10. Refit the oil pan.
11. Refill the gearbox with Automatic Transmission Fluid and check the level.
12. Check and adjust the down-shift cable.
13. Check the pressure setting, and adjust if necessary.



GEARBOX—AUTOMATIC

STARTER INHIBITOR/REVERSE LAMP SWITCH

– Check and Adjust

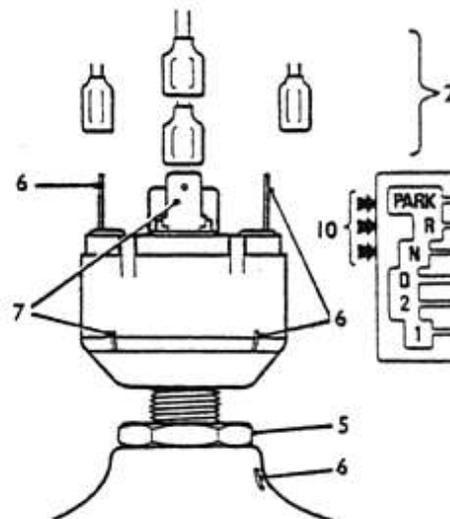
Service Tool
CBW 547A-50-3.

Checking

1. Apply the hand brake and chock the wheels.
2. Disconnect the leads from the switch.
3. Check the operation of the switch as follows:
 - a. Connect a test lamp across the starter terminals and select 'PARK', 'R', 'N', 'D', '2', '1' in sequence; the lamp should only come on in 'PARK' and 'N'.
 - b. Connect a test lamp across the reverse lamp terminals and select '1', '2', 'D', 'N', 'R', 'PARK' in sequence; the lamp should come on only in 'R'.
4. Re-connect the leads to the switch terminals.

Adjusting

5. Slacken the switch locknut using CBW 547A-50-3.
6. With a test lamp across the starter terminals select '1'. Screw in the switch until the lamp just goes out, and mark the position of the switch relative to the case.
7. Connect a test lamp across the reverse terminals; the lamp should be off. Screw in the switch until the lamp comes on, unscrew until the lamp just goes out, and mark the position on the switch relative to the previous marking on the case. Remove the test lamp.
8. Turn the switch until it is mid-way between the two marks, and tighten the locknut.
9. Re-connect the switch leads as in instruction 4.
10. Check that the starter operates only in 'PARK' and 'N' and the reverse lamp comes on in 'R'; renew the switch if faulty.



STARTER INHIBITOR/REVERSE LAMP SWITCH

– Remove and refit.

Service Tool
CBW 547A-50-3

Adjustable type (with locknut)
1 to 5, 8, 10 and 11

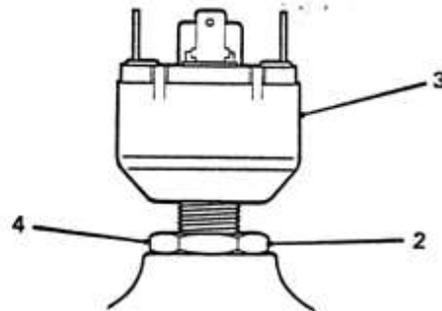
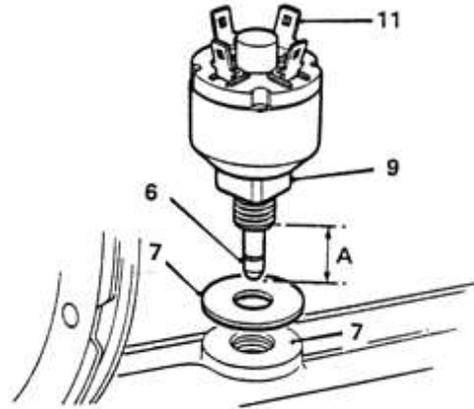
Non-adjustable type
1, 3, 5, 6 to 9, and 11

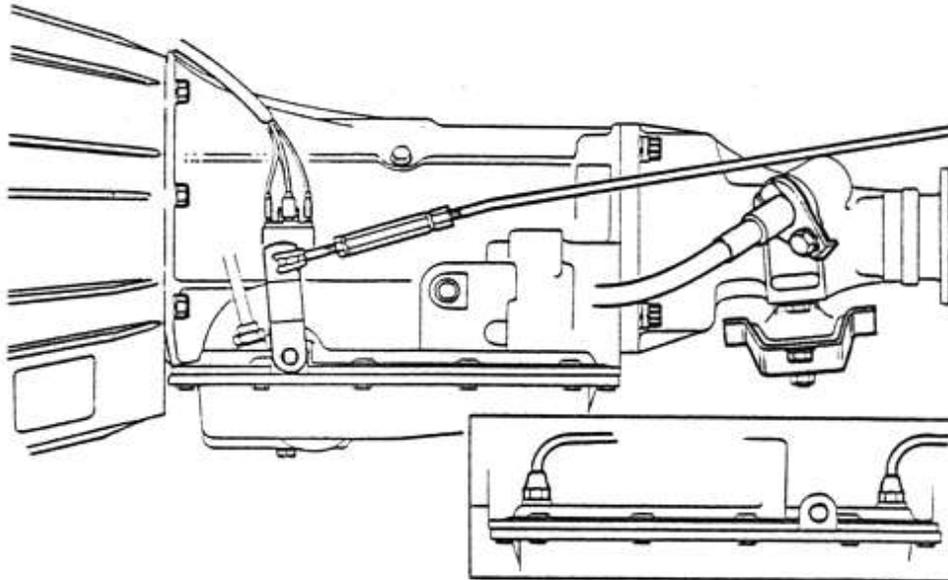
Removing

1. Disconnect the leads from the switch terminals.
2. Slacken the locknut using CBW 547A-50-3.
3. Unscrew the switch.

Refitting

4. Screw the locknut up to the switch.
5. Apply a small amount of sealer to the switch threads.
6. Measure the exposed length of plunger. Dimension 'A'; this must be $\frac{9}{16}$ in (14.28 mm). If the correct dimension cannot be obtained, repeatedly depress and release the plunger until the correct setting is obtained.
WARNING: Do not pull out the plunger more than the specified setting as this will render the switch inoperative. If the specified setting cannot be obtained, do not fit the switch.
7. Position the packing washer.
8. Screw the switch into the gearbox.
9. Tighten the switch to 6 lbf ft (0.7 kgf m).
10. Adjust the switch.
11. Check the switch for correct operation.





GEARBOX

— Remove and refit

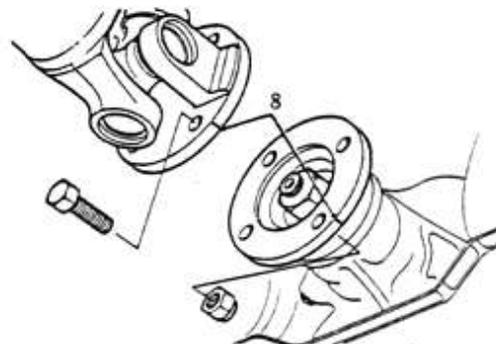
Removing

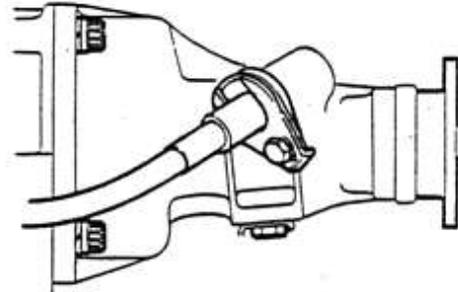
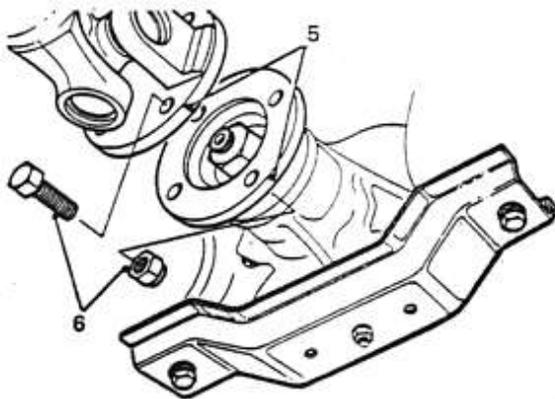
1. Disconnect the battery.
2. Remove starter motor.
3. Take the weight of the engine with a jack taking care not to damage engine sump.
4. Disconnect oil cooler connections where fitted.
5. Remove drain plug and drain oil.
6. Replace drain plug and tighten.
7. Disconnect speedo drive.
8. Mark the propeller shaft and gearbox flanges to ensure correct refitment.
9. Disconnect propeller shaft.
10. Disconnect rear mount, brackets and hand-brake.
11. Disconnect manual linkage rod lever, throttle cable and inhibitor switch wires.
12. Remove dipstick and disconnect filler tube.
13. Take the weight of the transmission with a jack taking care not to damage sump.
14. Remove the converter cover plate.
15. Remove the converter drive plate bolts.
16. Remove converter housing to engine block bolts.
17. Slide back unit — ensuring that converter is withdrawn at the same time.
(IMPORTANT — GREAT CARE MUST BE TAKEN NOT TO DISTORT CONVERTER DRIVE PLATE AND SIDE MOVEMENT OF THE TRANSMISSION MUST BE AVOIDED).
18. Remove transmission from vehicle.

ON MODELS FITTED WITH OIL COOLER LINES TO RADIATOR IT IS IMPORTANT THAT OIL COOLER IN THE RADIATOR AND LINES BE CLEANED WITH A QUICK DRYING SOLVENT AND DRIED THOROUGHLY BY USE OF COMPRESSED AIR.

Refitting

19. Reverse procedure in 1 to 18.
20. Align the propeller shaft and gearbox flange marks.
21. Refill the gearbox with Automatic Transmission Fluid and check the level.





REAR EXTENSION

— Remove and refit

Service Tools
18G2, 18G 1205

Removing

1. Chock the wheels and select 'N'.
2. Release the exhaust pipe at the manifold and its clip from the support stay, move the pipe aside and support.
3. Drain the transmission — it is not necessary to drain if the rear of the vehicle has been lifted for access.
4. Disconnect the manual selection lever at the transmission lever.
5. Mark the propeller and gearbox flanges to ensure correct refitment.
6. Remove the four locknuts and bolts retaining the propeller shaft to the output shaft flange.
7. Move the propeller shaft to one side.
8. Using 18G 1205 to hold flange remove the locknut and plain washer.
9. Pull the flange from the output shaft using 18G2.
10. Disconnect the speedometer drive at the extension housing.
11. Support the gearbox.
12. Remove the two bolts with spring and flat washers securing the rear engine mounting cross-member to the body frame.
13. Lower the gearbox to give access.
14. Remove the screws with spring washer securing the rear extension to the gearbox case and withdraw the rear extension.
NOTE: A certain amount of fluid will be released.
15. If a new rear extension is being fitted, remove the nuts, shakeproof and plain washers retaining the rear engine mounting and remove the mounting.

