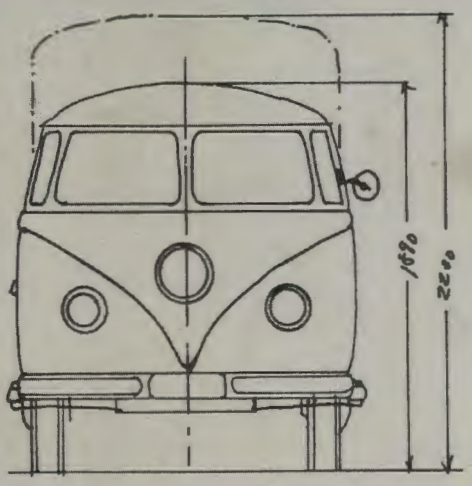
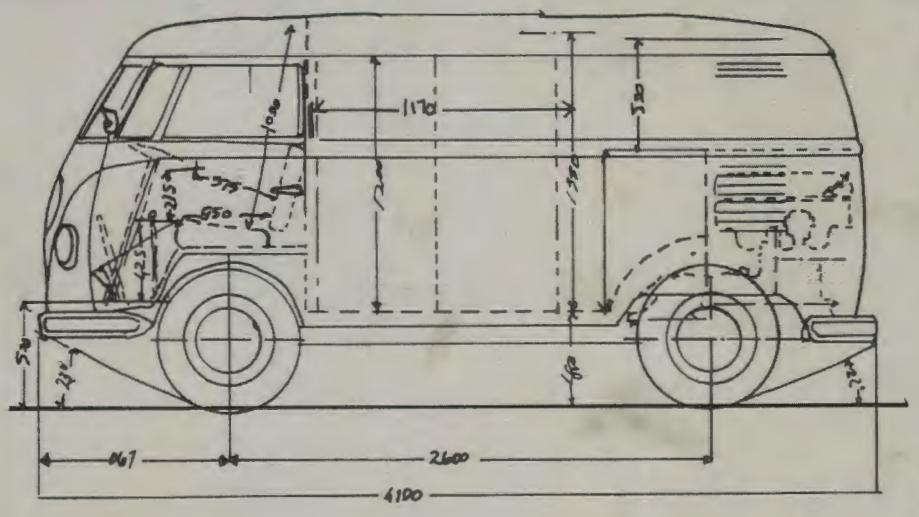
VOLKSWAGEN

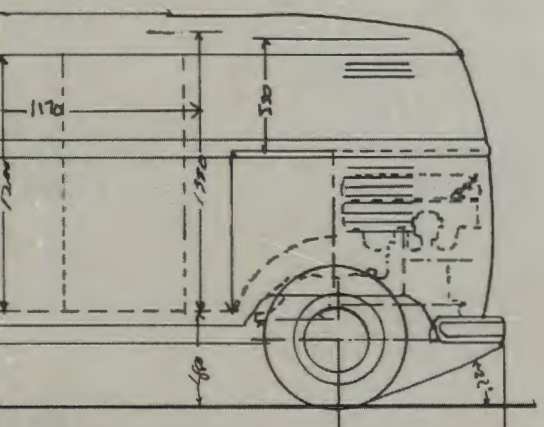
# Type II Transporter

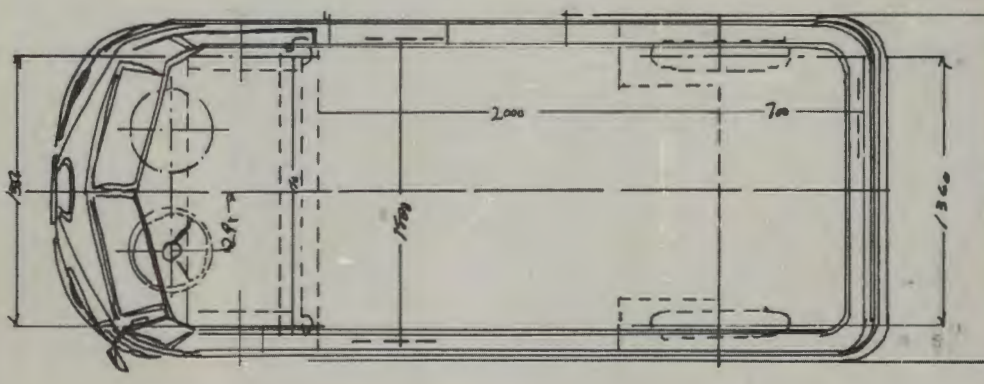
SERIES 1200-1600

# SHOP MANUAL









PAGE 2

# Volkswagen Transporters

**Series 1200 1500 1600**

**With Specifications,
Repair and Maintenance Data**

PAGE 4

PAGE 6

# ENGINE

## SPECIFICATIONS

### 1200 ENGINES

| | 36 bhp (Early) | 36 bhp (Late) | 40 bhp |
|---|---|---|---|
| Type | 36 bhp (Early) | 36 bhp (Late) | 40 bhp |
| Bore | 3.03" | 3.03" | 3.03" |
| Stroke | 2.52" | 2.52" | 2.52" |
| Capacity | 72.74 cu in | 72.74 cu in | 72.72 cu in |
| Bhp (max) | 36 at 3700 rpm | 36 at 3700 rpm | 41.5 at 3900 rpm |
| Maximum torque | 56 ft/lb at 2000 rpm | 58 ft/lb at 2400 rpm | 65 ft/lb at 2400 rpm |
| Compression ratio | 6.6:1 | 6.6:1 | 7.0:1 |
| Ignition firing point | 7.5° btdc | 7.5° btdc | 10° btdc |

### CRANKSHAFT

| | |
|---|---|
| Main bearing type: | |
| Early 36 bhp Nos 1, 3, 4 | Aluminium alloy bushes |
| No 2 | Aluminium alloy shells |
| Late 36 bhp Nos 1, 2, 3 | Steel-backed, lead bronze shells |
| No 4 | Aluminium alloy bush |
| Early 40 bhp | As for late 36 bhp |
| Late 40 bhp Nos 1, 3, 4 | Aluminium alloy bushes |
| No 2 | Aluminium alloy shells |
| Crankcase bore for crankshaft bearings: | |
| Nos 1, 2, 3 bearings | 2.5591" –2.5598" |
| Except up to Engine No 3520332 | 2.3622" –2.3630" |
| No 4 all 1200 engines | 1.9685" –1.9696" |
| * Crankshaft end float (at No 1 bearing) | .0027" –.005" |
| Crankshaft journal nominal diameter: | |
| Early 36 bhp Nos 1, 2, 3 and connecting rod journals | 1.9685" |
| All other engines | 2.1653" |
| All engines, No 4 main bearing journal | 1.5748" |

* No 1 main bearing is adjacent to the flywheel.

### PISTONS AND RINGS

| | |
|---|---|
| Piston to cylinder clearance | .0018" ± .0002" |
| Piston ring side clearance: | |
| Upper compression | .0031" ± .0004" |
| Except early 36 bhp | .0024" ± .0004" |
| Lower compression | .0024" ± .0004" |
| Oil scraper | .001" ± .001" .000" |
| Piston ring gap: | |
| Compression | .015" ± .003" |
| Oil scraper | .013" ± .003" |
| Weight in variation between pistons in one engine | 18 oz (max) |

### CONNECTING RODS

| | |
|---|---|
| Big-end bearing clearance: | |
| Early 36 bhp engine | .0008" –.0024" |
| Later engines | .0008" –.003" |
| Big end bearing end float: | |
| Early 36 bhp engine | .0067" –.016" |
| Later engines | .004" –.016" |
| Gudgeon pin clearance in bush: | |
| Early 36 bhp engine | .0004" –.001" |
| Later engines | .0004" –.0008" |
| Weight variation between connecting rods | .18 oz (new) –.36 oz (wear limit when repairing) |

### CAMSHAFT

| | | | |
|---|---|---|---|
| Bearing bore for shaft | .9456" –.9458" | .9850" –.9857" | .9850" –.9857" |
| Backlash between gears | .000" – .002" | .000" – .002" | .000" –.002" |
| Bearing clearance | .0008" –.0021" | .0008" –.0021" | .0008" –.0021" |
| End play | .0008" –.0027" | .0016" –.0051" | .0016" –.0051" |

## VALVES

| | 36 bhp (Early) | 36 bhp (Late) | 40 bhp |
|---|---|---|---|
| Valve head diameter: | | | |
| Inlet | 1.18" | 1.239" | 1.299" |
| Exhaust | 1.102" | 1.181" | 1.181" |
| Valve stem diameter: | | | |
| Inlet | .2736" –.2739" | .3126" –.3130" | .3126" –.3130" |
| Exhaust | .2732" –.2736" | .3114" –.3118" | .3114" –.3118" |
| Guide inner diameter: | | | |
| Inlet | .2759" –.2763" | .3150" –.3157" | .3150" –.3157" |
| Exhaust | .2763" –.2771" | .3150" –.3157" | .3150" –.3157" |
| Valve seat width: | | | |
| Inlet | .05" –.06" | .05" –.06" | .05" –.06" |
| Exhaust | .07" –.08" | .07" –.08" | .07" –.08" |
| Valve clearance (cold): | | | |
| Inlet | .004" | .004" | .004" |
| Exhaust | .004" | .004" | .004" |
| *Up to Engine No 9205699 or without relevant sticker: | | | |
| Inlet | — | .008" | .008" |
| Exhaust | — | .012" | .012" |
| Valve timing (clearance at .040"): | | | |
| Inlet opens | 2.5° btdc | 2°atdc | 4° btdc |
| Inlet closes | 37.5° abdc | 24° abdc | 32° abdc |
| Exhaust closes | 2.5° atdc | 9° btdc | 1° atdc |
| Exhaust opens | 37.5° bbdc | 32° bbdc | 41° bbdc |
| Later model 40 Bhp: | | | |
| Inlet opens | 6° btdc | | |
| Inlet closes | 35°30' abdc | | |
| Exhaust opens | 42°30' bbdc | | |
| Exhaust closes | 3° atdc | | |
| Valve springs pressure: | | | |
| Loaded length 1.102" | 73.5 ± 3.7 lbs | | |
| Loaded length 1.314" | — | 97 ± 6.6 lbs | 97 ± 6.6 lbs |

*Sticker placed on fan housing.

## ROCKERS AND TAPPETS

| | | | |
|---|---|---|---|
| Rocker arm inside diameter | .6294" –.6306" | .7086" –.7093" | .7086" –.7093" |
| Rocker shaft diameter | .6286" –.6290" | .7073" –.7077" | .7073" –.7077" |
| Crankcase bore diameter | .5905" –.5912" | .7480" –.7488" | .7480" –.7488" |
| Tappet diameter | .5892" –.5399" | .7464" –.7475" | .7464" –.7472" |

## LUBRICATION SYSTEM

| | | | |
|---|---|---|---|
| Oil pressure: | | | |
| With engine hot 3000 rpm | 28 psi | 28 psi | 28 psi |
| Pressure relief valve: | | | |
| Spring free length | 2.05" –2.08" | | |
| Loaded length .945" | — | 17lbs | 17 lbs |
| Relief valve opens at. | 4.2 –8.5 psi | 2.1 –6.4 psi | 2.1 –6.4 psi |

| | 36 bhp (Early) | 36 bhp (Late) | 40 bhp |
|---|---|---|---|
| Pump gears: | | | |
| End play between gears and body (with gasket) | .0027" –.007" | .0027" –.007" | .0027" –.007" |
| Backlash | .000" –.008" | .000" –.008" | .000" –.008" |

## 1500 ENGINES (VARIATIONS TO 1200 ENGINES)

| | 51 bhp | 53 bhp | 49 bhp (M240) |
|---|---|---|---|
| Type | 51 bhp | 53 bhp | 49 bhp (M240) |
| Bore | 3.27" | 3.27" | 3.27" |
| Stroke | 2.72" | 2.72" | 2.72" |
| Capacity | 91.1 cu in | 91.1 cu in | 91.1 cu in |
| Bhp (max) | 51 at 4000 rpm | 53 at 4200 rpm | 49 at 4200 rpm |
| Maximum torque | 74 ft/lb at 2600 rpm | 78 ft/lb at 2600 rpm | 71 ft/lb at 2600 rpm |
| Compression ratio | 7.8:1 | 7.5:1 | 6.6:1 |
| Ignition firing point | 10° btdc | 7.5° btdc | 7.5° btdc |
| Valve timing (clearance at .040"): | | | |
| Inlet opens | 7°30' btdc | 7°30' btdc | 7°30' btdc |
| Inlet closes | 37° abdc | 37° abdc | 37° abdc |
| Exhaust opens | 44°30' bbdc | 44°30' bbdc | 44°30' bbdc |
| Exhaust closes | 4° atdc | 4° atdc | 4° atdc |
| Piston to cylinder clearance | .0016" –.0024" | .0016" –.0024" | .0016" –.0024" |
| Upper compression ring side clearance | .0027" –.0039" | .0027" –.0039" | .0027" –.0039" |

## 1600 ENGINES (VARIATIONS TO 1500 ENGINES)

| | 57 bhp (std) | 57 bhp (M157) | 53 bhp (M240) |
|---|---|---|---|
| Type | 57 bhp (std) | 57 bhp (M157) | 53 bhp (M240) |
| Bore | 3.36" | 3.36" | 3.36" |
| Capacity | 96.6 cu in | 96.6 cu in | 96.6 cu in |
| Bhp (max) | 57 at 4400 rpm | 57 at 4400 rpm | 53 at 4200 rpm |
| Maximum torque | 82 ft/lb at 3000 rpm | 82 ft/lb at 3000 rpm | 77 ft/lb at 3000 rpm |
| Compression ratio | 7.7:1 | 7.5:1 | 6.6:1 |
| Ignition firing point | 0° | 0° | 0° |

## GENERAL ENGINE SPECIFICATIONS FOR ALL MODELS

| | |
|---|---|
| Type | Ohv – horizontally opposed – air cooled |
| Cylinders | Individual – cast iron with fins |
| Cylinder heads | Cast in pairs – aluminium alloy with fins |
| Valve guides | Replaceable |
| Valve seats | Replaceable |
| Gudgeon pins | Fully floating – retained by circlips |
| Big end bearings | 3 layer steel backed |
| Connecting rods | H section steel forgings |
| Pistons | Aluminium alloy – steel reinforcement |
| Number of rings | 2 compression – 1 oil scraper |
| Camshaft: | |
| 1200 and 1500 (51 bhp) | Grey cast iron – three bearing machined in block |
| 1500 (53 bhp) and 1600 | Grey cast iron – aluminium alloy split shell bearings |
| Oil pump | Gear type – submerged |
| Oil cooling | Cooler in air stream |
| Engine cooling | Air cooling by fan – driven by V-belt. |

### TORQUE WRENCH SETTINGS

| | |
|---|---|
| Crankcase nuts | 25 ft/lb |
| Crankcase bolts and nuts | 14 ft/lb |
| Cylinder head nuts | 23 ft/lb |
| Rocker shaft nuts | 16 ft/lb |
| Flywheel gland nut | 217 ft/lb |
| Connecting rod bolts and nuts | 24 ft/lb |
| Generator pulley nut | 45 ft/lb |
| Fan nut | 45 ft/lb |
| Engine carrier nuts | 18 ft/lb |
| Clutch to flywheel | 18 ft/lb |
| Oil drain plug | 25 ft/lb |
| Spark plugs | 25 ft/lb |
| Exceptions to the above: | |
| On 36 bhp engine | |
| Crankcase nuts | 22 ft/lb |
| Cylinder head nuts | 27 ft/lb |
| Oil drain plug (to August 1959) | 29 ft/lb |
| Spark plug insert | 52 ft/lb |
| On 53 and 57 bhp engine | |
| Generator pulley nut | 32 ft/lb |
| Bolt for fan and crank shaft pulley | 101 ft/lb |

## 1. DESCRIPTION

The air cooled, four cylinder, overhead valve engine is of the horizontally opposed type and is basically the same in all models.

The crankcase is two piece and die-cast in light alloy. As the two crankcase halves are machined to mate together, replacement can only be made in pairs.

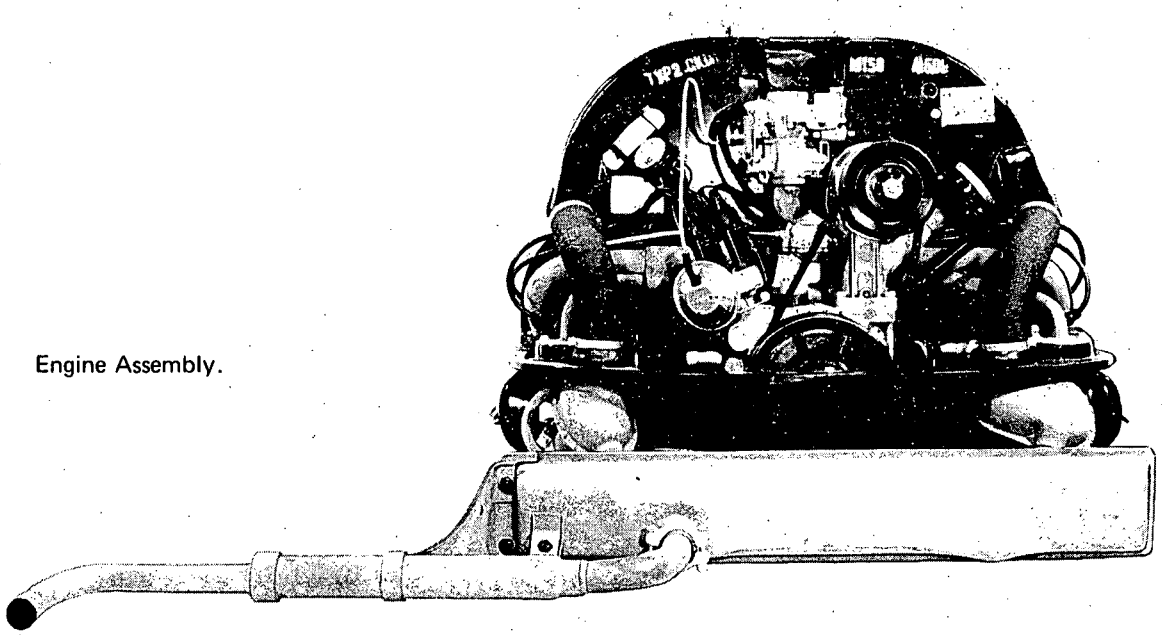
The cylinders attached to the crankcase are of special cast iron, incorporating fins on the outside surfaces for cooling purposes. As the cylinders are separate, each can be replaced or interchanged provided the matching piston is fitted to the appropriate cylinder.

A single removable cylinder head is fitted to each pair of cylinders, the head is also cast in light alloy incorporating fins for cooling purposes. Valve seat inserts and valve guides are shrunk into the head.

The crankshaft is mounted in the crankcase and supported by four main bearings. In earlier models three of the bearings are of split steel backed lead-bronze type, the fourth bearing is aluminium alloy of the bush type; crankshaft end thrust is taken by number two main bearing. Later models have four light alloy lead coated bearings one of which is the split type; crankshaft end thrust is taken by number one main bearing. At the clutch end of the crankshaft an oil seal is fitted, with an oil thrower and oil return thread incorporated on the pulley end of the shaft. The flywheel complete with starter ring gear is secured to the crankshaft by a gland nut and located in position by four dowel pins. Woodruff keys are used to secure the timing gear and distributor drive gear to the crankshaft.

The four connecting rods are fitted with detachable lead-bronze shells in the big end bearing end of the rod, with the fully floating gudgeon pin supported in a bronze bush at the small end of the rod.

The pistons are fitted with two compression rings and



Engine Assembly.

one oil control ring. The gudgeon pin is retained in the piston by a circlip located at each end. Pistons are of light alloy with steel inserts for reinforcement.

The camshaft is mounted in the crankcase and supported by three bearings. A light alloy gear is riveted to one end of the shaft and meshes with the crankshaft gear, both gears are helically cut.

The cams actuate the valves by transmitting movement through tappets, push rods and rocker arms.

Oil lubrication to the engine components is pressure fed from a gear type pump driven off the drive end of the camshaft.

An oil cooler and an oil pressure relief valve are incorporated in the system; oil drawn from the crankcase is passed through the oil cooler which is located on the crankcase in the air flow. When the oil is cold and thick the oil pressure relief valve permits oil to partially by-pass the oil cooler giving direct lubrication to the engine.

Air cooling of the engine is effected by a fan mounted on the generator shaft and driven by V-belt from the crankshaft pulley. Air drawn in through the fan housing aperture is directed by deflector plates around the cylinders and cylinder heads. Air flow is controlled by a thermostat via a throttle ring on the fan housing which enables the engine to reach working temperature quickly and maintains a constant running temperature.

## 2. ENGINE ASSEMBLY

### *1200 MODELS TO JANUARY, 1963*

**TO REMOVE**

(1) Disconnect the earth cable from the battery terminal.

(2) Disconnect and remove the oil bath air cleaner assembly and connecting hose to carburettor air intake.

(3) Take out the securing screws and remove the rear engine apron.

(4) Disconnect the leads from the terminals of the generator, oil pressure switch and ignition coil.

(5) Disconnect the accelerator cable and the choke cable at the carburettor connections.

(6) Raise the rear of the vehicle and support on stands.

(7) Loosen off and remove the exhaust tail pipe complete with sound neutralising pipe.

(8) Disconnect the two heating control cables at the control valves, and loosen off and detach the flexible tubes at the heat boxes.

(9) Detach the fuel hose at the connection in the cover plate at the front of the engine, plug the fuel line to prevent the loss of fuel.

(10) Pull out the accelerator cable and choke cable (if fitted) from the fan housing. Take out the securing screws and remove the front cover plate.

(11) Support the engine from beneath with a trolley jack.

(12) Loosen and remove the retaining nuts on the engine support bolts located top and bottom of the transmission case and engine flanges.

(13) Ease the engine assembly backward until the clutch pressure plate assembly is clear of the gearbox input shaft.

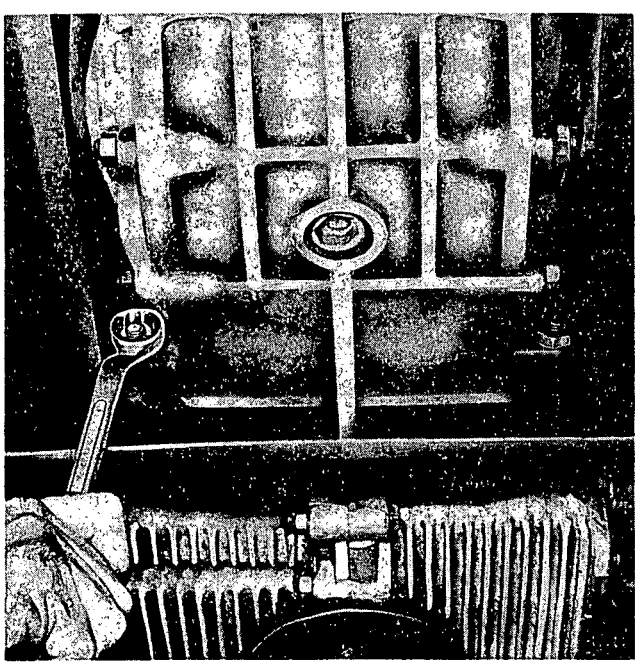
(14) Lower the assembly and withdraw from the vehicle.

*NOTE: It may be necessary to angle the rear of the engine down to facilitate removal.*

**TO INSTAL**

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Ensure that the clutch driven plate hub and the needle bearing for the gearbox input shaft spigot are correctly aligned.



Removing or Installing Engine Rear Mounting Bolts. (Earlier models.)

(2) Check that the transmission case and engine contact flanges are clean.

(3) Lubricate lightly with high melting point grease the starter shaft bush located in the transmission housing.

(4) Clean the gearbox input shaft splines and smear lightly with high melting point grease.

(5) With the engine supported on a trolley jack move the assembly into position, raise the engine to align the gearbox input shaft with the hub of the clutch driven plate.

(6) Engage a gear to hold the gearbox input shaft stationary.

(7) Move the assembly forward engaging the input shaft in the driven plate hub, turn the engine at the V-belt to engage the splines in the hub.

*NOTE: During installation of the engine, the engine weight must be fully supported by the jack and no stress must be placed on the gearbox input shaft or clutch driven plate hub to avoid the possibility of damage to the components.*

(8) Push the assembly fully home to bring the transmission case and engine flanges together, enter the two lower engine support bolts and screw on the nuts but do not tighten.

(9) Instal the upper engine support bolts and nuts and tighten them lightly, complete the tightening of the support bolts and nuts evenly.

(10) Connect the accelerator cable and manual choke cable (if fitted) and adjust.

(11) Check and adjust ignition timing.

**TO DISMANTLE AND ASSEMBLE**

(1) With the engine removed from the vehicle, drain off the engine oil into a suitable container.

(2) Take out the securing screws and remove the engine front cover plate.

(3) Release the securing nut on the generator shaft pulley and remove the nut, spacers, outer pulley half and the fan belt.

(4) Disconnect the high tension lead between the distributor cap and coil, pull free the connectors at the spark plugs and remove the distributor cap.

(5) Take out the securing screws located at each side of the fan housing, unhook the air control return spring and take out the throttle ring securing screws.

(6) Loosen off and remove the strap securing the generator to the mounting on the engine, and remove the fan housing and generator complete from the engine.

(7) Loosen and remove the crankshaft pulley securing bolt, using a suitable puller withdraw the pulley from the end of the crankshaft.

(8) Take out the securing screws and remove the cover plate located below the crankshaft pulley.

(9) Remove the fuel lines at the petrol pump and carburettor, and loosen off and remove the carburettor from the inlet manifold.

(10) Loosen off and remove the securing nuts and screws at the pre-heat pipe and inlet manifold flanges, and remove the manifold and gaskets.

(11) Loosen off the clamp bolts at the front exhaust pipe connections.

(12) Remove the securing nuts at the silencer flanges and remove the silencer and gaskets.

(13) Loosen off and remove the slotted screw at the bottom of the heat junction box.

(14) Take out the split pin and detach the connecting rod from the heat control panel.

(15) Remove the heating junction box and exhaust pipe.

(16) Detach heating control cable.

(17) Take out the threaded ring located in the oil filler and remove the oil filler and gasket.

(18) Take out the securing screws retaining the heating channels to the cylinder cover plates, and remove the heating channels.

(19) Take out the thermostat retaining screw and unscrew the thermostat from the connecting rod.

(20) Release the connecting rod from the operating lever located on top of the cylinders.

(21) Loosen and remove the throttle ring shaft nut and withdraw the shaft.

(22) Remove the thermostat support and securing nut.

(23) Take out the cover plate screws located at each end of the inlet manifolds and detach both cover plates.

(24) Loosen off the clutch pressure plate assembly retaining bolts evenly and progressively to avoid stress on the plate, and remove the clutch assembly.

(25) Ease off the cylinder head cover retaining clip and remove the cover.

(26) Loosen off evenly and alternately the rocker arm shaft securing nuts and remove the shaft assembly.

*NOTE: Later models may be fitted with stud seals which should be removed. Unless otherwise stated the dismantling procedure given for cylinder assemblies is applicable to both sides of the engine.*

(27) Loosen off evenly and progressively the cylinder head securing nuts and withdraw the cylinder head from the studs.

(28) Remove the push rod tubes and push rods from the cylinder block.

(29) Detach the deflector plates positioned below the cylinders.

(30) Ease the cylinders away from the block and off the studs.

*NOTE: Mark the piston crowns and cylinders so that they may be assembled in their original positions.*

(31) Using circlip pliers, take out the gudgeon pin retaining circlips from the pistons.

(32) Heat the piston to approximately 180°F using a suitable wrap around element or the special tool for this purpose.

(33) With the piston supported, push out the gudgeon pin using a drift of the same diameter as the gudgeon pin.

(34) Loosen off and remove the three oil cooler retaining nuts and remove the cooler and gaskets.

(35) Remove the oil pump cover and gasket after unscrewing the securing nuts.

(36) Mark the pump gears in relation to the pump body and remove the gears.

(37) Using the special extractor remove the oil pump body.

(38) Loosen off and remove the oil filter securing nuts at the base of the crankcase and remove the cover plate, gaskets and oil filter.

(39) Remove the fuel pump securing nuts and detach the pump, remove the flange, gaskets and pump push rod.

(40) Remove the distributor by releasing the retainer clamping bolt.

(41) Take out the coil spring from the centre of the distributor drive pinion.

(42) Turn the crankcase assembly upside down to allow the drive shaft and washer to fall from the casing.

(43) Using the special wrench and flywheel retainer tool, remove the flywheel gland nut and detach the flywheel. Remove the crankshaft oil seal at the flywheel end of the crankshaft.

(44) Remove the oil pressure switch from the side of the crankcase.

(45) To keep the tappets in position in the right crankcase half, instal the special retaining springs for this purpose.

(46) Loosen off and remove the nuts and bolts retaining the crankcase halves together, using a rubber mallet gently tap the right half of the crankcase to separate it from the left half.

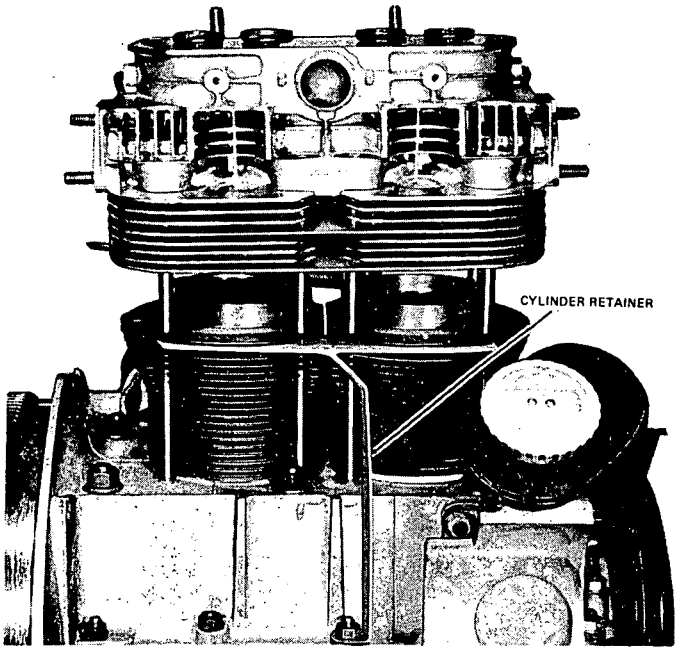
*NOTE: Do not insert levers or tools between the joint faces of the casing halves.*

(47) Remove the camshaft end plug, camshaft and tappets from the casing.

(48) Lift out the crankshaft complete with connecting rods.

(49) Take out the Woodruff key at the end of the crankshaft and remove the oil thrower.

(50) Remove No 4 main bearing which is located at the timing gear end of the crankshaft.




**Special Tool used to Retain Cylinders when Removing Cylinder Head.**

(51) Remove the distributor drive gear retaining circlip from its groove in the crankshaft.

(52) Immerse the timing gear end of the shaft in oil heated to approx. 180°F, using a suitable puller draw the distributor drive gear, spacer and timing gear from the end of the shaft.

(53) Loosen off and remove the connecting rods, marking the rods and bearing caps to ensure assembly in their original positions.

(54) Remove the bearing shells from the crankcase halves.

Assembly is a reversal of the dismantling procedure, for details relating to each sub assembly see under the appropriate heading.

## *1200/1500/1600 MODELS FROM JANUARY, '63*

### TO REMOVE

(1) Disconnect the earth cable from the battery terminal.

(2) Disconnect and remove the oil bath air cleaner assembly and connection to the carburettor air intake.

(3) Raise the rear of the vehicle and support on stands.

(4) Take out the securing bolts and screws and remove the crossmember at the rear end.

(5) Disconnect the leads from the terminals of the generator, ignition coil, oil pressure switch and carburettor choke unit.

(6) Disconnect the accelerator cable at the carburettor and remove the spring.

*NOTE: On 1600 models it is not necessary to remove the return spring.*

(7) Loosen off and remove the exhaust tail pipes and damper.

(8) Loosen off and remove the two upper engine mounting bolts and nuts.

(9) Withdraw the accelerator cable and detach the fuel hose at the connection in the front engine cover plate. Plug the fuel line to prevent the loss of fuel.

