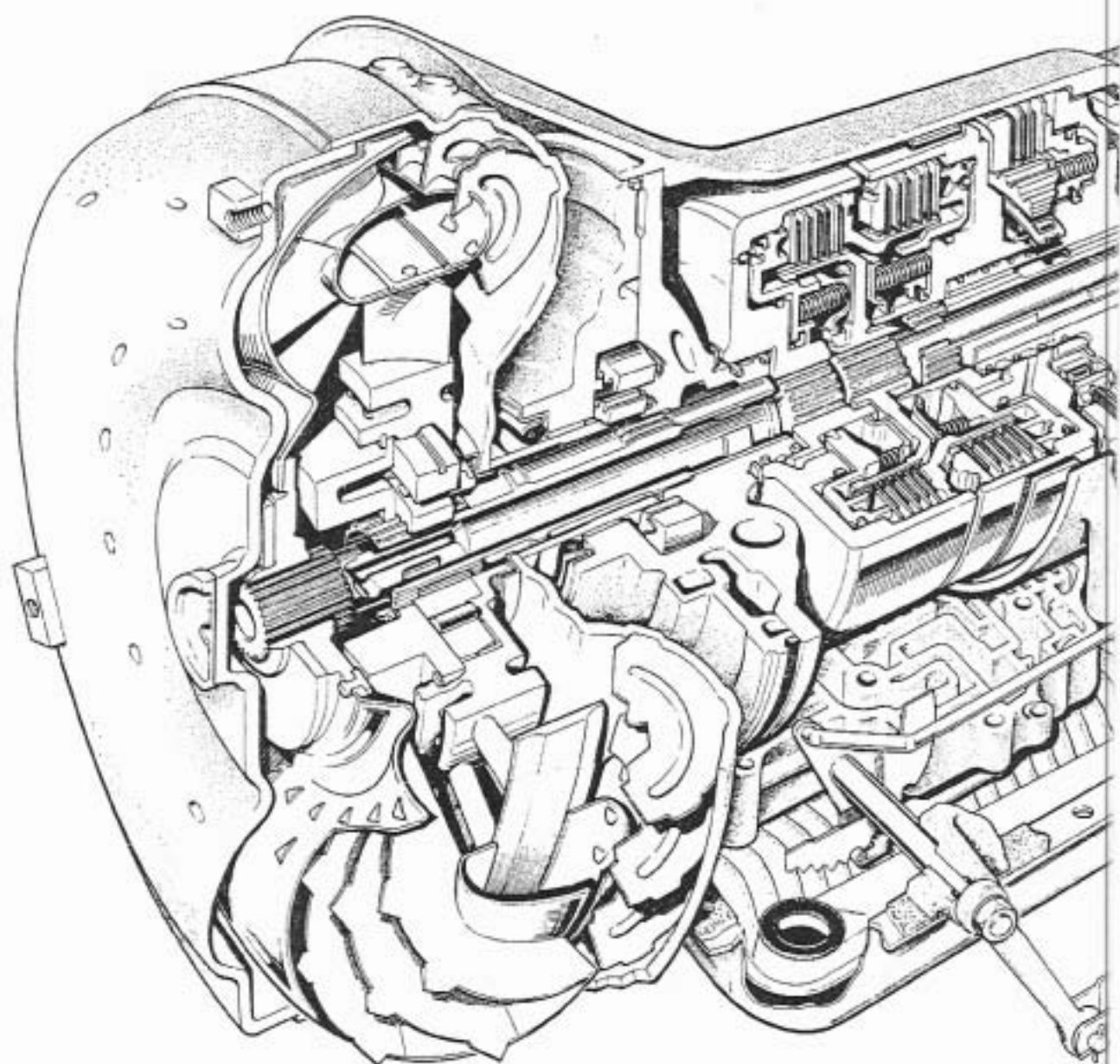


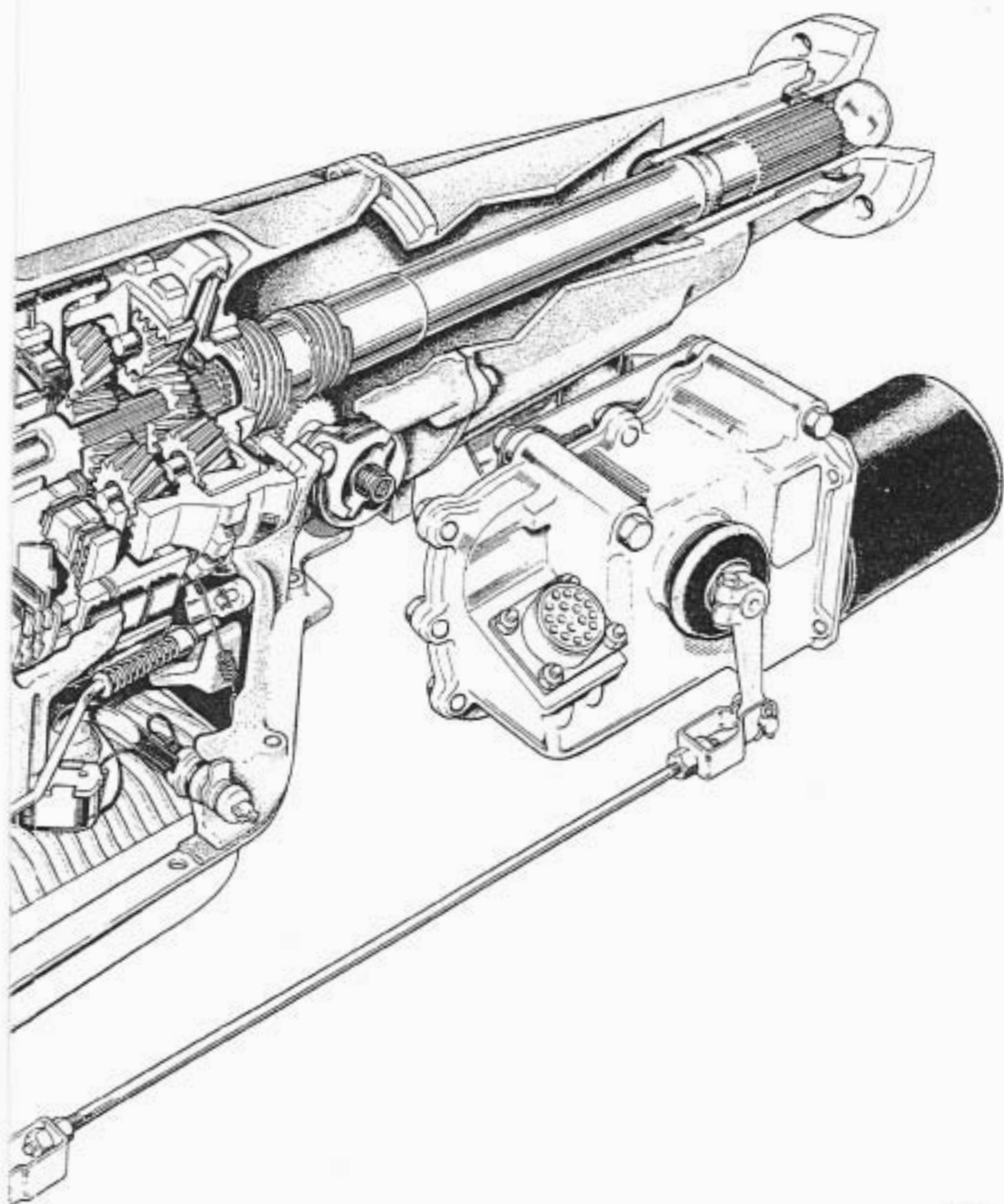
# **Chapter T TRANSMISSION - PART 2**

## **TURBOHYDRAMATIC 400 TORQUE CONVERTER TRANSMISSION**

| <b>SECTION</b>                                                                   | <b>PAGE</b> |
|----------------------------------------------------------------------------------|-------------|
| T1 Introduction                                                                  | T145        |
| T2 Servicing                                                                     | T163        |
| T3 Testing                                                                       | T167        |
| T4 Fault Diagnosis                                                               | T169        |
| T5 Control Linkage                                                               | T183        |
| T6 Removal of Units                                                              | T191        |
| T7 Gearchange Actuator, Neutral and Height<br>Control Switches                   | T195        |
| T8 Remote Gearchange Selector                                                    | T273        |
| T9 Transmission - To Remove and Fit                                              | T221        |
| T10 Torque Converter                                                             | T 227       |
| T11 Vacuum Modulator and Valve                                                   | T231        |
| T12 Governor Assmbly                                                             | T235        |
| T13 Speedometer Drive                                                            | T239        |
| T14 Sump, Strainer and Intake Pipe                                               | T241        |
| T15 Control Valve Unit                                                           | T243        |
| T16 Rear Servo                                                                   | T255        |
| T17 Detent Solenoid, Connector,<br>Control Valve Spacer and Front Servo          | T259        |
| T18 Rear Extension                                                               | T263        |
| T19 Oil Pump                                                                     | T265        |
| T20 Control Rods, Levers and Parking Linkage                                     | T273        |
| T21 Turbine Shaft, Forward and Direct Clutches,<br>Sun Gear Shaft and Front Band | T277        |
| T22 Intermediate Clutch, Gear Unit, Centre Support<br>and Reaction Carrier       | T287        |
| T23 Transmission Case                                                            | T305        |
| T24 Workshop Tools                                                               | T311        |

FIG. T117 THE TORQUE CONVERTER  
TRANSMISSION AND GEARCHANGE ACTUATOR—  
CUT-AWAY VIEW





P 500

FIG. T117 THE TORQUE CONVERTER  
TRANSMISSION AND GEARCHANGE ACTUATOR—  
CUT-AWAY VIEW

# Chapter T

## TRANSMISSION — PART 2

### Section T1

### INTRODUCTION

All left-hand drive Rolls-Royce Silver Shadow and Bentley T series motor cars are fitted with the Torque Converter Transmission.

Late right-hand drive Rolls-Royce Silver Shadow and Bentley T series motor cars are fitted with the Torque Converter Transmission as follows:

Car Serial Number SRH 4033 and onwards produced for export.

All right-hand drive from Car Serial Number SBH 4478 and SRH 4487 (except SRH 4488).

The Torque Converter Transmission (see Fig. T117) is a fully automatic unit, consisting primarily of a three-element hydraulic torque converter and a compound planetary gear train. On current cars three multiple-disc clutches, a sprag unit, two roller clutch units and two friction bands provide the elements which are required to obtain the desired functions of the gear train.

**Note** On early cars the gear train consists of two sprag units and on intermediate cars a sprag unit and roller clutch unit, in place of the current two roller clutch units.

The Torque Converter Transmission can be identified by a name plate, fitted to the right-hand side of the transmission, toward the centre of the case. The serial number is prefixed by the letters RR and the year in numerals.

**Note** On cars produced after 1972, destined for countries where full emission control systems are required (i.e. U.S.A., Canada and Japan), the transmission prefix letters are changed from RR to RS. The reason for this change in the prefix lettering is that a different transmission modulator is fitted.

The torque converter, clutches and rollers connect the engine to the planetary gears with the aid of pressurised transmission fluid. Three forward gears and Reverse are provided. When necessary, the torque converter will supplement the gears by multiplying engine torque.

The torque converter is of welded steel construction and cannot be dismantled. The unit is made up of two vaned sections which face each other across a fluid filled housing. The pump half of the converter is connected to the engine and the turbine half is connected to the transmission.

When the engine is running the converter pump rotates and throws fluid against the turbine, causing the turbine to rotate. The fluid then returns to the pump in a circular flow and continues this cycle as long as the engine is running.

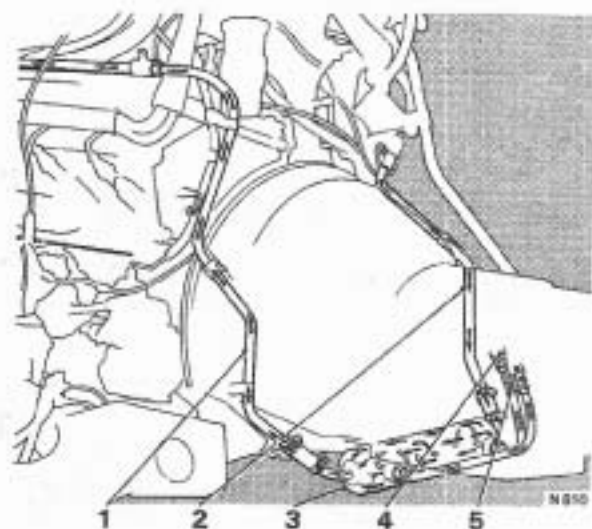
The converter also has a smaller vaned section, called a stator, which directs the fluid back to the pump through smaller openings at greater speed. The speeded-up fluid imparts additional force to the engine driven converter pump, thus multiplying engine torque.

A hydraulic system pressurised by an internal-external gear type of pump provides the working pressure required to operate the friction elements and automatic controls.

The external control connections to the transmission are:

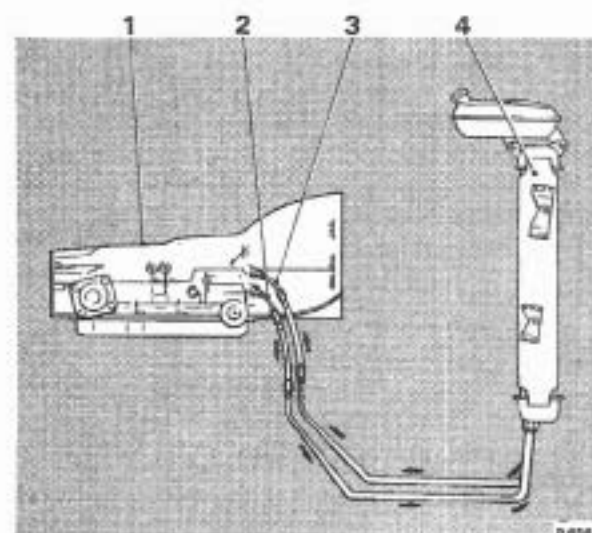
An electric gearchange actuator and a system of rods and levers. The actuator responds to an electrical signal from a switch on the steering column, then moves the gearchange lever on the transmission to the required position.

**Chapter T**



**FIG. T118 HEAT EXCHANGER SYSTEM  
(EARLY CARS)**

- 1 Coolant from heat exchanger to coolant pump
- 2 Coolant from cylinder head to heat exchanger
- 3 Heat exchanger
- 4 Transmission fluid to heat exchanger
- 5 Transmission fluid from heat exchanger



**FIG. T119 HEAT EXCHANGER SYSTEM  
(LATER CARS)**

- 1 Transmission
- 2 Transmission fluid to heat exchanger
- 3 Transmission from heat exchanger
- 4 Coolant radiator with heat exchanger in bottom tank

Engine vacuum — to operate a vacuum modulator unit.

12 volt electrical signals — to operate electrical detent solenoid.

Gear or torque ratios of the transmission are as follows:

|         |   |                    |
|---------|---|--------------------|
| First   | — | 2.5 : 1 gear ratio |
| Second  | — | 1.5 : 1 gear ratio |
| Third   | — | 1.0 : 1 gear ratio |
| Reverse | — | 2.0 : 1 gear ratio |

Each gear ratio can be multiplied by as much as two, depending upon the slip speed of the converter pump and turbine.

A vacuum modulator is used to automatically sense engine torque input to the transmission. The vacuum modulator transmits this signal to the pressure regulator which controls main line pressure, so that all the torque requirements of the transmission are met and the correct gearchange spacing is obtained at all throttle openings.

**Early cars** the detent solenoid is activated by a micro-switch adjacent to the carburettors. When the engine throttle is opened sufficiently a micro-switch is closed by the throttle controls, the solenoid in the transmission is activated and a down-change will occur at speeds below 70 m.p.h. (113 k.p.h.). At lower speeds a down-change will occur at smaller throttle openings without the aid of the micro-switch or the solenoid.

**Current cars** do not have the micro-switch situated adjacent to the carburettors, instead a micro-switch and plunger assembly are fitted to the toe board beneath the accelerator pedal. Service instructions for this later assembly are given in Chapter U — Part 2.

On **early cars** a transmission fluid heat exchanger is situated beneath the bell housing bottom cover, at the front of the transmission sump (see Fig. T118). The transmission is cooled by directing fluid from the converter to the heat exchanger, the cooled fluid then returns to the transmission to feed the lubricating system.

Engine coolant is directed to and from the heat exchanger by connections either at the rear of 'A' bank cylinder head and the radiator bottom tank (**early cars**) or on the inlet side of the coolant pump and the outlet side of the thermostat elbow (**intermediate cars**).

The fluid system incorporates an intake pipe and strainer assembly. An internal by-pass permits increased flow during cold operation when the oil is heavier.

On **current cars** the heat exchanger for the transmission fluid is situated in the bottom of the radiator matrix.

The transmission quadrant has six selector positions which enable the driver to control the operation of the



transmission under varying driving conditions. The six selector positions appear on the quadrant in the following sequence, from left to right: 'P' - Park, 'R' - Reverse, 'N' - Neutral, 'D' - Drive, 'I' - Intermediate and 'L' - Low. The engine can be started in the Park and Neutral positions only.

'P' - Park position positively locks the output shaft to the transmission case by means of a locking pawl and prevents the car from rolling either backward or forward when parked on a steep incline.

'R' - Reverse enables the car to operate in a reverse direction.

'N' - Neutral enables the engine to be started and run without the car moving.

'D' - Drive is used for all normal driving conditions and maximum economy. Drive range has three gear ratios from starting to direct drive. Forced down-changes are available for safe and rapid overtaking, by fully depressing the accelerator pedal.

'I' - Intermediate adds new performance for congested traffic conditions or hilly terrain. This range has the same starting ratio as 'D', but prevents the transmission from changing above second gear; acceleration is retained when extra performance is required.

The engine can be used to assist braking in this Range.

'L' - Low range permits operation at a lower gear ratio and should be used when maximum torque multiplication is required or, when descending a steep gradient. When the selector lever is moved from Drive to Low at normal road speeds, the transmission will change to second gear and remain in second gear until the speed of the car is reduced to the normal 2-1 down-change speed. The transmission will then change down to first gear and remain in first gear regardless of car speed or engine revolutions, until the selector lever is moved into either the Drive or the Intermediate position.