Refitting

16. Reverse procedure in 1 to 15, noting:
 - a. Fit a new extension to case joint washer and tighten screws (refer to torque chart).
 - b. Tighten the output shaft locknut to 55 to 60 lbf ft (7.6 to 8.3 kgf m).
 - c. Align the propeller shaft and gearbox flange marks.
 - d. Refill the gearbox with Automatic Transmission Fluid and check the level.

GEARBOX-AUTOMATIC



REAR OIL SEAL

– Remove and refit

Service Tools

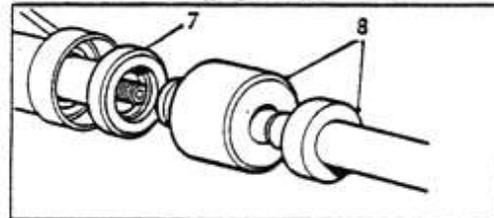
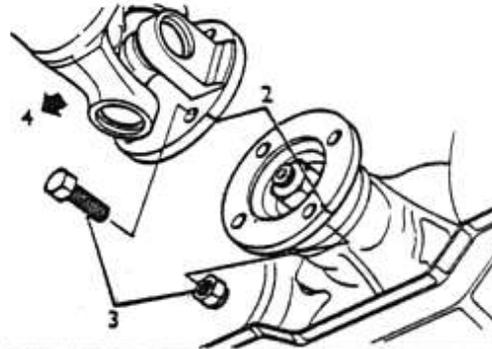
18G2, 18G.1205, 7657, CBW 46.

Removing

1. Chock the wheels and select 'N'.
2. Mark the propeller shaft and gearbox flanges to ensure correct refitment.
3. Remove the four locknuts and bolts retaining the propeller shaft to the output shaft flange.
4. Move the propeller shaft to one side and secure it.
5. Using 18G 1205 to hold the flange, remove the locknut and plain washer.
6. Pull the flange from the output shaft using 18G2.
7. Extract the oil seal using 7657, CBW 46.

Refitting

8. Dip the new oil seal in transmission fluid and fit it flush with the end of the rear extension.
9. Reverse procedure in 1 to 7, noting:
 - a. Tighten the output shaft locknut to 55 to 60 lbf ft.
 - b. Align the propeller shaft and gearbox flange marks.



GOVERNOR (Removable valve type)

– Remove and refit

Service Tools

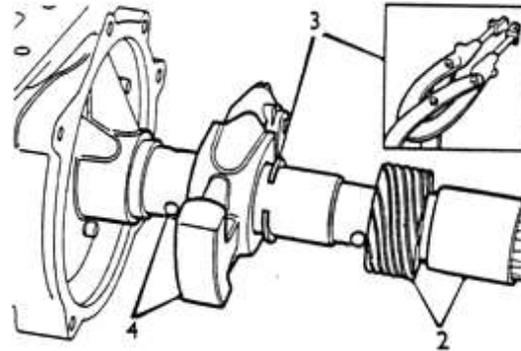
18G 1004, 18G 1004J

Removing

1. Remove the extension housing.
2. Withdraw the speedometer drive gear.
3. Remove the circlip retaining the governor, using 18G 1004 with 18G 1004J.
4. Withdraw the governor assembly retrieving the drive ball as it becomes free.

Refitting

5. Turn the output shaft until the detent is uppermost and locate the drive ball with petroleum jelly.
6. Slide the governor assembly into position, ensuring that the cover-plate faces away from the gearbox, and secure with the circlip.
7. Reverse procedure in 1 and 2.

**GOVERNOR**

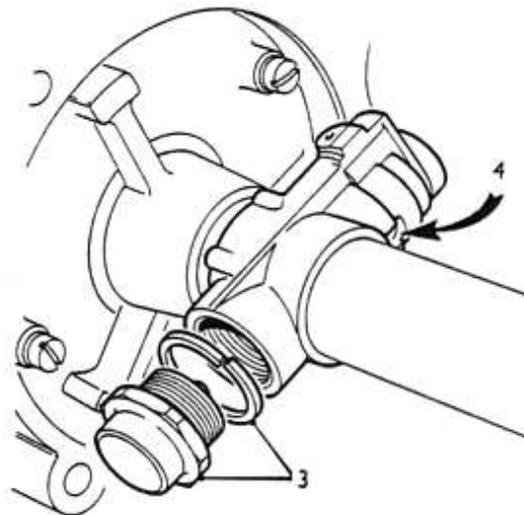
– Remove and refit

Removing

1. Remove the extension housing.
2. Withdraw the speedometer drive gear.
3. Remove the governor retaining bolt and spring washer.
4. Note the fitted position in relation to the oil-ways and withdraw the governor assembly.

Refitting

5. Refit the governor.
 - a. Fit the governor retaining bolt and spring washer and tighten the bolt to 15 to 18 lbf ft (2.07 to 2.49 kgf m).
6. Reverse the procedure in 1 and 2.



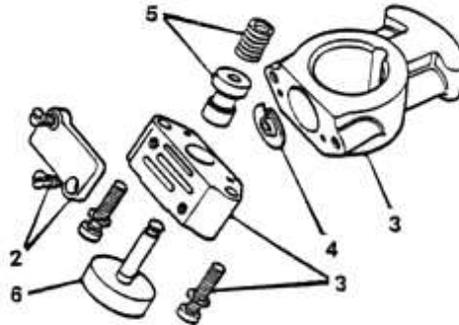
GEARBOX—AUTOMATIC

GOVERNOR (Removable valve type)

— Overhaul

Dismantling

1. Remove the governor assembly.
2. Remove the cover-plate.
3. Take out the two screws and separate the valve body and counter-weight, check the oilways for correct alignment.
4. Pull off the weight retainer.
5. Remove the spring and valve.
6. Withdraw the weight.



Inspection

7. Thoroughly clean the components and oilways; check the valve, weight and body for scorings; polish or renew if necessary.

Reassembling

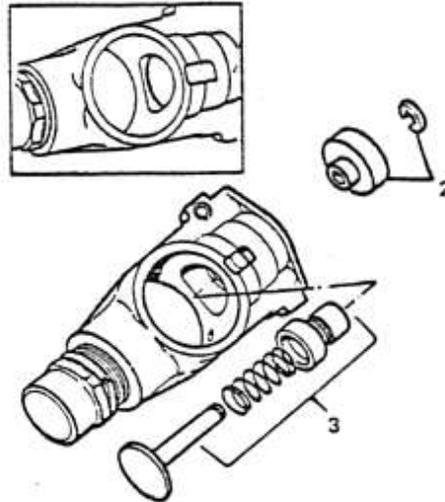
8. Reverse procedure in 1 to 6, noting:
 - a. Tighten valve body to counter-weight screws 4 to 5 lbf ft (0.6 to 0.7 kgf m). Tighten cover-plate screws 20 to 48 lbf in (0.23 to 0.55 kgf m).
 - b. Check that the valve and governor weight can move freely.

GOVERNOR

— Overhaul

Dismantling

1. Depress governor weight stem to expose circlip.
2. Remove circlip and weight, discard circlip.
3. Withdraw stem, spring and valve from governor body.



Inspection

4. Check all components for signs of damage and additionally, check spring for distortion. In the event of any component being found unsatisfactory, governor assembly must be renewed.

Reassembling

5. Reverse operations 1 to 3, use a new circlip.
6. Check weight stem for free movement.

OIL PAN

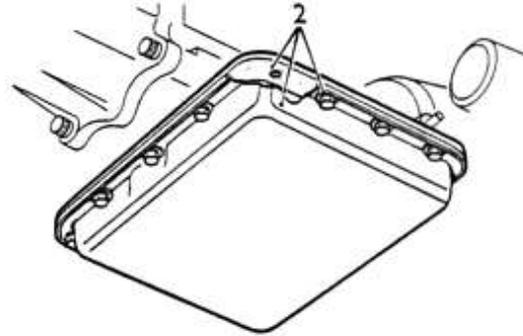
– Remove and refit

Removing

1. Drain the gearbox.
2. Remove the bolts with spring washers and detach the oil pan from the casing.

Refitting

3. Refit the oil pan, using a new gasket if necessary, and tighten the bolts to 9 to 12 lbf ft (1.2 to 1.7 kgf m).
4. Refill the gearbox.

**RECOMMENDED TRANSMISSION FLUID
LEVEL CHECKING PROCEDURE****Live Engine Dipping**

1. The fluid level must be checked with the vehicle standing on level ground.
2. With the hand and foot brake firmly applied and the engine running at the recommended idle speed, move the selector lever through all the positions two or three times, holding in each for approximately ten seconds to prime the hydraulic system.
3. Select Park and switch off engine. Remove dipstick and wipe the blade with a fluff free paper or cloth and dip immediately.
4. Re-insert the stick into the tube, pushing firmly home and withdraw it again immediately. Note the level on the face of the blade against the markings. If hot and cold marks are provided, then read according to the condition of the transmission. Hot, if the vehicle has been driven 5 miles, or if vehicle has not moved read Cold.
5. If it is necessary, add sufficient fluid to bring the level between the dipstick markings. After topping up, do not re-dip immediately, but follow the complete procedure again to allow the new level to stabilise and any residual fluid adhering to the filler tube wall to drain.

Note: The usual amount of fluid required to raise the level from low mark to high mark is approximately one imperial pint.

GEARBOX—AUTOMATIC**PARKING BRAKE**

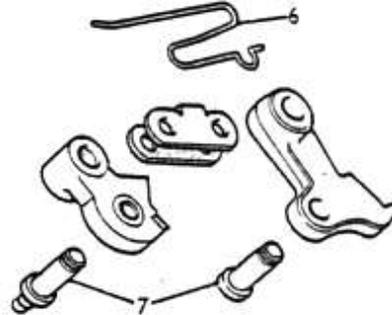
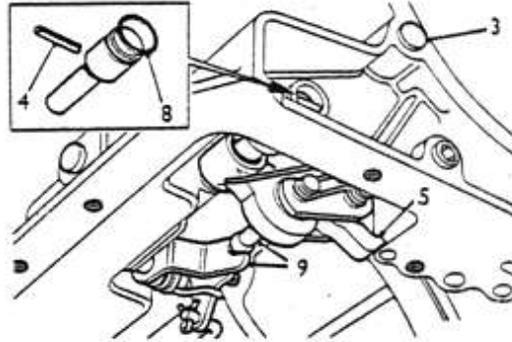
– Remove and refit

Removing

1. Remove the extension housing.
2. Remove the valve block.
3. Remove the anchor pin.
4. Tap out the roll pin and extract the toggle pin.
5. Remove the parking pawl assembly.
6. Remove the release spring.
7. Remove the two toggle pins and release the toggle.

