



The 1968 VW Program

Provisional Workshop Manual

VW 1600 Automatic (Type 3)

Rear Axle and Transmission

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The "Provisional Workshop Manual 1968" (Section 5) contains instructions for repairing, checking and adjusting the automatic transmission of the VW 1600.

The pages are punched so that they can easily be filed in normal binders. The issue of a special binder is not being contemplated. If you prefer to file the individual parts of the sections in existing Workshop Manuals, they can be cut apart at the spine.

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Rear Axle and Transmission

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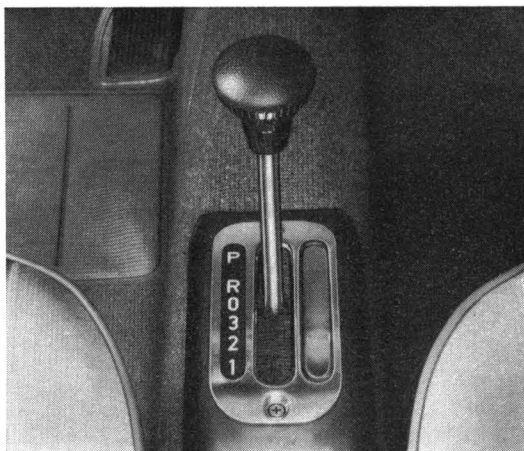
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The automatic transmission of the VW 1600 consists of a fully automatic 3-speed gear system combined with a torque converter. The normal friction clutch and pedal have been dispensed with and the gear lever replaced by a selector lever. The forward gears are shifted automatically at the appropriate road speed and in accordance with the engine speed and loading. The shift to the next higher or lower gear takes place at the same point as a skilled driver would change with a manual transmission.

Operation

With the selector lever fitted on the tunnel at the same location as the previous gear lever, three forward ranges, neutral, reverse and a parking position can be selected. The driving ranges are indicated on a small plate fixed to the frame tunnel alongside the opening for the selector lever.



From front to rear, the 6 selector lever positions are as follows:

“P” - Park

In this position, the transmission is locked by means of a small pawl which engages a gear on the output shaft of the transmission. “P” must only be engaged when the vehicle is stationary and after the handbrake has been applied. Move lever from park position before releasing handbrake.

“R” - Reverse

“R” must only be selected when the vehicle is stationary and engine at idling speed.

“0” - Neutral, no power transmission

The engine cannot be started unless the lever is in this position.

“3” - Forward gear

This position is used for all normal driving conditions. The three forward gears are shifted up and down automatically.

“2” - Forward gear

In this position, the transmission only shifts in the 1st and 2nd gears and should be used when the engine braking in position 3 is insufficient.

This position must only be selected when the vehicle speed is **below 60 mph** and this speed should not be exceeded in this gear.

“1” - Forward gear

In this position, the transmission remains in 1st gear so that full use can be made of the engine braking when descending steep hills.

This position must only be selected when the vehicle speed is **below 37 mph**.

The selector lever has a catch to prevent it from being moved from neutral into "P" or "R" accidentally. The catch is overcome by lifting the lever. There are spring-loaded stops between neutral and the forward gear range and between the gears.

The lever must only be moved from "0" to another position when the engine is running at idling speed. If the lever is moved to "0" accidentally while driving, release the accelerator pedal and wait until engine is idling before selecting a gear.

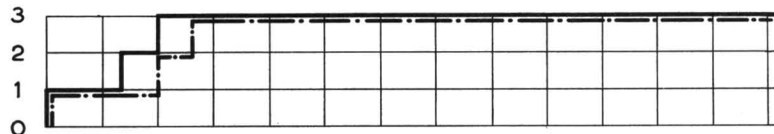
If 2nd gear is selected when vehicle is moving, in order to use engine braking force, the transmission will shift to 2nd gear immediately.

If lever is moved from 3rd gear to 1st gear at a vehicle speed of approximately 37 mph, the transmission will shift to 2nd gear first and then, according to accelerator pedal position, into 1st gear at a speed of between 37 and 18 mph. The gear then remains engaged regardless of vehicle speed.

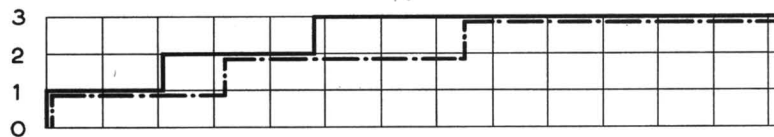
Apart from the selector lever, the transmission operation can also be influenced by the accelerator pedal. When the throttle is only slightly open, the gearshifts will occur at low vehicle speeds. At larger throttle openings and increased engine loading, the shift points will take place at higher speeds. The transmission still shifts at medium engine speeds however so that a smooth economical style of driving is obtained.

Shift points at:

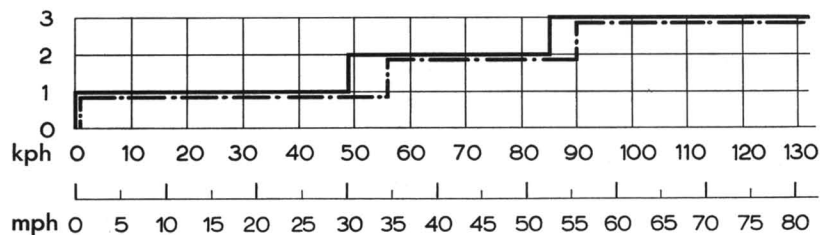
Part throttle



Full throttle



Kickdown



--- Upshift
 — Downshift

B i n d e r P u n c h A r e a

Forced throttle gearshifting

When the accelerator pedal is depressed through its “hard spot”, the engine revs right up in the gears so that the full engine output is available on hills and for overtaking purposes. Depressing the accelerator pedal fully in this manner moves the shift points for up and down shifts into a higher speed range.

Immediate downshifts from 3rd or 2nd gear within the permissible speed range of the next lower gear can be made by the kickdown method.

Emergency starting

Vehicles with the automatic transmission cannot be started by towing or pushing because the transmission oil pump only works when the engine is running. When the engine is not running there is no oil pressure for the hydraulic control circuits so no power can be transmitted.

Towing

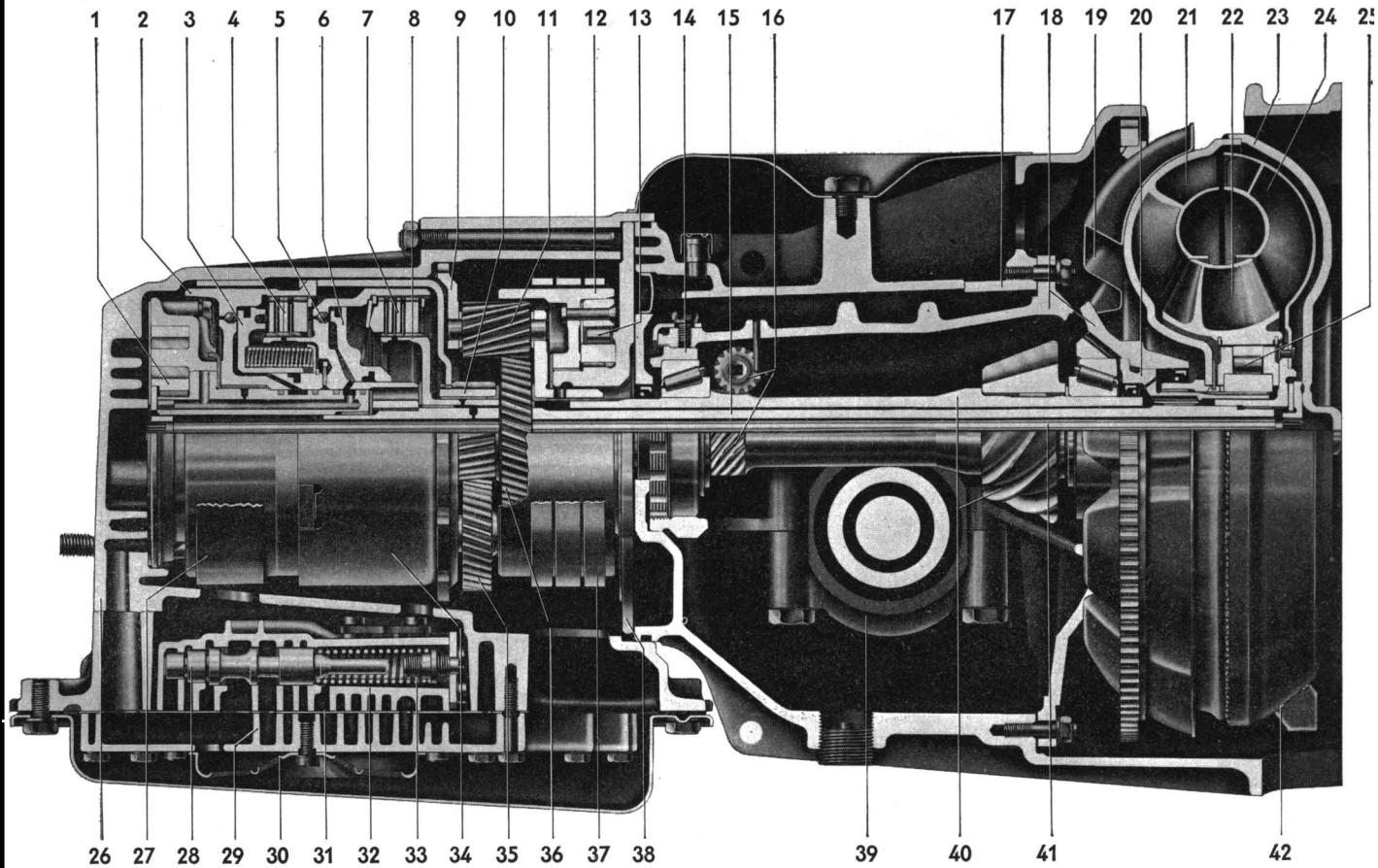
If a vehicle with automatic transmission has to be towed for any reason, the speed must not exceed 30 mph and the distance must not be more than 30 miles. This is because the lubrication of the rotating transmission parts is inadequate when the engine is stationary and the oil pump not working. If the vehicle has to be towed for a longer distance, the rear end must be lifted or, if the vehicle is to be towed on its wheels, the drive shafts to the rear wheels must be removed.

Construction of transmission

The transmission consists of the following main parts:

- Hydrodynamic torque converter
- Planetary gears with shift components
- Hydraulic controls
- Final drive.

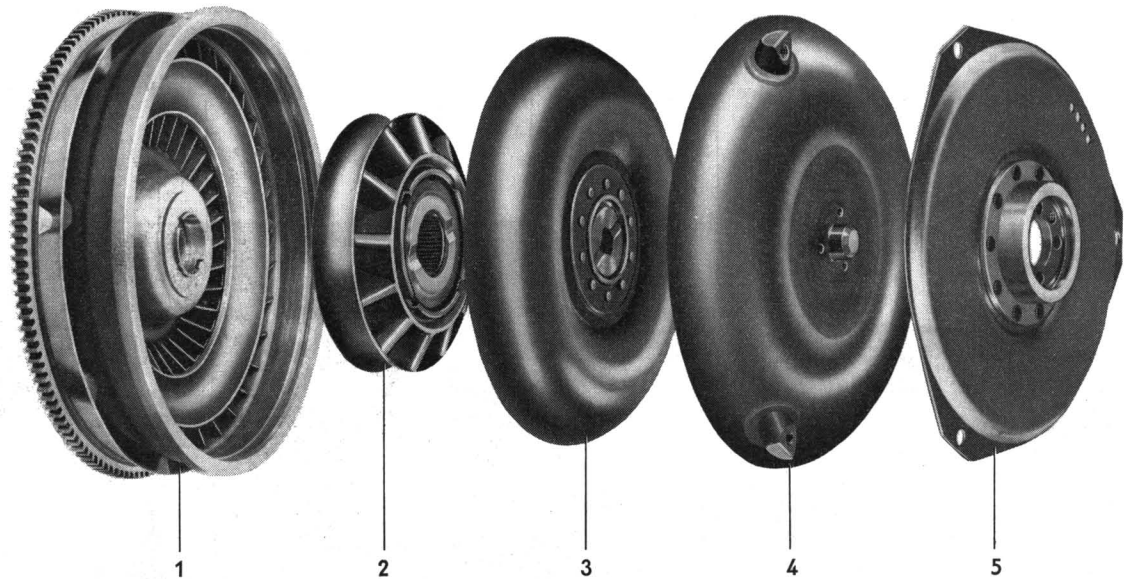
The aluminium transmission case is in two parts which are bolted together. In the front part are the planetary gears, two multiple disc clutches, two brake bands, a one-way clutch and parts of the hydraulic control mechanism. In the rear part are the final drive and the torque converter. The final drive is mounted in a cast iron differential carrier and installed in the final drive housing.



- | | | |
|--|------------------------------------|-----------------------------------|
| 1 - Oil pump | 15 - Turbine shaft | 29 - Transfer plate |
| 2 - Clutch drum | 16 - Governor drive | 30 - Oil strainer |
| 3 - Piston for direct and reverse clutch | 17 - Final drive housing | 31 - Separator plate |
| 4 - Direct and reverse clutch | 18 - Differential carrier | 32 - Valve body |
| 5 - Forward clutch drum with ball valve | 19 - Cooling fins | 33 - Spring for valve |
| 6 - Piston for forward clutch | 20 - Torque converter support tube | 34 - Driving shell |
| 7 - Forward clutch | 21 - Impeller | 35 - Large planet pinion |
| 8 - Forward clutch hub | 22 - Stator | 36 - Large sun gear |
| 9 - Planetary gear carrier | 23 - Converter housing | 37 - 1st and reverse brake band |
| 10 - Small sun gear | 24 - Turbine | 38 - Bearing flange |
| 11 - Small planet pinion | 25 - One-way clutch | 39 - Bearing cap for differential |
| 12 - Annulus or ring gear | 26 - Transmission case | 40 - Pinion with shaft |
| 13 - 1st gear one-way clutch | 27 - 2nd gear brake band | 41 - Impeller shaft |
| 14 - Adjusting ring for pinion bearing | 28 - Control valve | 42 - Connecting lug |

a - Hydrodynamic Torque Converter

The three vaned wheels of the converter are arranged one behind the other in a ring-shaped casing made up of two sheet metal shells welded together. At the front is the impeller which is fixed to the converter casing and driven by the engine via a drive plate. This assembly forms the centrifugal mass. At the rear is the turbine which is driven by the impeller and is connected to the planetary gears by the hollow turbine shaft. Between the two large wheels is the smaller stator on a roller-type one-way clutch which is mounted on a support tube pressed into the differential carrier of the final drive.



- 1 - Impeller in converter casing
- 2 - Stator
- 3 - Turbine
- 4 - Casing cover
- 5 - Drive plate

All three wheels can rotate independently of each other but the stator can only rotate in the same direction as the engine. The one-way clutch stops it turning in the opposite direction.

At the front the converter runs on a plain bearing on the free-wheel support tube and at the rear it is mounted in the crankshaft. On the outside of the converter casing is an air deflector plate to which the starter ring is welded. This plate circulates air round the transmission and converter so that the temperature in the transmission is kept within acceptable limits.

When the engine is running, the transmission oil pump supplies oil under pressure to the converter so that it is always full of oil.

The converter has two different operating ranges according to engine loading and vehicle speed. The first is the converter range in which torque multiplication takes place and then at higher speeds the second or coupling range comes into effect and the converter acts only as a hydrodynamic coupling.

Working principles

When the engine is running, the oil is carried round by the vanes on the impeller (A) and thrown out by centrifugal force into the turbine (C). It flows from the outside into the turbine which is at first stationary. As the oil strikes the angled vanes, the direction of flow is altered and the oil then flows down to the stator. In this way the flow energy of the oil is converted into rotary force.

If there were no stator fitted, the impeller and turbine would work as a simple fluid coupling. However, as the vanes of the stator, which is held by the one-way clutch so that it can only turn in direction of engine rotation, oppose the flow of oil from the turbine (see Fig. 1-B) a reaction is set up which boosts the torque.

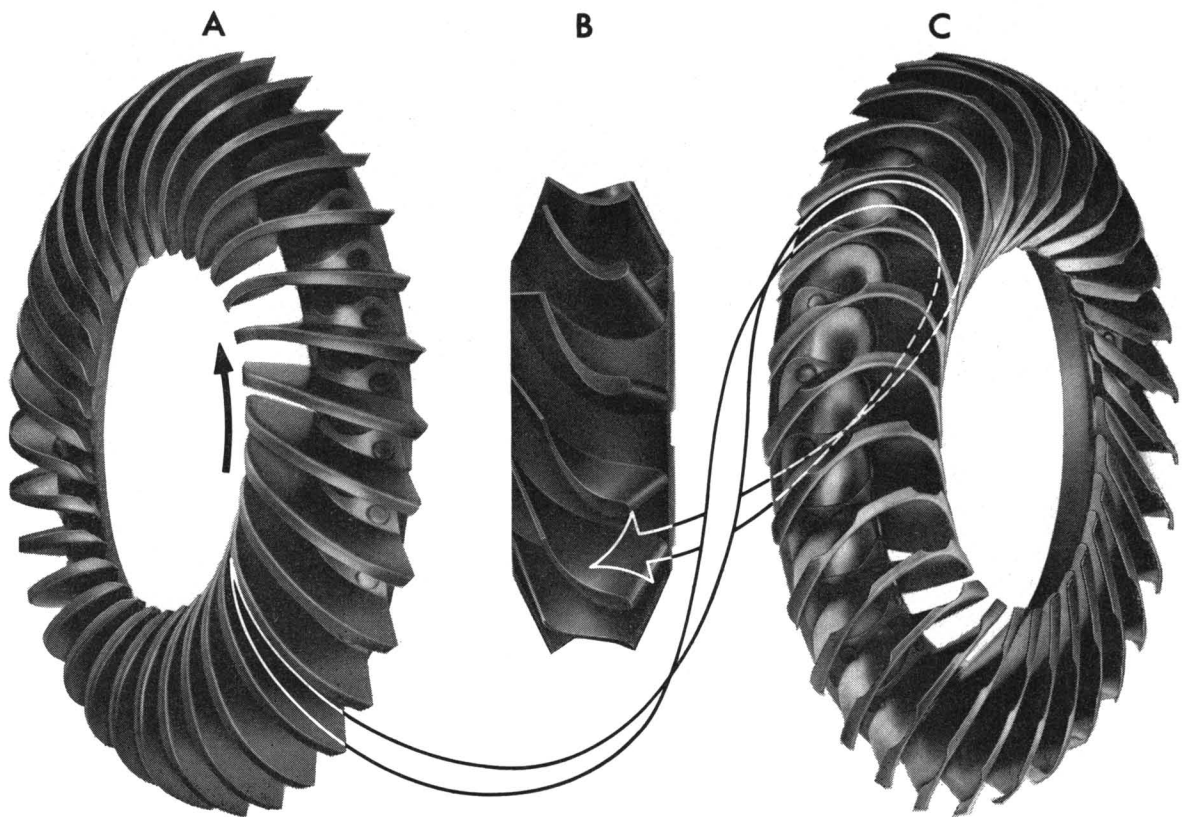


Fig. 1

In the stator, the oil flow is redirected by the shape of the vanes, accelerated and passed back to the impeller more or less free of turbulence and is then recirculated.

The extent of torque multiplication depends on the speed differential between the impeller and turbine and on the design and layout of the vanes on the impeller, stator and turbine.

The maximum torque, which is about 2.5 times the normal engine torque on this converter, is given when the vehicle is stationary (turbine stationary) and the engine (impeller) is turning at full throttle. The engine is then braked down to a speed of about 2000 rpm.

When the vehicle moves off, the turbine speed increases at the same rate as the road speed and rapidly approaches the engine speed which does not increase so much. As the road speed increases further and the speed differential between impeller and turbine becomes smaller (Fig. 2) the torque multiplication falls slowly from the initial value of 2.5 until it reaches a value of 1 when the speed ratio between the two wheels is 0.84 : 1.

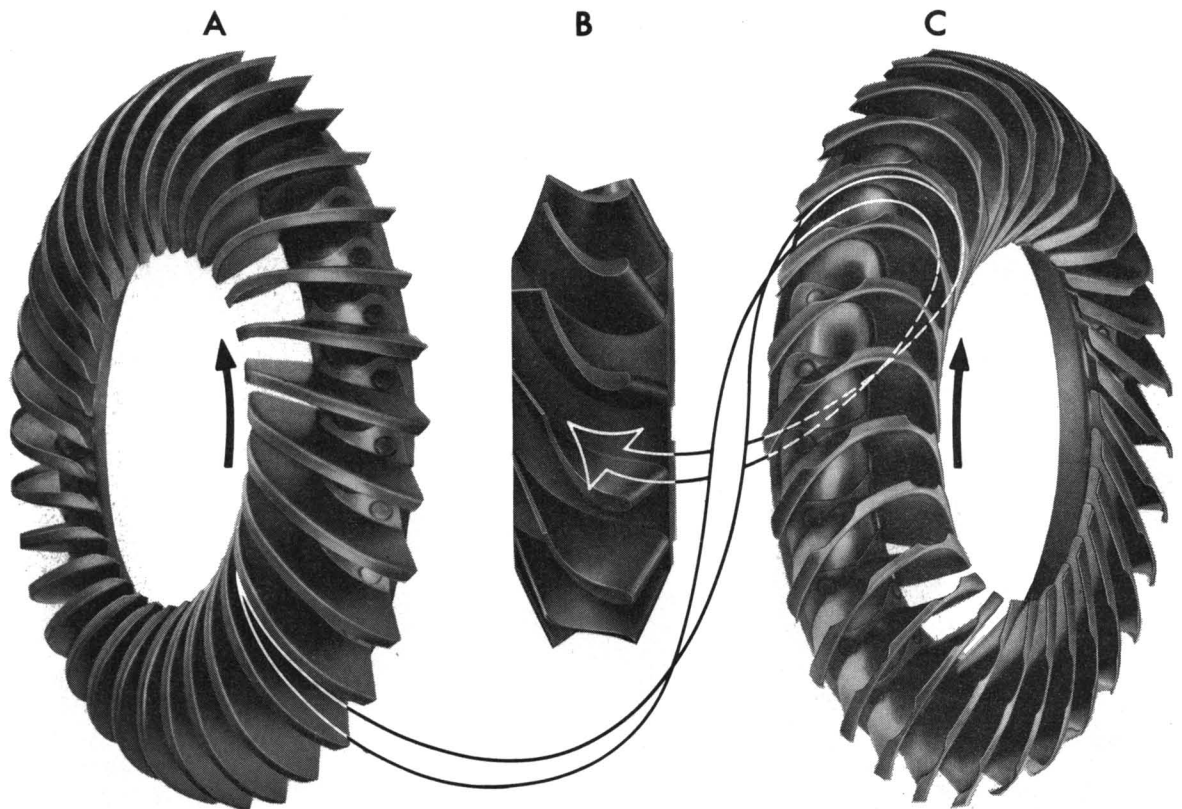


Fig. 2

At this so-called “coupling point”, the turbine torque and engine torque are the same. There is no torque multiplication at all as the road speed increases and the converter functions as a fluid coupling.

At the coupling point, the angle at which the oil leaves the turbine and enters the stator has changed so much that the oil flow strikes the reverse side of the vanes in the direction of engine rotation. The stator now turns on the freewheel and runs round in the oil flow with the two wheels. The speed differential between impeller and turbine becomes smaller still after the coupling point is passed and the torque remains the same up to the maximum degree of efficiency which is about 96 %.

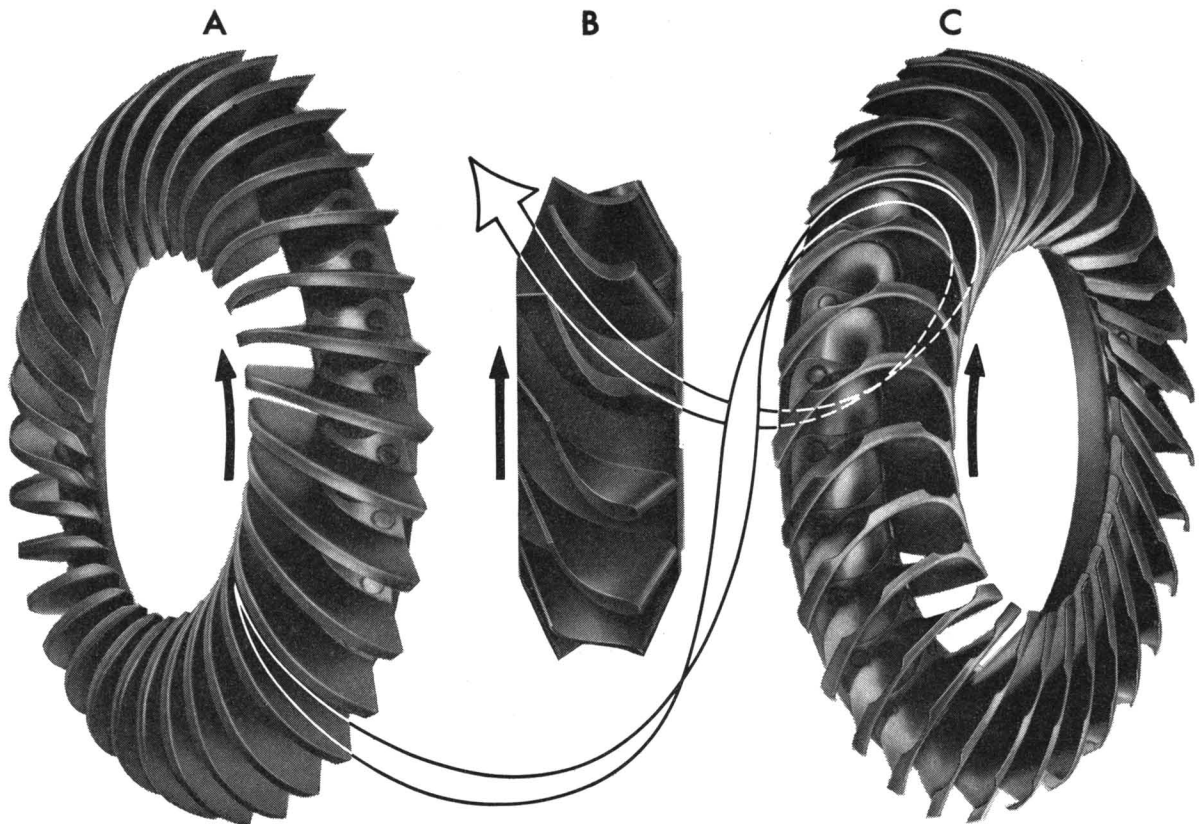


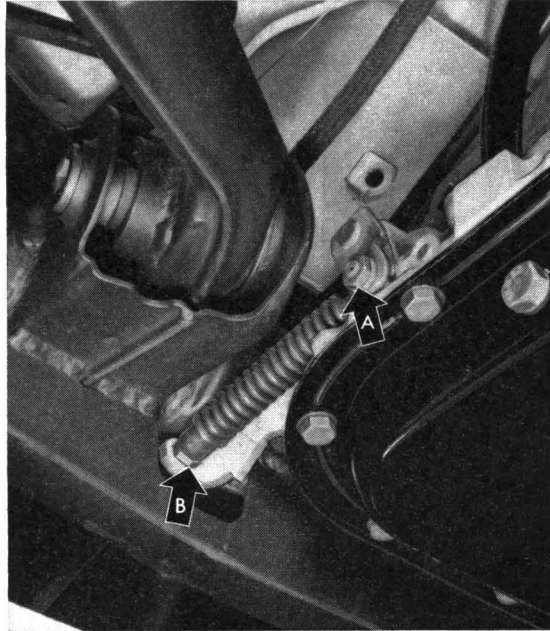
Fig. 3

Braking range

When the turbine speed becomes higher than that of the impeller (when vehicle is decelerating, for example) the torque converter works in the reverse direction. In this range, the turbine drives the impeller and thus the engine. The braking effort of the engine is then fully effective and the converter works only as a fluid coupling.

Removing and installing selector lever and cable

1 - Loosen cable clamp nut (arrow A) at transmission.



2 - Push rubber boot away, remove nut holding cable in bracket (arrow B) and push cable out to front.

3 - Screw knob off selector lever and remove cover. Take floor mats out. Pull cables off contact plate. Remove screws holding lever bracket to tunnel and lift bracket up.

4 - Detach Bowden cable from segment.

Note:

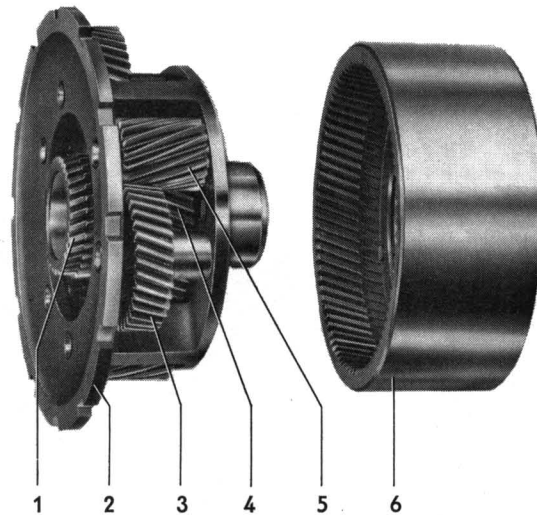
When removing cable, take rubber plug out of frame lower part first. To facilitate installation of Bowden cable, attach a long piece of wire to cable at front end before pulling cable out to the rear.

The installation of the selector lever and cable takes place in the reverse order.

5 - Adjust cable, see H/23, page 1-4.

b - Planetary Gear Transmission

The torque multiplication of the converter is not sufficient to supply the tractive effort necessary to cope with all driving conditions. For this reason, the converter is attached to a planetary gear transmission. In this type of transmission all the gears are in constant mesh and gearshifts can be made without interrupting the power flow.



- | | |
|-----------------------|-----------------------|
| 1 - Small sun gear | 4 - Large sun gear |
| 2 - Planet carrier | 5 - Small planet gear |
| 3 - Large planet gear | 6 - Annulus gear |

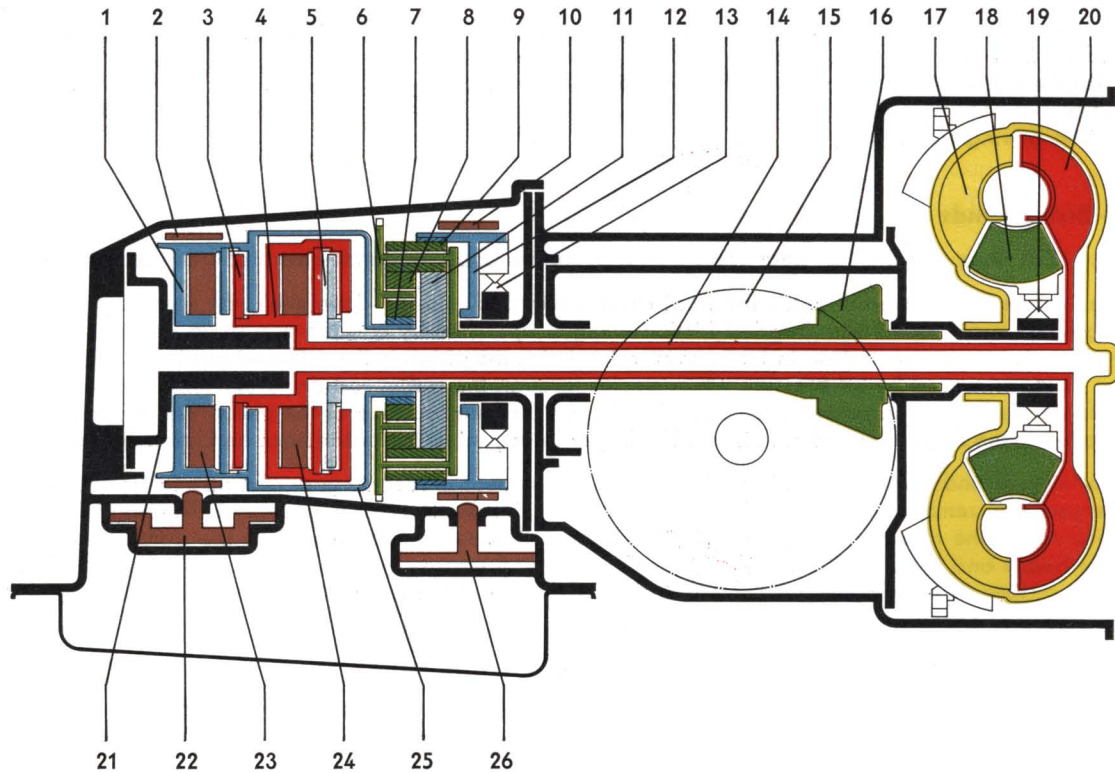
The planetary gear set consists of one large and one small sun gear, three large and three small planet gears, the planet carrier and the annulus gear.

The three large planet gears rotate on the small sun gear which is driven by the direct and reverse clutch. The large sun gear is driven by the forward clutch and meshes with the three small planet gears. The large and small planet gears mesh together in pairs. All six planet gears are mounted on the planet carrier which provides the output from the gearbox and is connected to the pinion shaft by a coupling sleeve. Externally, the three small planet gears mesh in the annulus gear, which also houses the one-way clutch. The one-way clutch prevents the annulus gear from rotating in the opposite direction to the engine but it can rotate freely in the engine rotation direction. The outer circumference of the annulus gear acts as a brake drum. The annulus gear has a bush pressed into it and runs on a shoulder on a flanged cover which forms the end plate of the transmission case.

The various ratios (3 forward gears, 1 reverse) are obtained by holding, releasing or driving different parts of the planetary gear set. In order to make these functions possible, the following parts are fitted in the transmission in addition to the planetary gears:

- 2 hydraulically operated clutches
- 2 hydraulically operated brake bands
- and the one-way clutch in the annulus gear which has already been mentioned.

The layout of the main parts of the transmission is shown in this simplified drawing.