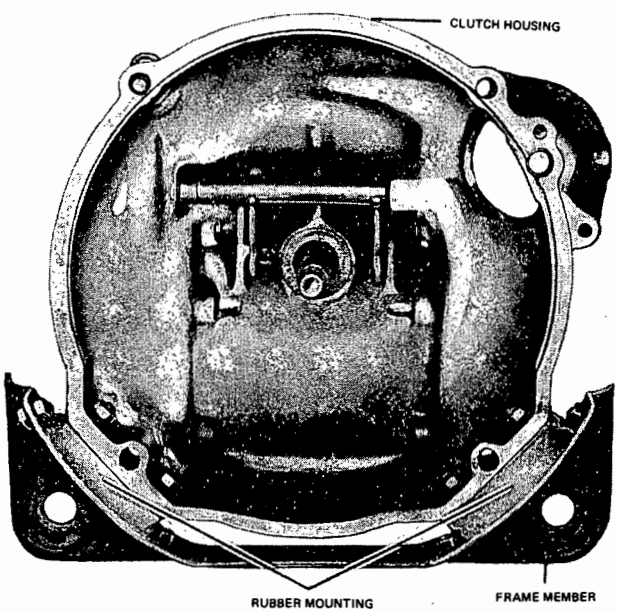
(10) Disconnect both heating control cables and the flexible pipes from the heat exchangers.

(11) Support the engine from beneath with a trolley jack, and loosen off and remove the two lower engine mounting bolts and nuts.

*NOTE: On 1600 models, the engine is supported by a crossmember and rubber mountings at the crankshaft pulley end of the engine. Take out the securing bolts attaching the crossmember to the engine, remove the securing bolt and nut from each rubber mounting and detach the crossmember.*

(12) Ease the engine assembly backward until the clutch pressure plate assembly is clear of the gearbox input shaft.

(13) Lower the assembly and withdraw from the vehicle.




Rear Engine Mounting Location and attachment. (Except 1600 models.)

**TO INSTAL**

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Ensure that the clutch driven plate hub and the needle bearing for the gearbox input shaft spigot are correctly aligned.

(2) Check that the transmission case and engine contact flanges are clean.

(3) Examine the clutch release bearing and release ring for cracks or wear. If the release bearing is fitted with a plastic ring, roughen the ring with emery cloth and smear with a molybdenum-disulfide based lubricant.

(4) Lubricate lightly with high melting point grease the starter shaft bush.

(5) Clean the gearbox input shaft splines and lightly apply a molybdenum-disulfide powder.

(6) With the engine supported on a trolley jack move the assembly into position, raise the engine to align the gearbox input shaft with the hub of the clutch driven plate.

(7) Engage a gear to hold the gearbox input shaft stationary.

(8) Move the assembly forward engaging the input shaft in the driven plate hub, turn the engine at the V-belt to engage the splines in the hub.

*NOTE: During installation of the engine, the engine weight must be fully supported by the jack, and no stress must be placed on the gearbox input shaft or clutch driven plate hub, to avoid the possibility of damage to the components.*

(9) Push the assembly fully home to bring the transmission case and engine flanges together. Enter the two lower engine mounting bolts and nuts but do not tighten.

(10) Instal the upper engine mounting bolts and nuts and tighten them lightly, complete the tightening of all the mounting bolts and nuts evenly.

*NOTE: On 1600 models, instal the engine support crossmember and rubber mountings.*

(11) Connect and adjust the accelerator cable at full throttle.

(12) Check and adjust ignition timing as described under the appropriate heading.

**TO DISMANTLE AND ASSEMBLE**

(1) With the engine removed from the vehicle, drain off the engine oil into a suitable container.

(2) Disconnect and remove the connecting hoses between the fan housing and heat exchangers.

(3) Loosen off and detach the front engine cover plate.

(4) Loosen off and detach the cover plate above the crankshaft pulley.

(5) Take out the securing screws and remove the manifold preheater pipe sealing plate.

(6) Loosen off and detach the rear engine cover plate.

(7) Loosen off heat exchanger clamps and the clips connecting the warm air channels.

(8) Unscrew and remove the securing nuts attaching the silencer flanges to the cylinder heads, and take off the pre-heater adaptor pipe.

(9) Take out the four screws in the manifold pre-heater pipe.

(10) Remove the silencer and gaskets.

(11) Release the securing nut on the generator shaft pulley and remove the nut, spacers, outer pulley half and the fan belt.

(12) Disconnect the cables connecting the ignition coil to the distributor, pull free the connectors at the spark plugs and remove the distributor cap.

(13) Take out the securing screws located at each side of the fan housing, unhook the air control return spring and take out the throttle ring securing screws.

*NOTE: On later models fitted with modified air control system, remove the right rear lower warm air duct and remove the thermostat securing screw. Unscrew and detach the thermostat from the end of the connecting link and lift the fan housing and generator from the engine.*

(14) Loosen off and remove the strap securing the generator to the mounting on the engine and remove the fan housing and generator complete from the engine.

(15) Remove the intake manifold and intermediate exhaust flange securing nuts, detach the manifold and remove the cylinder head sealing rings.

(16) Take out the screws in lower part of warm air channel and remove the exhaust pipe clamps. Remove the heat exchangers by easing forward.

(17) Remove both air guide plates and take off the cylinder cover plates.

(18) Loosen and remove the crankshaft pulley securing bolt, using a suitable puller withdraw the pulley from the end of the crankshaft.

(19) Take out the securing screws and remove the lower crankshaft pulley cover plate.

(20) Ease off the cylinder head cover retaining clips and remove the covers.

(21) Loosen off evenly the rocker arm shaft securing nuts and remove the rocker shaft assembly. Take out the stud seals.

(22) Withdraw the push rods from the cylinder heads.

(23) Loosen off and remove the cylinder heads retaining nuts and washers and withdraw the cylinder heads from the studs.

(24) Detach the push rod tubes and the deflector plates from below the cylinders.

(25) Ease the cylinders away from the block and off the studs.

*NOTE: Mark piston crowns and cylinders to ensure installation in the original positions.*

(26) Using circlip pliers, take out the gudgeon pin retaining circlips from the pistons.

(27) If the gudgeon pins cannot be finger pushed from the pistons, heat the piston using a wrap around element or the special tool for this purpose.

(28) With the piston fully supported, push out the gudgeon pin using a drift of the same diameter.

(29) Loosen off and remove the three oil cooler retaining nuts and remove the cooler and gaskets.

(30) Remove the oil pump cover and gasket after unscrewing the securing nuts.

(31) Take out the pump gears and withdraw the pump body using the special extractor for this purpose.

(32) Loosen off and remove the oil filter securing nuts at the base of the crankcase and remove the cover plate, gaskets and oil filter.

(33) Remove the fuel pump securing nuts and detach the pump, remove the flange, gaskets and pump push rod.

(34) Remove the distributor by releasing the retainer nut.

(35) Take out the coil spring from the centre of the distributor drive pinion.

(36) Turn the crankcase assembly upside down to allow the drive shaft and washer to fall from the casing.

(37) Loosen off and remove the clutch assembly and retaining bolts from the flywheel.

(38) Using the special wrench and flywheel retainer tool, remove the flywheel gland nut and detach the flywheel. Remove the crankshaft oil seal at the flywheel end of the crankshaft.

(39) Remove the oil pressure switch from the crankcase.

(40) Pull off the oil filler connecting hose and take out the threaded ring to detach the oil filler.

(41) To keep the tappets in position in the right crankcase half, instal the special retaining springs for this purpose.

(42) Loosen off and remove the nuts retaining together the two crankcase halves and using a rubber mallet gently tap the right half of the crankcase to separate it from the left.

*NOTE: Do not insert levers or tools between the joint faces of the casing halves.*

(43) Remove the camshaft end plug, camshaft and tappets from the casing.

(44) Lift out the crankshaft complete with connecting rods.

(45) Take out the Woodruff key at the end of the crankshaft and remove the oil thrower.

(46) Remove No 4 main bearing and the distributor drive gear retaining circlip.

(47) Immerse the timing gear end of the crankshaft in oil heated to approximately 180°F, using a suitable puller draw the distributor drive gear, spacer and timing gear from the end of the shaft.

(48) Remove No 3 main bearing from the crankshaft journal.

(49) Loosen off and remove the connecting rods, marking the rods and bearing caps to ensure assembly in their original positions.

(50) Remove No 1 main bearing and the shells of No 2 main bearing.

Assembly is a reversal of the dismantling procedure. For details relating to each sub assembly, see under the appropriate heading.

## 3. ROCKER ARMS AND SHAFTS

### *1200 MODELS TO JANUARY, 1963*

**TO DISMANTLE AND ASSEMBLE**

(1) With the rocker arm shaft assemblies removed from the engine as described earlier, remove the circlips at each end of the shaft.

(2) Slide off the shaft, the washers, rocker arms and support brackets.

*NOTE: Before reassembling check the shaft, adjusting screws and arm ball sockets for wear. Renew worn components as necessary.*

(3) Instal the rocker arms and support brackets on the shaft, with the washers located at the sides of the rocker arms which bear against the four circlips.

*NOTE: The washers are fitted in a set of three in each position with the waved washer inserted between two flat washers.*

(4) With the washers in position instal the circlips at each end of the shaft.

### *1200/1500/1600 MODELS FROM JANUARY, '63*

Modification to the rocker arm assembly at:

1200cc – December 1963, Chassis No 1219722 (Engine No 8247714)

1500cc – June 1963, Chassis 1139422 (Engine No 0243326)

Valve angle has now been increased to 9°30' from 9°, and parts of the valve gear changed. Modified cylinder heads can be identified at the embossed casting number, located on the head between the rocker shaft studs. In the case of 1200cc cylinder heads the number will be suffixed by the letter C, and with 1500cc cylinder heads the letter A.

Note that the rocker arm assembly securing nuts which must be of the correct grade are copper in colour. Also that rocker arms differ in dimension and are therefore not interchangeable between engines of different capacity.

Rocker shaft position has been altered slightly with the bores in the supports for the rocker shaft now off centre. The supports are marked with the word TOP which must be positioned to the outside on installation. The rocker arms are modified on the 1500cc and can be identified by two forged lines on the rib of the arm. Push rod length has been increased and the new rods can be identified by knurling on the rod shaft.

From January 1964, rocker arms have been provided with a drilling to allow oil flow to the contact area of the adjusting screw and valve stem. This modification reduces valve gear noise and wear on the valve stem ends. An oil deflector ring is fitted to the valve stems to minimise the passing of oil through the valve guides. This modification has brought about the shortening of the valve guides by .040". The oil deflector ring and modified rocker arms can only be installed on engines having cylinder heads with the 9°30' valve angle, shortening of the valve guides will be necessary and can be accomplished by using a suitable milled cutter.

It is important that in the case of engines fitted with slotted rocker shaft supports, that the supports are installed with the chamfered edges outwards and the slot upward. Two supports of the same type only must be installed to the rocker shaft.

From June 1966, Chassis No 216173747 (Engine No H0176639), the push rods of the 1500cc engine have been increased in length and diameter. New and old type push rods can be installed if necessary in one engine.

**TO DISMANTLE AND ASSEMBLE**

(1) With the rocker arm shaft assemblies removed from the engine as described earlier, remove the circlips at each end of the shaft.

(2) Slide off the shaft the washers, rocker arms and support brackets. Note the order in which the rocker arms are removed.

*NOTE: Before reassembling, check the shaft, adjusting*

*screws and arm ball sockets for wear. Renew worn components as necessary.*

(3) Instal the rocker arms and support brackets on the shaft in their original positions, and with the word TOP on the support brackets outwards.

(4) The washers should be fitted in sets of three with the waved washers inserted between the flat washers. Each set of three washers should be positioned at the sides of the rocker arms adjacent to the circlips.

(5) With the washers in position instal the circlips at each end of the shafts.

## 4. CYLINDER HEADS AND VALVES

### *1200 MODELS TO JANUARY, 1963*

### TO DISMANTLE

(1) Remove the cylinder head assemblies from the engine as described earlier and place them on a clean bench.

*NOTE: The following procedure is applicable to both cylinder heads.*

(2) Using a suitable valve spring compressor, compress each valve spring in turn to remove the valve retaining collets, remove the compressor.

(3) Lift off the valve spring retainer and spring.

(4) Remove any burrs on the valve stem collet grooves to prevent damage to the valve guides when the valves are removed.

(5) Remove the valves from the cylinder heads and place them in a rack so that they can be installed in their original positions when reassembling the cylinder head.

### TO CLEAN AND INSPECT

(1) Clean each valve thoroughly and renew any that are burned or cracked across the face, or that have bent or warped stems.

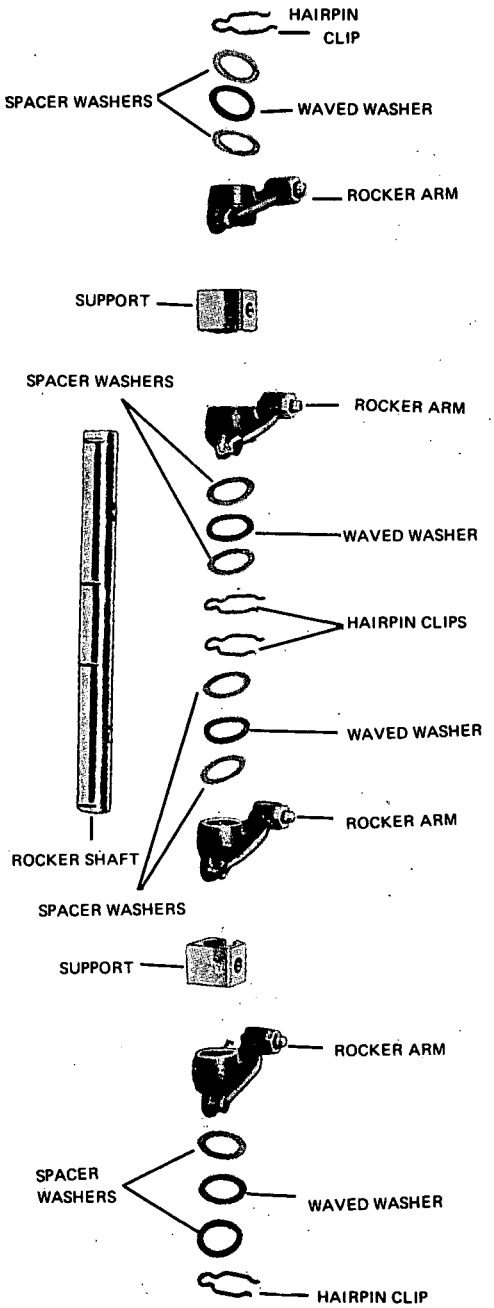
*NOTE: Maximum permitted valve stem run-out is .0004".*

(2) Remove the carbon deposits from the combustion chambers and ports and check the condition of the valve seats in the head. If the seat inserts are cracked, badly burnt, or the outer edge of the top chamfer exceeds the outer diameter of the valve seat insert, a reconditioned or new cylinder head should be fitted.

*NOTE: The fitting of valve seat inserts is a specialist job requiring special equipment and therefore is not recommended.*

(3) Check the cylinder heads for cracks in the combustion chambers and ports, cracked cylinder heads should be replaced.

(4) Check that the valve guides are not excessively




**Exploded Rocker Shaft Components. (Note the word TOP on rocker supports.)**

worn, the maximum permitted clearance between the valve stem and guide should not exceed .0063".

*NOTE: The fitting of valve guides is a specialist job requiring special equipment and therefore is not recommended.*

(5) Check the valve spring against the specifications. If a spring tester is not available, test by comparison with a new spring.

**TO REFACE VALVES AND VALVE SEATS**

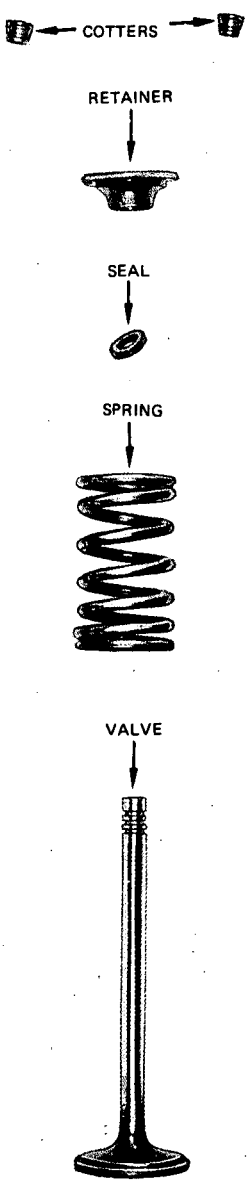
(1) The valve seats in the cylinder head should be refaced with a 45° seat cutter when badly pitted or burnt.

*NOTE: Only sufficient metal should be removed with the seat cutter to obtain a concentric seating surface clear of pits or other damage.*

(2) Using a 75° cutter chamfer the lower edge of the valve seat face.

(3) Using a 15° cutter chamfer the upper edge of the valve seat face.

*NOTE: It is essential that the correct seat width is obtained during the refacing procedure. The inlet seat width should be .051" –.063" and the exhaust seat width should be .067" –.079". The seat widths can be narrowed by operations (2) and (3) and increased by operation (1). The outer edge of the upper 15° chamfer should not exceed the outer diameter of the seat insert.*




Valve and Spring Components.

(4) Pitted or burnt valves should be refaced with a valve refacing machine provided the pitting or burning of the seat face is not extensive when the valve should be replaced.

*NOTE: Valve seat widths for both inlet and exhaust valves should be the same as specified earlier for the cylinder head valve seat inserts.*

(5) Correctly refaced valves and valve seats should require very little lapping to obtain accurate seating. Ensure that the valve is frequently lifted clear of the seat and rotated during the lapping operation to avoid grooving the seat faces.

(6) With the grinding compound thoroughly cleaned from the valves and seats, check the fit of the valves to the valve seats.

(7) Smear the valve face with bearing blue and insert the valve into position, using light hand pressure rotate the valve a quarter turn only.

(8) Remove the valve and inspect the faces. A correctly seated valve should have evenly transferred the blue to the valve seat.

**TO ASSEMBLE AND INSTAL**

Assembly and installation is a reversal of the dismantling and removal procedures with attention to the following points:

(1) Ensure that all grinding compound has been cleaned from the components.

(2) Check that the valve retaining collets are correctly seated in the spring seat and valve grooves.

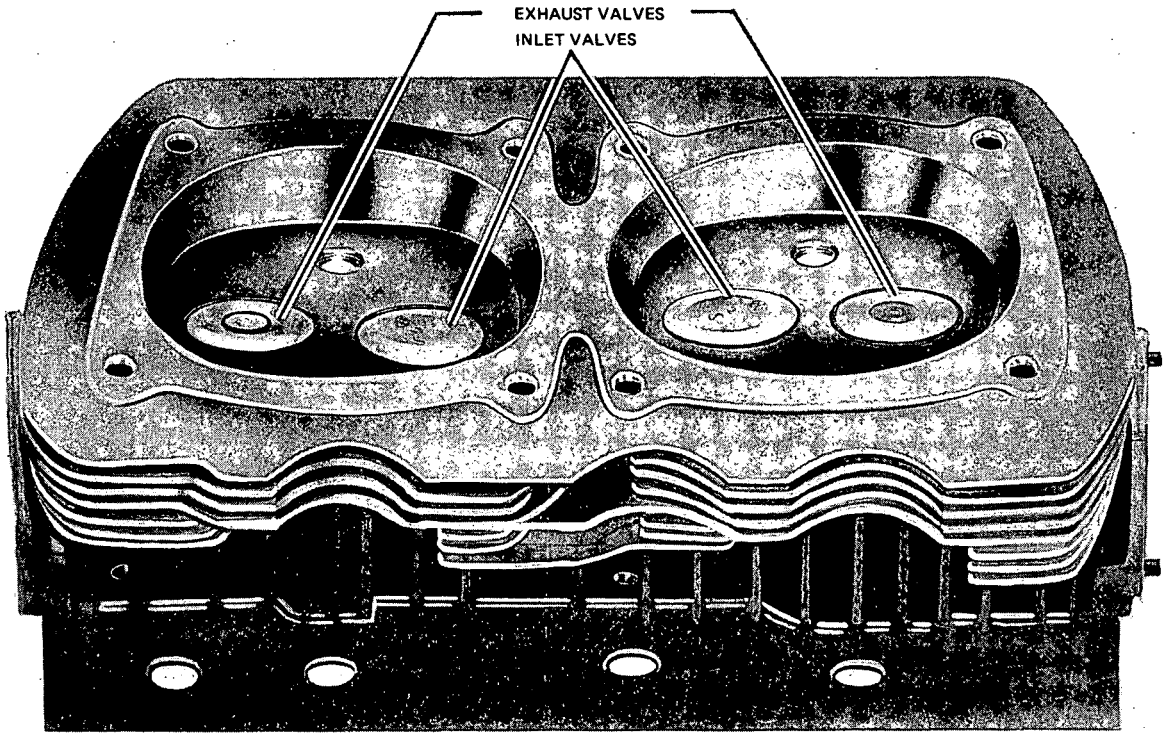
(3) Check that the cylinder head holding studs are tight in the block.

(4) Instal a new gasket between the cylinder head and the cylinder shoulder.

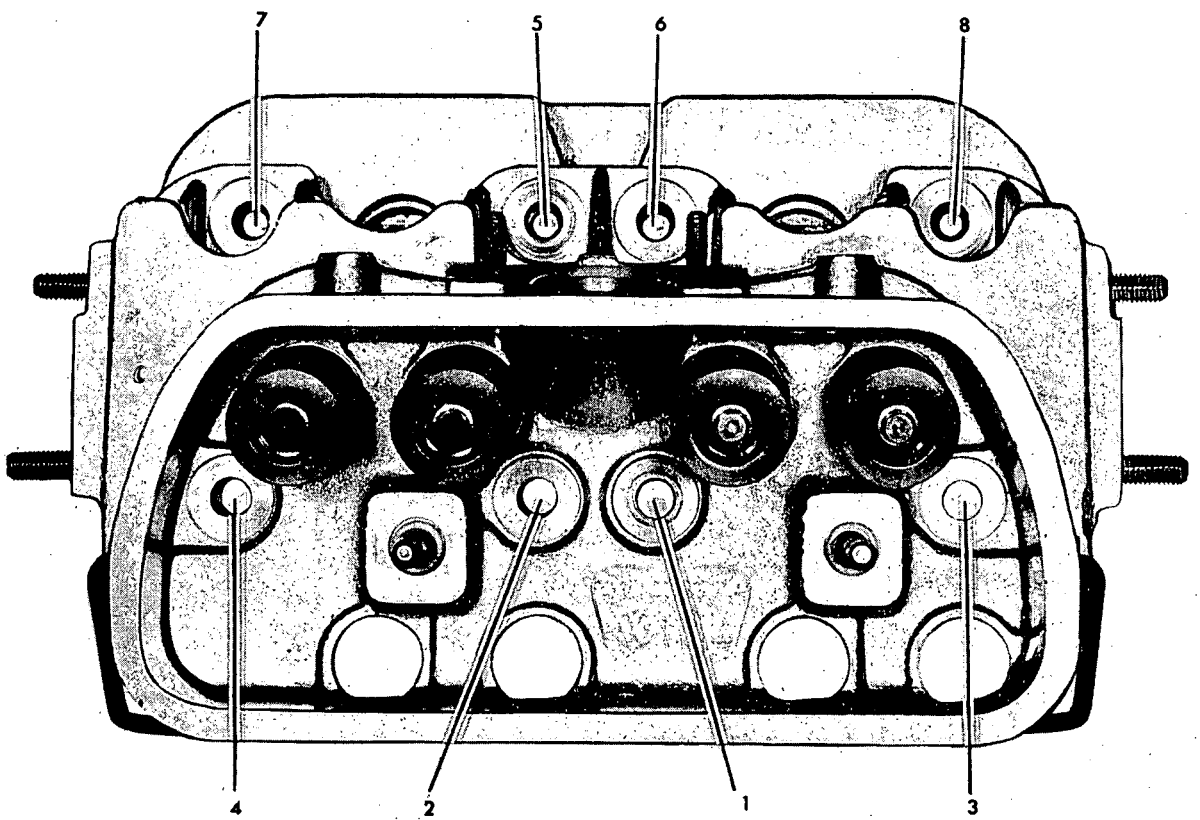
*NOTE: Gaskets are not fitted between the cylinder head and the top edge of the cylinder.*

(5) Fit new seals to the push rod tubes and instal them with the tube seam facing upwards. If necessary stretch the tubes to 7.11" –7.16" to ensure positive sealing, but use care to avoid cracking the tubes.

(6) Place the cylinder head in position over the studs, smear the cylinder head securing nuts with graphite paste and instal them on the studs after first fitting the nut washers.




Underside of Cylinder Head Showing Valve Arrangement.




Method and Sequence for Tightening Cylinder Head Nuts. First Tightening 7 ft/lb.

(7) Tighten the cylinder head nuts evenly and progressively to a torque of 7 ft/lb working from the centre outwards on the securing nuts located in the rocker shaft and valve spring chamber. Carry out the same procedure with the securing nuts located in line with the sparking plug apertures.

(8) Fully tighten the securing nuts to a torque of 23 ft/lb working from the centre outwards but taking alternate nuts in each row to ensure that the pressure is evenly exerted over the whole of the head.

(9) Instal the rocker arm shaft assembly and ensure that the ball ends of the push rods are located centrally in the rocker arm sockets.

*NOTE: Prior to fitting the rocker arm assembly instal the stud seals to those models to which it is applicable.*

(10) Check that the rocker arm adjusting screws are contacting the valve stems just right of the stem centre, this is to assist valve rotation during operation.

If necessary move the rocker arm shaft in the support bracket holes to obtain the correct position prior to tightening the securing nuts.

(11) Carry out the procedure for adjusting the valve clearances as described under the section *VALVE TIMING AND TAPPET ADJUSTMENT.*

(12) Immerse new cylinder head cover gaskets in slightly warmed water before cementing the gaskets to the covers. Ensure that the cement fully covers one face of the gasket before attaching it to the cover.

## *1200/1500/1600 MODELS FROM JANUARY, '63*

Engines fitted with the older type of cylinder head can be identified by the shape of the rocker shaft stud bosses, the old type head has round bosses whereas the new type head has square bosses. On the old type of cylinder heads cooling efficiency can be increased where the vehicle is driven under abnormal conditions, eg hard driving over long periods in a strong head wing and high air temperature. Drill three .40" diameter holes through the two ribs located near the inlet port, this will reduce the cylinder head temperature at full load.

On all engines fitted with the new type of cylinder head (square rocker shaft stud bosses) the valve clearance should be set at .004" for both inlet and exhaust valves, with the engine in a cold state or the oil temperature not exceeding 50°C.

Valve clearances for all other engines remain as specified. In the case of engines fitted with a sticker on the fan housing and/or a clip on the rocker shaft valve clearances must be adjusted accordingly.

On 1500cc engines from August 1964, Chassis No 265000335 (Engine No 627579) modified valve caps and springs are fitted and can be identified by colour marking of either silver-gray or violet paint. The new type springs and caps can be fitted in place of the old units provided they are installed in complete sets.

On 1200cc engines where the valves have worn stem ends, a detachable valve cap can be installed on the stem to make the valves serviceable.

In August 1965, from Chassis No 216000001 (Engine No H0000001) inlet valve diameter was increased to 1.40" and the exhaust valve diameter to 1.26".

### TO DISMANTLE

(1) Remove the cylinder head assemblies from the engine as described earlier and place them on a clean bench.

*NOTE: The following procedure is applicable to both cylinder heads.*

(2) Using a suitable valve spring compressor, compress each valve spring in turn to remove the valve retaining collets.

(3) Remove the compressor and lift off the spring cap and spring.

(4) Remove any burrs on the valve stem collet grooves to prevent damage to the valve guides when the valves are removed.

(5) Remove the valves from the cylinder heads and place them in a rack so that they can be installed in their original positions.

### TO CLEAN AND INSPECT

(1) Clean each valve thoroughly and renew any that are burned or cracked across the seat face, or that have bent or warped stems.

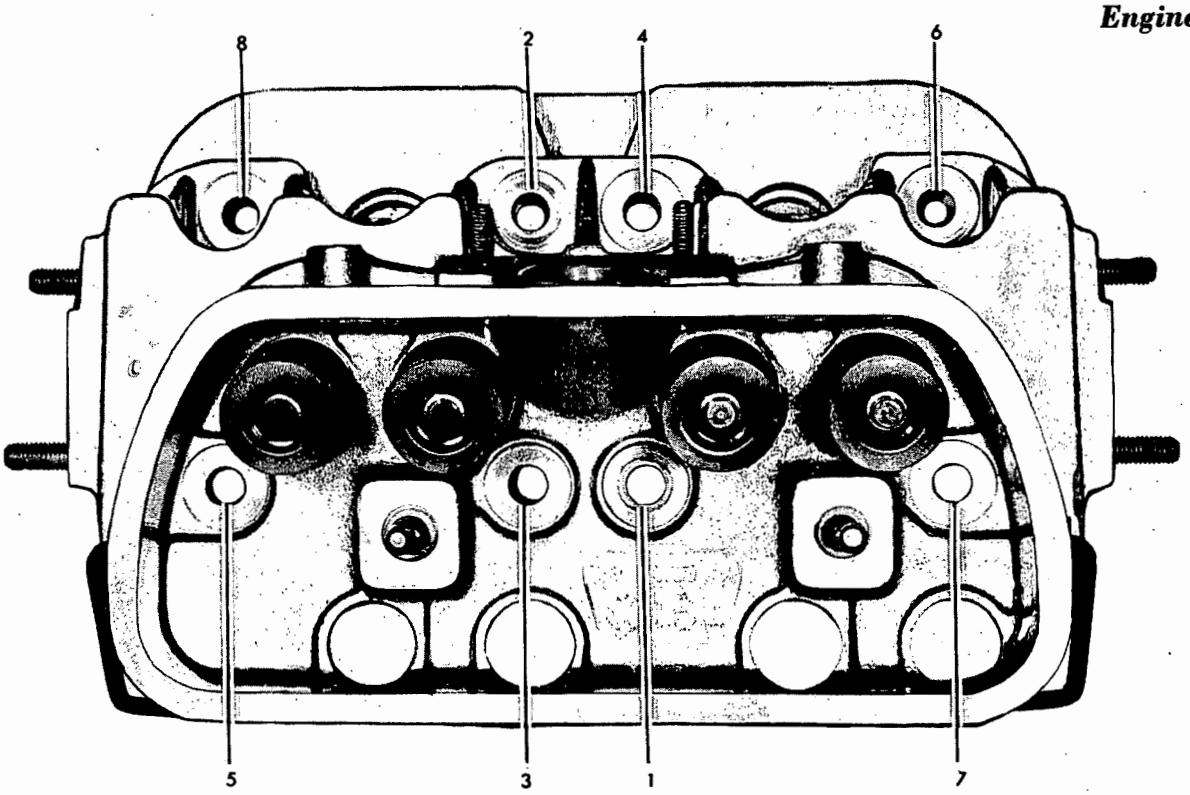
*NOTE: Maximum permitted valve stem run-out is .0004".*

(2) Remove the carbon deposits from the combustion chambers and ports, check the condition of the valve seats in the head. If the seat inserts are cracked, badly burnt or the outer edge of the top chamfer exceeds the outer diameter of the valve seat insert a reconditioned or new cylinder head should be fitted.

*NOTE: The fitting of valve seat inserts is a specialist job requiring special equipment and therefore is not recommended.*

(3) Check the cylinder heads for cracks, also in the combustion chambers and ports. Cracked cylinder heads must be replaced.

(4) Check that the valve guides are not excessively worn, the maximum permitted rock between the valve stem and guide is .0063".




Method and Sequence for Tightening Cylinder Head Nuts. Second Tightening 23 ft/lb.

*NOTE: The fitting of valve guides is a specialist job requiring special equipment and therefore is not recommended.*

(5) Check the valve spring against the specifications. If a spring tester is not available, test by comparison with a new spring.

## TO REFACE VALVES AND VALVE SEATS

(1) The valve seats in the cylinder head should be refaced with a 45° seat cutter when badly pitted or burnt.

*NOTE: Only sufficient metal should be removed with the seat cutter to obtain a concentric seating surface clear of pits or other damage.*

(2) Using a 75° cutter chamfer the lower edge of the valve seat faces on 1200cc engines.

*NOTE: On 1500cc engines the lower edge of the exhaust valve seat insert only should be cut with the 75° cutter. The lower edge of the inlet valve seat insert should be chamfered with a 60° cutter.*

(3) Using a 15° cutter chamfer the upper edge of both inlet and exhaust seat inserts.