Refitting

8. Fit a new 'O' ring seal to the toggle pin.
9. Reverse procedure in 1 to 7, ensuring the toggle pin and toggle lift lever are aligned.



DOWN-SHIFT CABLE

– Check and adjust 1 to 7

Initial setting 5 and 6

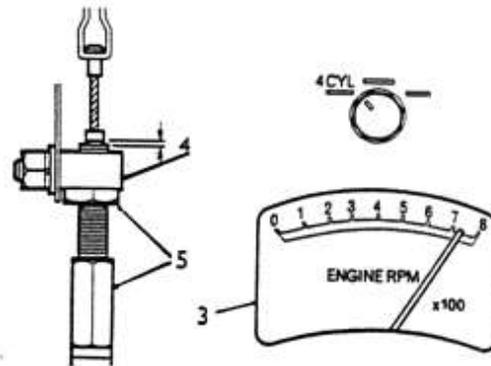
Service Tool
18G 677ZC

Checking

1. Chock the wheels and apply the hand brake.
2. Check that the down-shift inner cable has not become disconnected from the down-shift cam. To check, pull the inner cable. When released, the cable should return to the crimped stop under the influence of the down-shift cam return spring.
3. Connect a revolution counter, 18G 677ZC, and allow the engine to idle at 700 to 750 rev/min.
4. Check that the crimped stop on the inner cable is 1/16 in (1.5 mm) from the outer cable collar and the trunnion is free to swivel. Adjust if necessary.

Adjusting

5. Slacken the locknut and adjust the outer cable collar to give the initial setting for the crimped stop.
6. Check the pressure setting and adjust if necessary.



GEARBOX—AUTOMATIC

DOWN-SHIFT CABLE

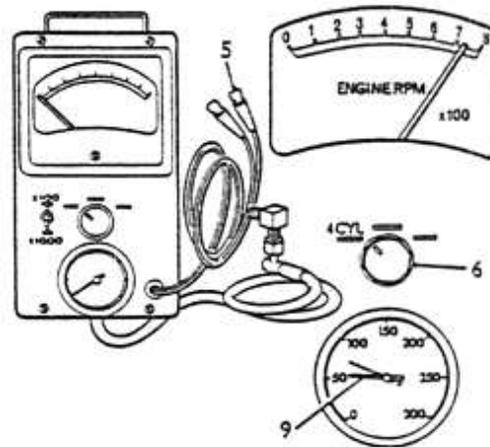
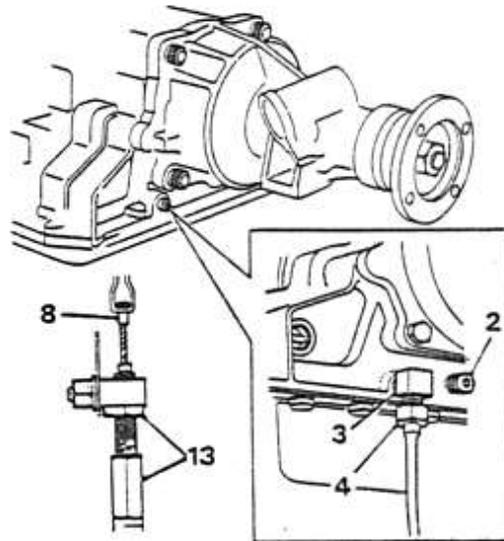
— Pressure check

Service Tool
18G 677ZC

Check and adjust

NOTE: This test is essential to determine the correct adjustment of the down-shift cable. Refer to 'FAULT DIAGNOSIS' for the effects of cable maladjustment.

1. Run the engine until the gearbox reaches its normal operating temperature, then stop the engine.
2. Remove the blanking plug from the line pressure take-off point.
3. Fit the gearbox adaptor of 18G 677ZC screw the plain end into the gearbox pressure point and tighten.
4. Connect the gauge hose end to the adaptor and tighten.
5. Connect the tachometer 18G 677ZC red lead to the (negative) terminal of the coil. Connect the black lead to a suitable earth point.
6. Switch to 6 - '4 Cyl' and to 'x 100' scale.
7. Chock the wheels, apply the hand brake, select 'N' and allow the engine to idle at correct idle speed.
8. Disconnect the down-shift cable at the throttle.
9. Apply the foot brake, select 'D' and note the pressure which should be 50 to 75 lb/in².
10. Re-connect the down-shift cable and repeat test item 9, the pressure readings should be the same, if not adjust the cable.
11. Increase the engine speed by 500 rev/min and note the pressure increase which should be between 10 - 25 lb/in².
12. Stop the engine.
13. Adjust as follows:
If the pressure increase is less than 10 lb/in² increase the effective length of the outer cable.
If the pressure increase is more than 25 lb/in² decrease the effective length of the outer cable.
14. Re-check pressure; procedures 7 to 11 and 12 and 13 until the pressure increase is correct.
15. Refit the blanking plug.



SELECTOR

– Check and adjust

Checking

1. Apply the hand brake.
2. Set the selector handle in the 'N' position and allow it to be positioned by the manual control detent.
3. Select 'PARK', release the hand brake, and rock the car back and forth. The pawl should hold the vehicle.

Adjusting

4. Disconnect the selector rod or cable at the gearbox lever.
5. Unlock the lock nut on selector rod or cable.
6. Set the gearbox lever to 'N' position.
7. With the vehicle selector lever held in 'N' position the connecting pin of the selector rod or cable should freely enter the hole in the gearbox lever.
8. If not, adjust rod or cable.
9. Re-connect rod or cable and check selector in all positions ensuring that control valve detent is not over-ridden.

REAR BRAKE BAND

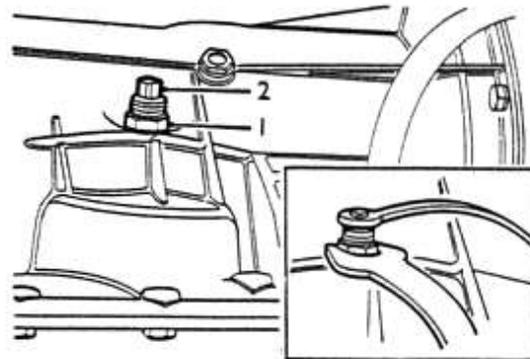
– Adjust

Service Tools
18G 701, 18G 537

Adjusting

Use 18G 701 when the gearbox is in situ. This adjustment is facilitated by lowering the gearbox slightly.

1. Slacken the locknut using 18G 701.
2. Tighten the adjusting screw to 10 lbf ft (1.4 kgf m) using 18G 537.
3. Slacken the adjusting screw (back off) 3/4 of a turn, tighten the locknut.



STALL TEST

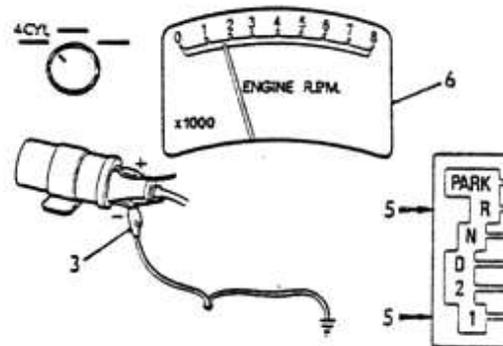
- Testing

Service Tool
18G 677ZC

The function of the test is to determine that the torque converter and gearbox are operating satisfactorily. The stall speed is the maximum obtainable at forced throttle (kick-down) while the turbine is held stationary. The condition of the engine must be taken into account when interpreting a low stall speed.

Testing

1. Allow the engine and gearbox to attain normal operating temperature.
2. Check that the gearbox fluid level is at the upper mark on the dipstick.
3. Connect the tachometer and position it where it can be read from the driver's seat. Red connector to coil -Ve terminal, select No. of Cyl. Switch to 'x 1000' scale.
4. Chock the wheels and apply the hand brake.
5. Apply the foot brake; select '1' or 'R' and depress the throttle to the forced position (kick-down) for not more than 10 seconds.
6. Note the highest rev/min obtained and refer to manufacturers handbook, or contact B-W Technical Dept.



IMPORTANT: Duration of the stall test must not exceed 10 seconds, otherwise the transmission will overheat.

CONVERTER FAULT DIAGNOSIS

Torque converter faults can only be correctly determined when road test findings, transmission performance, engine condition and stall test results have all been considered.

Slipping stator — (Stator free-wheel slipping)

1. Inability to pull away on steep gradients.
2. Poor acceleration from rest.
3. Stall test reading LOW.

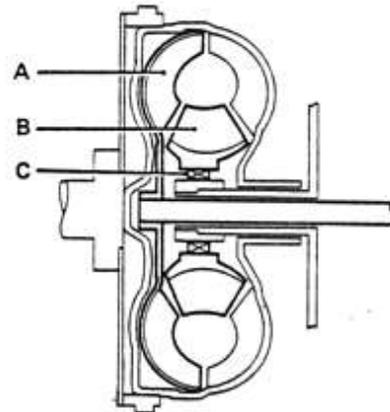
Seized stator — (Stator free-wheel seized — unusual fault)

4. Reduced maximum speed in all gears, pronounced in top ratio.
5. Severe overheating of converter and transmission.
6. Stall test reading NORMAL.

Transmission slip — (selected gear components slipping)

7. If fault is apparent in both '1' and 'R' it is usually due to low pressure.
8. If fault is present in only one position a faulty component is the most likely cause.
9. Stall test reading HIGH.

- A. Turbine — held stationary.
- B. Stator
- C. Free-wheel — one-way clutch.

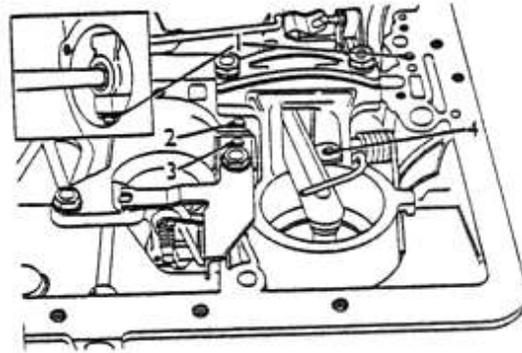


GEARBOX—AUTOMATIC**MECHANICAL OPERATION****— Air pressure checks**

Air pressure checks can be made on the gearbox assembly to determine whether the clutches and brake bands are operating. These checks can be made with the transmission in the car or on the bench, using a high pressure air-line. Remove the oil pan, the valve body, and the oil tubes.

