PART 2

CONTENTS

THE TORQUE	CONV	/ERT	ER CO	OUP	LING									Page
—Characteristi	cs							 						2
—Description								 						2
—Operation								 						3
MECHANICAL I	DOW/	. D E	WO											4
				•••		•••		 					•••	4
					•••	•••		 	• • • •				•••	7
				•••		•••	•••	 						7
		• • • •		•••		•••		 			•••			7
—One-way clut								 					•••	9
—Power-flow—								 						
			rive sel					 						11
			.ock-up	or D	rive se	lected)		 			•••	•••		13
	-3rd ge							 						15
	-Neutr		d Park					 						17
	-Rever							 						19
- ,, ,, -	-Planet	ary g	earing-	-num	ber of	teeth		 						20
THE HYDRAUL	IC SY	CTE	м											20
			M		•••			 	•••					20
—Front pump						1000		 	•••					20
								 						20
	•••			•••				 •••					••••	21
—Control syste				•••				 	•••	•••				
—Control system		eratio	n	•••		•••		 	•••				•••	23
—Operation in		•••					•••	 						25
	P							 						27
	R			•••		•••		 						29
- " "	DI				•••	0.01125		 				• • • • •		31
	D2							 						33
	D3		•••					 						35
— " "	L1							 						37
—Valve body a	assembl	y						 						39
—Primary	regula	tor v	alve					 						39
—Seconda	ry regu	ulator	valve					 						39
—Downsh	ift valv	e and	thrott	le val	ve			 						39
—Modulat	or plus	g and	valve					 						40
—Servo o								 						40
—1-2 shift								 						40
—2-3 shift								 						40
—Manual								 						41
—Table of hyd								 						42

Page 2

THE TORQUE CONVERTER COUPLING

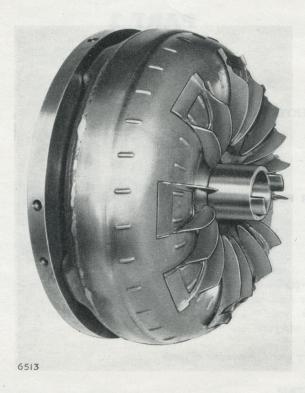


Fig. 1. Torque converter rear view

CHARACTERISTICS

The use of a hydraulic converter in conjunction with a three speed automatic gearbox provides a means of obtaining a smooth application of engine power to the driving wheels and additional engine torque multiplication to the 1st and 2nd gears of the gearbox.

The converter also provides extreme low speed flexibility when the gearbox is in 3rd gear and, due to the ability of multiplying engine torque, it provides good acceleration from very low road speed without having to resort to a downshift in the gearbox.

Torque multiplication from the converter is infinitely variable between the ratios of 2:1 and 1:1. The speed range, during which torque multiplication can be achieved is also variable, depending upon the accelerator position.

DESCRIPTION (see Fig. 1)

The hydraulic torque converter used in conjunction with the model 35 automatic gearbox is of the single phase, three element type, comprising an impeller connected to the engine crankshaft, a turbine connected to the input shaft of the gearbox, and a stator mounted on a sprag type one-way clutch supported on a fixed hub projecting from the gearbox case.

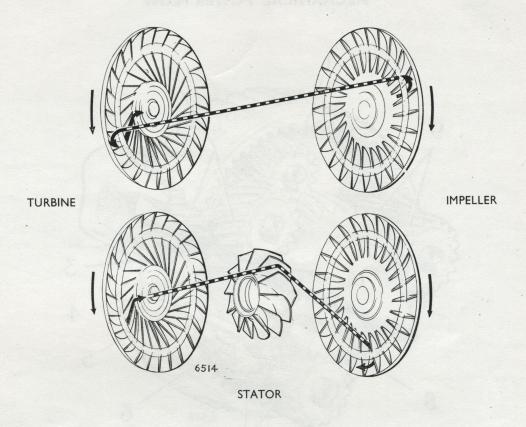


Fig. 2. Torque converter, principle of operation

OPERATION (see Fig. 2)

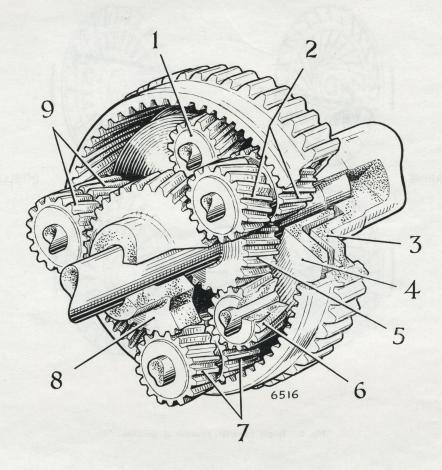
The impeller is rotated by the engine and converts the engine power into hydrokinetic energy. The fluid flows from the impeller vanes to the turbine vanes and returns to the impeller through the stator vanes.

The curvature of the various vanes is so designed that when a speed differential exists between the impeller and the turbine, the angle of the fluid flow from the turbine is changed by the stator vanes in such a way that the discharge of fluid from the stator assists in driving the impeller.

Under such conditions, torque multiplication occurs and varies from 2:1 when the turbine is stalled (i.e. when with any of the driving ranges selected, the vehicle is held stationary and the engine is operating at maximum throttle opening) to 1:1 when the turbine reaches a speed approximately 90% of the impeller.

When this speed differential between the impeller and turbine is achieved, the fluid flow angle from the turbine is such that the stator is driven in the same direction as the turbine and the impeller. Under these circumstances, the converter becomes a fluid flywheel or coupling and there is no torque multiplication.