*NOTE: It is essential that the correct seat width is maintained during the refacing procedure. The inlet seat width should be .051" –.063" and the exhaust seat width should be .067" –.079".*

The seat widths can be narrowed by operations (2) and (3) and increased by operation (1). The outer edge of the upper 15° chamfer should not exceed the outer diameter of the seat insert.

(4) Pitted or burnt valves should be refaced with a valve refacing machine provided the pitting or burning of the seat face is not excessive.

*NOTE: The valve seat angle for the exhaust valve should be refaced at 45°, whereas the inlet valve seat angle should be 44°.*

(5) Correctly refaced valves and valve seats should require very little lapping to obtain accurate seating. Ensure that the valve is frequently lifted clear of the seat and rotated during the lapping operation to avoid grooving the seat faces.

(6) With the grinding compound thoroughly cleaned from the valves and seats, check the fit of the valves to the valve seats.

(7) Smear the valve face with bearing blue and insert the valve into position, using light hand pressure rotate the valve a quarter turn only.

(8) Remove the valve and inspect the faces. A correctly seated valve should have evenly transferred the bearing blue to the valve seat.

**TO ASSEMBLE AND INSTAL**

Assembly and installation is a reversal of the dismantling and removal procedures with attention to the following points:

(1) Ensure that all grinding compound has been cleaned from the components.

(2) Check that the valve retaining collets are correctly seated in the spring seat and valve grooves.

(3) Check that the cylinder head holding studs are tight in the block.

(4) On 1200cc models instal a new sealing ring between the cylinder head and cylinder shoulder.

*NOTE: On all models, there is no gasket fitted between the upper edge of the cylinder and cylinder head.*

(5) Instal new seals on the push rod tubes and fit them with the tube seam facing upwards. If necessary stretch the tubes to 7.1" –7.15" for 1200cc, and 7.48" –7.52" for 1500cc. This will ensure positive sealing, but use care to avoid cracking the tubes.

(6) Place the cylinder head in position over the studs, smear the cylinder head securing nuts with graphite paste and instal them on the studs after first fitting the nut washers.

(7) Tighten the cylinder head nuts evenly and progressively to a torque of 7 ft/lb working from the centre outwards on the securing nuts located in the rocker shaft and valve spring chamber. Carry out the same procedure with the securing nuts located in line with the sparking plug apertures.

(8) Fully tighten the securing nuts to a torque of 23 ft/lb working from the centre outwards but taking alternate nuts in each row to ensure that the pressure is evenly exerted over the whole of the head.

(9) Instal the stud seals and rocker arm assemblies to the cylinder heads.

(10) Instal and tighten evenly the rocker assembly securing nuts to a torque of 18 ft/lb.

(11) Carry out the procedure for adjusting the valve clearances as described under the section *VALVE TIMING AND TAPPET ADJUSTMENT.*

(12) Instal the cylinder head covers fitting new gaskets.

## 5. CYLINDERS AND PISTONS

***1200 MODELS TO JANUARY, 1963***

It is important to establish prior to overhauling an engine whether loss of oil is due to consumption or leakage. Provided no external leaks are evident oil consumption at the rate of .250 gal per 600 miles would indicate the need of an engine overhaul. Apart from the wear factor, oil consumption can also be brought about by several other contributing factors such as gummy piston rings seized in the piston grooves, or fractured rings. It may be found that an engine fitted with new pistons, cylinders or rings may consume more oil initially than an engine already run-in. Careful examination of the components on dismantling will assist in diagnosing the source of the trouble.

The running clearance between piston and cylinder is .0014" –.0022" with a maximum wear limit clearance of .008" These clearances must be established by use of micrometer equipment and not by feeler gauge. Check the inside diameter of the cylinders at a point approximately .50" below the top edge of the cylinder. Check also the cylinder for out of round wear which must not exceed the wear limit of .0004". The piston measurement is taken at the bottom of the piston skirt parallel to the gudgeon pin axis. The piston nominal diameter is stamped on the piston crown together with the piston weight grading which is indicated by a paint line and symbol. A brown line indicates a minus weight and a grey line a plus weight. Piston size can also be determined by a paint dot on the crown which should match the cylinder in which it operates, to ensure correct running clearance. If it is necessary to replace cylinder and piston it is essential that the piston and cylinder are of identical size and weight grading, and are of the same grading as the remaining cylinders in the engine. The crown of the piston is stamped with an arrow and in some cases the word 'VORN' which should point towards the flywheel on installation.

Check the piston ring gaps (see specifications) with feeler gauges when the rings are installed squarely, approximately .200" into the cylinder bore.

With the piston rings installed on the piston check the ring side clearance in the grooves (see specifications).

The rings must be fitted to the piston with the word TOP or 'OBEN' towards the crown of the piston.

When installing the cylinder to the piston ensure that the ring gaps are staggered and not in line, and that the gap of the oil scraper ring is at the top when the piston assumes its normal horizontal running position.

Check the fit of the gudgeon pin in the connecting rod small end bush which should have a clearance of .0001" –.0006", the maximum wear limit is .0016". Should the wear limit be reached the pin and bush require replacing, an oversize gudgeon pin should not be fitted in this case.

The gudgeon pin may be a light finger-push fit in the piston without any piston heating being required, this depends on the amount of permissible tolerance discrepancy between the pin and bearing and is quite normal and therefore replacement is not required.

Oversize gudgeon pins (marked green) are available in cases where the piston pin hole diameter exceeds .7874". The practice of heating the piston is permissible where the gudgeon pin is not a finger-push fit when the piston is cold.

It is essential to ensure that gudgeon pin circlips are correctly located in their grooves, and that piston rings are installed on the pistons by use of a ring tool to avoid stress or fracture of the rings.

Lubricate with engine oil all components during assembly and ensure that a very high degree of cleanliness is maintained.

## TO REMOVE AND INSTAL CYLINDERS

(1) Remove the cylinder head as described previously.

(2) Detach the valve push rods and push rod tubes.

(3) Remove the deflector plates located below the cylinders.

(4) Mark the cylinders and corresponding pistons so that they can be installed in their original positions; withdraw the cylinders from the pistons and engine assembly.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the cylinder for wear and, if necessary, replace the cylinder and piston with another assembly of the same size and with the cylinder and piston matched.

*NOTE: The cylinder seating surface on the crankcase, cylinder contact face and gasket must be perfectly clean. Distortion of the cylinder may result if foreign matter is present on the surfaces. Always use a new gasket between the cylinder and crankcase.*

(2) Lubricate with engine oil the gudgeon pin and piston surfaces.

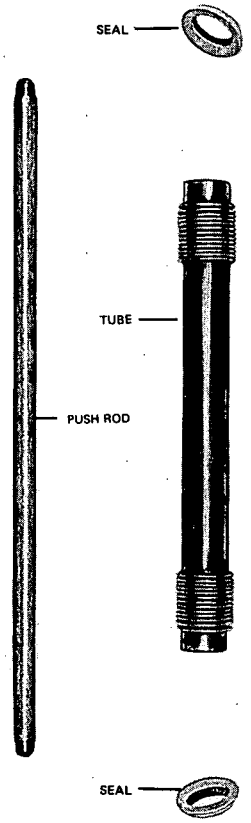
(3) Ensure that the oil scraper ring gap is at the top with the remaining piston ring gaps staggered. Compress the rings, to facilitate entry into the cylinder, with a ring compressing tool.

(4) Lubricate the cylinder walls and slide the cylinder over the piston until the rings are fully entered in the bore, remove the ring compressor and push home the cylinder.

*NOTE: The crankcase studs must not be in contact with the cylinder cooling fins.*

(5) Instal the deflector plates below the cylinders, bending them if necessary to obtain a tight fit at the crankcase studs to prevent rattling.

(6) Fit new seals to the push rod tubes and instal them with the tube seam facing upwards. If necessary stretch the tubes to 7.11" –7.16" to ensure positive sealing, but use care to avoid cracking the tubes.




Push Rod and Tube Components.

## TO REMOVE AND INSTAL PISTONS AND RINGS

(1) Remove the cylinders as described previously.

(2) Mark the pistons to ensure that they are installed in their original positions and with the appropriate cylinder.

(3) Using circlip pliers, remove the gudgeon pin retaining circlips at the piston ends.

(4) Heat the piston to approximately 180°F using a suitable wrap around element or the special tool for this purpose.

(5) With the piston supported, push out the gudgeon pin using a drift of the same diameter as the gudgeon pin.

(6) If it is necessary to remove the piston rings, use a piston ring tool for this operation to avoid damage to the rings or piston.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Free the piston of all carbon deposits on the crown and in the ring grooves.

*NOTE: Do not use a sharp tool for this operation or damage to the piston surface will result.*

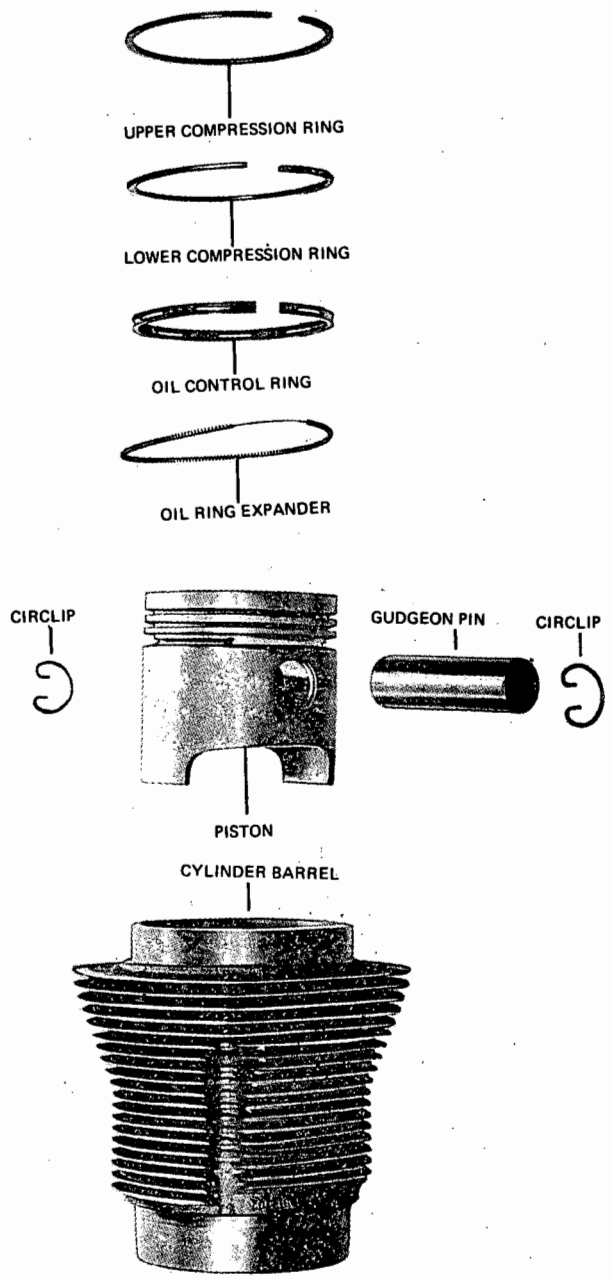
(2) Examine the piston skirt for carbon deposits, a build up of carbon on one side of the piston would indicate the possibility of a twisted connecting rod. Remove the carbon deposits using a fine oiled corundum stone.

*NOTE: Do not use emery cloth to remove carbon from the piston skirts.*

(3) Check the piston for wear and if necessary replace it with a piston of the same size and weight.

(4) Check the piston rings for gap and side clearance as previously described.

(5) Instal the gudgeon pin retaining circlip at the side of the piston which faces the flywheel.




Piston, Ring and Cylinder Barrel Components.

*NOTE: Pistons must be installed with the arrow or word 'VORN' pointing towards the flywheel.*

(6) Instal the piston on the connecting rod, heating the piston if the gudgeon pin is not a push fit.

(7) Insert the remaining gudgeon pin retaining circlip and check that both circlips are correctly seated in the piston grooves.

### *1200/1500/1600 MODELS FROM JANUARY, '63*

It is important to establish prior to overhauling an engine whether loss of oil is due to consumption or leakage. Provided no external leaks are evident, oil consumption at the rate of .250 gal per 600 miles would indicate the need of the engine overhaul.

Apart from the wear factor, oil consumption can also be brought about by several other contributing factors, eg, gummy or fractured rings seized in the piston grooves. Careful examination of the components on dismantling will assist in diagnosing the source of the trouble.

It may be found that an engine fitted with new pistons, cylinders or rings is consuming more oil initially than an engine already run-in, oil consumption should decrease as components are bedded in.

The running clearance between piston and cylinder is .0014" –.0022" with a maximum wear limit clearance of .008". These clearances must be established by use of micrometer equipment and not by feeler gauge. Check the inside diameter of the cylinders at a point approximately .50" below the top edge of the cylinder. The piston measurement is taken at the bottom of the piston skirt parallel to the gudgeon pin axis. Nominal diameter of the piston is stamped on the piston crown together with a paint spot which must be of the same colour as that of the cylinder in which it runs to ensure correct running clearance. Piston weight grading is also stamped on the piston crown and is identified by a paint mark and a symbol, a grey mark indicating a plus weight, and a brown mark indicating a negative weight. From May 1963 the weight tolerance of the pistons for all engines was increased to .35 oz, thereby allowing pistons of different makes and matching sizes to be installed in one engine provided the piston weights are checked. However it is still only permitted to fit pistons and cylinders of the same size grading in one engine. The crown of the piston is also stamped with an arrow which must point towards the flywheel when the piston is installed.

Check the piston ring gaps (see specifications) with feeler gauges when the rings are installed squarely, approximately .20" into the cylinder bore. With the piston rings installed on the piston check the ring side clearance in the grooves (see specifications).

The rings must be fitted to the piston with the word TOP or OBEN towards the crown of the piston.

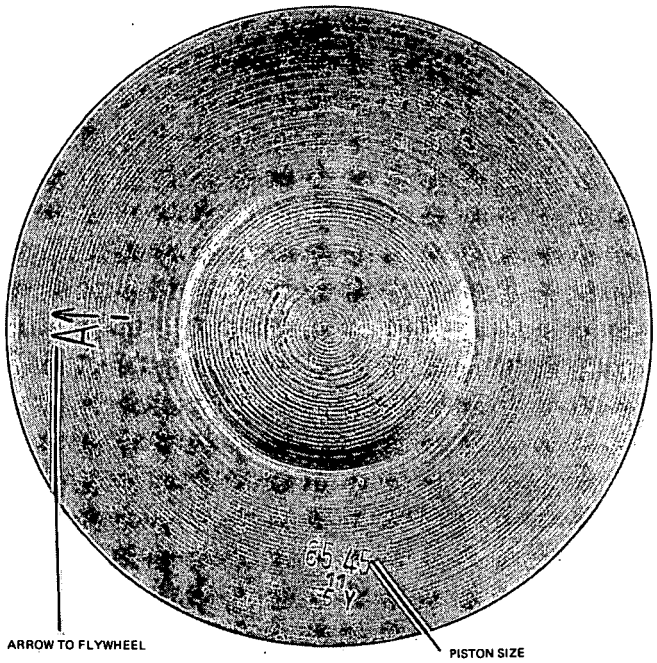
From February 1963, Chassis No 1072658 (Engine No 0168330) modified pistons and rings were fitted to all 1500cc engines. The new type of ring can be installed in the old type pistons but do not instal the old type piston rings on the new type pistons.

When installing the cylinder to the piston ensure that the ring gaps are not in line but equally staggered, the gap of the oil scraper ring should be at the top when the piston assumes its normal horizontal running position.

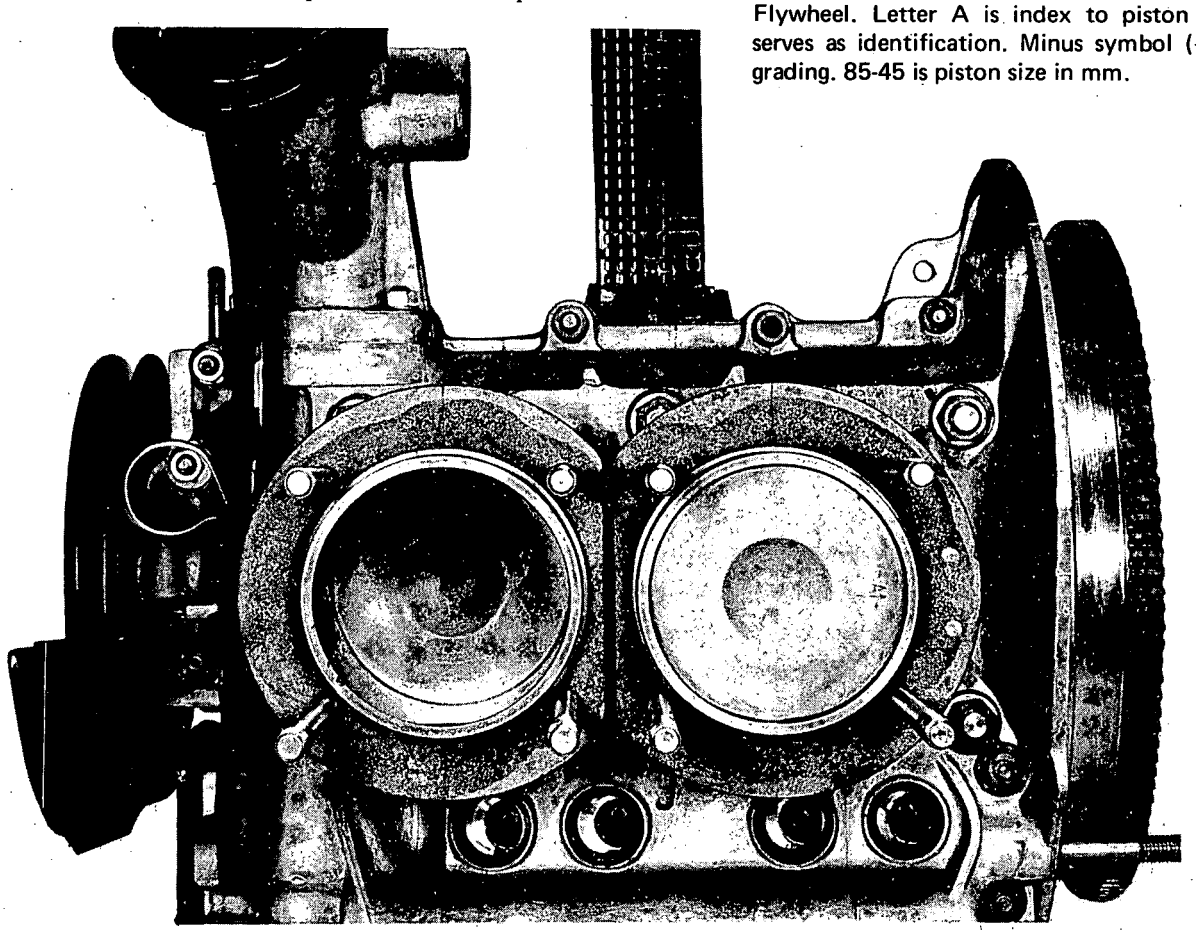
Check the fit of the gudgeon pin in the connecting rod small end bush which should have a clearance of .0001" –.0006", the maximum wear limit is .0016".

Should the wear limit be reached, the pin and small end bush require replacing, an oversize gudgeon pin should not be fitted in this case.

The gudgeon pin may be a light finger push fit in the piston without any piston heating being required, this depends on the amount of permissible tolerance discrepancy between the pin and bearing and is quite normal and therefore replacement is not required.




Details of Piston Crown Markings. Arrow Points Towards Flywheel. Letter A is index to piston part number and serves as identification. Minus symbol (—) denotes weight grading. 85-45 is piston size in mm.



Pistons Correctly Positioned in Bores with Arrows pointing to Flywheel.

Oversize gudgeon pins (marked green) are available in cases where piston pin hole diameter exceeds .8662" – 1500cc and .7874" – 1200cc.

It is essential to ensure that gudgeon pin circlips are correctly located in their grooves, and that piston rings are installed on the pistons by use of a piston ring tool to avoid stress or fracture of the rings.

Lubricate with engine oil all components during assembly and ensure that a very high degree of cleanliness is maintained.

From August 1965, Chassis No 216000001 (Engine No H0000001) cylinders have nineteen cooling fins and can be exchanged and matched with former cylinders. The piston rings are .078" thick and the upper ring has an annular groove which is fitted with Sintered Ferrox.

## TO REMOVE AND INSTAL CYLINDERS

(1) Remove the cylinder heads as described previously.

(2) Detach the valve push rods and push rod tubes.

(3) Remove the deflector plates located below the cylinders.

(4) Mark the cylinders and corresponding pistons so that they can be installed in their original positions; withdraw the cylinders from the pistons and engine assembly.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the cylinder for wear and, if necessary replace the cylinder and piston with another assembly of the same size and with the cylinder and piston matched.

(2) Check that the cylinder seating face on the crankcase, cylinder shoulder and gasket are perfectly clean. Distortion of the cylinder may result if foreign matter is present on the surfaces. Always use a new gasket between the cylinder and crankcase.

(3) Lubricate with engine oil the gudgeon pin and piston surfaces.

(4) Ensure that the oil scraper ring gap is at the top with the remaining piston ring gaps equally staggered. Compress the rings with a piston ring compressing tool to facilitate entry into the cylinder.

(5) Lubricate the cylinder walls and slide the cylinder over the piston until the rings are fully entered in the bore, remove the ring compressor and push home the cylinder.

*NOTE: The crankcase studs must not be in contact with the cylinder cooling fins.*

(6) Instal the deflector plates below the cylinders, bending them if necessary to obtain a tight fit at the crankcase studs to prevent rattling.

(7) Fit new seals to the push rod tubes and instal them with the tube seam facing upwards. If necessary stretch the tubes to 7.1" –7.15" for 1200cc, and 7.48" –7.52" for 1500cc. This will ensure positive sealing, but use care to avoid cracking the tubes.

## TO REMOVE AND INSTAL PISTONS AND RINGS

(1) Remove the cylinders as described previously.

(2) Mark the pistons to ensure that they are installed in their original positions and with the appropriate cylinder.

(3) Using circlip pliers, remove the gudgeon pin retaining circlips at the piston bore ends.

(4) Heat the piston to approximately 180°F using a suitable wrap around element or the special tool for this purpose.

(5) With the piston supported, push out the gudgeon pin using a drift of the same diameter as the pin.

(6) To avoid damage to the piston rings or piston during removal of the rings, use a piston ring tool for this operation.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Free the piston of all carbon deposits, on the crown and in the ring grooves.

*NOTE: Do not use a sharp tool for this operation or damage to the piston surface may result.*

(2) Examine the piston skirt for carbon deposits, irregular carbon build up would indicate the possibility of a twisted connecting rod.

(3) Remove the carbon from the piston skirt by using an oiled fine corundum stone. Do not use emery cloth.

(4) Check the pistons for wear and if necessary replace them with pistons of the same size and weight.

(5) Check the piston rings for gap and side clearance (see specifications), as described at the beginning of this section.

(6) Instal the gudgeon pin circlip at the side of the piston which faces the flywheel.

*NOTE: Pistons must be installed with the arrow or word VORN stamped on the crown pointing to the flywheel.*

(7) Instal the piston on the connecting rod, heating the piston as described earlier if the gudgeon pin is not a push fit.

(8) Insert the remaining pin circlip and check that both circlips are correctly seated in the piston grooves.

## 6. CRANKSHAFT AND CONNECTING RODS

### *1200 MODELS TO JANUARY, 1963*

From Chassis No. 562857 (Engine No. 3491700) a modified crankcase, crankshaft and flywheel is fitted with the crankshaft thrust taken at No 1 main bearing instead of No 2 as on earlier models. Spacer washers are located between the flywheel and main bearing thrust shoulder to permit adjustment of crankshaft end play. An oil pocket is now incorporated in the bearing shells, which can be fitted to engines where the crankshaft axial thrust is on No 1 or No 2 main bearings.

The wall thickness of Nos 1, 2 and 3 main bearing shells has been reduced to .0984" to .0979".

Radial play of bearings 1, 2 and 3 is now .0014" –.0035" instead of .0009" –.0034" as on earlier engines. Radial play of bearing 4 remains the same at .0039" –.004".

Only the new bearing shells are to be installed which can be identified by a red paint mark on the outside. The shell bearings with oil pocket are not so marked with red paint but the oil pocket indicates the increased running clearance.

From Chassis No 595973 (Engine No 352033) thick-walled aluminium alloy type bearings are installed at main bearing Nos 1, 2 and 3. The respective crankcase bores for those bearings and also the crankshaft oil seal seating bore have new diameters. The bores for Nos 1, 2 and 3 bearings are 2.5591" –2.5598" as against a previous diameter of 2.3622" –2.3630". The crankshaft oil seal seating bore is 3.5433" –3.5451" as against 3.9370" – 3.9379" diameter.

Bearings No 1 and 3 are of the ring type with No 1 bearing taking the crankshaft end thrust. No 2 bearing is of the split type with No 4 remaining unchanged. Dowel pins are used to locate all bearings to the bearing seats.

Crankshaft end float should fall between .0025" and .005" with a maximum wear of .006". Crankshaft bearing clearance for No 1 to 3 is between .0014" –.0039" with a maximum wear limit of .005". No 4 bearing clearance is between .0019" –.004" with a maximum wear limit of .007".

From Chassis No 599862 engines for countries with arctic climates are fitted with steel backed bearing shells at main bearings Nos 1, 2 and 3.

Crankshaft bearing clearance for No 1 to 3 is between .0008" –.0034". Main bearing No 4 remains the same at .0019" –.004".

From the end of May 1960 the No 4 bearing is replaced with a bearing having an annular oil groove, an oil drain groove and a hard lead coated running surface.

### TO REMOVE AND INSTAL

(1) Dismantle the crankcase as described previously.

(2) Remove the crankshaft oil seal and camshaft end plug.

(3) Remove the camshaft and crankshaft from the crankcase half casing.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Ensure that there are no sharp edges at the jointing faces of the crankshaft bore in the crankcase. If necessary chamfer slightly.

(2) Check that the crankshaft oilways are free of obstruction and sharp edges.

(3) Remove any foreign matter embedded in the main bearings but take care not to damage or remove metal from the bearing face.

(4) Lubricate the bearings and instal No 2 main bearing shell in the crankcase.

(5) With Nos 1, 3 and 4 bearings in position instal the crankshaft engaging the dowel pins in the bearings.

### TO DISMANTLE AND ASSEMBLE CRANKSHAFT

(1) Remove No 1 main bearing.

(2) Take out the Woodruff key at the timing gear end of the crankshaft, and remove the oil thrower.

(3) Remove No 4 main bearing and using circlip pliers, remove the distributor drive gear retaining ring.

(4) Remove the distributor drive gear, spacer and crankshaft timing gear, using draw gear or press. Remove No 3 main bearing.

*NOTE: To avoid damage to the gears and seating surfaces during removal, immerse the gears in oil heated to approximately 180°F. Light signs of seizure can be removed, provided that the press fit will not be affected.*

(5) Loosen off and remove the connecting rods, but keep each bearing cap with its corresponding connecting rod.

Assembly is a reversal of the dismantling procedure with particular attention to the following points:

(1) Check the crankshaft for wear or run-out, carry out a ringing test for cracks. If necessary regrind or renew the crankshaft fitting the appropriate new main bearings.

(2) Check that flywheel dowel holes in the end face of the crankshaft for wear.

(3) Check the distributor drive gear and the crankshaft timing gear for wear and tooth contact. Instal No 3 main bearing.

(4) Instal the Woodruff key for the gears in the

crankshaft. Heat the gears in oil to about 180°F and instal on the crankshaft with the spacer fitted between the gears. Check the gears for secure seating when they have cooled down.

(5) Fit the distributor drive gear retaining ring taking care not to damage the crankshaft journal.

(6) Using compressed air blow out all oil passages and ensure that there is no obstruction.

(7) Instal No 4 main bearing, and the oil thrower, with the concave face towards the crankshaft pulley, and insert the Woodruff key.

(8) Instal the connecting rods and tighten the securing bolts to the specified torque. Instal No 1 main bearing.

**TO CHECK CRANKSHAFT END FLOAT (Engine in Vehicle).**

Crankshaft end float can be checked when the engine is located in the vehicle by attaching a dial indicator on the rearmost crankcase stud, with the plunger bearing on the crankshaft pulley.

Obtain the end float reading by moving the crankshaft back and forth at the pulley. End float should be from .0028" to .0047", the wear limit is .006".

**TO ADJUST THE CRANKSHAFT END FLOAT**

(1) With the flywheel removed, push the installed crankshaft against the flywheel side of the engine to take up the end float.

(2) Measure the distance from the crankshaft end face to the outer thrust face of No 1 main bearing by inserting a dial gauge in the flywheel seat so that it contacts the crankshaft.

(3) Position the dial gauge on the flywheel jointing flange and measure the depth of the crankshaft seat.

(4) To determine the thickness of shims required, take the difference between the two readings plus the thickness of the paper gasket in its compressed state which is .006", the resulting figure is end float.

*NOTE: Only one paper gasket should be installed. Shims are available in different thicknesses, each shim has the thickness etched on it. Three shims of the required thickness are to be installed in each case.*

**TO INSTAL STEEL BACKED CRANKSHAFT BEARINGS (Engines for arctic climates)**

(1) Working on the right hand crankcase half, insert the dowel pins for main bearings Nos 2 and 3 into the crankcase and instal the bearing shells.

(2) Working on the left hand crankcase half, insert all the dowel pins in the crankcase and instal the bearing shells for main bearings Nos 1, 2 and 3.

*NOTE: The shell for No 1 bearing is installed at a slight angle to facilitate the centering of the crankcase halves.*

(3) With No 4 main bearing positioned on the crankshaft, instal the crankshaft locating No 4 bearing on the dowel pin.

(4) Position the second half of No 1 bearing on the crankshaft.

*NOTE: The oil pockets in the bearing shoulder must be towards the flywheel.*

(5) With bearings Nos 2 and 3 installed, place in position the right hand crankcase half.

From Engine No 3520333 these bearing shells can be service installed. However a dowel pin hole must be drilled in the right hand crankcase half for No 3 main bearing. Use an old No 3 ring type bearing as a template by cutting the bearing in half so that the cut edges are level with the joint face of the crankcase, and the dowel pin hole is exactly vertical, but with the offset towards No 2 crankshaft bearing.

**TO REMOVE AND INSTAL CONNECTING RODS**

(1) Remove the crankshaft as described earlier.

(2) Loosen off and remove the connecting rod securing bolts and remove the rods and caps.

*NOTE: Bearing caps should be kept with their corresponding connecting rods.*

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the weight of the connecting rods, to ensure that any difference in weight of the connecting rods does not exceed 0.18 oz otherwise engine balance will be affected. Weight reduction can be made on heavy connecting rods by removing metal at the points indicated in the connecting rod illustration.

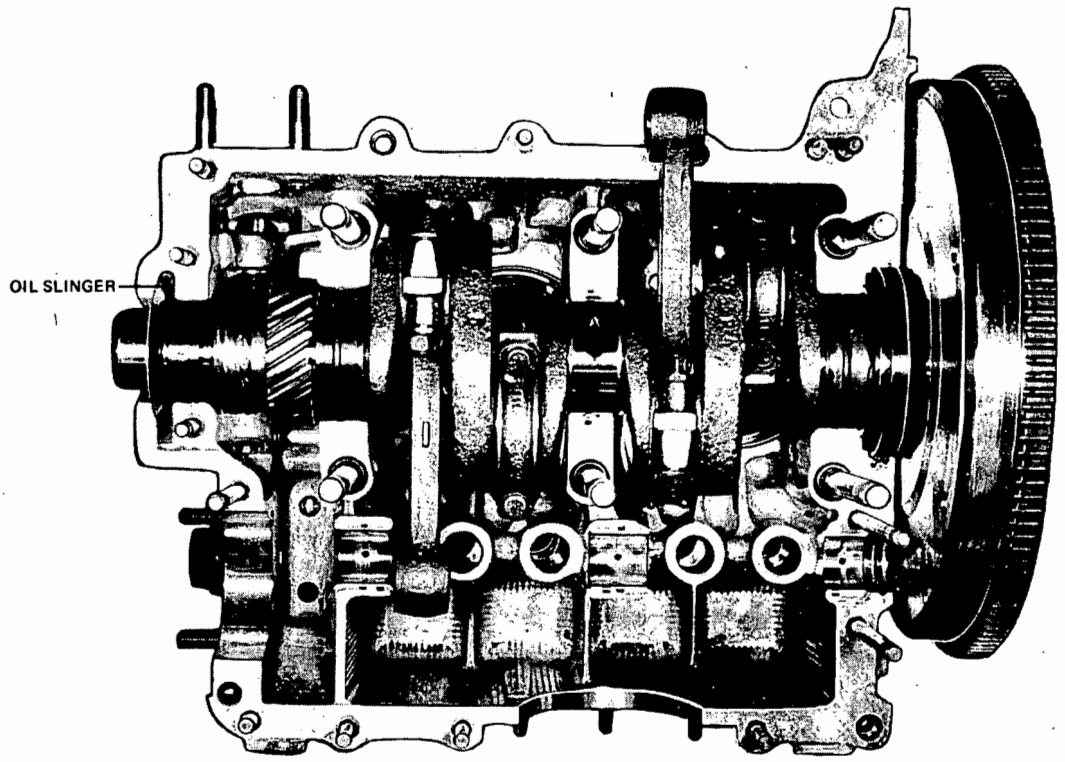
(2) Inspect the gudgeon pin bearing for wear or damage.