- | | |
|--------------------------------------|---|
| 1 - Direct and reverse clutch drum | 14 - Turbine shaft |
| 2 - 2nd gear brake band | 15 - Final drive ring gear |
| 3 - Direct and reverse clutch | 16 - Drive pinion |
| 4 - Forward clutch drum | 17 - Impeller |
| 5 - Forward clutch | 18 - Stator |
| 6 - Planet carrier | 19 - One-way clutch for stator |
| 7 - Small sun gear | 20 - Turbine |
| 8 - Large planet pinion | 21 - Oil pump housing |
| 9 - Small planet pinion | 22 - Piston for 2nd gear brake band |
| 10 - 1st gear and reverse brake band | 23 - Piston for direct and reverse gear clutch |
| 11 - Large sun gear | 24 - Piston for forward clutch |
| 12 - Annulus gear | 25 - Driving shell |
| 13 - 1st gear one-way clutch | 26 - Piston for 1st and reverse gear brake band |

c - Clutches

Two hydraulically operated multiple disc clutches transmit the torque from the turbine shaft to the large sun gear, the small sun gear or — in 3rd gear — to both sun gears at the same time. The internally splined plates of the clutches are coated with friction material and the externally splined clutch plates are of steel. The clutches are applied by ring-shaped pistons moved axially by oil under pressure so that the plates are pressed together against the pressure plates which are located by circlips. The clutches are released by relieving the oil pressure on the pistons so that they are pushed back by springs and allow the clutch plates and discs to rotate freely.

Ball valves which are lifted from their seats by centrifugal force when the pistons are relieved of pressure, ensure that the pressure chambers are emptied completely.

The forward clutch is fitted in a clutch drum which is mounted on splines on the turbine shaft. The externally splined plates of the forward clutch engage in splines inside the forward clutch drum. The return spring consists of a dished washer which also acts as a lever for the piston force. The piston force is increased 2½ times and transmitted to the clutch plates.

The forward clutch is applied in all forward gears. It transmits the driving torque via the clutch hub to the large sun gear of the planetary gear set.

The direct and reverse clutch is in the front clutch drum. The externally splined plates engage the drum and the internally splined plates are fitted on a shoulder on the forward clutch hub. The piston pressure is applied directly to the plates here and release is by means of 18 springs. The direct and reverse clutch is applied in 3rd gear and in reverse and connects the forward clutch drum to the small sun gear via the driving shell.

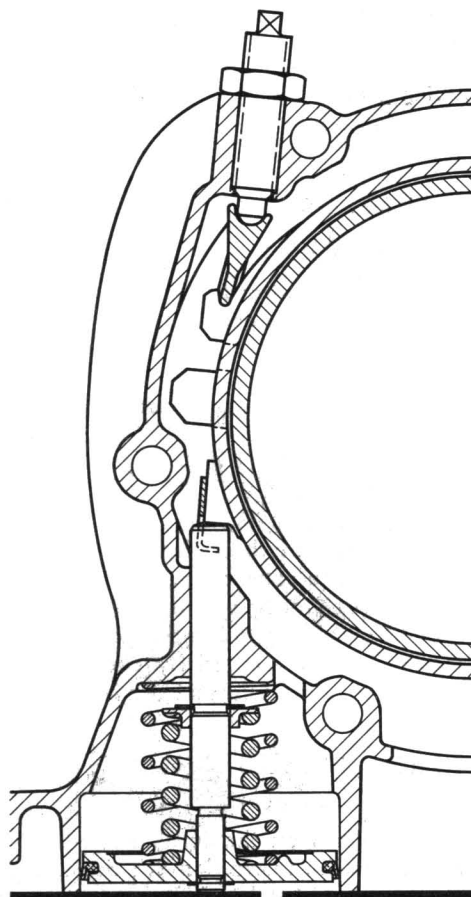
d - Brake bands

The clutch drum and annulus gear can be held by means of brake bands operated by hydraulic servos.

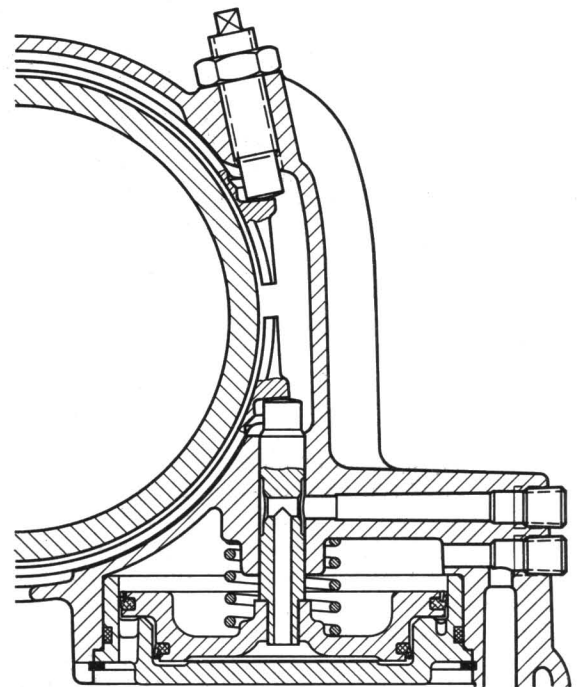
The 2nd gear brake band holds the front clutch drum and, via the drive shell, the small sun gear. A single coil brake band with bonded friction lining is operated by a two stage servo inserted into the transmission case from below. In 1st gear, a spring holds the piston in the released position. In 2nd gear, the piston is moved by oil pressure which passes through the piston rod on to the small surface of the piston. In 3rd gear the pressure remains effective on the small surface of the piston and oil pressure is applied to the large surface from above. The larger force pushes the piston back and releases the brake.

The 1st gear and reverse brake band holds the annulus gear in reverse gear and also in 1st gear when the gear is to remain engaged for braking purposes with selector lever in position 1. The band is coiled twice round the ring gear and has a bonded lining. The servo is inserted into the transmission case from below and is held released by a spring. To apply the brake band, oil pressure is supplied to the lower surface of piston and a second spring transmits the piston force at a steadily increasing rate to the piston rod so that engagement is smooth.

Both brake bands are supported in the housing by adjusting screws with locknuts. These screws are used to adjust the clearance between the bands and the brake drums.



1st gear brake band



2nd gear brake band

e - Transmission control

The hydraulic control system shifts the gears up and down automatically at the appropriate times.

The various functions of the hydraulic control system are as follows:

it supplies the transmission with AT fluid for working, lubricating and cooling purposes,

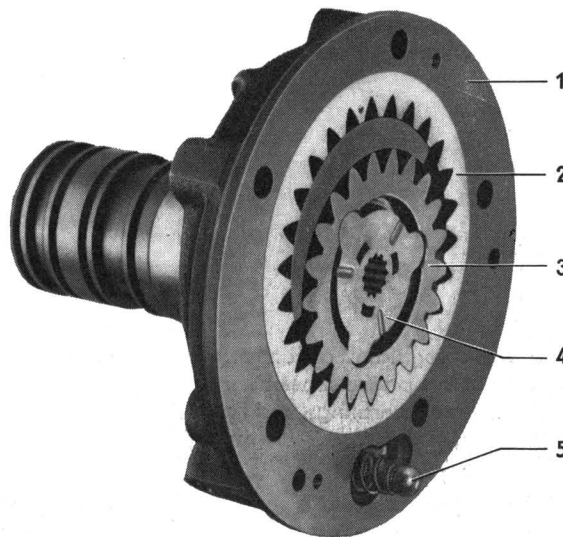
it controls the oil pressure supplied by the transmission oil pump for the clutches and brake bands according to selector lever position, engine load and converter torque ratio. The pressure varies between 45 and 242 psi.

it controls the shift points according to engine load and vehicle speed by regulating the oil flow to apply or release the clutches and brake drums at the moment when a gearshift is to take place. It also ensures that all gearshifts are made smoothly and without jerking.

The main parts of the hydraulic control system are:

- Transmission oil pump,
- Governor,
- Primary throttle pressure valve,
- Accumulator,
- Valve body assembly.

Transmission oil pump

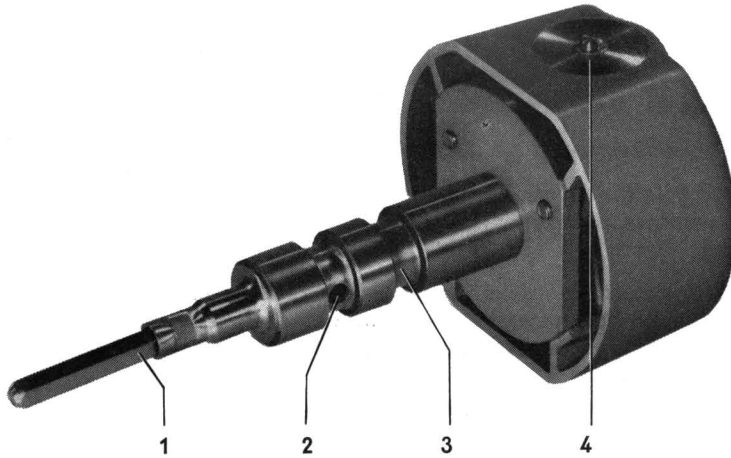


- 1 - Pump housing
- 2 - Outer gearwheel
- 3 - Inner gearwheel
- 4 - Driving dog
- 5 - Pressure relief valve

The oil pump consists of two internally and externally toothed gearwheels in a cast iron housing. It is driven from the engine via the converter housing, drive plate and the pump shaft. The pump draws oil from an oil sump underneath the valve body through a strainer and pumps it to the valve body.

A pressure relief valve for reverse gear prevents the oil pressure from becoming too high and causing damage to the control system. A further pressure relief valve for the forward gears is located in the transmission case.

Governor



- 1 - Square drive.
- 2 - Oil inlet
- 3 - Oil outlet
- 4 - Centrifugal weights

The governor supplies an oil pressure which is dependent on the vehicle speed and is routed to the control valve assembly for the purpose of regulating the shift points and gear changing operations. The governor consists of a driving shaft with a square end, oil drillings and a flange. Mounted on the flange is an aluminum housing which contains the valve, the centrifugal weight and springs. The governor is driven from the drive pinion so it only turns when the vehicle is moving.

Primary throttle pressure valve

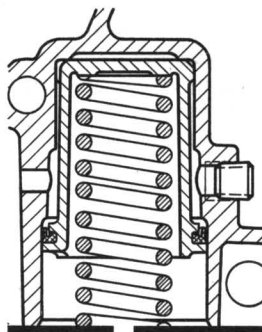
The primary throttle pressure valve regulates a control oil pressure according to the engine intake manifold vacuum pressure. This control pressure assists in the regulating of the main oil pressure and the shift points according to the engine operating conditions.

The valve is pushed against the oil pressure and a spring by means of a plunger and a spring-loaded diaphragm. The tension of the diaphragm spring is adjustable and when a new vacuum unit is fitted it must be adjusted to suit the individual transmission.

Accumulator

The accumulator provides gradual application of the 2nd gear brake band when changing from 1st to 2nd gear and thus prevents bumpy gearshifts. It consists of a cylinder with a freely floating piston which has a spring beneath it and can be supplied with oil pressure from both sides.

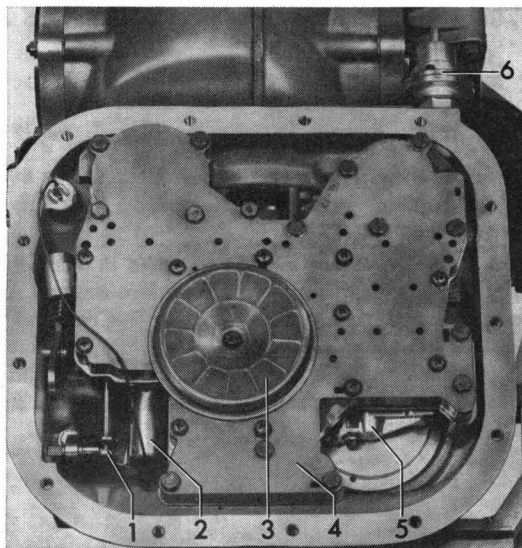
The main pressure line which the 1/2 shift valve connects to the underside of the 2nd gear brake servo and the accumulator when it moves from the 1st gear position to the 2nd gear position is restricted with a jet. At the beginning of the gearshift, both pistons are at the bottom of the housings and the accumulator spring is tensioned by the main oil pressure on the top of the piston. When the shift valve has moved, a restricted flow of oil passes to the pistons which then move slowly upwards. The pressure on the bottom of the piston then increases gradually and restrains the braking force of the 2nd gear band to the same extent as the accumulator spring tension is relieved.



Accumulator

Valve body assembly

The valve body assembly contains all the other parts of the hydraulic transmission control system. It consists of the valve body, the transfer plate and a separator plate of steel which is located between the valve body and transfer plate and is drilled to connect the various passages.



- | | |
|-----------------------|---|
| 1 - Manual valve | 4 - Transfer plate |
| 2 - Kickdown solenoid | 5 - Valve body |
| 3 - Oil strainer | 6 - Vacuum unit for primary throttle pressure valve |

The functions of the individual valves in the valve body assembly are as follows:

1 - Main pressure valve

The main pressure valve controls the oil pressure (main pressure) for the operation of the clutches and brakes and general transmission control. Acting on one side of the valve is a spring which is preset to a certain tension and also the throttle valve pressure. Working in the opposite direction from the other side is the oil pressure to be regulated which acts on one of two differently sized surfaces.

In selector lever positions 0, 3, 2 and 1, this oil pressure is directed by the manual valve to a second area on the valve and also works against the spring and throttle valve pressures. When the oil pressure exceeds the spring and throttle valve pressures, the main pressure valve is pushed against the spring and allows oil to flow to the converter valve and from here the converter is filled with oil. As the pressure rises further, the valve is pushed further and allows excess oil to return to the pump suction line. The oil pressure is regulated to the following upper and lower limits:

<p>Selector lever positions 0, 3, 2, and 1 closed throttle full throttle</p>	<p>approx.: 45 psi approx.: 114 psi</p>
<p>Selector lever positions R and P closed throttle full throttle</p>	<p>approx.: 95 psi approx.: 242 psi</p>

The oil pressure with closed throttle (45 psi) is determined by the setting of the spring tension which is adjusted in the factory to suit the valve-governor combination. The setting must not be altered.

2 - Modulator valve

The modulator valve initiates a limitation of the main pressure to approximately 88 psi at a vehicle speed of roughly 17 mph. Under the influence of governor pressure, the valve moves against a spring and connects the primary throttle pressure line with the line to the pressure limiting valve. When the speed drops below this level, the valve returns to its original position and cuts off this connection.

3 - Pressure limiting valve

The pressure limiting valve continues the limiting of the **main pressure to 88 psi** which is initiated in the modulator valve by restricting the throttle valve pressure passing to the main pressure valve.

The movement of the modulator valve at about 17 mph supplies primary throttle valve pressure to the pressure limiting valve so that it is pressed against the spring tension and restricts the inlet of a second **primary throttle valve line leading to the main pressure valve**. This reduces **to about 28 psi** the primary throttle valve pressure which was flowing to the main regulating valve unrestricted. Against this reduced primary throttle valve pressure on the spring-loaded face of the main pressure valve, the valve moves further in the direction of the spring. More excess oil then flows back to the pump suction line and the main pressure drops.

4 - Manual valve

The manual valve is controlled by the driver by means of the selector lever and a Bowden cable. According to the position of the lever, he gives instructions to the hydraulic control system which then delivers main oil pressure to the various points so that the appropriate shift can be made.

5 - Converter pressure valve

The converter pressure valve regulates the pressure of the oil flowing to the converter to **64 psi**.

As long as the main pressure is **less than 61 psi** the valve remains open and allows the oil to flow unrestricted to the converter. When the pressure rises above this point, the valve is pushed against the spring and restricts the oil flow so that the **converter pressure does not rise above 64 psi**.

6 - Secondary throttle pressure valve

At high engine loads, this valve creates an intermediate pressure from the small primary throttle pressure and the large main pressure. This pressure is used via the shift valve or the kickdown valve to move the gearshift points to a higher speed range. At small primary throttle pressures (low engine loads) a spring holds the secondary throttle pressure valve on its stop. In this position, the primary pressure line is connected to the kickdown valve and the shift valves. An increase in the throttle valve pressure (as engine load increases) acting on the end opposite the spring pushes the valve against the spring. This restricts the primary throttle pressure flow and opens the main pressure flow at the same time. In the valve chamber in between, these two pressures combine to form the secondary throttle pressure which increases in relation to the primary throttle pressure as the engine load increases until, at full throttle, it reaches the **maximum value of 68 psi**.

In selector lever position "1", the main pressure acts on the 1st gear plug of the secondary throttle pressure valve which then pushes the valve against the spring tension until it contacts a stop. The secondary throttle valve now supplies main pressure direct to the kickdown valve and the shift valves instead of throttle pressure.

The spring tension of the secondary throttle pressure valve is set for each valve body assembly to suit a matched governor and must not be interfered with.

7 - Kickdown valve

The kickdown valve has the effect of moving the gearshift points to a higher speed range when the accelerator pedal is depressed past the full throttle "hard spot", by supplying throttle pressure to additional surfaces on the shift valve. When the pedal is in this position, the carburetor linkage operates a switch which supplies current to a solenoid in the kickdown valve. The solenoid presses the valve against a spring on to a stop and connects the secondary throttle pressure valve line to the two shift valves.

In selector lever position "1" main oil pressure is supplied to the valve at the end opposite to the solenoid. This pressure pushes the valve against the solenoid and holds it there even when the solenoid is switched on. This prevents the 1st gear from engaging when the speed is too high.

8 - Shift valve 1/2

The 1/2 shift valve engages 1st and 2nd gear according to extent of governor pressure by either relieving oil pressure on, or applying oil pressure to the apply side of the 2nd gear band servo.

When moving off with selector lever in position 3 or 2, the valve spring and the throttle pressure push the valve into 1st gear position. The main pressure line to the valve is then closed and the apply side of the 2nd gear band piston receives no oil pressure.

As the speed increases and the governor pressure overcomes the spring force and throttle pressure, the valve is pushed against the spring into 2nd gear position.

This opens the main pressure line and the apply side of 2nd gear band piston and the underside of the accumulator receive oil pressure. The brake is applied and 2nd gear engaged. The valve movement brought about by the governor pressure is reinforced by the main pressure which acts on the surface between the valve diameters. In this way the valve is held in the 2nd gear position at speeds which lie below the upshift speeds. This prevents the continuous up and downshifting which could otherwise occur in this range when the speed remains almost constant. When moving off with lever in position 1, both surfaces of the governor plug are under main oil pressure. Furthermore, the 1st gear plug of the secondary throttle pressure valve directs main oil pressure to the shift valve instead of throttle pressure. These combined pressures in direction of 1st gear hold the shift valve in 1st gear position independently of governor pressure (road speed). If the selector lever is moved from 3 or 2 to position 1 when vehicle is moving and the shift valve is in 2nd gear position, then only the ring shaped surface on the large governor plug diameter is subject to main oil pressure.

In this way the governor pressure can hold the shift valve in 2nd gear position at high speeds until the speed is reduced and governor pressure has dropped so far that there is no danger of the engine being over-revved when 1st gear is engaged.

9 - Shift valve 2/3

According to governor pressure, secondary throttle pressure and position of kickdown valve, the 2-3 shift valve shifts the transmission from 2nd gear to 3rd gear and vice versa by supplying oil to or exhausting oil from the release side of the 2nd gear band servo and the piston of the direct and reverse clutch.

At low speeds, the valve spring and the throttle pressure hold the valve in 2nd gear position. The main oil line from the manual valve is then closed.

As the speed increases and the governor pressure exceeds the force of spring and throttle pressure, the valve snaps into 3rd gear position. The main pressure line opens and oil is supplied to the release side of 2nd gear servo and to the direct and reverse clutch.

The main pressure holds the valve in 3rd gear position until the road speed drops below the upshift speed. This gives a speed difference between upshifting and downshifting which corresponds to the normal driving technique and prevents continuous shifting to and fro.

During kickdown and forced throttle shifts, secondary throttle pressure is applied to additional surfaces on the 2/3 governor plug and works against the governor pressure. This moves the gearshift from 2 to 3 into a higher speed range or shifts into 2nd gear at a certain speed in 3rd gear.

10 - Control valve 3/2

This valve varies the restriction in the main pressure line from the 1/2 shift valve to the apply side of the 2nd gear servo according to vehicle speed and engine load. The downshift from 3 to 2 then takes place smoothly under all driving conditions. During kickdown shifts made at high speeds, as well as shifts at low speeds without throttle, the governor pressure predominates and holds the valve on the stop against primary throttle valve pressure. The pressure line from 1/2 shift valve to the apply side of 2nd gear servo is then restricted by a small jet near the 2/3 valve. The brake band is then applied with a considerable delay after the direct clutch is released and gives the engine time to accelerate to its new speed. When downshifts are made with throttle at medium speeds, the primary throttle pressure predominates and presses the valve on to the stop against regulator pressure. The pressure line from 1/2 shift valve is then connected to the apply side of the servo via an additional large jet. In accordance with the shorter time required for the engine to accelerate from a medium speed, the brake band is applied quicker.

11 - 1st gear ball valve

The action of this valve is to ensure that the 1st gear band is applied slowly when the lever is moved to position 1 and to release the band quickly when the lever is moved out of position 1.

When lever is placed in position 1, the main pressure moves the ball in the valve so that the oil flow to 1st gear band is restricted by a small jet. The pressure on the servo piston thus builds up gradually. When lever is taken out of position 1 the ball is lifted off its seat and the oil flows unrestricted. The brake band is released immediately.

12 - B₁ valve

This two-way valve connects the line to the 1st gear servo in lever position 1, with the main pressure line from 1/2 shift valve, or in lever position R with the reverse line from the manual valve. The line which is relieved of pressure is closed by the ball valve.

13 - K₂ valve

This two-way valve connects the line to the direct and reverse clutch with the main pressure line from the 2/3 shift valve in 3rd gear or with the reverse line from the manual valve in reverse gear. The line which is relieved of pressure is closed by the ball valve.

14 - 2/3 ball valve

This spring-loaded ball valve is closed to apply 2nd gear servo and brings into operation the restriction jet which ensures that the band is applied slowly. During automatic changes into 3rd gear, the valve opens and allows the oil to flow from the apply side of the 2nd gear servo unrestricted.

f - Parking lock

When the selector lever is moved to position P, a pawl is pressed against the outer rim of the planet carrier which is grooved to form teeth. When the vehicle is moving very slowly, the pawl engages in one of the grooves and locks the rear wheels via the planet carrier. If the vehicle is moving faster, the planet carrier forces the pawl out so that damage is not caused by violent engagement.

g - Final drive

The drive to the rear wheels passes through a hypoid drive gear set. The pinion, differential and ring gear are mounted on taper roller bearings in a cast iron differential carrier which is installed in the magnesium final drive housing from the rear.

The ratio is 3.67 : 1 (33/9 teeth)

Short shafts with flanges for the inner joints of the drive shafts of the double-joint rear axle are inserted through holes in the sides of the final drive housing into the differential housing and retained by cover plates.

A centrifugal oil pressure governor for the hydraulic transmission control is driven from the pinion shaft by a skew gear mounted in the differential carrier. The governor itself is mounted in the final drive housing which also contains the feed and return pipes for the governor oil supply.

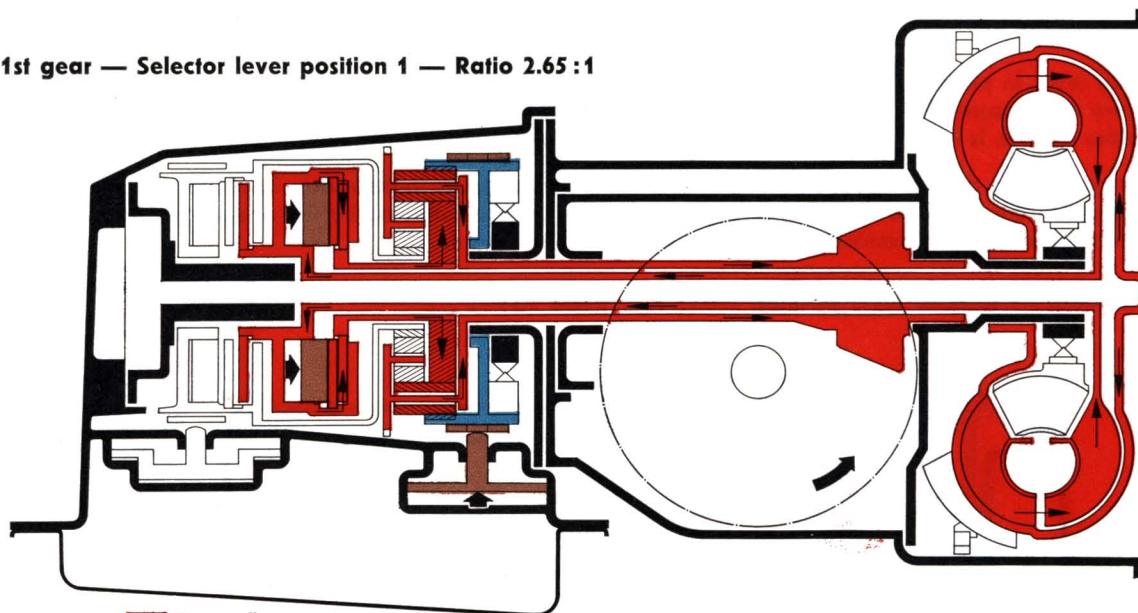
The final drive and governor drive are lubricated by hypoid oil. The final drive housing is sealed against the transmission oil by oil seals on the pinion and on the governor shaft. The drive shafts are sealed by oil seals in the side cover plates.

The converter is mounted on a tube pressed into the differential carrier and between tube and converter is a further oil seal.

Power flows in the various driving ranges

In all selector lever positions and all gears the initial power flow from the crankshaft via the converter and the turbine shaft (14) to the forward clutch drum (4) is the same. From this point onwards the power flow varies according to the selector lever position and transmission ratio.

1st gear — Selector lever position 1 — Ratio 2.65 : 1

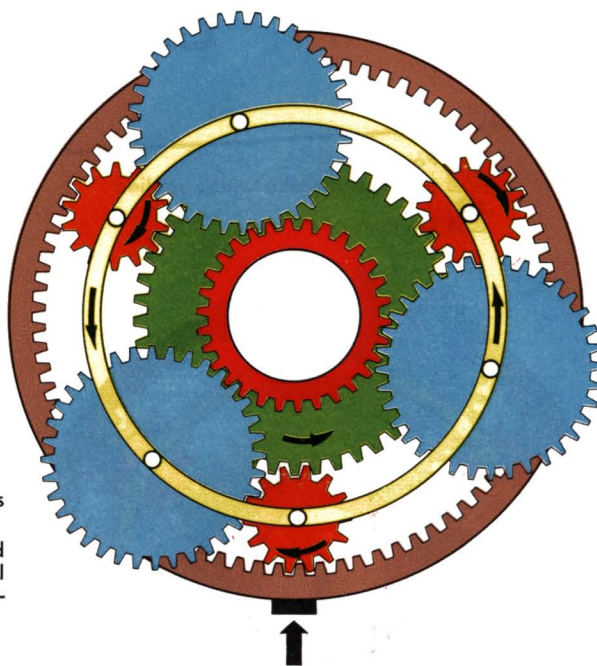


█ Power flow
█ Clutches or brake bands applied
█ Stationary

Forward clutch	applied
Direct and reverse clutch	released
1st gear and reverse band	applied, takes coasting force
2nd gear band	released
1st gear one-way clutch	stationary, takes driving force

red	small sun gear
green	large sun gear
light blue	large planet gear
light brown	small planet gear
yellow	planet carrier
dark brown	annulus gear

Torque reaction taken by	small planet gears — annulus gear — brake band
Power flow	forward clutch drum — forward clutch — large sun gear — small planet gears — planet carrier — drive pinion



The large sun gear (11) is driven by the forward clutch drum (4) via the applied forward clutch (5). The annulus gear (12) is held by the brake band (10). The small planet gears (9) are driven by the large sun gear (11) and rotate between the large sun gear and the annulus gear (12) which is held. The planet carrier (6) is driven at reduced speed by the planet gears and drives the pinion (16). The direct and reverse clutch drum (1) is driven in reverse direction by the large planet gears (8) and the small sun gear (7) and runs free.

B i n d e r P u n c h A r e a

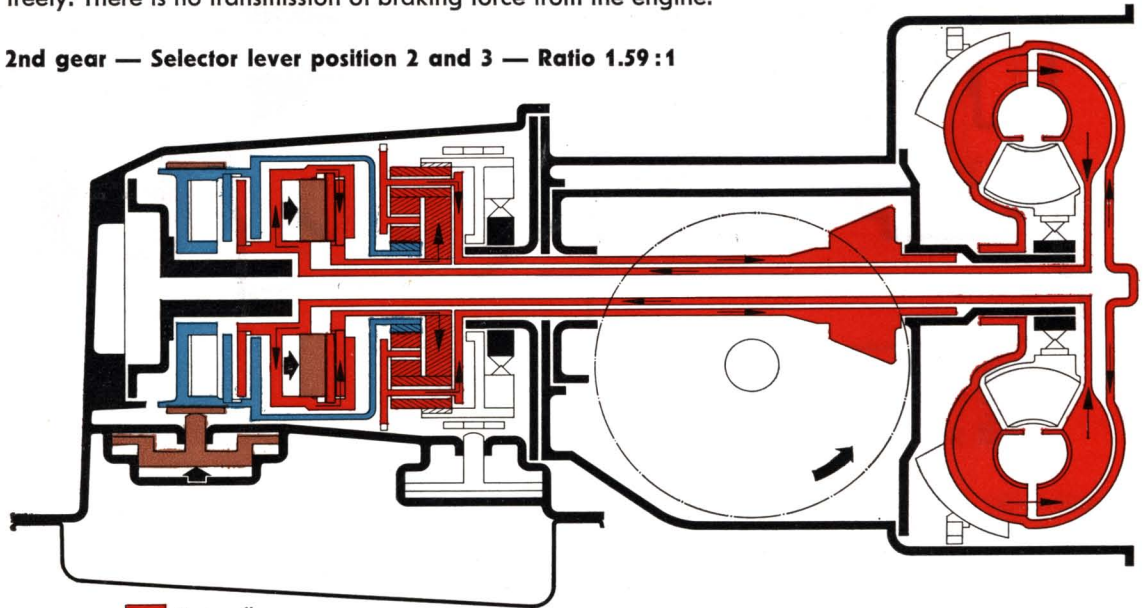
1st gear — Selector lever position 2 and 3

Forward clutch	applied
Direct and reverse clutch	released
1st gear and reverse band	released
2nd gear band	released
1st gear one-way clutch	holding
Torque reaction taken by Power flow	as for 1st gear, selector lever position 1

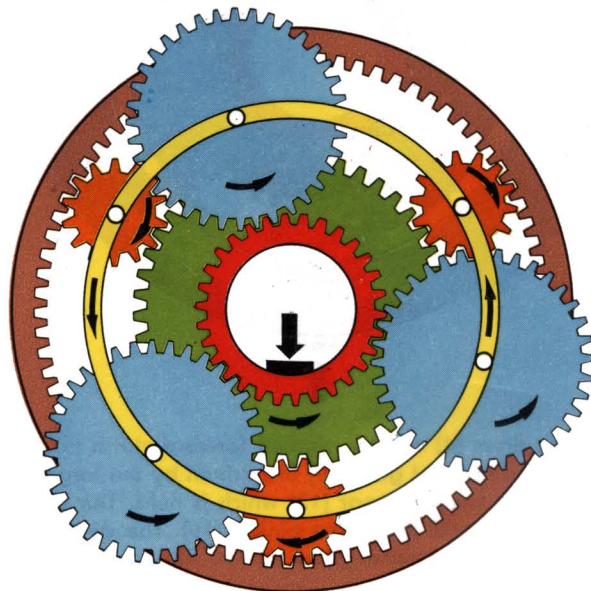
With lever in position 2 and 3, no oil pressure is supplied to the servo for 1st gear band (10) and the band is not applied. In this gear, the annulus gear (12) which attempts to rotate in the opposite direction to the engine, is held by the rollers of the one-way clutch. The power flow is then as in lever position 1.

However, only driving forces from the engine can be transmitted to the road wheels. When coasting, the drive is in the opposite direction so that the annulus gear is released by the one-way clutch and turns freely. There is no transmission of braking force from the engine.

2nd gear — Selector lever position 2 and 3 — Ratio 1.59 : 1



█ Power flow
█ Clutches or brake bands applied
█ Stationary



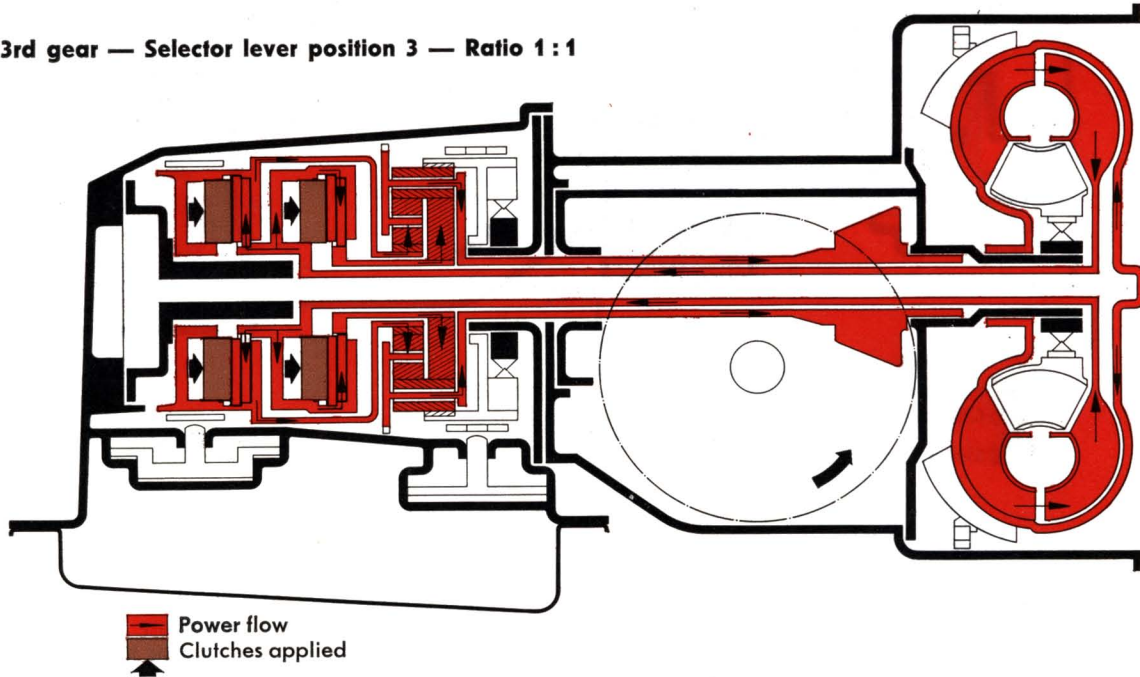
Forward clutch	applied
Direct and reverse clutch	released
1st gear and reverse band	released
2nd gear band	applied
1st gear one-way clutch	running

Torque reaction taken by
 large planet gears — small sun gear —
 drive shell — direct/reverse clutch drum —
 brake band

Power flow
 forward clutch drum — forward clutch —
 large sun gear — small planet gears —
 large planet gears — planet carrier —
 drive pinion

The forward clutch (5) is applied and drives the large sun gear (11). The small planet pinions (9), driven by the large sun gear, rotate with and drive the large planet pinions (8). The large planet pinions rotate round the small sun gear (7) which is held by the 2nd gear band. The planet carrier (6) with the drive pinion (16) is turned by the planet gears. The annulus gear (12) is driven by the small planet gears and runs free.