1. Front Clutch and Governor Feed.

Apply air pressure to the passage (1). Listen for a thump, indicating that the clutch is functioning. With the unit on a bench, verify by rotating the input shaft with air pressure applied. Keep air pressure applied for several seconds to check for leaks in the circuit. If the extension housing has been removed, rotate the output shaft so that the governor weight will be at the bottom of the assembly. Verify that the weight moves inwards with air pressure applied.

**2. Rear Clutch**

Apply air pressure to the passage (2). With the unit on the bench, verify that the clutch is functioning by turning the input shaft. Keep air pressure applied for several seconds to check for leaks. then listen for a thump indicating that the clutch is releasing.

3. Front Servo

Apply air pressure to the apply tube location (3) immediately adjacent to the rear retaining bolt. Observe the movement of the piston pin.

4. Rear Servo

Apply air pressure to the tube location (4). Observe the movement of the servo lever.

Conclusions

If the clutch and bands operate satisfactorily with air pressure, faulty operation of the transmission indicates malfunction of the hydraulic control system which will necessitate removing and overhauling the valve bodies.

ROAD TEST

NOTE: It is important to gain as much information as possible on the precise nature of any fault. The road test procedure should be carried out in its entirety, as there may be more than one fault. Refer to the 'FAULT DIAGNOSIS' chart and to the 'RECTIFICATION CHART' on Page 59.

Preliminary checks

- a. Check the fluid level, and adjust if necessary.
- b. Check the down-shift cable adjustment.
- c. Fully depress the accelerator pedal to the 'kick-down' position and check that the carburetter(s) is fully open.

Road Test	Fault Diagnosis	Rectification
1. Check that the starter will operate only with the selector lever in 'P' and 'N' and that the reverse lights (when fitted) operate only in 'R'	Starter will not operate in 'P' or 'N'	19
	Starter operates in all selector positions	20
2. Apply the hand and foot brakes and with the engine idling select 'N-D', 'N-2', 'N-1' and 'N-R'. Gearbox engagement should be felt in each position.	Excessive bump on engagement of 'D', '2', '1' or 'R'	4,3
3. Check the stall speed in '1' and 'R'. Do not stall for more than 10 seconds	High stall speed:	
	a. With slip and squawk in '1'	1,2,3,13a,c,f,11
	b. With slip and squawk in 'R'	1,2,3,13a,c,f,e,12
	Low stall speed: more than 600 rev/min below normal	21
	Low stall speed: less than 600 rev/min below normal	23
4. Transmission at normal temperature select 'D'; Release the brakes and accelerate with minimum throttle. Check for 1-2 and 2-3 shifts. Confirm that third gear has been obtained by selecting '2' when a 3-2 shift should be felt NOTE: A feature of this transmission is that a slight increase in throttle depression between 15 and 30 mph (25 and 48 km/h) may produce a 3-2 down-shift (part throttle down-shift).	No drive in 'D' '2' or '1'	1,2,3,13a,11,16
	No drive in 'D', drive in '1'	1,2,3,16
	No drive in 'D', '2', '1' or 'R'	1,2,3,13a,11,16,17
	Delayed or no 1-2 shift	3,14,13a,5,6
	Slip on 1-2 shift	2,3,5,6,7,13c,f
	Delayed or no 2-3 shift (if normal drive in 'R', omit 12)	3,14,13g,h,c,d,5,6,12
	Slip or engine run-up on 2-3 shift	2,3,5,13a,c,12
	Bumpy gear-shifts	3
	Drag in 'D' and '2'	8
	Drag or binding on 2-3 shift	5,6
5. From a standing start, accelerate using 'kick-down', Check for 1-2 and 2-3 shifts.	Slip and squawk or judder on full throttle take-off in 'D'	1,2,3,13a,c,11
	Loss of performance and overheating in third gear.	21
	Other possible faults are as given in test No.4	Continue as in test 4



Road Test	Fault Diagnosis	Rectification
6. a. At 40 mph (65 km/h) in top gear release the accelerator and select '2'. Check for 3-2 shift and engine braking. Check for 2-1 roll out.	No 3-2 down-shift or engine braking	1,5,6,7,12
b. At 15 mph (25 km/h) in second gear release the accelerator and select '1'. Check for 2-1 shift.	No 2-1 down-shift and engine braking	8,9,10
7. a. At 40 mph (65 km/h) in top gear, depress the accelerator to kick-down, when the gearbox should down-shift to second gear	Transmission will not down-shift	3,13f,g,14
b. At 20 mph (30 km/h) in second gear, depress the accelerator to kick-down when the gearbox should down-shift to first gear.	Transmission will not down-shift	3,13f,g,14
8. a. Stop, engage '1' and accelerate to 20 mph (30 km/h). Check for clutch slip or break-away noise (squawk) and that no up-shift occurs.	Slip, squawk or judder on take-off in '1' Transmission up-shifts	1,2,3,13,11 1
b. Stop, engage 'R' and reverse the vehicle using full throttle if possible. Check for clutch or break-away noise (squawk)	Slip, squawk or judder on take-off in 'R' As above, with engine braking available in '1' Slip but no judder on take-off in 'R'. No engine braking available in '1' Drag in 'R' No drive in 'R', no engine braking As above, with engine braking in '1'	1,2,3,13b,c,e,f,g,12 1,2,3 1,2,3,8,9,10 5 1,2,3,8,13e,f,g,9,10, 12 1,2,3,13e,12
9. Stop the vehicle facing downhill, apply the brakes and select 'P'. Release the brakes and check that the pawl holds. Re-apply the brakes before disengaging 'P'. Repeat facing uphill	Parking pawl inoperative Miscellaneous: Screech or whine increasing with engine speed Grinding or grating noise from gearbox Knocking noise from torque converter area At high speeds in 'D' transmission down-shifts to second ratio and immediately up-shifts back to third ratio	1,15 17 18 22 12

continued

RECTIFICATION CHART

1. Recheck fluid level.
2. Check manual linkage adjustment.
3. Check adjustment of down-shift valve cable.
4. Reduce engine idle speed.
5. Check adjustment of front band.
6. Check front servo seals and fit of tubes.
7. Check front band for wear.
8. Check adjustment of rear band.
9. Check rear servo seal and fit of tubes.
10. Check rear band for wear.
11. Examine front clutch, check ball valve and seals, also forward sun gear shaft sealing rings. Verify that cup plug in driven shaft is not leaking or dislodged.
12. Examine rear clutch, check ball valve and seals. Verify that rear clutch spring seat inner lip is not proud. Check fit of tubes.
13. Strip valve bodies and clean, checking:
 - a. Primary regulator valve sticking.
 - b. Secondary regulator valve sticking.
 - c. Throttle valve sticking.
 - d. Modulator valve sticking.
 - e. Servo orifice control valve sticking.
 - f. 1 to 2 shift valve sticking.
 - g. 2 to 3 shift valve sticking.
 - h. 2 to 3 shift valve plunger sticking.
14. Strip governor valve and clean.
15. Examine parking pawl, gear, and internal linkage.
16. Examine one-way clutch.
17. Strip and examine pump and drive tangs.
18. Strip and examine gear train.
19. Adjust starter inhibitor switch inwards.
20. Adjust starter inhibitor switch outwards.
21. Replace torque converter.
22. Examine torque converter drive plate for cracks or fracture.
23. Check engine performance.

Selection tests

It is possible to determine whether a clutch or band is not operating effective as follows:

Move selector to each position shown in chart below.

Note whether drive is obtained through components indicated.

Conclusions

- a. If a clutch or band functions in one selector position the element is normal and fault is elsewhere.
- b. If a clutch or band is tried in two positions and fails to drive in both, that element or hydraulic feed is suspect. Confirm fault by using 'Air pressure test' to check for mechanical operation.

Selector position	Ratio	D 3	D,2 2	D,1 1	1 1	R
Applied	Front clutch	*	*	*	*	
	Rear clutch	*				*
	One-way clutch			*		
	Front band		*			
	Rear band				*	*
Driven	Forward sun	*	*	*	*	
	Reverse sun	*				*
Held	Planet carrier			*	*	*
	Reverse sun		*			

FRONT PUMP

— Remove and refit

Service Tools
CBW 87, CBW 35B

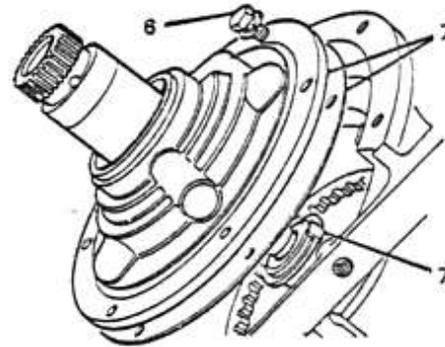
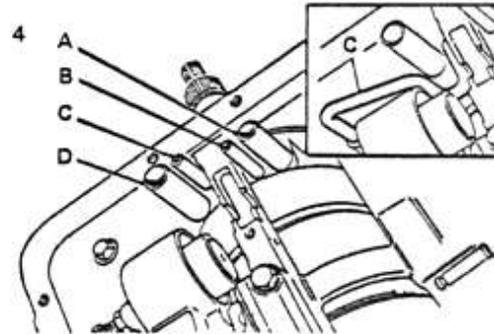
Removing

1. Remove the gearbox.
2. Remove the oil pan.
3. Remove the valve block.
4. Pull out the pump and converter oil tubes:
 - A. Pump outlet.
 - B. Converter inlet.
 - C. Converter outlet or oil cooler feed.
 - D. Pump inlet 'O' ring on tube.
5. Check the input shaft end-float.

NOTE: The existing gear train end-float must be checked before the front pump is removed so that subsequently due compensation can be made for thrust washer wear.
6. Take out the six bolts with spring washers.
7. Remove the front pump with its joint washer and the input shaft thrust washer.

Refitting

8. Reverse procedure in 1 to 7, noting:
 - a. Retain the thrust washer in position on the front pump assembly using petroleum jelly.
 - b. Use a new joint washer and tighten bolts to 9 to 12 lbf ft (1.1 to 2.5 kgf m).
 - c. Refill the gearbox with Automatic Transmission Fluid and check the level.