*NOTE: When a new bearing is installed the gudgeon pin should be a light finger push fit at room temperature.*

(3) Check the connecting rod alignment and if necessary correct.

(4) Thoroughly clean all components prior to assembly; instal the bearing shells in the connecting rods and caps, and lubricate with engine oil.

(5) Fit the connecting rods to the crankshaft and ensure that the identification numbers stamped on the rods and bearing caps are at the same side.




Showing Correct Position of Crankshaft Oil Slinger with Concave Face toward Crankshaft Pulley.

(6) The connecting rod securing bolts should be tightened evenly to a torque of 36 ft/lb. Any pre-tension occurring between the bearing halves during tightening can be eliminated by light hammer taps.

*NOTE: Connecting rod bearings should not at any time be scraped, reamed or filed. When lubricated the connecting rods should slide on the crankshaft journal by their own weight.*

(7) Lock the connecting rod securing bolts in position.

## TO RECONDITION CONNECTING RODS

Worn gudgeon pin bearings should be replaced and the connecting rods checked for alignment.

Gudgeon pin bearings can also be renewed with the crankshaft in place, after cylinders and pistons have been removed. Do not fit oversize gudgeon pins to take up the clearance in a worn bearing.

(1) With the connecting rods removed from the engine press out the gudgeon pin bearings using special tool for this purpose.

(2) Press in the new gudgeon pin bearings and ream to an inner diameter of .7876" –.7881".

*NOTE: Ensure that the bearing bore after reaming is free of scores and chatter marks. The gudgeon pin should be a light finger push fit in the bearing when in a dry state and at room temperature.*

(3) If necessary drill the oil passages in the new bearing.

(4) Take special care to see that both bearings are parallel to each other and that there is no twist, carry out a connecting rod alignment check.

## *1200/1500/1600 MODELS FROM JANUARY, '63*

On 1200cc engines from February 1962, Chassis No 1070466 (Engine No 7484343) the gudgeon pin bearing in the connecting rod was offset .040" in relation to the big end bearing, the gudgeon pin bearing now runs centre of the gudgeon pin. On 1500cc engines from Chassis No 1072658 (Engine No 0168330) the gudgeon pin bearing offset was made .060" to bring the bearing centre of the gudgeon pin. Connecting rods of this type have a forged mark on the shank which must be positioned upwards when the rod is installed in its normal running position.

In February 1964, Chassis No 1256311 (Engine No 0471421) connecting rods were made heavier and now fall into two weight classes. Connecting rods weighing less than 500 grams must be replaced and only rods with a weight difference not exceeding 10 grams may be installed in one engine.

In August 1965, Chassis No 516000001 (Engine No H0000001) fitted bolts and nuts are used to secure the bearing cap to the connecting rod. This modified

connecting rod is not interchangeable with the older type because of the weight difference.

From January 1967, Chassis No 217088359, (Engine No H0703231), a crankshaft with an additional oil passage permitting the flow of oil from main bearings Nos 1 and 3 to the connecting rod bearings is installed in all engines except the 1200cc. Due to the increased oil flow to the connecting rods modified piston rings are fitted to prevent an increase in oil consumption. The new crankshaft can be service installed in other engine types but modified piston rings and flywheel/crankshaft seal will be necessary.

**TO REMOVE AND INSTAL**

(1) Dismantle the crankcase as described previously.

(2) Remove camshaft and crankshaft from crankcase half casing.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Ensure that there are no sharp edges or burrs on the edges of the crankcase bearing bores. If necessary chamfer slightly.

(2) Check that the crankshaft oilways are free of obstruction and sharp edges.

(3) Remove any foreign matter embedded in the main bearings, but take care not to damage or remove metal from the bearing face.

(4) Check that the dowel pins are tight and in serviceable condition.

(5) Position No 2 main bearing half shell in the crankcase location, and slide into position No 1 main bearing with the dowel pin hole towards the flywheel.

(6) With Nos 3 and 4 main bearings still in position on the crankshaft, lubricate the bearings and instal the crankshaft, locating the dowel pins in the bearings.

**TO DISMANTLE AND ASSEMBLE CRANKSHAFT**

(1) With the crankshaft removed from the engine as already described, remove No 1 main bearing.

(2) Take out the Woodruff key at the timing gear end of the crankshaft and remove the oil thrower.

(3) Pull off No 4 main bearing and, using circlip pliers remove the distributor drive gear retaining circlip.

(4) Remove the distributor drive gear, spacer, and crankshaft timing gear, using a suitable puller for the latter.

*NOTE: To facilitate removal and to avoid damage to the seating surfaces, immerse the gears in oil heated to approximately 180°F. Light signs of seizure can be removed, provided the press fit of the gears to the shaft is not affected.*

(5) Pull off No 3 main bearing from its crankshaft location.

(6) Loosen off and remove the connecting rods keeping each bearing cap with its corresponding rod.

Assembly is a reversal of the dismantling procedure with particular attention to the following points:

(1) Check the crankshaft for wear and run-out, carry out a ringing test for cracks. If necessary regrind or renew the crankshaft, fitting the appropriate new main bearings. Clean the crankshaft and check that all oil passages are free of obstruction.

(2) Check the flywheel dowel holes in the end face of the crankshaft for wear.

(3) Check the distributor drive gear and the crankshaft timing gear for wear and tooth contact.

(4) Lubricate No 3 main bearing with engine oil and instal on the crankshaft.

(5) Instal the Woodruff key for the gears in position in the crankshaft. Heat the gears in oil to about 180°F and fit to the crankshaft with the spacer. Check the gears for secure seating when they have cooled down.

(6) Fit the distributor drive gear retaining circlip, taking care not to damage the crankshaft journal. Lubricate with engine oil and instal No 4 main bearing.

*NOTE: No 4 main bearing must be installed with the annular groove in the running surface towards the oil thrower.*

(7) Position the oil thrower on the crankshaft with the concave face towards the crankshaft pulley. Insert the Woodruff key into its location.

(8) Instal the connecting rods and tighten the bolts to the specified torque.

*NOTE: The 53 bhp 1500cc connecting rod bolts are also fitted with hexagon nuts, which should be tightened to a torque of 25 ft/lb.*

**TO CHECK CRANKSHAFT END FLOAT**

Crankshaft end float is measured when the engine is assembled and the flywheel fitted. End float should be between .0028" and .0047" with a wear limit of .006".

(1) Attach a dial indicator to the crankcase with the plunger bearing on the flywheel.

(2) Tap the crankshaft fully home into the engine, zero the dial indicator and tap the crankshaft out the other way. Check the reading on the dial indicator to establish the end-float.

**TO ADJUST CRANKSHAFT END FLOAT**

(1) Instal flywheel to the crankshaft fitting two shims and the paper or metal gasket, do not fit the seal at this point.

(2) Attach the dial indicator to the crankcase with the plunger bearing on the flywheel.

(3) Tap the crankshaft fully home into the engine, zero the dial indicator, and tap the crankshaft out the other way. Check the reading on the dial indicator, deduct the specified end float (.0028" to .0047") to give the thickness of the third shim required.

(4) Remove the flywheel and instal the oil seal in the crankcase.

(5) Instal the flywheel complete with the three shims and a new metal or paper gasket.

*NOTE: Shims of various thickness are available for carrying out end float adjustment. The total thickness required should be made up of three shims. Do not fit more than one metal gasket.*

(6) With the flywheel fully secured, recheck the end float as described in (2) and (3) of this operation.

**TO REMOVE AND INSTAL CONNECTING RODS**

(1) Remove the crankshaft as described earlier.

(2) Loosen off and remove the connecting rods securing bolts and remove the rods and caps.

*NOTE: Later models have nuts and bolts attaching the cap to the rod. Bearing caps should be kept with their corresponding connecting rod.*

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the weight of the connecting rods, the difference in weight between the connecting rods must not exceed .35 oz. Connecting rods which weigh less than 500 grams must be replaced.

(2) Inspect the gudgeon pin bearing for wear or damage.

*NOTE: When a new bearing is installed the gudgeon pin should be a push fit at room temperature.*

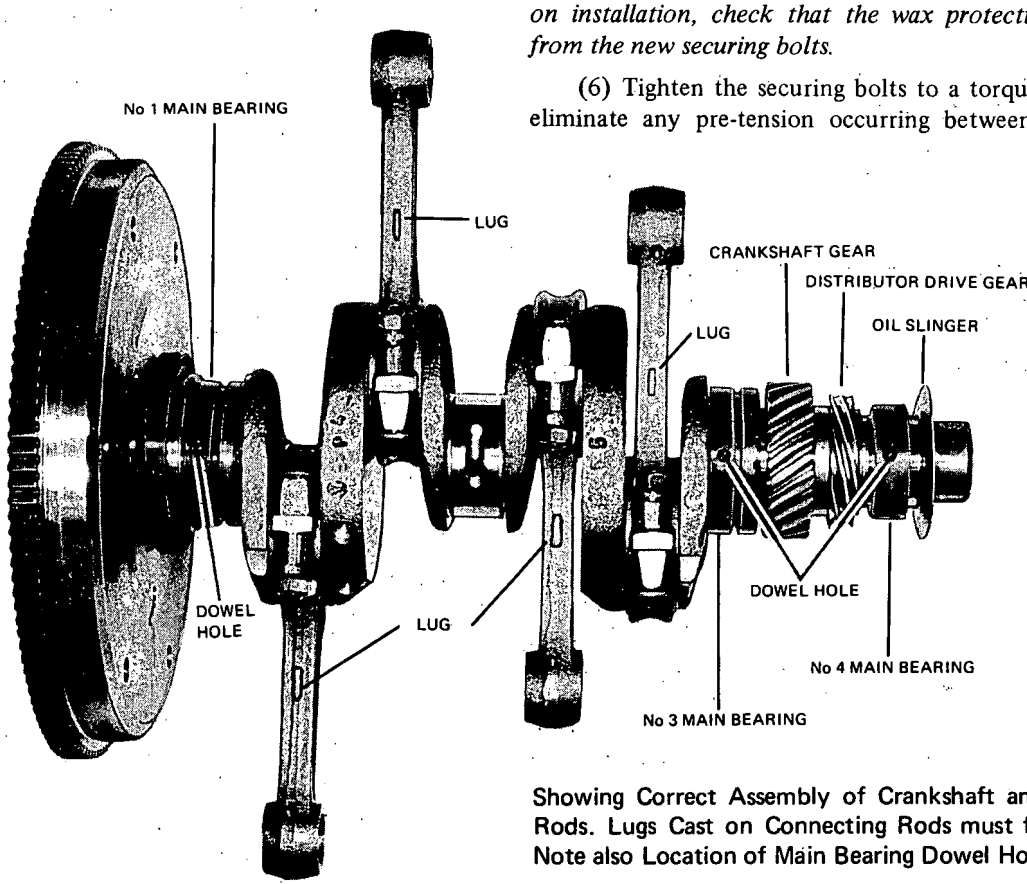
(3) Check the connecting rod alignment and if necessary correct.

(4) Thoroughly clean all components prior to assembly; instal the bearing shells in the connecting rods and caps, and lubricate with engine oil.

(5) Fit the connecting rods to the crankshaft and, when fitting the bearing caps ensure that the identification numbers stamped on the rods and caps are at the same side. Connecting rods having a forged mark on the shank should be fitted with the mark upwards with the rods in running position.

*NOTE: Connecting rod securing bolts should be renewed on installation, check that the wax protective is cleaned from the new securing bolts.*

(6) Tighten the securing bolts to a torque of 25 ft/lb, eliminate any pre-tension occurring between the bearing




**Showing Correct Assembly of Crankshaft and Connecting Rods. Lugs Cast on Connecting Rods must face Upwards. Note also Location of Main Bearing Dowel Holes.**

halves during tightening by light hammer taps applied at the sides of the connecting rod.

*NOTE: Connecting rod bearings should not at any time be scraped, reamed or filed. When lubricated the connecting rods must fall smoothly through 180° under their own weight.*

(7) Using feeler gauges, check the axial float of the connecting rods on the crankshaft journal.

(8) Lock the connecting rod securing bolts into position by peening with a peening chisel.

**TO RECONDITION CONNECTING RODS**

(1) With the connecting rods removed from the engine press out the gudgeon pin bearings using the special tool for this purpose.

(2) Press in the new gudgeon pin bearings and ream to an inner diameter of:

1200cc Pin with black dot:- .7874" –.7876"
Pin with white dot:- .7877" –.7879"
1500cc Pin with black dot:- .8661" –.8664"
Pin with white dot:- .8664" –.8667"

*NOTE: Ensure that the bearing bore after reaming is free of scores and chatter marks. The gudgeon pin should be a light finger push fit in the bearing, when in a dry state and at room temperature.*

(3) If necessary drill the oil passages in the new bearing.

(4) Carry out a connecting rod alignment check and ensure that both bearings are parallel to each other.

## 7. CAMSHAFT

### *1200 MODELS TO JANUARY, 1963*

From Chassis No 624263 (Engine No 5009585) on the 40 bhp engine a modified camshaft together with modified cam followers is installed. This modification can be carried out to engines from Engine No 3400000, but it is important that the modified cam followers are fitted with the new camshaft.

Push rods of the previous shortened type can be installed in all engines manufactured since May 1959. If it is found that the rocker arm rests on the valve stem without any clearance adjustment available, it will be necessary to grind the rocker arm slightly.

In addition the following modifications have been carried out:

(a) From Engine No 5067818 due to camshaft modifications the end float has been increased to .0024" –.0045", as against .0012" –.0033" for earlier models. Wear limit is .0055".
(b) From Engine No 5012820 an annular oil groove is provided at the camshaft thrust bearing in the crankcase.
(c) From Engine No 3464486 the camshaft thrust surface in the crankcase has been increased to 1.496" from 1.417".

**TO REMOVE AND INSTAL**

(1) Dismantle the crankcase as described earlier.

(2) Remove camshaft end plug and camshaft from the crankcase half. Note the timing marks on the gears.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check that the timing gear is securely riveted to the camshaft and that no free movement exists at the joint.

(2) Cam faces and camshaft bearing points must be smooth and square, and free from wear or scoring.

(3) Remove any burrs from the cam edges or slight damage to the faces by use of a fine grain oil stone.

(4) Check the camshaft for run-out and the camshaft timing gear for wear and correct tooth contact.

(5) Lubricate with engine oil the bearing journals and cams; instal the camshaft engaging the tooth marked 0 between the two teeth of the crankshaft timing gear which are centre punched.

(6) Check the backlash of the camshaft timing gear by moving the gears back and forth, gradually turn the camshaft until all teeth have been meshed and checked. Specified backlash of camshaft timing gear is .0020".

*NOTE: Camshafts are available with timing gears of seven different sizes to enable the specified backlash to be obtained. Sizes are marked on the timing gears in digits indicating in one hundredth of a millimeter, the variation from the standard pitch radius.*

### *1200/1500/1600 MODELS FROM JANUARY, '63*

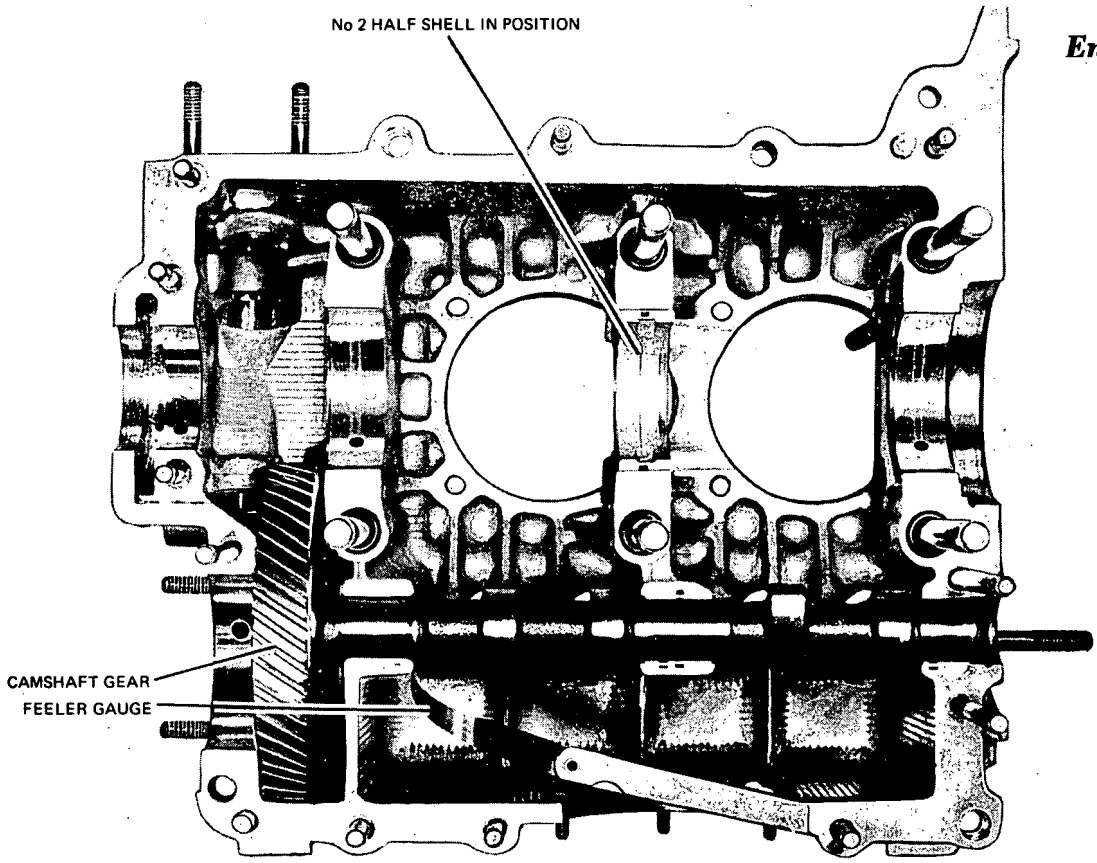
From August 1965, Chassis No 216000001 (Engine No H0000001) the camshaft is mounted in three lead-coated steel bearings of the split type. Shoulders are provided at No 3 bearing to take the camshaft thrust. These bearings cannot be service installed in previous crankcases.

**TO REMOVE AND INSTAL**

(1) Dismantle the crankcase as described earlier.

(2) Remove camshaft end plug and camshaft from the crankcase half. Note the timing marks on the gears.

*NOTE: On engines fitted with detachable camshaft bearing shells, take out the shells.*




Checking Camshaft End Float.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check that the timing gear is securely riveted to the camshaft and that no free movement exists at the joint.

(2) Cam faces and camshaft bearing points must be smooth and square, and free of wear or scoring.

(3) Remove any burrs from the cam edges or slight damage to the faces by use of a fine grain oilstone.

(4) Check the camshaft for run-out and the camshaft timing gear for wear and correct tooth contact.

*NOTE: On engines fitted with detachable bearing shells, check the shells for wear or damage and replace if necessary. Chamfer the edges of the bearing bores in the crankcase to prevent pressure on the shells. Instal the bearing shells in the crankcase halves locating the tongues of the bearing shells in the crankcase recesses.*

(5) Lubricate with engine oil the bearing journals and cams instal the camshaft engaging the tooth marked O between the teeth of the crankshaft timing gear which are centre punched.

(6) Check the axial float at the camshaft thrust bearing which should be .0016" –.005", wear limit is .006".

(7) Check the backlash of the camshaft timing gear by moving the gears back and forth, gradually turn the camshaft until all teeth have been meshed and checked. Specified backlash of camshaft timing gear is .0020".

*NOTE: Camshafts are available with timing gears of various sizes to enable the specified backlash to be obtained. Sizes are marked on the timing gears in digits indicating in one hundredth of a millimeter variation from the standard pitch radius. Standard size is identified by the letter O which should not be confused with the timing mark O located on the outer edge of the gear.*

## 8. CRANKCASE

### *1200 MODELS TO JANUARY, 1963*

### TO DISMANTLE AND ASSEMBLE

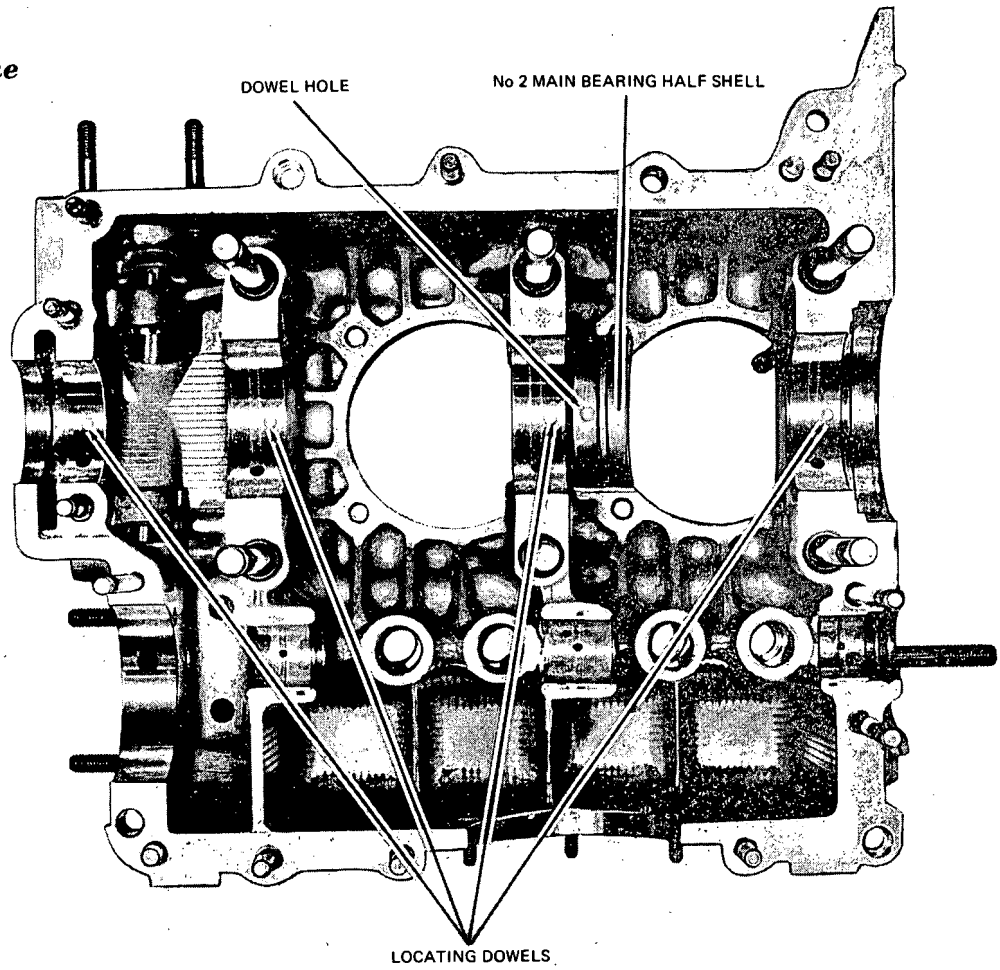
(1) Take out oil pressure switch and loosen off and remove crankcase securing nuts.

(2) Part crankcase halves as described earlier.

(3) Remove the crankshaft oil seal, camshaft end plug and take out the crankshaft, camshaft, cam followers and bearing shells.

Assembly is a reversal of the dismantling procedure with particular attention to the following points:

(1) Thoroughly clean the crankcase in a cleaning




Left Side Half of Crankcase Showing Camshaft Bearing Half Shells in Position (except early models without shells). Note the Crankshaft Bearing Locating Dowels and No. 2 Main Bearing Half Shell.

solvent and remove any old sealing compound from the jointing faces. Check the crankcase for damage or cracks.

(2) It is essential that the crankcase jointing faces are perfectly even and free of burring, check and if necessary, slightly chamfer the edges at the main bearing points.

(3) Ensure that the studs are tight in their seatings and not leaking oil, check also the oil lift pipe for secure seating and oil leaks.

(4) Blow out with compressed air all oil passages and ensure that there is no obstruction.

(5) Lubricate and instal cam followers and bearing shells and ensure that the oil thrower is correctly positioned.

(6) Lubricate the crankshaft and camshaft bearings and instal both shafts in position.

*NOTE: Ensure that the camshaft timing gear tooth marked 0 is engaged between the two teeth of the crankshaft gear which are centre punched.*

(7) Instal the camshaft end plug, using a sealing compound, and the thrust washers and crankshaft oil seal. Check that the oil seal is seated squarely at the base of its recess in the crankcase.

(8) Smear a thin coat of sealing compound evenly on the crankcase jointing faces, but take particular care that none is allowed to enter the oil passages.

(9) Position together the crankcase halves and tighten evenly the securing nuts to the specified torque.

(10) Instal oil pressure switch.

### *1200/1500/1600 MODELS FROM JANUARY, '63*

From August 1963, Engine No 0275975 on 1500cc engines the oil return hole between the sump and timing gear chamber was enlarged.

This modification can be carried out on engines prior to the above engine number by machining out the oil return hole .400" towards the housing dividing web. This operation is necessary where there is a tendency to throw oil out of the crankcase breather.

From August 1965, Chassis No 216000001, Engine No H0000001 the crankcase has camshaft bores to accommodate the detachable camshaft bearings.

From September 1966, Chassis No 217030318, (Engine No H0194248) the six crankcase studs are sealed with rubber seals. Because the seals are between the

crankcase halves the stud holes in each half have been countersunk. The two sealing nuts for the centre studs are now replaced by nuts and washers. Exchange engines and crankcase have the countersinks in the right crankcase half only which accommodates the whole of the seal.

From August 1966, Chassis No 217003784 (Engine No H0255071) the centre crankcase studs near No 2 main bearing are sealed in production with sealing nuts. Washers are not installed. The plastic ring pressed into the sealing nut faces the crankcase. These new sealing nuts can be service installed on older engines, but washers are not to be fitted. Sealing nuts should be tightened to a torque of 18 ft/lb and not 25 ft/lb as previously mentioned.

From December 1966, Chassis No 217067544 (Engine No H0298634) the sealing compound for the crankcase joints is changed from the light gray D2 type to a light brown D3.

**TO DISMANTLE AND ASSEMBLE**

(1) Remove oil pressure switch, oil filler and oil strainer.

(2) Loosen off and remove crankcase securing nuts, and part crankcase halves as described earlier.

(3) Remove the crankshaft oil seal, camshaft end plug and take out the crankshaft, camshaft, cam followers and bearing shells.

Assembly is a reversal of the dismantling procedure with particular attention to the following points:

(1) Thoroughly clean the crankcase in a cleaning solvent and remove any old sealing compound from the jointing faces. Check the crankcase for damage or cracks.

(2) Blow out with compressed air all oil passages and ensure that there is no obstruction.

(3) It is essential that the crankcase jointing faces are perfectly even and free of burring, check and if necessary, slightly chamfer the edges of the bearing bores.

(4) Ensure that the studs are tight in their seatings, and that the oil lift pipe is secure and not leaking oil.

(5) Crankcase bores for the crankshaft bearings can be measured with dial gauge and micrometer by joining together the crankcase halves and tightening the securing nuts to the specified torque.

(6) Lubricate and instal cam followers and crankshaft bearing dowel pins.

(7) With the bearing shells in position, instal the crankshaft and camshaft.

*NOTE: Ensure that the camshaft timing gear tooth marked 0 is engaged between the two teeth of the crankshaft gear which are centre punched.*

(8) Instal the camshaft end plug using a sealing compound.

(9) Instal the shims and crankshaft oil seal making sure that the seal seats squarely in the crankcase recess.

(10) Smear a thin coat of sealing compound evenly on the crankcase jointing faces but take particular care that none is allowed to enter the oil passages.

(11) Position together the crankcase halves and tighten evenly the securing nuts to a torque of 25 ft/lb.

*NOTE: It is important that the smaller nut adjacent to No 1 crankshaft bearing stud is tightened prior to tightening fully the main securing nuts.*

(12) Rotate the crankshaft to check for ease of movement.

(13) Instal the oil switch and oil pressure relief valve if removed.

*NOTE: If the engine is being overhauled because of seizure of components, particular care must be taken during the cleaning process to ensure that all metal particles or dust are removed from the crankcase. To avoid possible damage after the overhaul the oil cooler must be replaced.*

## 9. FLYWHEEL AND CRANKSHAFT OIL SEAL

### *1200 MODELS TO JANUARY, 1963*

Four dowels and a gland nut are used to position and secure the flywheel to the crankshaft, a paper gasket is located between the faces.

An oil seal recessed in the crankcase at No 1 main bearing bears on the shoulder of the flywheel to form a seal.

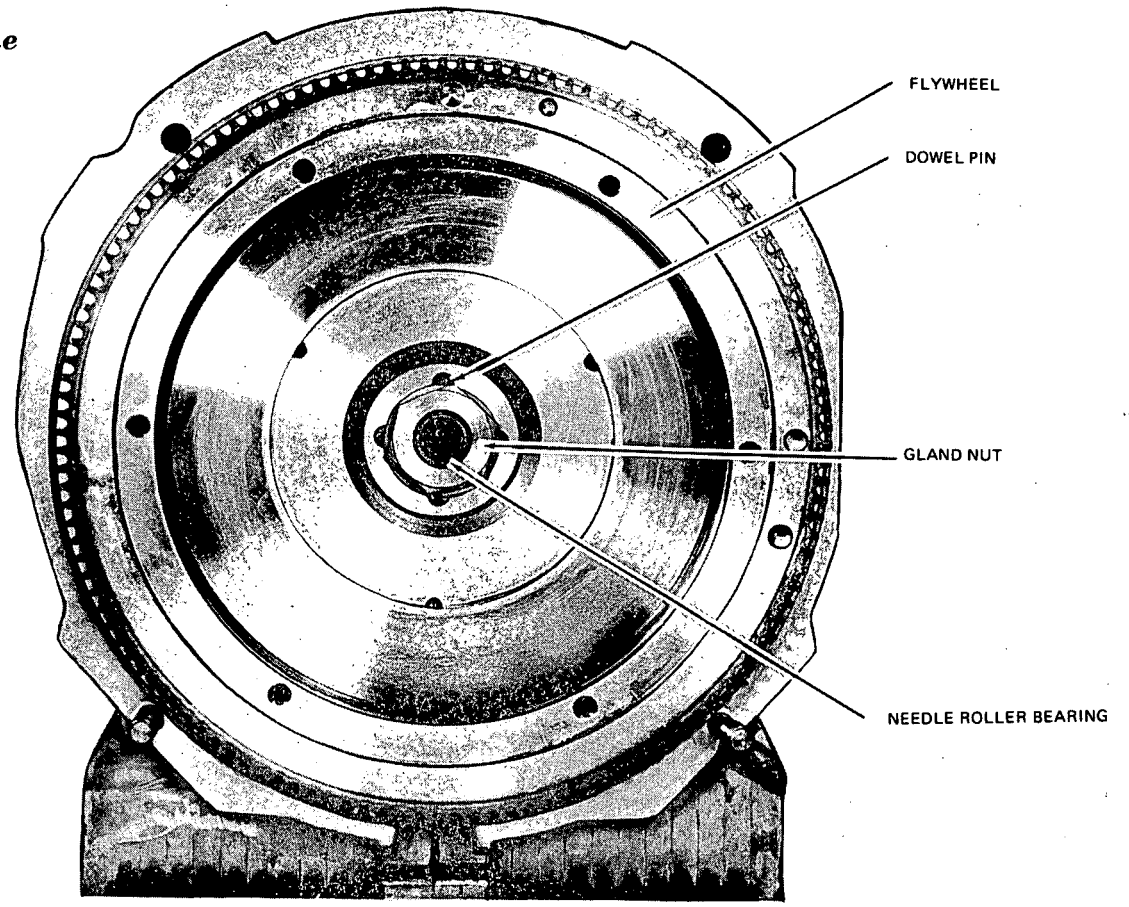
The main drive shaft spigot is supported by a needle bearing located within the gland nut. Gland nuts and bearings requiring renewal should be replaced by a modified type marked with the letters 'K.D.'