3rd gear — Selector lever position 3 — Ratio 1 : 1



Forward clutch	applied
Direct and reverse clutch	applied
1st gear and reverse band	released
2nd gear band	released
1st gear one-way clutch	running
Torque reaction taken by	none
Power flow	forward clutch drum — forward clutch — large sun gear and direct and reverse clutch — small sun gear — planet pinions — planet carrier — drive pinion

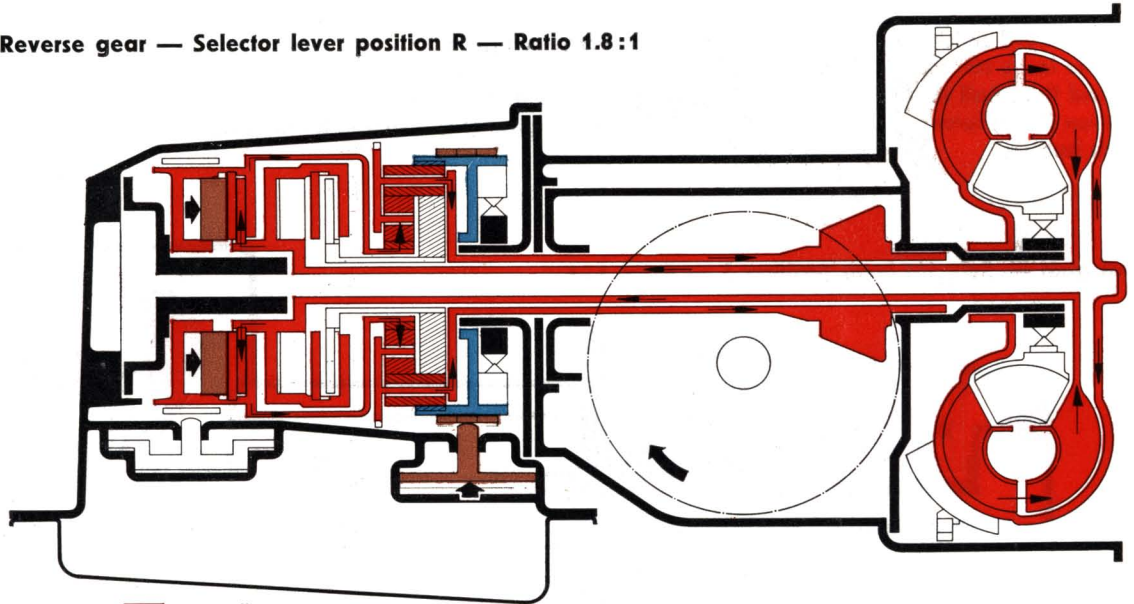
The forward clutch drum (4) drives the large sun gear (11) via the applied forward clutch (5) and also drives the small sun gear via the applied direct and reverse clutch (3). As both sun gears are then turning at the same speed there is no internal rotation, the entire planetary gear is locked into one unit and the drive pinion is driven without reduction.

Neutral — Selector lever position "0"

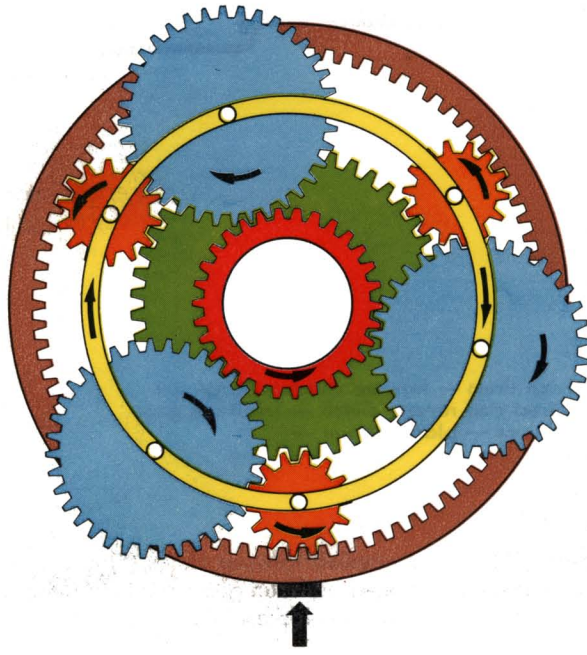
Both brakes and both clutches are released, the forward clutch drum (4) is turning and the externally splined plates of the forward clutch (5) and the internally splined plates of the direct and reverse clutch (3) rotate freely with it. No power is transmitted to the planetary gears.

B i n d e r P u n c h A r e a

Reverse gear — Selector lever position R — Ratio 1.8:1



— Power flow
 Clutches or brake bands applied
 Stationary



Forward clutch	released
Direct and reverse clutch	applied
1st gear and reverse band	applied
	released
2nd gear band	stationary
1st gear one-way clutch	no power transmission

Torque reaction taken by small planet pinions — annulus gear — brake band

Power flow
 forward clutch drum — direct and reverse clutch — small sun gear — large planet pinions — planet carrier — drive pinion

Drive is from the forward clutch drum (4) via the applied direct and reverse clutch (3) to the small sun gear (7). The power flow then continues via the large planet pinions (8) to the small planet pinions (9) and these rotate round inside the annulus gear (12) which is held by the brake band. The planet carrier (6) and the drive pinion (16) then rotate in the opposite direction.

Parking lock — Selector lever position P

When the selector lever is moved to position P, a pawl is pressed against the outer rim of the planet carrier which is grooved to form teeth. When the vehicle is moving very slowly, the pawl engages in one of the grooves and locks the rear wheels via the planet carrier. If the vehicle is moving faster, the planet carrier forces the pawl out so that damage is not caused by violent engagement.

The following operations must be carried out during the maintenance service:

1 - Check oil level in automatic transmission every 6000 miles (10,000 km).

The oil level is checked with the dipstick, with engine running at idling speed, oil handwarm and selector lever in 0. (Hand-brake applied.) Wipe dipstick only with clean, lint-free cloth.

It is essential to the operation of the automatic transmission that the oil level is correct. That is why the level must be checked very carefully. The level should be between the upper and lower marks on the dipstick. If the oil is low, add "Automatic Transmission Fluid" to bring the level up to the top mark. Do not overfill because too much oil will affect the operation of the transmission. The excess oil should be drained off. When transmission is cold or very hot, the oil level can be outside the marks. For this reason the oil must only be checked when it is warm.

The difference between the upper and lower marks on the dipstick is .7 Imp. pint (.8 US pint).

Important
Only automatic transmission fluids which have been approved by the VW factory may be used.

2 - Change the transmission oil and clean oil sump and strainer every 18,000 miles (30,000 km). The total oil capacity is 10.5 Imp. pints (12.6 US pints).

The oil change capacity is 5.25 Imp. pints (6.3 US pints).

When changing oil, remove plug and allow oil to drain out.

Important
The oil cannot be drained from the converter.

Take oil sump off to clean it and use a new gasket when fitting the sump back. Tighten sump retaining screws to 7 lb. ft. (1 mkg).

Important
Do not run engine or tow vehicle when transmission oil sump is off or when there is no oil in the transmission.

Put 4.4 Imp. pints (5.3 US pints) of ATF in first using a clean funnel with a 20 in. long extension hose. Start engine and select all lever positions once with vehicle stationary. Then check the oil level on dipstick with selector lever in neutral (0). The oil level should now be up to the lower end of the dipstick. Carry out a short road test to warm the oil up. Then correct the oil level as described at point 1.

Important
When installing the sump and putting in the oil, ensure that everything is kept perfectly clean.

Check for leaks.

3 - Every 6000 miles, check oil level in final drive (Hypoid oil) and top up as necessary. Check for leaks.

4 - Change oil in final drive (Hypoid oil), clean magnetic drain plug and check for leaks at 500—750 miles and then at 30,000 miles, 60,000 miles and so on.

The oil in the final drive is checked and changed as with the fully synchronized transmission.

The capacity is 1.75 Imp. pints (2.1 US pints) of SAE 90 hypoid oil.

The oil change quantity is the same.

When a new gear set is fitted, the transmission must be filled with a special running-in oil for hypoid gears. This oil is then drained at 500—750 miles and normal hypoid oil put in.

5 - Check operation of kickdown switch every 6000 miles. This is done by connecting a test lamp to the tab of the kickdown switch to which the cable leading to the transmission is attached and moving the throttle linkage passed the full throttle position.

The lamp should light up when the linkage has just passed the full throttle position.

A certain amount of experience with automatic transmissions and knowledge of the working principles is an advantage when assessing the functioning of the VW 1600 automatic transmission and trying to locate defects. Otherwise it is advisable to use another vehicle on which the automatic transmission is known to be working properly as a means of comparison.

For the operation of the transmission, it is essential that the engine is running properly (idling, transfer, ignition setting). Inadequate engine output due to incorrect adjustments or defective parts can, in certain circumstances, give the impression that something is wrong with the automatic transmission. For this reason, always check the engine and rectify any incorrect adjustments before starting to look for defects in the transmission.

Important

All work on the vehicle which entails running the engine must only be carried out with the selector lever at 0 and the handbrake properly applied. The only exceptions are in the case of pressure testing and when checking the stall test speed.

The following equipment is required to test the automatic transmission:

- 1 - Pressure gauge with connecting hose and a range of **0—350 psi** for measuring the main pressure.
- 2 - Pressure gauge with connecting hose and a range of **0—140 psi** for measuring the primary throttle pressure.
- 3 - Electronic rev counter for the engine speed.

a - General checks

The following operations should be carried out before every transmission check and if defects are found they must be rectified before proceeding any further

- 1 - Check engine settings.
- 2 - Check transmission oil level. See Section H/22, page 1-1.
- 3 - Check adjustment of selector lever cable. See Section H/23, page 1-4.

- 4 - Check operation and adjustment of kick-down switch. See Section H/22, page 1-1.

When checking the oil level, **the appearance of the oil and the smell should also be checked.** Burnt friction linings will make the oil smell burnt. Dirty oil can cause trouble in the hydraulic control system. Too much or too little oil can also affect the operation of the transmission. The oil level should, therefore, be checked very carefully in order to avoid unnecessary repair work.

b - Road test

Road test the vehicle (unless there is obvious mechanical damage). During the test, the vehicle should be driven in all ranges and all possible road conditions and observed carefully so that as much information as possible is gained. In particular, the shift points for up- and downshifts and the smoothness of gear changing should be noted.

All shifts should take place quickly and without interrupting the power flow. Listen for any sign of engine run-up during gearshifts as this indicates slipping brake bands or clutches.

After the road test, **check transmission for oil leaks.**

c - Stall speed test

This test provides a rapid check on the functioning of the converter. It should only be carried out if the vehicle does not reach maximum speed or if the acceleration is poor.

Connect electronic revolution counter. Start engine and **hold vehicle firmly with hand and foot brakes.** Put selector lever in position 3 and depress accelerator pedal briefly to full throttle. The engine will then run at a reduced speed which is known as the **stall speed.**

If the engine does not reach the specified stall speed despite the fact that all engine adjustments are correct, the converter is not in order. If the engine speed is higher than specified, it indicates that the clutches or the 1st gear one-way clutch are faulty.

Important

During this test the transmission oil heats up very quickly so do not continue test longer than the time required to read the instruments.

d - Pressure test

In this test the two most important oil pressures which occur in the transmission are measured. It is essential to the correct operation of the transmission that the pressures are up to the specified limits.

Two different pressures are measured:

- 1 - Primary throttle pressure
- 2 - Main pressure

The test is carried out as follows:

Connect the **0—350 psi gauge** to the main pressure test point (connection 2) and the **0—140 psi gauge** to the primary throttle pressure test point (connection 3). Route the connection hoses into the vehicle so that they cannot drag on the ground or rub on the wheels when vehicle is moving.

See Section H/23, page 3-1.

Selector lever in 0

- 1 - Start engine and measure both pressures with **vacuum hose pulled off** and engine running at a fast idle. Plug the vacuum hose so that engine runs smoothly. (With the hose off, the pressures will be slightly higher than at full throttle.)

If the primary throttle pressure deviates from the specified pressure of 42 psi with the vacuum hose off, the pressure must be corrected by turning the adjusting screw in the vacuum unit connection before proceeding with the test (see Section H/23, page 3-1).

Connect vacuum hose again.

- 2 - Check both pressures at idling speed.

Selector lever in 3

- 1 - Hold vehicle securely with foot and hand-brakes and check both pressures at full throttle.
- 2 - Drive vehicle and measure main pressure at speeds above 18 mph.

Selector lever in R

- 1 - Hold vehicle securely with foot and hand-brakes and check both pressures at full throttle.
- 2 - Check main pressure at idling speed as well.

If the main pressure deviates from the specified figures, the following defects may be found:

- a - Oil pump defective (wear).
- b - Oil leakage at gaskets and sealing surfaces or leakage in housing.
- c - Control valve sticking.

Important
Do not continue full throttle test longer than the time required to read the instruments. The extent of the primary throttle pressure has a direct influence on the **regulation of the main pressure**. This is why the main pressure should only be measured when the primary throttle pressure is within the specified limits. If necessary, the vacuum unit should be replaced with a new part and the new part adjusted correctly.

After the pressure test, check the oil level again and top up as necessary. Check the plugs in the testing connections for leakage.

e - Tables

Stall test speed	1900—2100 rpm		
	Selector lever position		
Primary throttle pressure in kg/cm ² (psi)	0	3	R
Idling speed, vacuum hose off	3.0 (42)	3.0 (42)	3.0 (42)
Full throttle, vacuum hose on	—	approx. 2.8 (40)	approx. 2.8 (40)
Idling speed, vacuum hose on	0.4 (5.7)	—	—
Main pressure in kg/cm ² (psi)			
Idling speed, hose off	8.0 (114)	8.0 (114)	15.0—20.0 (213—284)
Full throttle, hose on	—	approx. 7.5 (106)	15.0—20.0 (213—284)
Idling speed, hose on	3.2 (45)	—	6.5—7.5 (92—106)
Full throttle, at speeds above 18 mph	—	6.2 (88)	—

Gear shift speeds in kph (mph)

Upshifts	1st/2nd gear	2nd/3rd gear
	Part throttle	18—22 (11—14)
Full throttle	29—33 (18—20)	71—78 (44—48)
Kickdown	50—60 (31—37)	86—94 (53—58)
Downshifts	3rd/2nd gear	2nd/1st gear
	Part throttle	22—17 (14—10)
Full throttle	57—51 (35—31)	23—19 (14—12)
Kickdown	88—80 (54—50)*	55—43 (34—27)*

* The downshift **can** occur below the large figures, but it **must** occur below the small figure. Bear in mind, therefore, that the speedometer can vary within the permissible tolerances.

Binder Punch Area

It is not claimed that this table is absolutely complete because a combination of various faults can occur at the same time.

Condition	Possible cause	Correction
No drive in any lever position	a - Low oil level b - Oil pump or drive defective c - Shafts or planet gear set broken d - Drive plate broken	a - Check oil level, rectify, eliminate cause of leakage b - Repair pump c - Repair transmission d - Replace plate
No drive in any forward gear	Forward clutch defective	Repair clutch
No drive in 1st gear (coast) with lever in 1 or reverse	1st and reverse band or servo faulty	Check and repair 1st and reverse band and servo
No drive in 1st gear with lever in 3	1st gear one-way clutch in annulus gear defective	Replace annulus gear and one-way clutch
No drive in 2nd gear with lever in 2 or 3	2nd gear band or servo faulty	Check and repair band and servo
No drive in 3rd gear and reverse	Direct and reverse clutch (plates or piston seals) faulty	Repair direct and reverse clutch
Does not shift out of 1st gear (lever in 2 or 3)	a - Governor drive defective (mechanical) b - Governor valve sticking	a - Repair governor drive b - Disassemble governor and clean valve
Power transmission erratic	a - Low oil level b - Selector lever incorrectly adjusted	a - Fill to correct level, eliminate cause of leakage b - Adjust lever
Delayed engagement, engine races	a - Oil level too high or too low b - Friction linings burnt or worn c - Oil pressure wrong due to incorrect adjustment of vacuum unit or internal leakage	a - Check and rectify oil level, eliminate cause of leakage b - Disassemble transmission and replace defective parts c - Adjust vacuum unit or disassemble the transmission and replace all seals and gaskets
Shifts occur when speed is too low	a - Governor or valve body defective b - Oil pressure wrong due to incorrect adjustment of vacuum unit or leakage in transmission	a - Replace governor and valve body (these parts are matched and may only be replaced together) b - Adjust vacuum unit or disassemble transmission and replace all seals and gaskets

B i n d e r P u n c h A r e a

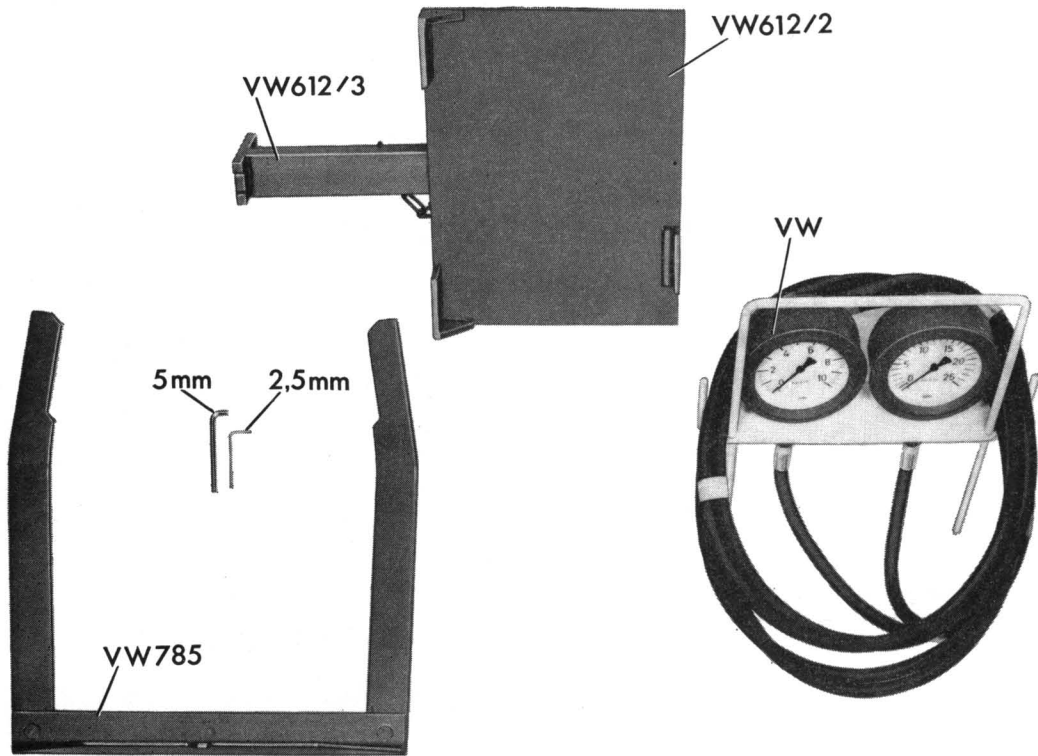
Condition	Possible cause	Correction
Shifts occur when speed is too high	<ul style="list-style-type: none"> a - Vacuum unit or hose leaking or hose off b - Governor or valve body faulty c - Oil pressure wrong due to incorrect adjustment of vacuum unit or leakage in transmission 	<ul style="list-style-type: none"> a - Replace unit or hose or fit hose b - Replace governor and valve body (these parts are matched and may only be replaced together) c - Adjust vacuum unit or disassemble transmission and replace all seals and gaskets
No upshift to 3rd gear with lever at 3	<ul style="list-style-type: none"> a - Governor pressure incorrect, valve body defective b - Direct and reverse clutch defective (no shift at "R" as well) 	<ul style="list-style-type: none"> a - Replace governor and valve body (these parts are matched and may only be replaced together) b - Repair direct and reverse clutch and clean transmission and control system
Harsh engagement when lever is moved from 0 into a gear	<ul style="list-style-type: none"> a - Idle speed too high b - Vacuum hose leaking or fallen off 	<ul style="list-style-type: none"> a - Adjust idle b - Replace vacuum unit or hose or secure hose properly (if vacuum unit is replaced the primary throttle pressure must be reset)
Vehicle "creeps" excessively at idling speed	Idle speed too high	Adjust idle speed properly
No kickdown	<ul style="list-style-type: none"> a - Incorrect throttle linkage and switch adjustment b - Electrical fault (switch, cables, solenoid) c - Valve body dirty 	<ul style="list-style-type: none"> a - Adjust linkage properly b - Check and repair cables and switch. Check solenoid with oil sump removed, replace if necessary c - Remove and clean valve body and governor (these parts are matched and may only be replaced together)
Poor acceleration when moving off. Low maximum speed despite good engine output	<ul style="list-style-type: none"> a - Converter faulty b - Bands or clutches slipping c - Low oil level 	<ul style="list-style-type: none"> a - Replace converter b - Repair bands or clutches c - Fill to correct level, eliminate cause of leakage
Poor acceleration and screeching noise in transmission when moving off (hissing noise from converter is normal)	Converter or one-way clutch faulty. Make stall test to find out whether converter or one-way clutch is defective	Replace converter complete or annulus gear with 1st gear one-way clutch

Condition	Possible cause	Correction
Oil consumption without external leakage, possibly smoke from exhaust	a - Vacuum unit leaking (oil is being drawn into engine) b - Oil seals on pinion or governor shaft faulty (oil getting into final drive housing)	a - Replace vacuum unit b - Replace faulty oil seals (check shaft surfaces for damage)
Transmission oil very dirty or discolored and smells burnt	Friction linings burnt (clutch plates, brake bands)	Disassemble and clean transmission, replace faulty parts
Parking lock not working	a - Incorrect selector lever adjustment b - Operating linkage broken	a - Adjust cable b - Replace damaged parts

Important

When transmission has failed due to burnt or defective friction linings on clutches or brake bands it is generally necessary to disassemble the complete transmission, particularly the control system, and clean everything thoroughly. It may also be necessary to replace the converter.

Special Tools

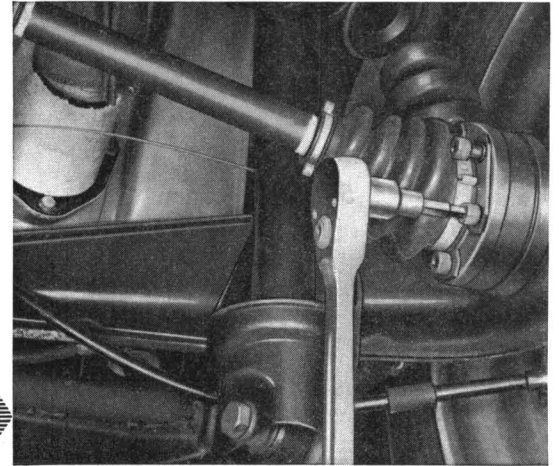


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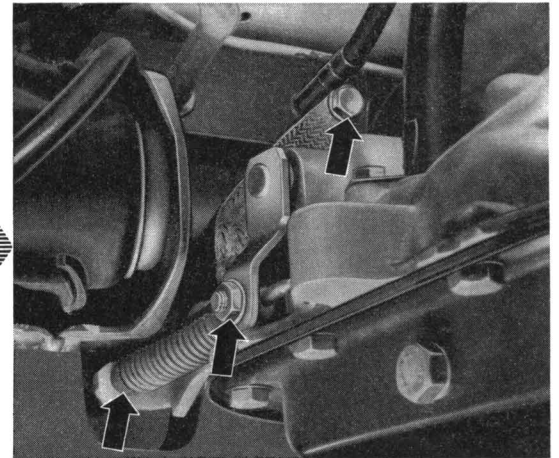
If the transmission has to be taken out, it is advisable to remove engine and transmission together. The engine and transmission can, however, be taken out separately one after the other if so desired.

Removing

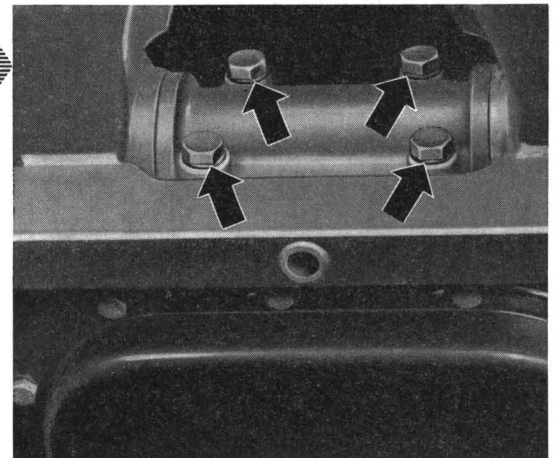
- 1 - Disconnect ground cable from battery.
- 2 - Remove air cleaner.
- 3 - Pull cables off generator, ignition coil and oil pressure switch.
- 4 - Disconnect accelerator cable and pull it out. Pull off and seal fuel hose.
- 5 - Disconnect heater flap cables and take heater hoses out. Take carburetor preheating hose off.
- 6 - Take dipstick out and pull rubber boot off. Loosen clips on cooling air bellows and pull bellows off.
- 7 - Remove drive shaft socket head screws. Tilt shafts down and take them off.



- 8 - Loosen nut on selector lever cable clamp (arrow), push boot away, screw cable sleeve apart (left arrow) and take it off. Detach ground strap from body (upper arrow).



- 9 - Loosen screws in front transmission mounting (arrows) and take out two upper screws.



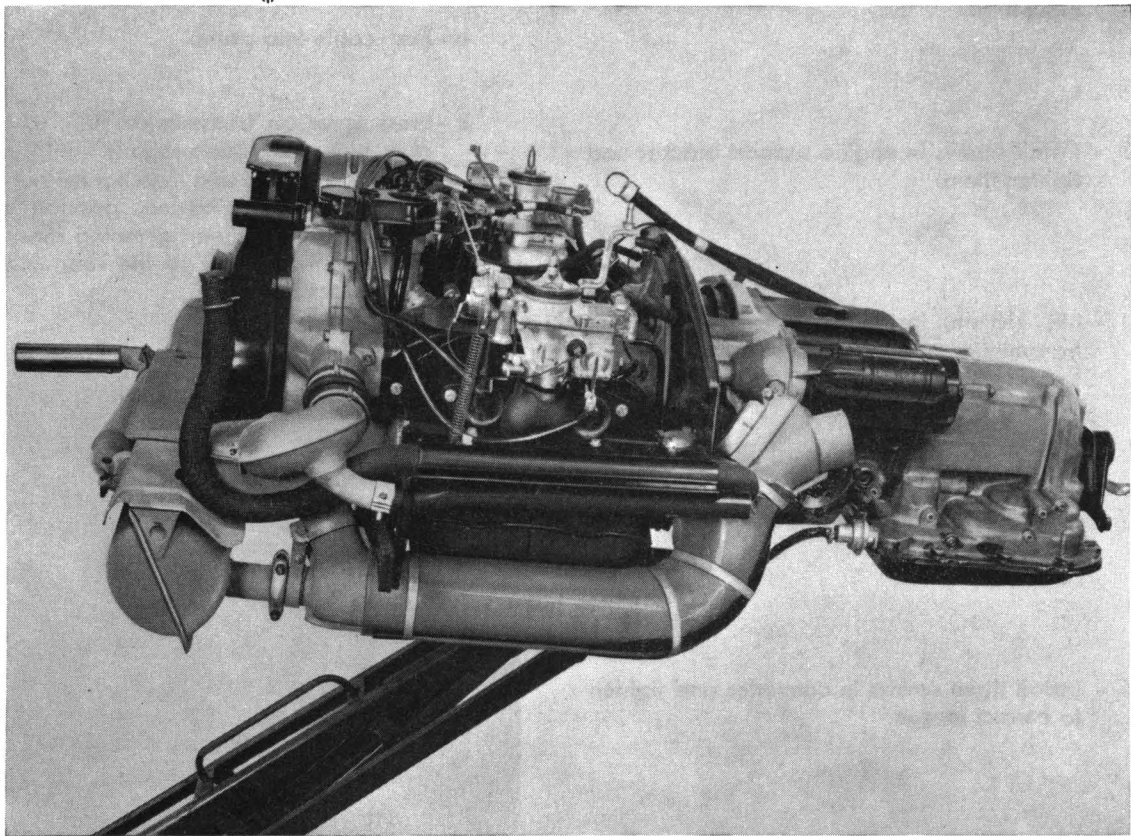
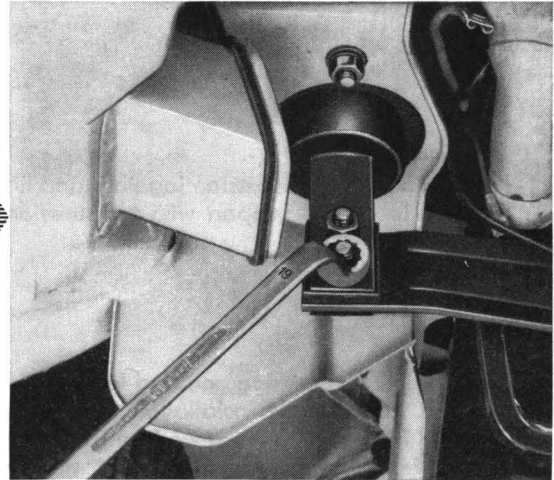
Important

Do not remove all four screws as otherwise the transmission will drop at the front.

10 - Lower vehicle lift slightly, place jack with engine support VW 612/2 and transmission bracket VW 612/3 under the engine/transmission unit and lift slightly.

11 - Remove lower screw of front transmission mounting. Remove screws holding engine support bracket.

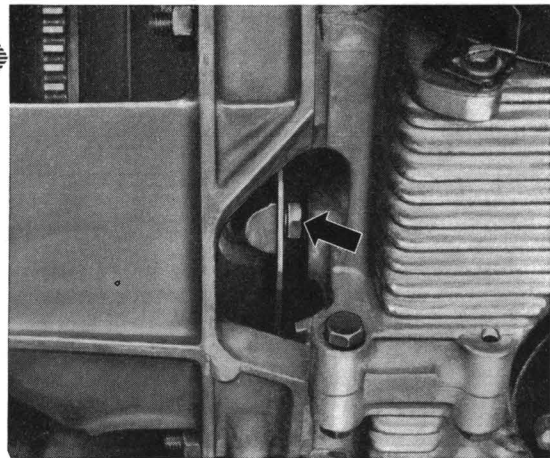
12 - Lower engine/transmission unit slowly and take it out of vehicle.



13 - Remove screws (arrow) in converter. Turn the converter by levering the starter ring with a screwdriver.

14 - Pull vacuum hose off unit. Pull kickdown switch cable off.

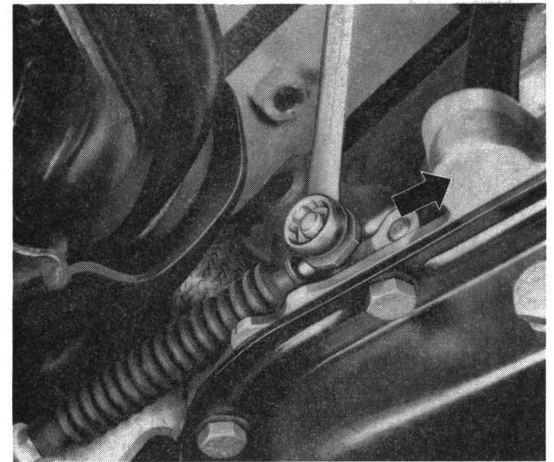
15 - Remove screws from transmission flange and take transmission off engine.



Important
The converter is only pushed on to the one-way clutch support tube. It should be secured with a retaining plate.

Installing

- 1 - Fit engine and transmission together and lift unit on to engine support with transmission bracket.
- 2 - Lift engine/transmission unit and locate it in vehicle. To facilitate installation, two studs (M 10×70) should be screwed into the two lower holes in the front bonded rubber mounting.
- 3 - Install screws in engine support bracket and tighten them.
- 4 - Lift vehicle, install upper screws in front transmission mounting, screw studs out of lower holes, install and tighten lower screws.
- 5 - Attach vacuum hose. Connect kickdown switch cable.
- 6 - Install three screws in converter and tighten to **correct torque**.
- 7 - Install drive shafts and tighten socket head screws to correct torque.
- 8 - Install selector lever cable and secure ground strap on body. Connect cables to terminals 30 and 50 on starter.
- 9 - Adjust selector lever:
 - a - Move selector lever to park position
 - b - Push cable into clamp
 - c - Press lever on transmission fully to the rear, turn rear wheels slightly until parking lock engages and then tighten nut on clamp. When doing so, position the wrench so that when tightening the nut, the lever is pressed to the rear in the park direction.