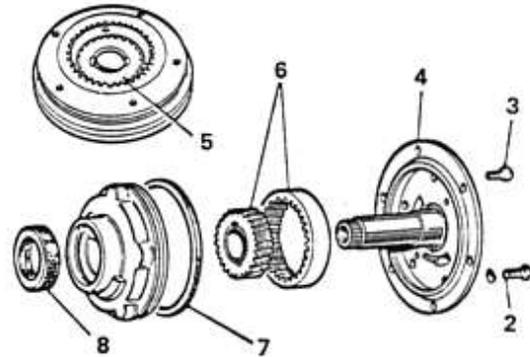


FRONT PUMP

– Overhaul

Dismantling

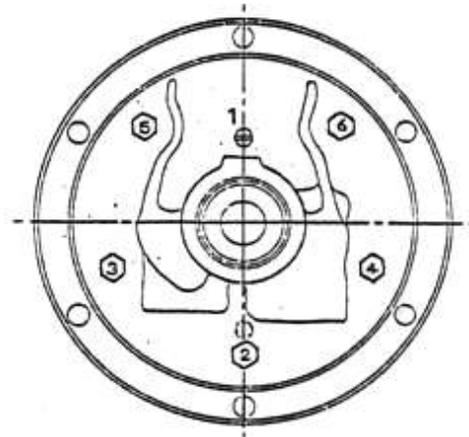
1. Remove the front pump.
2. Unscrew the five bolts and spring washers securing the pump body to the stator support.
3. Take out the locating screw and spring washer.
4. Separate the stator support from the pump body assembly.
5. Mark the outside faces of the gears to facilitate correct assembly.
6. Remove the gears.
7. Remove the sealing ring.
8. Extract the seal.


Inspection

9. Check the pump body and gear teeth for scores and excessive wear; remove light scores with very fine abrasive cloth.

Reassembling

10. Renew the seal.
11. Renew the sealing ring.
12. Fit the gears into the pump body.
13. Lightly lubricate the gears and the sealing ring.
14. Refit the stator support.
15. Fit and tighten the locating screw with the lock washer to 2 to 3 lbf ft (0.28 to 0.41 kgf m).
16. Fit and tighten the bolts with spring washers to 17 to 22 lbf ft (2.4 to 4.4 kgf m).
17. Refit the front pump.


FRONT PUMP OIL SEAL

– Remove and refit

Removing

1. Remove the gearbox.
2. Remove the oil seal.

Refitting

3. Smear the new seal with Automatic Transmission Fluid and fit. Refit the gearbox.

Tightening Sequence

1. Torque set to 25-35 lbs. ins.
2. Torque set to 17-22 lbs. ft.
3. Torque set to 17-22 lbs. ft.
4. Torque set to 17-22 lbs. ft.
5. Torque set to 17-22 lbs. ft.
6. Torque set to 17-22 lbs. ft.

(Recheck after tightening 1-6).

FRONT SERVO

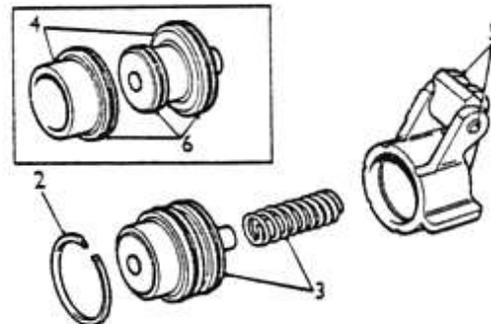
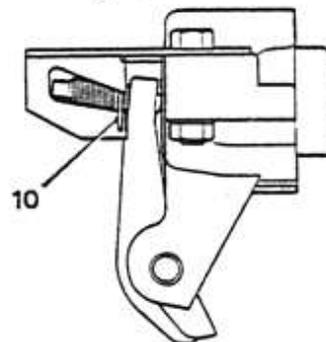
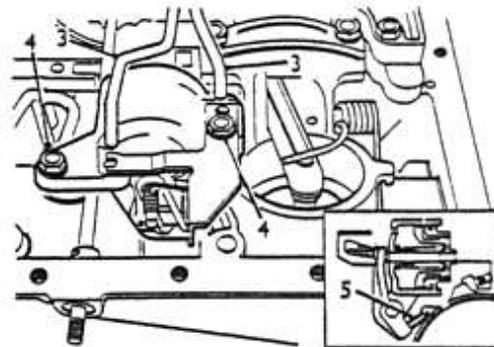
— Remove and refit

Removing

1. Drain the gearbox.
2. Remove the oil pan and joint washer.
3. Remove the front servo apply and release oil pipes.
4. Remove the two bolts with spring washers and take out the front servo.
5. Extract the brake band strut.

Refitting

6. Locate the strut on the front brake band with petroleum jelly.
7. Locate the servo, retain in position by loosely fitting the front retaining screw.
8. Position the adjusting screw so that it protrudes 1/16 in (1.59 mm) through the lever arm.
9. Set the spring position on the adjusting screw 0.062 to 0.124 in (1.574 to 3.149 mm) behind the lever, ensuring that the spring arm is correctly positioned to engage the plate slot.
10. Assemble the plate to the servo, ensuring that the spring arm engages the slot. Finger tighten the rear bolt.
11. Refit the servo pipes.
12. Tighten the servo retaining bolts to 9 to 12 lbf ft (1.1 to 1.8 kgf m).
13. Position a 0.025 in (0.635 mm) feeler gauge between the screw and the servo plunger.
14. Tighten the adjusting screw to 10 lbf in (0.115 kgf m) and remove the feeler gauge. Check that the spring arm is correctly engaged in the plate slot.
15. Refit the oil pan.
16. Refill the gearbox with Automatic Transmission Fluid and check the level.



FRONT SERVO

— Overhaul

Dismantling

1. Remove the front servo.
2. Remove the snap-ring.
3. Remove the piston sleeve, piston and spring.
4. Remove the piston from the sleeve.
5. Press out the lever pivot pin from the body and remove the lever.

Inspecting

6. Check the 'O' rings and oil sealing rings for signs of deterioration or damage; renew the rings as necessary.

7. Examine the piston, sleeve and body for cracks, scratches and wear.

Reassembling

8. Reverse the procedure in 1 to 5, noting:
 - a. Lubricate components before assembling.
 - b. Ensure that the piston and lever move freely.

REAR SERVO

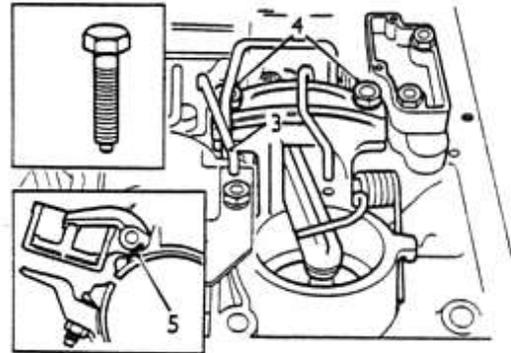
– Remove and refit

Removing

1. Drain the gearbox.
2. Remove the oil pan.
3. Remove the rear servo and rear clutch apply oil pipes, and the front servo apply pipe.
4. Remove the two bolts with spring washers and take out the rear servo. The front bolt is dowelled and also locates the centre support.
5. Extract the brake band strut.

Refitting

6. Locate the strut on the rear servo lever.
7. Position the rear servo, locating the strut into the rear brake band, and tighten the bolts to 13 to 18 lbf ft (1.8 to 3.7 kgf m).
8. Adjust the rear brake band.
9. Refit the oil pipes.
10. Refit the oil pan, tightening the bolts to 9 to 12 lbf ft (1.2 to 1.6 kgf m).
11. Refill the gearbox with Automatic Transmission Fluid and check the level.

**REAR SERVO**

– Overhaul

Dismantling

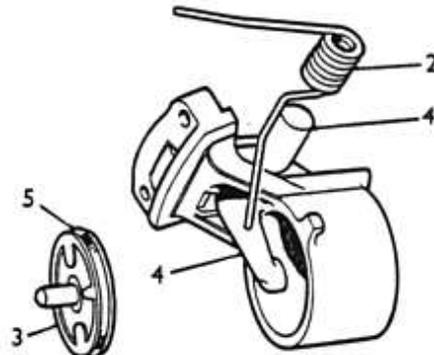
1. Remove the rear servo.
2. Disengage and release the return spring.
3. Withdraw the piston assembly.
4. Press the lever pivot pin from the body and remove the lever.

Inspection

5. Check the 'O' ring for signs of deterioration or damage; renew the ring if necessary.
6. Check the piston and bore for cracks, scratches and wear.

Reassembling

7. Reverse procedure in 1 to 4 noting:
 - a. Lubricate components before assembling.
 - b. Ensure the piston and lever move freely.



GEARBOX—AUTOMATIC



OUTPUT SHAFT AND RING GEAR

— Remove and refit

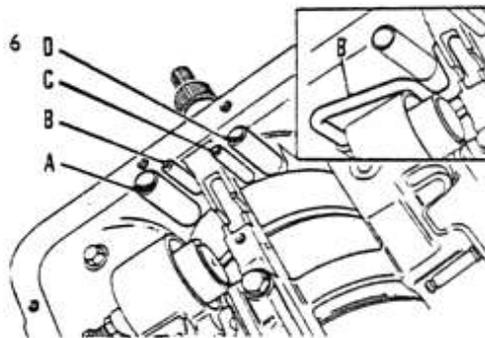
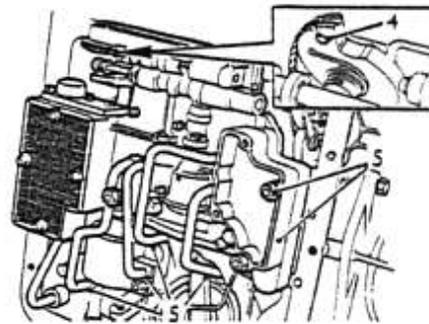
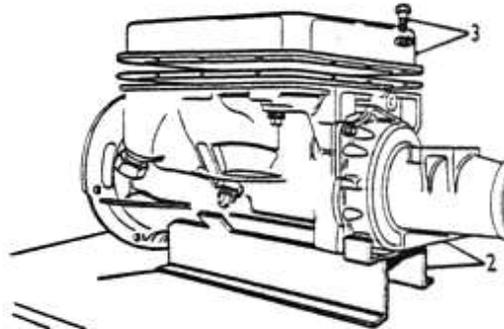
Service Tools