## HYDRAULIC SYSTEM

### Pressure control

The transmission is controlled automatically by a hydraulic system (see Fig. T120). Hydraulic pressure is supplied by the transmission oil pump, which is engine driven.

Main line oil pressure is controlled by a pressure regulator valve train which is located in the pump and by the vacuum modulator which is connected to engine vacuum.

The pressure regulator controls main line oil pressure automatically, in response to a pressure signal from a modulator valve, in such a manner, that the torque requirements of the transmission clutches are met and correct gearchange spacing is obtained at all throttle openings.

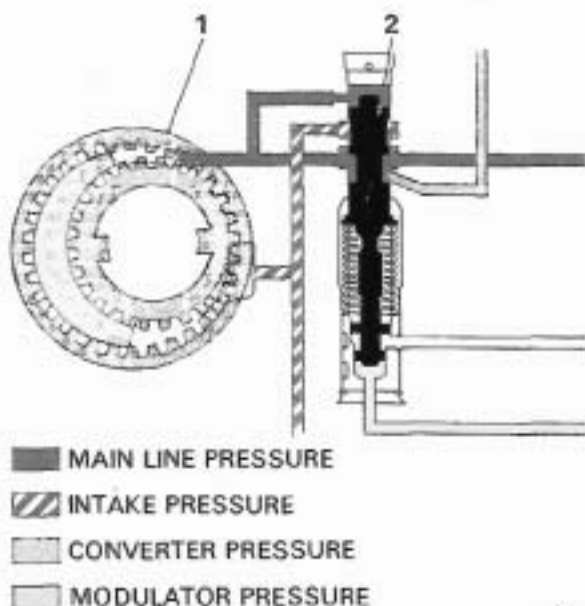


FIG. T120 PRESSURE CONTROL

- 1 Transmission oil pump  
2 Pressure regulator valve train

To control line pressure, a modulator pressure is used. This pressure varies in the same manner as torque input to the transmission. Since the torque input to the clutches is the product of engine torque and converter ratio, modulator pressure must compensate for changes in either or both of these.

To meet these requirements, modulator pressure is regulated by engine vacuum, which is an indicator of engine torque and carburettor throttle opening. It will decrease as the car speed increases to compensate for the changing converter torque ratio.

### Vacuum modulator assembly

The engine vacuum signal is received by the vacuum modulator (see Fig. T121), which comprises an evacuated metal bellows, a diaphragm and two springs. The assembly is so arranged that the bellows and external spring apply a force that acts on the modulator valve so that it increases modulator pressure. Engine vacuum and an internal spring oppose the bellows and external spring to control modulator pressure.

To reduce the effect of altitude on change points, the effective area of the diaphragm is different than that of the bellows. Atmospheric pressure acts on the resulting differential area to reduce modulator pressure.

## Chapter T

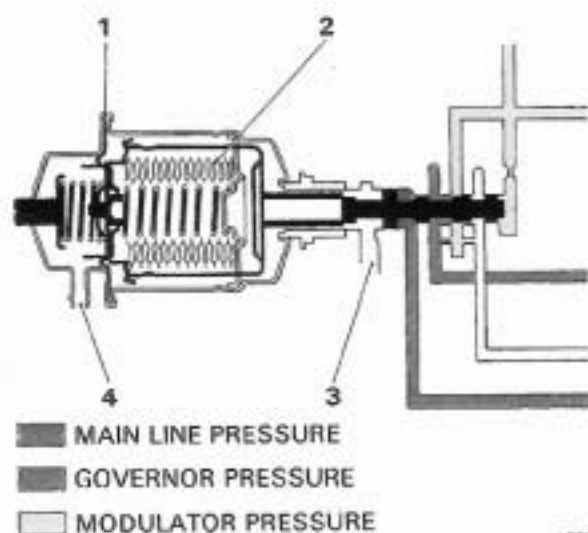


FIG. T121 VACUUM MODULATOR ASSEMBLY

- 1 Diaphragm
- 2 Aneroid bellows
- 3 Exhaust
- 4 Engine vacuum

**Governor assembly**

The speed of the car is signalled to the transmission by a governor (see Fig. T177) which is driven by the transmission output shaft. The governor is comprised basically of a valve body, a regulator valve and flyweights.

Centrifugal force causes the flyweights to act on the regulator valve. The valve then regulates a pressure signal which increases with road speed.

Governor pressure acts on the modulator valve to cause modulator pressure to decrease as the speed of the car increases.

**Operation of valves and hydraulic Control units****Line pressure regulator**

The line pressure regulator valve regulates line pressure according to pump speed and engine torque.

**Manual valve**

The manual valve establishes the range in which the transmission is to operate as selected by the driver through the selector switch and the gear change actuator.

**Governor assembly**

The governor assembly generates an oil pressure that is sensitive to the speed of the car and which increases as the car speed increases.

Governor pressure is used to control the change points and to regulate modulator pressure.

**Vacuum modulator valve**

The vacuum modulator valve provides modulator pressure which senses engine torque and car speed. It is used to vary the change points, according to throttle opening, by opposing governor oil on the shift valves and also to raise line pressure proportional to engine torque.

**1-2 shift valve**

This valve controls the speeds at which the 1-2 and 2-1 changes occur.

**1-2 regulator valve**

The 1-2 regulator valve regulates modulator pressure to a proportional pressure and tends to hold the 1-2 shift valve in the down-change position.

**1-2 detent valve**

The 1-2 detent valve senses regulated modulator pressure which tends to hold the 1-2 shift valve in the down-changed position and provides an area for detent pressure for 2-1 detent changes.

**2-3 shift valve**

This valve controls the speeds at which the 2-3 and 3-2 changes occur.

**2-3 modulator valve**

The 2-3 modulator valve is sensitive to modulator pressure and applies a variable force on the 2-3 shift valve which tends to hold the 2-3 shift valve in the down-changed position.

**3-2 valve**

The 3-2 valve prevents modulator pressure from acting on the shift valves after the direct clutch has been applied. This allows fairly heavy throttle operation in third gear without effecting a down-change. In third gear, detent pressure or modulator pressure above 87 lb/sq.in. (6.1 kg/sq.cm.) can be directed to the shift valves to provide the necessary force to effect the down-change.

**1-2 accumulator valve**

The 1-2 accumulator valve is sensitive to modulator oil and regulates drive oil to a proportionally smaller value. The pressure increases as modulator pressure increases and is used to control the engagement of the intermediate clutch.

**Detent valve**

The detent valve moves when line oil is exhausted from the end of the valve when the detent solenoid is energised. As a result, detent oil is directed to the 1-2 and 2-3 modulator valves and allows the detent regulator valve to regulate.



### Detent regulator valve

When the detent valve moves, the detent regulator is freed and allows drive oil to enter the detent passage at a regulated pressure of 70 lb/sq.in. (4.9 kg/sq.cm.). Detent oil will also flow into the modulator passages which lead to the shift valves. Low oil moves the detent regulator to accept drive oil, allowing drive oil to enter the modulator and detent passages.

### Rear servo and accumulator assembly

The rear servo applies the rear band for engine braking in Low range 1st. gear. It also applies the rear band in Reverse to hold the reaction carrier to provide the reverse gear ratio.

During the 1-2 up-change in Drive and Intermediate ranges the servo acts as an accumulator for the intermediate clutch oil to provide a smooth up-change.

### Front servo

The front servo applies the front band to provide engine braking in 2nd. gear in Low and Intermediate ranges. It is used also as an accumulator for direct clutch oil during the application of the direct clutch and in conjunction with a series of check balls which control orifices, is part of the timing for the release of the direct clutch.

To prevent the application of the front band in Neutral, Drive or Reverse ranges, oil is directed from the manual valve to the release side of the servo piston.

In 'D' range, the servo release oil from the manual valve is used to charge the servo in preparation for the application of the direct clutch.

Direct clutch oil is directed to the front servo accumulator piston where spring force, plus direct clutch pressure, stroke the piston up against the force of servo release oil. This lowers the clutch apply pressure for a smooth engagement.

The release of the direct clutch and the exhausting of the front servo accumulator is slowed down by three check balls and three orifices. This permits a smooth return of the drive load to the intermediate roller clutch and also allows the engine r.p.m. to increase during a detent 3-2 down-change in preparation for the lower gear ratio, which results in a smooth change and better acceleration.

The position of the shift valves in each range and gear, and the various oil passages which are used are shown in Figures T122 to T130. The operation of the valves when each gear is selected is described in the following paragraphs.

### Drive and Intermediate—First gear

#### Power flow

Forward clutch – applied. Direct clutch – released. Intermediate clutch – released. Roller clutch – effective. Front band – released. Intermediate roller clutch – ineffective. Rear band – released.

With the selector lever in either Drive or Intermediate range, the forward clutch is applied. This delivers turbine torque to the mainshaft and turns the rear internal gear clockwise. (Converter torque ratio is approximately 2 : 1 at stall).

Clockwise motion of the rear internal gear causes the rear pinions to turn clockwise to drive the sun gear anti-clockwise. In turn, the sun gear drives the front pinions clockwise, thus turning the front internal gear, output carrier, and output shaft clockwise in a reduction ratio of approximately 2.5 : 1. Reaction of the front pinions against the front internal gear is taken by reaction carrier and roller clutch assembly to the transmission case. (Approximate stall ratio – 5 : 1).

#### Oil flow

When the selector lever is moved to either Drive or Intermediate position, the manual valve is repositioned to allow line pressure to enter the drive circuit. Drive oil then flows to the following (see Fig. T122):

- Forward clutch
- 1-2 Shift valve
- Governor assembly
- 1-2 Accumulator valve
- Detent regulator valve

### Basic control

Drive oil is directed to the forward clutch where it acts on two areas of the clutch piston to apply the forward clutch. The first, or inner area, is fed through an unrestricted passage. The outer area is fed through an orifice to ensure a smooth change into Drive.

Drive oil at the governor assembly is regulated to a variable pressure. This pressure increases with car speed and acts against the ends of the 1-2 and 2-3 shift valves and an area on the modulator valve.

Drive oil is regulated also to another variable pressure at the 1-2 accumulator valve. This pressure is controlled by modulator oil and is directed to the rear servo. 1-2 accumulator oil at the rear servo acts on the accumulator piston.

In addition, to maintain the lower pressure in the 1-2 accumulator passage, the 1-2 accumulator valve intermittently uncovers the Low oil passage and oil is exhausted at the manual valve.

### Summary

The converter is filled. The forward clutch is applied. The transmission is in first gear.

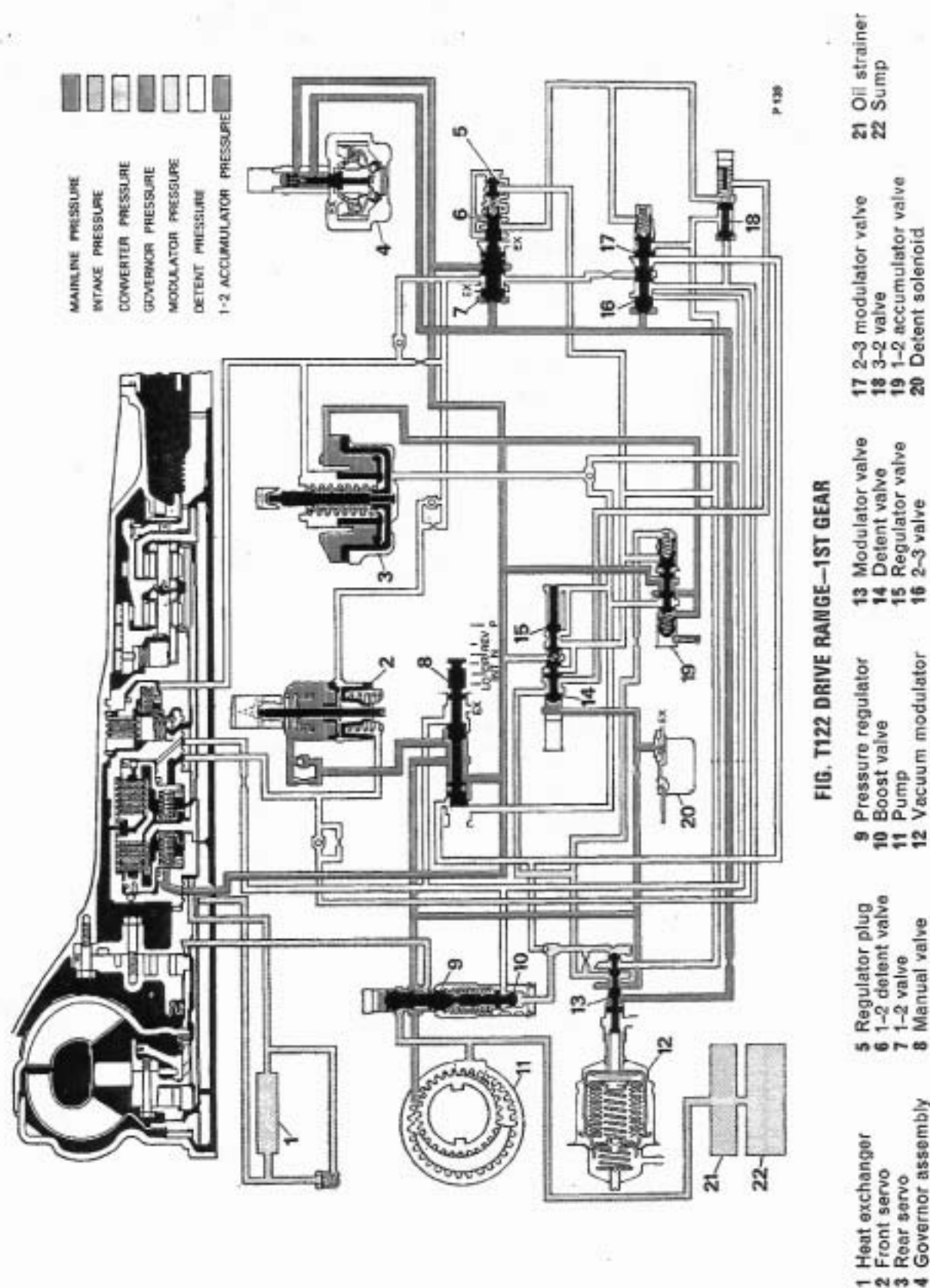
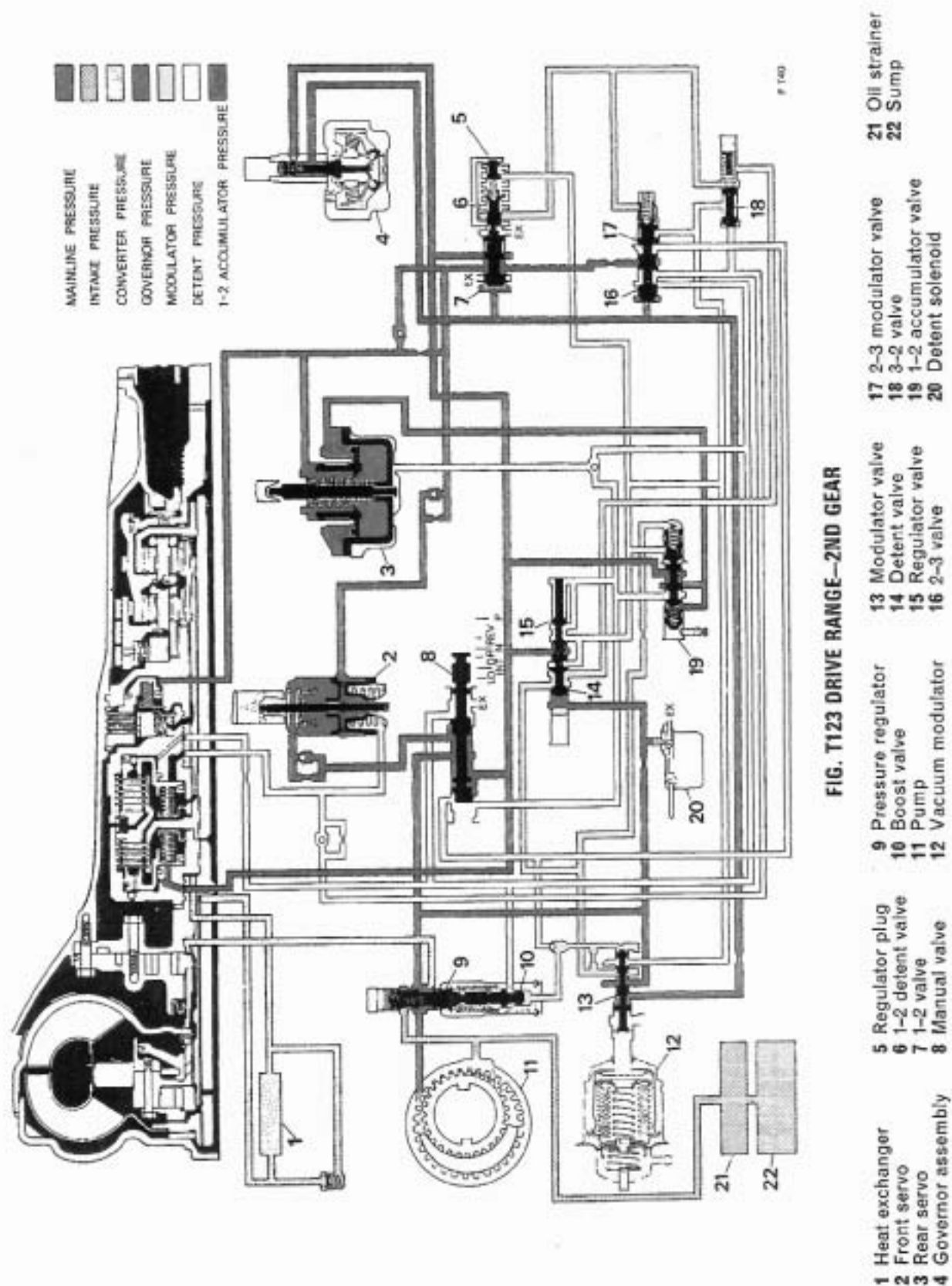