From Chassis No 366150 to No 469446 the spigot of the main drive shaft has been modified to prevent clutch spin caused by friction in the needle bearing.

To maintain engine balance, the crankshaft, flywheel and clutch are marked with paint at their heaviest points. On assembly if all three components are so marked the marks should be located 120 degrees apart, where only two components are marked the marks should be 180 degrees apart. Location of marks as follows:

(a) Crankshaft – Paint dot in the threaded hole for the gland nut.

(b) Flywheel – Paint mark and .20" hole on the side facing the clutch.




Flywheel Showing Retaining Gland Nut and Clutch Spigot Bearing.

(c) Clutch – Paint mark on outside of the pressure plate.

From Chassis No 557693 to No 563728 a number of engines have been fitted with a thrust spring and a thrust piece between the crankshaft and the main drive shaft. The large end of the cone type spring is positioned against the crankshaft in the bore for the gland nut, with the small end on which the thrust piece is seated supported in the centering hole of the main drive shaft. This modification can be carried out to all transporters produced since May 1959 and will eliminate the humming noise which is at times present at idling speed.

## TO REMOVE AND INSTAL FLYWHEEL

(1) Loosen off evenly and progressively the clutch securing bolts and detach the pressure plate and driven plate assembly.

(2) Loosen off and remove the flywheel gland nut and detach the flywheel.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the flywheel teeth for wear and damage, if necessary the ring gear can be machined .080" on its clutch side to remove slight damage to the teeth. New chamfers should be machined on the teeth.

(2) Check the dowel holes in the flywheel and crankshaft for wear, and replace the dowels if necessary.

(3) Ensure that the needle bearing in the gland nut is in serviceable condition and not worn. Lubricate the bearing with universal grease but not exceeding 0.35 oz, with the majority of the grease installed in the needle cage.

(4) Fit new flywheel gasket, and instal flywheel, tightening the gland nut to a torque of 217 ft/lb.

(5) Check that the flywheel run-out if any, does not exceed the maximum of .012".

(6) Ensure that during the installation of the flywheel and clutch to the crankshaft correct location is given to the balance marks, as described at the beginning of this section.

## TO REMOVE AND INSTAL CRANKSHAFT OIL SEAL

(1) Loosen off and remove clutch assembly and flywheel.

(2) Examine oil seal lip bearing surface on the flywheel jointing flange.

(3) Take out old oil seal from its crankcase location.

(4) Clean out oil seal recess in the crankcase, and if

necessary slightly chamfer the outer edge with a scraper to facilitate entry of the new seal.

(5) Apply a coat of sealing compound to the oil seal recess and instal the new seal. Ensure that the seal is seated squarely at the base of the recess.

(6) Lubricate with oil the flywheel flange on which the seal bears and instal the flywheel.

### *1200/1500/1600 MODELS FROM JANUARY, '63*

Four dowels and a gland nut are used to position and secure the flywheel to the crankshaft. Located between the flywheel and crankshaft is a paper or metal gasket depending upon flywheel type. An oil seal recessed in the crankcase No 1 main bearing bears on the shoulder of the flywheel to form a seal. From April 1966, Chassis No 216139032 (Engine No H0140936) the metal seal between the flywheel and crankshaft is replaced with a rubber seal, at the same time the crankshaft, flywheel and shims for end-float adjustment have been modified.

The main drive shaft spigot is supported by a needle bearing located within the gland nut. From May 1966, Chassis No 216149910 (Engine No H0153536) all engines have been installed with a modified gland nut of increased length. The modified nut can be installed in all engines except the 30 and 36 bhp.

To maintain engine balance, the crankshaft, flywheel and clutch are marked with paint at their heaviest points. On assembly if all three components are so marked the marks should be located 120 degrees apart, where only two components are marked, the marks should be 180 degrees apart.

Location of marks as follows:-

(a) Crankshaft – Paint dot in the threaded hole for the gland nut.

(b) Flywheel – Paint dot and .200" hole on the face which is toward the clutch.

(c) Clutch – Paint line on the outer edge of the pressure plate.

From August 1966, Chassis No 217000001 (Engine No H0183373) the outside diameter of the flywheel has been increased by .157", also the number of teeth has been increased to 130 instead of 109. The transmission housing has been modified as a result of the increased flywheel diameter, and the hole for the starter pinion shaft has been reduced to accommodate the new starter. Installation of the new flywheel can only be made to previous engines when the starter and transmission of new design are fitted.

### TO REMOVE AND INSTAL FLYWHEEL

(1) Loosen off evenly and progressively the clutch securing bolts and detach the pressure plate and driven plate assembly.

(2) Loosen off and remove the flywheel gland nut and flywheel using the special wrench and flywheel retainer tool.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the flywheel teeth for wear and damage, if necessary the ring gear can be machined .080" on its clutch side to remove slight damage to the teeth. New 45 degree chamfers should be machined on the teeth after the initial machining.

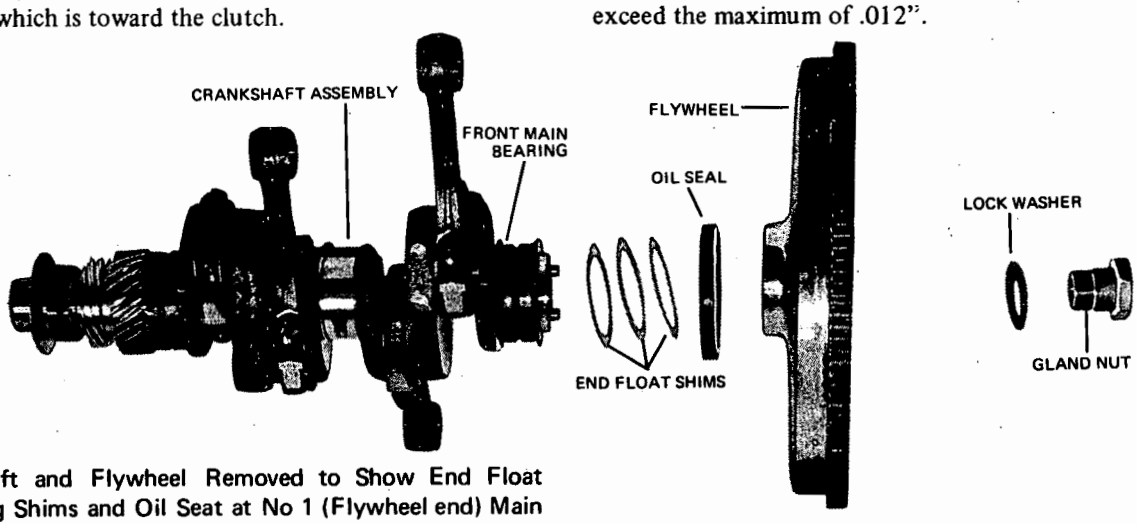
(2) Check the dowel holes in the flywheel and crankshaft for wear, and replace the dowels if necessary.

(3) Ensure that the needle bearing in the gland nut is in serviceable condition and not worn. Lubricate the bearing with a small quantity of universal grease.

(4) Adjust the crankshaft end-float as specified.

(5) Instal the metal gasket and flywheel tightening the gland nut to a torque of 217 ft/lb.

(6) Check that the flywheel run-out if any does not exceed the maximum of .012".




**Crankshaft and Flywheel Removed to Show End Float Adjusting Shims and Oil Seat at No 1 (Flywheel end) Main Bearing.**

(7) Ensure that during the installation of the flywheel and clutch to the crankshaft correct location is given to the balance marks, as described at the beginning of this section.

**TO REMOVE AND INSTAL CRANKSHAFT OIL SEAL**

(1) Loosen off and remove clutch assembly and flywheel.

(2) Examine the oil seal lip bearing surface on the flywheel jointing flange.

(3) Take out the old oil seal from its crankcase location.

(4) Clean out the oil seal recess in the crankcase, and if necessary slightly chamfer the outer edge with a scraper to facilitate entry of the new seal.

(5) Apply a coat of sealing compound to the oil seal recess and instal the new seal. Ensure that the seal is seated squarely in the recess.

(6) Lubricate with oil the flywheel flange on which the seal bears and instal the flywheel.

## 10. DISTRIBUTOR DRIVE

### *1200 MODELS TO JANUARY, 1963*

**TO REMOVE AND INSTAL**

(1) Loosen off the distributor clamping bolt and remove the distributor.

(2) Loosen off and remove the fuel pump, intermediate flange, gaskets and operating rod.

(3) Take out the coil spring from the distributor drive, and turn the crankcase upside down to permit the drive and washer to fall out.

*NOTE: Ensure that the washer located at the bottom of the drive does not fall into the timing gear housing.*

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the eccentric and spiral gear for wear and replace if necessary.

(2) Ensure that the drive washer is in serviceable condition, replace if worn.

(3) Position the engine so that No 1 cylinder is at firing point (note timing mark on the fan pulley).

(4) Instal the distributor drive so that when it is fully engaged in position the narrow side of the slot in the top is towards the crankshaft pulley, with the slot approximately parallel to the pulley.

(5) Instal the distance spring and distributor, carry out the setting of the ignition timing as described under the appropriate heading.

(6) Instal the fuel pump operating rod, new gaskets, flange and fuel pump.

### *1200/1500/1600 MODELS FROM JANUARY, '63*

From March 1966, Chassis No 216113121 (Engine No H0114794) a modified distributor drive shaft has been fitted to all engines. The modified shaft is fitted with two shims each .024" thick and can be installed complete with shims in all 1200/1500 engines from Engine No 5497750. Some exchange engines have the thrust surface for the distributor drive shaft in the crankcase machined, and require the lower shim to be replaced by one of .118" thickness, which must be installed below the thin shim.

**TO REMOVE AND INSTAL**

(1) Loosen the distributor retaining nut and remove the distributor.

(2) Loosen off and remove the fuel pump, intermediate flange, gaskets and operating rod.

(3) Take out the coil spring from the distributor drive, and turn the crankcase upside down to permit the drive and washer to fall out.

*NOTE: Ensure that the washer located at the bottom of the drive does not fall into the timing gear housing.*

With the engine installed in the vehicle the washer can be removed with a magnet, after first withdrawing the drive shaft using a special extractor tool and turning the drive anti-clockwise.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the eccentric and spiral gear for wear and replace if necessary. Should the spiral gear be excessively worn the teeth of the distributor drive gear on the crankshaft should also be examined.

(2) Ensure that the washer beneath the drive pinion is in serviceable condition, replace if worn.

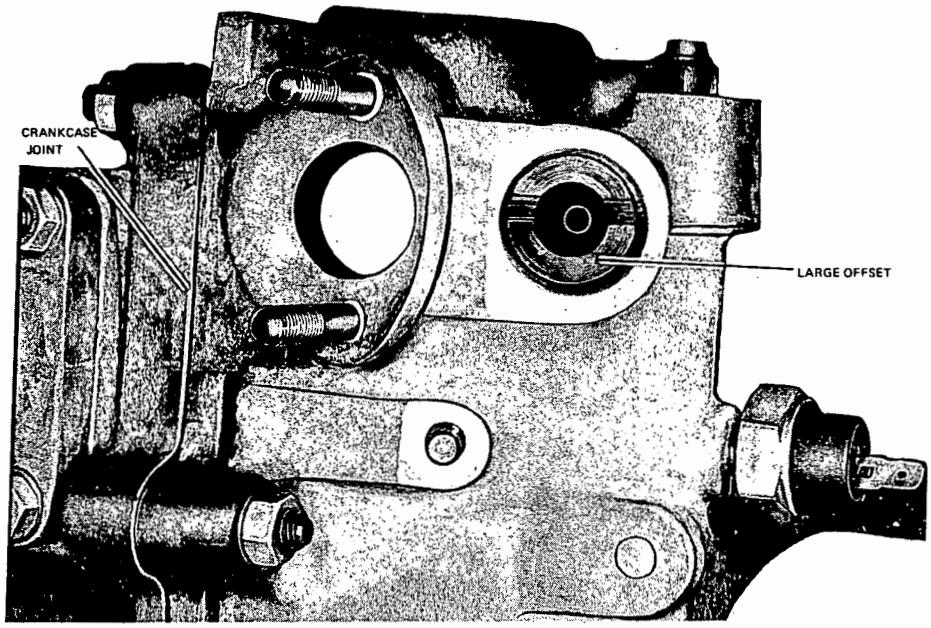
(3) Position the engine so that No 1 cylinder is at firing point (note the timing mark on the front pulley).

(4) Instal the distributor drive complete with washer so that when the drive is fully engaged in position the narrow side of the slot in the top is towards the crankshaft pulley, and with the slot parallel to the pulley.

(5) Instal the distance spring and distributor, carry out the setting of the ignition timing as described under the appropriate heading.

(6) Instal the fuel pump operating rod, new gaskets, flange and fuel pump.

*NOTE: If the engine has been completely dismantled the oil pump, lower pulley cover plate and pulley have to be installed prior to the installation of the distributor drive shaft.*




When Correctly Installed, Slot in Top of Distributor Drive Gear will be approximately at Right Angle to Joint in Crankcase with Large Offset to Flywheel End of Engine.

## 11. VALVE TIMING AND TAPPET ADJUSTMENT

### *1200 MODELS TO JANUARY, 1963*

### TO ADJUST AND TIME THE VALVES (36 Bhp Engine)

Valve adjustment should only be carried out when the engine is in its cold state and with the outside temperature at approximately 68°F. The clearance for both inlet and exhaust valves with those conditions prevailing is .004" each. Should the engine be slightly warm the clearance for the inlet valve should be set at .005", and .006" for the exhaust valve.

(1) To check the valve timing, establish tdc on No 1 cylinder by putting a mark on the crankshaft pulley .470" to the left of the timing mark, as viewed from the rear of the vehicle.

(2) Make a second mark .120" to the left of the tdc (.470") mark.

(3) With the cylinder at tdc on the compression stroke adjust the valve clearance of No 1 cylinder to .040".

(4) Turn the engine in a clockwise direction and note the point at which the inlet valve opens. The timing is correct when the second mark on the crankshaft pulley is in line with the vertical joint of the crankcase at which point the inlet valve should open.

*NOTE: An alteration of .870" is effected by the movement of one tooth on the camshaft gear.*

(5) With the valve timing adjusted reset the valve clearance back to its normal setting.

### TO ADJUST AND TIME THE VALVES (40 Bhp Engine)

Valve adjustment may be carried out with the engine cold, or with a maximum oil temperature of 122°F. The valve clearance should be: Inlet, .008"; exhaust, .012".

*NOTE: The 36 bhp engine camshaft was installed up to Engine No 5009662.*

(1) To check the valve timing, establish tdc on No 1 cylinder by putting a mark on the crankshaft pulley .630" to the left of the right hand timing mark, as viewed from the rear of the vehicle.

(2) Make a second mark .120" to the right of the tdc (.630") mark.

(3) With the cylinder at tdc on the compression stroke adjust the valve clearance of No 1 cylinder to .040".

(4) Turn the engine in a clockwise direction and note the point at which the inlet valve opens.

The timing is correct when the .120" mark on the crankshaft pulley is in line with the vertical joint of the crankcase at which point the inlet should open.

*NOTE: An alteration of .870" is effected by the movement of one tooth on the camshaft gear.*

(5) With the valve timing adjusted, reset the valve clearance back to its normal setting.

### TO CHECK AND RESET VALVE CLEARANCE

Refer to the specifications at the beginning of this section for the appropriate setting.

(1) With the cylinder head covers removed, turn the engine until the cylinder to be adjusted is at firing position.

*NOTE: To check that a cylinder is at firing position, remove the distributor cap; the contact arm on the rotor should be in line with the contact of the distributor cap leading to the spark plug of the cylinder to be adjusted.*

(2) Using a feeler gauge check both valves on the cylinder to establish the clearance.

(3) If adjustment is required, loosen the adjusting screw locknut and turn the adjusting screw in the direction required to obtain the specified clearance.

(4) Hold the adjusting screw firmly with a screwdriver while tightening the locknut. Recheck the clearance to ensure that no alteration has taken place.

(5) Carry out the same procedure at each pair of valves on the remaining three cylinders, ensuring that the firing position is obtained at each cylinder for adjustment.

(6) Ensure that the cylinder head cover gaskets are in serviceable condition, and instal the covers.

### *1200/1500/1600 MODELS FROM JANUARY, '63*

Valve adjustment should only be carried out when the engine is in its cold state or with a maximum oil temperature of 122°F.

The valve clearance with these conditions prevailing should be adjusted to: Inlet .008"; Exhaust .012". Except for engines fitted with modified cylinder heads which can be identified by a sticker on the air intake housing and square bosses at the base of the rocker shaft studs, valve clearances for both inlet and exhaust must be adjusted to .004". This clearance also applies to exchange engines which are fitted with short replacement rocker shaft studs, again identified by a sticker on the air intake housing and a clip on the rocker shaft.

### TO ADJUST VALVE CLEARANCES

(1) With the cylinder head covers removed, turn the engine until the cylinder to be adjusted is at firing position. Adjust cylinders in the order 1-2-3-4.

*NOTE: To check that a cylinder is at firing position, remove the distributor cap and check that the contact on the rotor arm is in line with the contact of the distributor cap leading to the spark plug of the cylinder to be adjusted.*

(2) Using a feeler gauge check both valves on the cylinder to establish the clearance.

(3) If adjustment is required, loosen the adjusting screw locknut and turn the adjusting screw in the direction required to obtain the specified clearance. (See the beginning of this section).

(4) Hold the adjusting screw firmly with a screwdriver while tightening the locknut. Recheck the clearance to ensure that no alteration has taken place.

(5) Carry out the same procedure at each pair of valves on the remaining three cylinders. Turn the engine 180° to the left each time to bring the cylinder to firing position for adjustment, again confirm this at the distributor.

(6) Instal the cylinder head covers with new gaskets.

## 12. LUBRICATION SYSTEM

### *1200 MODELS TO JANUARY, 1963*

### TO REMOVE AND INSTAL OIL FILTER

(1) Remove the drain plug in the bottom plate and drain the engine oil.

(2) Unscrew the nuts and spring washers and remove the bottom plate and gasket. Discard the gasket.

(3) Withdraw the filter and remove and discard the gasket.

Installation is a reversal of the removal procedure.

(1) Thoroughly clean all components in a suitable solvent, and blow dry with compressed air.

(2) Ensure that the bottom plate is not bent or distorted, renew all gaskets.

(3) Instal the filter and check that the opening of the filter is a neat fit around the lift pipe.

(4) Tighten the bottom plate securing nuts evenly, but do not overtighten.

### TO REMOVE AND INSTAL OIL COOLER

(1) It will be necessary to remove the fan housing if not already done, for description see appropriate section.

(2) Loosen off and remove the oil cooler securing nuts.

(3) Detach the oil cooler and gaskets.

Installation is a reversal of the removal procedure.

(1) Renew all gaskets at installation.

(2) Check the oil cooler for leaks at a pressure of 85 psi and ensure that the nuts and retaining bracket are tight.

(3) Should the oil cooler leak, check the oil pressure relief valve for a sticky plunger.

(4) Ensure that the hollow ribs of the cooler are not in contact with one another, and that the partition flap is secure.

## TO REMOVE AND INSTAL OIL PRESSURE RELIEF VALVE

(1) Check the oil pressure relief valve for malfunction if the oil cooler is leaking or if there are any other irregularities in the oil circulation.

(2) Unscrew the plug and withdraw the spring and plunger.

*NOTE: If the plunger is stuck in the bore its removal can be effected by inserting a tap (10 mm metric thread) into it.*

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the plunger and bore in the crankcase for indication of seizure, carefully remove seizure marks and renew the plunger if necessary.

(2) Examine the spring and check against the specifications.

(3) Ensure that the upper end of the spring does not damage the bore wall by scratching when being installed.

(4) Renew the securing plug gasket.

## TO REMOVE AND INSTAL OIL PUMP

(1) If not already done, remove the engine rear cover plate, crankshaft pulley and lower cover plate as described earlier.

(2) Remove the nuts on the oil pump cover and remove the cover and gasket.

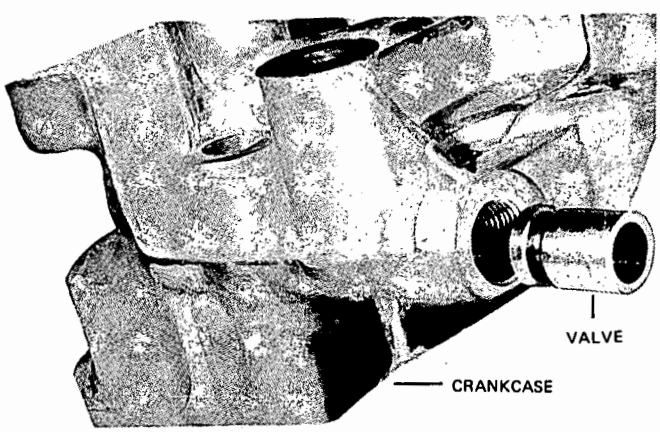
(3) Withdraw the gears from the oil pump body.

(4) Using an extractor remove the oil pump housing from the crankcase.

Installation is a reversal of the removal procedure with particular attention to the following points:

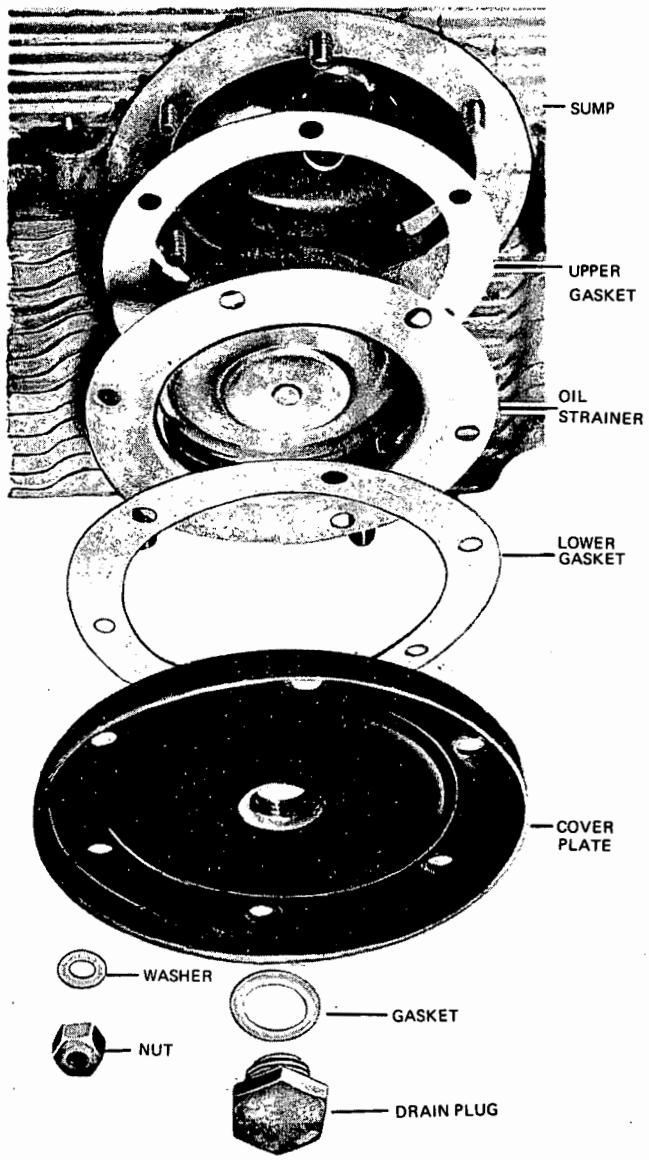
(1) Check the oil pump body and gear contact points for wear. Loss of oil pressure will result due to excessive wear.

(2) Examine the gears for wear (see specifications).

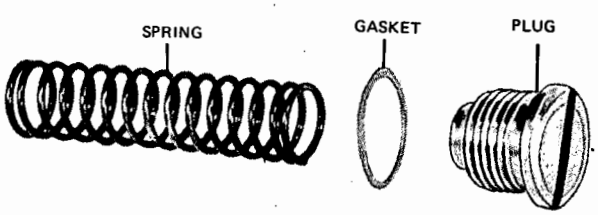



(3) Check the idler gear pin for security and, if necessary, peen it securely in position or replace the housing.

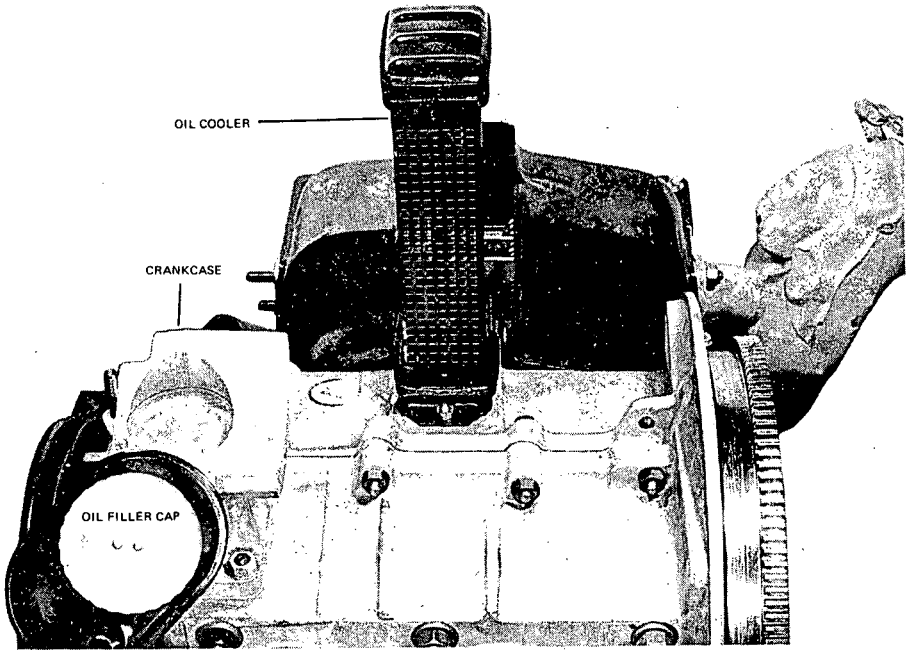
(4) Ensure that the contact faces of the body and crankcase are clean, instal the body with a new gasket.




Components of Engine Sump Plate and Oil Strainer.




Oil Pressure Relief Valve Components.




Oil Cooler in Position.

(5) Position an adjusting mandrel into the body in place of the pump drive shaft.

(6) Rotate the camshaft one complete turn (two turns of the crankshaft), this will centre the oil pump drive shaft to the slot in the camshaft.

(7) Mark the pump body position so that after the cover has been installed it can be checked for correct seating.

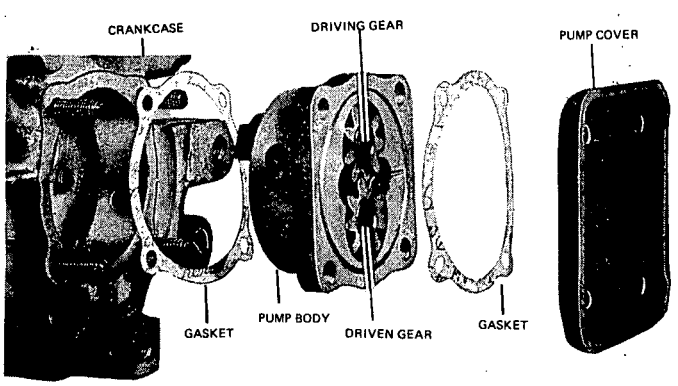
(8) Take out the adjusting mandrel and instal the gears and pump shaft making sure that the shaft engages the camshaft slot.

(9) Place a rule across the housing and check the clearance between the rule and the gears. With the gasket removed the clearance should not exceed .004".

(10) If the coverplate is worn due to gear contact, machine it off.

(11) It is important that the correct thickness of gasket is used (.08 mm) and that sealing compound is not used. An alteration of gasket thickness will cause an alteration in oil pressure.

(12) Ensure that there is no change in the oil pump body position when tightening the securing nuts.




Oil Pump Components.

### *1200/1500/1600 MODELS FROM JANUARY, '63*

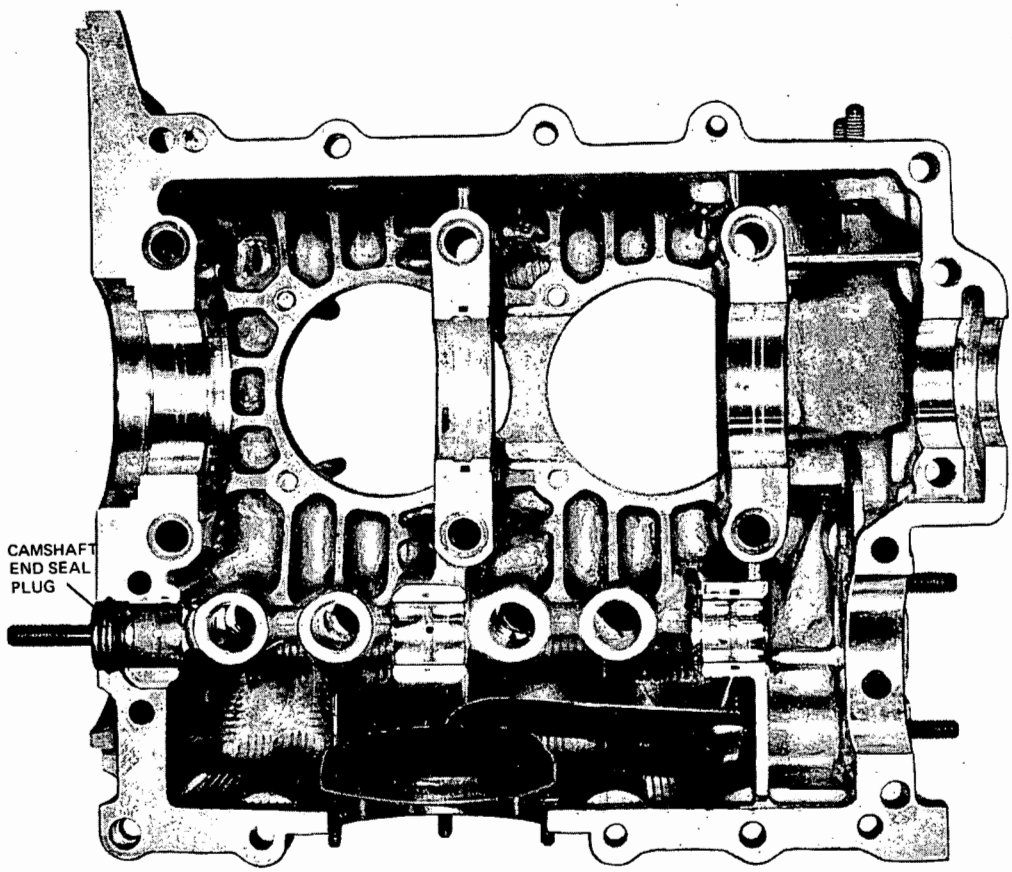
From August 1967, Chassis No 218001941 (Engine No B0002333) a modified oil filter is fitted which incorporates a spring loaded valve and a funnel shaped insert riveted to the bottom of the filter. This modification ensures oil flow even if the filter should become blocked. The new oil filter can be installed in all engines having a .550" diameter oil lift pipe.

From August 1966, Chassis No 217010233 (Engine No HO263648) the oil pressure relief valve plunger (with annular groove) is installed in all engines except the 1200cc. The effect of the new plunger is a lowering of oil temperature. The plunger may be service installed in older engines, but should be installed in 1200cc engines only where operation is in a very hot climate.

From July 1967, Chassis No 217146841 (Engine No H0760138) the four studs securing the oil pump to the crankcase are increased in diameter. The old type securing nuts and washers are replaced by nuts fitted with pressed-in plastic rings, which when installed should have the plastic ring facing the oil pump cover.

Where plastic coated gaskets have been used for the oil pump and the oil strainer cover, removal of the gaskets should not be attempted with a scraper otherwise damage to the sealing surfaces may result.

By applying a 5 per cent ammonia solution to the gasket easy removal can be effected after a short soaking period.