- 10 - Install heater hoses and connect heater flap cables. Install fuel hose.

Important

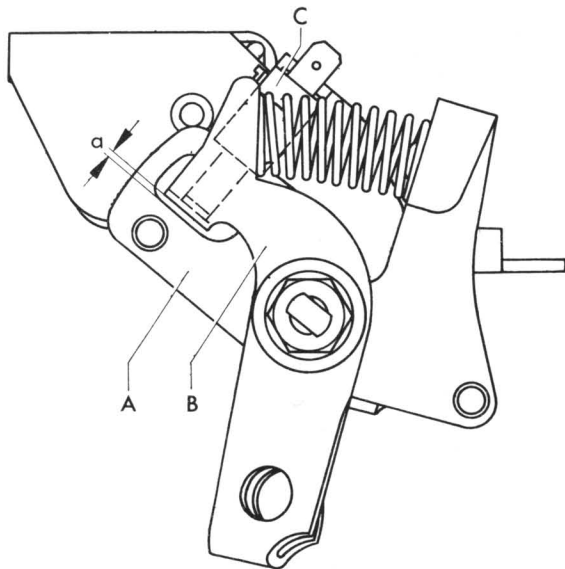
The contact surfaces of drive shafts and flanges must be clean and free of grease. Check rubber seals for leakage. Add more grease to joints if necessary. See Provisional Manual for Type 1, Drive Shafts, Section H-13, page 1-2.

- 11 - Fit bellows on to cooling air duct and tighten clip. Install rubber boot for dipstick and insert dipstick.

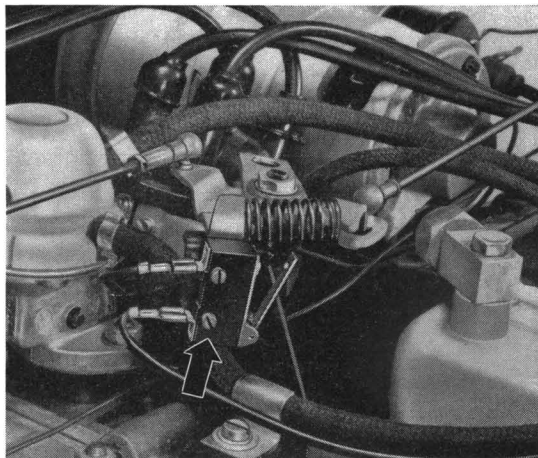
- 12 - Lower vehicle, connect accelerator cable and adjust it.

Press accelerator pedal down until it is contacting the stop on the footrest and hold it in this position. With adjusting nut, tighten the accelerator cable so far that the moving lever (B) is swung on to the stop on the three-arm lever (A) against the spring pressure. Lock cable adjusting nut in this position.

- 13 - Check adjustment of kickdown switch and rectify as necessary. To do this, switch ignition on and connect a test lamp to the terminal for the cable leading to the transmission. Let pedal return slowly from the kickdown position (end stop) until there is a clearance of 0.5 to 1.0 mm (a) at the stop for the moving lever (B). In this range the kickdown switch should break the circuit and the lamp should go out. If necessary, loosen the switch securing screws and adjust switch.



A - Three-arm lever
 B - Moving lever
 C - Kickdown switch
 a - Clearance 0.5—1.0 mm (.020—.040 in.)



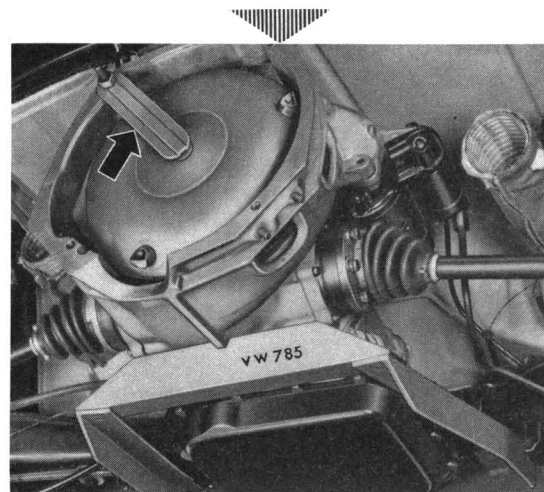
- 14 - Connect cables to generator, coil and oil pressure switch.

- 15 - Install air cleaner and connect battery ground strap.

Removing transmission

- 1 - Lift vehicle, disconnect hose from vacuum unit and cable from kickdown switch. Remove three screws from converter. Insert transmission support VW 785 (local manufacture) into diagonal arm mountings.

Remove engine and secure converter with retaining plate (arrow).



- 2 - Remove drive shafts.
- 3 - Disconnect selector lever cable and starter cable. Detach ground strap.
- 4 - Support transmission and remove screws from front transmission mounting.
- 5 - Remove support VW 785 and take transmission out of vehicle.

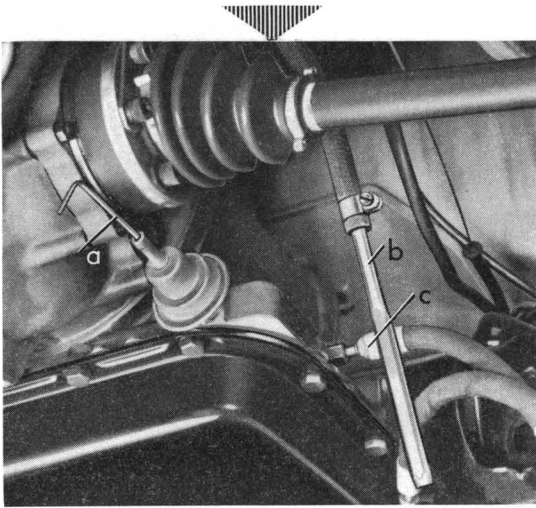
Installing

See installation of engine-transmission together.

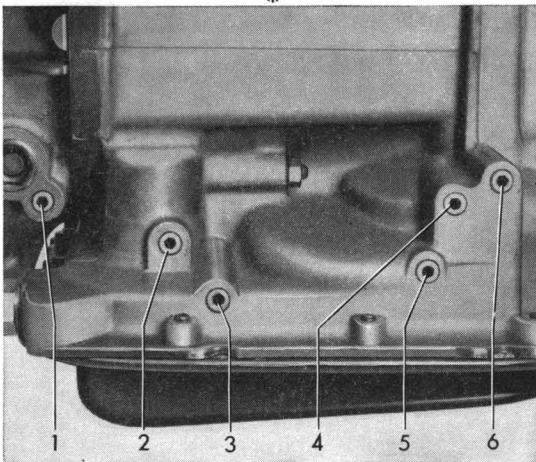
Adjusting vacuum unit

If the vacuum unit is replaced or a new or exchange transmission installed, the **primary throttle pressure must be checked and corrected if necessary by adjusting the vacuum unit.**

- 1 - Pull hose off vacuum unit and seal hose with an 8 mm punch (b) so that engine does not draw in secondary air.

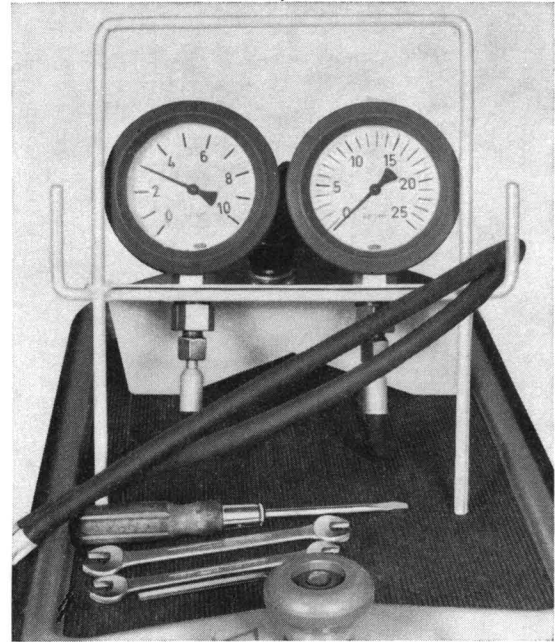


- 2 - Connect pressure gauge (up to 140 psi) to the primary throttle pressure test point (connection 3) as shown at (c).



- 1 - Regulator pressure
- 2 - Main pressure
- 3 - Primary throttle pressure
- 4 - Main pressure-release side of 2nd gear band
- 5 - Secondary throttle pressure
- 6 - Main pressure-apply side of 2nd gear band

- 3 - Start engine, run it at a fast idling speed and read off the pressure.



- 4 - Adjust the primary throttle pressure **accurately** by screwing the socket head screw (a) in or out. Compare the values with the table.

- 5 - Connect vacuum hose and read pressure on gauge.

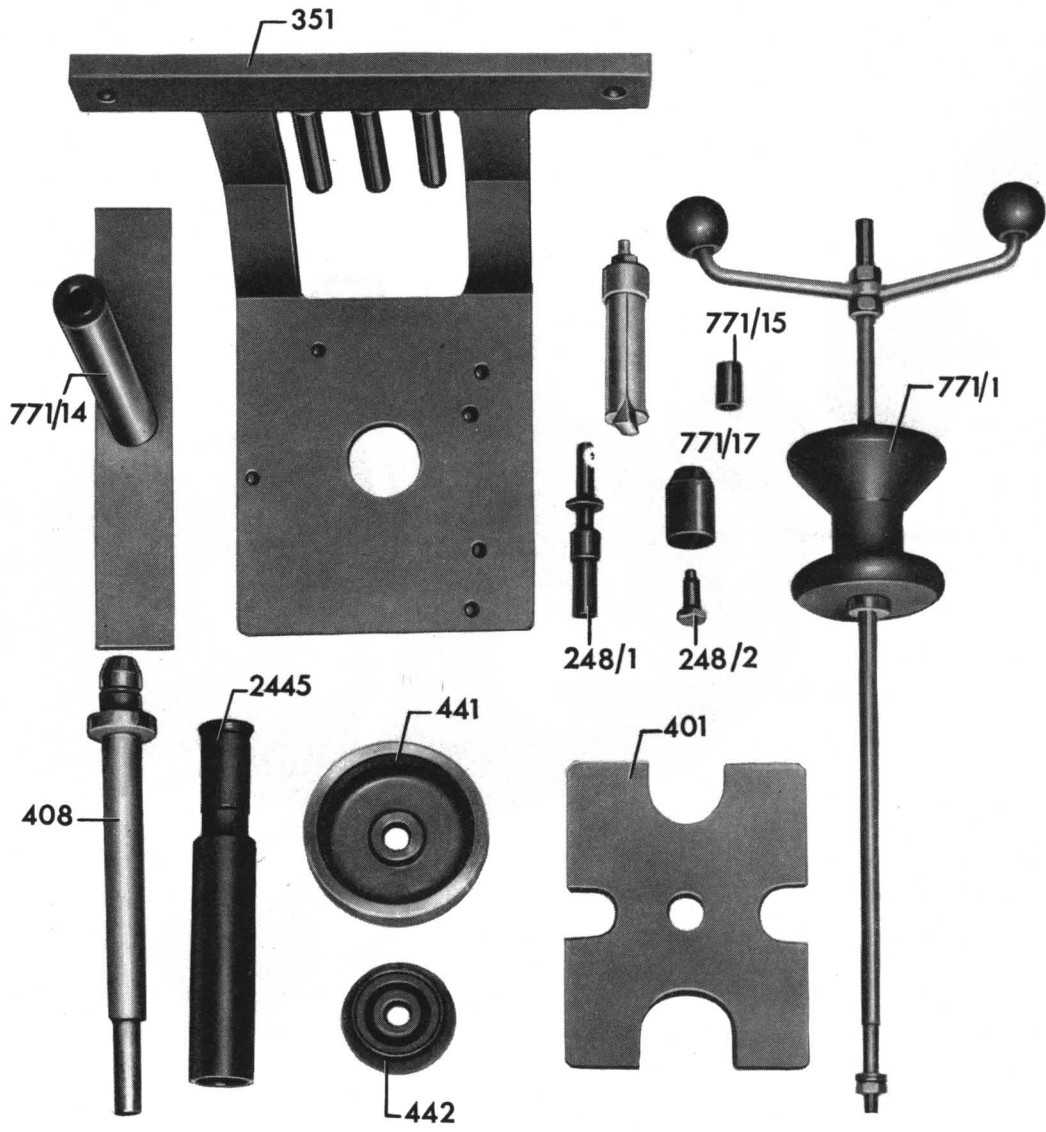
Important

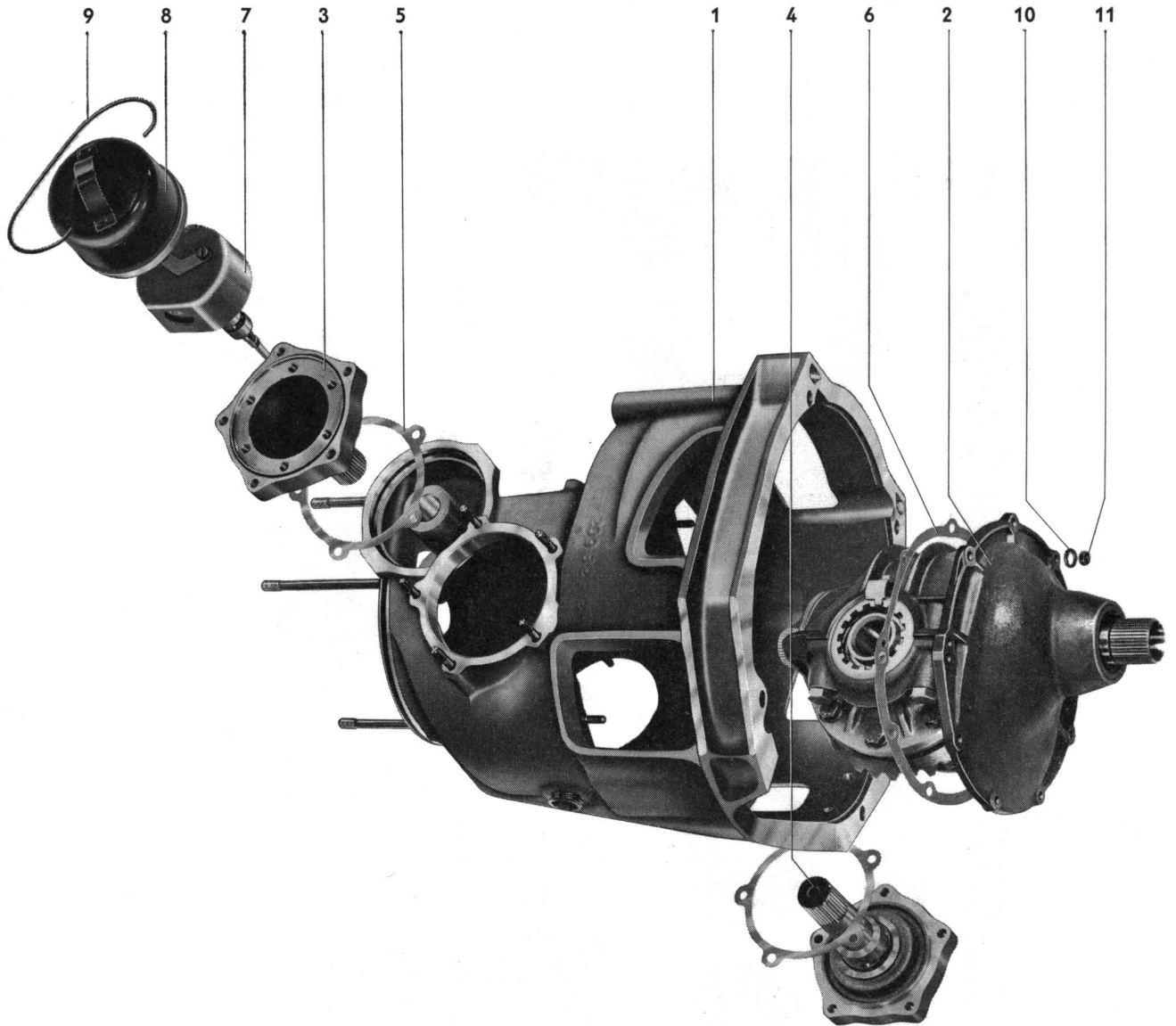
Compare the figures with those in the table in section H/22, page 2-3.

- 6 - Take pressure testing hose off transmission, seal hole with plug and check for leakage.

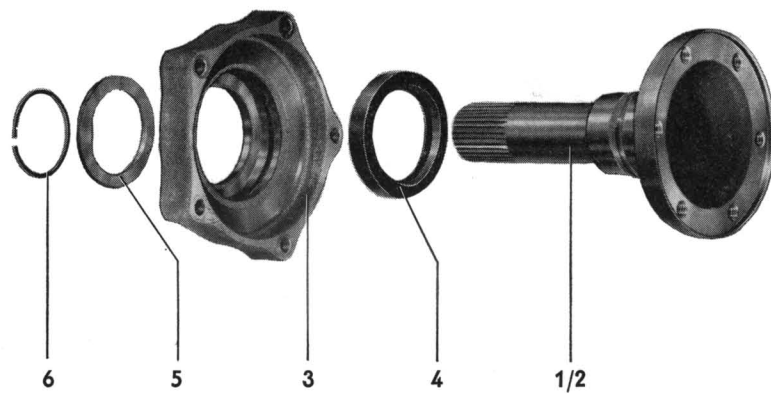
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Special Tools





Flanged shaft — left and right



No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	Final drive housing	1			
2	Differential carrier	1			Section H/24, page 2-1
3	Flange shaft, left	1			Section H/24, page 1-1
4	Flange shaft, right	1			Section H/24, page 1-1
5	Gasket/side cover	2		fit new	
6	Gasket/diff. carrier	1		fit new	
7	Governor	1		engage square drive	
8	Governor cover	1		fit properly	
9	Cover clip	1			
10	Spring washer B 6	19			
11	Nut M 6	19		tighten to 0.5 mkg	

Flange shaft — left and right

No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	Flange shaft, left	1	check for scoring by oil seal		
2	Flange shaft, right	1	check for scoring by oil seal		
3	Side cover	2	check for wear		
4	Oil seal	2	press out with VW 681	press in with VW 401, 441, 442 and 408	Section H/24, page 1-5
5	Thrust washer	2	check for wear		
6	Circlip	2			

Converter

The converter is welded together and must be **replaced complete** if damaged or leaking or if the starter ring is defective.

- 1 - Check hub for signs of scoring from oil seal.

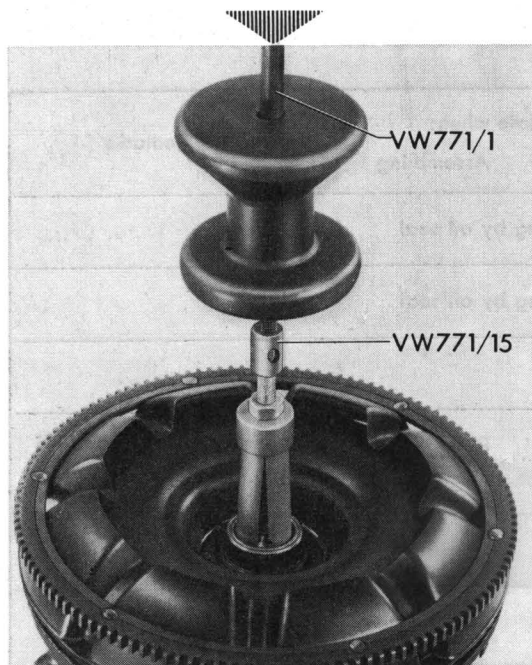


- 2 - Check security of starter ring and air deflector plate. Remove burr from starter ring.

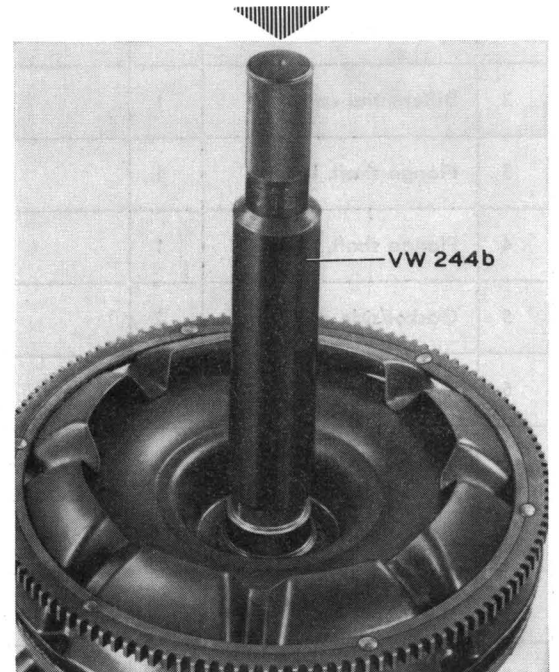
Important

Cover hub bore in converter to keep out dirt.

- 3 - Check bush for wear and replace if scored. Pull bush out with extractor VW771/1 and 15.



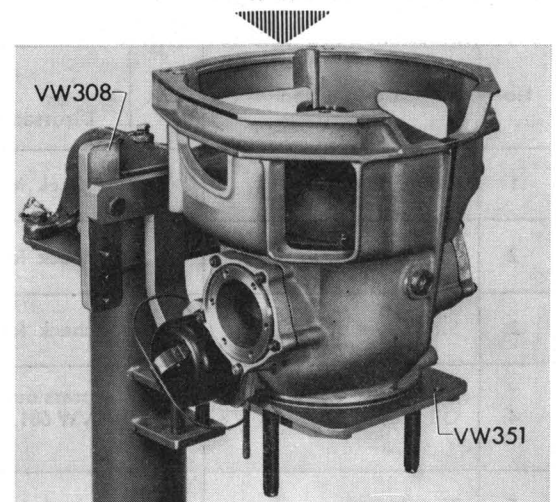
- 4 - Drive new bush in with drift VW 244 b.



Differential carrier

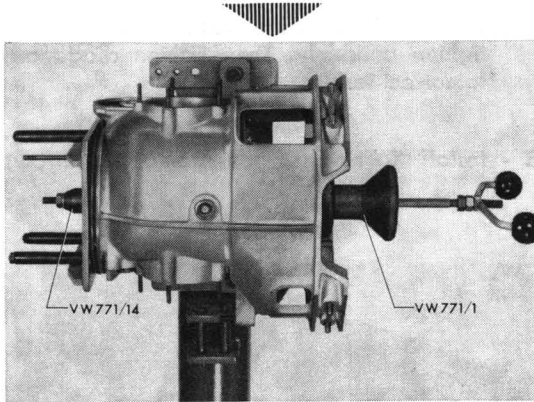
Removing

- 1 - Take converter off, pull pump and turbine shafts out and take rear axle off transmission.
- 2 - Secure rear axle in assembly stand VW 351.

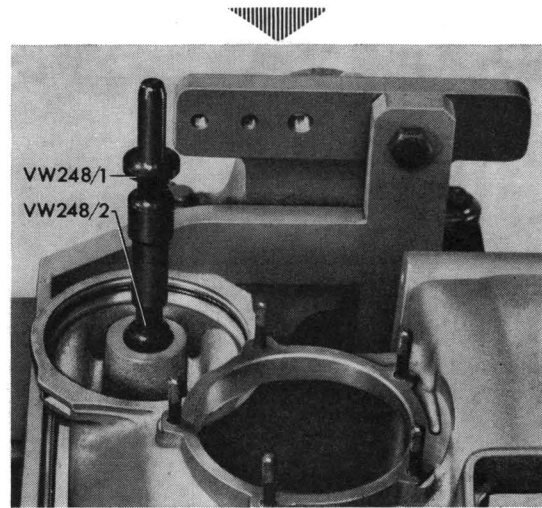


- 3 - Remove governor (7), both flanged shafts and side covers (3/4).

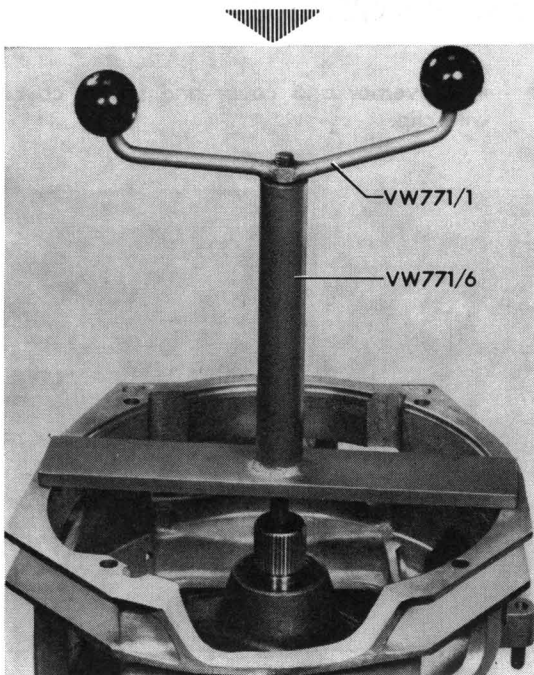
4 - Remove nuts (11) holding differential carrier. Slide tool VW 771/14 over pinion and insert multi-purpose tool 771/1 (local manufacture) into pinion.



7 - Check governor oil seal and "O" ring. Drive out with drift VW 248/1 and 2.



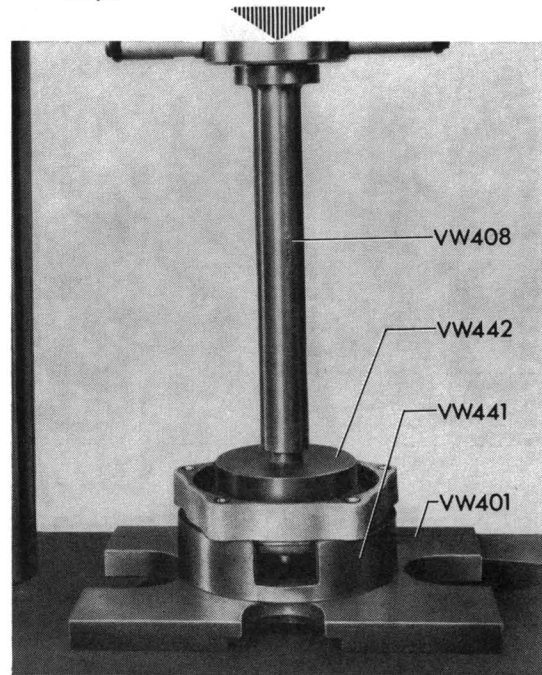
5 - Lift differential carrier out of rear axle housing. If the carrier is tight, it can be pulled out with the cross member VW 771/6 (local manufacture).



8 - Remove flange shafts (1/2) and check oil seals. If necessary press oil seal out with special tool VW 681.

Installing

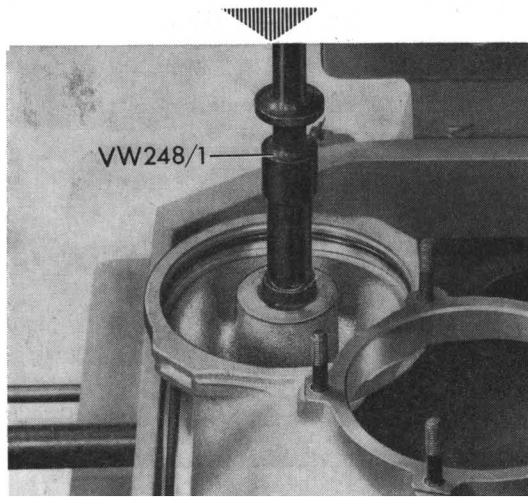
1 - Press flange shaft seals (5) into side covers with VW 401, 441, 442 and 408. Grease lips slightly, insert flange shafts and install snap rings.



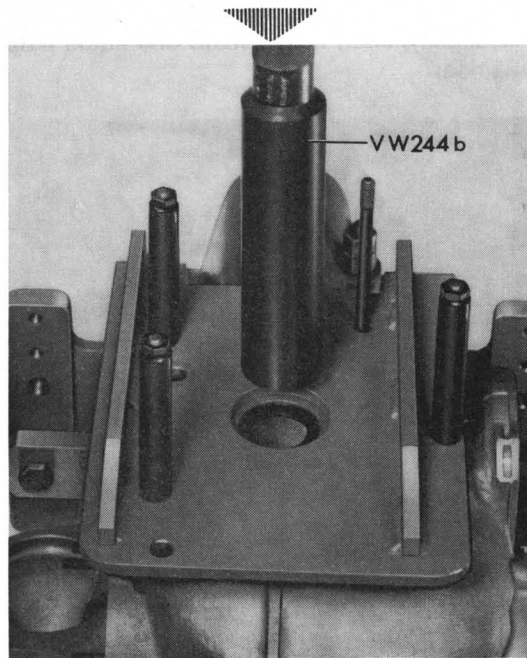
6 - Check pinion oil seal. Press it out with lever VW 681.

Important
Coat oil seals with oil outside before installing them.

- 2 - Drive governor oil seal in with VW 248/1. The sealing lip **must be towards governor**.



- 3 - Drive pinion oil seal in with VW 244 b until seal is flush with casing. The sealing lip **must be outwards**.

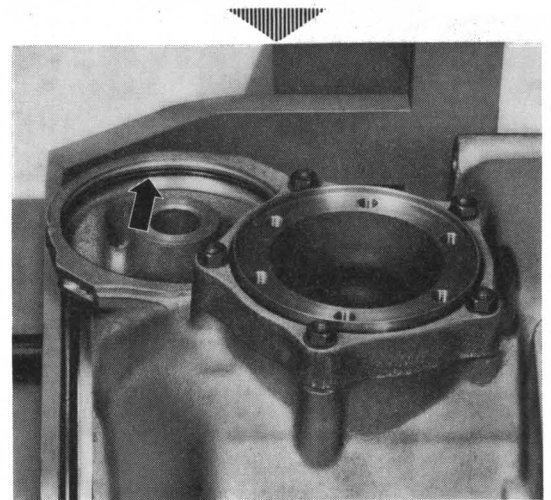


- 4 - Install paper gasket (6) for differential carrier (2).
- 5 - Slide fitting sleeve VW 771/14 over the pinion and insert multi-purpose tool VW 771/1 (local manufacture) into pinion.

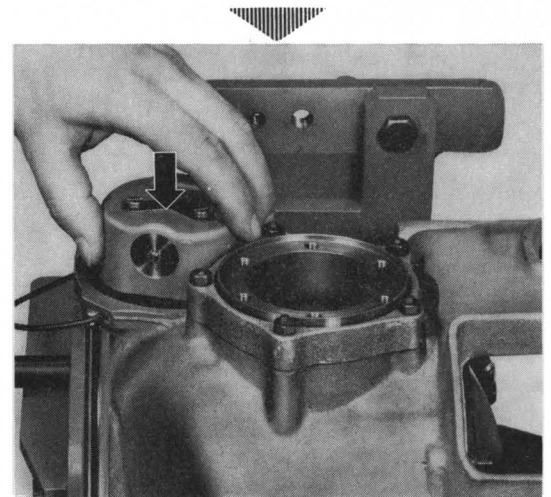
- 6 - Insert differential carrier (2) into housing (1), fit spring washers and nuts (11) and tighten lightly first before pulling down to proper torque diagonally.

- 7 - Install oil seals (5) for flange shafts, insert shafts (3/4), fit spring washers and nuts and tighten uniformly. Then tighten diagonally to correct torque.

- 8 - Install "O" ring for governor cover (arrow).

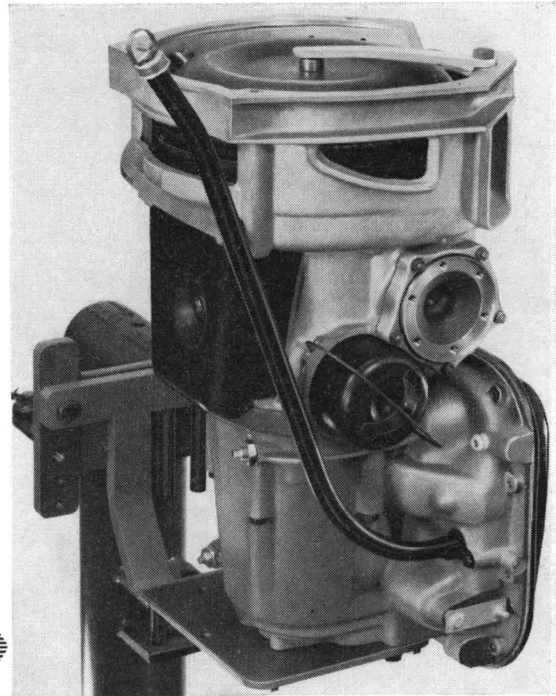


- 9 - Fit governor and cover and secure cover with clip.



- 10 - Place new gasket between transmission case and rear axle housing, fit parts and pull them together with nuts and spring washers before tightening nuts diagonally to correct torque.