FIG. T122 DRIVE RANGE—1ST GEAR



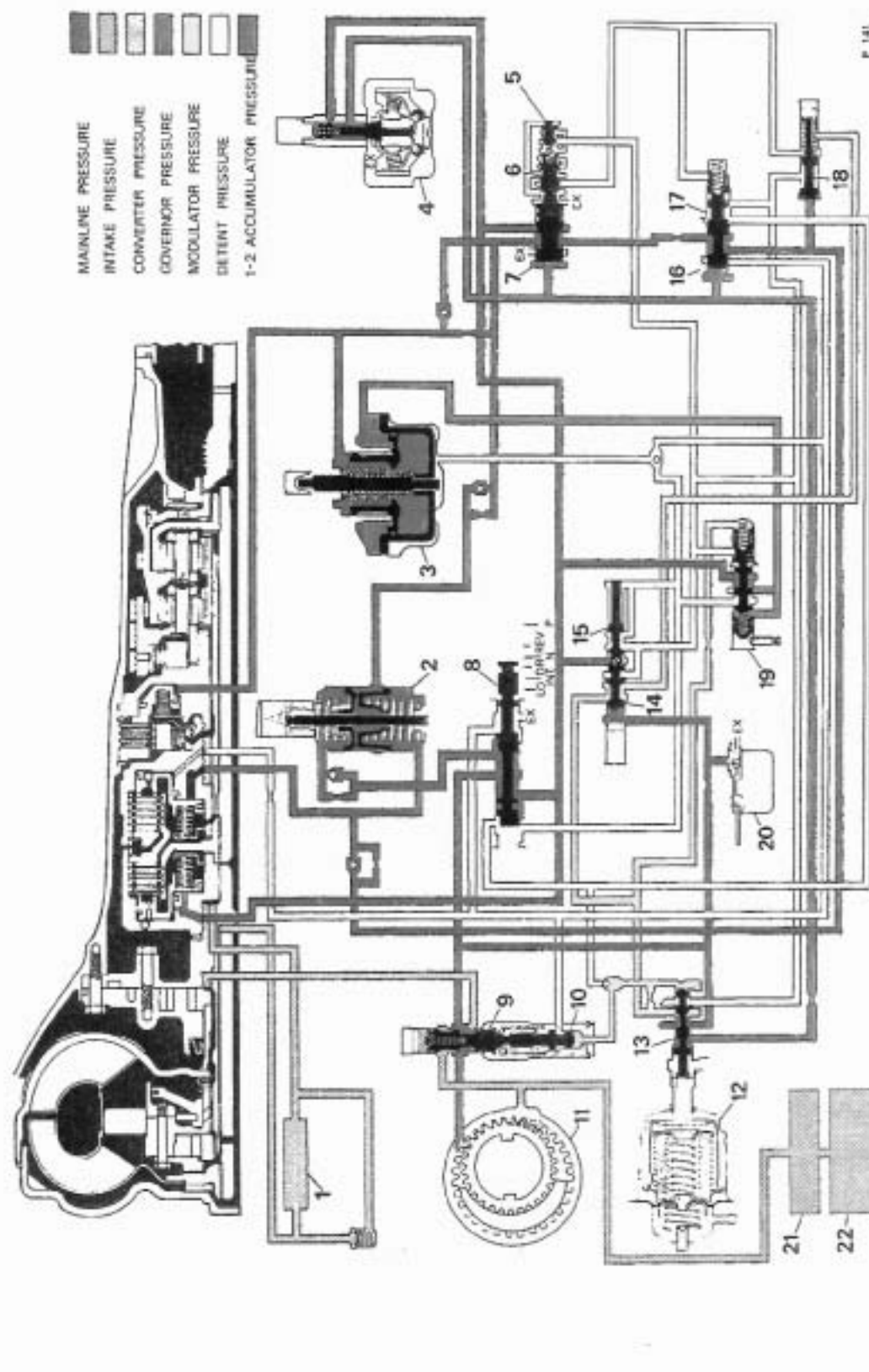


FIG. T124 DRIVE RANGE—3RD GEAR

- |                     |                    |                      |                    |                          |                 |
|---------------------|--------------------|----------------------|--------------------|--------------------------|-----------------|
| 1 Heat exchanger    | 5 Regulator plug   | 9 Pressure regulator | 13 Modulator valve | 17 2-3 modulator valve   | 21 Oil strainer |
| 2 Front servo       | 6 1-2 detent valve | 10 Boost valve       | 14 Detent valve    | 18 3-2 valve             | 22 Sump         |
| 3 Rear servo        | 7 1-2 valve        | 11 Pump              | 15 Regulator valve | 19 1-2 accumulator valve |                 |
| 4 Governor assembly | 8 Manual valve     | 12 Vacuum modulator  | 16 2-3 valve       | 20 Detent solenoid       |                 |

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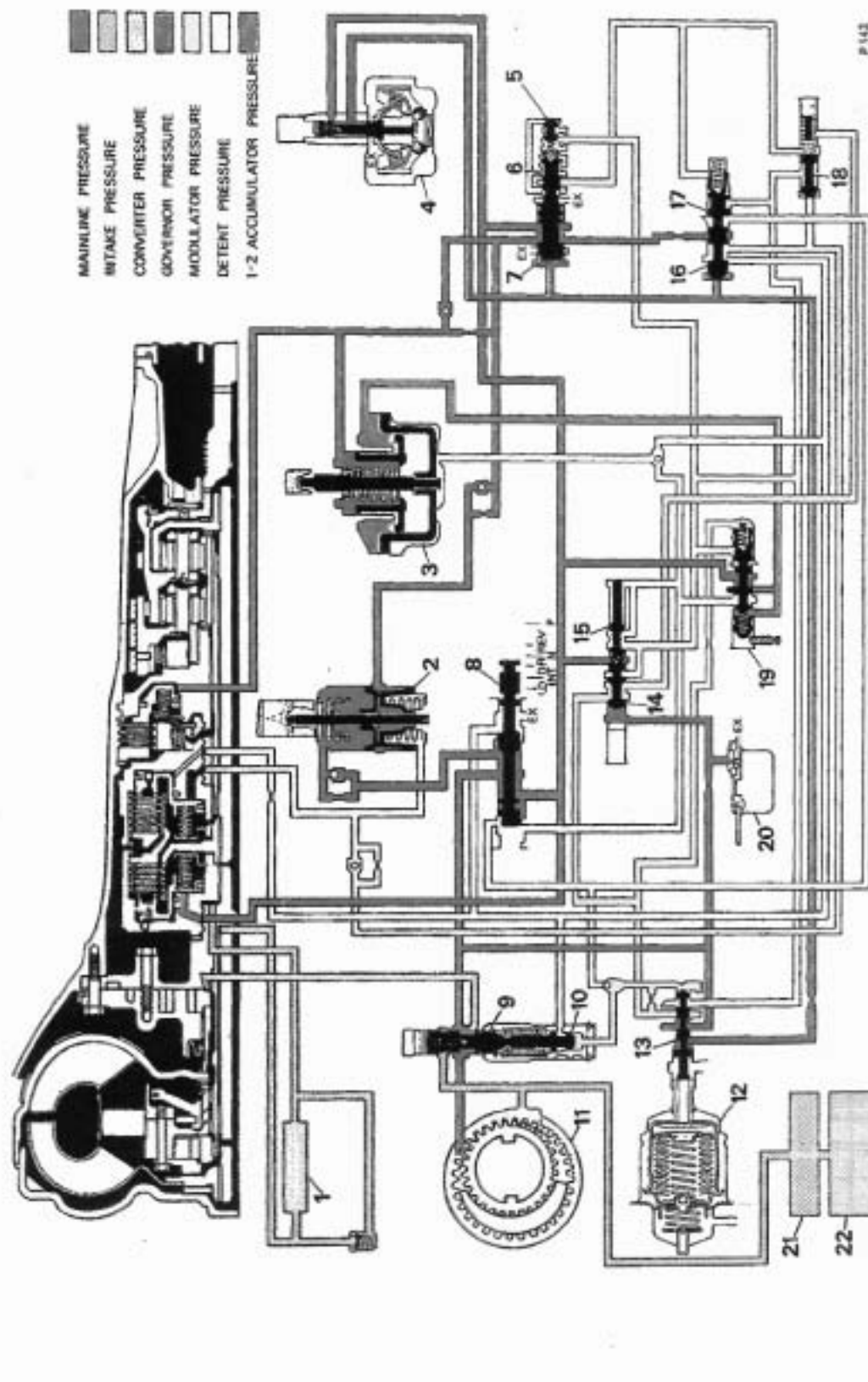


FIG. T125 PART THROTTLE DOWN-CHANGES



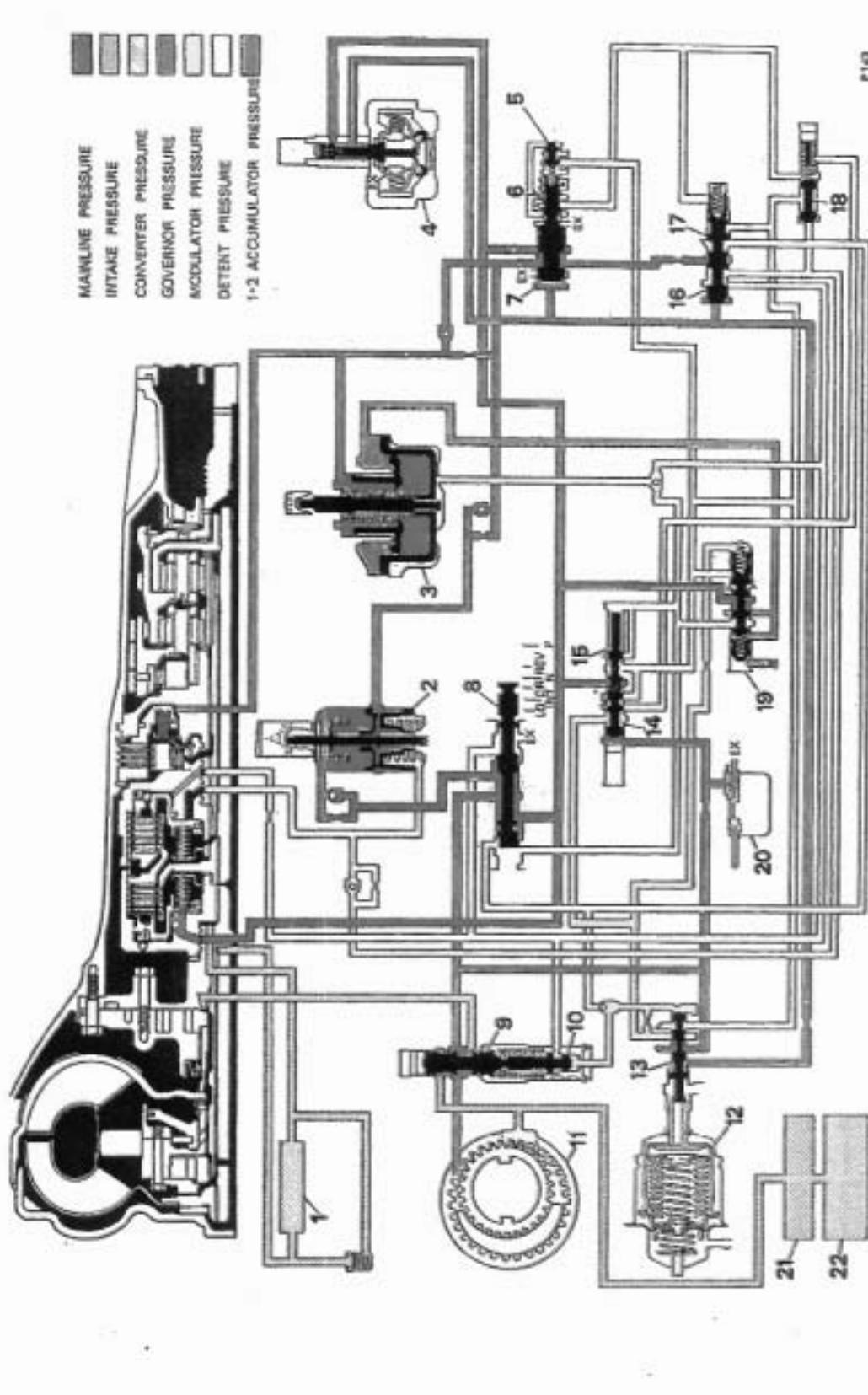


FIG. T126 DETENT DOWN-CHANGE

- |                     |                    |                      |                    |                          |                 |
|---------------------|--------------------|----------------------|--------------------|--------------------------|-----------------|
| 1 Heat exchanger    | 5 Regulator plug   | 9 Pressure regulator | 13 Modulator valve | 17 2-3 modulator valve   | 21 Oil strainer |
| 2 Front servo       | 6 1-2 detent valve | 10 Boost valve       | 14 Detent valve    | 18 3-2 valve             | 22 Sump         |
| 3 Rear servo        | 7 1-2 valve        | 11 Pump              | 15 Regulator valve | 19 1-2 accumulator valve |                 |
| 4 Governor assembly | 8 Manual valve     | 12 Vacuum modulator  | 16 2-3 valve       | 20 Detent solenoid       |                 |



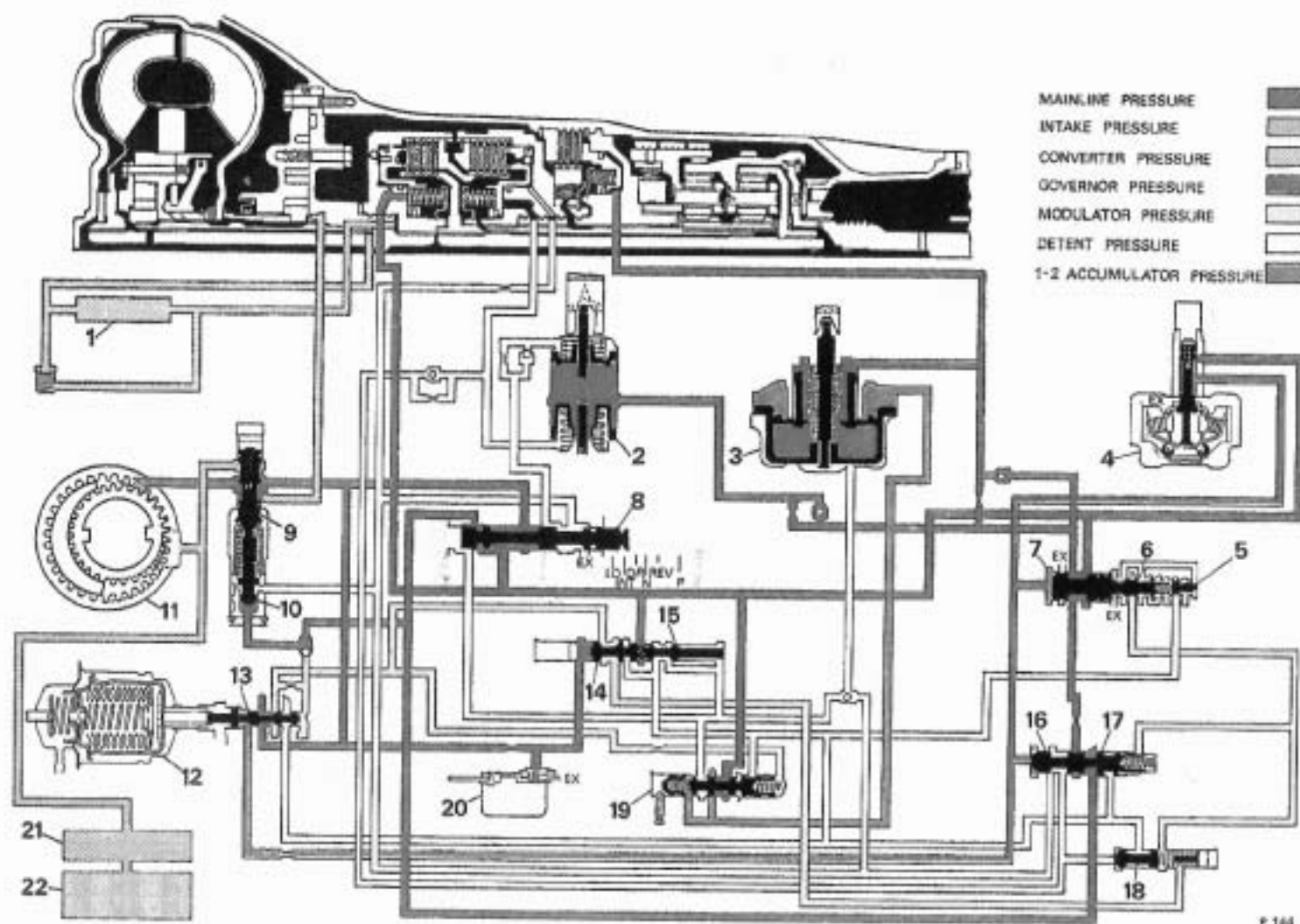


FIG. T127 INTERMEDIATE RANGE 2ND GEAR

- |                     |                    |                      |                    |                          |                 |
|---------------------|--------------------|----------------------|--------------------|--------------------------|-----------------|
| 1 Heat exchanger    | 5 Regulator plug   | 9 Pressure regulator | 13 Modulator valve | 17 2-3 modulator valve   | 21 Oil strainer |
| 2 Front servo       | 6 1-2 detent valve | 10 Boost valve       | 14 Detent valve    | 18 3-2 valve             | 22 Sump         |
| 3 Rear servo        | 7 1-2 valve        | 11 Pump              | 15 Regulator valve | 19 1-2 accumulator valve |                 |
| 4 Governor assembly | 8 Manual valve     | 12 Vacuum modulator  | 16 2-3 valve       | 20 Detent solenoid       |                 |