Right Side Half of Crankcase Showing Position of Oil Pick Up Pipe.

**TO REMOVE AND INSTAL OIL FILTER**

(1) Remove the drain plug in the bottom plate and drain off the engine oil.

(2) Unscrew the nuts and washers and remove the bottom plate and gasket. Discard the gasket.

(3) Withdraw the filter and remove and discard the gaskets.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Thoroughly clean all components in a suitable solvent and blow dry with compressed air. Check that all of the old gaskets are removed from the surfaces.

(2) Ensure that the bottom plate is not bent or distorted.

(3) Check the oil lift pipe for correct seating and tightness.

*NOTE: Check the bottom of the filter for marking by the oil lift pipe. Should the filter be marked it will be necessary to bend the pipe slightly and renew the filter.*

(4) Instal the filter with a new gasket making sure that the lift pipe is properly seated in the filter. If necessary, bend the filter slightly.

*NOTE: An incorrectly fitted filter with the oil lift pipe too low may result in damage to the crankshaft and associate components. Should the lift pipe penetrate the bottom of the filter, harmful matter may be drawn into the system.*

(5) Instal the bottom plate with a new gasket and fit the securing nuts and washers. Do not overtighten the securing nuts to avoid bending or distorting the bottom plate. Check the drain plug for tightness.

**TO REMOVE AND INSTAL OIL COOLER**

(1) It will be necessary to remove the fan housing if not already done, for description see appropriate section.

(2) Loosen off and remove the oil cooler securing nuts.

(3) Detach the oil cooler and gaskets.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the oil cooler for leaks at a pressure of 85 psi, and ensure that the studs and bracket, if fitted, are tight.

(2) Should the oil cooler leak, check the oil pressure relief valve for faulty operation.

(3) Ensure that the hollow ribs of the cooler are not in contact with one another, and that the partition panel is secure.

(4) Instal the oil cooler using new gaskets.

**TO REMOVE AND INSTAL OIL PRESSURE RELIEF VALVE**

(1) Check the oil pressure relief valve for malfunction if the oil cooler is leaking or if there are any other irregularities in the oil circulation.

(2) Unscrew the plug and withdraw the spring and plunger.

*NOTE: If the plunger is stuck in the bore its removal can be effected by inserting a tap (10mm metric thread) into it.*

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the plunger and bore in the crankcase for indication of seizure, carefully remove seizure marks and renew the plunger if necessary.

(2) Examine the spring and check the free length 2.44" —2.52" and the loaded length .930" with a 17.1 lbs load imposed.

(3) Ensure that the upper end of the spring does not damage the bore wall by scratching when being installed.

(4) Instal the securing plug with a new gasket.

**TO REMOVE AND INSTAL OIL PUMP**

(1) If not already done, remove the engine rear cover plate, crankshaft pulley and lower cover plate as described previously.

(2) Remove oil pump cover securing nuts and detach the cover and gasket.

(3) Withdraw the gears from the oil pump body.

(4) Using an extractor withdraw the oil pump body from the crankcase.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the oil pump body and the gear seating for wear. Oil pressure may be reduced due to excessive wear.

(2) Check the idler gear pin for security and, if necessary, peen it securely in position, or replace the housing.

(3) Examine the gears for wear. Backlash between the gear teeth should be .0012" —.0031". Gear end float should not exceed .004" measured from the oil pump body face without the gasket.

(4) Ensure that the contact faces of the body and crankcase are clean and instal the body with a new gasket.

(5) Position the special oil pump mandrel into position in place of the pump drive shaft.

(6) Rotate the camshaft one complete turn (two turns of the crankshaft), this will centre the oil pump body opposite to the camshaft slot.

(7) Mark the pump body position so that after the cover has been installed it can be checked for correct seating.

(8) Take out the mandrel and instal the gears and pump shaft making sure that the shaft engages the camshaft slot.

(9) Machine or replace the cover plate if worn due to gear contact.

(10) Complete the installation with new gaskets but do not use sealing compound. Ensure that there is no change in the oil pump body position when tightening the securing nuts.

## 13. ENGINE FAULT DIAGNOSIS

**(1) Engine will not start by normal cranking.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Dirty or corroded distributor points. | – Clean or renew and adjust points. |
| (b) | Carburettor flooding. | – Check needle valve and float, clean out fuel system. |
| (c) | Moisture on high tension wires and/or inside distributor cap. | – Dry out high tension wires and cap. |
| (d) | Dirt or water in carburettor and fuel system. | – Clean out carburettor and fuel system. |
| (e) | Incorrectly set spark plug gaps. | – Reset spark plugs to specification. |
| (f) | Faulty coil or capacitor. | – Test and renew faulty component. |
| (g) | Faulty low or high tension wires. | – Test and renew faulty wires. |
| (h) | Fuel vapour lock. | – Check source of vapour lock and insulate against heat. |
| (i) | Faulty fuel pump. | – Test and overhaul fuel pump. |
| (j) | Incorrectly set ignition timing. | – Check and retime ignition. |
| (k) | Broken or short-circuited low tension lead to distributor points. | – Test and renew lead. |

**(2) Engine will not start – weak or erratic cranking.**

| *Possible cause* | *Remedy* |
|---|---|
| (a) Weak or faulty battery. | – Recharge or renew battery. |
| (b) Fault in starter lead or solenoid. | – Test and renew faulty component. |
| (c) Faulty starter. | – Test and overhaul starter. |

**(3) Engine Stalls.**

| *Possible cause* | *Remedy* |
|---|---|
| (a) Idling speed set too slow. | – Readjust idling speed stop screw. |
| (b) Idling mixture too lean or rich. | – Readjust idling mixture screw and idling speed screw. |
| (c) Carburettor flooding or float level incorrect. | – Check needle valve or reset float level. |
| (d) Fault in coil or capacitor. | – Test and renew faulty component. |
| (e) Valve clearance or lash out of adjustment. | – Adjust valve clearance or lash. |
| (f) Air leak at inlet manifold or carburettor flange. | – Tighten securing bolts or renew gaskets. |

**(4) Engine missing at idling speed.**

| *Possible cause* | *Remedy* |
|---|---|
| (a) Dirty, defective or incorrectly set spark plugs. | – Clean or renew and set spark plugs. |
| (b) Burned or pitted distributor contact points. | – Clean or renew and adjust contacts. |
| (c) Carburettor idling mixture out of adjustment. | – Adjust idling mixture screw. |
| (d) Burned or cracked distributor rotor. | – Renew faulty component. |
| (e) Moisture on high tension wires, spark plug or distributor cap. | – Dry out high tension system and cap. |
| (f) Carbon tracking or cracked distributor cap. | – Clean or renew cap. |
| (g) Weak or faulty battery and/or corroded terminals. | – Recharge or renew battery and/or clean or renew terminals. |
| (h) Carburettor flooding or incorrect float level setting. | – Check needle valve or reset float level. |
| (i) Faulty coil or capacitor. | – Test and renew faulty component. |
| (j) Excessive wear in distributor shaft and bushes or contact breaker cam. | – Renew worn components. |
| (k) Burned, warped or pitted valves. | – Carry out top overhaul on engine. |

**(5) Engine misses on acceleration.**

| *Possible cause* | *Remedy* |
|---|---|
| (a) Distributor points dirty or incorrectly adjusted. | – Clean and readjust points. |
| (b) Spark plug/s dirty, faulty or gap set too wide. | – Clean or renew and reset faulty plug/s. |
| (c) Dirt or water in carburettor. | – Clean and blow out carburettor and fuel pump filter. |
| (d) Carburettor accelerator pump discharge jet blocked or pump defective. | – Clean out carburettor. |
| (e) Coil or capacitor faulty. | – Renew defective component. |
| (f) Incorrect ignition timing. | – Check and reset ignition timing. |
| (g) Burned, warped or pitted valves. | – Carry out top overhaul on engine. |

**(6) Engine misses at high speed.**

| *Possible cause* | *Remedy* |
|---|---|
| (a) Distributor points dirty or incorrectly adjusted. | – Clean and readjust points. |
| (b) Spark plug/s dirty, faulty or gap set too wide. | – Clean or renew and reset faulty plug/s. |
| (c) Dirt or water in carburettor. | – Clean out carburettor and fuel pump filter. |
| (d) Burned or cracked distributor rotor. | – Renew faulty component. |

| | | |
|---|---|---|
| (e) | Faulty coil or capacitor. | – Renew faulty component. |
| (f) | Dirt in carburettor power jet. | – Clean and blow out carburettor. |
| (g) | Incorrect ignition timing. | – Check and reset ignition timing. |
| (h) | Excessive wear in distributor shaft or cam. | – Renew faulty components. |

**(7) Engine lacks power.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Dirty or incorrectly set spark plugs. | – Clean and reset gap to specifications. |
| (b) | Dirt or water in carburettor and fuel system. | – Drain and clean out fuel system and carburettor. |
| (c) | Incorrect ignition timing. | – Check and reset ignition timing. |
| (d) | Incorrect carburettor float level. | – Check and reset float level. |
| (e) | Faulty fuel pump. | – Check and overhaul fuel pump. |
| (f) | Incorrect valve clearance or lash adjustment. | – Check and readjust valve clearance or lash. |
| (g) | Faulty distributor automatic advance. | – Check and rectify or renew. |
| (h) | Restricted muffler or tail pipe. | – Check and clean as necessary. |
| (i) | Faulty coil or capacitor. | – Renew faulty component. |
| (j) | Burned or cracked distributor rotor. | – Renew faulty component. |
| (k) | Excessive wear in distributor shaft or cam. | – Renew faulty component. |
| (l) | Incorrect valve timing. | – Check and reset as necessary. |
| (m) | Burned, warped or pitted valves. | – Carry out top overhaul on engine. |

**(8) Noisy valve operation.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Incorrectly adjusted clearance lash. | – Check and adjust to specifications. |
| (b) | Weak or broken valve springs. | – Check and renew faulty components. |
| (c) | Worn valve guides. | – Renew or ream and fit oversize valves. |
| (d) | Worn tappets. | – Renew or fit oversize tappets. |

**(9) Big end bearing noise.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Lack of adequate oil supply. | – Check oil level in sump, condition of oil pump and relief valve. |
| (b) | Excessive bearing clearance. | – Renew bearing shells check and regrind journals if oval. |
| (c) | Thin oil or crankcase dilution. | – Change to correct oil grade. Check operating conditions and cooling system thermostat. |
| (d) | Low oil pressure. | – Check pressure relief valve and spring, oil filter by-pass valve. |
| (e) | Misaligned big end bearings. | – Align connecting rods and renew bearings if necessary. |

**(10) Apparent main bearing noise.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Loose flywheel. | – Tighten securing bolts to specified torque. |
| (b) | Loose crankshaft pulley. | – Renew or tighten pulley. |
| (c) | Low oil pressure. | – Check bearing to journal clearance, check condition of oil pump and pressure relief valve. Recondition as necessary. |
| (d) | Excessive crankshaft end play. | – Renew centre main bearing thrust washers. |
| (e) | Crankshaft journals out of round and excessive. | – Regrind journals and fit undersize bearings. |
| (f) | Insufficient oil supply. | – Replenish oil in sump to correct level. |

**(11) Excessive oil consumption.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Oil leaks. | – Check and renew gaskets as necessary. |
| (b) | Damaged or worn valve stem oil seals. | – Renew damaged or worn components. |
| (c) | Excessive clearance, valve stem and valve guide. | – Renew valve guides, bushes and valves, or ream and fit oversize valves. |
| (d) | Worn or broken rings. | – Renew rings. |
| (e) | Rings too tight or stuck in grooves. | – Renew rings and clean out ring grooves. |
| (f) | Excessive wear in cylinders, pistons, and rings. | – Recondition cylinders and renew pistons and rings. |
| (g) | Compression rings incorrectly installed, oil rings clogged or broken. | – Renew rings. |

# COOLING AND EXHAUST SYSTEM

## SPECIFICATIONS

| | |
|---|---|
| Type | Air cooling by fan |
| Fan drive | V-belt from crankshaft |
| System control | Thermostat |
| Distance from fan housing to upper edge of throttle ring where fitted: | |
| Engine cold | .8" |
| Engine warm | 1" – 1.2" |
| Thermostat length: | |
| Early models 1.81" at | 167 to 176°F |
| Later models 1.81" at | 149 to 158°F |

## 1. COVER PLATE

### TO REMOVE AND INSTAL COVER PLATES

Cover plates should be removed from the engine assembly in the following sequence, where engine dismantling is entailed to facilitate removal of the cover plates refer to the engine dismantling section for description.

On Early Models:

(1) Take out the securing screws and remove the rear cover plate prior to engine removal.

(2) Loosen off and remove the front cover plate.

(3) Remove the fan housing and generator assembly as described under *FAN HOUSING – TO REMOVE AND INSTAL.*

(4) Loosen off and remove the exhaust system and heating channels.

(5) Loosen off and remove the cylinder cover plates (refer to engine dismantling section for procedure).

(6) Remove the crankshaft pulley and loosen off and detach the lower pulley cover plate.

On Later Models:

(1) Loosen off and remove the front cover plate.

(2) Release the clips and detach the hoses between the fan housing and heat exchangers, and the pre-heater hose.

(3) Remove the cover plate above the crankshaft pulley and the pre-heating pipe sealing plate.

(4) Remove the rear engine cover plate.

(5) Remove the fan housing and generator assembly as described under *FAN HOUSING – TO REMOVE AND INSTAL.*

(6) Loosen off and remove the inlet manifold complete with pre-heating pipe.

(7) Remove both air deflector plates and disconnect the carburettor pre-heater adaptor pipe located on the left side.

(8) Loosen off and remove the cylinder cover plates.

(9) Remove the crankshaft pulley and lower pulley cover plate.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check that the sparking plug rubber caps are in serviceable condition and correctly fitted in the cylinder cover plates.

(2) The fan housing and cylinder cover plates should fit snugly together to prevent the loss of cooling air.

(3) Check that the weather strip is in serviceable condition prior to installing the front cover plate.

### TO REMOVE AND INSTAL REAR COVER PLATE

On Early Models:

(1) Take out rear cover plate slot headed securing screws and detach the cover plate.

On Later Models:

(2) Release the hose clips and detach the hoses between the heat exchangers and fan housing.

(3) Disconnect the carburettor pre-heat hose at the air filter intake pipe.

(4) Loosen off and remove the cover plate located at the crankshaft pulley.

(5) Take out the securing screws and remove the pre-heater pipe sealing plate.

(6) Remove the engine cover plate from the vehicle.

Installation is a reversal of the removal procedure with attention to the following points:

(1) On early models, position the weatherstrip with the cover plate sandwiched between the lips.

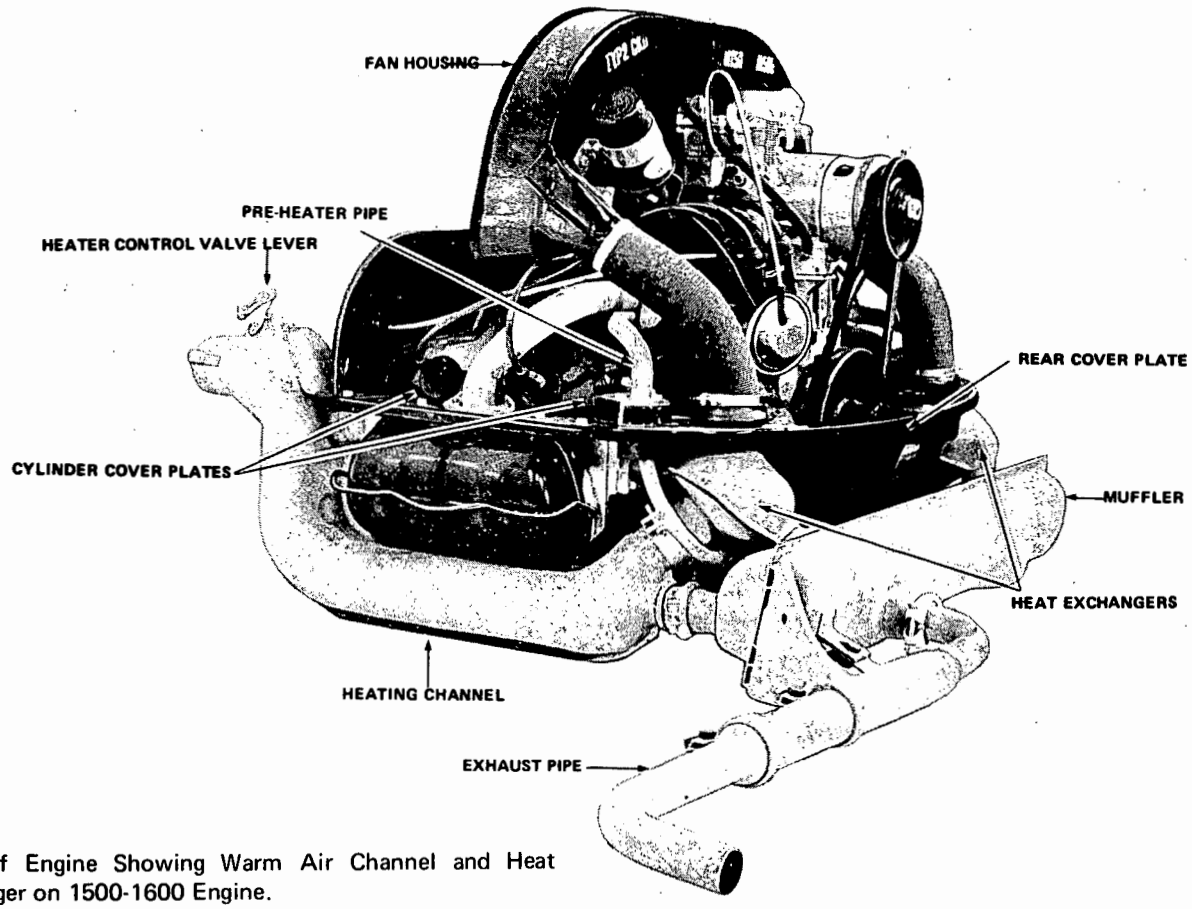
(2) Ensure that the rubber grommet for the breather pipe is fitted flush to the cover plate.

(3) On later models, ensure that the asbestos seal for the pre-heater pipe is in sound condition. Instal the rubber seal on the right hand side between the cover plate and cylinder cover plate.

(4) The two rubber grommets must be located with the flat face flush against the cover plate.

(5) Ensure that the cover plate does not touch the elbows of the heat exchangers.

(6) Position the weatherstrip with the cover plate sandwiched between the lips.




View of Engine Showing Warm Air Channel and Heat Exchanger on 1500-1600 Engine.

## 2. FAN AND HOUSING

### TO CHECK AND ADJUST THERMOSTAT CONTROL

Periodic examination of the cooling air intake system should be made, particularly at seasonal changes.

Note that if the throttle ring opens too soon or remains in the open position, the engine will not achieve working temperature as quickly as it should. This may lead to a tendency of carburettor spitting and increased fuel consumption. Where a throttle ring remains open while the engine is in cold state the thermostat should be checked for malfunction. To prevent overheating of the engine when the thermostat is defective, the throttle ring will fully open automatically.

Where the throttle ring opens too far it may foul the fan and cause considerable noise. If during the warm season there is a tendency for the throttle ring to open too slowly this may result in engine overheating.

From August 1964, Chassis No 215004262 (Engine No 8785397) the cooling air flow is regulated by four control flaps located within the fan housing, replacing the throttle ring system. Flap control is by linkage to the thermostat. The new system regulates the cooling air and not the warm air when the engine is cold, and as a result a larger volume of air is available for heating purposes. Thermostat control adjustment is described for this system under *TO ADJUST AIR CONTROL FLAPS*.

(1) With the engine in a cold state, the throttle ring should be closed with a slight amount of tension against the air intake flange.

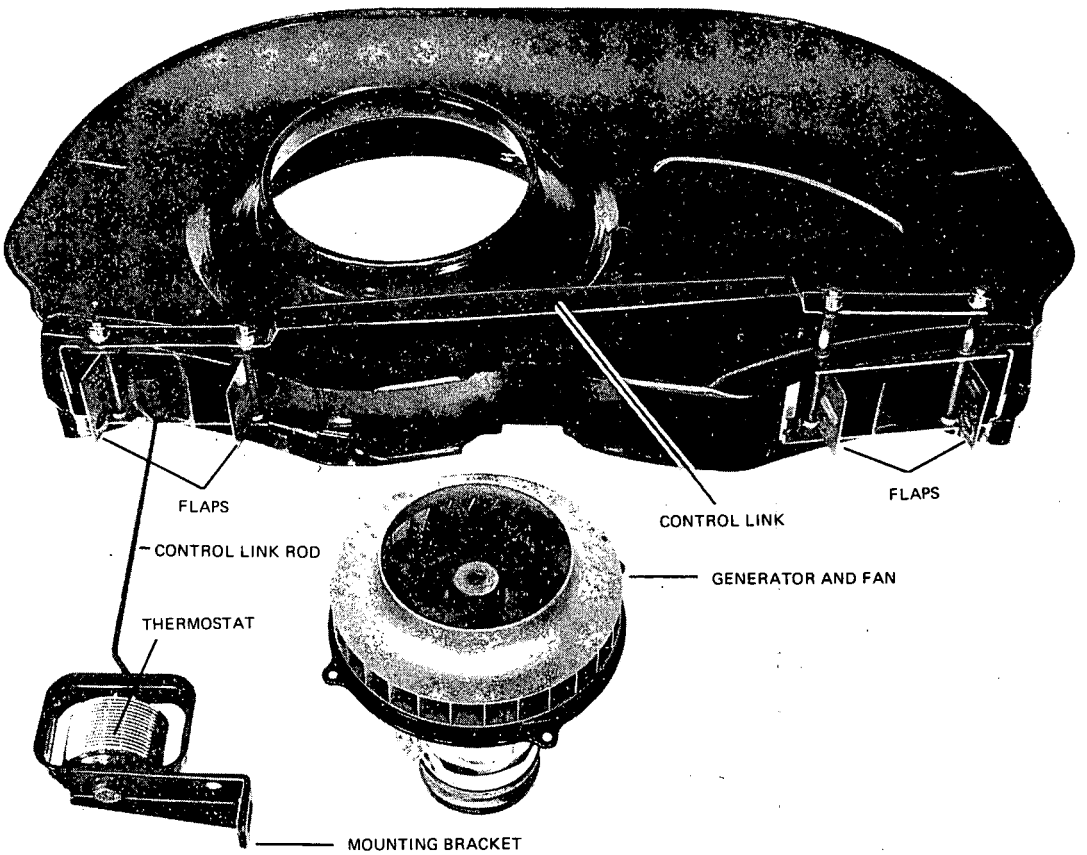
(2) With the engine warm, the thermostat should expand until the upper end contacts the stop support. Check the distance from the top middle of the housing intake flange to the edge of the throttle ring which in this position should be 1" – 1.2".

### TO ADJUST (Engine in Vehicle)

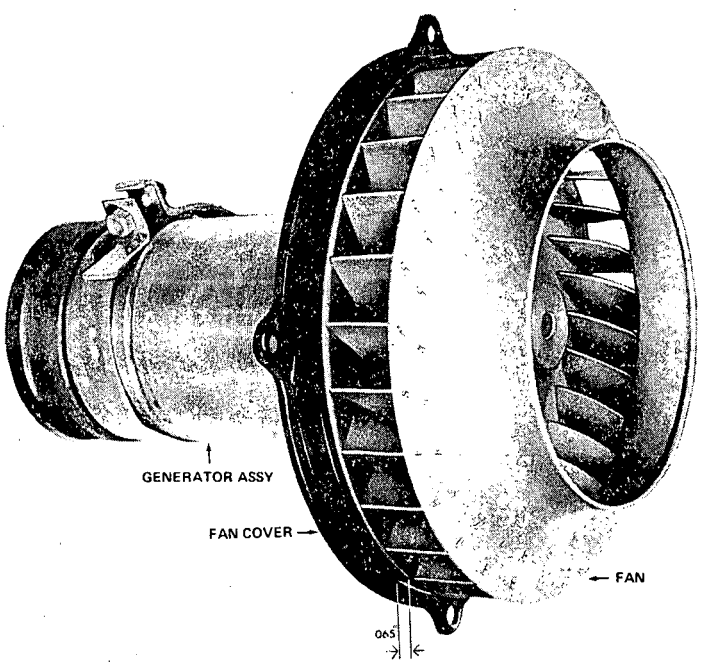
(1) Disconnect the return spring and release the throttle ring operating lever.

(2) Run engine until warm and check that the upper end of the thermostat contacts the upper stop of the support.

(3) Check the throttle ring opening and adjust until the




Fan Housing and Air Flap Assembly. (Late 1200 and subsequent models.)




Fan and Generator Assembly Showing Correct Clearance of .060"/.070" between Back Face of Fan and Fan Cover.

distance between the middle of the housing intake flange and the edge of the throttle ring is 1" – 1.2".

*NOTE: This measurement should be made at the top of the throttle ring and intake flange.*

(4) Tighten the operating lever and connect the lever return spring.

(5) Ensure that the throttle ring and linkage move freely in all positions.

**TO ADJUST (During Engine Assembly)**

(1) Raise the thermostat until it is in contact with the upper stop of the support.

(2) Adjust the throttle ring until it opens .800" and tighten the operating lever.

(3) Secure the thermostat in position making sure that the faces milled in the tapped boss of the thermostat fit correctly in the guide hole in the support. It may be found necessary to turn the thermostat back by up to half a turn to obtain a correct fit.

*NOTE: With the thermostat tightened, the throttle ring*

*should be closed with a slight amount of tension against the air intake flange.*

(4) Connect the return spring and instal the right heating channel.

## TO REMOVE AND INSTAL FAN HOUSING

(1) Release the nut on the generator shaft pulley and remove the nut, spacers, outer pulley half and the fan belt.

(2) Loosen off and remove the strap securing the generator to the mounting on the engine.

(3) Disconnect the high tension lead between the distributor cap and coil and pull free the connectors at the spark plugs. The distributor cap can now be removed.

(4) Take out the securing screws located at each side of the fan housing.

(5) Unhook the air control return spring and take out the throttle ring securing screws.

(6) Remove the fan housing complete with generator from the engine.

Installation is a reversal of the removal procedure with attention to the following points:

(1) Ensure that the fan housing is free of damage and that the air deflector plates are secure.

(2) Check after installation that the joint between the housing and cylinder cover plates will not allow the loss of cooling air, if necessary bend the cylinder cover plates to improve the joint.

(3) Position the throttle ring in a central position in the air intake flange, maintaining that position instal and tighten the securing screws. Connect the air control return spring.

*NOTE: When correctly fitted the throttle ring will lie at an angle to the air intake flange, no attempt should be made to rectify this otherwise cooling efficiency will be impaired.*

(4) Carry out the throttle ring adjustment as described in this section.

## TO REMOVE AND INSTAL FAN

(1) Take out the four securing screws attaching the fan cover to the housing.

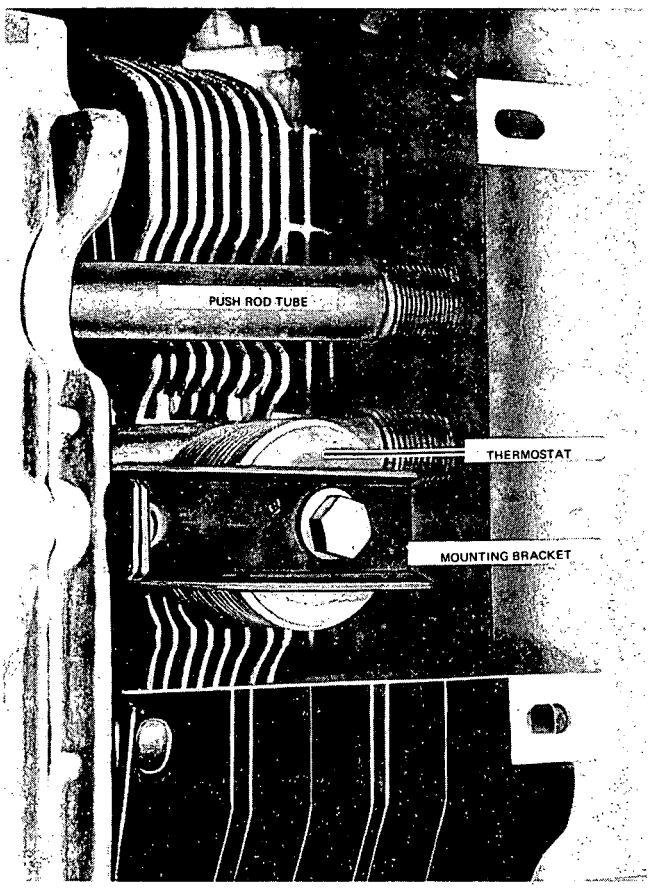
(2) Withdraw the generator and fan from the fan housing.

(3) With the fan securely held, remove the nut retaining the fan to the end of the generator shaft.

(4) Withdraw the fan, spacer washers and hub from the end of the shaft.

Installation is a reversal of the removal procedure with attention to the following points:

(1) Position fan hub on the generator shaft with the Woodruff key correctly located.




Heat Control Thermostat in Position.

(2) Instal the spacer washers, fan, and retaining nut which should be tightened to a torque of 45 ft/lb.

(3) Check the clearance between the rear face of the fan and the front face of the cover which should be .060" to .070". Adjustment is effected by inserting shim washers between the fan hub and thrust washer.

*NOTE: Normally three shims are installed between the hub and thrust washer, after inserting the required number to give the correct clearance the remaining shim washers should be fitted between the lockwasher and fan. Some later models may have up to nine shims fitted but the procedure for adjustment remains the same.*

(4) Instal the generator and fan cover in the fan housing, fit and tighten the four securing screws.

## TO REMOVE AND INSTAL AIR CONTROL FLAPS

(1) Remove the generator and fan housing assembly as previously described, unhook and remove the flap return spring.

(2) Take out the four screws securing each flap assembly to the fan housing and withdraw the assemblies complete from the housing.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Ensure that the rubber stop is installed in the right hand flap housing and adjust the flaps as described.

(2) Screw the thermostat on the end of the connecting link and adjust the thermostat bracket.

**TO ADJUST AIR CONTROL FLAPS**

(1) With the housing and flap assembly installed on the engine, screw the thermostat onto the thermostat connecting link securely.

(2) Loosen the nut securing the thermostat bracket to the engine, place the flaps in the fully open position, move the thermostat bracket until the top face of the bracket is just touching the top face of the thermostat and tighten the bracket securing nut.

(3) Check the operation of the thermostat and control flaps.

## 3. FAN BELT

The fan belt serves two purposes by driving the generator and the fan for the cooling system, this imposes a considerable load on the fan belt because of the power absorbtion by the two units. It is therefore essential that the fan belt should be in serviceable condition and correctly adjusted to avoid overheating due to a loose slipping belt or excess load on the generator bearings due to an overtight belt.

The belt, when lightly pressed with the thumb, must deflect approximately .600".

A belt which has frayed edges or shows indication of cracking should be replaced.

*NOTE: Fan belts should not be contaminated by oil when lubricating the engine. Provided the belt has not been exposed to oil over a long period it may be made serviceable by cleaning in an alkaline degreasing solution. Petrol must not be used for this purpose.*

(1) Release the nut on the generator shaft pulley. The pulley can be held stationary whilst loosening the nut by inserting a screwdriver into the inner pulley slot and allowing the blade to bear against the top generator housing bolt.

(2) Detach the outer pulley half.

(3) Insert the spacer washers as necessary to obtain the correct fan belt tension.

*NOTE: The fan belt tension is adjusted by inserting or removing spacer washers between the pulley halves depending on whether the belt is too slack or too tight until it deflects .600" by thumb pressure.*

(4) Instal the outer pulley half and fit any surplus spacer washers between the outer pulley and pulley securing nut. In this way all spacer washers are retained on the pulley hub.

(5) Instal and tighten the pulley securing nut.

*NOTE: If the belt is worn or stretched to the extent where no washers are required between the pulleys to correct the tension, the belt should be renewed. The belt should not bear on the base of the pulley formed by the spacer washers.*

*Because there is a tendency for newly installed fan belts to stretch it is essential that the belt tension is checked and rectified if necessary during the first sixty miles.*

## 4. EXHAUST SYSTEM

**TO REMOVE AND INSTAL SILENCER**

On Early Models:

(1) Remove engine rear cover plate and loosen off and remove the tail pipe.

(2) Slacken back the nuts and bolts at the clamps attaching the silencer to the front exhaust pipes.