MECHANICAL POWER FLOW



SHORT PLANET PINION (THIRD PINION NOT SHOWN)

& 9. LONG PLANET PINION

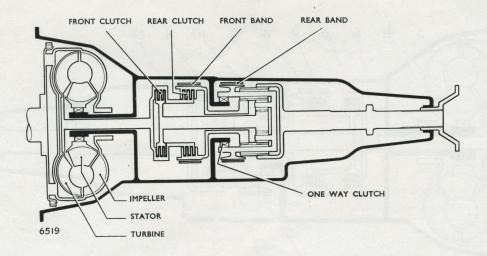
- RING GEAR (ANNULUS) AND OUTPUT SHAFT
- PLANET CARRIER
- FORWARD SUN GEAR
- REVERSE SUN GEAR

Fig. 3. Planetary set, cut away view

GEAR SET (see Figs. 3 and 5)

involute tooth forms are used throughout. Power

enters the gear set via the sun gears. In all forward The planetary gear set consists of two sun gears, two sets gears, power enters through the forward sun gear; in of pinions, a pinion carrier and a ring gear. Helical Reverse, power enters through the reverse sun gear. Power leaves the gear set by the ring gear.



SELECTOR LEVER POSITION	FRONT CLUTCH	REAR CLUTCH	FRONT BAND	REAR BAND	ONE WAY
L — LOCK-UP 1	• /			•	
D — DRIVE 1	•				• .
L or D — LOCK-UP 2 DRIVE 2	•		•		
D — DRIVE 3	•	•			
N — NEUTRAL					
R — REVERSE		•		•	
P — PARK				•	

• = APPLIED

Fig. 4. Power flow summar,

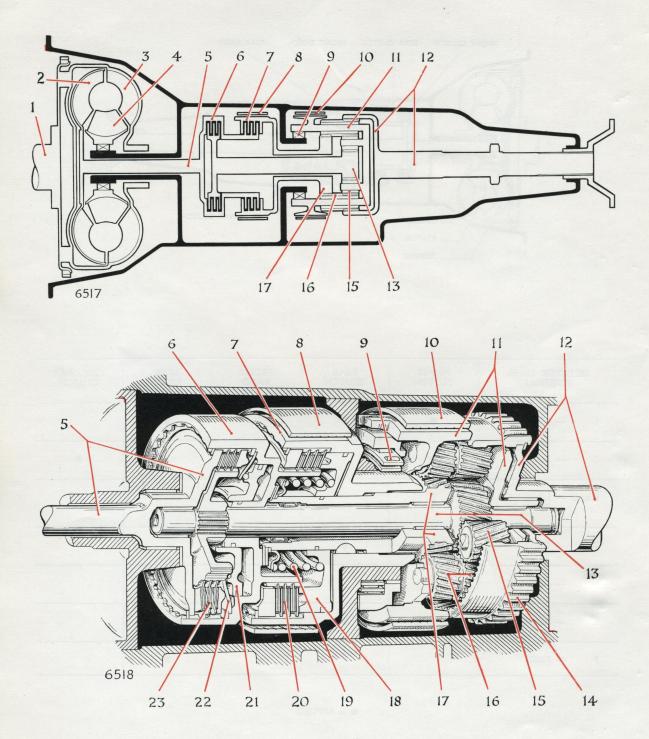


Fig. 5. Schematic view of transmission and cut away view of clutches and planetary gears

Part 2

Key to Fig. 5 Schematic view of transmission and cut away view of clutches and planetary gears

- 1. ENGINE CRANKSHAFT
- 2. TURBINE
- 3. IMPELLOR TORQUE CONVERTER
- 4 STATOR
- 5. INPUT SHAFT
- 6. FRONT CLUTCH
- 7. REAR CLUTCH
- 8. FRONT BRAKE BAND
- 9. ONE-WAY CLUTCH (SPRAG TYPE)
- 10. REAR BRAKE BAND
- 11. PLANET PINION CARRIER
- 12. RING GEAR (ANNULUS) AND OUTPUT SHAFT
- 13. FORWARD SUN GEAR AND SHAFT
- 14. PARKING PAWL TEETH
- 15. SHORT PLANET PINION
- 16. LONG PLANET PINION
- 17. REVERSE SUN GEAR
- 18. REAR CLUTCH OPERATING PISTON
- 19. REAR CLUTCH PISTON RETURN SPRING
- 20. REAR CLUTCH PLATES
- 21. FRONT CLUTCH OPERATING PISTON
- 22. FRONT CLUTCH PISTON RETURN SPRING (DISC TYPE)
- 23. FRONT CLUTCH PLATES

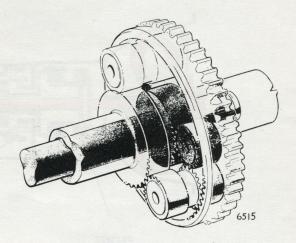


Fig. 6. Meshing of pinions

The pinions are used to transmit power from the sun gears to the ring gear. In Reverse, a single set of pinions is used, which causes the ring gear to rotate in the opposite direction to the sun gear. In forward gears, a double set of pinions is used to cause the ring gear to rotate in the same direction as the sun gear.

The carrier locates the pinions in their proper positions relative to the two sun gears and the ring gear (and also forms a reaction member for certain conditions).

The various mechanical ratios of the gear set are obtained by the engagement of hydraulically operated multi-disc clutches and brake bands. A detailed illustration of the transmission is given in Fig. 5, and a schematic explanation of the mechanical operation in Fig. 4.

CLUTCHES

Multi-disc clutches operated by hydraulic pistons connect the converter to the gear set. In all forward gears the

front clutch connects the converter to the forward sun gear; for Reverse, the rear clutch connects the converter to the reverse sun gear.

BANDS

Brake bands, operated by hydraulic servos, hold elements of the gear set stationary to effect an output speed reduction and a torque increase. In first gear of Lock-up the rear band holds the pinion carrier stationary and provides the 1st gear ratio of 2.39:1 and, in Reverse, a ratio of 2.09:1. The front band holds the reverse sun gear stationary to provide the 2nd gear ratio of 1.45:1.

ONE-WAY CLUTCH

In Drive, a one-way clutch is used in place of the rear band to prevent the pinion carrier from turning opposite to engine rotation, thus providing the 1st gear ratio of 2·39:1. This one-way clutch, allowing the gearbox to freewheel in 1st gear, provides smooth ratio changes from 1st to 2nd and vice versa.