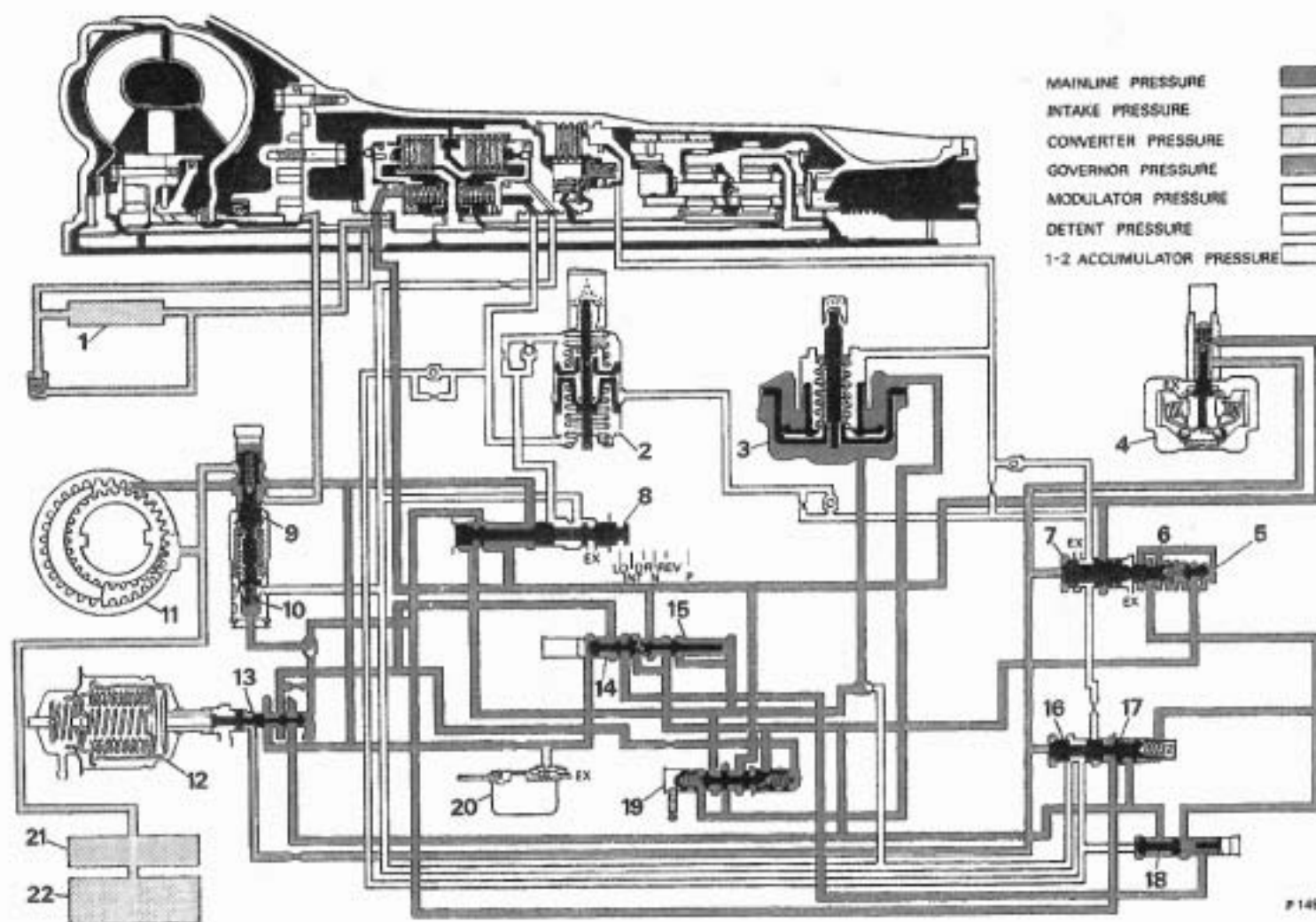


FIG. T128 LOW RANGE-1ST GEAR

- |                     |                    |                      |                    |                          |                 |
|---------------------|--------------------|----------------------|--------------------|--------------------------|-----------------|
| 1 Heat exchanger    | 5 Regulator plug   | 9 Pressure regulator | 13 Modulator valve | 17 2-3 modulator valve   | 21 Oil strainer |
| 2 Front servo       | 6 1-2 detent valve | 10 Boost valve       | 14 Detent valve    | 18 3-2 valve             | 22 Sump         |
| 3 Rear servo        | 7 1-2 valve        | 11 Pump              | 15 Regulator valve | 19 1-2 accumulator valve |                 |
| 4 Governor assembly | 8 Manual valve     | 12 Vacuum modulator  | 16 2-3 valve       | 20 Detent solenoid       |                 |

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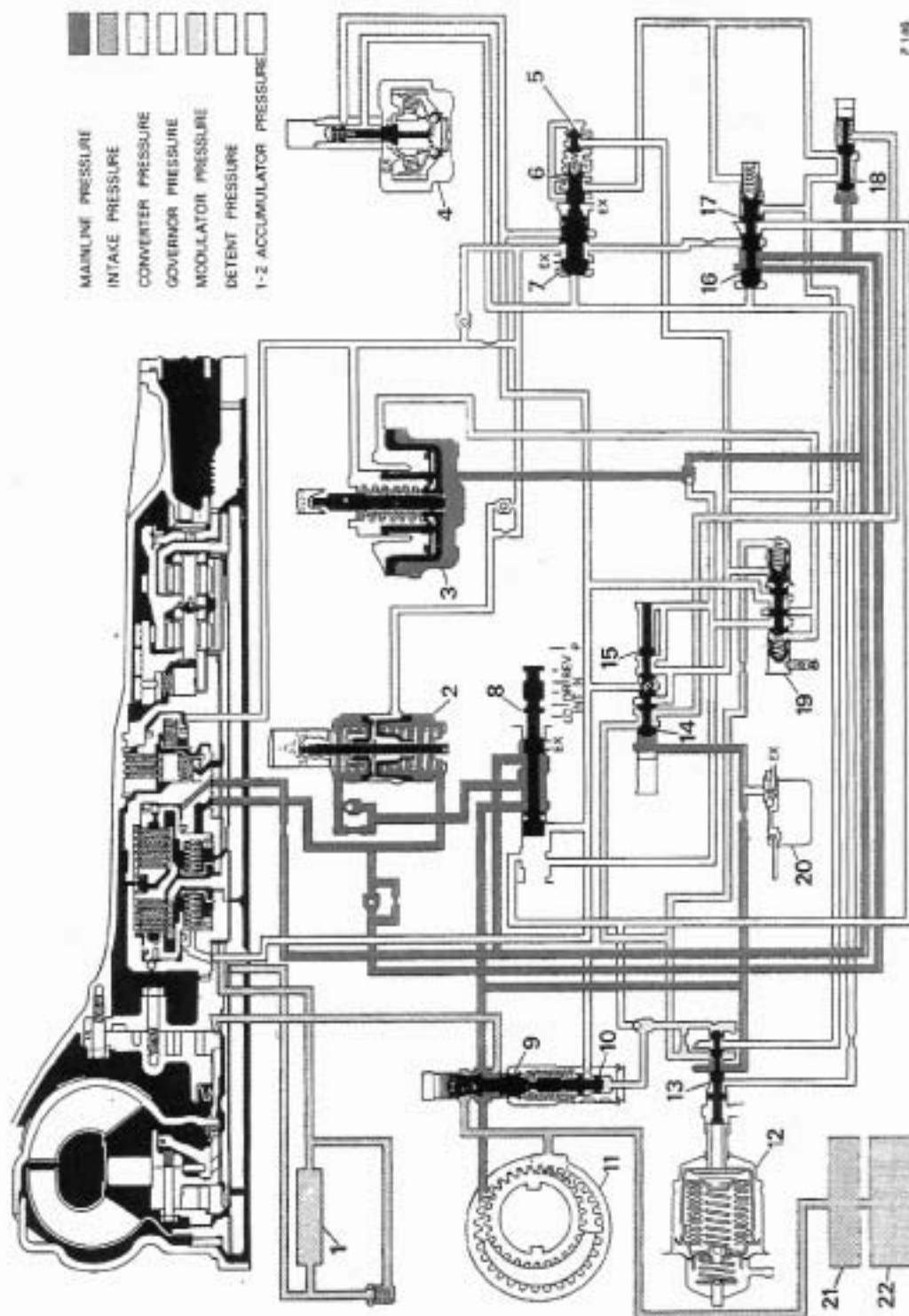
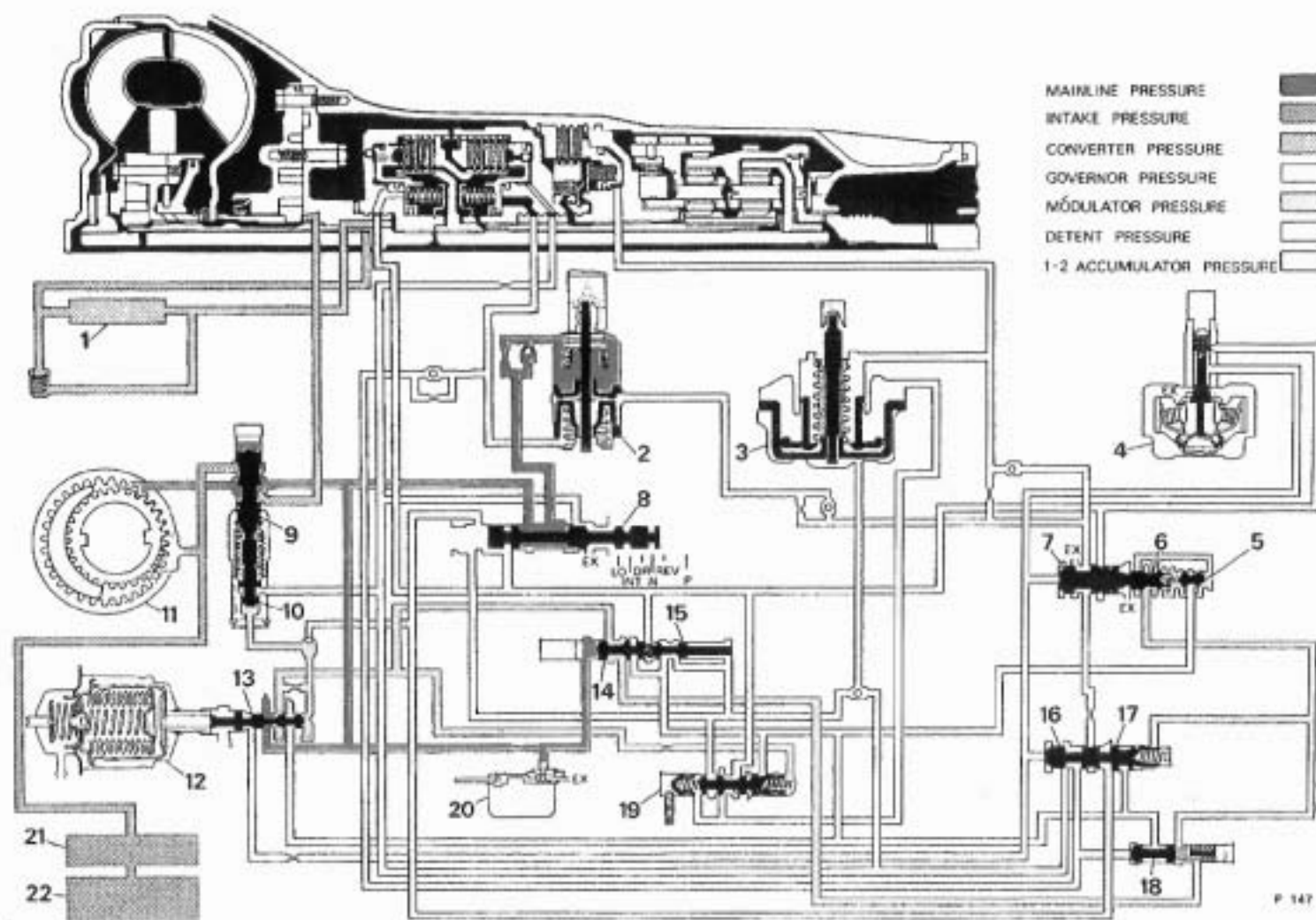


FIG. T129 REVERSE

- |                     |                      |                          |                 |
|---------------------|----------------------|--------------------------|-----------------|
| 1 Heat exchanger    | 9 Pressure regulator | 17 2-3 modulator valve   | 21 Oil strainer |
| 2 Front servo       | 10 Boost valve       | 18 3-2 valve             | 22 Sump         |
| 3 Rear servo        | 11 Pump              | 19 1-2 accumulator valve |                 |
| 4 Governor assembly | 12 Vacuum modulator  | 20 Detent solenoid       |                 |
|                     | 5 Regulator plug     |                          |                 |
|                     | 6 1-2 detent valve   |                          |                 |
|                     | 7 1-2 valve          |                          |                 |
|                     | 8 Manual valve       |                          |                 |
|                     | 13 Modulator valve   |                          |                 |
|                     | 14 Detent valve      |                          |                 |
|                     | 15 Regulator valve   |                          |                 |
|                     | 16 2-3 valve         |                          |                 |



**FIG. T130 NEUTRAL—ENGINE RUNNING**

- |                     |                    |                      |                    |                          |                 |
|---------------------|--------------------|----------------------|--------------------|--------------------------|-----------------|
| 1 Heat exchanger    | 5 Regulator plug   | 9 Pressure regulator | 13 Modulator valve | 17 2-3 modulator valve   | 21 Oil strainer |
| 2 Front servo       | 6 1-2 detent valve | 10 Boost valve       | 14 Detent valve    | 18 3-2 valve             | 22 Sump         |
| 3 Rear servo        | 7 1-2 valve        | 11 Pump              | 15 Regulator valve | 19 1-2 accumulator valve |                 |
| 4 Governor assembly | 8 Manual valve     | 12 Vacuum modulator  | 16 2-3 valve       | 20 Detent solenoid       |                 |

**Drive—Second gear****Power flow**

Forward clutch – applied. Direct clutch – released. Intermediate clutch – applied. Roller clutch – ineffective. Front band – released. Intermediate roller clutch – effective. Rear band – released.

In second gear the intermediate clutch is applied to allow the intermediate roller clutch to hold the sun gear against anti-clockwise rotation. Turbine torque through the forward clutch is then applied clockwise through the mainshaft to the rear internal gear.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of approximately 1.5 : 1.

**Note** Further reduction is possible at low speeds, due to the torque multiplication provided by the converter.

**Oil flow**

As the car speed and the governor pressure increases, the force of governor oil acting on the 1-2 shift valve will overcome the force of regulated modulator oil pressure. This allows the 1-2 shift valve to open, permitting drive oil to enter the intermediate clutch passage.

Intermediate clutch oil from the 1-2 shift valve is directed to the following (see Fig. T123):

- Intermediate clutch
- Rear servo
- Front servo and accumulator pistons
- 2-3 Shift valve

**Basic control**

Intermediate clutch oil from the 1-2 shift valve seats a one-way check ball and flows through an orifice to the intermediate clutch piston to apply the intermediate clutch. At the same time, intermediate clutch oil moves the accumulator piston against the 1-2 accumulator oil and accumulator spring to maintain lower pressure in the clutch during a 1-2 shift for a smooth clutch application. Intermediate clutch oil seats a second one-way check ball and flows to the front servo and accumulator pistons. Intermediate clutch oil is also directed to a land of the 2-3 shift valve.

**Summary**

The forward and intermediate clutches are applied. The transmission is in second gear.

**Drive—Third gear****Power flow**

Forward clutch – applied. Direct clutch – applied.

Intermediate clutch – applied. Roller clutch – ineffective. Front band – released. Intermediate roller clutch – ineffective. Rear band – released.

In direct drive, engine torque is transmitted from the converter, through the forward clutch to the mainshaft and rear internal gear. Because the direct clutch is applied, equal power is also transmitted to the sun gear shaft and the sun gear. Since both sun gear and internal gears are now turning at the same speed, the planetary gear set is essentially locked and turns as one unit in direct drive or a ratio of 1 : 1.

**Oil flow**

As car speed and governor pressure increase, the force of governor oil acting on the 2-3 shift valve overcomes the force of 2-3 shift valve spring and modulator oil. This allows the 2-3 shift valve to move, feeding intermediate clutch oil to the direct clutch passage.

Direct clutch oil from the 2-3 shift valve is directed to the following (see Fig. T124):

- Direct clutch
- Front accumulator piston
- 3-2 Valve

**Basic control**

Direct clutch oil from the 2-3 shift valve flows past a one-way check valve to the inner area of the direct clutch piston to apply the direct clutch. Simultaneously, direct clutch oil is fed to the front accumulator piston. Pressure of the direct clutch oil, combined with the accumulator spring, moves the accumulator and servo pistons against servo oil. This acts as an accumulator for a smooth direct clutch application.

Direct clutch oil is supplied also to the 3-2 valve to move the valve against modulator pressure. This cuts off modulator oil to the 1-2 regulator and 2-3 modulator valves and allows the transmission to utilize the torque multiplying characteristics of the converter during medium throttle operation without down-changing.

**Summary**

The forward, intermediate and direct clutches are applied. The transmission is in third gear (direct drive).

**Part throttle down-change****Power flow**

Forward clutch – applied. Direct clutch – released in second. Direct clutch – applied in third. Intermediate clutch – applied. Roller clutch – ineffective. Front band – released. Intermediate roller clutch – effective in second. Intermediate roller clutch – ineffective in third. Rear band – released.

In second gear, the intermediate clutch is applied to allow the intermediate roller clutch to hold the sun



**Chapter 1**

gear against anti-clockwise rotation. Turbine torque through the forward clutch is then applied clockwise through the mainshaft to the rear internal gear.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of approximately 1.5 : 1.

**Oil flow**

A part throttle 3-2 down-change can be accomplished below approximately 33 m.p.h. (53 k.p.h.) by depressing the accelerator far enough to raise modulator pressure to approximately 87 lb/sq.in. (6.1 kg/sq.cm.). Modulator pressure and the 3-2 valve spring will move the 3-2 valve against direct clutch oil and allow modulator oil to act on the 2-3 modulator valve. This moves the 2-3 valve train against governor oil and changes the transmission to second gear (see Fig. T125).

**Detent down-change****Power flow**

Forward clutch - applied. Direct clutch - released in second. Direct clutch - applied in third. Intermediate clutch - applied. Roller clutch - ineffective. Front band - released. Intermediate roller clutch - effective in second. Intermediate roller clutch - ineffective in third. Rear band - released.

In second gear, the intermediate clutch is applied to allow the intermediate roller clutch to hold the sun gear against anti-clockwise rotation. Turbine torque through the forward clutch is then applied clockwise through the mainshaft to the rear internal gear.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of approximately 1.5 : 1.

**Oil flow**

While operating at speeds below approximately 70 m.p.h. (113 k.p.h.) a forced or detent 3-2 down-change is possible. The down-change is effected by depressing the accelerator pedal so that the kick-down button is depressed and the kick-down switch actuates the detent solenoid. The detent solenoid opens an orifice that allows line oil at the detent valve to be exhausted, thus permitting the detent regulator valve to operate. Line oil acting on the detent valve and solenoid is supplied by a small orifice.