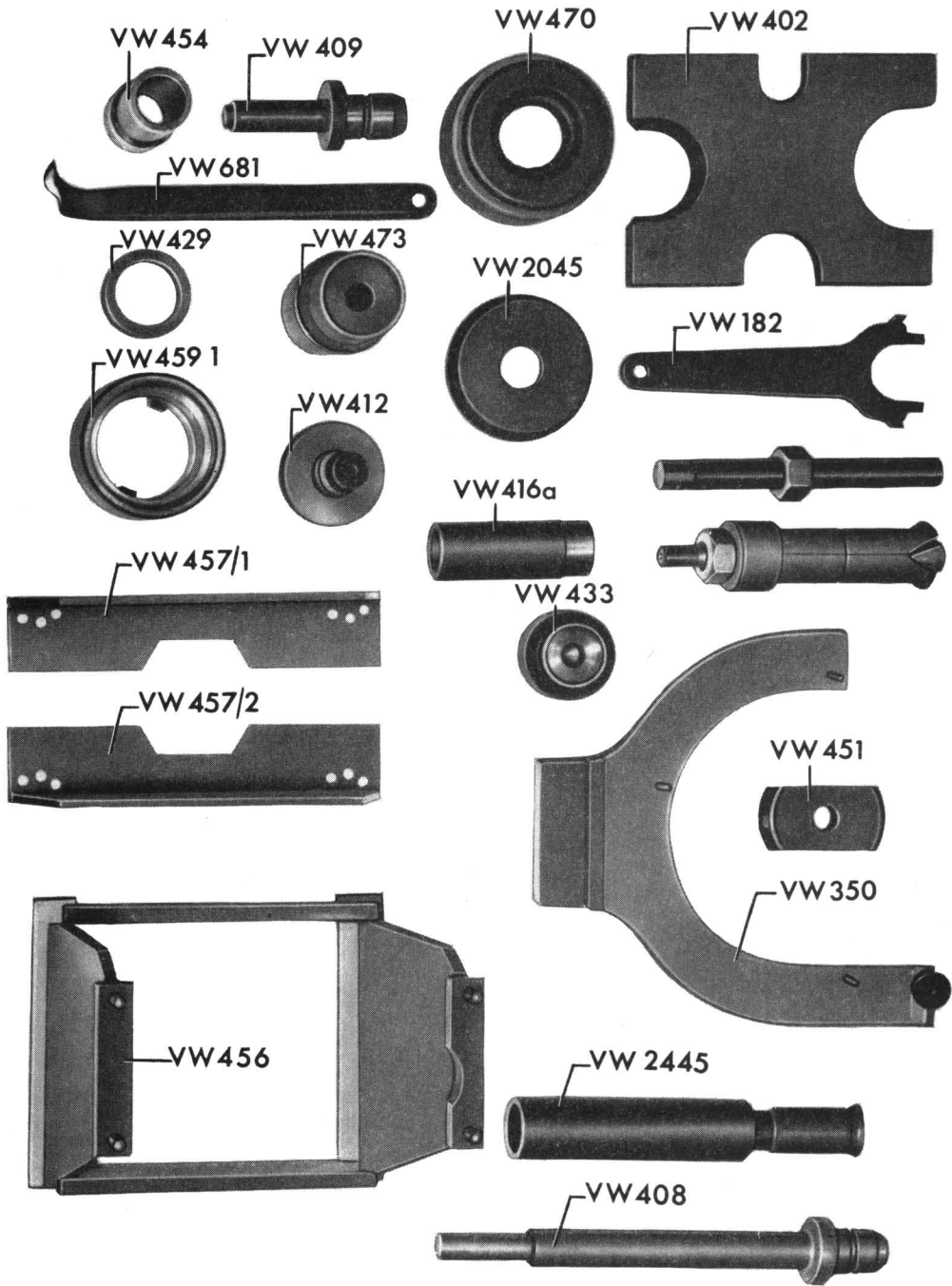
Important
Before fitting the converter, check that the pump and turbine shafts can be turned freely by hand. The end of the turbine shaft with the small pilot should be inserted into the transmission.



11 - Insert pump and turbine shafts and fit converter. Install oil filler tube and air deflector plate.

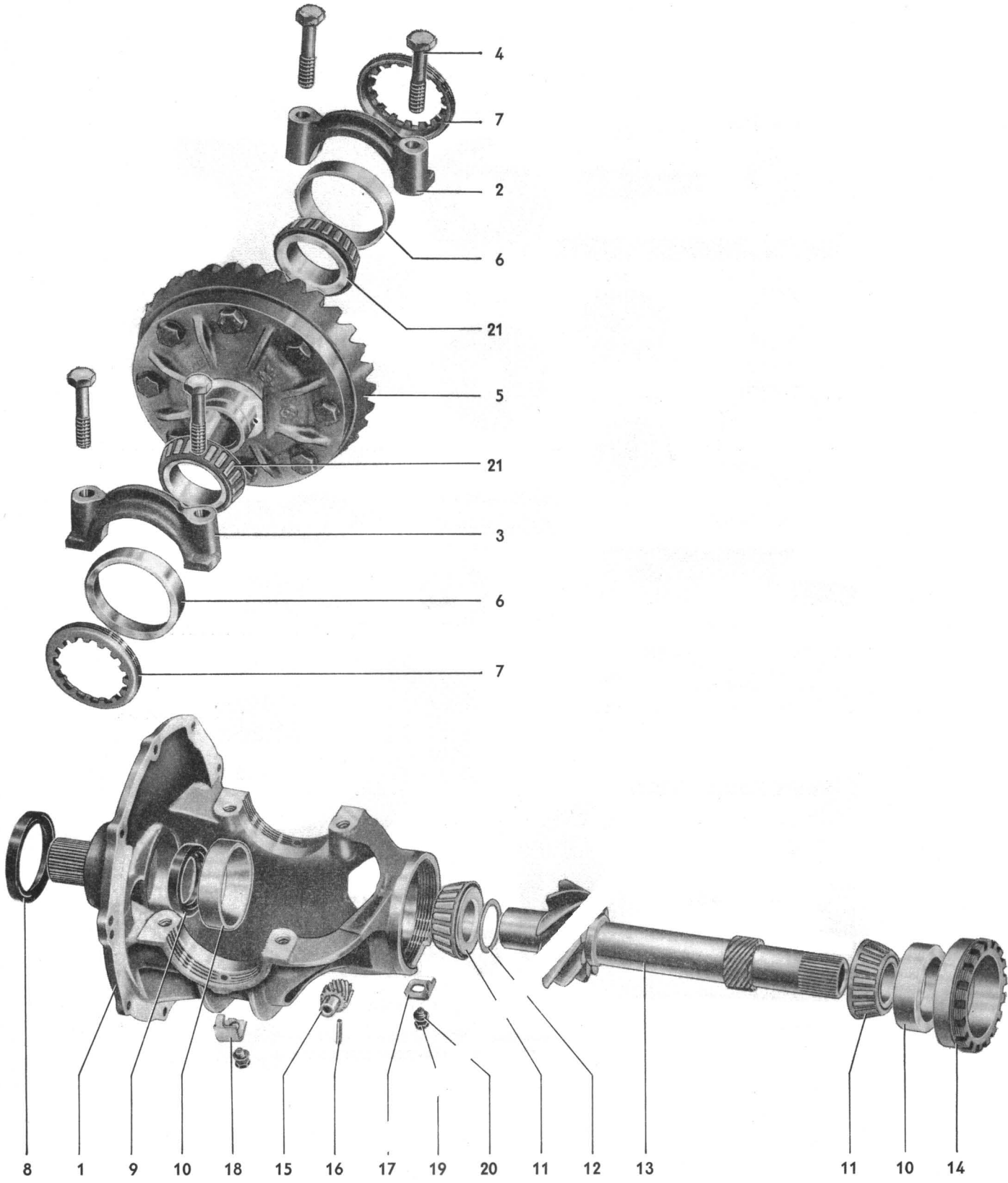


Special Tools



H₂₄ Differential Carrier

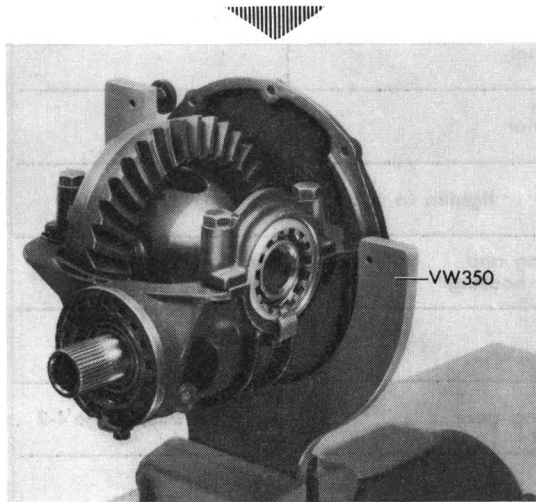
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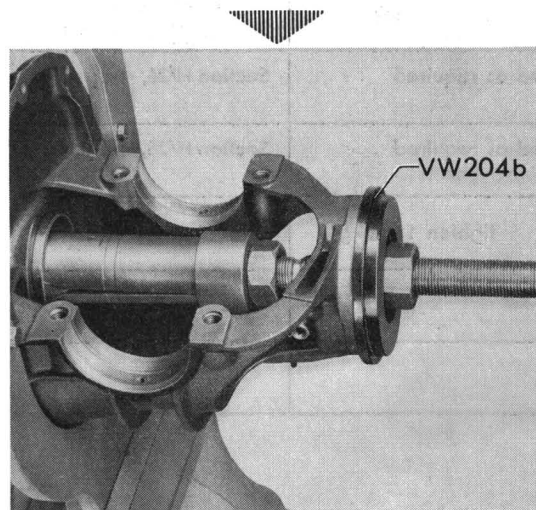
No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	Differential carrier	1			
2	Bearing cap, right	1		matched to carrier	
3	Bearing cap, left	1		matched to carrier	
4	Screw M 10 × 52	4		tighten to 5 mkg	
5	Differential housing	1	see disassembling and assembling diff. housing		Section H/24, page 3-2
6	Taper roller bearing/ outer ring	2			
7	Adjusting ring/ring gear	2	see adjusting ring gear		Section H/26, page 4-2
8	Seal/converter	1			
9	Seal/pinion	1			
10	Taper roller bearing/ outer ring	2			
11	Taper roller bearing/ inner ring	2			
12	Shim/pinion	×	see adjusting pinion		Section H/26, page 3-2
13	Pinion	1			
14	Adjusting ring/pinion	1	see adjusting bearings		Section H/26, page 3-2
15	Drive gear/governor	1			
16	Pin 3 × 24	1		secure gear	
17	Lock plate/pinion adjusting ring	1	two versions used as required		Section H/26, page 3-3
18	Lock plate/ring gear adjusting ring	2	two versions used as required		Section H/26, page 4-3
19	Screw M 6 × 10	3		tighten 1.0 mkg	
20	Spring washer B 6	3			
21	Taper roller bearing/ inner ring	2			

Disassembling

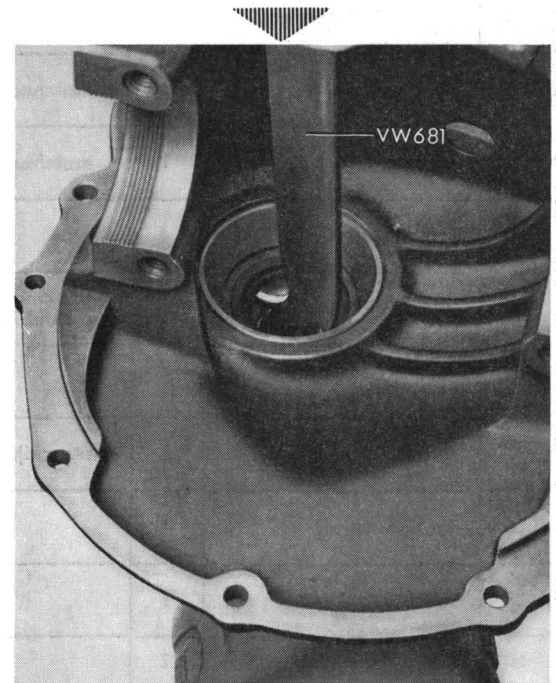
- 1 - Clamp differential carrier in vise with holding plate VW 350.



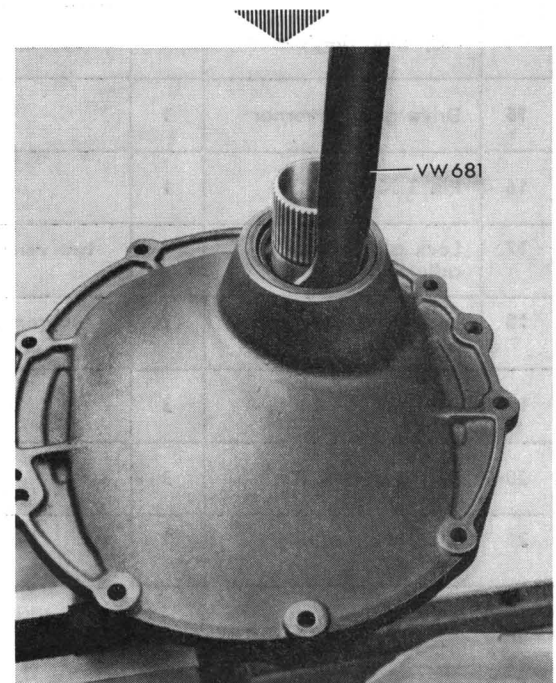
- 2 - Take off lock plates (17/18) for adjusting rings on differential (7) and pinion (14).
- 3 - Remove screws (4) holding the retaining caps (2/3), lift caps off and take out differential (5).
- 4 - Unscrew pinion adjusting ring (14) with special wrench VW 182 and take pinion (13) out.
- 5 - Knock pin (16) down and take governor drive pinion (15) off.
- 6 - Pull rear outer bearing ring (10) of pinion out of carrier with extractor and VW 204b.



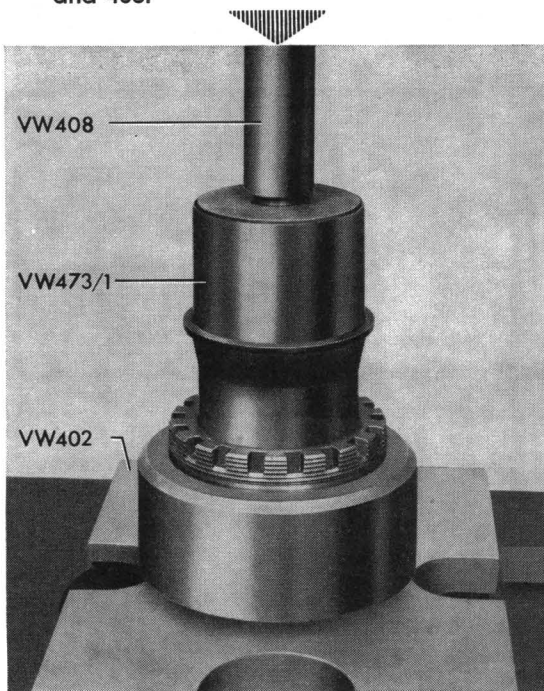
- 7 - Press pinion oil seal (9) out with VW 681.



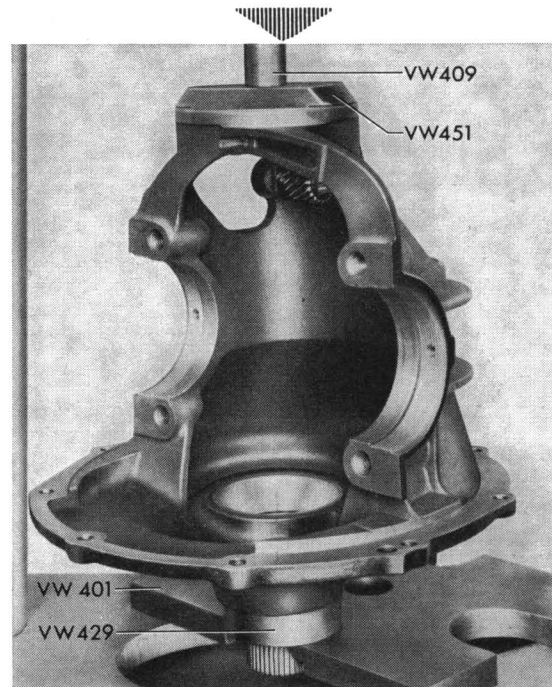
- 8 - Press converter oil seal (8) out with VW 681.



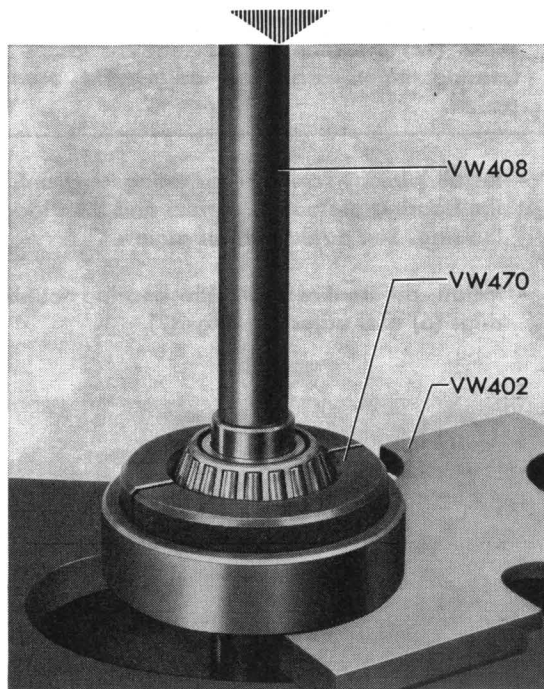
9 - Press pinion bearing outer ring (10) out of adjusting ring (14) with VW 402, 459/1, 473/1 and 408.



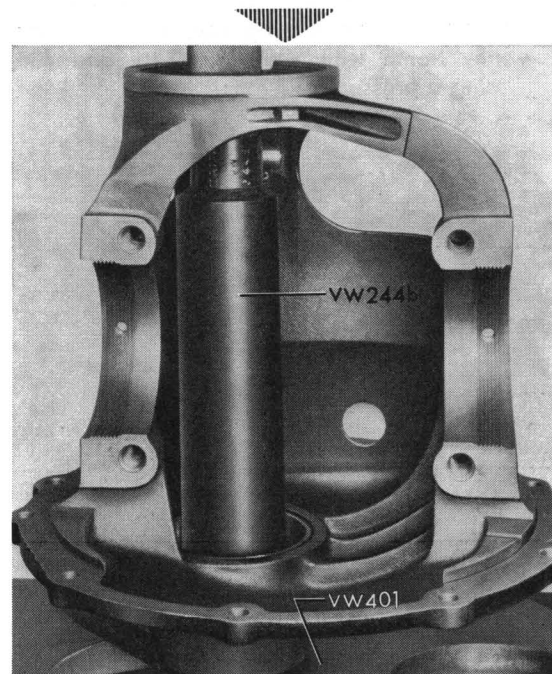
2 - Press converter oil seal (8) in with VW 402, 409, 451 and 429.



10 - Press bearing inner rings (11) off pinion with VW 402, 470 and 408.



3 - Drive pinion oil seal (9) in with VW 244b.



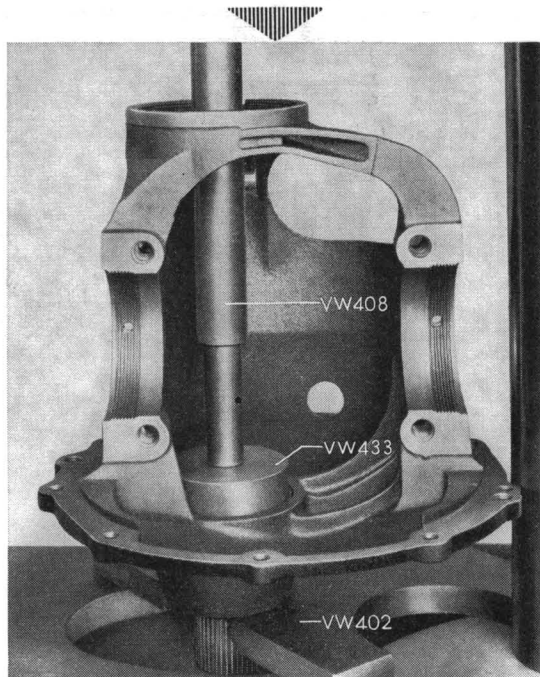
Assembling

1 - Insert governor drive pinion (15) and drive in the retaining pin.

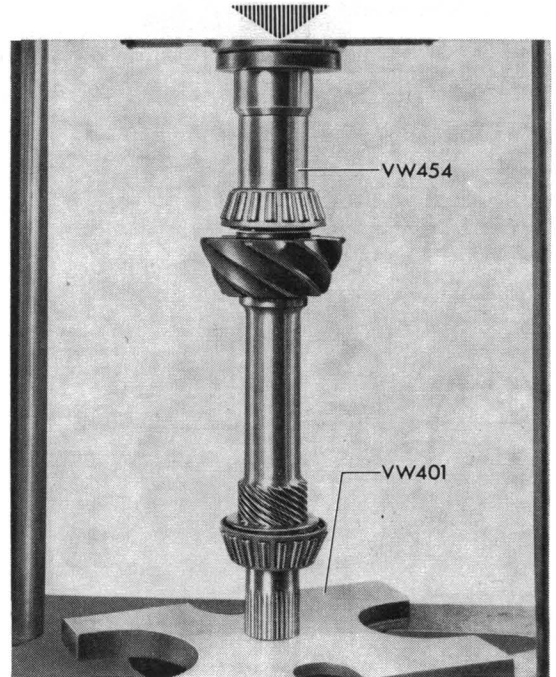
Important

Dip oil seals in oil before installing them.

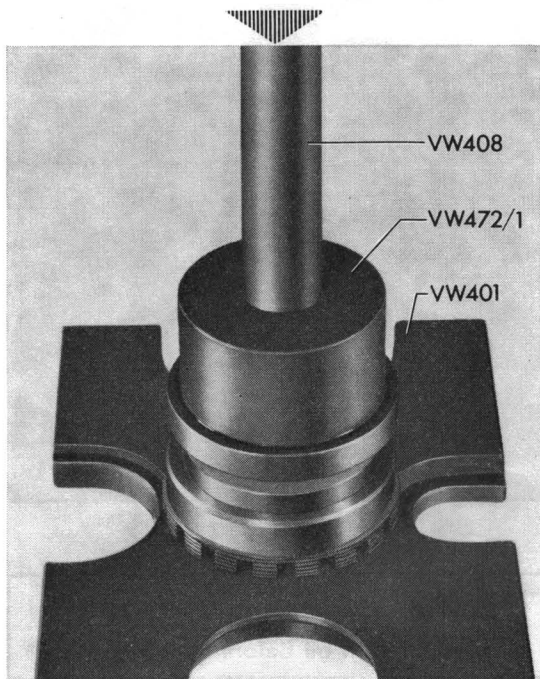
4 - Press pinion bearing outer ring (6) into differential carrier with VW 402, 433 and 408.



6 - Heat bearing inner rings (11) to about 100° C, place them on pinion and press home with VW 401, 454 and 412, using a pressure of 3 tons.



5 - Heat adjusting ring (14) for pinion to about 100° C, install bearing ring (6) and press fully home with VW 401, 472/1 and 408, using a pressure of 3 tons.

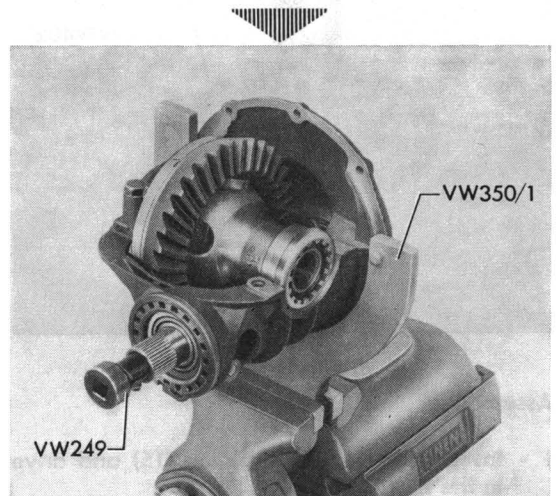


Important

When assembling finally, place the correct shims (12) between pinion shoulder and bearing inner ring. **See adjustment of pinion.**

7 - Install pinion, screw in adjusting ring until the bearing preload is correct and then lock the ring. See adjustment of pinion.

8 - Install differential (5) with bearing outer rings (6) and adjusting rings (7).

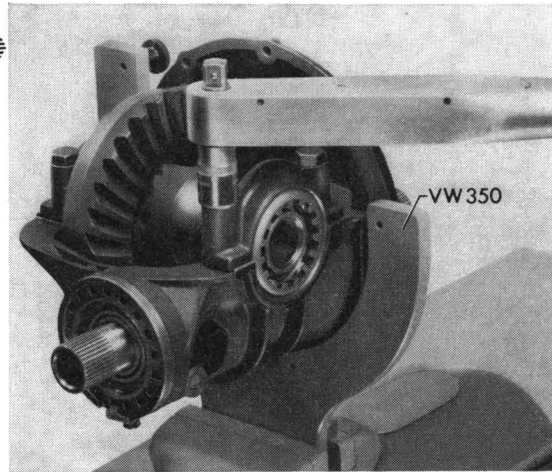


Fit bearing caps (2/3) and tighten screws (4).



- 9 - Turn the adjusting rings with the special wrench VW 182 to adjust the bearing pre-load and backlash. See adjustment of ring gear.

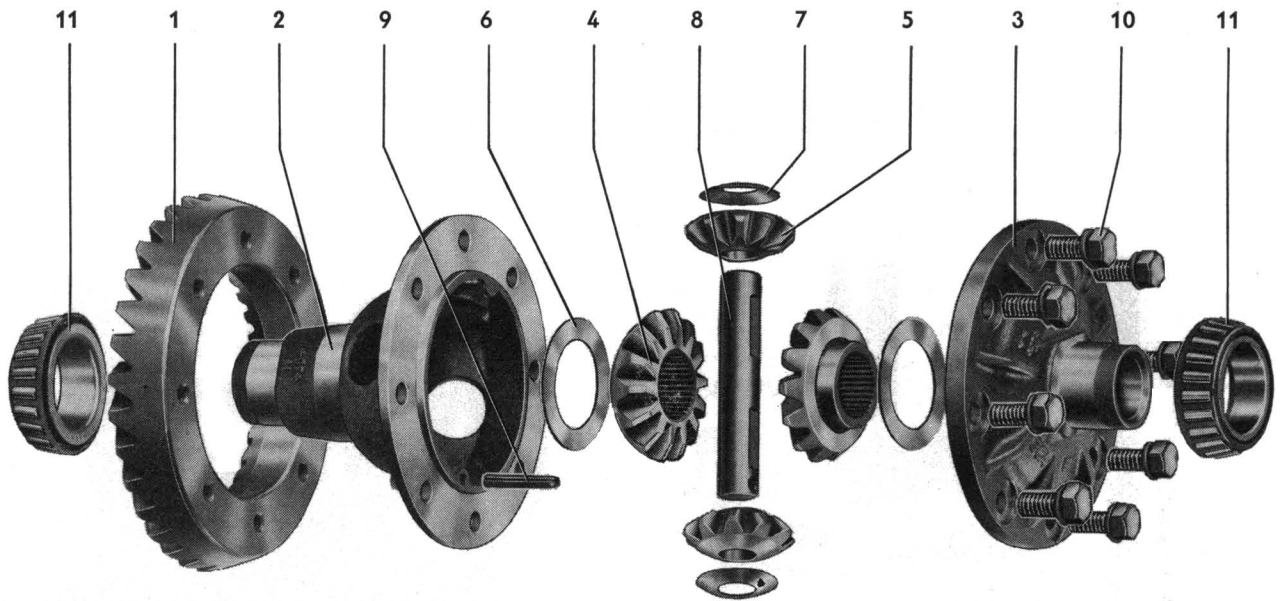
See ring gear adjustment.



- 10 - Secure adjusting rings (7) with lock plates (18).

Important

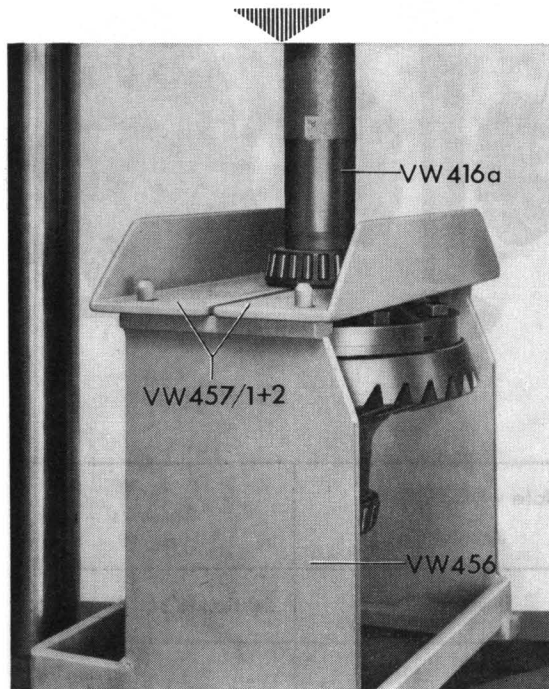
Before fully tightening the retaining cap screws, check that the adjusting rings are properly located in the threads.



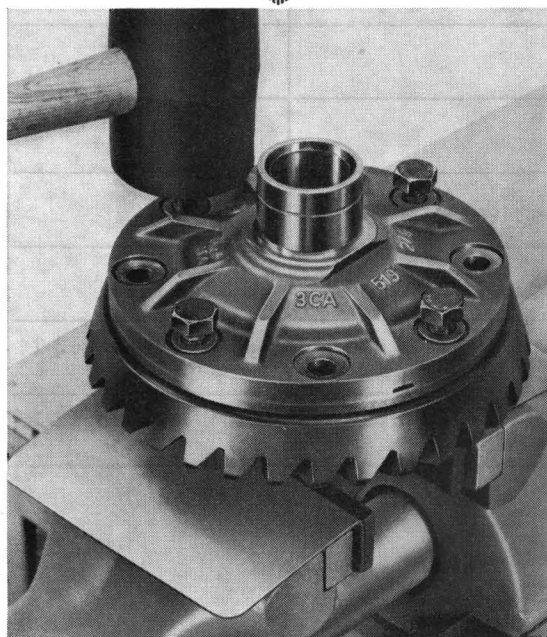
No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	Ring gear	1		heat to fit	Section H/24, page 3-2
2	Differential housing	1			
3	Cover for housing	1			
4	Differential gear	2	check for wear		
5	Differential pinion	2	check for wear		
6	Thrust washer (large)	2	check for wear		
7	Thrust washer (small)	2	check for wear		
8	Shaft	1	drive out	drive in	
9	Retaining pin 5 × 32	1			
10	Ring gear screw with spring washer	8		tighten to 4.5 mkg	Section H/24, page 3-2
11	Taper roller bearing/inner ring	2	press off	heat to fit	Section H/24, page 3-2

Disassembling

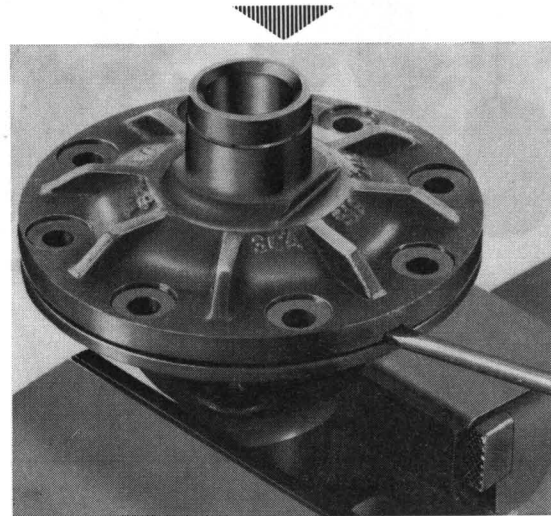
- 1 - Press bearing inner rings (11) off differential housing and cover (2/3) with VW 456, 457/1 and 2, and 416 a.



- 2 - Clamp differential housing in a vise, using vise clamps. Remove ring gear screws (10) and knock ring gear (1) off.



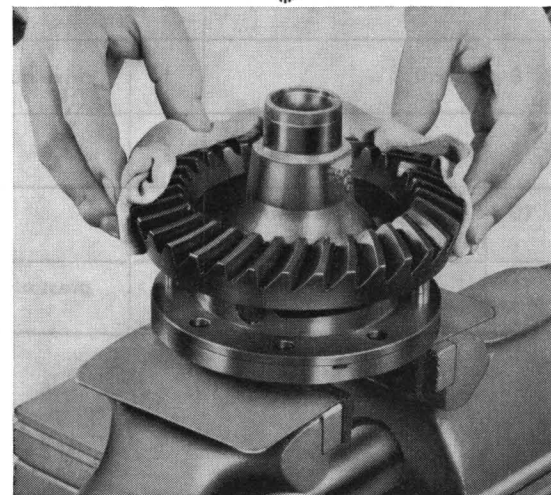
- 3 - Lever cover (3) off housing (2) with a screwdriver.



- 4 - Knock out shaft retaining pin (9) and shaft (8).
- 5 - Check thrust washers (6/7) bevel gears (4/5) and thrust surfaces for wear.

Assembling

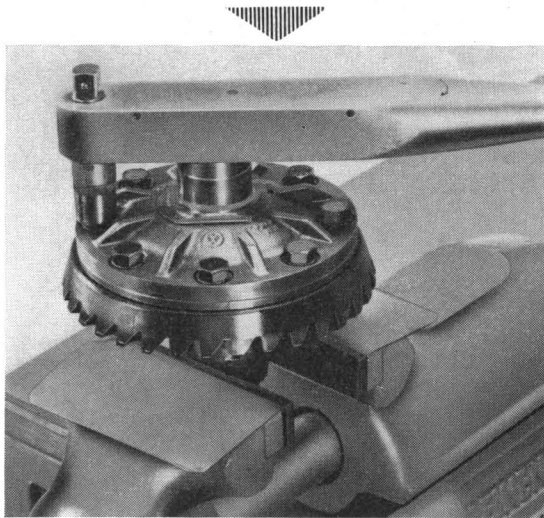
- 1 - Install bevel gears and thrust washers and insert shaft. **Drive new pin in and peen housing over ends of pin on both sides.**
- 2 - Heat ring gear (1) to about 100°C and install it on the housing (2) with the aid of two centering pins.