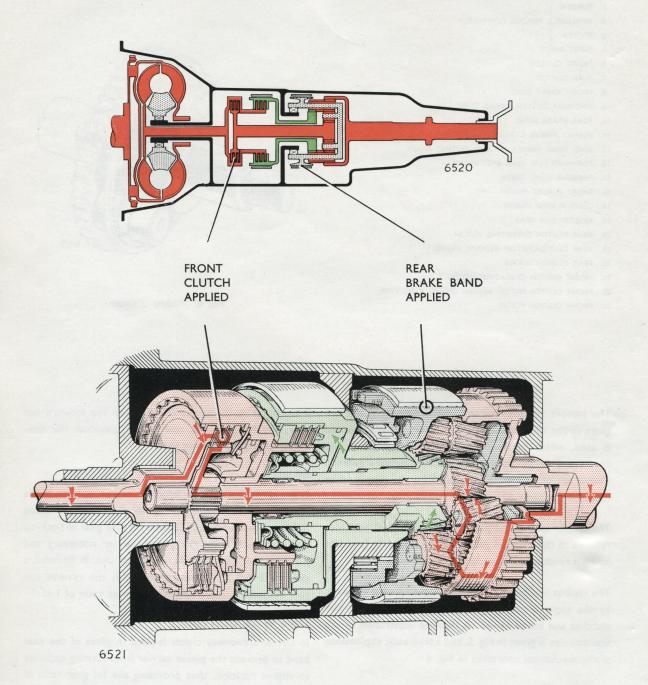


Fig. 7A. Mechanical power flow—First gear L (Lock-up) selected

1st gear (Lock-up selected) see Fig. 7

The front clutch is applied, connecting the converter to the forward sun gear.

The rear band is applied, holding the pinion carrier stationary; the gear set provides a reduction of 2.39:1.

The reverse sun gear rotates freely in the opposite direction to the forward sun gear.

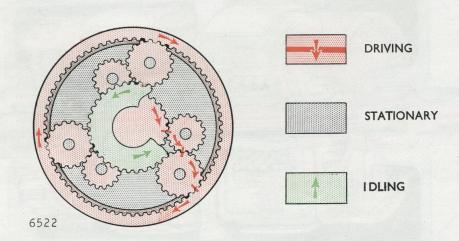


Fig. 7B. First gear L (Lock-up) selected—gear train rotation

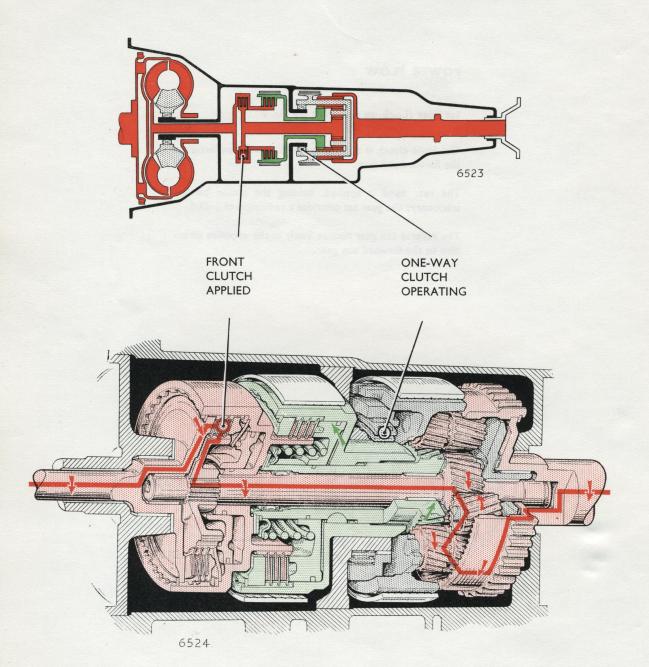


Fig. 8A. Mechanical power flow—First gear D selected

Page 11

POWER FLOW

Low

1st Gear (Drive selected) see Fig. 8

The front clutch is applied, connecting the converter to the forward sun gear.

The one-way clutch is in operation preventing the pinion carrier from turning opposite to engine rotation; the gear set provides the reduction of $2\cdot 39:1$.

On the overrun the one way clutch does not drive, and thus the gearbox freewheels.

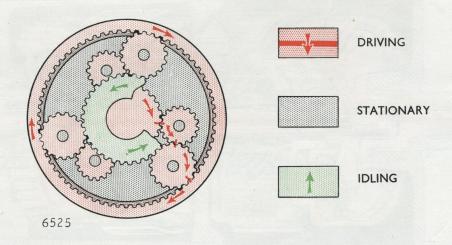


Fig. 8B. First gear D selected—gear train rotation

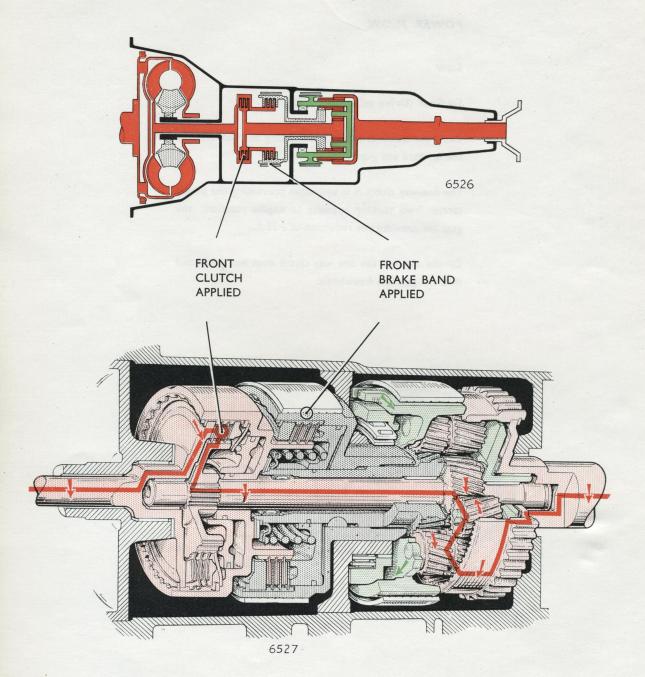


Fig. 9A. Mechanical power flow—Second gear D or L selected

Intermediate

2nd gear (Lock-up or Drive selected) see Fig. 9

The front clutch is applied, connecting the converter to the forward sun gear.