Drive oil on the detent regulator valve is then regulated to a pressure of approximately 70 lb/sq.in. (4.9 kg/sq.cm.) and called detent oil. Detent oil is then routed to the following (see Fig. T126):

Modulator passage

1-2 Regulator valve

2-3 Modulator valve

3-2 Valve

1-2 Primary accumulator valve

Vacuum modulator valve

Detent oil in the modulator passage and at the 2-3 modulator valve will close the 2-3 shift valve, changing the transmission to second gear.

A detent 2-1 down-change can also be accomplished below approximately 20 m.p.h. (32 k.p.h.) because detent oil is directed to the 1-2 regulator valve. This allows detent oil to act on the 1-2 regulator, and 1-2 detent valve to close the 1-2 shift valve, changing the transmission to first gear.

Detent oil is directed also to the modulator valve to prevent modulator pressure from regulating below 70 lb/sq.in. (4.9 kg/sq.cm.) at high speeds or at high altitudes.

**Intermediate—Second gear****Power flow**

Forward clutch - applied. Direct clutch - released. Intermediate clutch - applied. Roller clutch - ineffective. Front band - applied. Intermediate roller clutch - effective. Rear band - released.

In second gear, the intermediate clutch is applied to allow the intermediate roller clutch to hold the sun gear against anti-clockwise rotation. Turbine torque through the forward clutch is now applied clockwise through the mainshaft to the rear internal gear.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of approximately 1.5 : 1.

In second gear, engine braking is provided by the front band as it holds the sun gear fixed. Without the band applied, the sun gear would overrun the intermediate roller clutch.

**Oil flow**

When the selector lever is in Intermediate range, intermediate oil from the manual valve is directed to the following (see Fig. T127).

Pressure boost valve

2-3 Shift valve

Intermediate oil at the boost valve will increase line pressure to 150 lb/sq.in. (10.5 kg/sq.cm.). This increased intermediate oil pressure at the 2-3 shift valve will close the 2-3 shift valve, regardless of car speed.

For engine braking the front band is applied by exhausting servo oil at the manual valve. This allows intermediate clutch oil, acting on the servo piston, to move the piston and apply the front band. Once the

transmission is in second gear – Intermediate range, it cannot change to third gear regardless of car speed.

### Summary

The forward and intermediate clutches and front band are applied. The transmission is in second gear – Intermediate range.

### Low range—First gear Power flow

Forward clutch – applied. Direct clutch – released. Intermediate clutch – released. Roller clutch – effective. Front band – released. Intermediate roller clutch – ineffective. Rear band – applied.

With the selector lever in Low range, the forward clutch is applied. This delivers turbine torque to the mainshaft and turns the rear internal gear clockwise. (Converter torque ratio is approximately 2.0 : 1 at stall).

Clockwise motion of the rear internal gear causes the rear pinions to turn clockwise to drive the sun gear anti-clockwise. In turn, the sun gear drives the front pinions clockwise, thus turning the front internal gear, output carrier and output shaft clockwise in a reduction ratio of approximately 2.5 : 1. The reaction of the front pinions against the front internal gear is taken by the reaction carrier and roller clutch assembly to the transmission case. (Total stall ratio is approximately 5 : 1).

Downhill or overrun braking is provided in Low range by applying the rear band as this prevents the reaction carrier from overrunning the roller clutch.

### Oil flow

Maximum downhill braking can be attained at speeds below 40 m.p.h. (64 k.p.h.) with the selector lever in Low position as this directs Low oil from the manual valve to the following: (see Fig. T128).

- Rear servo
- 1-2 Accumulator valve
- Detent regulator valve
- 1-2 Shift valve

### Basic control

Low oil flows past a ball check to the apply side of the rear servo piston and to the 1-2 accumulator valve to raise the 1-2 accumulator oil to line pressure for a smooth band application.

Low oil acts on the detent regulator valve. Combined with the detent spring, Low oil holds the detent valve against line oil acting on the detent valve, causing drive oil to flow through the detent regulator valve into the detent and modulator passages. Modulator and detent oil at line pressure acting on the 1-2 regulator and 1-2 detent valve overcomes governor oil and Low oil on the 1-2 shift valve at any vehicle speed

below approximately 40 m.p.h. (64 k.p.h.) and the transmission will change to first gear.

In first gear – Low range, the transmission cannot up-change to second gear regardless of car or engine speed.

### Summary

The forward clutch and rear band are applied. The transmission is in first gear – Low range.

### Reverse Power flow

Forward clutch – released. Direct clutch – applied. Intermediate clutch – released. Roller clutch – ineffective. Front band – released. Intermediate roller clutch – ineffective. Rear band – applied.

In Reverse, the direct clutch is applied to direct turbine torque to the sun gear shaft and sun gear. The rear band is also applied, holding the reaction carrier.

Clockwise torque to the sun gear causes the front pinions and front internal gear to turn anti-clockwise in reduction. The front internal gear is connected directly to the output shaft, thus providing the reverse output gear ratio approximately 2 : 1. The reverse torque multiplication at stall (converter and gear ratios) is approximately 4 : 1.

### Oil flow

When the selector lever is moved to the Reverse position, the manual valve is repositioned to allow oil at line pressure to enter the reverse circuit. Reverse oil then flows to the following (see Fig. T129):

- Direct clutch
- 2-3 Shift valve
- Rear servo piston
- Pressure boost valve

### Basic control

Reverse oil from the manual valve flows to the large area of the direct clutch piston and to the 2-3 shift valve. From the 2-3 shift valve, it enters the direct clutch passage and is directed to the small area of the direct clutch piston to apply the direct clutch.

Reverse oil flows to the rear servo and acts on the servo piston to apply the rear band. Reverse oil acts also on the pressure boost valve to boost line pressure.

### Summary

The direct clutch and the rear band are applied. The transmission is in Reverse.

### Park or Neutral—Engine running Power flow

Forward clutch – released. Direct clutch – released. Intermediate clutch – released. Roller clutch – ineffective.

**Chapter T**

tive. Front band – released. Intermediate roller clutch – ineffective. Rear band – released.

In Neutral or Park no bands or clutches are applied, therefore no power is transmitted.

**Oil flow**

Whenever the engine is running at idle with the selector lever in 'P' or 'N', oil from the pump is directed to the following (see Fig. T130):

|                          |                            |
|--------------------------|----------------------------|
| Pressure regulator valve | Manual valve               |
| Torque converter         | Detent valve               |
| Oil cooler               | Detent solenoid            |
| Oil cooler by-pass valve | Vacuum modulator valve     |
| Lubrication system       | Front servo (Neutral only) |
| Stator valve             | Stator solenoid and valve  |
| (early cars only)        | (early cars only)          |

**Cooling and lubrication**

Oil flows from the pump to the pressure regulator valve which regulates pump pressure. When the pump output exceeds the demand of line pressure, oil from the pressure regulator is directed to the converter feed passage to fill the converter. Oil from the converter is directed to the transmission heat exchanger by-pass valve. Oil from the heat exchanger is directed to the transmission lubrication system.

The heat exchanger by-pass valve permits oil to be fed directly from the converter to the lubrication circuits if the heat exchanger becomes restricted.

**Note** On early cars fitted with a stator valve and solenoid, when the pump output exceeds the demand of line pressure, oil from the pressure regulator is directed to the transmission heat exchanger by-pass valve. Oil from the heat exchanger is directed to the transmission lubrication system.

Line pressure acts on the following:

Manual valve  
Detent valve  
Detent solenoid  
Modulator valve  
Stator valve (early cars only)  
Stator solenoid (early cars only)

Line pressure at the modulator valve is regulated to a pressure called modulator oil, which acts on the pressure boost valve, 1-2 accumulator and primary valves, and passes through the detent valve and the 3-2 valve to the 1-2 and 2-3 valve trains.

**Summary**

The torque converter is filled, (early cars—stator blades are at high angle) and all clutches and bands are released. The transmission is in Neutral.

## Section T2 SERVICING

Careful and regular maintenance of the Transmission is necessary to ensure maximum reliability; the following table gives the recommended servicing periods.

### SERVICING PERIODS

| ESSENTIAL MAINTENANCE                                               | PERIOD                                                                  |
|---------------------------------------------------------------------|-------------------------------------------------------------------------|
| Check oil level                                                     | After first 3 000 miles (5 000 km.) then every 6 000 miles (10 000 km.) |
| Drain transmission and fill with new fluid                          | Every 12 000 miles (20 000 km.)                                         |
| Fit new intake strainer                                             | After first 24 000 miles (40 000 km.)                                   |
| ADDITIONAL MAINTENANCE                                              | PERIOD                                                                  |
| Lubricate control linkage<br>Road test for satisfactory performance | Every 6 000 miles (10 000 km.)                                          |

It is absolutely essential that great attention be paid to cleanliness whenever the interior of the transmission is exposed and when work is being carried out on a particular unit belonging to the transmission. The smallest particle of dirt in the oil may interfere with the correct operation of the valves, particularly in the control valve unit.

### Fluid level—To check

Car attitude and fluid temperature are particularly important when checking the fluid level on a Torque Converter Transmission. Careful attention to the following procedures is necessary in order to determine the actual fluid level.

### Fluid recommendations

Whenever fluid is added, use only a Dexron fluid. For a complete list of the Dexron lubricants currently approved for use in this transmission refer to Chapter D of this Workshop Manual T.S.D. 2476 or the latest Service Bulletin.

### Transmission dipstick and filler tube

The transmission dipstick and filler tube are situated on the right-hand side of the engine and are easily accessible when the bonnet is raised (see Fig. T131).

### To check and add fluid

The level of the transmission fluid should be checked at every engine oil change. The full 'MAX' and low 'MIN' marks on the dipstick are approximately  $\frac{1}{2}$  pint (Imp.), 1 pint (U.S.), 0.45 litre apart and should be used to determine the correct fluid level at the normal operating temperature of 76-77°C., (170°F.). Careful attention to transmission fluid temperature is necessary because the correct fluid level at low operating temperatures will be below the 'MIN' mark on the dipstick (see Fig. T131), and the correct fluid level at higher operating temperatures will rise above the 'MAX' mark. Fluid level must always be checked when the car is on an even, level surface and with the engine running to ensure that the converter is full. To determine the correct fluid level proceed as follows.

1. Run the car on the road for approximately 20 miles. This will ensure that the transmission has reached normal operating temperature.

## Chapter 1

2. Position the car on a level surface and firmly apply the handbrake.

3. Allow the engine to idle slowly, move the gear range selector lever through each range, return to the **Park** position and immediately check the fluid level.

4. With the engine running, add fluid as required to bring it to the correct level (see Fig. T131).

**Note** Do not overfill.

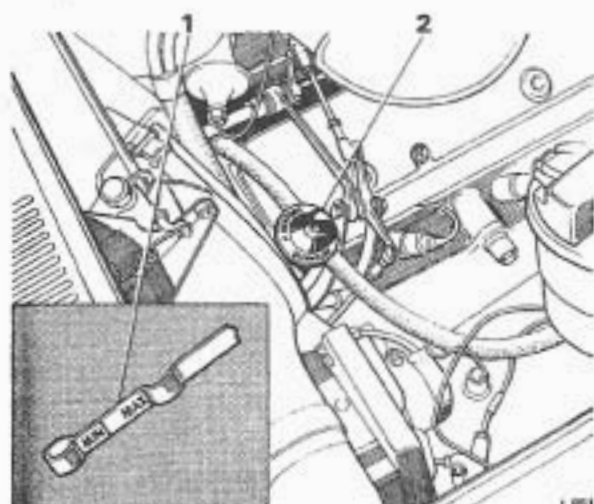


FIG. T131 CHECKING THE OIL LEVEL

- 1 Minimum and Maximum oil level marks  
2 Transmission oil dipstick

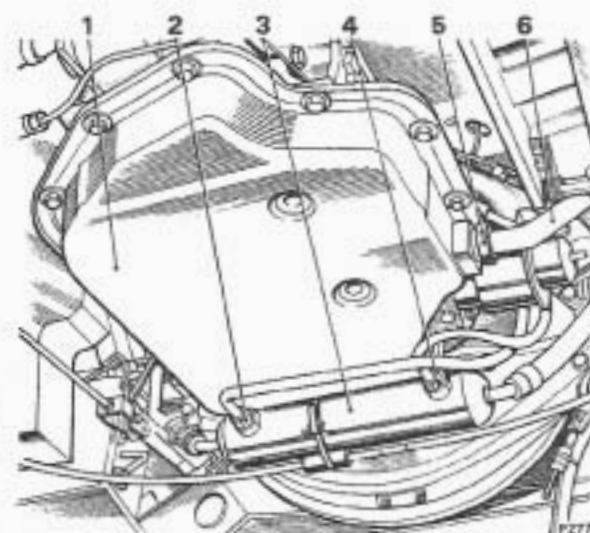


FIG. T132 TRANSMISSION SUMP

- 1 Transmission sump  
2 Fluid inlet from transmission  
3 Fluid heat exchanger  
4 Fluid outlet to transmission  
5 Fluid drain point  
6 Dipstick filler tube

### To drain the sump and renew the intake pipe and strainer assembly

1. Position the car on a ramp or over an inspection pit.
2. Place a clean container, minimum capacity 5 pints (Imp.) 6 pints (U.S.) 2.8 litres under the sleeve nut which secures the filler tube to the side of the sump.
3. Slacken the clips which secure the filler tube. Slacken the sleeve nut at the base of the tube and allow the fluid to drain into the container.
4. Remove the dipstick and filler tube from the sump.

#### Early Cars Only

5. Unscrew the two unions securing the transmission fluid inlet and outlet pipes to the heat exchanger (see Fig. T132), withdraw the pipes and collect any fluid in a container. Remove the four setscrews (two at each end) securing the heat exchanger to the bell housing bottom cover. Lower the heat exchanger on the flexible coolant pipes to gain access to the two forward sump retaining setscrews.

**Note** It should not be necessary to release the flexible coolant pipes.

#### All Cars

6. Remove the thirteen setscrews securing the sump.
7. Remove the sump; discard the gasket.
8. Drain the remainder of the fluid from the sump.
9. Examine the residue of the sump for signs of wear in the transmission then wash the sump in clean paraffin (kerosene). Thoroughly dry the sump with clean compressed air.
10. Remove the intake pipe and strainer; discard the 'O' ring.
11. Fit a new 'O' ring into the intake pipe bore in the transmission case then fit the new intake pipe and strainer. Fit the strainer retaining bolt.

**Important** There is more than one combination of strainer and sump fitted to the Torque Converter Transmission. If an incorrect combination is fitted, a transmission failure will result.

12. Fit the sump, using a new gasket. Torque tighten the setscrews (refer to Chapter P of this Workshop Manual T.S.D. 2476).
13. Fit the oil filler tube, positioning the clips before tightening the sleeve nut.
14. Add 8 pints (Imp.) 9½ pints (U.S.) 4.5 litres of fresh clean transmission fluid through the filler tube.

**Note** When draining the sump and not renewing the intake pipe and strainer, add only 5 pints (Imp.) 6 pints (U.S.) 2.8 litres of fluid.

15. Run the engine at a fast idle for approximately 90 seconds with the selector lever in 'P' position.



16. Reduce the engine speed to slow idle, move the gear range selector lever through each range, return to the **Park** position. Immediately, check the fluid level with the engine running and the car on level surface. This should be approximately 0.0625 in. (1.59 mm.) below the 'MIN' mark when the transmission is cold 20°C. (68°F.).

**Caution** Do not overfill as foaming may occur when the fluid warms up. If the fluid level is too low, especially when cold, complete loss of drive may result after quick stops. Extremely low fluid levels will result in damage to the transmission.

17. Finally check that the transmission fluid level is correct (see **To check and add fluid — operations 1-4 inclusive**).

### To fill a dry transmission unit

The fluid capacity of a Torque Converter Transmission, including the torque converter, is approximately 18½ pints (Imp.) 22½ pints (U.S.) 10.6 litres, but the correct level is determined by the marks on the dipstick rather than by the quantity of fluid added. It is important that the correct level be maintained. When the transmission has been overhauled and a complete fill is required, including the torque converter, proceed as follows.

1. Pour approximately 11½ pints (Imp.) 14 pints (U.S.) 6.5 litres through the filler tube.
2. Run the engine at a fast idle for approximately 90 seconds with the selector lever in 'P' position.
3. Reduce the engine speed to slow idle, move the gear range selector lever through each range, return to the **Park** position. Immediately, check the fluid level with the engine running and the car on level surface. This should be approximately 0.0625 in. (1.59 mm.) below the 'MIN' mark when the transmission is cold 20°C. (68°F.).

The transmission sump should be drained every 12 000 miles (20 000 km.) or 12 months, whichever occurs first. Fresh fluid should be added to maintain the correct level on the dipstick (see *Fig. T131*).

The fluid intake system incorporates an intake pipe and strainer assembly. This assembly should be renewed after the first 24 000 miles (40 000 km.) or two years, whichever occurs first. In the event of a major failure in the transmission, the strainer must be renewed.

**Important** There is more than one combination of strainer and sump fitted to the Torque Converter Transmission. If an incorrect combination is fitted, a transmission failure will result.

### To check for leaks

Whenever the transmission has been dismantled, completely or partially, the following procedure must be observed to minimise the possibility of fluid leakage.

1. Always fit new gaskets and 'O' ring seals.
2. Use a small amount of petroleum jelly to hold a gasket in position during assembly.
3. Do not use a sealing compound (e.g. Wellseal) with a gasket.
4. Ensure that the composition cork and paper gaskets are not wrinkled or creased when fitted. Ensure that gaskets have not shrunk or stretched during storage.
5. Ensure that square-sectioned 'O' rings are correctly fitted and are not twisted.
6. Ensure that all mating faces are clean and free from burrs and damage.
7. Torque tighten bolts, setscrews etc., to the torque figures given in Chapter P of this Workshop Manual T.S.D. 2476.

### Possible leakage points

When examining the transmission for leaks, determine whether the fluid originates from the transmission or the engine. The original factory fill fluid in the transmission is formulated with a red aniline dye to assist in locating the source of leakage. If the colour of the dye cannot be detected in the transmission fluid, add a red aniline dye preparation to the fluid. Red dye appearing in the leaking fluid will positively identify the source of the leak.

If the fluid is known to be leaking from the transmission, examine the following areas.