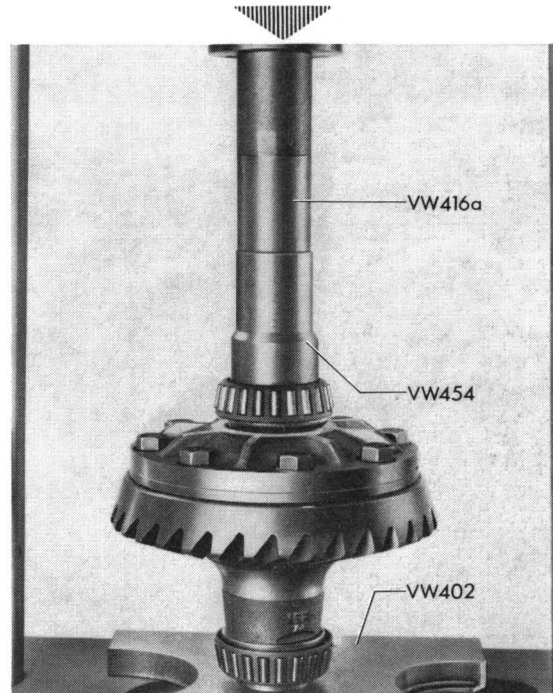
Important

Clean contact surfaces are essential to ensure that the ring gear and end cover fit properly. Remove all burrs and pressure marks with an oil stone.

- 3 - Heat cover (3) to about 100° C and install it. Tighten ring gear screws diagonally.



- 4 - Heat bearing inner rings (11) to about 100° C, install them and press them fully home with VW 402, 454, and 416a, using a pressure of 3 tons.



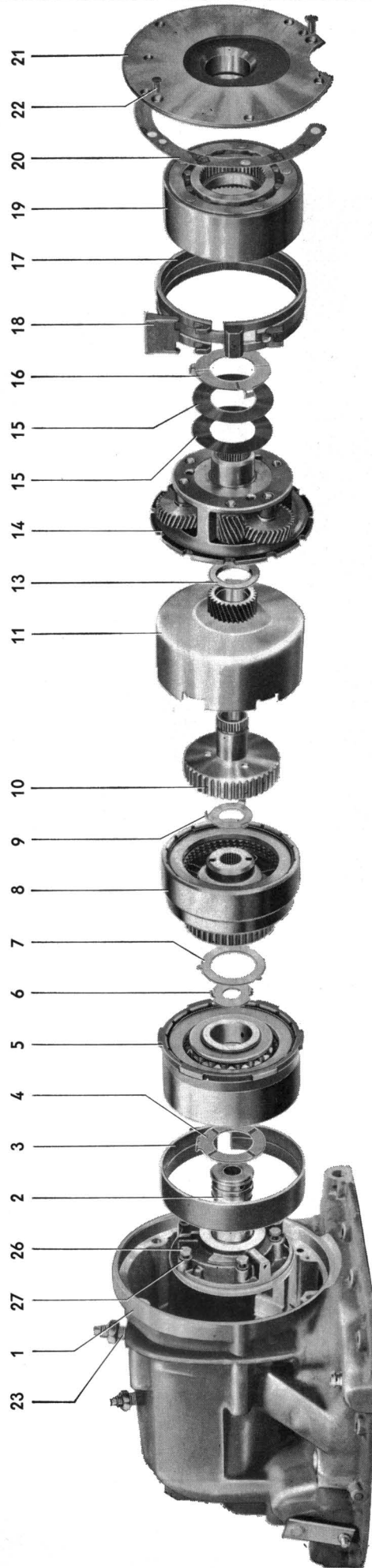
Important

Use only the proper screws and spring washers.

B i n d e r P u n c h A r e a

Special Tools





No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	Transmission case	1			
2	Oil pump	1	see disassembling and assembling oil pump		Section H/25, page 5-1
3	2nd gear band	1			
4	Thrust washer 1	1	check for wear and scoring		
5	Direct and reverse clutch	1	see disassembling and assembling direct and reverse clutch		Section H/25, page 4-1
6	Thrust washer 2	1	check for wear and scoring		
7	Thrust washer 3	1	check for wear and scoring		
8	Forward clutch	1	see disassembling and assembling forward clutch		Section H/25, page 3-1
9	Thrust washer 4	1	check for wear and scoring		
10	Clutch hub	1	check bushes for wear		
11	Driving shell	1	check teeth for wear		
12	Sun gear, small	1	check bush and teeth for wear		
13	Thrust washer 5	1	check for wear and scoring		
14	Planetary gear set	1	see checking planetary gear seat		Section H/25, page 2-2
15	Shim	x	see adjust of transmission axial play		Section H/25, page 1-6
16	Thrust washer 6	1	check for wear and damage		
17	1st gear band	1			
18	Support fork	1			
19	Annulus gear with one-way clutch	1	see disassembling and assembling annulus gear		Section H/25, page 2-1
20	Gasket for bearing flange	1		fit new	
21	Bearing flange	1	check contact surfaces and teeth for wear		
22	Screw M 6 × 15	2			
23	Adjusting screw for 1st gear band	1	see band adjustment with thin dog point		Section H/25, page 1-7
24	Adjusting screw for 2nd gear band	1	see band adjustment with thick dog point		Section H/25, page 1-7
25	Nut for adjusting screw	2	tighten to correct torque		
26	Screw M 6 × 35	5	tighten to correct torque		
27	Spring washer B 6	5			

Disassembling

The transmission fluid must be drained off when working on the transmission but it is not necessary to drain the final drive oil.

Important

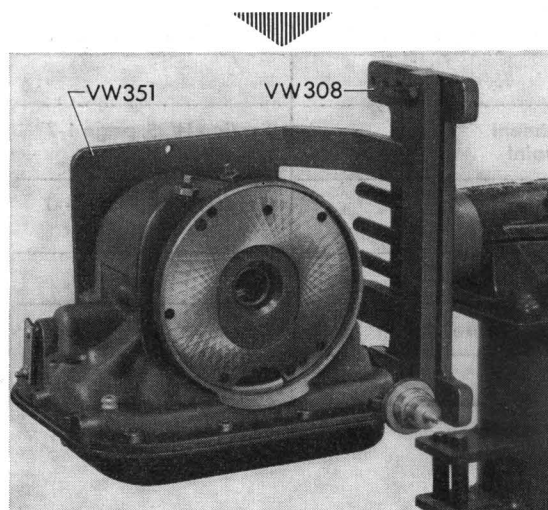
Before starting to disassemble the transmission, clean the **outside of the housing thoroughly** so that no dirt can get into the transmission when dismantling. Wash all parts carefully with cleaning benzine or kerosene and dry them with compressed air. **Do not use rags.**

- 1 - Pull converter off the one-way clutch support, withdraw pump and turbine shafts and take transmission off final drive housing.

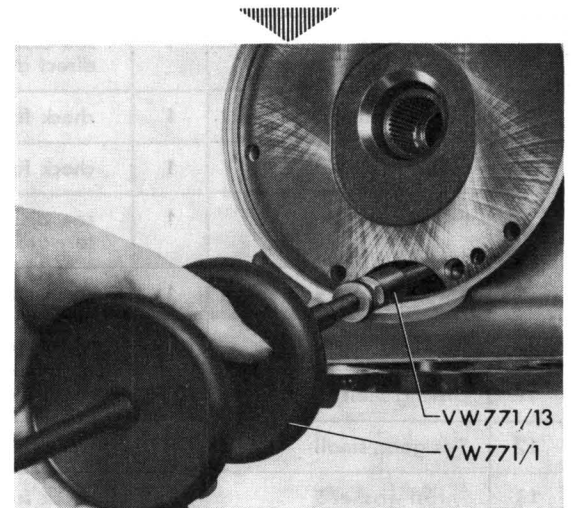
Important

Cover the converter hub opening.

- 2 - Remove front bonded rubber mounting and place transmission in repair stand with VW 351.



- 3 - Remove countersunk screws (22) and pull bearing flange (21) out with VW 771/1 and 13.



- 4 - Loosen brake band adjusting screws (23/24). Lift out 1st gear band (17), annulus gear with one-way clutch (19) and planetary gear set (14).

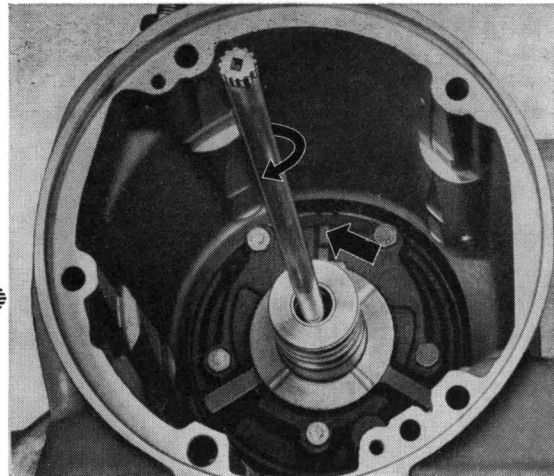
Important

Note number and thickness of all shims (15).

- 5 - Take out drive shell with small sun wheel (11/12), clutch hub (10) and forward clutch (8).
- 6 - Take out direct and reverse clutch (5) and 2nd gear band (3). Remove hexagon screws (26) and take out oil pump (2).

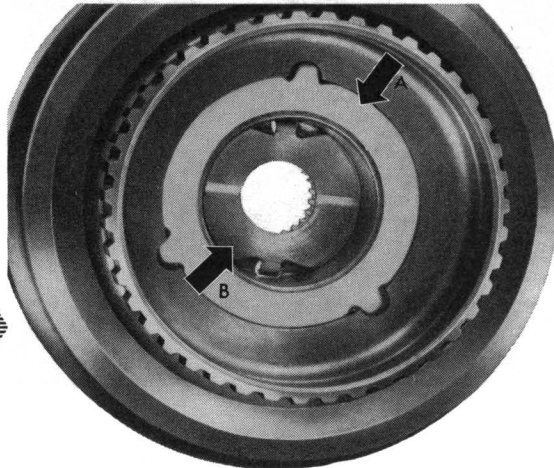
Assembling

- 1 - Insert oil pump (2) so that the lug (arrow) points upwards. Fit screws and spring washers and partly tighten all uniformly before tightening diagonally to correct torque.
- 2 - Insert pump shaft in drive plate and turn oil pump.

**Important**

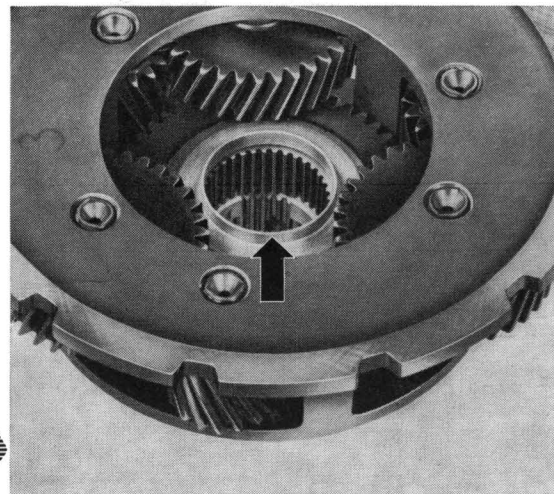
It should be possible to turn the pump smoothly by hand without any signs of catching.

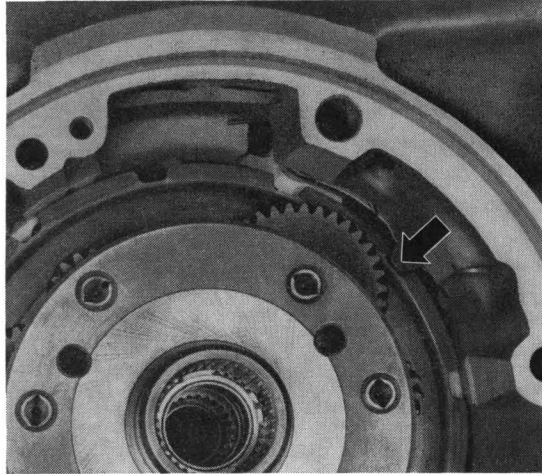
- 3 - Slide thrust washer (4) for direct and reverse clutch over the neck of pump housing and engage it on the lug.
- 4 - Install 2nd gear band and screw adjusting screw in until it contacts the recess in the band. Install direct and reverse clutch (5) and press it down until it is on the thrust washer.
- 5 - Stick thrust washers (6/7) (arrows A and B) in the forward clutch (8) with grease and install forward clutch.

**Important**

In order to facilitate insertion of the forward clutch hub into the internally splined plates of the direct and reverse clutch, it is advisable to align the plates properly beforehand with a screwdriver.

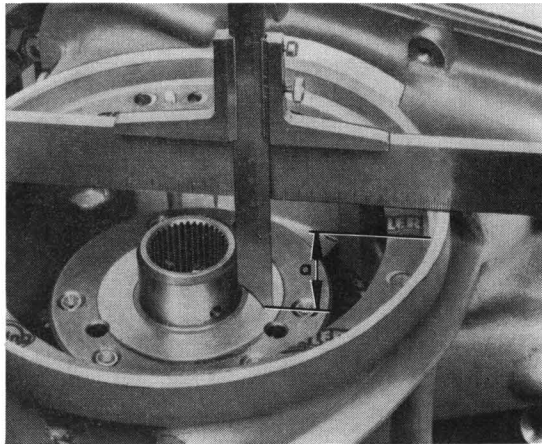
- 6 - Stick thrust washer (9) on to clutch hub (10) with grease and install hub in the internal splines of the forward clutch (8) plates. Align plates beforehand.
- 7 - Install drive shell (11) and small sun wheel (12) and engage shell in the teeth on the drum of the direct and reverse clutch.
- 8 - Push thrust washer (13) for large sun wheel between the large planet pinions with the projecting shoulder towards the small sun wheel (arrow). Install planetary gear set (14).





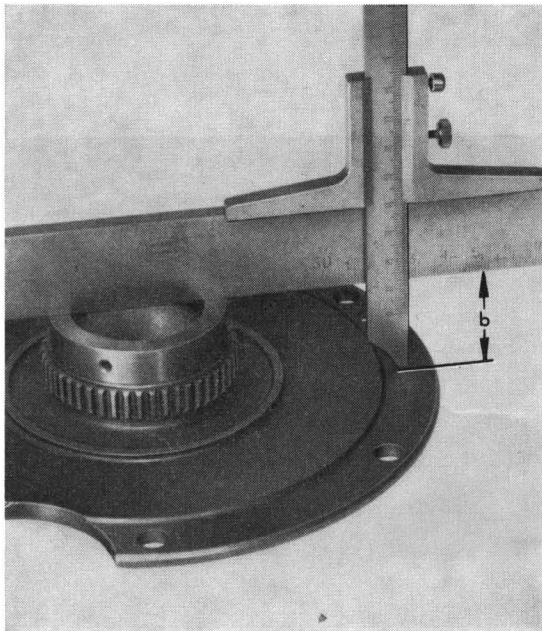
Important

If all parts have been installed properly the flange with the parking lock teeth should be aligned with the pawl (arrow).



9 - Adjust axial play "x" of transmission

a - Measure dimension "a" from case with gasket to planetary gear carrier, using a depth gauge.



b - Measure dimension "b" on bearing flange with a depth gauge.

Axial play $x = a - b$	Thickness and number of shims
1.95—2.25 mm	none
2.25—2.65 mm	1 × 0.4 mm
2.65—3.05 mm	2 × 0.4 mm
3.05—3.45 mm	1 × 1.2 mm
3.45—3.85 mm	1 × 0.4 mm and 1 × 1.2 mm

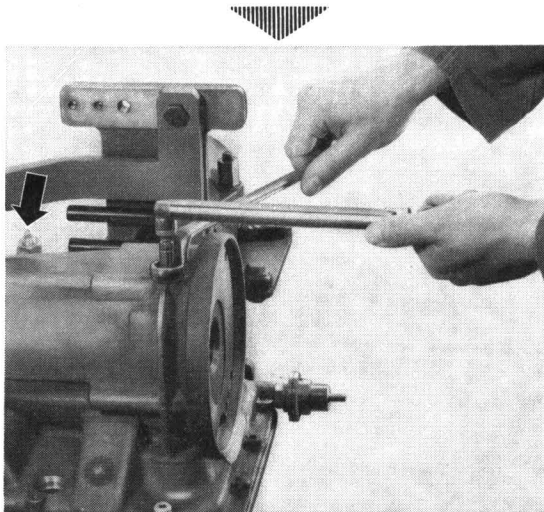
Important

The axial play can be from **0.45 to 1.05 mm**.

- 10 - Place shims (15) under the thrust washer (16) and install annulus gear with one-way clutch (19).
- 11 - Install 1st gear band (17) with support fork (18) and screw the adjusting screw into the support fork.
- 12 - Install bearing flange (21) with gasket (20) and tighten screws (22).
- 13 - **Adjusting brake bands:**
- a - Tighten front (2nd gear) band adjusting screw (arrow) to about **1 mkg** to settle the band, then loosen the screw and tighten again to **0.5 mkg**. From this position, **turn the screw out 2 turns** and tighten locknut.
- b - Tighten rear (1st gear) band adjusting screw as under "a", **then turn screw out 3 1/2 turns** and lock it.
- 16 - Insert converter and turn it to and fro to engage it on the splines.

Important

The converter is loose on the one-way clutch support tube so it is essential to fit the retainer bar (local manufacture) when working on the transmission or transporting it.

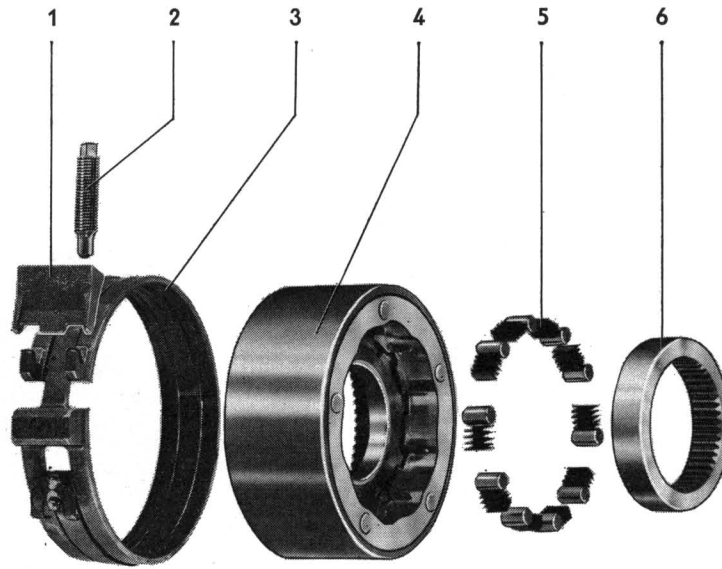
**Important**

The transmission must be horizontal when the screws are being adjusted as otherwise the brake bands can jam.

- 14 - Attach transmission to final drive housing, and tighten nuts diagonally. Use a new paper gasket.
- 15 - Insert pump and turbine shafts. The spigot for the turbine shaft is in the transmission.

Annulus Gear with One-way Clutch **H**₂₅

B i n d e r P u n c h A r e a



No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	Support fork	1			
2	Adusting screw	1			
3	1st gear band	1	check for wear and grooving, remove embedded fragments of metal		Section H/25, page 2-2
4	Annulus gear	1	check friction surface and teeth for wear		Section H/25, page 2-2
5	Spring spacers for rollers	10	check for wear		
6	Inner ring — one-way clutch	1	check for wear and pressure marks		Section H/25, page 2-2

Disassembling

- 1 - Pull inner ring of one-way clutch (6) out of the annulus gear (2).
- 2 - Take out rollers (4) and springs (5). There are 10 of each.
- 3 - Check annulus gear, teeth, outer ring, one-way clutch hub and rollers for wear and scoring.
- 4 - Check lining and band (1) for damage, burn marks and excessive wear. Remove any small metal particles which may have become embedded in the lining. Check operating parts for wear.

Assembling

- 1 - Install one-way clutch inner ring and insert rollers.
- 2 - Insert springs between rollers and support plate lugs.
- 3 - Install one-way clutch on bearing flange and check locking effect and direction.

Planetary gear set

Checking

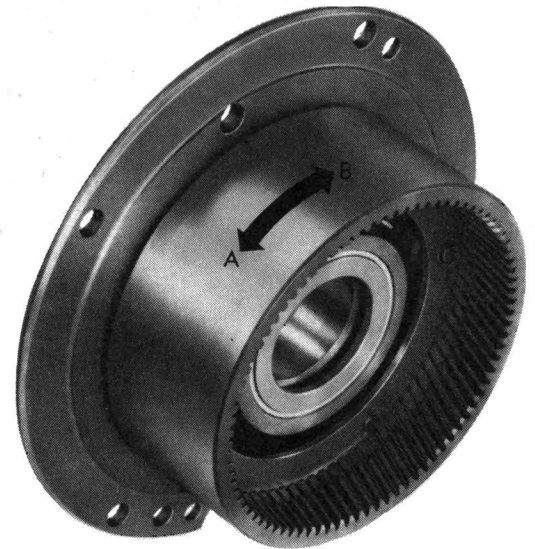
The planetary gear set should not be dismantled. The planet pinions run on needle bearings on the peened-in shafts. If damaged or badly worn, replace gear set.

- 1 - Check the teeth and thrust surfaces visually.

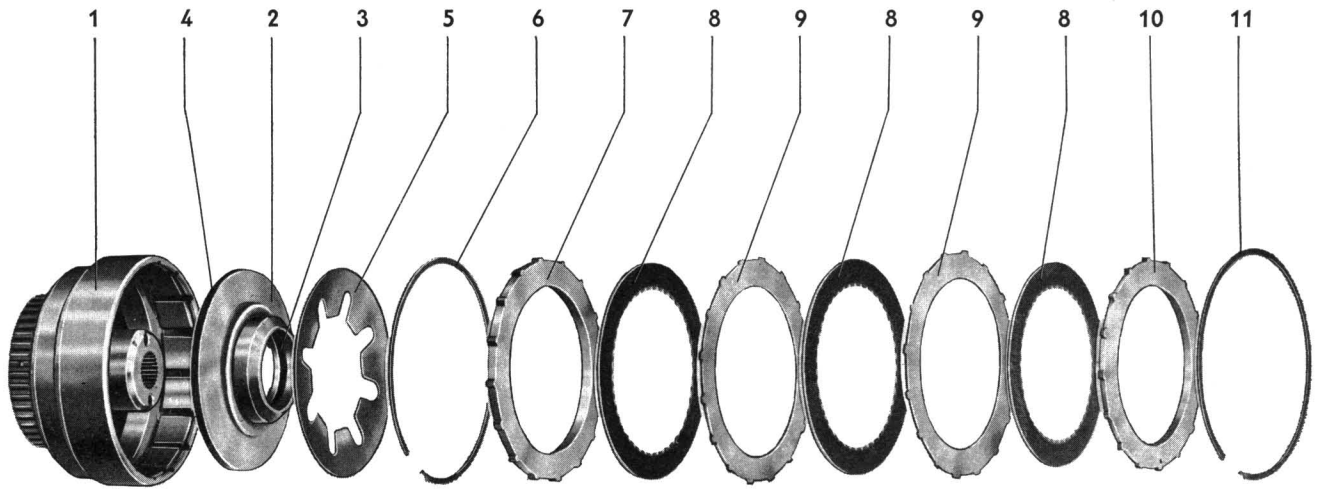
Important

The one-way clutch must hold the annulus gear against the engine direction of rotation.

A = free
B = held



- 2 - Check backlash of gears and radial play of planetary gears.
- 3 - Check parking lock flange for wear, remove burr.
- 4 - Check internal splines.



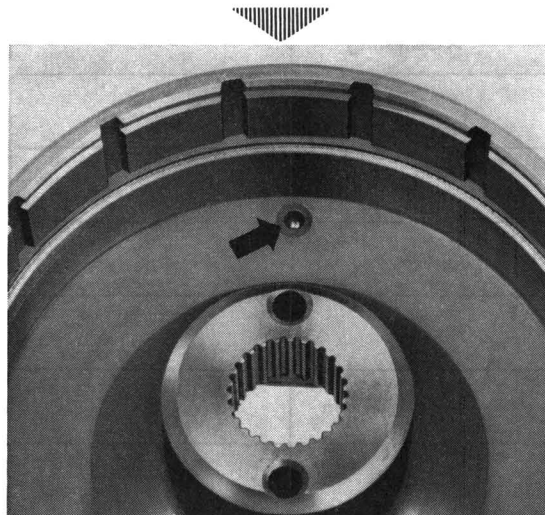
No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	Clutch drum	1	check for wear		
2	Clutch piston	1	check for wear		
3	Seal — piston (small)	1		fit new	
4	Seal — piston (large)	1		fit new	
5	Diaphragm spring	1		watch position	
6	Circlip (2 mm thick)	1			
7	Pressure plate	1	check for wear		
8	Plate (lined)	3	soak new plates in ATF for 1 hour before installing		Section H/25, page 3-2
9	Plate (steel)	2	check for wear		
10	End plate	1	check for wear		
11	Circlip (2.0 or 2.5 mm thick)	1	adjust clutch axial play to 0.55—1.2 mm		Section H/25, page 3-2

Disassembling

- 1 - Lever outer circlip (11) out with a screwdriver and take out end plate (10), clutch plates (8/9) and pressure plate (7).
- 2 - Lever inner circlip (6) out and take diaphragm spring (5) out.
- 3 - Rotate clutch piston (2) slightly and withdraw it from the clutch drum.
- 4 - Take inner (3) and outer (4) sealing rings off piston.

Checking

- 1 - Check friction surfaces of piston (2) and clutch drum (1) and splines for clutch plates for damage and wear.
- 2 - Check that ball valve (arrow) moves freely and that drilling is clear.



- 3 - Check diaphragm spring. The spring should reach at least to the lower edge of the groove for the circlip when the piston is installed.
- 4 - Check steel clutch plates. The steel plates must not be scored or grooved.
- 5 - Check lined plates for damage, signs of burning and wear, and replace as necessary.

Assembling

- 1 - Install new sealing rings. The lips must point into the clutch drum, that is, **towards the oil pressure side**.
- 2 - Oil the sealing rings (3/4) well and install piston (2) in drum (1) with a slight turning movement.



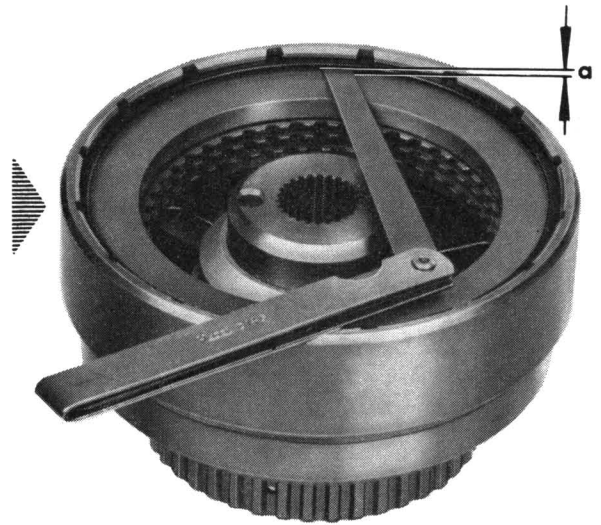
- 3 - Install diaphragm spring (5) so that the curved side is towards the piston (2). Fit circlip (6). The diaphragm spring must be firmly fixed.
- 4 - Install pressure plate (7) with conical side towards the diaphragm spring.
- 5 - Install lined and steel plates alternately.

Important

New lined plates should be immersed in transmission fluid for at least 1 hour before they are installed.

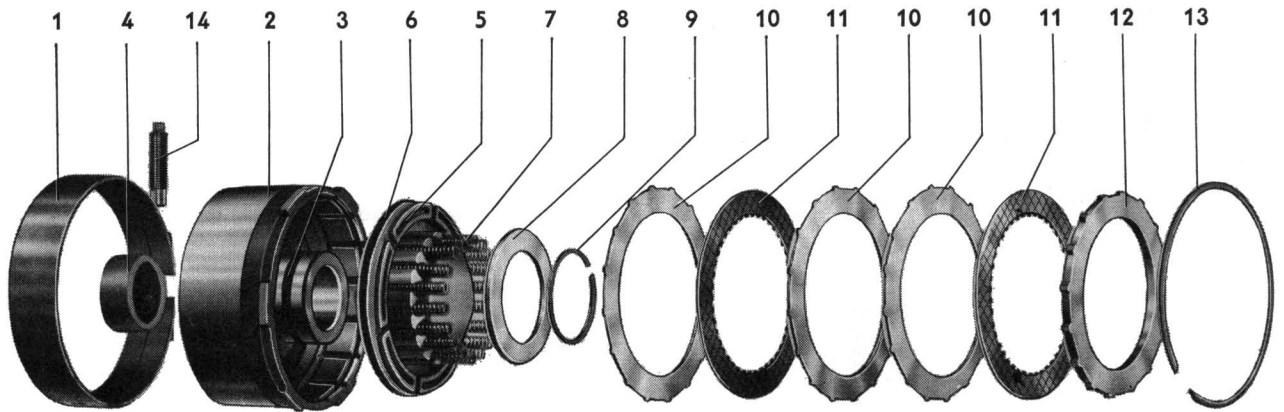
6 - Install end plate (10) and fit circlip (11).

7 - Check play "a" between circlip and end plate. The play should be between **0.55 and 1.2 mm**. Install a suitable circlip (11).



Direct and Reverse Clutch H₂₅

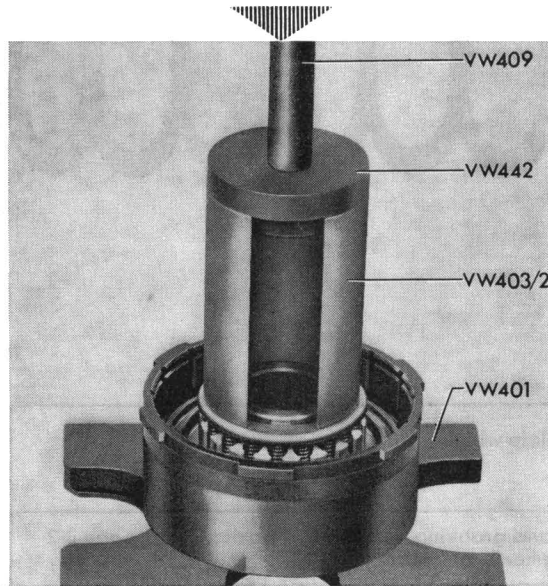
Binder Punch Area



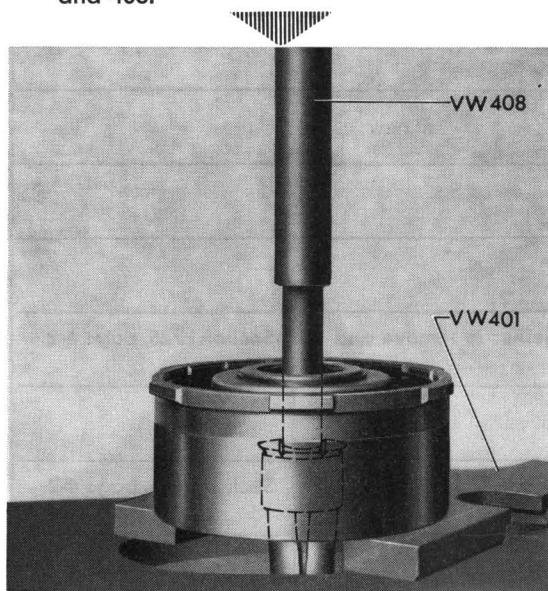
No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	2nd gear band	1	check for wear and grooving, remove embedded fragments of metal		Section H/25, page 2-2
2	Clutch drum	1	check ball valve		Section H/25, page 4-2
3	Seal — clutch drum	1			
4	Bush — clutch drum	1	check for wear, replace if necessary		Section H/25, page 4-2
5	Clutch piston	1			
6	Seal — clutch piston	1	fit new		
7	Return spring	18			
8	Spring plate	1			
9	Circlip (small)	1	press plates together to remove and install		Section H/25, page 4-2
10	Plate (steel)	3	check for wear		
11	Plate (lined)	2	soak new plates in ATF for 1 hour before installing		Section H/25, page 4-2
12	Pressure plate	1	check for wear		
13	Circlip (large)	1			
14	Adjusting screw	1	adjust		with large dog point

Disassembling

- 1 - Remove circlip (13) and take out plates (10/11) and pressure plate (12).
- 2 - Press the spring retaining plate (8) down on the press with VW 401, 403/2, 442 and 409 and take out small circlip (9).



- 3 - Pull piston (5) complete with return springs (7) out of clutch drum (2) with a slight turning movement. Take sealing rings (3/6) off.
- 4 - Remove bush (4) with extractor and VW 401 and 408.



Checking

- 1 - Check friction surfaces of piston (5), clutch drum (2) and plate grooves for damage and wear.

- 2 - Check that ball valve moves freely and that drilling is clear.
- 3 - Check steel plates (10). The plates must not be scored or grooved.
- 4 - Check lined plates (11) for damage, signs of burning and wear.