The front band is applied holding the reverse sun gear stationary; the gear set provides the reduction of 1.45:1.

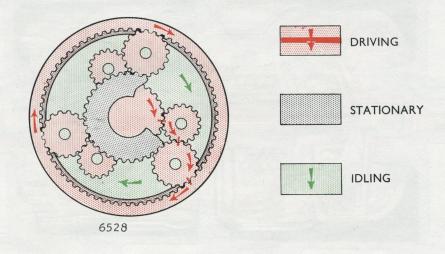


Fig. 9B. Second gear, D or L selected—gear train rotation

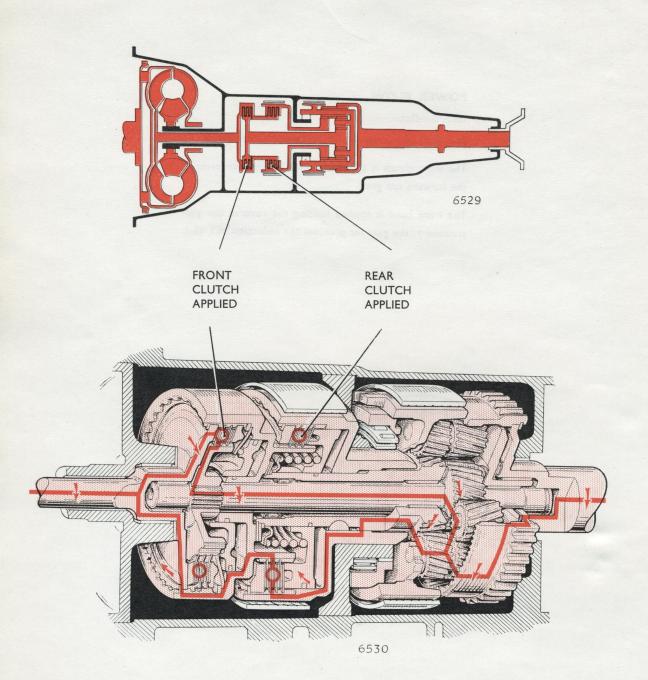


Fig. 10A. Mechanical power flow—Third gear D selected

High

3rd gear (see Fig. 10)

The front clutch is applied, connecting the converter to the forward sun gear.

The rear clutch is applied, connecting the converter also to the reverse sun gear.

Thus both sun gears are locked together and the gear set rotates as a unit providing a ratio of 1:1.

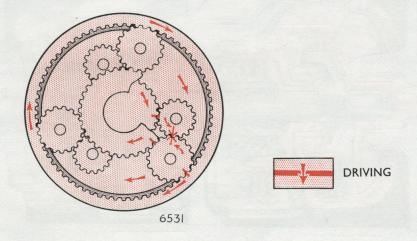
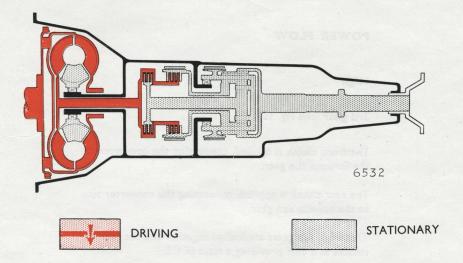


Fig. 10B. Third gear D selected—gear train rotation



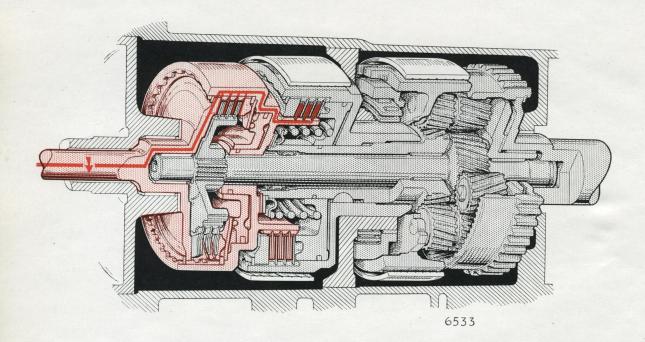


Fig. 11. Mechanical power flow—Neutral—N selected

Neutral and Park (see Fig. 11)

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 Park where for constructional reasons the rear band is applied as long as the engine is running.

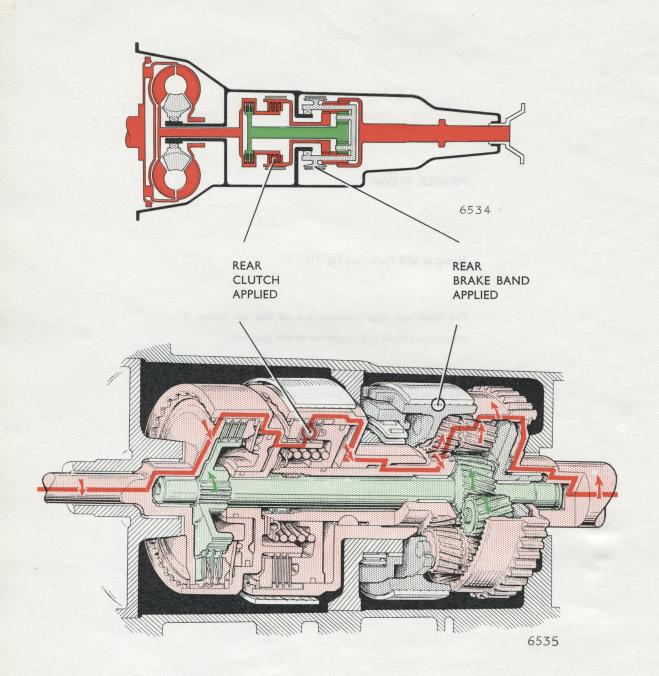


Fig. 12A. Mechanical power flow—Reverse—R selected

Page 19

POWER FLOW

Reverse (see Fig. 12)

The rear clutch is applied, connecting the converter to the reverse sun gear.