### Front end

It will be necessary to remove the bell housing bottom cover and the lower front cover plate in order to examine the transmission for leakage at the front end.

To correct a leak at the front end, the transmission will have to be removed from the car.

1. If the pump oil seal is suspected of leaking fluid, ensure that the seal has been correctly fitted and is not damaged.

When fitting a new seal (see *Section T19*) ensure that the seal bore in the case is clean and that the seal garter spring is fitted. Examine the finish on the converter neck and the bearing surface in the pump body.

2. Examine the pump square-sectioned 'O' ring and the gasket for damage, renew if necessary.
3. Ensure that the rubber coated washers on the pump securing setscrews are correctly fitted and are not damaged.
4. Examine the torque converter for leakage (see *Section T10*).

## **Chapter T**

### **Rear extension**

1. Examine for damage the **rear extension lip-type seal**.
2. Examine the finish on the **sliding coupling**.
3. Ensure that the **square-sectioned 'O' ring** at the front of the rear extension has been correctly fitted and is not damaged.

**Note** On later transmissions, the 'O' ring is superseded by a **gasket**, fitted between the joint faces.

4. Check the **securing setscrews** for correct torque tightness.
5. Examine the **housing** for cracks or porosity.

### **Transmission case**

1. Examine the speedometer drive **'O' ring** and **lip-type seal**. Ensure that the securing setscrew is torque tightened.
2. Examine the **governor cover gasket**. Ensure that the **setscrews** are torque tightened.
3. Examine for damage the **detent and stator** (if fitted) **connector 'O' ring**.
4. Examine for damage the **parking pawl shaft 'O' ring**.
5. Examine for damage the **manual shaft 'O' ring**.
6. Examine for damage the **vacuum modulator 'O' ring**. Ensure that the retaining setscrew is torque tightened.
7. Examine the **vacuum modulator** for possible damage to the **diaphragm**.

**Note** If the transmission is found to be consistently low on fluid, check the modulator to make certain that there is no split in the diaphragm. Apply suction to the vacuum tube and check for leaks. A split diaphragm would allow transmission fluid to be drawn into the engine induction manifold and vacuum line. This condition can usually be detected because the exhaust will be excessively smokey due to the transmission fluid being added to the combustion mixture.

8. Examine the **sump gasket**. Check the torque tightness of the securing setscrews.
9. Check the torque tightness of the **main line pressure tapping plug**.
10. Examine the **breather pipe** for damage.
11. Ensure that the transmission has not been overfilled.
12. Check for coolant in the transmission fluid.
13. Examine the **case** for cracks or porosity.
14. Ensure that the **pump to case gasket** is not incorrectly positioned.
15. Ensure that foreign material is not between the **pump and case**, or between the **pump cover and body**.

16. Ensure that the breather hole in the **pump cover** is not obstructed.

17. Ensure that the **'O' ring** on the filter assembly is not cut.

### **Heat exchanger connections**

Ensure that the heat exchanger transmission **fluid pipes** are correctly fitted and are not damaged. Ensure that the nuts are tight.

### **Dipstick and filler tube**

Examine the **flared end** of the dipstick and filler tube for cracks or damage. Examine the **spherical seat** in the sump. Ensure that the **sleeve nut** is tightened sufficiently to nip the tube securely to the sump.

### **Internal leaks**

It will be necessary to remove the sump in order to determine the source of internal leaks.

1. Check the **governor pipes** for security and damage.
2. Examine the **rear servo cover gasket** for damage. Ensure that the **square-sectioned 'O' ring** is fitted correctly and is not damaged. Torque tighten the cover securing setscrews.
3. Examine the **control valve unit assembly** and **oil guide plate gaskets**. Check the torque tightness of the unit securing setscrews.
4. Examine the **solenoid gaskets** for damage. Check the torque tightness of the solenoid securing setscrews.
5. Examine the **intake pipe 'O' ring** for damage.
6. Check that the **case valve body mounting face** is not distorted.

### **Control joints—To lubricate**

During initial assembly, the clevis pins in the manual control linkage are lubricated with Rocol MTS 1000 grease and should be similarly treated whenever they are removed.

The emergency (Get-You-Home) lever (fitted to early cars) pivots on an Oilite bush and should not require lubrication.

When a car is being serviced, the opportunity should be taken to check the controls for correct operation and to lubricate all the control joints with a few drops of light oil.

### **Manual shaft—To lubricate**

As part of the normal controls maintenance procedure, it is recommended that the manual shaft be lubricated with a few drops of oil at the point where it enters the transmission case.

If a manual shaft shield is fitted, the shaft should not require lubrication.

## Section T3 TESTING

Before road testing the car to check the functioning of the transmission, carry out the following checks.

1. Check the fluid level and top-up, if necessary.
2. Ensure that the engine and transmission are at normal operating temperature  $76.7^{\circ}\text{C}$ . ( $170^{\circ}\text{F}$ ).
3. Ensure that the gearchange actuator is operating satisfactorily.
4. Check the manual linkage and adjust, if necessary (see Section T5).
5. Check the operation of the detent switch and adjust, if necessary (see Section T17).
6. If the oil pressure is to be checked, fit a gauge. The car can then be road tested, using all the selector ranges. Note when any operating faults occur. Check the gearchange pattern as follows.

### Gearchange pattern check

#### Drive range

1. Select 'D' range, then accelerate the car from standstill.
2. A 1-2 and a 2-3 up-change should occur at all throttle openings.

**Note** The change points will vary according to throttle opening.

3. As the speed of the car decreases to a stop, the 3-2 and the 2-1 down-changes should occur.

#### Intermediate range

1. Select 'I' range.
2. Accelerate the car from standstill.
3. A 1-2 up-change should occur at all throttle openings.

4. A 2-3 up-change cannot be obtained in this Range.

5. The 1-2 up-change point will vary according to throttle opening.

6. As the speed of the car decreases to a stop, the 2-1 down-change should occur.

#### Low range

1. Select 'L' range.
2. No up-change should occur in this Range, regardless of throttle opening.

### 2nd. gear overrun braking

1. Select 'D' range.
2. When a speed of approximately 35 m.p.h. (56 k.p.h.) has been reached, move the selector lever to the 'I' range position.
3. The transmission should change down to 2nd. gear.
4. An increase in the speed of the engine as well as an engine braking effect should be observed.
5. Line pressure should change from 70 lb/sq.in. (4.9 kg/sq.cm.) to approximately 150 lb/sq.in. (10.5 kg/sq.cm.).

### 1st. gear—downhill or overrun engine braking

1. Select 'I' range.
2. When the speed of the car is approximately 30 m.p.h. (48 k.p.h.) – not exceeding 40 m.p.h. (64 k.p.h.) – and at constant throttle, move the selector to 'L' range.

**Chapter T**

3. An increase in engine r.p.m. and a braking effect should be noticed as the down-change occurs.

**Oil pressure—To check**

Before attempting to check oil pressure or to road test the car, always ensure that the level of fluid in the transmission is correct (see Section T2 – Servicing).

The pressure can be checked with the transmission in the car by using an oil pressure gauge coupled to the main line tapping in the left-hand side of the transmission case.

1. Clean any dirt from around the line pressure plug; remove the plug.
2. Fit adapter RH 7914 into the main line tapping; tighten the adapter.
3. Screw a pressure gauge, 0 lb/sq.in. to 300 lb/sq.in. (0 kg/sq.cm. to 21,1 kg/sq.cm.) onto the adapter then position the gauge so that it can be seen from the driver's seat. This can be achieved by removing the carpet from the driver's side then removing the rubber plug from the side of the transmission tunnel. Run the gauge pipe through the hole then couple it to the adapter (see Fig. T133). Ensure that the gauge pipe does not interfere with the gear-change linkage.
4. Connect a tachometer to the engine; this will enable the gear change points to be positively identified.
5. Drive the car until the transmission has reached normal operating temperature 76–77°C. (170°F.).

6. Check the fluid level and correct, if necessary.

The following checks may be carried out during road test.

**Engine idle pressure check**

1. Select 'D' range then drive the car at approximately 30 m.p.h. (48 k.p.h.) with the throttle eased back. The line pressure should be 70 lb/sq.in. (4,9 kg/sq.cm.).
2. Select 'I' range then drive the car to obtain a steady road load, speed 25 m.p.h. (40 k.p.h.). Line pressure should be 150 lb/sq.in. plus or minus 5 lb/sq.in. (10,5 kg/sq.cm. plus or minus 0,35 kg/sq.cm.).

**Full throttle pressure check**

1. Jack up the rear of the car and suitably position blocks so that the rear wheels are clear of the ground.
2. Disconnect the vacuum line at the induction manifold.
3. Blank off the orifice in the manifold.
4. Run the engine at a fast idle (700 r.p.m. to 1 000 r.p.m.) in Neutral. The oil pressure should be 145 lb/sq.in. (10,2 kg/sq.cm.).
5. Repeat the procedure in Reverse. Reverse pressure should be 150 lb/sq.in. plus or minus 5 lb/sq.in. (10,5 kg/sq.cm. plus or minus 0,35 kg/sq.cm.).
6. Connect the vacuum pipe.

**Towing**

Cars which are fitted with the Torque Converter Transmission cannot be started by pushing the car.

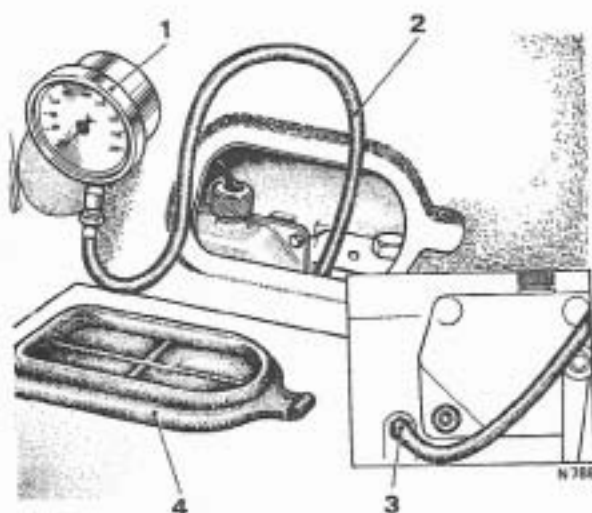
If the engine cannot be started by the starter motor, the car should be towed to the nearest service station.

If the transmission, propeller shaft, final drive unit and drive-shafts are serviceable, the car may be towed, in Neutral (N) at speeds of up to 35 m.p.h. (56 k.p.h.) for distances of up to 50 miles (80 kilometres).

When higher towing speeds, or extended mileage is necessary, it is recommended that the propeller shaft be disconnected or the rear wheels raised clear of the road.

Before towing, check the fluid level in the transmission. The level must be **above** the 'MAX' mark on the dipstick when the engine is **not running**. The car must always be towed with the transmission in Neutral.

If it is necessary to raise either the front or the rear part of the car when towing, the wheels should be raised so that they just clear the ground. When towing with the rear wheels raised, secure the steering wheel with the front road wheels in the 'straight ahead' position.



**FIG. T133 CHECKING THE OIL PRESSURE**

- 1 Oil pressure gauge
- 2 Gauge pipe
- 3 Pipe adapter (RH 7914)
- 4 Rubber cover

## Section T4

# FAULT DIAGNOSIS

Accurate diagnosis of transmission problems begins with a thorough understanding of normal transmission operation. In particular, knowing which units are involved in the various speeds and gears is essential so that the specific unit or fluid flow path can be isolated and investigated further.

The following diagnosis table lists the various diagnosis operations in the sequence in which they are to be performed.

Following the chart will, in most cases, correct the condition without having to remove the transmission from the car.

The instructions must be followed in exact sequence

as any deviation will result in incorrect diagnosis.

The following sequence of tests may help to simplify the diagnosis of defects and should be performed first.

1. Check fluid level.
2. Warm up engine and transmission.
3. Check manual controls.
4. Check detent switch.
5. Road test car.

**Note** If possible, test the car with the Customer as a passenger. It is possible that the condition which the Customer requires correcting is a normal function of the transmission, thus, unnecessary work can be avoided.

### DIAGNOSIS

| SYMPTOM                                                         | POSSIBLE CAUSE                                                                                                                                                                                                                                                                                                                                                                                                 | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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| 1 No drive in Drive range.                                      | <ol style="list-style-type: none"> <li>1 Insufficient fluid in transmission.</li> <li>2 Car battery flat — actuator inoperative.</li> <li>3 Manual linkage</li> <li>4 Incorrect line pressure.</li> <li>5 (a) Low line oil pressure.</li> <li>(b) Normal line oil pressure.</li> <li>6 Pump assembly.</li> <li>7 Forward clutch.</li> <li>8 Roller clutch (late cars)<br/>Sprag clutch (early cars)</li> </ol> | <ol style="list-style-type: none"> <li>1 Top-up as described on Page T163.</li> <li>2 Fit new fully charged battery. Also check thermal cut-out in Fusebox.</li> <li>3 Check and adjust the manual linkage as described on Page T183.</li> <li>4 With brakes applied, check line oil pressure (see Fig. T133).</li> <li>5 (a) Check items as listed under 'Low line pressure—Page T177'.</li> <li>(b) Check items 6-8 inclusive.</li> <li>6 Check forward clutch feed passage for restriction.</li> <li>7 Check items as listed under 'Burned forward clutch—Page T178'.</li> <li>8 Check clutch assembly for damage or incorrect installation.</li> </ol> |
| 2 (a) No drive in Reverse range.<br>(b) Slips in Reverse range. | <ol style="list-style-type: none"> <li>1 Insufficient fluid in transmission.</li> <li>2 Actuator inoperative.</li> <li>3 Manual linkage.</li> <li>4 Incorrect line oil pressure.</li> </ol>                                                                                                                                                                                                                    | <ol style="list-style-type: none"> <li>1 Top-up as described on Page T163.</li> <li>2 (a) Check operation of actuator as described in Section T7.</li> <li>(b) Check charge condition of battery.</li> <li>3 Check and adjust the manual linkage as described on Page T183.</li> <li>4 With brakes applied, check line oil pressure (see Fig. T133).</li> </ol>                                                                                                                                                                                                                                                                                            |



**Chapter T**

| SYMPTOM                                                                        | POSSIBLE CAUSE                                                                                                                                                                                                      | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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| 2 (a) No drive in Reverse range.<br>(b) Slips in Reverse range<br>— continued. | 5 (a) Low line oil pressure.<br>(b) Normal line oil pressure.<br>6 Control valve assembly.<br><br>7 Rear servo and accumulator.<br><br>8 Forward clutch.<br>9 Direct clutch.<br>10 Rear band.<br>11 Centre support. | 5 (a) Check items as listed under 'Low line oil pressure — Page T177'.<br>(b) Check items 6–11 inclusive.<br>6 (a) Check valve body gaskets are not damaged or incorrectly fitted.<br>(b) Check 2–3 valve train is not sticking open (this condition will also cause a 1–3 up-change in Drive range).<br>7 (a) Check for damaged rear piston seal.<br>(b) Check for short band apply pin (this condition may also cause no overrun braking or slipping in overrun braking — Low range).<br>(c) Check rear servo piston and bore.<br>8 Check clutch unit will release (if unit does not release this will also cause drive in Neutral).<br>9 Check items listed under 'Burned direct clutch — Page T178'.<br>10 Check the band for burned or loose linings, damaged anchor or apply pins, broken band.<br>11 Check to ensure oil seal rings or grooves are not damaged or worn. |
| 3 Drive in Neutral.                                                            | 1 Manual linkage.<br>2 Internal linkage.<br>3 Pump assembly.<br>4 Forward clutch.                                                                                                                                   | 1 Check and adjust manual linkage as described on Page T183.<br>2 (a) Manual valve disconnected or broken end.<br>(b) Inside detent lever pin broken.<br>3 Transmission fluid pressure leaking into forward clutch apply passage.<br>4 (a) Check items listed under 'Burned forward clutch — Page T178'.<br>(b) Incorrect assembly of forward clutch.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 4 (a) Will not hold in Park.<br>(b) Will not release from Park.                | 1 Manual linkage.<br>2 Internal linkage.                                                                                                                                                                            | 1 Check and adjust manual linkage as described on Page T183.<br>2 (a) Check parking brake lever.<br>(b) Check actuator assembly (check the chamfer on the actuator sleeve rod).<br>(c) Parking pawl broken, chamfer omitted.<br>(d) Parking pawl return spring broken, missing or incorrectly hooked.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 5 No engine braking in Low range — 1st. gear.                                  | 1 Transmission case assembly.<br><br>2 Rear servo.<br><br>3 Rear band.                                                                                                                                              | 1 (a) Low — Reverse check ball mis-positioned or missing.<br>(b) Transmission case damaged in area surrounding Low — Reverse check ball.<br>2 (a) Check servo for damaged oil seal ring, ring bore or piston.<br>(b) Rear band apply pin short.<br>(c) Incorrect assembly of parts.<br>3 (a) Broken or burned (check for cause).<br>(b) Check assembly engages correctly on anchor pins and/or servo pin.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 6 No engine braking in Intermediate Range — 2nd. gear.                         | 1 Front servo and accumulator.<br><br>2 Front band.                                                                                                                                                                 | 1 (a) Check for leaking or broken oil seal rings.<br>(b) Check for scored bores.<br>(c) Check for sticking servo piston.<br>2 (a) Check to ensure front band is not burned or broken.<br>(b) Check to ensure front band is engaging correctly on anchor pin and/or servo pin.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| SYMPTOM                                                                                                                                                                | POSSIBLE CAUSE                                                                                                                                                                                                                                                                                                                                                                            | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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| <p>7 No detent down-changes.<br/>Note Position car on a suitable ramp. Switch-on ignition but do not start engine.</p>                                                 | <p>1 Transmission case electrical plug.</p> <p>2 (a) Light off.<br/>(b) Light on.</p>                                                                                                                                                                                                                                                                                                     | <p>1 (a) Disconnect electrical plug.<br/>(b) Connect test-lamp to 'detent terminal' of disconnected wiring harness.<br/>(c) Depress accelerator 'fully'.</p> <p>2 (a) Incorrectly adjusted or faulty micro-switch. Faulty electrical circuit.<br/>(b) Check operation of detent solenoid. If solenoid cannot be heard to operate this may be due to<br/>(i) Faulty electrical connection.<br/>(ii) Sticking detent valve train.<br/>(iii) Restricted oil passage.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <p>8 Noisy transmission.<br/>Note Before checking transmission, ensure that noise is not from coolant pump alternator, air conditioning unit, power steering, etc.</p> | <p>1 Noise in Park, Neutral and all Drive ranges.</p> <p>2 First, Second and Reverse.</p> <p>3 During acceleration any gear.</p> <p>4 Squeak at low vehicle speeds.</p> <p>5 Clutch application during Neutral-to-Drive and/or Park-to-Drive.</p> <p>6 1-2 up-change in Intermediate and Drive ranges.</p> <p>7 2-3 up-change in Drive range, Neutral-to-Reverse and Park-to-Reverse.</p> | <p>1 (a) Pump cavitation.<br/>(i) Transmission fluid level low top-up as described on Page T163.<br/>(ii) Restricted or incorrect filter assembly.<br/>(iii) Intake 'O' ring damaged or intake pipe split.<br/>(iv) Transmission case — porosity at pump face intake port.<br/>(v) Pump to transmission case gasket not correctly fitted.<br/>(vi) Coolant in transmission fluid.<br/>(b) Pump assembly.<br/>(i) Defective or damaged gears.<br/>(ii) Drive gear incorrectly assembled.<br/>(iii) Crescent interference.<br/>(iv) Orifice cup plug in pressure regulator damaged or missing (buzzing noise).<br/>(v) Seal rings damaged or worn.<br/>(c) Converter.<br/>(i) Damaged converter.<br/>(ii) Loose bolts converter to flywheel.</p> <p>2 (a) Planetary gear train.<br/>(i) Gears or thrust bearings damaged. Thoroughly clean thrust bearings and thrust races. Closely inspect needles and surfaces for pitting and roughness.<br/>(ii) Front internal gear ring damaged.</p> <p>3 (a) Check coolant or transmission fluid lines to and from cooler are not fouling.<br/>(b) Check engine mounts are not loose or broken.</p> <p>4 Check speedometer driven gear shaft seal (lubricate or replace).</p> <p>5 Check condition of forward clutch assembly.</p> <p>6 Check condition of intermediate clutch plates.</p> <p>7 Check condition of direct clutch plates.</p> |
| <p>9 1st and 2nd speeds only (no 2-3 up-change).</p>                                                                                                                   | <p>1 Control valve assembly.</p>                                                                                                                                                                                                                                                                                                                                                          | <p>1 (a) Check for sticking 2-3 shift valve train (valves should fall under their own weight).<br/>(b) Check for damaged or incorrectly fitted gaskets between the control valve unit, oil guide plate and case.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