(3) Remove the four nuts connecting the silencer flanges to the cylinder heads.

(4) Detach silencer and gaskets from the flanges or cylinder heads.

On Later Models:

(1) Slacken back the nuts and bolts and remove the heat exchanger clamps.

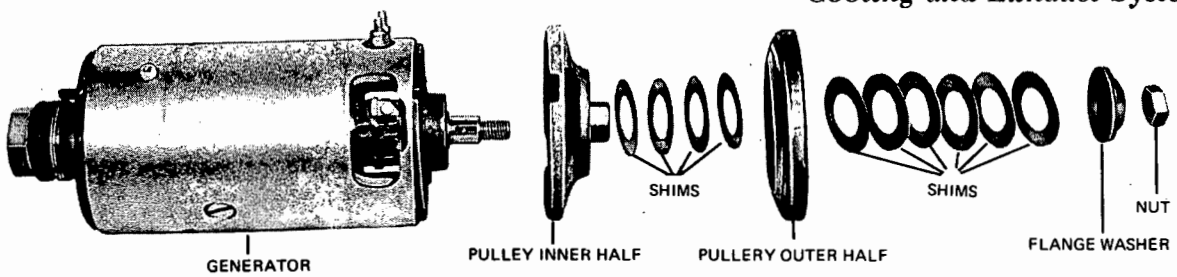
(2) Remove the clips connecting the warm air channels.

(3) Remove the four nuts connecting the flanges to the cylinder heads, and take off the pre-heater pipe.

(4) Take out the four screws securing the manifold pre-heater pipe.

(5) Detach the silencer and gaskets from the flanges or silencer.

Installation is a reversal of the removal procedure with




Generator and Split Drive Pulley with Shims for Fan Belt Adjustment.

particular attention to the following points:

(1) Check the silencer and exhaust pipes for cracks and damage. Bent or damaged exhaust pipes must be repaired.

(2) Use new gaskets and ensure that the connections are all gas tight.

**TO REMOVE AND INSTAL JUNCTION BOX AND EXHAUST PIPE (Early Models)**

(1) Loosen off and remove the exhaust flange securing nuts.

(2) Take out the slotted screw located at the bottom of the junction box.

(3) Take out the split pin and disconnect the connector rod from the heat control panel.

(4) Remove the heating junction box and exhaust pipe.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the heating junction box and exhaust pipe for cracks and damage.

*NOTE: Any leakage may result in exhaust fumes entering the car interior through the warm air heating system.*

(2) Ensure that the contact surfaces of the flanges are clean and even. Flanges which are bent or out of shape should be repaired.

(3) Use new gaskets and lubricate moving joints with high melting point grease.

**TO REMOVE AND INSTAL HEATING CHANNEL (Early Models)**

(1) Loosen off and remove engine rear cover plate.

(2) Remove silencer as described previously.

(3) Loosen off the heating control cable at the clamping device.

(4) Remove heating junction box and exhaust pipe as described previously.

(5) Release the slotted screws of the heating channel and remove the channel.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Ensure that the heating channel is free of damage.

(2) Check that the heat control valve and the control panel at the rear move freely and that they open and close together to obtain correct heating control.

(3) The heating control cable should be adjusted so that with the heating control knob in the fully off position, the heat control valve is closed.

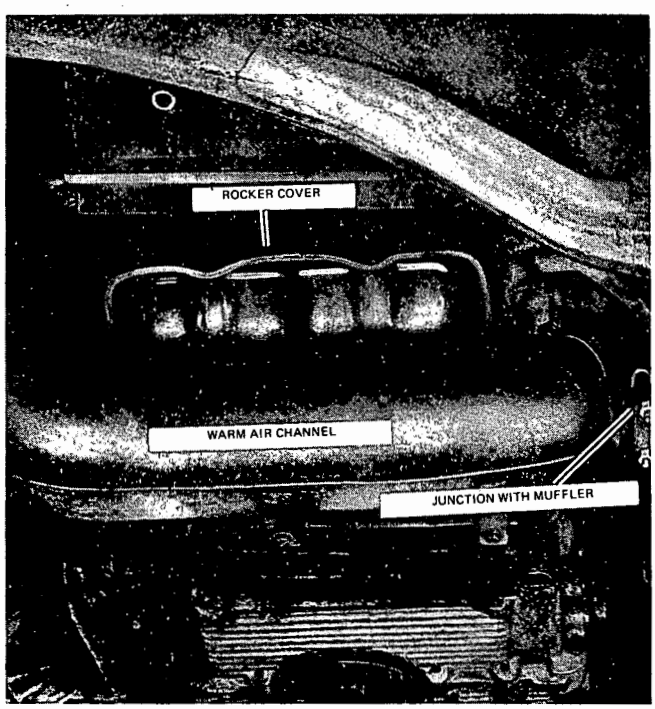
**TO REMOVE AND INSTAL HEAT EXCHANGERS (Later Models)**

(1) Loosen off the clips and remove the hoses between the fan housing and heat exchangers.

(2) Take out the rear engine cover plate.

(3) Loosen off and remove the nuts securing the flanges to the cylinder heads.

(4) Remove the warm air channel connecting clips and




Arrangement of Warm Air Channel Connection. (Left-hand Side shown – 1200 model.)

take out the screws in the cover plate below the fan pulley.

(5) Remove the exhaust clamps and withdraw the heat exchangers towards the front.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the casing and exhaust pipes for perforation and damage.

*NOTE: If there are heat exchanger leaks, the exhaust fumes may enter the body through the heating system.*

(2) Ensure that the sealing surfaces of the flanges are clean and smooth. Flanges which are distorted or rough should be straightened or machined.

(3) Use new gaskets when installing the units.

**TO REMOVE AND INSTAL HEATER BOXES**

(1) Remove the locking washer for the heater flap operating lever and take off the lever.

(2) Bend up the metal tabs on the heater control box and detach the box.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check that the control flaps make proper contact all round.

(2) Should the metal tabs be broken, screws can be used as a substitute.

(3) Lubricate all bearing points with high melting point graphite grease.

# FUEL SYSTEM

## SPECIFICATIONS

### CARBURETTORS

| | 1.2 Litre, 36 BHP | 1.2 Litre, 40 BHP |
|---|---|---|
| Make | Solex (Up to June 1960) | |
| Type | 28 PCI Downdraught Manual | 28 PICT Downdraught Automatic – temperature controlled |
| Venturi | 21.5 mm | 22.5 mm |
| Main jet | 117.5 | 122.5 |
| Air correction jet | 180 | 145y |
| Pilot jet | 50 | g55 |
| Float needle valve | 1.5 mm dia. | 1.5 mm dia. |
| Float weight | 5.7 grams | 5.7 grams |
| Pump capacity | 0.40-0.60 cc | 0.8-1.00 cc |
| Pump fuel system with/ without ball | 1.0 without | 1.0 without |

**1.2 Litre, 40 BHP (From December 1962-November 1963)**

| | |
|---|---|
| Make | Solex |
| Type | 28 PICT Downdraught Automatic – temperature controlled |
| Venturi | 22.5 mm |
| Main jet | 122.5 |
| Air correction jet | 145y |
| Pilot jet | g55 |
| Float needle valve | 1.5 mm dia |
| Float weight | 5.7 grams |
| Pump capacity | 1.1-1.4 cc |
| Pump fuel system with/without ball | 1.0 without |

**1.2 Litre 40 BHP (From November 1963-August 1964)**

| | |
|---|---|
| Make | Solex |
| Type | 28 PICT-1 Downdraught Automatic – temperature controlled |
| Venturi | 22.5 mm |
| Main jet | 122.5 |
| Air correction jet | 145y |
| Pilot jet | g55 |
| Float needle valve | 1.5 mm dia. |
| Float weight | 5.7 grams |
| Pump capacity | 1.1-1.4 cc |
| Pump fuel system with/ without ball | 1.0 without |

**1.5 Litre, 51 BHP (January 1963)**

| | |
|---|---|
| Make | Solex |
| Type | 28 PICT Downdraught Automatic – temperature controlled |
| Venturi | 22.5 mm |
| Main jet | 115 |
| Air correction jet | 145y/150z |
| Pilot jet | g45 |
| Float needle valve | 1.5 mm dia |
| Float weight | 5.7 grams |
| Pump capacity | 1.1-1.4 cc |
| Pump fuel system with/ without ball | 0.7 without |

**1.5 Litre, 51 BHP (From November 1963-August 1964)**

| | |
|---|---|
| Make | Solex |
| Type | 28 PICT-1 Downdraught Automatic – temperature controlled |
| Venturi | 22.5 mm |
| Main jet | 115 |
| Air correction jet | 150z |
| Pilot jet | g45 |
| Float needle valve | 1.5 mm dia. |
| Float weight | 5.7 grams |
| Pump capacity | 1.1-1.4cc |
| Pump fuel system with/ without ball | 0.7 without |

**1.5 Litre 53 BHP (From August 1965-August 1966)**

| | |
|---|---|
| Make | Solex |
| Type | 30 PICT-1 Downdraught Automatic – temperature controlled |
| Venturi | 24 mm |
| Main jet | 115 (engines with larger air cleaners 117.5 and recessed pistons 0120) |
| Air correction jet | 135z (engines with recessed crown pistons 145z) |
| Pilot jet | 60 |
| Float needle valve | 1.5 mm dia. |
| Float weight | 5.7 grams |
| Pump capacity | 1.3-1.6cc |

**CARBURETTOR**
**1.6 Litre, 57 BHP (August 1967)**

(Engines with recessed crown pistons or larger air cleaners are fitted with standard carburettors.)

| | |
|---|---|
| Make | Solex |
| Type | 30 PICT-1 Downdraught Automatic – temperature controlled |
| Venturi | 24 mm |
| Main jet | 120 |
| Air correction jet | 135z |
| Pilot jet | 55 |
| Float needle valve | 1.5 mm dia |
| Float weight | 5.7 grams |
| Pump capacity | 1.3-1.6 cc |

**CARBURETTOR**
**1.6 Litre (August 1967)**

| | |
|---|---|
| Make | Solex |
| Type | 30 PICT-2 Downdraught Automatic – Exhaust control system |
| Venturi | 24 mm |
| Main jet | X116 |
| Air correction jet | 125z |
| Pilot jet | 55 |
| Float needle valve | 1.5 mm dia |
| Float weight | 8.5 grams |
| Pump capacity | 1.3-1.6cc |

**FUEL PUMP**

| | |
|---|---|
| Type | Mechanical diaphragm |
| Operating pressure | 1.6 psi (early models)<br>2.5 psi (later models) |
| Delivery rate | 267 cc per min (early models)<br>300 cc per min (later models)<br>400 cc per min (1500/1600) |
| Fuel filter | In pump top |
| Fuel tank capacity | 8.8 Imp gal. (10.5 US gal.) |

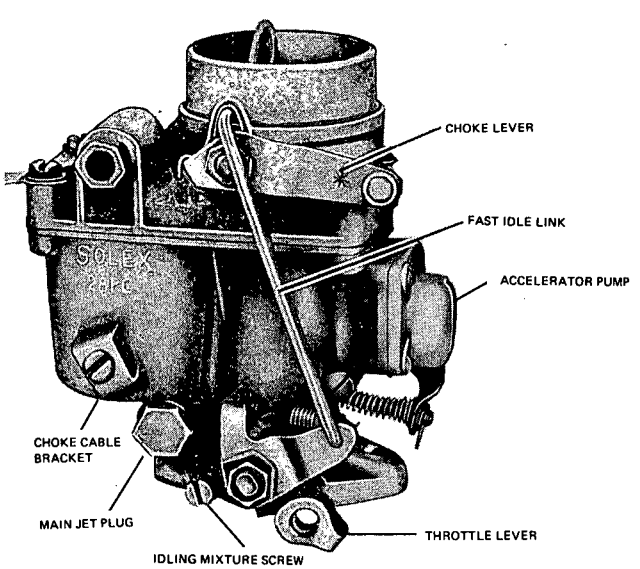
**AIR CLEANER**

| | |
|---|---|
| Type | Oil bath |

## 1. CARBURETTOR SOLEX TYPE PCI

### DESCRIPTION

The mixing of air and petrol, in the correct proportion, takes place in the carburettor to control performance of the engine. The advantage of the downdraught carburettor is to raise the cylinder charge by fully utilising the increasing velocity of the air intake. It also greatly assists in the higher flexibility and improved performance of the engine and facilitates starting.




Solex 28 PCI Carburettor with Manual Control Choke.

The supply of air to the carburettor enters through the air cleaner which is connected to the carburettor upper body. The carburettor float chamber is so designed to provide for a constant fuel level.

Pre-heating the induction manifold prevents condensation of fuel vapor, improves the performance of the engine and completely vaporises the fuel air mixture. Thus the mixture is well balanced.

The carburettor incorporates a choke valve in the air horn to assist starting when an engine is cold. The device is operated from the dash panel by means of a control knob and a Bowden type cable.

The idling circuit of the carburettor regulates the fuel-air mixture depending on the closed or slightly open position of the throttle.

Linked to the throttle level is the diaphragm type accelerator which aids the acceleration of the engine to ensure economy and maximum performance.

The body of the carburettor incorporates the float, venturi, throttle valve, accelerator pump and the jet system,

and the upper portion incorporates the choke valve, float needle valve and the accelerator pump jet.

## TO REMOVE

(1) Slacken the mounting clamp screw and mounting bolts and remove the air cleaner and the air intake elbow.

(2) Detach the fuel pipe connecting the fuel pump and carburettor.

(3) Disconnect controls including the accelerator cable, choke control inner cable and the choke control outer cable sleeve.

(4) Remove the accelerator cable swivel screw on the throttle lever.

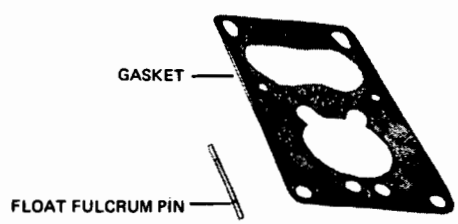
(5) Using a suitable wrench undo the carburettor mounting stud nuts, and remove the carburettor assembly from the engine.

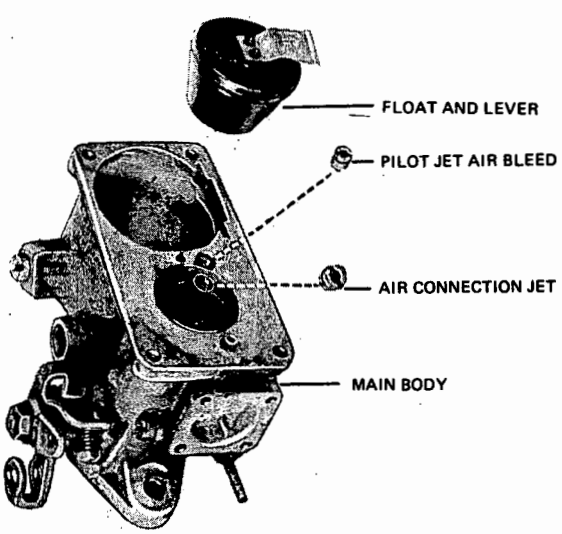
## TO INSTAL

Installation is a reversal of the removal procedure observing the following points:

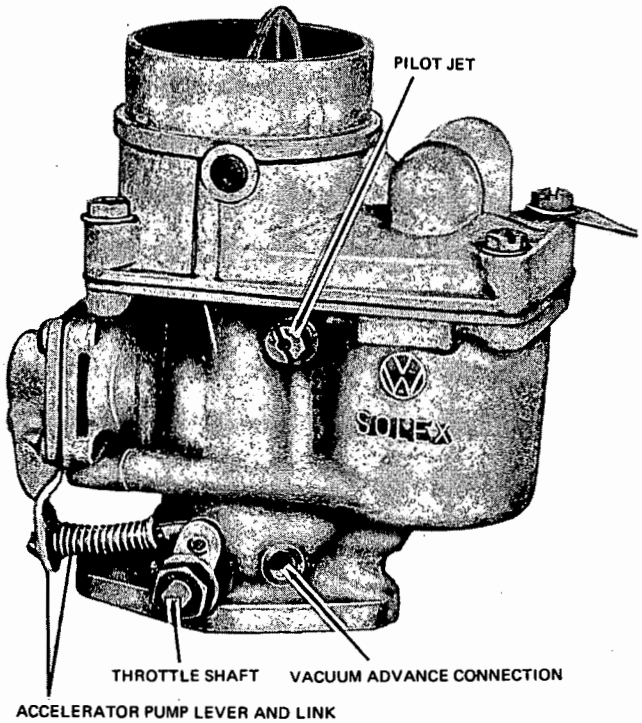
(1) Renew the intake manifold flange gasket.

(2) Use the following procedure for connecting the accelerator to the throttle lever. Open the throttle valve sufficiently to allow for a gap of .040" between the throttle lever and the carburettor body stop in nearly wide open position. With the accelerator pedal fully pressed down, connect the accelerator cable to the throttle lever.




Solex 28 PCI Carburettor Main Body and Float Components.




Solex 28 PCI Carburettor.

(3) Ensuring that the choke valve is in the fully open position and the control knob pushed in on the panel, connect the choke control cable and secure by tightening the screw.

(4) While mounting the air cleaner do not excessively tighten the clamp screw.

(5) Adjust the engine idling speed.

## TO DISMANTLE

(1) As previously described, remove the carburettor.

(2) Undo the securing screws and separate the top cover from the body of the carburettor.

(3) Unscrew the float needle valve from the top cover.

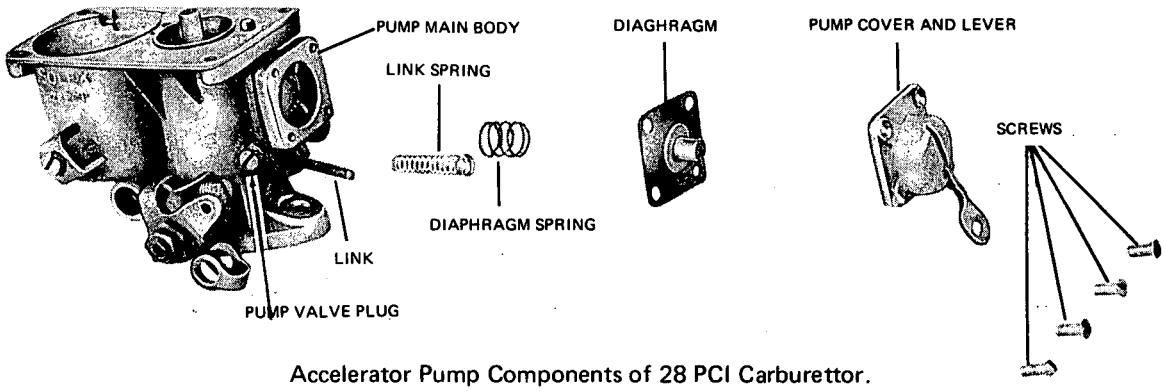
(4) Take out the toggle lever and pin and remove the float.

(5) Take out the air correction jet and the emulsion tube.

(6) Take out the main jet, pilot jet and pilot jet air bleed.

(7) Remove the idling mixture screw and spring.

(8) Extract the split pin from the throttle/accelerator pump connector rod.




Accelerator Pump Components of 28 PCI Carburettor.

(9) Undo the pump cover securing screws and remove the cover, diaphragm and spring.

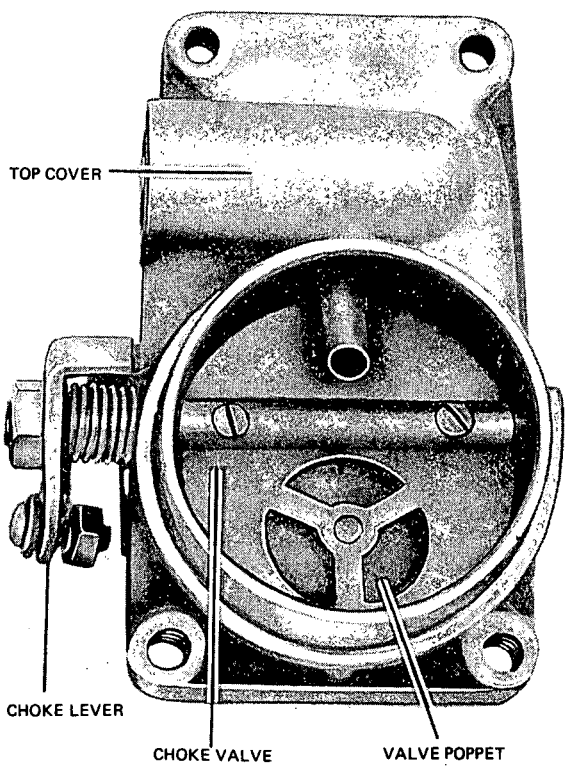
(10) Unscrew the accelerator pump discharge nozzle plug screw.

## TO CLEAN CARBURETTOR

(1) Place all carburettor components into a small tray containing petrol and clean them thoroughly.

(2) Using compressed air, blow through the jets, valves and passages.

*NOTE: Do not use pins or pieces of thin wire for cleaning otherwise damage to the jets will result.*




Choke Valve and Lever in Closed Position on 28 PCI Carburettor.

## TO CHECK AND ASSEMBLE

Assembling is a reversal of the dismantling procedure observing the following points.

(1) Check the condition of the needle valve and test for leaks.

(2) Check needle valve gasket for damage or deterioration and if condition is good, instal it correctly in position.

(3) Check the condition of the choke valve spring and the wear on the choke valve shaft.

(4) Check condition and operation of the choke poppet valve.

(5) Check the pump diaphragm for deterioration or damage and renew if necessary.

*NOTE: If spitting back occurs in the carburettor with sudden acceleration, it usually is an indication that the accelerator pump diaphragm is leaking or the pump jet blocked.*

(6) Test condition of the float by dipping it in hot water and if bubbles appear, it is an indication that the float is leaking and must be renewed.

(7) Check all jets to ascertain whether the sizes agree with those specified.

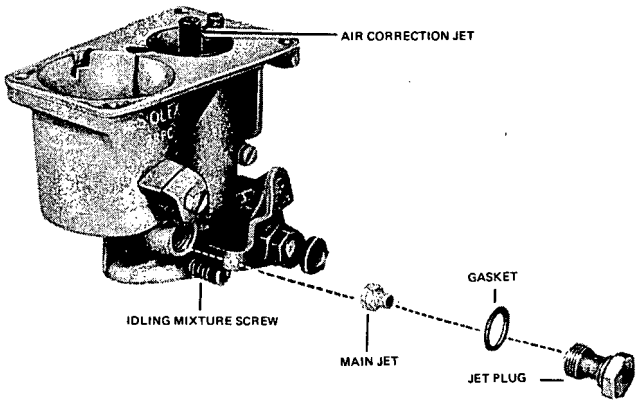
*NOTE: It is good policy to use genuine parts for better performance and economy.*

(8) When installing the air correction jet ensure that .020" clearance exists between the shoulder of the jet and the face of the spray well, otherwise possible damage will result.

(9) When installing the venturi, ensure that the flared end is positioned to the top.

(10) Carefully check the throttle shaft clearance as any excessive wear permits the ingress of air which adversely affects starting and idling of the engine. The holes for the throttle shaft should be fitted with suitable bushes, if necessary, to take up the excessive clearance.

(11) Check the idling screw tip for wear or damage and renew with a genuine part.




Main Jet Components of 28 PCI Carburettor.

Also check the tapered seat on the tip of the idling screw to ensure that it is not damaged.

(12) Instal the float and toggle lever.

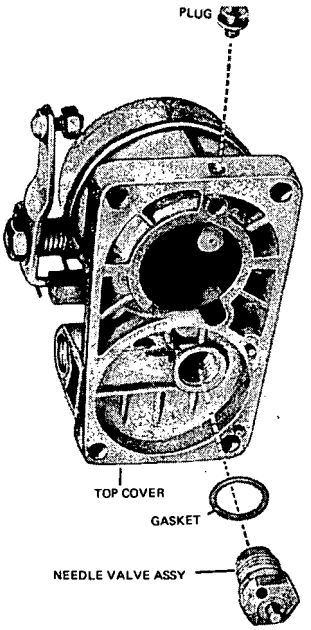
### TO ADJUST IDLING SPEED AND MIXTURE

The engine must be hot before idling adjustment is attempted.

(1) Using a suitable screwdriver, tighten and slacken the idling speed adjusting screw until the engine is idling at approximately 550 rpm.

(2) Turn the idling mixture adjusting screw clockwise until there is a drop in engine speed and as soon as this happens, turn the screw anti-clockwise. Continue turning the screw very slightly in either direction until the engine idles smoothly.

(3) With the engine firing evenly on all cylinders, readjust the idling speed screw until the normal idling speed is obtained.




Float Needle Valve Assembly. 28 PCI Carburettors. Typical also of PICT Carburettors.

Usually the correct idling setting is obtained by turning the mixture control screw 1¼ to 1½ turns from the closed position. In no case should the screw be tightened in fully as this is likely to damage the screw tapered point.

Accurate setting of the idling is very important as it greatly affects fuel consumption at low speeds.

Poor idling can be caused by damaged gaskets or intake manifold being incorrectly tightened or the fuel pump adjustment being incorrect.

Faulty ignition system or weak engine compression can also have an adverse affect on the idling.

## 2. CARBURETTOR SOLEX TYPE PICT

### DESCRIPTION

Transporters from Engine No 5000001 are fitted with the PICT Type Solex carburettor which incorporates an automatic choke.

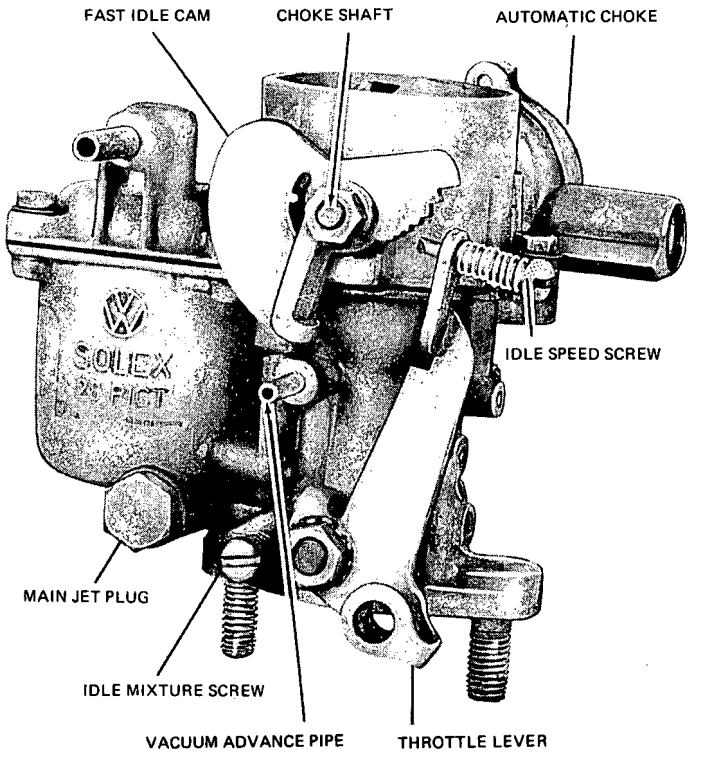
When a cold engine is being started, the carburettor choke operation is automatically controlled by a heater element and a bi-metal spring. Under normal driving conditions, a vacuum piston, (on later models a diaphragm,) connected to the choke shaft link and operated by the vacuum in the manifold, ensures proper functioning of the arrangement. A richer mixture, at full load, is provided by the power fuel system.

This type of carburettor is so designed to ensure easy engine starting in any weather and the engine performance is improved at all temperatures. This improvement is more marked at idling speeds and between idling and normal running. A better fuel consumption is experienced with part load and city traffic operation. With this type of carburettor there is no provision for a choke control cable.

The mounting of the carburettor on the induction manifold is the same as for the previous type.

The carburettor body is in two parts, the lower and the upper, with a gasket installed between the two and five screws attaching them together.

The upper portion of the carburettor houses the float needle valve and the fuel delivery pipe from the fuel pump. The float chamber vent tube is pressed into the upper portion in which the automatic choke is also located. On one end of the choke valve shaft and choke valve is a fast idle cam and lever. On the other end is installed a heater element and a bi-metal thermostat spring fixed firmly in a




Solex 28 PICT Carburetor.

ceramic plate secured by a retainer ring and three screws in a housing which forms an integral part of the carburettor. There is a cylinder cast on this same housing containing a sliding vacuum piston connected to the choke valve shaft. A passage connects the cylinder to the vacuum below the throttle valve. Commencing with the 28 PICT-1 carburettor the vacuum piston was changed to a diaphragm type vacuum control mentioned previously.

The lower portion of the carburettor houses the mixing and float chambers, the float and connected parts necessary for providing the air-fuel mixture. The carburettor is mounted on the induction manifold and is secured in position on two studs in the lower flange. Located below the mixing chamber are the throttle valve and shaft which are operated by the throttle lever. The accelerator pump is located in a housing on the side of the float chamber and is connected to the throttle valve shaft by a lever and a connecting rod. The float and needle valve maintain the level of the fuel in the carburettor. The automatic choke located in the upper portion of the carburettor facilitates engine starting and also controls the preparation of the fuel-air mixture required for idling and driving while the engine is cold and till it warms up to the normal operating temperature.

A calibrated power fuel tube is pressed into the carburettor cover just above the choke valve and is connected by a drilling to the float chamber. The tube ends above the discharge arm in the area of reduced vacuum.

At low or medium speeds, vacuum is not sufficiently high to draw fuel from the power fuel tube, consequently the system only comes into operation at higher speeds and vacuum.

The idling circuit of the carburettor regulates fuel-air mixture when the throttle valve is nearly closed. Enriching or weakening the fuel-air mixture is done by the volume control screw. The idle speed adjustment screw controls the idling speed of the engine.

The improved design idling stop segment on the fast idle cam ensures the correctness of the idling speed with the choke valve position from the time the engine starts until it reaches normal operating temperature.

Pre-heating the intake prevents condensation of fuel vapor and also helps to create a readily combustible mixture.

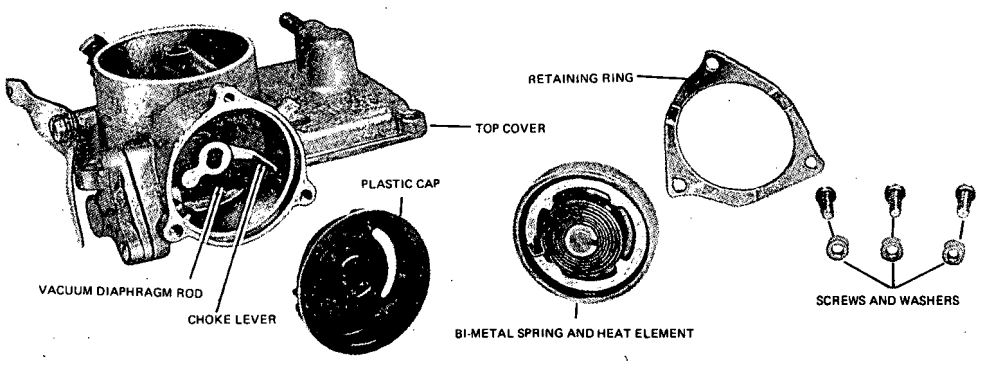
## TO REMOVE

(1) Disconnect the pre-heater connection of the oil bath air cleaner intake tube.

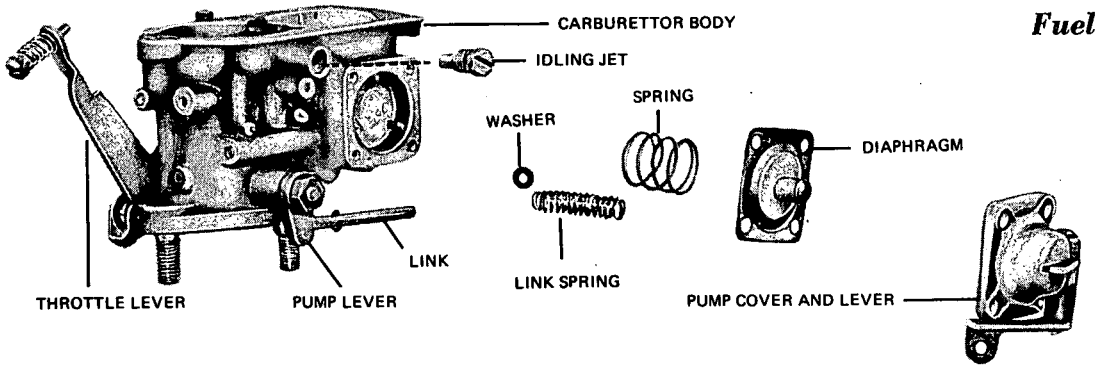
(2) Undo the mountings and remove the oil bath air cleaner and the elbow.