The rear band is applied, holding the pinion carrier stationary.

The gear set provides the reduction of 2.09:1 in the reverse direction.

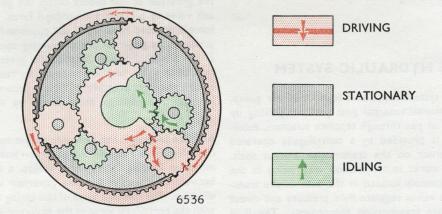
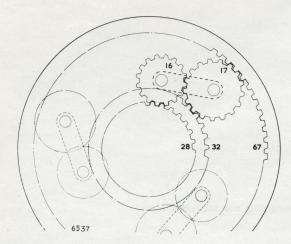


Fig. 12B. Reverse—R selected—gear train rotation



28 GEAR TEETH ON FORWARD SUN GEAR
32 GEAR TEETH ON REVERSE SUN GEAR
16 GEAR TEETH ON SHORT PLANET PINION
17 GEAR TEETH ON LONG PLANET PINION
67 GEAR TEETH ON RING GEAR (ANNULUS)

Fig. 13. Number of teeth on planetary gears

Planetary gearing

The number of teeth on the sun gears, planet gears and ring gear (annulus) is given in Fig. 13.

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. 14.

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 or pushing.

GOVERNOR (see Fig. 15 and 16)

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.

Two illustrations of the governor appear in Figs. 40 and 41 in Part 4 of this manual.

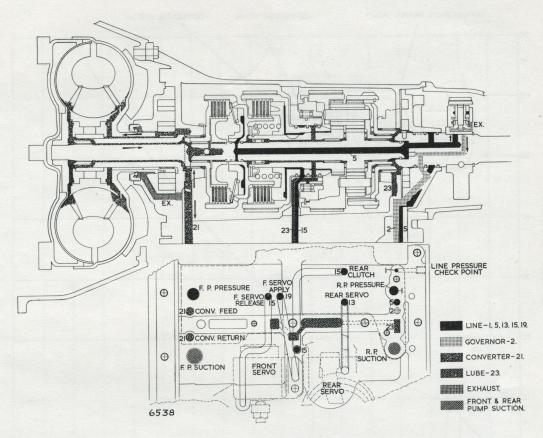


Fig. 14. fluid passages in transmission and gearbox case

CONTROL SYSTEM

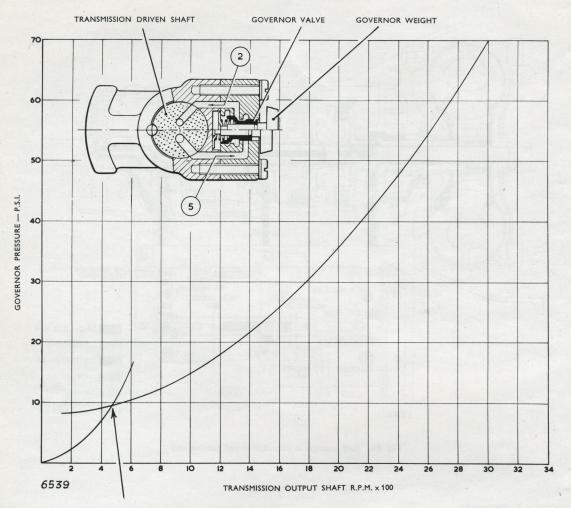
Hydraulic control of clutches, and brake bands, requires the application of correct pressures as well as correct timing. Too high a pressure will cause fierce gear changes and too low a pressure will cause transmission slip. The torque converter must be supplied with fluid at a correct pressure and fluid 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. 20 to 26. It is shown in another schematic form in Fig. 27 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 in Figs. 13 and 14 in Part 4 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 and pressures appears at the end of this section.

The control system utilises these basic types of valves known as regulating valves, shuttle valves and manual



SPRING TAKE OVER POINT

Fig. 15. Governor pressure relation to driven shaft speed

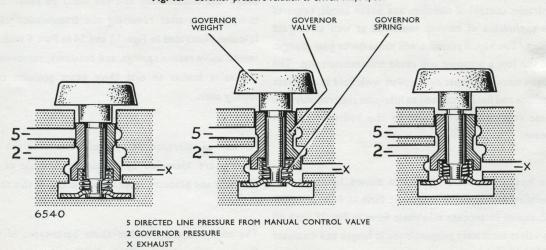
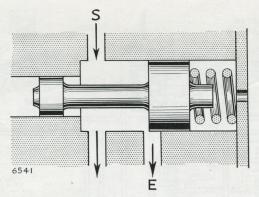
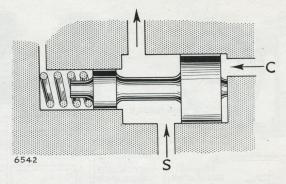


Fig. 16. Governor—phases of operation



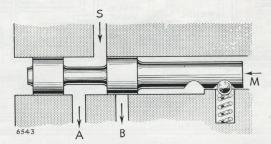
When supply pressure at S is high enough to compress piston return spring excess fluid is exhausted at E so that a steady pressure is maintained.

Fig. 17. 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. 18. 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. 19. Manual valve operating principle

valves. The principles on which these valves operate is shown in Figs. 17, 18 and 19, 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 tap.