**Chapter T**

| SYMPTOM                                                         | POSSIBLE CAUSE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| 9 1st and 2nd speeds only (no 2-3 up-change) — <i>continued</i> | 2 Direct clutch.<br>3 Incorrect vacuum.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2 Check items listed under 'Burned direct clutch' — Page T178.<br>3 Check items listed under 'Incorrect vacuum at modulator' — Page T177.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 10 (a) No 1-2 up-change<br>(b) Delayed up-change.               | 1 Insufficient fluid in transmission.<br>2 Transmission case electrical plug.<br><br>3 (a) Normal up-change occurs.<br><br>(b) No up-change occurs.<br><br>4 (a) Pressure 60 to 90 lb/sq.in. (4,2 to 6,3 kg/sq.cm.) see test 3(b).<br><br>4 (b) Pressure 90 to 150 lb/sq.in. (6,3 to 10,5 kg/sq.cm.) see test 3(b).<br><br>5 (a) Pressure 55 to 70 lb/sq.in. (3,8 to 4,9 kg/sq.cm.) see test 4(b).<br><br>(b) Pressure 70 to 160 lb/sq.in. (4,9 to 11,2 kg/sq.cm.) see test 4(b).<br><br>6 Intermediate clutch. | 1 Top-up as described on Page T163.<br>2 Disconnect electrical plug and road test car.<br>3 (a) (i) Check for short circuit, correct detent switch and wiring.<br>(ii) Check for solenoid click.<br>(b) Check line pressure at 1 000 r.p.m. in Drive range.<br>4 (a) Control valve assembly.<br>(i) Check for sticking 2-3 shift valve train (valves should fall under their own weight).<br>(ii) Check for damaged or incorrectly fitted gaskets between control valve unit, oil guide plate and case.<br>4 (b) Check line pressure at 1 000 r.p.m. in Neutral.<br>5 (a) (i) Check detent system.<br>(ii) Check solenoid for operation and damage.<br>(iii) Check 'line - to - detent' orifice in spacer plate.<br>(iv) Check detent valve train.<br>(b) (i) Check for vacuum leaks or no vacuum as described on Page T177.<br>(ii) Check vacuum modulator for leaking diaphragm or bent neck see Page T179.<br>(iii) Check vacuum modulator valve is free to operate.<br>(iv) Check transmission case for damage or porosity at modulator valve.<br>6 Ensure intermediate clutch seals are sealing correctly (if transmission is dismantled for complaint of 'no 2nd gear' or 'transmission changes 1-3', always fit new inner and outer clutch piston seals). |
| 11 Rough 1-2 up-change.                                         | 1 Insufficient fluid in transmission.<br>2 Check condition of engine.<br>3 Vacuum line and components.<br><br>4 Line oil pressure.<br><br>5 (a) High line pressure.                                                                                                                                                                                                                                                                                                                                             | 1 Top-up fluid as described on Page T163.<br>2 Tune engine.<br>3 (i) Check vacuum as described on Page T177.<br>(ii) Check vacuum modulator for leaking diaphragm or bent neck see Page T179.<br>(iii) Check vacuum modulator valve is free to operate.<br>(iv) Check 'feel' of up-change.<br>4 Check line pressure in 'Drive' at 1 000 r.p.m.<br>5 (a) Check causes of high line pressure (see Page T176).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

| SYMPTOM                                | POSSIBLE CAUSE                                                                                                                   | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| 11 Rough 1-2 up-change<br>— continued. | 5 (b) Normal line pressure.                                                                                                      | 5 (b) (i) Remove control valve assembly and solenoid. Check 1-2 accumulator system in control valve assembly.<br>(ii) Check rear accumulator for sticking piston or leaks.<br>(iii) Check rear accumulator feed restricted in transmission case.<br>(iv) Check for correct number and location of check balls (see Fig. T216).                                                                                                                                                                                    |
|                                        | 6 Intermediate clutch.                                                                                                           | 6 (i) Check intermediate clutch, if 'burnt' check cause (see Page T178).<br>(ii) Check correct number and type of plates.                                                                                                                                                                                                                                                                                                                                                                                         |
| 12 Slipping 1-2 up-change.             | 1 Insufficient fluid in transmission.<br>2 Check condition of engine.<br>3 Vacuum line and components.                           | 1 Top-up fluid as described on Page T163.<br>2 Tune engine.<br>3 Check vacuum system for response at modulator. On pressure should vary and respond rapidly to quick changes in throttle openings.                                                                                                                                                                                                                                                                                                                |
|                                        | 4 (a) Poor response at modulator.<br><br>(b) Normal response at modulator.                                                       | 4 (a) (i) Check vacuum feed, including carburettor for restriction.<br>(ii) Check modulator assembly (see Page T179).<br><br>(b) Check line pressure in 'Drive' at 1 000 r.p.m.                                                                                                                                                                                                                                                                                                                                   |
|                                        | 5 (a) Low line oil pressure.<br>(b) Normal line oil pressure.                                                                    | 5 (a) Check causes of Low line pressure (see Page T177).<br>(b) (i) Check control valve assembly bolt torque.<br>(ii) Remove control valve assembly and detent solenoid.<br>(iii) Check spacer plate for blocked orifice.<br>(iv) Check for damaged rear servo piston or oil seal ring.<br>(v) Check rear accumulator piston, rings and case bore.<br>(vi) Check 1-2 accumulator valve system. Check front accumulator piston and oil rings.<br>(vii) Check centre support bolt torque and support for looseness. |
|                                        | 6 Intermediate clutch.                                                                                                           | 6 Air check intermediate clutch for leakage at seals.                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                        | 7 (a) Excessive leakage.<br><br>(b) Normal leakage.                                                                              | 7 (a) Remove and inspect intermediate clutch and centre support — check case to support face. If plates are 'burnt' check cause (see Page T178).<br>(b) Check intermediate clutch for correct components, correct number of release springs or 'cocked' release spring. Check intermediate clutch piston for flatness.                                                                                                                                                                                            |
| 13 Rough 2-3 up-change.                | 1 Insufficient fluid in transmission.<br>2 Check condition of engine.<br>3 Check line pressure.<br>4 (a) High line oil pressure. | 1 Top-up fluid as described on Page T163.<br>2 Tune engine.<br>3 With brakes applied check line pressure in 'Drive' at 1 000 r.p.m.<br>4 (a) Check cause of high line oil pressure (see Page T176).                                                                                                                                                                                                                                                                                                               |

**Chapter T**

| SYMPTOM                                          | POSSIBLE CAUSE                                                                                                                                                                                                         | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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| 13 Rough 2-3 up-change<br>— continued.           | 4 (b) Normal line oil pressure.<br><br>5 Direct clutch.                                                                                                                                                                | 4 (b) Remove control valve assembly.<br>(i) Check front accumulator for sticking piston, also for broken or missing spring.<br>(ii) Check control valve assembly for drilling to accumulator.<br>5 (a) Check direct clutch for leakage to outer area of clutch piston (leak could be at centre piston seal — 2nd ring on centre support).<br>(b) Damaged centre support.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 14 Slipping 2-3 up-change.                       | 1 Insufficient fluid in transmission.<br>2 Check condition of engine.<br>3 Check line oil pressure.<br><br>4 (a) Low line oil pressure.<br>(b) Normal line oil pressure.<br><br>5 Front Servo.<br><br>6 Direct clutch. | 1 Top-up fluid as described on Page T00.<br>2 Tune engine.<br>3 With brakes applied check line oil pressure in Drive at 1 000 r.p.m.<br>4 (a) Check cause of Low line oil pressure (see Page T177).<br>(b) Remove control valve assembly.<br>(i) Check spacer plate for damage, blocked direct clutch feed orifice or mispositioned gasket.<br>(ii) Check for damaged or leaking oil passages.<br>(iii) Check for sticking valves.<br>5 (a) Check for broken or missing front servo spring.<br>(b) Check for leak at servo pin.<br>6 (a) (i) Air check direct clutch for excessive leak.<br>(ii) Remove transmission, inspect for case to centre support leak.<br>(iii) Broken or undersize oil rings.<br>(iv) Damaged or missing piston seals.<br>(b) Remove transmission and inspect direct clutch for correct number and type of clutch plates.                                         |
| 15 (a) Delayed up-changes.<br>(b) No up-changes. | 1 Detent system (full throttle) micro-switch.<br><br>2 Incorrect modulator vacuum.<br><br>3 Incorrect line pressure.                                                                                                   | 1 Disconnect the Green/White wire from connection on side of transmission. Test up-changes.<br>(a) If up-changes occur, problem is in micro-switch or wiring.<br>(b) If fault persists continue to Operation 2.<br>2 Connect gauge to lower end of vacuum modulator pipe. Check for normal vacuum.<br>(a) If vacuum is low or not present, check for leaks and restrictions.<br>(b) If fault persists continue to Operation 3.<br>3 Connect gauge to transmission and check 'Line pressure' in 'Drive' range with engine speed of 1 000 r.p.m. Normal pressure is between 65 lb/sq.in. and 75 lb/sq.in. (4.57 kg/sq.cm. and 5.27 kg/sq.cm.)<br>Note Normal Line pressure in 'Drive' range with car stationary should vary from approx. 65 lb/sq.in. (4.57 kg/sq.cm.) at idle speed to 150 lb/sq.in. (10.55 kg/sq.cm.) at full throttle. The pressure increases as engine vacuum decreases. |



| SYMPTOM                                                                                                                   | POSSIBLE CAUSE                                                                                                                                                                                                                                                                                      | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| 15 (a) Delayed up-change.<br>(b) No up-changes<br>— continued.                                                            | 4 Line pressure 95 lb/sq.in. to 110 lb/sq.in. (6.68 kg/sq.cm. to 7.73 kg/sq.cm.).<br><br>5 Line pressure 135 lb/sq.in. to 150 lb/sq.in. (9.49 kg/sq.cm. to 10.55 kg/sq.cm.).<br><br>6 Normal Line pressure 65 lb/sq.in. to 75 lb/sq.in. (4.57 kg/sq.cm. to 5.27 kg/sq.cm.).<br><br>7 Detent system. | 4 Check complete detent system.<br><br>5 With good vacuum at modulator check.<br>(a) Modulator valve.<br>(b) Pressure regulator components.<br>6 Remove governor assembly; check for freedom of operation and presence of dirt. Clean if necessary. Check bleed orifice in centre of governor valve is not blocked.<br>7 (a) Detent solenoid loose or defective.<br>(b) Solenoid feed orifice blocked. This is the 0.034 in. (0.86 mm.) dia. hole in the valve body spacer plate, nearest to the detent solenoid. (An incorrectly fitted gasket could block the hole).<br>(c) Detent valve spacer pin either short or missing. The pin should be 1.221 in. to 1.215 in. (31.01 mm. to 30.86 mm.) in length.<br>(d) Detent valve bore plug pushed too far and tilted. The plug should be seated against the retaining pin.<br>(e) Detent valve bore plug under-size or eccentric, causing an excessive leak at the detent valve. |
| 16 Torque Converter Leaks.                                                                                                | 1 Converter welding.<br><br>2 Damaged or worn converter hub.                                                                                                                                                                                                                                        | 1 (a) Carry out converter leak check (see Page T229 — Torque Converter — To Leak test).<br>(b) Fit new converter if unit is leaking.<br>2 (a) Closely inspect converter hub for wear and scoring that can damage seal.<br>(b) Repair converter hub with crocus cloth if practical, or fit new components.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 17 Torque Converter Vibrations                                                                                            | 1 Converter/Flex-plate out of balance.<br><br>2 Converter balance weight.<br><br>3 Crankshaft pilot.                                                                                                                                                                                                | 1 (a) Isolate cause of vibration.<br>(b) Change position of converter on flex-plate 120° at a time to cancel out engine/converter out of balance condition.<br>2 (a) Check converter for loss of balance weight.<br>(b) Change converter if balance weight is lost.<br>3 (a) Check to ensure converter to crankshaft pilot is not broken.<br>(b) Change converter if pilot is broken.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 18 Torque Converter Noisy or Slips.<br>(Most converter noise occurs under light throttle in 'Drive' with brakes applied). | 1 Loose flex-plate to converter bolts.<br><br>2 Cracked flex-plate.<br><br>3 Items listed under Operation 17 — Torque Converter Vibrations.<br>4 Internal damage to converter.                                                                                                                      | 1 (a) Check flex-plate and converter for damage.<br>(b) If no damage is apparent, tighten bolts.<br>(c) If damage is apparent replace components.<br>2 (a) Check for cracked flex-plate (engine to case dowel pins missing can result in cracked flex-plate).<br>(b) Replace damaged components.<br>3 Items listed under Operation 17 — Torque Converter Vibrations.<br>4 (a) Check thrust roller bearing, thrust races and roller clutch for damage.<br>(i) Thrust roller bearing and thrust races can be checked by viewing them when looking into the converter neck or feeling through the opening to                                                                                                                                                                                                                                                                                                                       |

**Chapter T**

| SYMPTOM                                                 | POSSIBLE CAUSE                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| 18 Torque Converter Noisy or Slips — <i>continued</i> . | <p>5 Excessive Torque Converter end clearance.</p> <p>6 Converter Fluid.</p> <p><b>Note</b> Do not change the converter if a failure in some other part of transmission has resulted in converter containing dark discoloured fluid. The full flow filters used in the transmission will remove all harmful residue from failures (other than converter or pump failures) before oil is pumped into converter. Full flow filter fitted to this transmission from late 1967.</p> | <p>make sure they are not cracked, broken or incorrectly positioned (see Fig. T171).</p> <p>Fit a new converter if damage is apparent.</p> <p>(ii) Roller clutch function can be checked by placing a finger into the converter neck and with side pressure against the splines, turn the stator race. The race should turn fairly free in a clockwise direction and not turn in an anti-clockwise direction.</p> <p>Fit a new converter if damage is apparent.</p> <p>5 (a) Check Torque Converter end clearance (see Page T229).</p> <p>(b) Fit a new converter if end clearance is excessive.</p> <p>6 (a) Check colour of fluid, if this appears as 'aluminium paint' converter is internally damaged.</p> <p>(b) Check anti-freeze has not contaminated converter fluid.</p> <p>(c) Fit new converter.</p> <p>Correct transmission problem, change fluid and filter.</p> |

**High line pressure**

If either the idle or full throttle pressure checks is high, the cause may be as follows.

**1. Vacuum leak**

- a Full leak (vacuum line disconnected).
- b Partial leak in line from engine modulator.
- c Incorrect engine vacuum.
- d Leak in vacuum operated accessories.

**2. Damaged Modulator**

- a Sticking valve.
- b Water in modulator.
- c Incorrect operation of modulator  
(See Page T231 — Section T11).

**3. Detent System**

- a Detent switch actuated (plunger sticking) or shorted.
- b Detent wiring shorted.

- c Detent solenoid stuck open.
- d Detent feed orifice in spacer plate blocked.
- e Detent solenoid loose.
- f Detent valve bore plug damaged.
- g Detent regulator valve pin short.

**4. Pump**

- a Pressure regulator and/or boost valve stuck.
- b Incorrect pressure regulator spring.
- c Excessive number of pressure regulator valve spacers.
- d Faulty pump casting.
- e Pressure boost valve installed incorrectly or otherwise defective.
- f Aluminium bore plug defective.
- g Pressure boost bush defective.

**5. Control valve assembly**

- a Spacer plate-to-case gasket incorrectly fitted.
- b Incorrect plate-to-case gasket.

**Low line pressure**

If either the idle or full throttle pressure checks is low, the cause may be as follows.