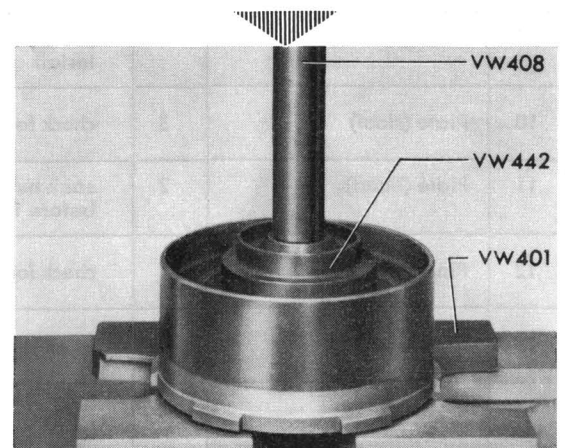
Assembling

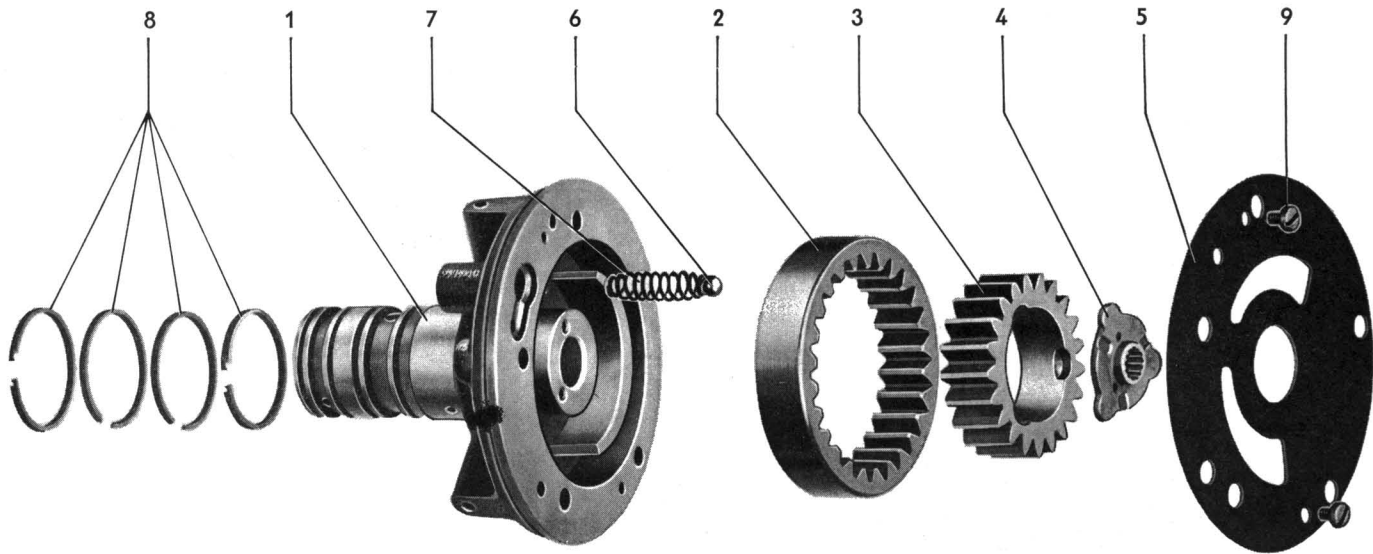
- 1 - Install new sealing rings (3/6). The lips must point into the clutch drum, that is, **towards the oil pressure side**.
- 2 - Oil the sealing rings well and install piston (5) in drum (2) with a slight turning movement.
- 3 - Install return springs (7) and spring retainer plate (8) and press together with VW 401, 403/2, 442 and 408. Fit circlip (9).
- 4 - Install lined and steel plates alternately but note that in the center of the pack there are **two steel plates together**. See illustration on page 4-1.

Important

New lined plates should be immersed in transmission fluid for at least 1 hour before they are installed.

- 5 - Install pressure plate (12) and fit circlip (13).
- 6 - Press new bush (4) in with VW 401, 442 and 408.

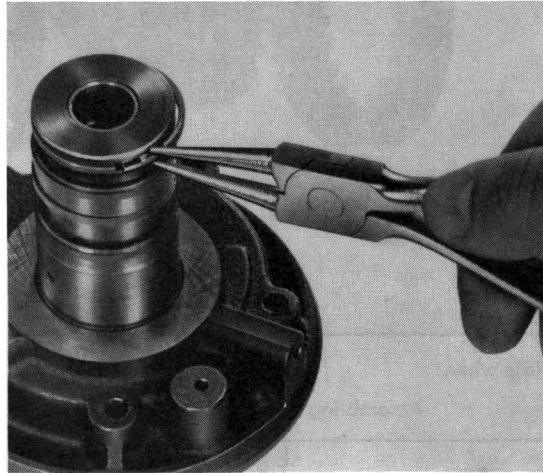




No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	Pump housing	1	check for wear and scoring		Section H/25, page 5-2
2	Outer gear	1	check for wear and scoring		
3	Inner gear	1	check for wear and scoring		
4	Drive plate	1			
5	Cover plate	1	check for wear and scoring		
6	Ball 7.5 mm dia.	1			
7	Ball spring	1			
8	Piston ring	4	hook in and out sideways		Section H/25, page 5-2
9	Screw M 4 × 6	2			

Disassembling

- 1 - Remove two slotted screws (9) and take cover plate (5) off.
- 2 - Take out ball valve (6), spring (7), inner and outer gears (3/2) and drive plate (4).
- 3 - Unhook piston rings (8) and take off.



Checking

- 1 - Check pump body (1), gears (2/3), cover plate (5), bush and piston rings (9) for wear. Clean all parts thoroughly and blow oil drillings out with compressed air.
- 2 - Drive plate and piston rings can be replaced if necessary.
- 3 - When other parts are excessively worn, replace complete pump.

Assembling

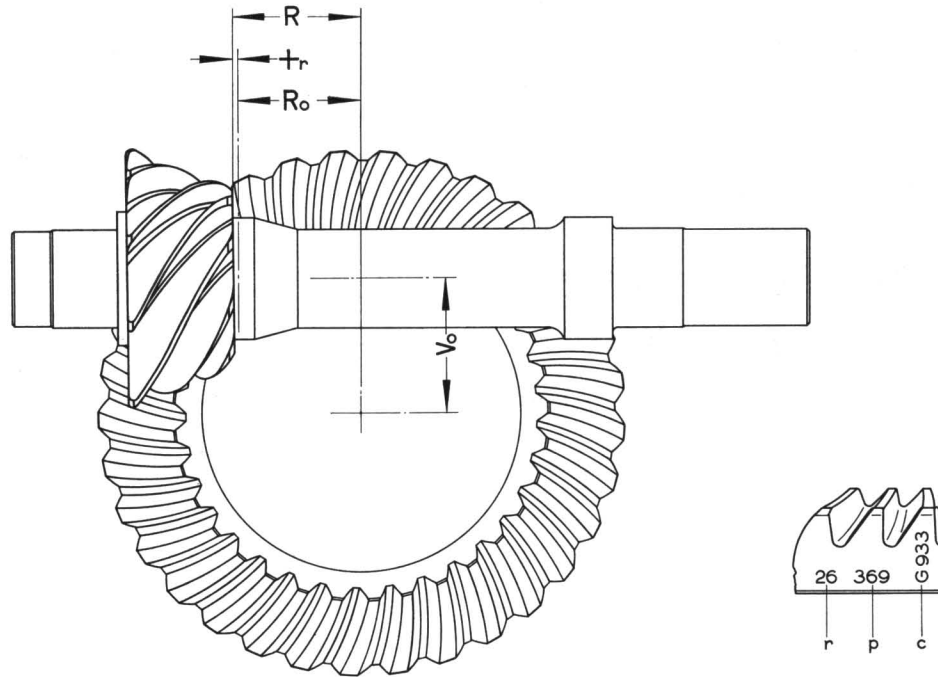
- 1 - Oil all parts well and install gears (2/3) and drive plate (4).
- 2 - Insert spring (7) and ball (6) and fit cover plate (5).

Important

After assembling the pump, insert drive shaft into drive plate and turn pump by hand. The gears should turn freely and without catching.

Adjusting pinion and ring gear

Careful adjustment of ring gear and pinion is essential to ensure long rear axle service and silent running. For this reason the ring gear and pinion are matched during manufacture and run on special testing machines to check the contact pattern and silent running in both directions. The position for the quietest running is obtained by moving the pinion axially and at the same time the ring gear is lifted out of the no-play meshing position to the point where the backlash is within the **specified tolerance range of 0.15—0.25 mm**. The deviation "r" based on the master gauge "Ro" of the special testing machine used in production is measured and recorded on the outer face of the ring gear. Each hypoid gear set — pinion and ring gear — is marked with a matching number and may only be replaced together.



- 1 - The marking H "G 933" means a Gleason gear set with a ratio of 9 : 33.
- 2 - Matching number of gear set (369).
- 3 - Deviation "r" based on master gauge of the special testing machine used in production. The dimension "r" is always given in 1/100 mm. For example "26" means $r = 0.26$ mm.

Ro - Length of master gauge used in the special testing machine "Ro" = 40.55 mm.

R - Actual dimension between ring gear centerline and end face of pinion at the quietest running point for this particular gear set.

Vo - Hypoid offset = 42.5 mm.

The gear set usually only needs readjusting when carrying out repairs to the rear axle, if parts which directly influence the adjustment have been replaced. When the differential housing, the cover for the differential housing or a differential taper roller bearing have been replaced it is sufficient to reset only the ring gear. Pinion and ring gear must be adjusted however, if either the differential carrier or the complete gear set have been replaced. If the taper roller bearing for the pinion is replaced, only the pinion need be adjusted again.

The object of the adjustment is to set the gears to the same quiet running position as was obtained on the special test machines in production.

H₂₆ Adjusting Final Drive

First of all the pinion must be located by placing shims between the pinion shoulder and the taper roller bearing so that the dimension from ring gear centerline to pinion end face corresponds exactly with the fitting dimension "R" obtained in production.

The preload of the taper roller bearings is then set by tightening the adjusting ring for the pinion.

The ring gear is then installed and adjusted so that there is a certain preload between the taper roller bearings and also so that the specified amount of backlash is obtained between ring gear and pinion teeth. The amount of preload is measured from the friction in the taper roller bearings when the gear set is rotated. The preload and backlash is set with adjusting rings in the differential carrier.

Maximum possible care and cleanliness during all assembly and measuring operations are essential if the results are to be satisfactory.

Working sequence for adjustment of gear set

- A - Adjust the pinion taper roller bearings.
- B - Adjust pinion and check.
- C - Adjust differential taper roller bearings and backlash.

What needs adjusting:

When working on the transmission, it is only necessary to adjust the pinion and ring gear if parts which **directly** influence the setting of the transmission have been replaced.

The following table should be noted in order to prevent unnecessary adjustments being carried out.

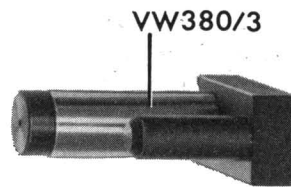
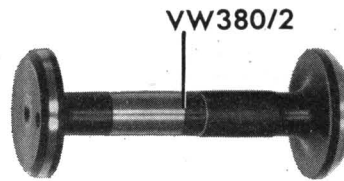
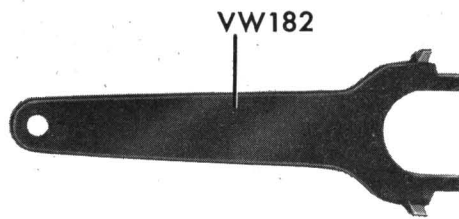
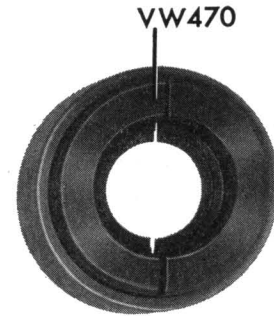
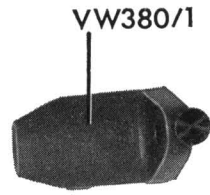
Part replaced	Parts to be adjusted:	
	Pinion	Ring gear*
Differential carrier	×	×
Differential taper roller bearings		×
Adjusting rings for differential		×
Differential housing		
Differential housing cover		
Pinion taper roller bearing	×	×
Adjusting ring for pinion	×	

* includes adjustment of differential bearings

Binder Punch Area

Sign	Designation	Dimension
S_1	Adjusting ring (ring gear end)	
S_2	Adjusting ring (opposite end)	
S_3	Shim between taper roller bearing and pinion	See table for thickness
R_o	Length of master gauge used on special testing machine	40.55 mm
R	Position of pinion in relation to centerline of ring gear at quietest running point	$R = R_o + r$
r	Deviation from " R_o ", marked on gear set	
S_{vo}	Backlash	0.15—0.25 mm
V_o	Hypoid offset	42.5 mm
G 933	Gear set: G = Gleason; 933 = 9/33 number of teeth	$i = 3.67$
$D/2$	Half diameter of setting mandrel	$D/2 = 10.00$ mm
E_o	Length of setting gauge VW 380/3; $E_o = R_o + D/2$ mm	$E_o = 50.55$ mm
e	Difference between mandrel and setting gauge	measured in mm

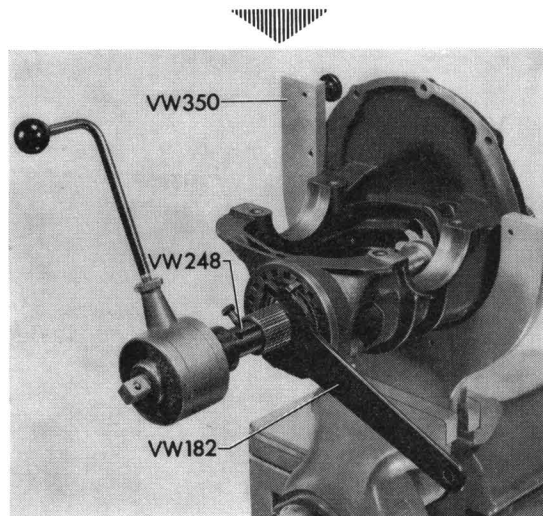
Special Tools



H₂₆ Adjusting Drive Pinion

Pinion

- 1 - Install bearing inner ring behind pinion **without shims**.
- 2 - Lubricate bearing with hypoid oil. Install pinion and tighten adjusting ring until there is no longer any axial play.
- 3 - Clamp VW 249 in pinion. Fit torque gauge and turn pinion about 15—20 times in both directions. Then, while still turning rapidly, turn the adjusting ring until the specified torque is obtained (see table). Note the value.



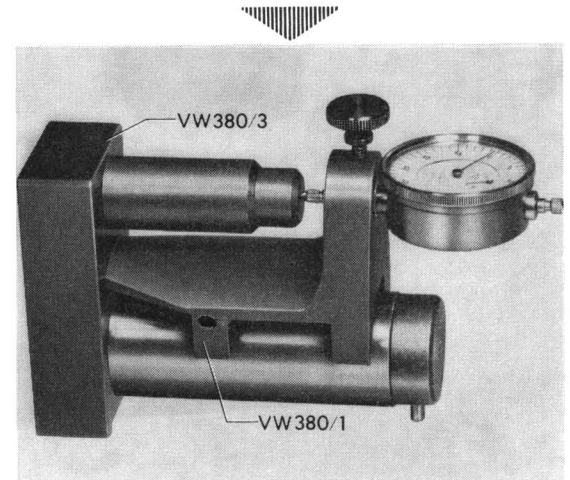
Important

The taper roller bearings may only be lubricated with **hypoid transmission oil**. When dry, or if lubricated with any other oil, the test results will be inaccurate.

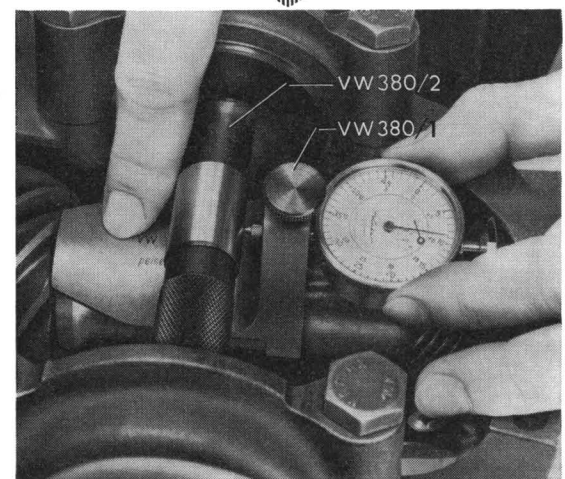
Pinion turning torque	
Nominal value	in cmkg
New bearings	8—12
Used bearing*	0—4

* After running at least 300 miles (500 km)

- 4 - Place dial gauge holder VW 380/1 with dial gauge (3 mm range) on setting block VW 380/3 and set to zero with 1 mm preload.



- 5 - Place setting mandrel VW 380/2 in differential carrier with bearing outer rings and adjusting rings. Fit bearing caps and tighten screws to correct torque.
- 6 - Locate the mandrel VW 380/2 by turning the adjusting rings. Turn rings until the mandrel can just be turned by hand.
- 7 - Place dial gauge holder VW 380/1 on the pinion, press it lightly against the pinion head and swing slightly to find highest point. Note the reading.



Important

All surfaces being measured must be spotlessly clean.

- 8 - Read off the deviation "r" on the pinion and subtract it from the measured reading. The difference is the thickness of shim to be fitted behind pinion head "S₃".

Determining thickness of "S₃" shim

Actual dimension of setting gauge VW 380/3	E _o = 50.55 mm
+ Measurement (gauge reading)	<u>e = 1.64 mm</u>
Actual pinion dimension (without shim)	= 52.19 mm
Master gauge dimension	R _o = 40.55 mm
+ Deviation (for quietest running)	<u>r = 0.23 mm</u>
Fitting dimension (pinion in diff. carrier)	R = 40.78 mm
+ Half diameter of mandrel VW 380/2	<u>D/2 = 10.00 mm</u>
Nominal pinion dimension R + D/2	= 50.78 mm
Actual pinion dimension (without shim)	= 52.19 mm
- Nominal pinion dimension	<u>= 50.78 mm</u>
Thickness of shim "S ₃ "	<u><u>S₃ = 1.41 mm</u></u>

From this, we obtain the following simple formula for workshop use:

$$S_3 = e - r$$

$$S_3 = 1.64 \text{ mm} - 0.23 \text{ mm}$$

$$S_3 = 1.41 \text{ mm}$$

This example shows how the thickness of the "S₃" shim is obtained. According to the simple formula it is only necessary to find the dimension "e" between end of pinion and rear edge of cylinder on mandrel (1.64 mm in example) and subtract the deviation "r" (0.23 mm in example) from it. The difference gives the thickness of shim "S₃" (1.41 mm in example).

Important

The selected shim should be measured **carefully at several points** with a micrometer. Check shim for burr or damage and **use only shims which are in good condition.**

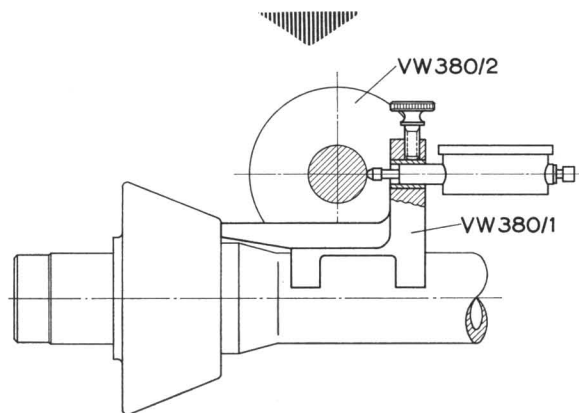
Actual thickness of "S₃" is determined from table

Shim No.	Part No.	Thickness (mm)
1	003 519 141	1.00
2	003 519 142	1.05
3	003 519 143	1.10
4	003 519 144	1.15
5	003 519 145	1.20
6	003 519 146	1.25
7	003 519 147	1.30
8	003 519 148	1.35
9	003 519 149	1.40
10	003 519 150	1.45
11	003 519 151	1.50
12	003 519 152	1.55
13	003 519 153	1.60
14	003 519 154	1.65
15	003 519 155	1.70

- 9 - Remove pinion, press bearing inner ring off, fit correct shim, heat inner ring again, install and press fully home.

- 10 - Install pinion again and set it to give the **bearing torque which was obtained previously.**

- 11 - Check the measurement. If the shim has been selected correctly, the dial gauge should now **read "r" ± 0.04 mm.**



- 12 - Lock the adjusting ring. **Two different lock plates** are available according to position of ring.

Determining "S₃" from old and new gear set (by calculation)

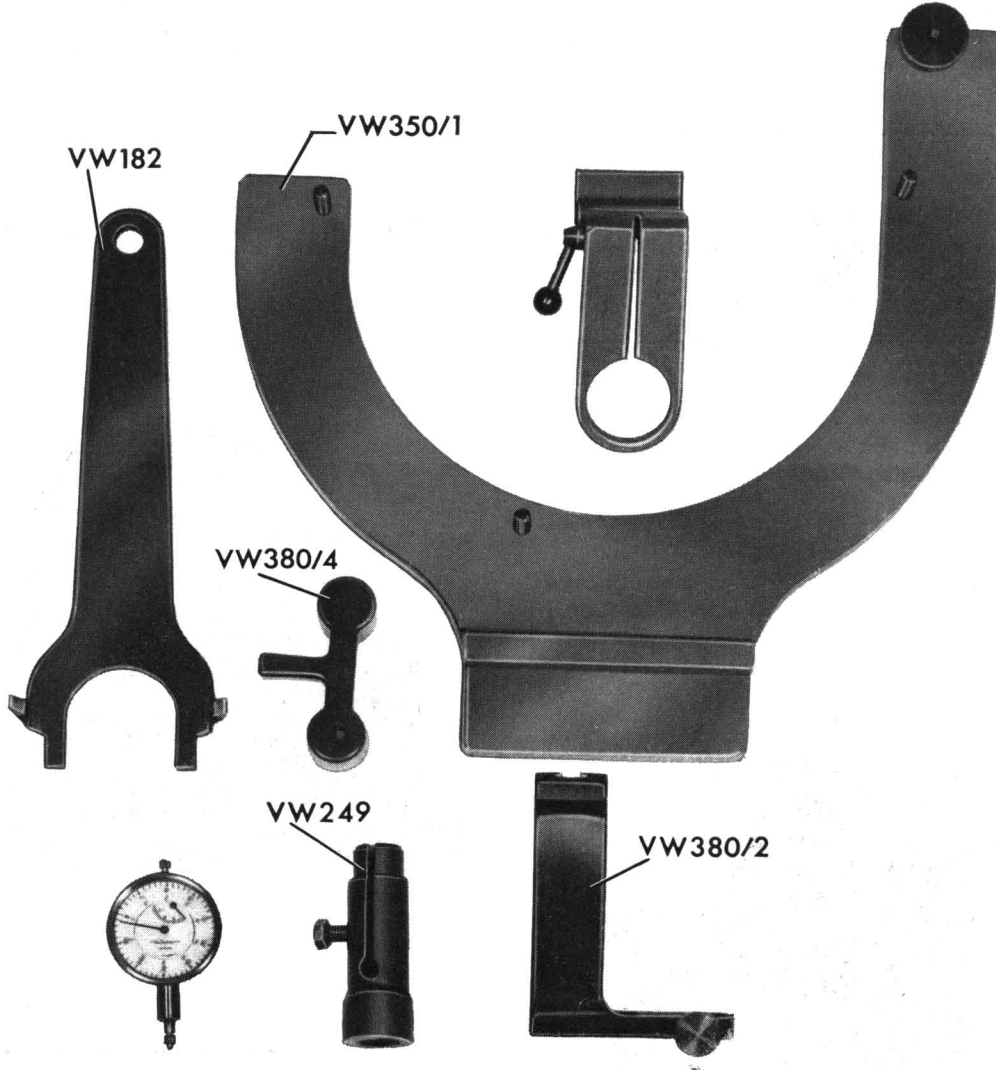
If the gear set is replaced during a repair, the thickness of the "S₃" shim for the **new pinion** can be calculated from the shim thickness "S₃" and deviation "r" of the old pinion and deviation "r" of the new pinion.

When this is done, it is not necessary to install the pinion without a shim. All that has to be done is to check the adjustment after installation of pinion.

Example

Shim (old pinion)	S ₃ = 1.65 mm
+ Deviation (old pinion)	r = 0.23 mm
	<hr/>
	e = 1.88 mm
- Deviation (new pinion)	r = 0.43 mm
= Shim (new pinion)	<u>S₃ = 1.45 mm</u>

Special Tools



H₂₆ Adjusting Ring Gear

B i n d e r P u n c h A r e a

Ring gear

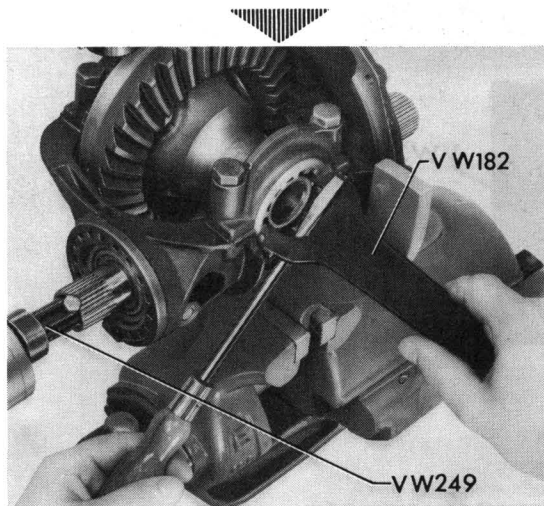
1 - Place differential in carrier with ring gear, bearings and adjusting rings. Fit bearing caps and tighten screws. Lubricate bearings with hypoid oil.

Important

The taper roller bearings may only be lubricated with **hypoid transmission oil**. When dry, or if lubricated with any other oil, the test results will be inaccurate.

2 - Install clamp VW 249 in pinion and turn the differential with the pinion about 15—20 times in both directions with the torque gauge.

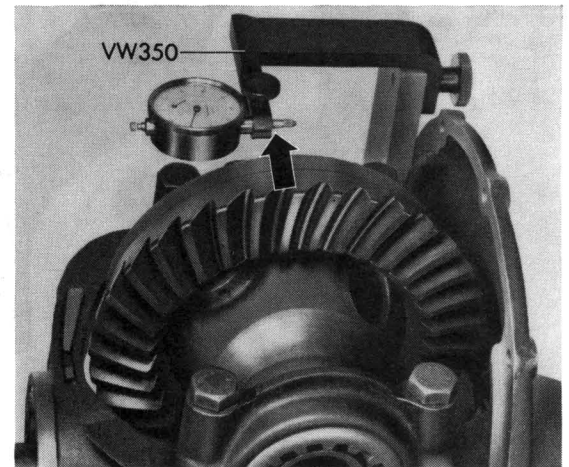
3 - Tighten the adjusting ring at end opposite to ring gear until the specified torque is obtained (see table).



Total torques			
Actual pinion torque in cmkg		Total torque in cmkg	
new bearings	used bearings	new bearings	used bearings
8	0	10—12	1—3
9	1	11—13	2—4
10	2	12—14	3—5
11	3	13—15	4—6
12	4	14—16	5—7

4 - Screw the adjusting ring at opposite end to ring gear out and adjusting ring at ring gear end in the **same amount** until a backlash (Svo) of about **0.20 mm** is obtained.

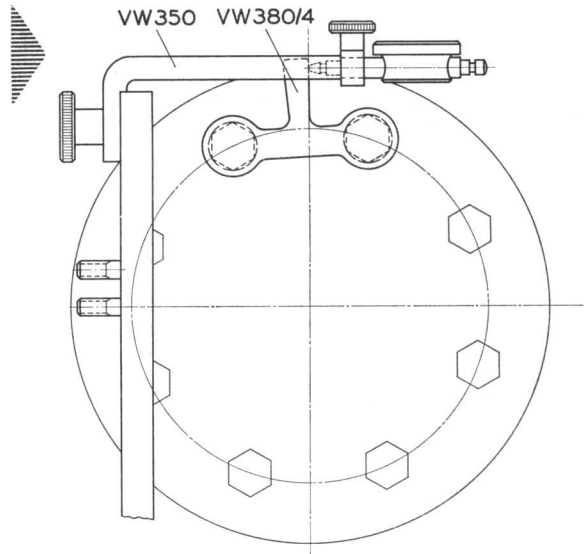
5 - Attach dial gauge (3 mm range) to support plate VW 350/1 with holder VW 350/2.



Important

The dial gauge is mounted tangentially to the pitch circle diameter of the ring gear. The gauge must be pushed into the holder so far that the clamping cylinder (arrow) is flush with the front edge of the holder.

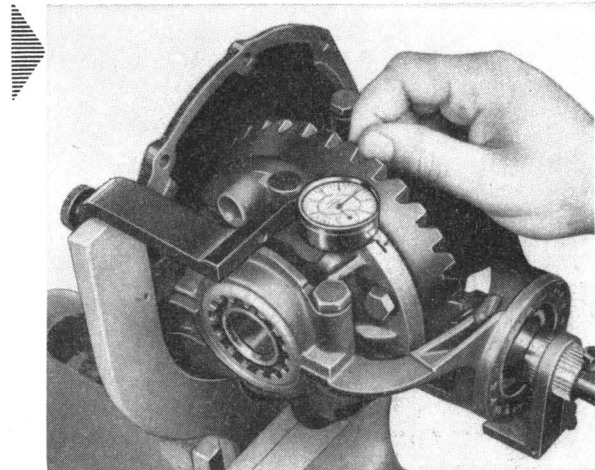
- 6 - Install bracket VW 380/4 and turn ring gear until the bracket VW 380/4 presses the gauge pin to give 1.5 mm preload.



Important

In this position, the bracket VW 380/4 is vertical to the ring gear centerline and at right angles to the feeler pin of the gauge.

- 7 - Measure backlash. The backlash should be **0.15—0.25 mm**. Try to get an average of the tolerance figures.

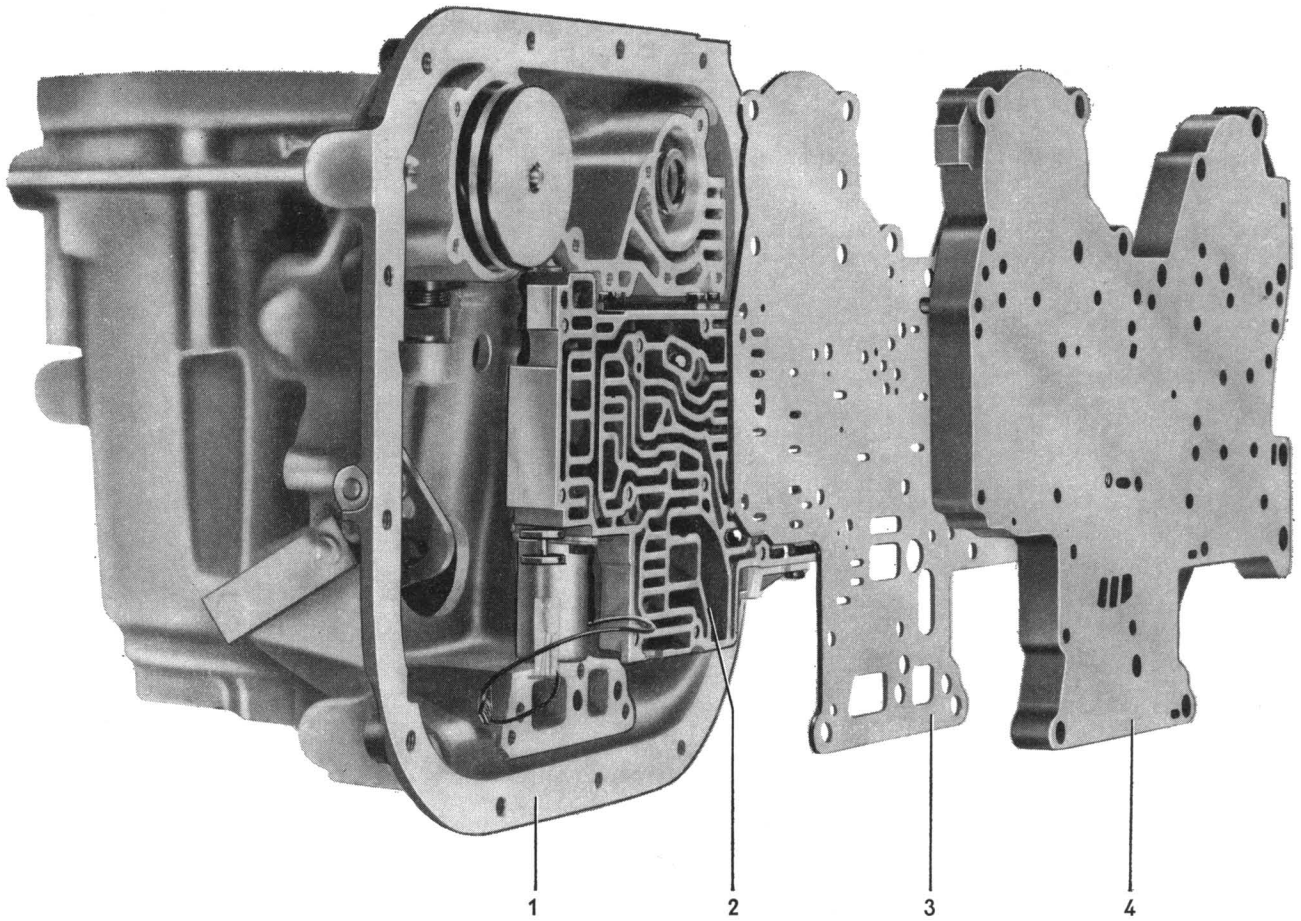


Important

When correcting the backlash, ensure that both adjusting rings are always moved the same amount so that the **bearing preload setting is not altered**.

- 8 - Lock the differential bearing adjusting rings. There are **two different locking plates** available according to the position of the adjusting rings.

- 9 - Check the backlash. It must be checked at four points equally spaced round the ring gear. **The maximum permissible difference between the readings is 0.05 mm.**



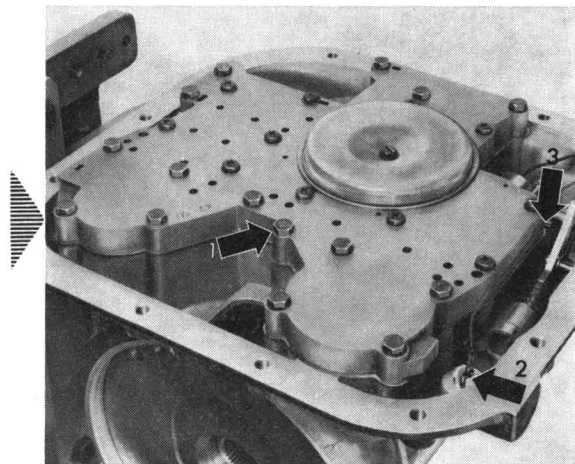
1 - Transmission case
 2 - Valve body (1)
 3 - Separator plate (38)
 4 - Transfer plate (39)

Removing

- 1 - Remove screws and take off oil pan with gasket.
- 2 - Remove 14 screws and disconnect cable from solenoid (arrow 2).
- 3 - Remove 15th screw (arrow 1) and take valve body assembly off.