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

Control system—operation

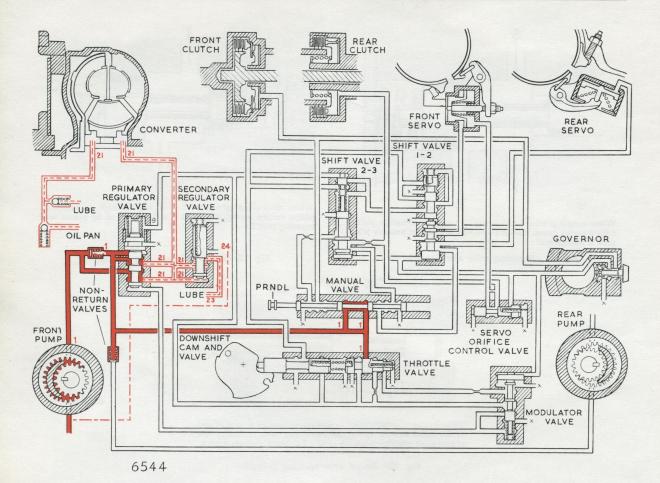
Pressure control is provided by the primary and secondary regulator valves, the former operating in conjunction with throttle valve pressure acting on the spring

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. 20 to 26.

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.



CONVERTER PRESSURE

The numbers refer to the hydraulic circuits listed on page 42.

EXHAUST

Fig. 20. Operation of hydraulic circuit in N-neutral

HYDRAULIC ACTION

IN

N - Neutral

See Figure 20 on opposite page

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.

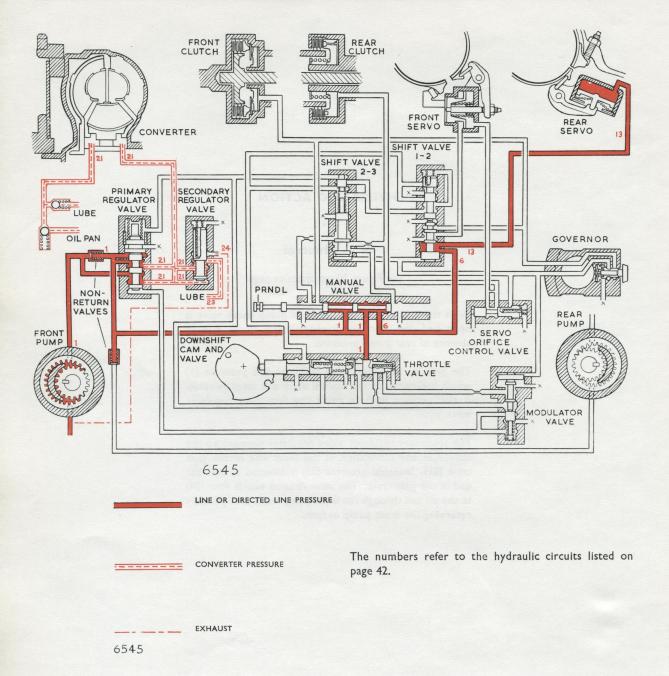


Fig. 21. Operation of hydraulic circuit in P—park

Part 2

HYDRAULIC ACTION

IN

P - Park

See Figure 21 on opposite page

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 bands serve to control both the L and P selector positions, without the rear servo or band performing any function in P.

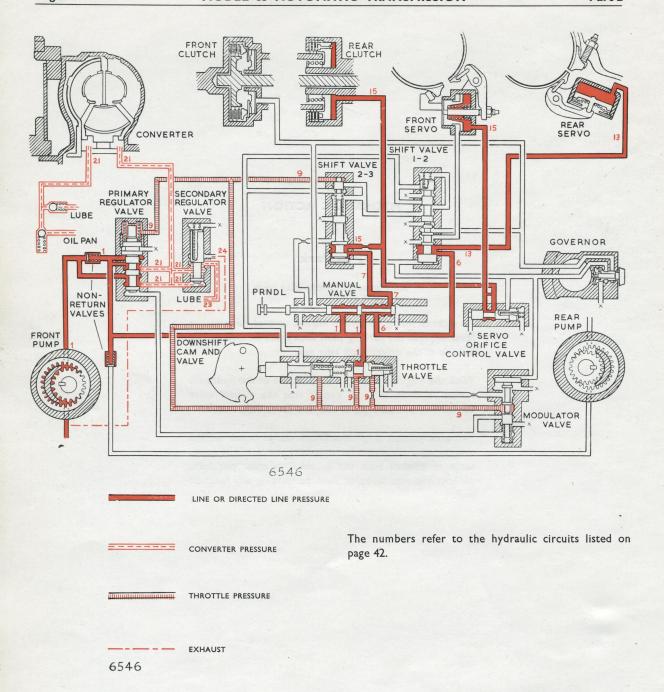


Fig. 22. Operation of hydraulic circuit in R-reverse

HYDRAULIC ACTION

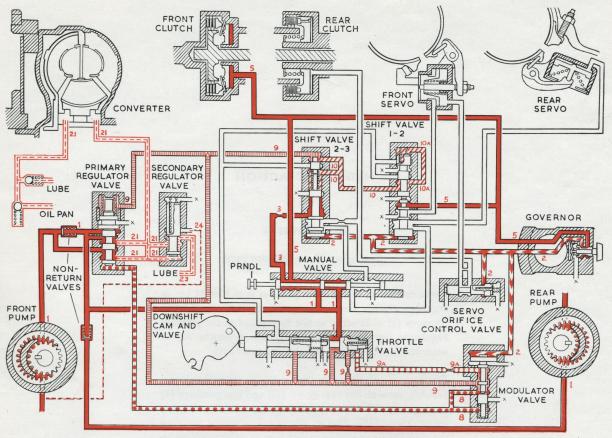
IN

R - Reverse

See Figure 22 on opposite page

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 utilised in R to simplify the hydraulic circuit.