1. **Transmission oil level low.**
2. **Modulator assembly** (see Fig. T174).
3. **Filter**
  - a Blocked or restricted.
  - b 'O' ring on intake pipe omitted or damaged.
4. **Split or leaking intake pipe**
5. **Incorrect filter assembly**
6. **Pump**
  - a Pressure regulator or boost valve sticking.
  - b Gear clearance, damaged or worn (pump will become damaged if the drive gear is installed the wrong way or if the converter pilot does not enter the crankshaft freely).
  - c Pressure regulator spring weak.
  - d Insufficient spacers in pressure regulator.
  - e Pump to case gasket incorrectly positioned.
  - f Defective pump body and/or cover.
7. **Leaks in the internal circuit**
  - a Forward clutch leak (pressure normal in Neutral and Reverse — pressure low in Drive).
    - (i) Check pump rings.
    - (ii) Check forward clutch seals.
  - b Direct clutch leak (pressure normal in Neutral), Low, Intermediate and Drive — pressure low in Reverse).
    - (i) Check centre support oil seal rings.
    - (ii) Check direct clutch outer seal for damage.
    - (iii) Check rear servo and front accumulator pistons and rings for damage or missing.
8. **Case assembly**
  - a Porosity in intake bore area.
  - b Check case for intermediate clutch plug leak or blown out.
  - c Low - Reverse check ball incorrectly positioned or missing (this condition will cause no Reverse and no overrun braking in Low range).

**Note** When checking item 3 — Filter it should be noted that there is no approved method for either checking or cleaning the filter. If the performance of the filter is suspect a new filter must be fitted.

**Improper vacuum at modulator**

1. **Engine**
  - a Requires tune-up.
  - b Loose vacuum fittings.
  - c Vacuum operated accessory leak.
2. **Vacuum line to modulator**
  - a Leak.
  - b Loose fitting.
  - c Restricted orifice, or incorrect orifice size.
  - d Carbon build-up at modulator vacuum fitting.
  - e Pinched line.
  - f Grease or varnish material in pipe (no or delayed upchange — cold).

**Oil leaks**

1. **Transmission oil sump leaks**
  - a Securing bolts not correctly torque tightened.
  - b Improperly installed or damaged sump gasket.
  - c Oil sump gasket mounting face not flat.
2. **Case extension leak**
  - a Securing bolts not correctly torque tightened.
  - b Rear seal assembly damaged or incorrectly installed.
  - c Gasket (extension to case) damaged or incorrectly installed.
  - d Porous casting.
  - e Output shaft 'O' ring damaged.
3. **Case leak**
  - a Filler pipe 'O' ring damaged or missing; mispositioned filler pipe bracket to engine 'loading' one side of the 'O' ring.
  - b Modulator assembly 'O' ring damaged or incorrectly installed.
  - c Connector 'O' ring damaged or incorrectly installed.
  - d Governor cover, gasket and bolts damaged or loose; case face leak.
  - e Damaged or porosity. Leak at speedometer driven gear housing or seal. Leak at speedometer hole plug.
  - f Manual shaft seal damaged or incorrectly installed.
  - g Line pressure tap plug stripped.
  - h Vent pipe (refer to Item 3).
  - i Porous case or crack at pressure plug boss.
4. **Front end leak**
  - a Front seal damaged (check converter neck for nicks, etc., also for pump bushing moved forward), garter spring missing.

**Chapter T**

- b Pump securing bolts and seals damaged; bolts missing or loose.
  - c Converter (leak in weld).
  - d Pump 'O' ring seal damaged (Also check pump oil ring groove and case bore).
  - e Porous casting (pump or case).
  - f Pump drain back hole not open.
5. **Oil comes out vent pipe**
- a Transmission over-filled.
  - b Water in oil.
  - c Filter 'O' ring damaged or incorrectly assembled causing oil to foam.
  - d Foreign material between pump and case or between pump cover and body.
  - e Case porous, pump face incorrectly machined.
  - f Pump porous.
  - g Pump to case gasket mispositioned.
  - h Pump breather hole blocked or missing.
  - i Hole in intake pipe.
6. **Modulator Assembly**
- a Diaphragm defective.

**Control valve assembly—Governor line pressure check**

1. Install line pressure gauge.
2. Disconnect vacuum line to modulator.
3. With car on hoist (rear wheels off ground), foot off brake, in Drive, check line pressure at 1 000 r.p.m.
4. Slowly increase engine revolutions to 3 000 r.p.m. and determine if a line drop occurs of 7 lb/sq. in. (0.49 kg/sq. cm.) or more.
5. If pressure drop occurs, dismantle, clean and inspect control valve assembly.
6. If no pressure drop occurs:
  - a Inspect governor.
    - (i) Sticking valve.
    - (ii) Weight freeness.
    - (iii) Restricted orifice in governor valve.
  - b Governor feed system.
    - (i) Check screen in governor feed pipe hole in case assembly.
    - (ii) Check for restrictions in governor pipe.

**Burned clutch plates**

**Note** Burned clutch plates can be caused by incorrect usage of clutch plates. Also, anti-freeze in transmission fluid can cause severe damage, such as large pieces of composition clutch plate material peeling off.

1. **Forward clutch**
  - a Check ball in clutch housing for damage, sticking or missing.
  - b Clutch piston cracked, seals damaged or missing.
  - c Low line pressure.
  - d Manual valve mispositioned.
  - e Restricted oil feed to forward clutch. (Clutch housing to inner and outer areas not drilled, restricted or porosity in pump).
  - f Pump cover oil seal rings missing, broken or undersize; ring groove oversize.
  - g Case valve body face not flat or porosity between channels.
  - h Manual valve bent and centre land not ground properly.
2. **Intermediate clutch**
  - a Rear accumulator piston oil ring, damaged or missing.
  - b 1-2 accumulator valve sticking in control valve assembly.
  - c Intermediate clutch piston seals damaged or missing.
  - d Centre support bolt loose.
  - e Low line pressure.
  - f Intermediate clutch plug in case missing.
  - g Case valve body face not flat or porosity between channels.
  - h Manual valve bent and centre land not ground properly.
3. **Direct clutch**
  - a Restricted orifice in vacuum line to modulator (poor vacuum response).
  - b Check ball in direct clutch piston damaged, sticking or missing.
  - c Defective modulator bellows.
  - d Centre support bolt loose (Bolt may be tight in support but not holding support tight to case).
  - e Centre support oil rings or grooves damaged or missing.
  - f Clutch piston seals damaged or missing.
  - g Front and rear servo pistons and seals damaged.
  - h Manual valve bent and centre land not cleaned up.
  - i Case valve body face not flat or porosity between channels.
  - j Intermediate roller clutch installed backwards.
  - k 3-2 valve, 3-2 spring or 3-2 spacer pin installed in wrong location in 3-2 valve bore.

**Note** If direct clutch plates and front band are burned, check manual linkage.

### Vacuum modulator assembly

The following procedure is recommended for checking modulator assemblies in service before replacement is undertaken.

1. **Vacuum Diaphragm Leak Check.** Insert a pipe cleaner into the vacuum connector pipe as far as possible and check for the presence of transmission oil. If oil is found, replace the modulator.

**Note** Petrol or water vapour may settle in the vacuum side of the modulator. If this is found **without** the presence of oil, the modulator should **not** be changed.

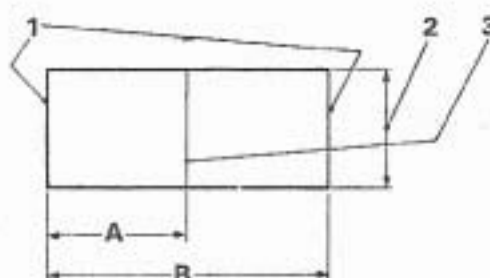
2. **Atmospheric Leak Check.** Apply a liberal coating of soap bubble solution to the vacuum connector pipe seam, the crimped upper to lower housing seam, and the threaded screw seal. Using a short piece of rubber tubing, apply air pressure to the vacuum pipe by blowing into the tube and observe for leak bubbles. If bubbles appear, replace the modulator.

**Note** Do not use any method other than human lung power for applying air pressure, as pressures over 6 lb/sq. in. (0.42 kg/sq. cm.) may damage the modulator.

3. **Bellows Comparison Check.** Make a comparison gauge (see Fig. T134), and compare the load of a known good modulator with the assembly in question.

- a Install the modulator that is known to be acceptable on either end of the gauge.
- b Install the modulator in question on the opposite end of the gauge.
- c Holding the modulators in a horizontal position, bring them together under pressure until either modulator sleeve end just touches the line in the centre of the gauge. The gap between the opposite modulator sleeve end and the gauge line should then be 0.0625 in. (1.59 mm.) or less. If the distance is greater than this amount the modulator in question should be replaced.

4. **Sleeve Alignment Check.** Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the body. If the sleeve is concentric and the plunger is free, the modulator is acceptable. Once the modulator assembly passes all of the above tests, it is an acceptable part and should be fitted again.



F229

FIG. T134 COMPARISON GAUGE

- 1 Ends to be square within 1/64 in. (0.397 mm.)
- 2 Round or flat bar between 13/32 in. (10.32 mm.) and 3/8 in. (9.5 mm.) in width
- 3 Scribed centre line
- A 1/2 in. (12.7 mm.)
- B 1.0 in. (25.4 mm.)

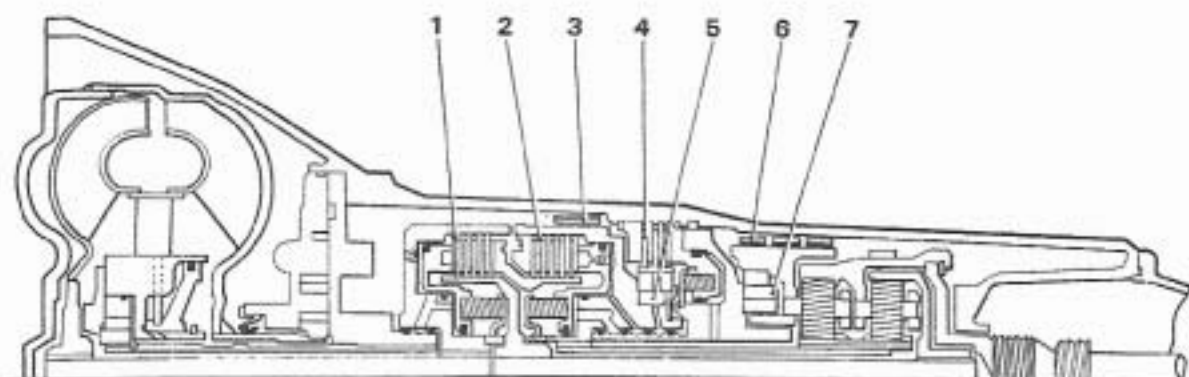
### Down-change solenoid circuit—To check

**Note** Before checking the down-change solenoid circuit, make certain that the transmission down-change switch is properly adjusted as described in Operation 5.

1. With the transmission gear range selector lever in Park, turn the ignition switch to the 'ON' position but do not start the engine. Leave the ignition switch 'ON' throughout the checking procedure.
2. Working under the bonnet slowly advance the throttle linkage to the full throttle position. One click should be heard from the transmission.
3. Allow the throttle to return to the closed position. One click should be heard from the transmission.
4. If the system performed as described above, the down-change circuit is operating properly. If the system does not perform as described above, proceed to Operation 5.
5. Disconnect the Green/White wire from the connection on the side of the transmission case, fit a test lamp into the circuit between the Green/White wire and the connection on the side of the transmission case, ensure that the test lamp bulb lights when the throttle linkage is in the full throttle position. The bulb should extinguish when the throttle is released.



## Chapter T



| SELECTOR POSITION | Park - Neut: | Drive                      |     |     | Intermediate |   | Lo        |   | Reverse   |
|-------------------|--------------|----------------------------|-----|-----|--------------|---|-----------|---|-----------|
|                   |              | 1                          | 2   | 3   | 1            | 2 | 1         | 2 |           |
| PUMP PRESSURE     | 70-160       | 70-160<br>70-160<br>70-160 |     |     | 175 - 175    |   | 175 - 175 |   | 100 - 230 |
| FORWARD CLUTCH    | OFF          | ON                         | ON  | ON  | ON - ON      |   | ON - ON   |   | OFF       |
| DIRECT CLUTCH     | OFF          | OFF                        | OFF | ON  | OFF - OFF    |   | OFF - OFF |   | ON        |
| 2nd OVERRUN BAND  | OFF          | OFF                        | OFF | OFF | OFF - ON     |   | OFF - ON  |   | OFF       |
| INT. CLUTCH       | OFF          | OFF                        | ON  | ON  | OFF - ON     |   | OFF - ON  |   | OFF       |
| INT. SPRAG        | OFF          | OFF                        | ON  | OFF | OFF - ON     |   | OFF - ON  |   | OFF       |
| REAR SPRAG        | OFF          | ON                         | OFF | OFF | ON - OFF     |   | ON - OFF  |   | OFF       |
| REVERSE BAND      | OFF          | OFF                        | OFF | OFF | OFF - OFF    |   | ON - OFF  |   | ON        |

P130

FIG. T135 BAND, ROLLER CLUTCH AND CLUTCH APPLICATION CHART

- 1 Forward clutch
- 2 Direct clutch
- 3 Second overrun (front) band
- 4 Intermediate clutch
- 5 Intermediate sprag or roller clutch
- 6 Reverse (rear) band
- 7 Rear sprag or roller clutch

- a If the system operates as described above, but did not perform properly during Operations 1-3, replace solenoid after first checking to see that the internal wiring is operational.
  - b If the test lamp bulb fails to light with the throttle in the wide open position, the circuit is open, proceed to Operation 6.
  - c If the test lamp bulb lights with the throttle closed, the circuit is shorted, proceed to Operation 9.
6. Remove the Green/White wire from the transmission down-change switch. Connect the test lamp between the switch terminal and earth; at full throttle ensure that the bulb of the test lamp lights.
    - a If the test lamp bulb lights, replace electrical wire. Re-check system.
    - b If the test lamp bulb fails to light, proceed to Operation 7.
  7. Check the White feed wire at the transmission down-change switch with test lamp.
    - a If the test lamp bulb lights, replace transmission down-change switch. Re-check system.
    - b If the test lamp fails to light, proceed to Operation 8.

8. Check the transmission thermal cut-out on the fuse panel.
  - a If necessary to replace the cut-out, re-check system.
  - b If the cut-out is correct it will be necessary to locate the fault in the wiring. Test for circuit continuity from the White feed wire at the down-change switch to the battery.
9. Remove the Green/White wire at transmission down-change switch. Use the test lamp to check from the bare terminal at the switch with throttle closed.
  - a If the test lamp bulb fails to light, system is correct.
  - b If the test lamp bulb lights, proceed to Operation 10.
10. With the throttle in the closed position, check the White feed wire at transmission down-change switch.
  - a If the test lamp bulb lights, replace transmission down-change switch. Re-check system.
  - b If the test lamp bulb fails to light, it will be necessary to locate the short in the wiring. Test the circuit from the White feed wire at down-change switch to the battery.

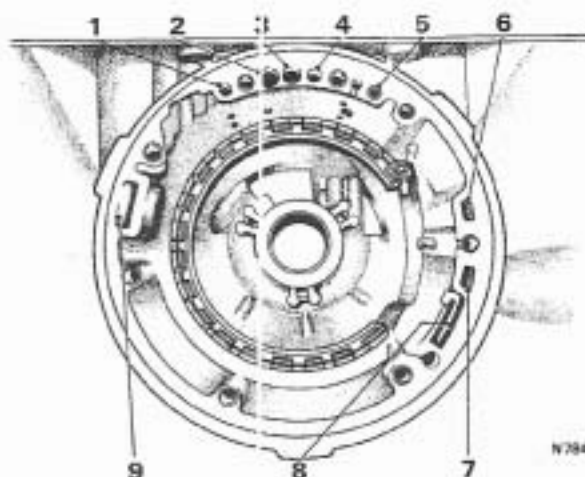
**Type AA Clutch Parts**

| Clutch              | No. of Flat Steel Clutch Plates | No. of Waved Steel Clutch Plates |
|---------------------|---------------------------------|----------------------------------|
| Forward Clutch      | *4                              | 1                                |
| Direct Clutch       | *5                              | 1                                |
| Intermediate Clutch | 2                               | 1                                |

\* Steel Plate Thickness 0.0915 in. (2.323 mm.)

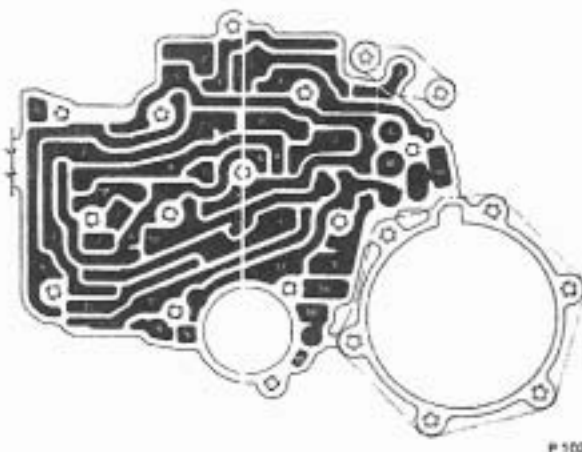
| Clutch              | No. of Clutch Composition Plates | No. of Piston Release Springs |
|---------------------|----------------------------------|-------------------------------|
| Forward Clutch      | 5                                | 16                            |
| Direct Clutch       | 6                                | 16                            |
| Intermediate Clutch | 3                                | 6                             |

For additional information in diagnosing the faults which may occur in a Torque Converter Transmission, a chart showing the application of bands and clutches in the various drive ranges is shown in Figure T135. Transmission fluid passages are shown in Figures T136 and T137.



**FIG. T136 TRANSMISSION CASE FLUID PASSAGES—FRONT VIEW**

- 1 Reverse
- 2 Line
- 3 Drive
- 4 Modulator
- 5 Stator signal (early cars only)
- 6 To heat exchanger
- 7 From heat exchanger
- 8 Vent
- 9 Pump intake



**FIG. T137 TRANSMISSION CASE FLUID PASSAGES—BOTTOM VIEW**

- 1 Intermediate oil
- 2 Exhaust
- 3 Line pressure oil
- 4 Lo oil
- 5 Reverse oil
- 6 Detent oil
- 7 Modulator oil
- 8 Drive range oil
- 9 Servo oil
- 10 Intermediate clutch oil
- 11 Reverse/Lo oil
- 12 Modulator/intermediate oil
- 13 Direct clutch oil
- 14 1-2 accumulator oil
- 15 Governor oil