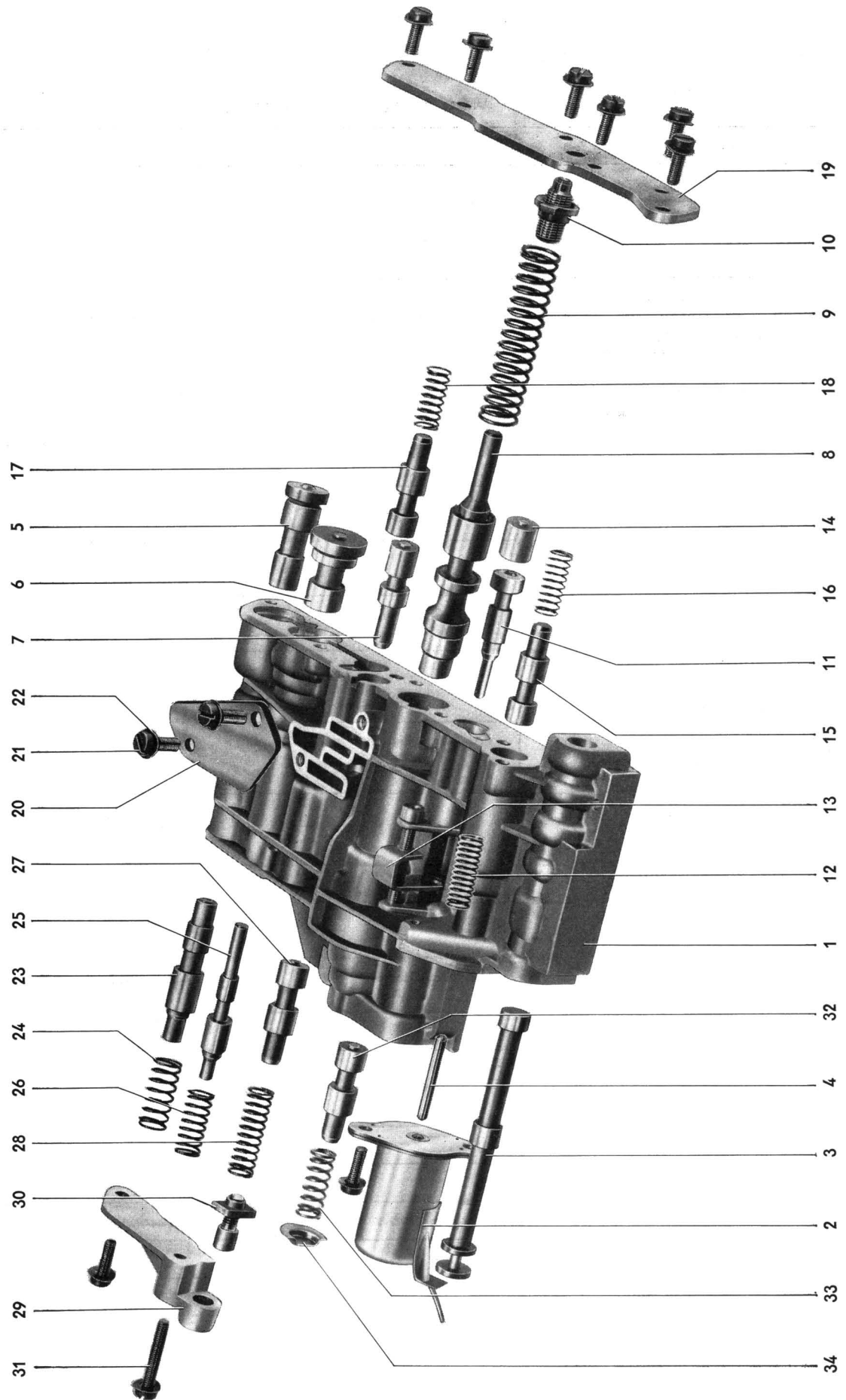
Important

When the transmission is in vehicle, the small servo piston for the 1st gear band can fall out when the valve body assembly is taken off.



Installing

- 1 - Attach valve body assembly to the housing with one screw (arrow 1). Make sure that the manual valve (arrow 3) engages in the operating lever.
- 2 - Fit 14 remaining screws and spring washers and tighten lightly.
- 3 - Tighten all screws diagonally to proper torque.
- 4 - Connect cable to solenoid (arrow 2) and fit oil pan and gasket. Use a new gasket if necessary.



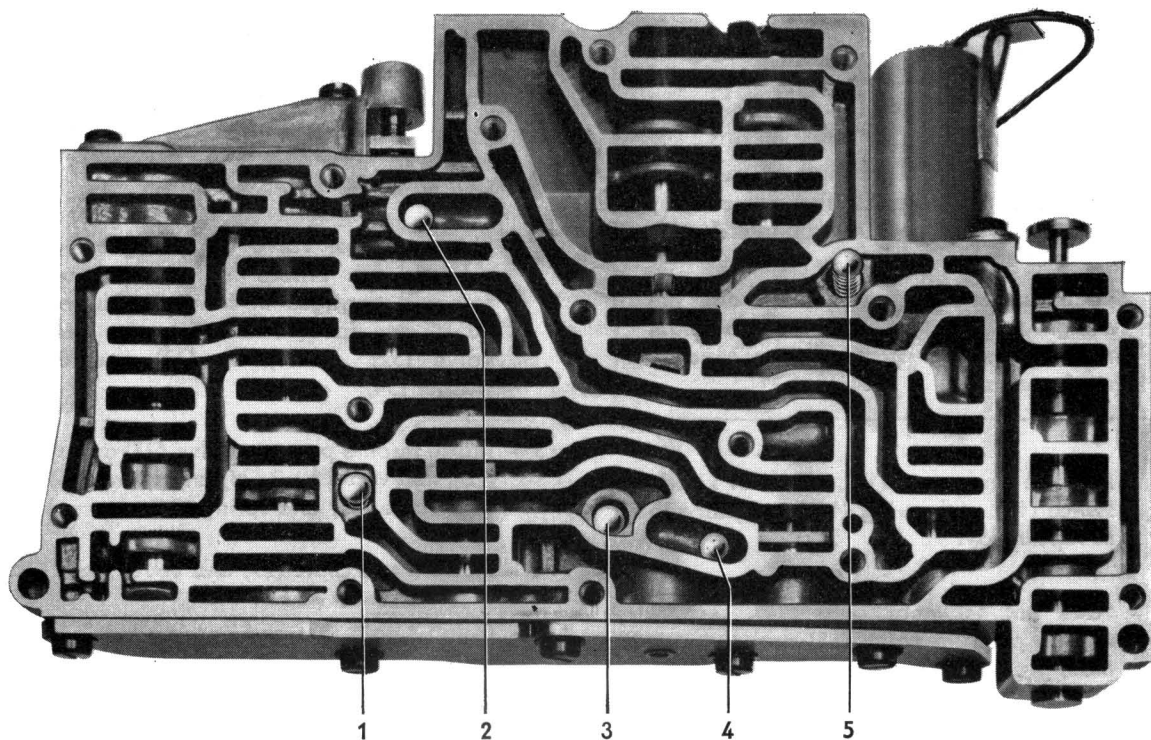
H₂₇ Valve Body Assembly

B i n d e r P u n c h A r e a

No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	Valve body	1			
2	Solenoid	1		watch position	
3	Manual valve	1			
4	Plunger	1			
5	Governor plug 2—3				
6	Governor plug 1—2	1			
7	Control valve 3—2	1			
8	Main regulating valve	1			
9	Spring — main regulating valve	1	see spring table		Section H/27, page 2-4
10	Adjusting screw with spring seat	1	can only be set on a test stand		
11	Secondary throttle pressure valve	1			
12	Spring — secondary throttle pressure valve	1	see spring table		Section H/27, page 2-4
13	Adjusting screw — secondary throttle pressure				
14	1st gear plug — secondary throttle pressure valve	1	can be adjusted		
15	Kickdown valve	1			there are 3 more valves like this Section H/27, page 2-4
16	Spring — kickdown valve	1	see spring table		
17	Modulator valve	1			there are 3 more valves like this
18	Spring — modulator valve	1	see spring table		Section H/27, page 2-4
19	End plate, rear	1			
20	Cover plate	1			
21	Screw M 5 × 15	11			
22	Spring washer B 5	12			
23	Shift valve 2—3	1			
24	Spring — shift valve 2—3	1	see spring table		Section H/27, page 2-4
25	Shift valve 1—2	1			
26	Spring — shift valve 1—2	1	see spring table		Section H/27, page 2-4
27	Throttle pressure limiting valve	1			there are 3 more valves like this

B i n d e r P u n c h A r e a

No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
28	Spring — throttle pressure limiting valve	1	see spring table		Section H/27, page 2-4
29	End plate, front	1			
30	Adjusting screw with spring seat	1	can only be set on a test stand		
31	Screw M 5 × 28	1			
32	Converter pressure valve	1			there are 3 more valves like this
33	Spring — converter pressure valve	1	see spring table		Section H/27, page 2-3
34	Spring cup — converter pressure valve	1			
35	Spring — pressure relief valve	1	see spring table		Section H/27, page 2-3
36	Spring — 2—3 valve	1	see spring table		Section H/27, page 2-3
37	Ball — 6 mm dia.	5			
38	Separator plate	1			
39	Transfer plate	1			
40	Screw M 5 × 30	15	tighten to 0.4 mkg		
41	Spring washer B 5	15			



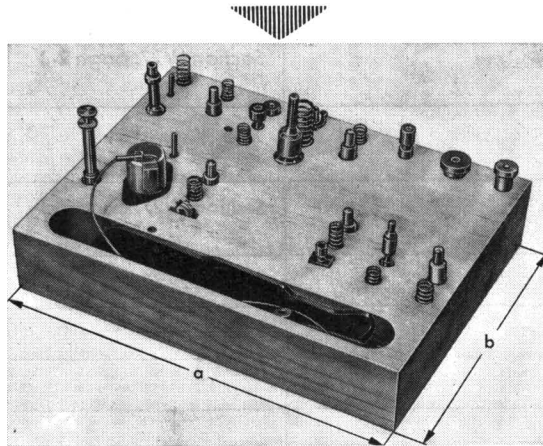
1 - 2—3 valve (36/37)
2 - K₂ valve (37)

3 - 1st gear valve (37)
4 - B₁ valve (37)

5 - Pressure relief valve (35/37)

Disassembling

- 1 - Remove the 13 screws (40) which hold the valve body, the separator plate and the transfer plate together and take off separator plate (38) and transfer plate (39).
- 2 - Remove the five steel balls (37) and two valve springs (35/36) out of the oil passage side of the valve body and place them in the special repair tray.



a - 290 mm b - 210 mm

Important

Remove all valves with their springs one at a time and place them in the proper holes in the repair tray (local manufacture) immediately.

The valves and springs must be put back into the same holes in the valve body when re-assembling. Do not interchange valves or springs on any account.

Do not, under any circumstances, alter the settings of the adjusting screws for main pressure, limiting pressure or secondary throttle pressure.

- 3 - Remove end plate (19), take out kickdown switch (15) and spring (16) and place them in repair tray.
- 4 - Take out 1st gear plug (14), secondary throttle pressure valve (11) and spring (12), main pressure valve (8) and spring (9).
- 5 - Take out modulator valve (17) with spring (18), control valve 3—2 (7), governor plug 1—2 (6) and governor plug 2—3 (5).

Important

If valves are tight in the body, press them out carefully with a brass rod.

- 6 - Remove cover plate (20), front end plate (29) and take off solenoid (2) with plunger (4).
- 7 - Take out manual valve (3), throttle pressure limiting valve (27) and spring (28), shift valve 1—2 (25) and spring (26), shift valve 2—3 (23) and spring.
- 8 - Take out dished washer (34) on converter pressure valve (32) and remove valve and spring (33).

Assembling

Wash all parts thoroughly in washing benzine or kerosene and dry with compressed air.

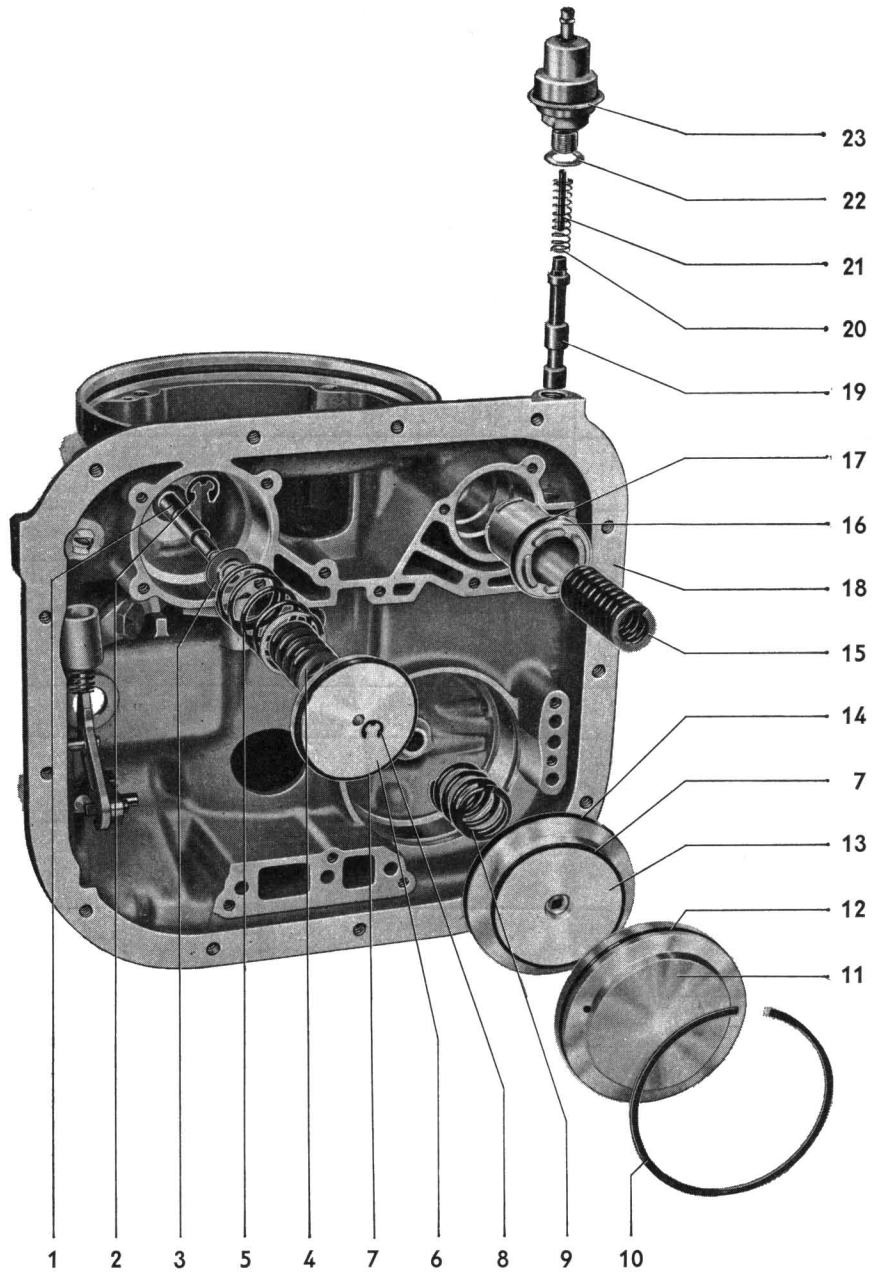
Do not use water and do not use fluffy rags or cloths when assembling the parts. Assemble the control valve on a clean bench.

Lubricate all parts with ATF when assembling and check for ease of movement. The valves should slide **under their own weight** in the holes.

- 1 - Install governor plug 2—3 (5), governor plug 1—2 (6), shift valve 3—2 (7), modulator valve (17) and spring (18), main pressure valve (8) and spring (9), adjusting screw (10), secondary throttle pressure valve (11) and spring (12), 1st gear plug (14), kickdown valve (15) and spring (16) and fit rear end plate (19).
- 2 - Install manual valve (3), plunger (4) and solenoid (2). Ensure that the lug on the solenoid engages in front of the manual valve end face. Insert converter pressure valve (32) with spring (33) and dished washer (34).
- 3 - Install throttle pressure valve (27) and spring (28), shift valve 1—2 (25) and spring (26) and shift valve (23) and spring (24).
- 4 - Fit front end plate (29) and cover plate (20).
- 5 - Install 3 balls (37) and 2 spring-loaded balls as shown in illustration on page 2-3. Locate plate (38) and transfer plate (39), secure with 13 screws and spring washers and tighten screws to correct torque. Ensure that the **spring-loaded balls** are in the **proper holes in the separator plate**.

Spring chart

Designation	Part No.	Dimensions			
		free length (mm)	inner dia. of coil (mm)	wire thickness (mm)	coils
Main pressure valve spring (9)	003 325 131	68.5	11.9	1.5	16.5
Secondary throttle pressure valve spring (12)	003 325 157	28.0	7.4	0.8	11.5
Kickdown valve spring (16)	003 325 175	24.0	7.7	0.63	10.5
Modulator valve spring (18)	003 325 185	22.5	7.75	0.95	9.5
2—3 shift valve spring (24)	003 325 207	25.4	9.0	1.0	8.5
1—2 shift valve spring (26)	003 325 217	23.6	8.0	1.0	9.5
Throttle pressure limiting valve spring (28)	003 325 227	33.1	7.7	1.0	12.5
Converter pressure valve spring (33)	003 325 247	27.3	8.13	1.25	9.5
Pressure relief valve spring (35)	003 325 267	27.7	4.7	0.8	15.5
2—3 valve spring (36)	003 325 269	5.8	4.3	0.2	4.5
Primary throttle pressure valve spring	003 325 295	36.3	9.0	0.63	10.5



No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	Piston rod — 1st gear band	1	check for wear		
2	Lock washer 9 mm dia.	1			
3	Dished washer	1			
4	Accumulator spring — 1st gear band	1			
5	Return spring — 1st gear band	1			
6	Piston — 1st gear band	1			
7	Seal — piston	2		fit new	
8	Lock washer 6 mm dia.	1			

No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
9	Return spring — 2nd gear band	1			
10	Circlip — sealing cover	1			
11	Sealing cover	1			
12	"O" ring			fit new	
13	Piston with rod	1			
14	Seal/piston — 2nd gear band	1		fit new	
15	Accumulator spring	1			
16	Accumulator piston	1			
17	Seal — accumulator piston	1		fit new	
18	Housing	1			
19	Primary throttle pressure valve	1	do not damage	place in repair tray VW 787	
20	Spring — primary throttle pressure valve	1		place in repair tray VW 787	
21	Thrust pin 4 × 20	1		place in repair tray VW 787	
22	Aluminum ring	1		fit new	
23	Vacuum unit	1		adjust	Section H/23, page 3-1

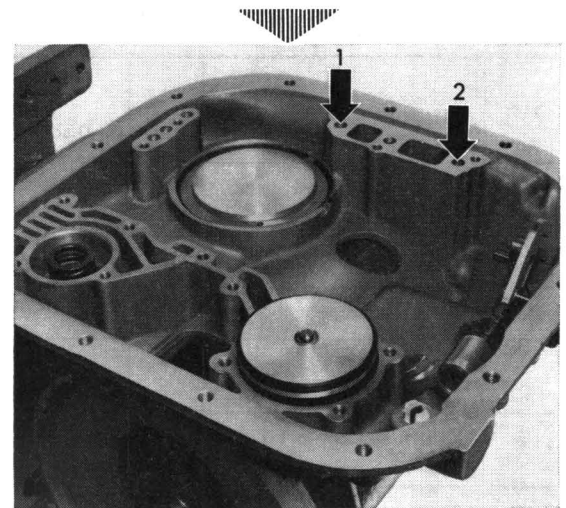
Removing servo piston

- 1 - Remove oil pan and valve body, take out piston for 1st and reverse gear band (6), disassemble and check for wear. Take seal (7) off.
- 2 - Remove circlip (10) and take out cover (11) for 2nd gear band piston (13). Take seals off (7/14).
- 3 - Replace "O" ring (12) in cover (11).
- 4 - Take out accumulator spring (15) and piston (16) and take seal (17) off.

Installing

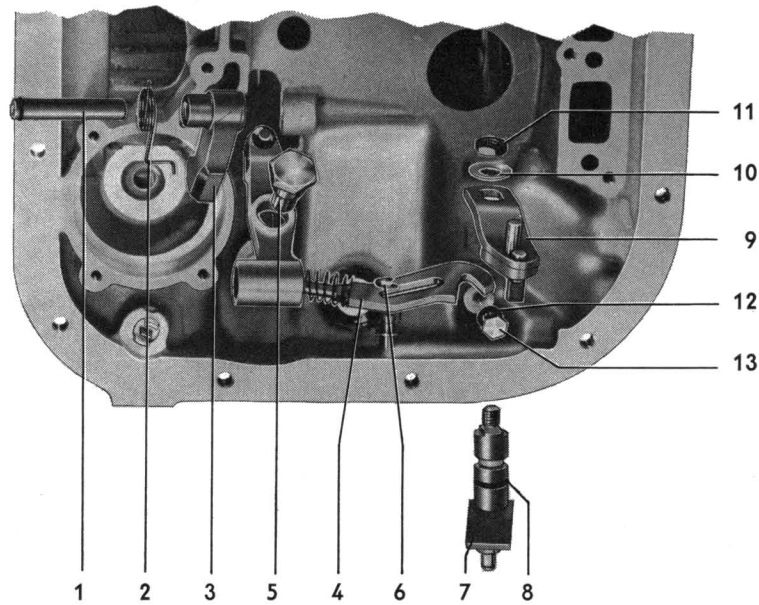
- 1 - Fit new sealing rings. The lips of the seals **must always be towards the oil pressure side**. Dip the seals in transmission fluid before installing.
- 2 - Insert 2nd gear piston (13) into the cover (11) with a rotating motion.
- 3 - Insert cover (11) with piston (13) and spring (9) into the housing and install circlip (10).
- 4 - Assemble piston (6), accumulator spring for piston (4) and piston rod (1) for 1st and reverse gear band.

- 5 - Install accumulator piston (16) and spring (15) and piston for 1st and reverse gear servo (6) with spring (4).



- 1 - Feed to forward clutch
- 2 - Feed to direct and reverse clutch

- 6 - Install valve body assembly and oil pan.



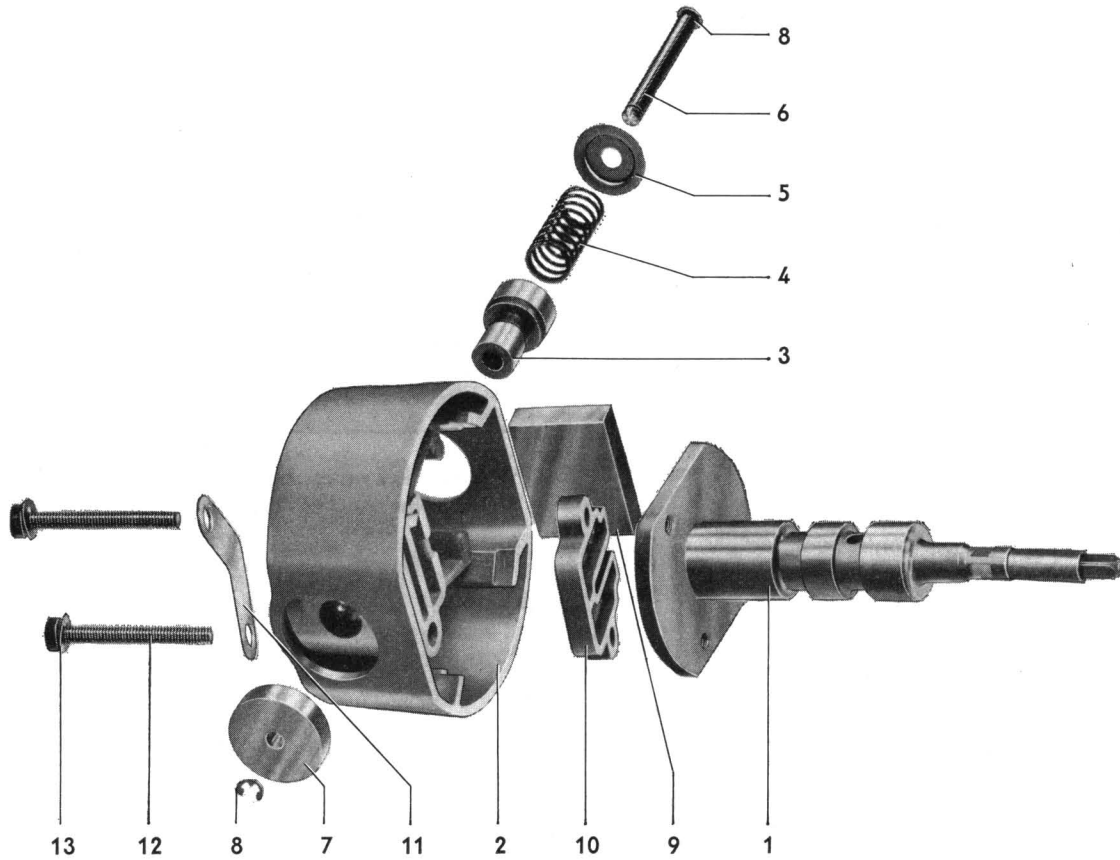
No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	Pin	1	drive out and in		
2	Return spring	1			
3	Pawl	1	check for wear		
4	Operating lever	1			
5	Threaded pin	1	tighten to 2.5 mkg		Section H/27, page 4-1
6	Lock washer	2			
7	Cable lever and shaft	1			
8	"O" ring	1	fit new		
9	Manual valve lever	1	watch position		
10	Washer A 8.4	1			
11	Self-locking nut M 8	1	tighten to 0.6 mkg		
12	Spring washer B 6	1			
13	Retaining screw	1	tighten to 0.5 mkg		

Removing

- 1 - Unscrew pin (5) for operating lever (4), take off lock washer (6) and remove lever.
- 2 - Drive out pawl pin (1) and take off pawl (3) and return spring (2).
- 3 - Remove nut (11) on lever for manual valve (9) and press lever off.
- 4 - Remove retaining screw (13) and take out shaft (7) for cable lever.

Installing

- 1 - Fit new "O" ring (8) on lever shaft. Install shaft (7), fit lever for manual valve (9), washer (10) and nut (11) and tighten. Install the retaining screw (13) and spring washer (12).
- 2 - Insert pawl (3) and return spring (2) so that the pawl is out of engagement. Drive the pawl pin (1) in.
- 3 - Fit operating lever (4) and lock washer (6) and tighten pin (5).
- 4 - Check operation of parking lock.



No.	Designation	Qty.	Note when:		Remarks
			Disassembling	Assembling	
1	Governor shaft	1	check for wear		
2	Governor housing	1	check for wear		
3	Valve	1			
4	Spring	1			
5	Spring cup	1			
6	Pin	1			
7	Centrifugal weight	1			
8	Lock washer 3.2 mm dia.	2			
9	Balance weight	1	do not interchange, governor is balanced		Section H/27, page 5-2
10	Transfer plate	1		watch position	
11	Thrust plate	1	check for wear		
12	Screw M 5 x 40	2			
13	Spring washer B 5	2			

Removing

- 1 - Release the clip, take cover off and remove governor.
- 2 - Check thrust plate, square drive and governor shaft for wear and scoring.

Disassembling

- 1 - Remove two screws (12) and take off thrust plate (11) complete with governor housing (2).
- 2 - Take out transfer plate (10) and balance weight (9).
- 3 - Take lock washer (8) off and remove valve (3), spring (4), centrifugal weight (7) and dished washer (5).

Assembling

- 1 - Wash all parts in washing benzine or kerosene.
- 2 - Install valve (3), spring (4) and dished washer in housing (2). Fit lock washer (8).

Important

Lubricate governor with ATF when assembling.

- 3 - Place balance weight (9) and transfer plate (10) in the housing.

Important

Ensure that the plate is installed properly. The two tapering drillings must be on the governor shaft flange (1).

- 4 - Assemble housing (2) and governor shaft (1). Note location of thrust plate (11).

Installing

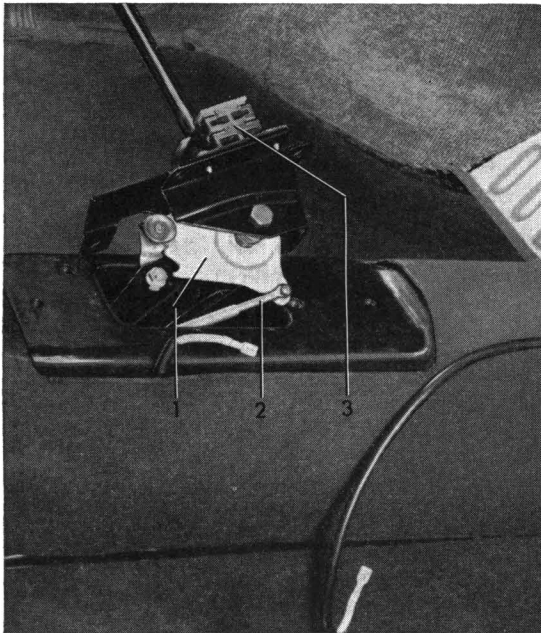
- 1 - Insert governor into transmission case and ensure that the square drive engages.
- 2 - Check "O" ring for governor cover and fit new if necessary.
- 3 - Install governor cover and secure it with clip.

B i n d e r P u n c h A r e a

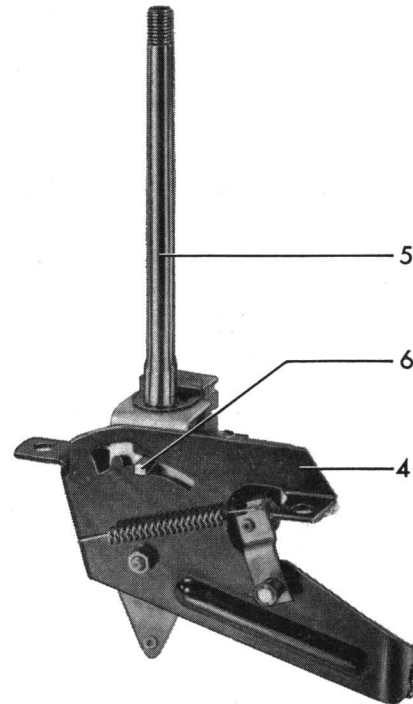
Location	Designation	Thread	Grade	mkg	lb. ft.
Oil pump to transmission case	hex. hd. screw	M 6×1	8 G	0.4	2.8
Transfer plate on valve body	slotted screw	M 5×0.8	8 G	0.3	2.1
Valve body to transmission case	hex. hd. screw	M 6×1	8 G	0.4	2.8
Oil pan to transmission case	hex. hd. screw	M 8×1.25	8 G	1.0	7.0
Oil strainer to valve body	slotted screw	M 6×1	8 G	0.3	2.1
Manual valve lever — cable lever	nut	M 8×1.25	8 G	0.6	4.3
Cable lever to transmission case	retaining screw	M 6×1	8 G	0.5	3.5
Operating lever on transmission case	threaded pin	M 10×1.5	8 G	0.6	4.3
Cable bracket on transmission case	hex. hd. screw	M 8×1.25	6 G	1.5	11
Oil filler pipe on transmission case	hex. hd. screw	M 6×1	8 G	0.5	7.0
Plug — transmission case	socket head	M 10×1		1.0	14
Vacuum unit — transmission case		M 14×1.5		2.5	18
Lock nut for band adjusting screw	nut	M 12×1.75	8 G	2.0	14
Air deflector on final drive housing	hex. hd. screw	M 10×1.5	8 G	1.0	7.0
Differential carrier on final drive housing	nut	M 6×1	8 G	0.5	3.5
Side cover — final drive housing	nut	M 6×1	8 G	0.5	3.5
Starter — final drive housing	nut	M 10×1.5	8 G	2.5	18
Bearing cap — differential carrier	hex. hd. screw	M 10×1.5	10 K	5.0	36
Ring gear — differential housing	hex. hd. screw	M 9×1	10 K	4.5	32
Transmission case — final drive housing	nut	M 8×1.25	8 G	2.0	14
Converter to drive plate	hex. hd. screw	M 8×1.25	8 G	2.0	14
Drive shaft	socket hd. screw	M 8×1.25	10 K	3—3.5	21—25

Description

The gear selection controls consist mainly of a bracket in which the selector lever and a selector segment are mounted. On the left of the lever is a pin which projects into a slot in the side of the bracket. The lever must be lifted before it can be moved into the "R" or "P" positions. A contact on the right hand side of the bracket ensures that the engine can only be started when the lever is in neutral (0). The other two connections are for the back-up lamps.

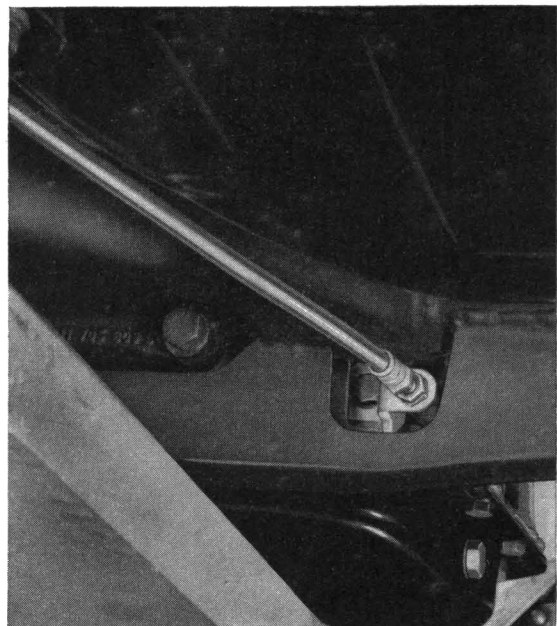


- 1 - Selector segment
- 2 - Cable
- 3 - Contacts



- 4 - Bracket
- 5 - Lever
- 6 - Pin

The operating cable is of the Bowden cable type and transmits the movements of the lever to the transmission. The front end has an eye and it is attached to the selector segment. The outer cable is fixed to the selector lever bracket and the cable runs through the frame to the rear to emerge just in front of the sub-frame mounting. The cable is attached to the transmission with a small angle bracket. In the frame and between frame and transmission the cable is not supported in any way.



B i n d e r P u n c h A r e a

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Part 5 — VW 1600 Automatic — Rear Axle and Transmission