6547 -

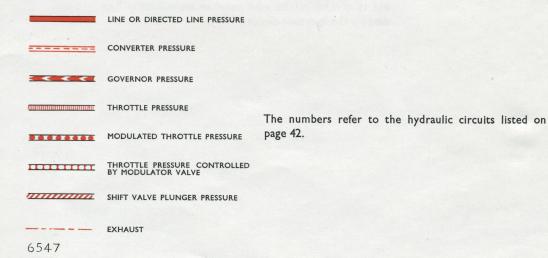


Fig. 23. Operation of hydraulic circuit in D1

HYDRAULIC ACTION

IN

D1 - Low

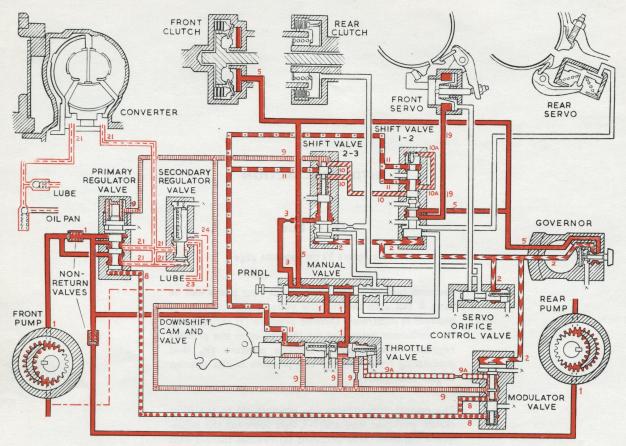
See Figure 23 on opposite page

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.





6548

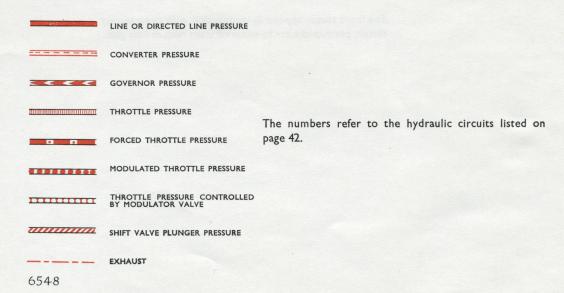


Fig. 24. Operation of hydraulic circuit in D2-intermediate

Page 33

HYDRAULIC ACTION

IN

D2-Intermediate

See Figure 24 on opposite page

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. 24 shows front pump supplying line pressure which it does at quite low road speeds.

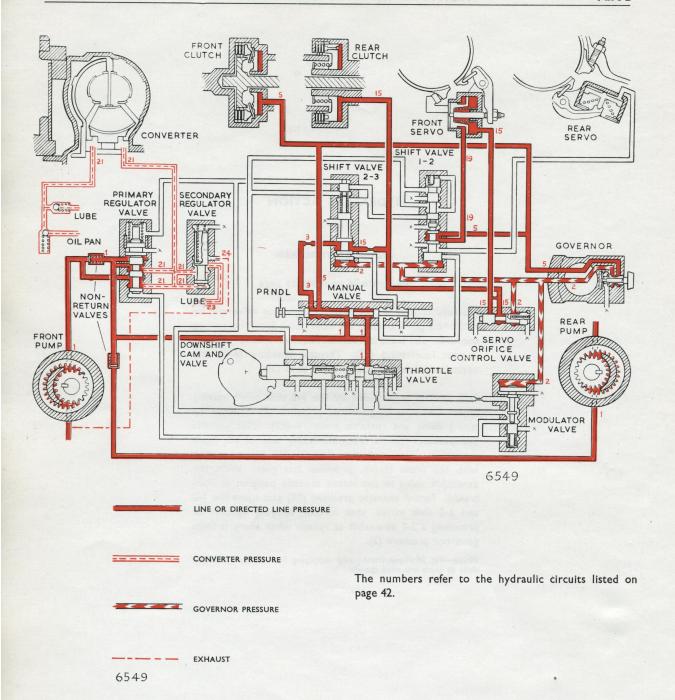


Fig. 25. Operation of hydraulic circuit in D3—High

FOR D3 — High

See Figure 25 on opposite page

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.

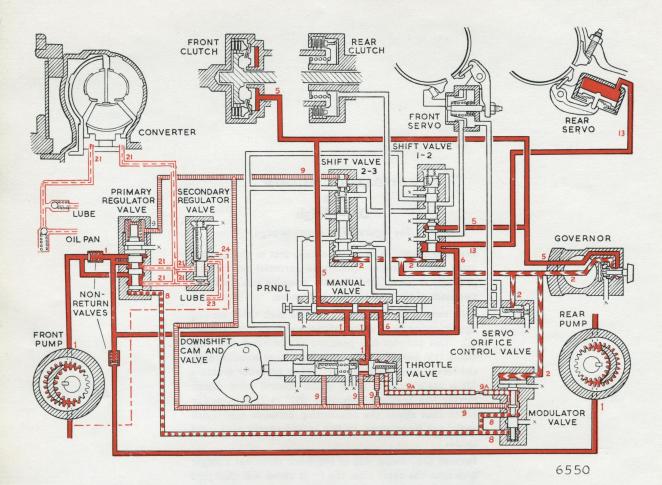
Shift control is provided by the 2-3 shift valve moving against spring force under influence of governor pressure (2). This permits line pressure (3) to reach the rear clutch (15) and the release side of the front servo through the servo orifice control valve. When governor pressure (2) is apparent, the servo orifice control valve closes, forcing line pressure through a .052" (1.32 mm) orifice which thus affects 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. 25 shows condition below this speed.