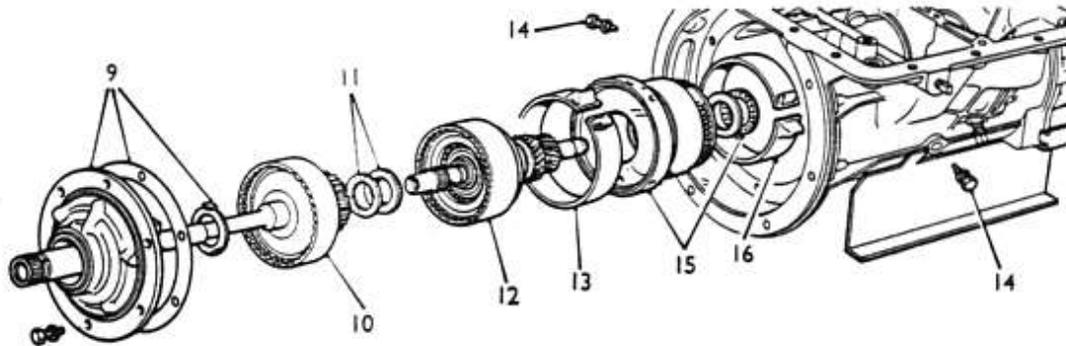
CBW 35B, 18G 1205, 18G2

Removing

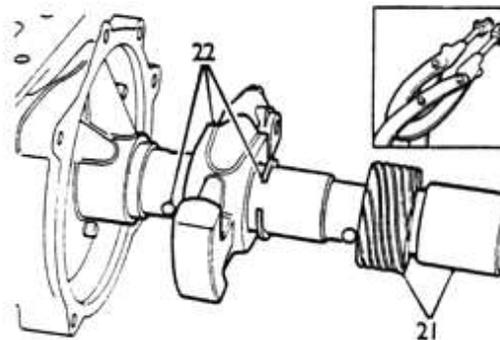
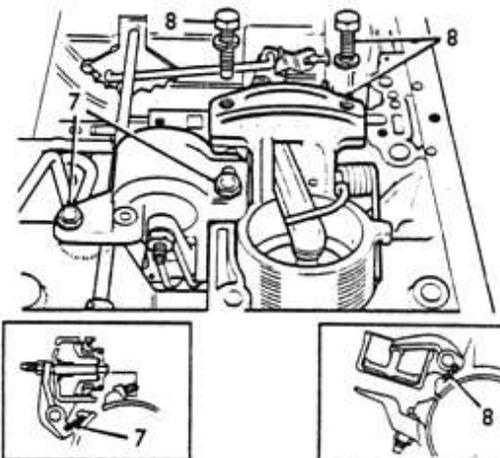
1. Remove the gearbox.
2. Clean the exterior casing with paraffin, invert the unit and place on tool CBW 35B.
3. Remove the oil pan and joint washer.
4. Release the downshift inner cable from the downshift cam.
5. Remove the magnet and pull out the oil tubes. Remove the three bolts with spring washers and lift off the valve block.
6. Pull out the pump and converter oil tubes.
'A' Front pump inlet 'O' ring on tube —
'B' Converter outlet
'C' Converter inlet
'D' Front pump outlet

continued.

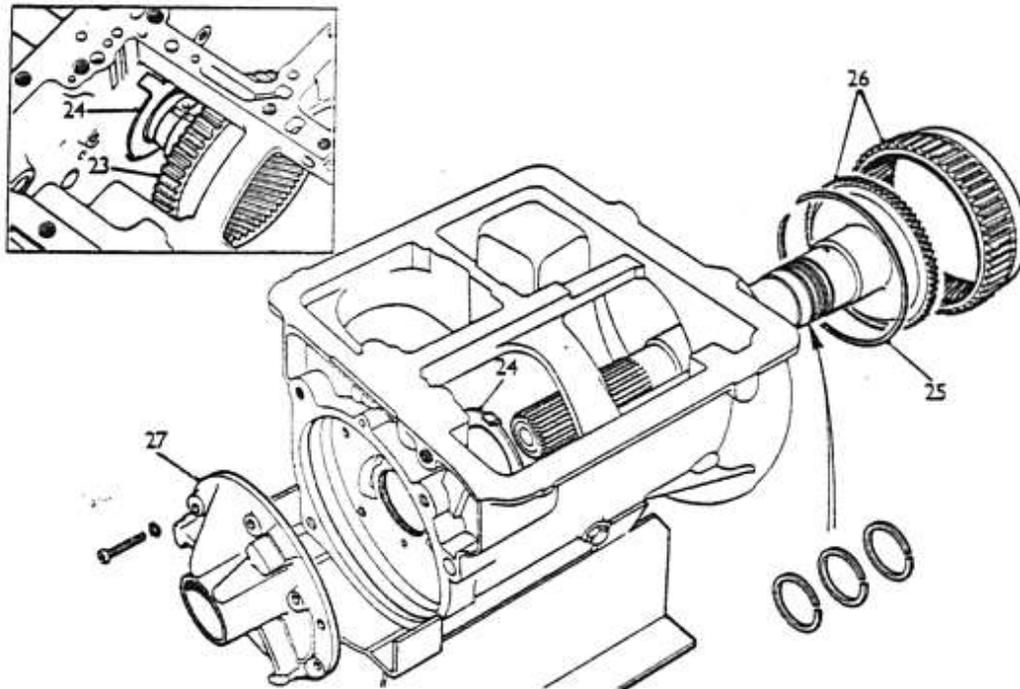




7. Remove the two bolts with spring washers and take out the front servo and extract the front brake band strut.
8. Remove the two bolts with spring washers and take out the rear servo and extract the rear brake band strut.
Front bolt securing the rear servo – dowelled bolt which also locates the centre support.
9. Remove the front pump and input shaft thrust washer.
10. Remove the input shaft and front clutch assembly.
11. Remove the bronze and steel thrust washers.
12. Withdraw the rear clutch and forward sun gear assembly.
13. Squeeze the ends of the front brake band together and remove it from the casing.
14. Take out the two centre support bolts with lock washers.
15. Withdraw the centre support and planet gear assembly with its needle thrust washer from the casing.
16. Squeeze the ends of the rear brake band together and remove it from the casing.
17. Remove the speedometer drive pinion.
18. Using 18G 1205 to hold the output shaft flange, remove the locknut and plain washer.
19. Pull the flange from the output shaft, using 18G2.
20. Remove the screws with spring washers securing the rear extension to the gearbox case and withdraw the rear extension.
21. Withdraw the distance tube and speedometer drive gear; retrieve the drive ball.
22. Remove the circlip retaining the governor and withdraw the governor assembly, retrieve the drive ball.



continued



23. Withdraw the output shaft and ring gear assembly, taking care not to damage the surface of the rear support bearing in the casing.
24. Remove the output shaft thrust washer.
25. Remove the snap-ring.
26. Withdraw the output shaft from the ring gear.
27. Remove the adaptor plate, secured to the gearbox casing by five screws with spring washers.

Refitting

28. Fit the output shaft to the annulus and secure with the snap-ring.
29. Fit new oil sealing rings.
30. Using petroleum jelly, stick the output shaft thrust washer in position with its tabs against the casing so that one tab is at the top (with gearbox inverted).
31. Install the output shaft assembly.
32. Locate the adaptor plate on the rear of the unit.
33. Place the rear band in the casing and locate it in the correct position.
34. Retain the needle thrust washer, backing plate to carrier, using petroleum jelly.
35. Install the centre support and planet gear carrier assembly, ensuring that the oil feed holes are uppermost (with gearbox inverted) and the locating holes are aligned with those in casing.
36. Fit and tighten the two locating bolts with washers to 10 to 15 lbf ft (1.4 to 2.5 kgf m). The washers act as a seal and must be fitted with their flat faces against the casing.
37. Reverse procedure in 1 to 20, noting:
 - a. Retain thrust washers using petroleum jelly.
 - b. Use a new joint washer and tighten the front pump bolts to 9 to 12 lbf ft (1.1 to 1.6 kgf m).
 - c. Tighten the rear servo bolts to 13 to 18 lbf ft (1.8 to 3.7 kgf m).
 - d. Tighten the front servo bolts to 9 to 12 lbf ft (1.1 to 1.8 kgf m).
 - e. Adjust the front and rear brake bands.
 - f. Ensure the governor is fitted with its cover-plate away from the gearbox.
38. Refill the gearbox with Automatic Transmission Fluid and check the level.

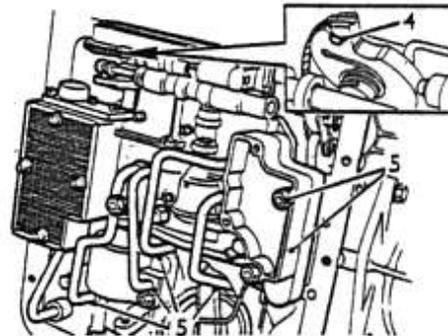
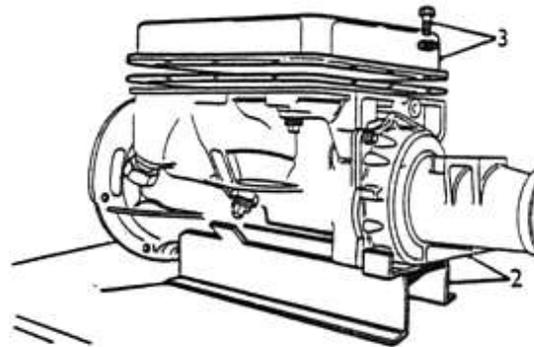
PLANET GEARS AND CENTRE SUPPORT

- Remove and refit 1 to 16, 25 to 28
- Overhaul 1 to 28

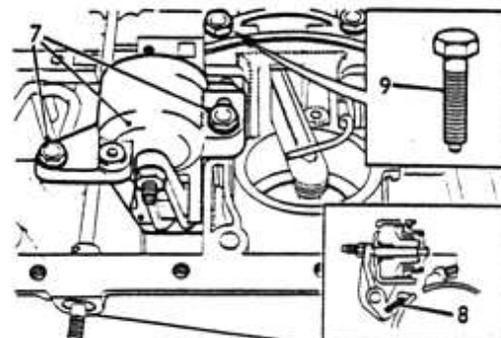
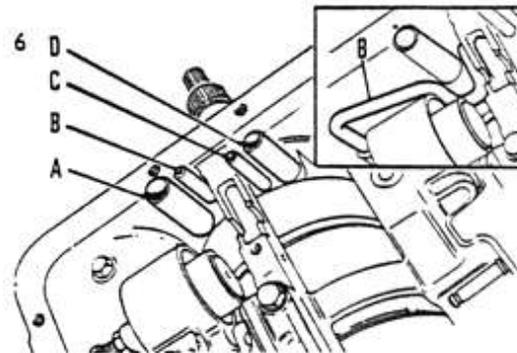
Service Tool
CBW 35B

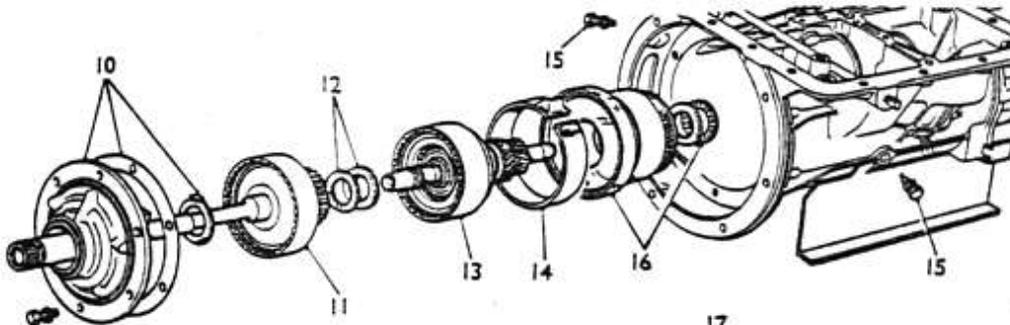
Removing

1. Remove the gearbox.
2. Clean the exterior casing with paraffin, invert the unit and place on tool CBW 35B.
3. Remove the oil pan and joint washer.
4. Release the downshift inner cable from the downshift cam.
5. Remove the magnet and pull out the oil tubes. Remove the three bolts with spring washers and lift off the valve block.
6. Pull out the pump and converter oil tubes.
 - 'A' Front pump inlet 'O' ring on tube
 - 'B' Converter outlet
 - 'C' Converter inlet
 - 'D' Front pump outlet
7. Remove the two bolts with spring washers and take out the front servo.
8. Extract the front band strut.
9. Remove the front bolt securing the rear servo - doweled bolt which also locates the centre support.

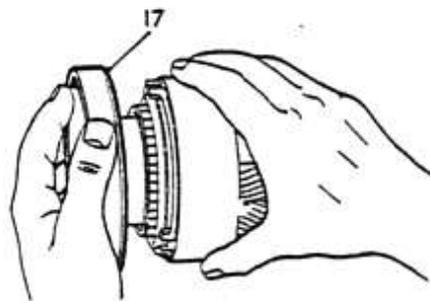


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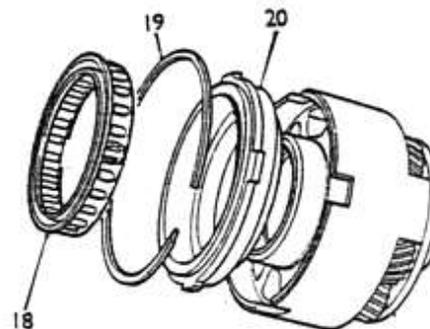


10. Remove the front pump and input shaft thrust washer.
11. Remove the input shaft and front clutch assembly.
12. Remove the bronze and steel thrust washers.
13. Withdraw the rear clutch and forward sun gear assembly.
14. Squeeze the ends of the front brake band together and remove it from the casing.
15. Take out the two centre support bolts with lock washers.
16. Withdraw the centre support and planet gear assembly with its needle thrust washer from the casing.
17. Separate the centre support from the planet gear carrier; turn the support to relax the one-way clutch.
18. Withdraw the one-way clutch.
19. Lever out the circlip.
20. Remove the one-way clutch outer race.



Inspecting

21. Check the gears for worn or damaged teeth; check the fit of the gear carrier pins.
22. Check the condition of one-way clutch.



Refitting

23. Locate the outer race in the planet gear carrier with the circlip and install the one-way clutch with its lips facing outwards.
24. Assemble the centre support and the planet gear carrier (with centre support facing you and held stationary, planet gear carrier should rotate in clockwise direction only).
25. Retain the needle thrust washer, backing plate to carrier, using petroleum jelly.
26. Install the centre support and planet gear carrier assembly, ensuring that the oil feed holes are uppermost (with gearbox inverted) and the locating holes are aligned with those in the casing.

27. Fit and tighten the two locating bolts with washers to 10 to 15 lbf ft (1.4 to 2.5 kgf m). The washers act as a seal and must be fitted with their flat faces against the casing.
28. Reverse procedure in 1 to 14, noting:
 - a. Retain thrust washers using petroleum jelly.
 - b. Use a new joint washer and tighten the front pump bolts to 9 to 12 lbf ft (1.1 to 2.6 kgf m).
 - c. Tighten the rear servo bolts to 13 to 18 lbf ft (1.8 to 3.7 kgf m).
 - d. Tighten the front servo bolts to 9 to 12 lbf ft (1.1 to 1.8 kgf m).
 - e. Adjust the front and rear brake bands.
 - f. Refill the gearbox with Automatic Transmission Fluid and check the level.

INPUT SHAFT

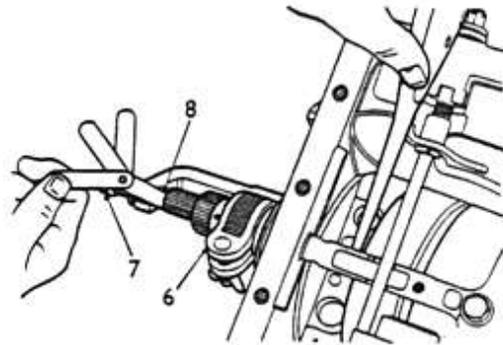
– End-float check

Service Tools

CBW 35B, CBW 87

Checking

1. Remove the gearbox.
2. Clean the exterior casing with paraffin, invert the unit and place on tool CBW 35B.
3. Remove the oil pan and joint washer.
4. Release the downshift inner cable from the downshift cam.
5. Remove the magnet and pull out the oil tubes. Remove the three bolts with spring washers and lift off the valve block.
6. Clamp CBW 87 to the converter support shaft.
7. Gently lever the gear train forward and adjust the screw of the tool until it just contacts the end of the input shaft.
8. Lever the clutch back, using light pressure, and measure the gap produced between the tool and the end of the shaft. (See Data).
Remove the tool.
Fit new thrust washers if the end-float is excessive.

**Refitting**

9. Reverse procedure 1 to 5, noting:
 - a. Use a new joint washer and tighten the oil pan bolts to 9 to 12 lbf ft (1.2 to 1.6 kgf m).
 - b. Refill the gearbox with Automatic Transmission Fluid and check the level.

DATA

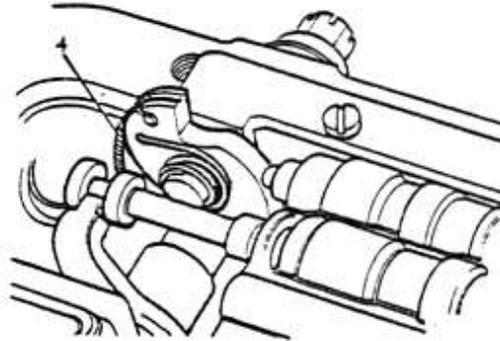
Input shaft: End-float	.. .. .	0-010 to 0-030 in (0-25 to 0-75 mm)
Thrust washer thickness	.. .. .	0-061 to 0-063 in (1-97 to 2-03 mm)

****VALVE BODY ASSEMBLY****

– Remove and refit

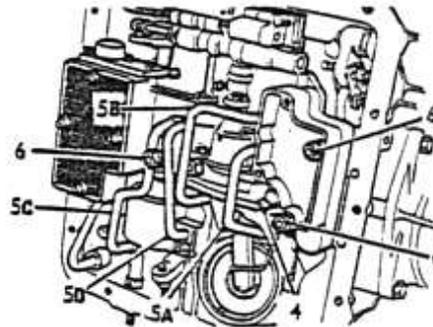
Removing

1. Drain the gearbox.
2. Remove the oil pan.
3. Remove the magnet attached to one of the bolt heads.
4. Release the down-shift inner cable from the down-shift cam.
5. Pull out the oil connector pipes.
 'A' Rear servo 'C' Front servo release
 'B' Rear clutch 'D' Front servo apply
6. Remove the three bolts with spring washers.
7. Remove the valve block assembly.



Refitting

8. Reverse procedures 1 to 7, noting:
 - a. Ensure the oil pipes are pushed fully into place.
 - b. Use a new gasket and tighten the oil pan bolts to 9 to 12 lbf ft (1.2 to 1.6 kgf m).
 - c. Refill the gearbox.



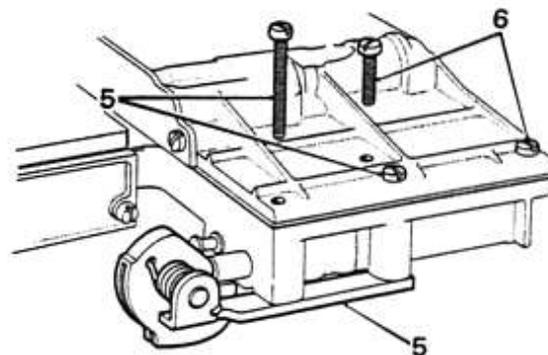
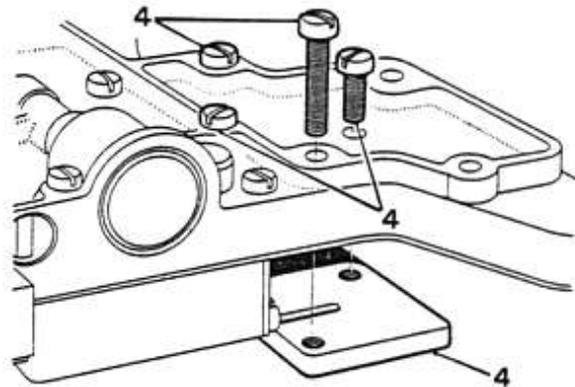
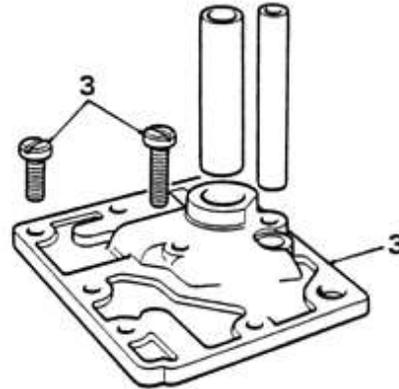
VALVE BODY ASSEMBLY

- Overhaul

Dismantling

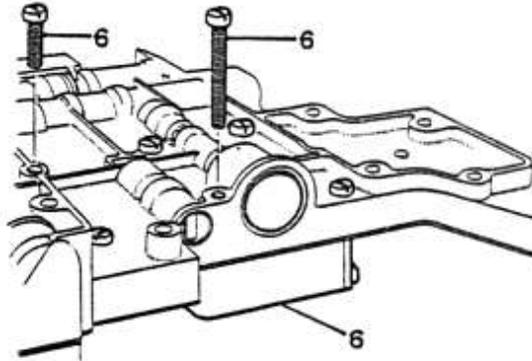
1. Remove the valve body assembly.
2. Carry out air pressure checks and rectify faults.
3. Place a sheet of clean paper over the bench.
Remove the six short and two long screws retaining the oil tube plate to the separating plate.
4. Remove the two short and two long screws retaining the governor line plate.
5. Remove the two long screws retaining the down-shift cam assembly.