6550



CONVERTER PRESSURE

GOVERNOR PRESSURE

THROTTLE PRESSURE

MODULATED THROTTLE PRESSURE

THROTTLE PRESSURE CONTROLLED
BY MODULATOR VALVE

EXHAUST

Fig. 26. Operation of hydraulic circuit in L1—first Lock-up

HYDRAULIC ACTION

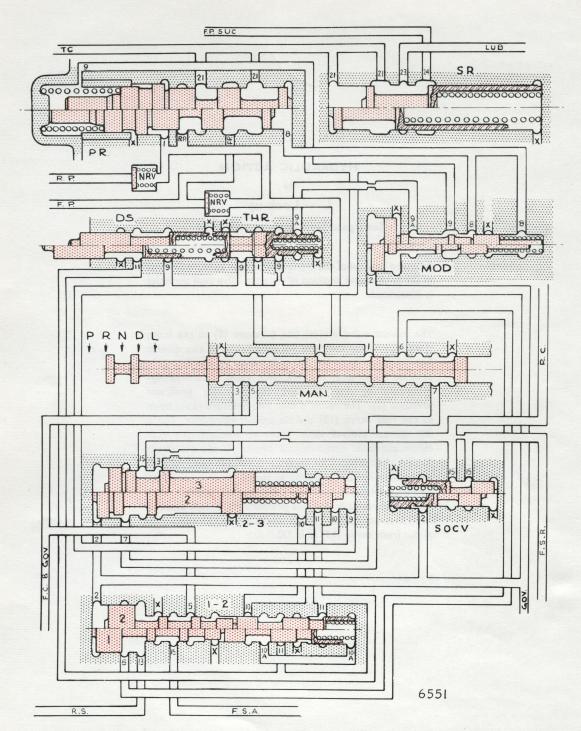
IN

L - Lock-up

See Figure 26 on opposite page for LI

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.



Note—Feed hole 1 into the Primary Regulating Valve is a restricting orifice $\cdot 040''$ (1 $\cdot 01$ mm) dia.

Fig. 27. Control system passages in valve bodies assembly—schematic

Key to Fig. 27

тс	=TO CONVERTER	P.R.N.D.L.	=SELECTOR LEVER POSITIONS, PARK—REVERSE—NEUTRAL—DRIVE—LOCK-UP
FP Suc	=FRONT PUMP SUCTION	MAN.	=MANUAL VALVE
LUB	=LUBRICATION	2—3	=2—3 SHIFT VALVE, 2nd GEAR POSITION TO LEFT, 3rd GEAR POSITION TO RIGHT
PR	=PRIMARY REGULATOR VALVE	socv	=SERVO ORIFICE CONTROL VALVE
SR	=SECONDARY REGULATOR VALVE	R.C.	=REAR CLUTCH
X	= EXHAUST	F.R.S.	=FRONT SERVO RELEASE
RP	= REAR PUMP FEED	GOV.	=GOYERNOR
FP NRV	=FRONT PUMP FEED =NON RETURN VALVES	FC and GOV.	=FRONT CLUTCH AND GOVERNOR FEED
NKV	= NON RETORIN VALVES	1—2	=1-2 SHIFT VALVE, 1st GEAR POSITION TO LEFT, 2nd GEAR
DS	=DOWNSHIFT VALVE		POSITION TO RIGHT
THR	=THROTTLE VALVE	RS	=REAR SERVO
MOD.	=MODULATOR VALVE	F.S.A.	=FRONT SERVO APPLY

VALVE BODY ASSEMBLY (see Fig. 27)

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. 27 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.

Part 2

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 unision 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

Page 41

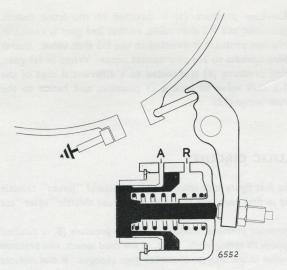


Fig. 28. Front servo operation

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. 28, 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 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 upshift.

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 he 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. 29 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

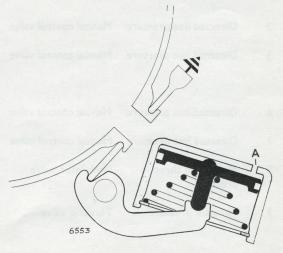


Fig. 29. Rear servo operation

Part 2

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).

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 bumping 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. See also Page 5 Part 5 for

Circuit No.	Name of Pressure	From	То	Theoretical pressure range p.s.i.	Remarks
1	Line pressure	Front and rear pump	Primary regulator valve Manual control valve Throttle valve	57—160—78	
2	Governor pressure	Governor	Modulator valve 1-2 shift valve 2-3 shift valve Servo orifice control valve	0—70	According to road speed
3	Directed line pressure	Manual control valve	2-3 shift valve	57—160—78	In D
5	Directed line pressure	Manual control valve	Front clutch and governor feed 1–2 shift valve	57—160—78	In L and D
6	Directed line pressure	Manual control valve	1–2 shift valve	57—160—78	In L, D, R and P
7	Directed line pressure	Manual control valve	2-3 shift valve	57—160—78	In R and P
8	Modulated throttle pressure	Modulator valve	Primary regulator valve (piston end)	0—135—68	
9	Throttle pressure	Throttle valve	Modulator valve Primary regulator valve (spring end) 2–3 shift valve Shift valve plunger	0—135—68	

Circuit No.	Name of Pressure	From	То	Theoretical pressure range p.s.i.	Remarks
9a	Throttle pressure controlled by modulator valve	Modulator valve	Throttle valve	0—135	Doubles throttle pressure before cut-back and in- creases line pres- sure under part throttle accelera- tion
10	Shift valve plunger pressure	Shift valve plunger	2–3 shift valve 1–2 shift valve	0—68	
10a	Shift valve plunger pressure	Shift valve plunger	1–2 shift valve	0—68	In first gear only
11	Forced throttle pressure	Downshift valve	1–2 shift valve 2–3 shift valve	135	
13	Line pressure	1-2 shift valve	Rear servo apply	57—160—78	
15	Line pressure	2-3 shift valve	Rear clutch and front servo release	57—160—78	
19	Line pressure	1–2 shift valve	Front servo apply	57—160—78	Front servo re- lease through servo orifice or valve
21	Converter pressure	Primary regulator valve	Secondary regulator valve and converter	18—25	
23	Lubrication pressure	Secondary regulator valve		18—25	
24	Exhaust	Secondary regulator valve	Front pump suction		