Continued

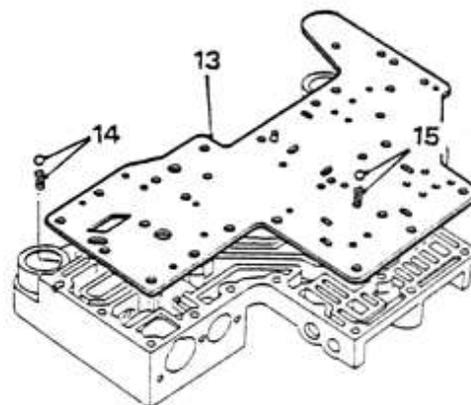
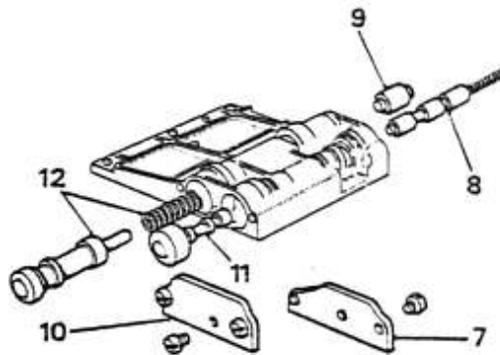


Upper Valve Body

6. Remove the two short screws and six short screws, one 1-4 in (35 mm) long retaining upper valve body assembly.
7. Remove the front end plate.
8. Withdraw the 1-2 shift valve spring and plunger.
9. Withdraw the 2-3 shift valve plunger.
10. Remove the rear end plate.
11. Withdraw the 1-2 shift valve.
12. Withdraw the 2-3 shift valve and spring.
13. Remove the separating plate.
14. Remove converter nylon outlet ball and spring.
15. Remove the 3-2 shift restrictor steel ball and spring.

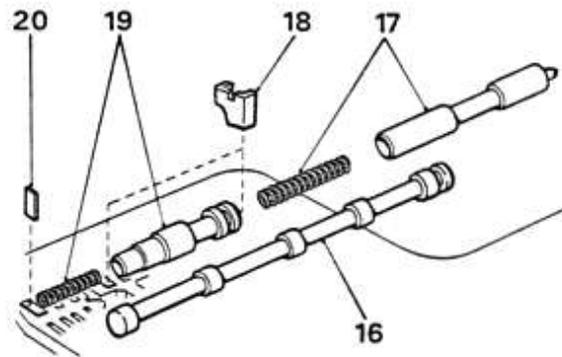


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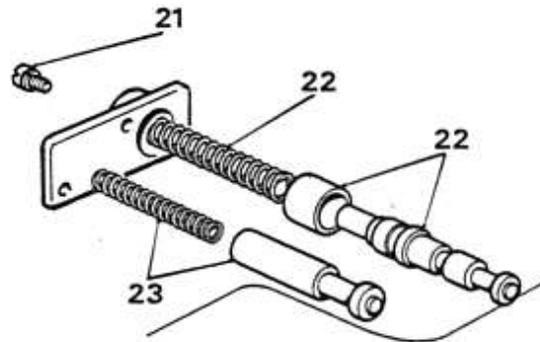


Lower Valve Body

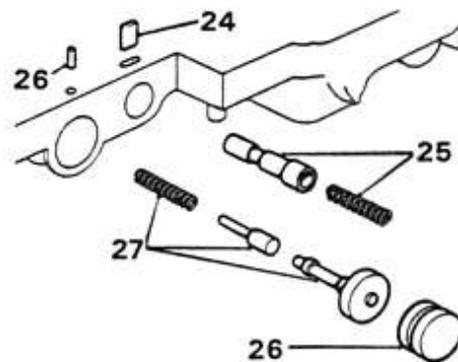
16. Remove the manual control valve.
17. Remove the down-shift valve and spring.
18. Withdraw the stop plate for the throttle valve.
19. Remove the throttle valve and spring.
20. Withdraw the retainer for the throttle valve spring.
21. Remove the end plate from the lower body, releasing the screws progressively.
22. Withdraw the spring, sleeve and primary regulator valve.
23. Withdraw the spring and secondary regulator valve.
24. Withdraw the stop for the servo orifice control valve.
25. Remove the spring and servo orifice control valve.
26. Withdraw the dowel pin and retainer for the modulator valve.
27. Remove the modulator valve, plug and spring.


Inspecting

28. Clean all parts in cleaning solvent; dry by blowing with air.
29. Check all fluid passages for obstructions. Inspect valves, bores, mating surfaces for burrs or scoring.
30. Check the springs.


Assembling

31. Lubricate all components in clean Automatic Transmission Fluid.
32. Reverse the procedure in 1 to 27, verifying that all valves move freely in their bores. Tighten all screws evenly to 1.7 to 2.5 lbf ft (0.23 to 0.35 kgf m).



TORQUE SPECIFICATION CHART

APPLICATION	DESCRIPTION	LBS. FT	LBS. INS.
Converter to Drive Plate	3/8-24 UNF	25-30	300-360
Extension to Case	5/16-18 UNC 2A x 1	9-12	108-144
Trans. Case to Conv. Hsng	5/16-18 UNC 2A x 7/8	9-12	108-144
Oil Pan to Case	5/16-18 UNC 2A x 5/8	9-12	108-144
Front Servo to Case	5/16-18 UNC 2A x 1	9-12	108-144
	5/16-18 UNC 2A x 1.3/8	9-12	108-144
Rear Servo to Case	3/8-16 UNC 2A x 1.1/2	13-18	156-216
	3/8-16 NC 3	13-18	156-216
Pump Adaptor to F/p Hsng	10-24 UNC 2A x 5/8	2-3	24-36
	5/16-18 UNC 2A x 7/8	17-22	204-264
Pump Adaptor to Trans Case	5/16-18 UNC 2A x 7/8	9-12	108-144
Rear Pump to Case	1/4-20 UNC 2A x 1.1/8	5-8	60-96
	10-24 UNC 2A x 1.1/8	2-3.5	24-42
Manual Shaft Locknut	5/16-24 UNF 2B	7-9	84-108
Pressure point on Case	1/8-27 Dryseal NPTF	4-5	48-60
Oil Pan Drain Plug	3/8-24 x 3/8	9-12	108-144
Upper Valve Body/Lower Valve Body	10-24 UNC 2A x 5/8	1.7-2.5	20-30
Lower Valve Body/Upper Valve Body	10-24 UNC 2A x 15/16	1.7-2.5	20-30
Lower Valve Body/Upper Valve Body	10-24 UNC 2A x 1.3/8	1.7-2.5	20-30
Lower Valve Body/Lower Valve Body	10-24 UNC 2A x 15/16	1.7-2.5	20-30
Oil Screen & Lower V/B Lower V/B (202)	10-24 UNC 2A x 2	1.7-2.5	20-30
Front Oil Screen/Lower Valve Body	10-24 UNC 2A x 3/8	1.7-2.5	20-30
Oil Tube Plate/Lower Valve Body	10-24 UNC 2A x 5/8	1.7-2.5	20-30
	10-24 UNC 2A x 15/16	1.7-2.5	20-30
End Plate (238)/Lower Valve Body	10-24 UNC 2A x 5/8	1.7-2.5	20-30
End Plate (232)/Upper Valve Body	10-24 UNC 2A x 3/8	1.7-2.5	20-30
End Plate (231)/Upper Valve Body	10-24 UNC 2A x 3/8	1.7-2.5	20-30
Lower Valve Body/Case	1/4-20 UNC 2A x 1.1/4	5-8	60-96
Rear Oil Screen & Lower Valve Body/Case	1/4-20 UNC 2A x 2	5-8	60-96
Lower Valve Body/Cam Bracket	10-24 UNF 2A x 1.7/16	1.7-3.5	20-42
Gov. Inspection Cover to Extension Hsng	1/4-20 UNC 2A x 1/2	4-5	48-60
Governor Cover Plate to Governor Valve Body	10-24 UNC 2A x 3/8	1.7-4.0	20-48
Front Servo Adj. Screw Locknut	3/8-16 UNC 2B	15-20	180-240
Rear Servo Adj. Screw Locknut	9/16-12 UNC 2A	30-40	360-480
Starter Inhibitor Locknut	7/16-14 UNC 2B	4-6	48-72
Downshift Valve Cable Adaptor	1/2-13 UNC 2A	8-9	96-108
Filler Tube Sleeve to Case	1/2 B.S.I.	25-30	300-360
Filler Tube to Sleeve	1.1/16-16 UNS	17-18	204-216
Stoneguard to Converter Housing	8 speed screw 1/2 long	1.4-1.6	16.8-19.2
Coupling Flange to Driven Shaft	3/8-24 UNF 2A (wedglok)	20-25	240-300
Extension Housing to Trans. Case	7/16-14 x 1.3/8	40-50	480-600
Screw-Coupling Flange	1/2-20 x 1.1/4	40-50	480-600
Nut - Coupling Flange	3/4-16 UNF	55-60	660-720
Nut - Coupling Flange	16 M/M x 1 M/M	55-60	660-720
Connector Oil Cooler	1/4-18 Dryseal	12-15	144-180
Nut - Connector	1/2-24 UNS	10-12	120-144
Centre Support to Case	3/8-16 NC.3	10-15	120-180
Bolt - Governor Retaining	M24 MM x 2 MM pitch	15-18	180-216
Support Strap LH & RH to Maincase Centre			
Support Stud	3/8-16 UNC 2B	13-18	156-216
Support Strap LH & RH to Converter Hsng	3/8-16 UNC 2B x 3/4	25-30	300-360
Oil pan to conv. hsg.	3/8-16 UNC 2A x 2.1/4	13-18	156-216
Nut - Coupling Flange	5/8 UNC Nyloc	55-60	660-720
Starter Inhibitor (self setting)	7/16-14 UNC 2B	6-8	72-96