(3) Disconnect the fuel line connecting the fuel pump to the carburettor.

(4) From the heater element, disconnect the push-on connector.



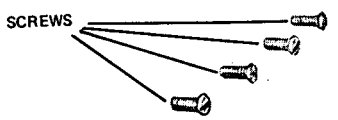

Automatic Choke Components on 30 PICT-2 Carburettor.




(5) From the carburettor, disconnect the vacuum pipe.

(6) Detach the accelerator cable from the throttle lever and take out the spring, washer and cable swivel pin.

(7) Undo the carburettor mounting nuts from the studs and remove the carburettor.




Accelerator Pump Components of 28 PICT Carburettor.

## TO INSTAL

Installation is a reversal of the removal procedure observing the following points:

(1) Instal a new gasket between the carburettor and the intake manifold flange.

(2) To connect the accelerator cable on the throttle lever, first open the throttle lever to provide a .040" clearance between the throttle lever and the carburettor body stop in nearly wide open position. Press the accelerator pedal down to the limit of its travel and connect the cable to the throttle lever. Ensure that all other linkages are installed free of play and without strain.

(3) The intake elbow securing screw must not be tightened in excess of reasonable limits.

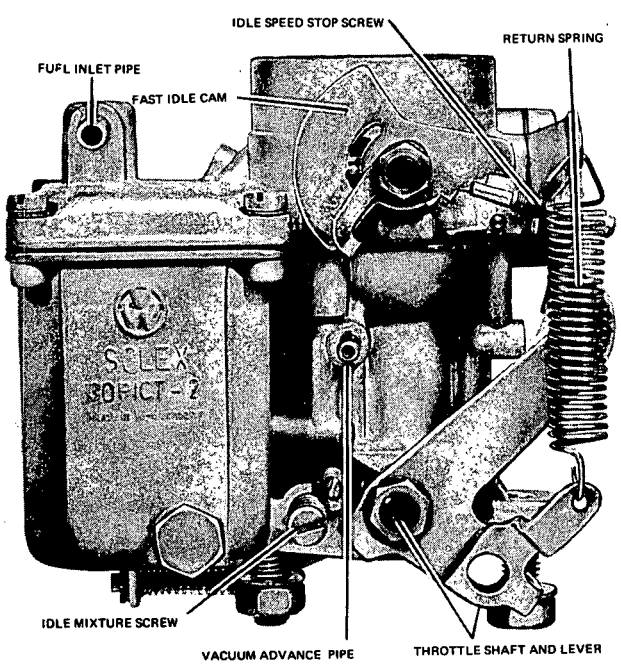
(4) Do not overlook connecting the heater element pipe to the air cleaner intake tube.

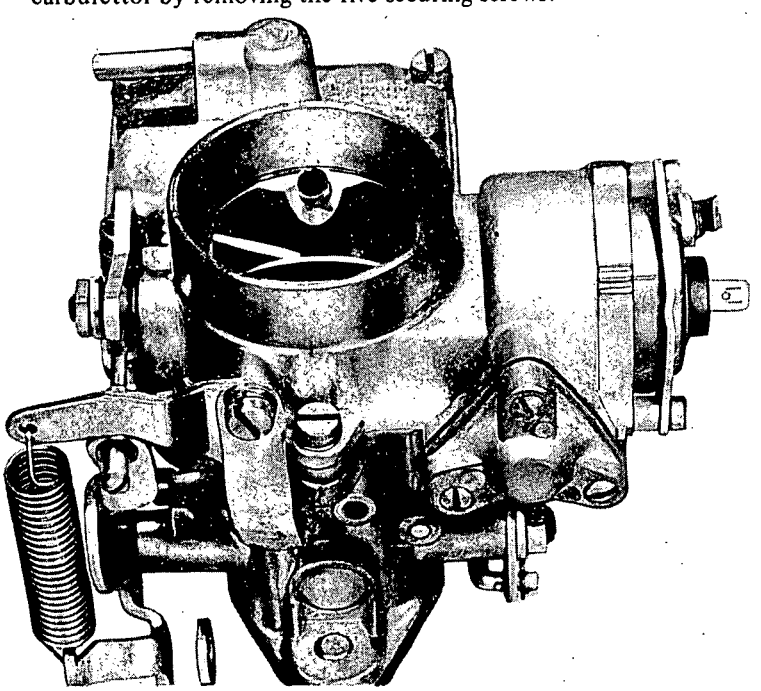
(5) Always adjust the idling speed when the engine is at operating temperature.

## TO DISMANTLE

(1) As previously described, remove the carburettor.

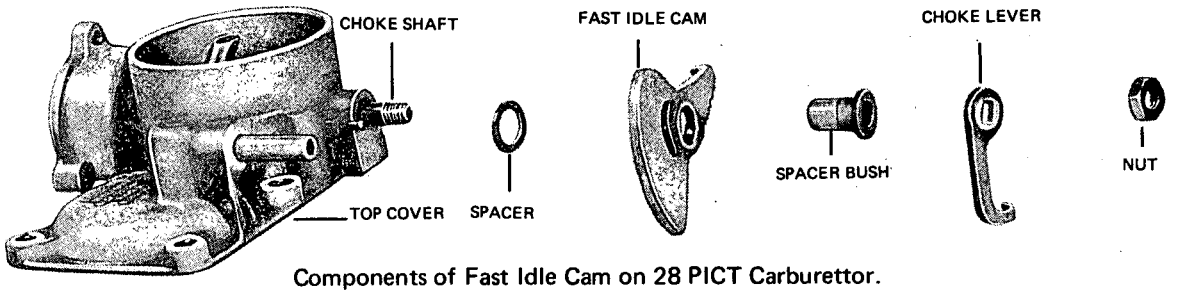
(2) Separate the upper and lower portions of the carburettor by removing the five securing screws.



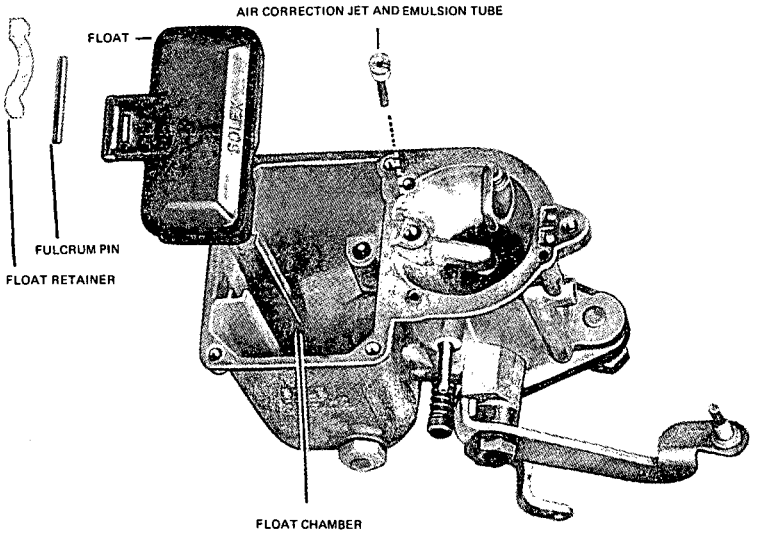



▲ Cover Calibrations for Automatic Choke Adjustment.

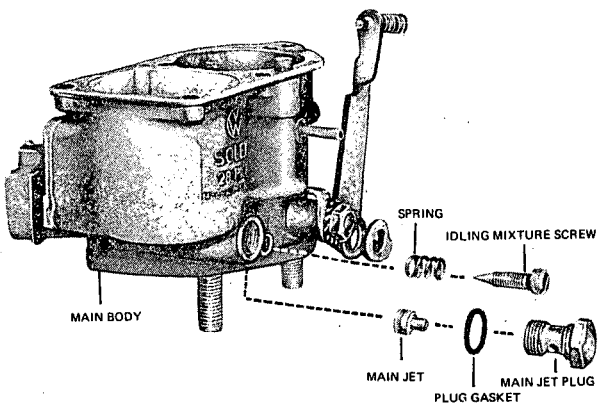
◄ Left Hand Side View of 30 PICT-2 Carburettor. (1600 models typical also of 30 PICT-1 Carburettor fitted to 1500 models.)




Components of Fast Idle Cam on 28 PICT Carburettor.




Float Chamber and Components on 30 PICT-2 Carburettor.




Idling Mixture Screw and Main Jet Components of 28 PICT Carburettor.

(3) Unscrew the float needle valve.

(4) Undo the three securing screws of the automatic choke retainer and withdraw the retaining ring with the ceramic plate, bi-metal spring and the heater element.

(5) Remove the float and fulcrum pin.

(6) Unscrew and remove the air correction jet with emulsion tube. Remove the pilot jet.

(7) Unscrew the main jet carrier with main jet and also the idling mixture screw and spring.

(8) Extract the split pin from the accelerator pump connector rod and remove two washers and spring.

(9) Undo the pump cover securing screws and withdraw the cover, diaphragm and spring.

## TO CLEAN

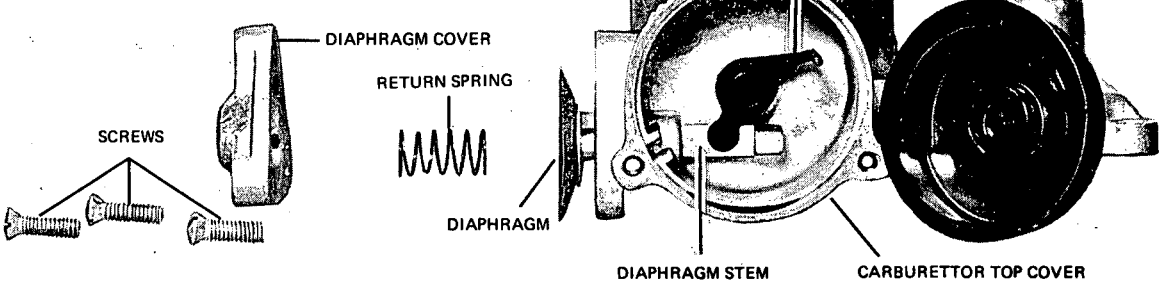
(1) Except for the porcelain plate, heater element and bi-metal spring, thoroughly clean all parts with petrol.

(2) Using a jet of compressed air, blow out the jets, valves and passages.

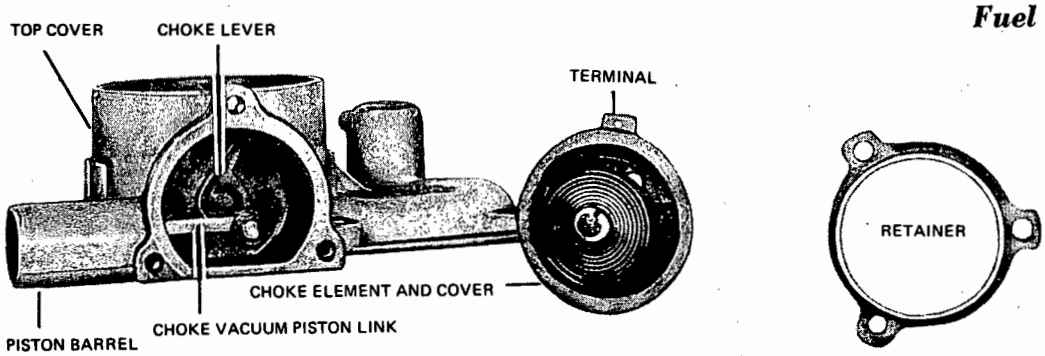
Do not use pins or pieces of thin wire for cleaning the jets as this method will damage the jets.

## TO ASSEMBLE

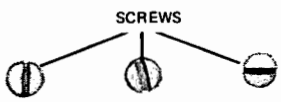
Assembly is a reversal of the dismantling procedure observing the following points.




Automatic Choke Vacuum Control Components. Typical of all models with Vacuum Diaphragm.




Automatic Choke Components of 28 PICT Carburettor.




(1) Carefully check the needle valve for any trace of leaks.

(2) Check the condition of the needle valve gasket and ensure that the gasket is correctly seated.

(3) Check condition of the gasket separating both portions of the carburettor (upper and lower).

(4) Check for play in the choke valve shaft.

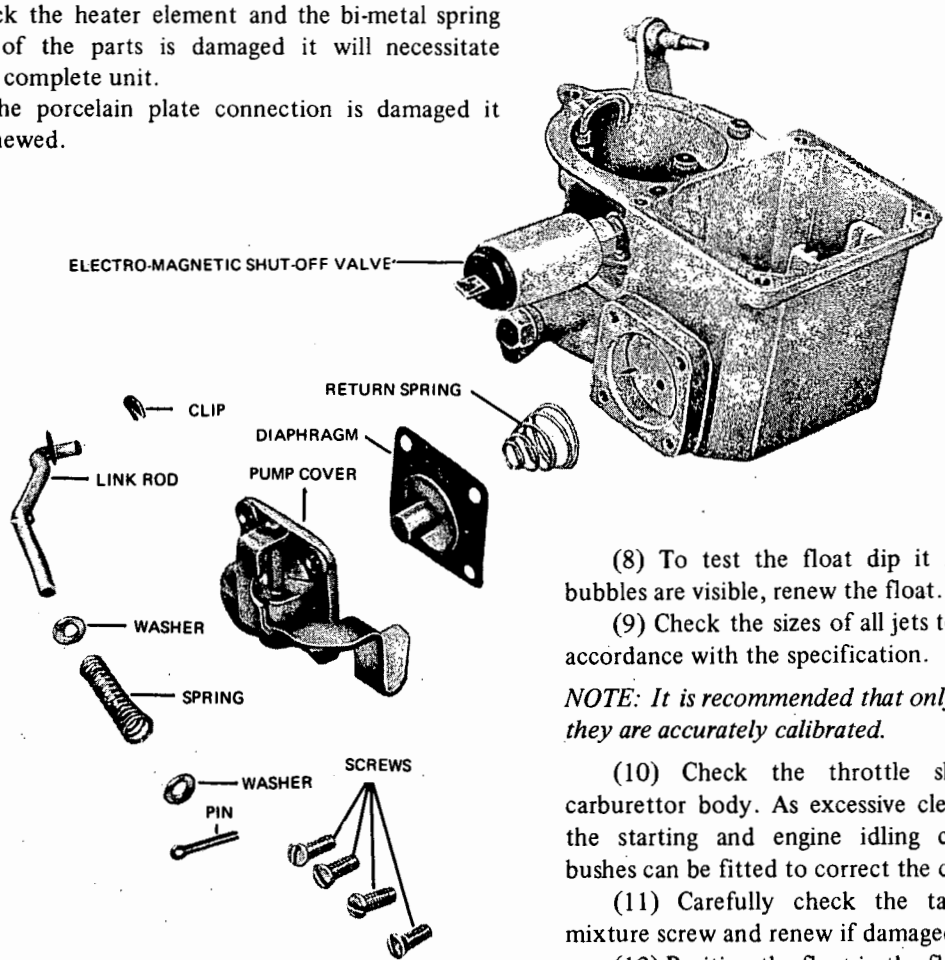
(5) Check the heater element and the bi-metal spring and if one of the parts is damaged it will necessitate renewing the complete unit.

(6) If the porcelain plate connection is damaged it should be renewed.

*NOTE: Special attention is necessary when installing the ceramic plate with bi-metal spring and heater element, that the marking on the plate corresponds with the mark on the spring housing.*

(7) Check condition of accelerator pump diaphragm and renew if necessary.

*NOTE: Spitting back in the carburettor on acceleration usually is an indication of a leaking diaphragm.*




Accelerator Pump Components on 30 PICT Carburettor.

(8) To test the float dip it in hot water and if air bubbles are visible, renew the float.

(9) Check the sizes of all jets to ensure that they are in accordance with the specification.

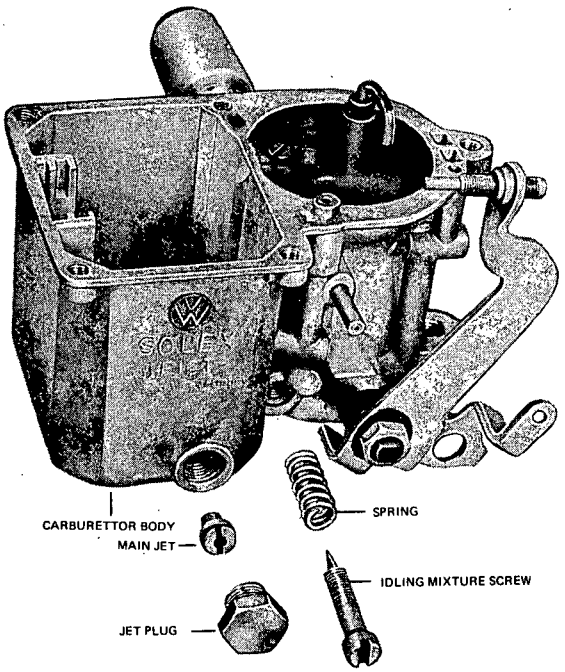
*NOTE: It is recommended that only genuine jets be used as they are accurately calibrated.*

(10) Check the throttle shaft clearance in the carburettor body. As excessive clearance is detrimental to the starting and engine idling conditions, if necessary bushes can be fitted to correct the clearance.

(11) Carefully check the tapered end of the idle mixture screw and renew if damaged.

(12) Position the float in the float chamber.

(13) Lubricate the fast idle cam steps.




Main Jet and Idling Mixture Screw on 30 PICT-2 Carburettor.

**TO ADJUST IDLING**

It may be necessary to adjust the idling occasionally but this must only be done when the engine is at operating temperature.

*NOTE: Ensure that the idling speed screw is no longer resting on any of the steps on the fast idle cam.*

(1) By means of the idle speed adjusting screw, set the engine idling at 550 rpm.

(2) Using a screwdriver, turn the mixture control screw in a clockwise direction until the engine speed slows down and then turn the screw anti-clockwise ¼ to 1/3 turn.

(3) Slowly turn the screw in either direction, as required, to regulate the idling speed.

The normal initial mixture can be set by turning the mixture control screw 1¼ to 1½ turns from the fully closed position. Do not tighten the screw excessively as it is likely to be damaged. It is very important to set the idling accurately.

**PRE-IGNITION IN ENGINES**

In some countries the qualities of fuels vary considerably. Having a somewhat lower pre-ignition temperature, pre-ignition can take place in the engine, especially in the following conditions:

(1) Wrong setting of carburettor idling, being too rich.

(2) Check and re-set ignition timing if necessary.

(3) Check adjustment of cooling air throttle ring, when fitted.

(4) Accumulation of excessive carbon deposits in combustion chambers.

(5) Cooling of the engine insufficient due to improper fan belt tension and excessive dirt on the outside of the engine assembly.

In some cases where it is not possible to deal satisfactorily with pre-ignition troubles by normal workshop means, a special pilot jet with electro-magnetic shut-off valve is serviced.

**TO INSTAL ELECTRO-MAGNETIC SHUT-OFF VALVE**

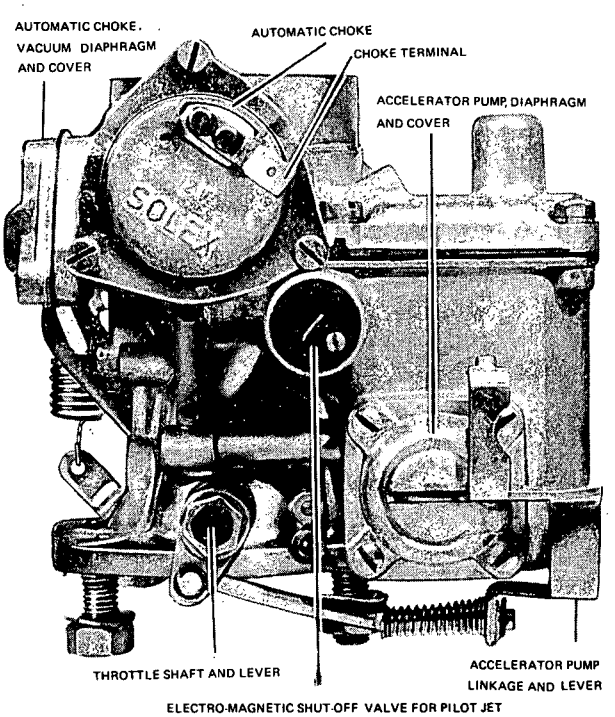
(1) Take out the standard pilot jet and in its place instal the pilot jet with electro-magnetic shut-off valve.

(2) Attach a 16" connecting cable to the terminal of the pilot jet with the electro-magnetic shut-off valve and also the terminal 15 of the ignition coil.

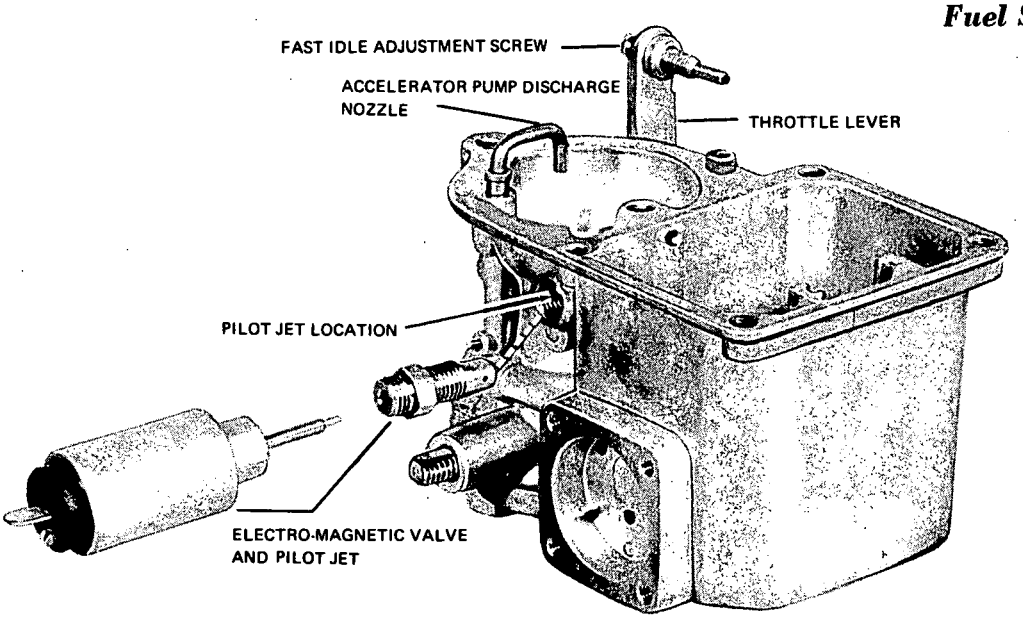
By switching off the ignition, the jet needle which is operated by an electro-magnet, obstructs the flow of fuel by closing the pilot jet. By this means pre-ignition is practically eliminated. When the ignition is switched on, the jet is once again open.

The electro-magnet can be switched off by turning the hand lever. When the handle of the lever points towards the fan housing, the pilot jet with electro-magnet shut-off valve is switched on. In the opposite position it works like an ordinary pilot jet.

Remove the jet piece from the housing when required to be cleaned otherwise no other maintenance is necessary.




30 PICT-2 Carburettor fitted to 1600 Models Showing Right Hand Side. Typical also of 1500 models.




Electro-magnetic Shut-Off Valve and Pilot Jet on 30 PICT-2 Carburettor. Typical also of all Carburettors so equipped.

## 3. FUEL PUMP

### DESCRIPTION

Fuel is supplied to the carburettor by means of a diaphragm pump mounted on the engine crankcase. An eccentric on the distributor shaft mechanically operates the pump. The pump fuel delivery rate is regulated automatically by the drop in level of the fuel in the carburettor float bowl.

The fuel pump is divided into two parts, ie, upper and lower. The upper part contains the suction valve and the delivery valve and the lower part the rocker mechanism. The diaphragm is located between the two parts. The diaphragm is made up of a number of layers of a special flexible rubberised fabric which is not damaged by fuel and towards the centre, the layers are held together by two protector plates riveted to the diaphragm pull rod.

With every two revolutions of the engine the distributor drive shaft, with eccentric, completes one revolution. During this one revolution of the eccentric, the fuel pump performs two strokes, ie, one suction stroke and one discharge stroke. This is made possible by the eccentric on the distributor drive shaft causing the push rod to come into contact with the fuel pump rocker arm which pulls down the pump diaphragm against the diaphragm spring. This downward movement of the diaphragm creates a vacuum above the diaphragm which draws the suction valve off its seat and simultaneously fuel is drawn through the valve into the pump. When the push rod moves in the opposite direction, the diaphragm is pushed up by its loaded spring and this movement forces the sucked-in fuel through the delivery valve and into the carburettor float chamber. By this method the carburettor receives a constant supply of fuel while the engine is running.

The pump pressure depends on the extent to which the spring is compressed during each suction stroke of the pump. The buoyancy of the carburettor float regulates this pressure by causing pressure at the needle valve. With the rise in the level of the fuel in the float chamber, the float forces up the needle.

In this manner there is an increase of pressure in the fuel line and float chamber, causing a decrease in the working stroke of the pump. When an engine is running normally, the diaphragm moves very slightly.

Below the diaphragm a small hole is provided for bleeding the chamber which also serves as a drain-hole for any fuel which may enter the lower chamber due to a faulty diaphragm.

The fuel pump is lubricated from the engine crankcase and therefore no regular lubrication is necessary.

*NOTE: All engines from Chassis No 651001 (Engine No 5132057) have been fitted with a fuel pump having a bent delivery pipe instead of the previous straight vertical type.*

### TO CHECK PUMP PRESSURE

With the needle valve closed and the engine running at 1000-3000 rpm, the correct setting of the pump pressure should be 1.30-1.85 psi. At this setting the fuel delivery rate is 10.2 cu in per minute minimum.

For the purpose of checking fuel pump pressure, connect a gauge which has been brazed to a fuel test line

between the fuel pump and the carburettor by means of a T-joint piece and with a test range 0-5.7 psi. Behind the gauge a fuel tap is fitted in the fuel test line.

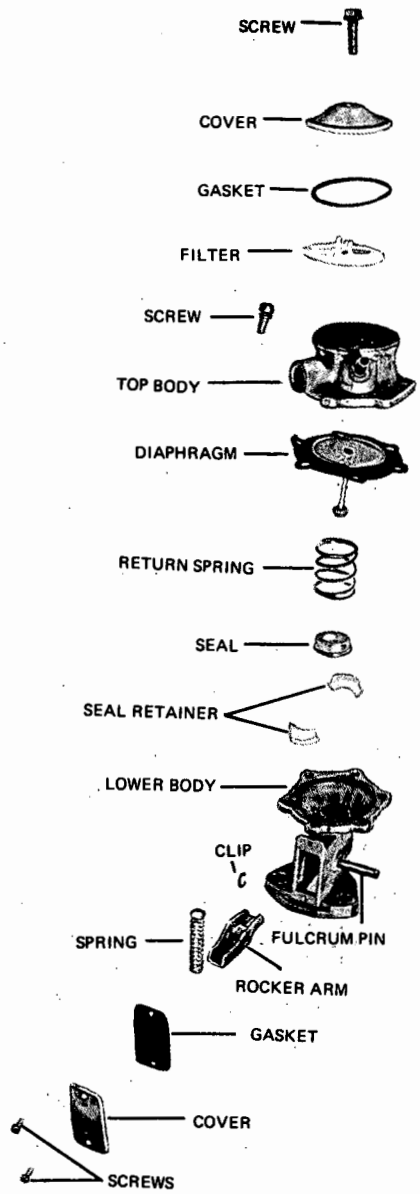
Correct adjustment of the push rod stroke and the diaphragm spring tension determines the pump pressure.

By adding or removing flange gaskets, the push rod stroke can be adjusted.

In case the desired result is not obtained by adjusting the push rod stroke, renew the diaphragm spring.

Too high pump pressure can cause flooding and dilution of engine oil.

Too low pump pressure will not deliver fuel in sufficient quantity to the carburettor and the engine performance will suffer as a result.




Exploded View of Fuel Pump Components. (Typical of all models.)

## TO REMOVE

(1) Detach the fuel hose from the fuel pump.

(2) Using a suitable wrench, undo the two mounting stud nuts at the flange mounting.

(3) Remove the fuel pump.

(4) Remove the push rod, intermediate flange and gasket.

## TO ADJUST FUEL PUMP STROKE

(1) For the purpose of adjustment, position the intermediate flange, push rod and the two gaskets on the fuel pump mounting studs. Position the push rod so that the convex end is at the eccentric of the distributor drive pinion.

(2) Position adjusting gauge VW328c on the fuel pump mounting studs and on the gaskets and intermediate flange. Screw on the two securing nuts and tighten them to the same torque used when installing the fuel pump so that the gaskets will be compressed to the usual thickness.

The stroke of the push rod is approximately .160" which is determined by the eccentric on the distributor drive shaft. The movement of the stroke should be within the range of .2" as marked on the gauge. The marks correspond to a length of .310" and .510" measured from the fuel pump contact flange, including the two gaskets, to the end of the projecting push rod. To check the fuel pump stroke rotate the engine. The stroke can be altered, as required, by fitting the suitable number of gaskets to the intermediate flange. Less than the required number of gaskets must not be fitted, as this could result in damaging the diaphragm and the drive mechanism. Remove intermediate flange and gaskets.

## TO INSTAL

Installation is a reversal of the removal procedure observing the following points:

(1) Before installing the pump, using universal grease, fill the lower chamber of the pump.

(2) Position on the mounting studs, one gasket, intermediate flange, second gasket and then the fuel pump so that the inspection cover of the pump is towards the left. Screw on the securing nuts and tighten them to the prescribed torque when the engine is warm.

(3) Connect up the fuel line and fuel hose.

*NOTE: Ensure that the fuel line rubber grommet is seated correctly in the engine front cover plate.*

**TO DISMANTLE**

(1) As already described, remove the fuel pump.

(2) Extract the locking ring from the rocker arm pin.

(3) Using a suitable punch, drive out the rocker arm pin.

(4) From the inspection cover remove the two securing screws and take off the cover.

(5) Using a screwdriver take out the rocker arm return spring.

(6) Undo the top cover screw and remove the cover.

(7) From the top remove the gauze filter very carefully.

(8) Undo the six attaching screws and separate the two portions of the fuel pump.

(9) With the finger and thumb press down the diaphragm and take out the rocker arm.

(10) From the lower portion of the pump remove the diaphragm with spring and gasket.

**TO ASSEMBLE**

Assembling is a reversal of the dismantling procedure observing the following points:

(1) Carefully check the suction and the delivery valves, and replace if necessary.

(2) Check the diaphragm and the top cover rubber gasket for wear or deterioration and renew if necessary.

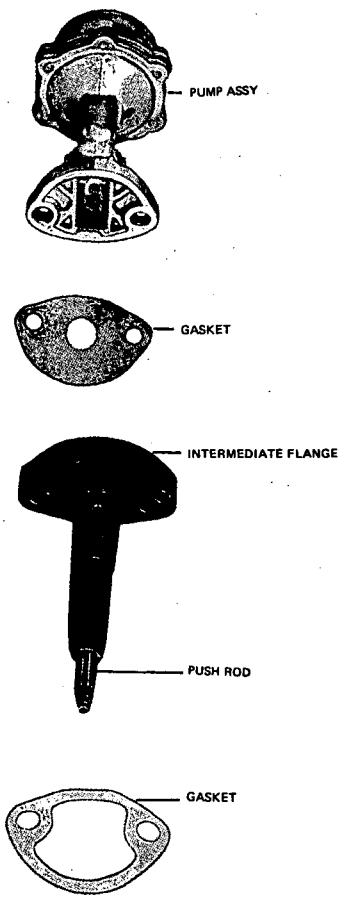
(3) Using thumb and finger press down the diaphragm and spring and insert the rocker arm in the diaphragm. Insert rocker arm pin and secure with the locking ring.

(4) Position the lower body of the fuel pump in a vice. The diaphragm should be brought to the necessary assembling position by drawing level with the face of the lower body.

(5) The upper portion of the pump can now be placed in position with the fuel connections being located above the inspection cover. Ensure that the diaphragm is seated properly all round and without any creasing. Insert the filter with the flat side facing downward. Do not forget to instal the fibre sealing washer between the pump cover and the mounting screw.

(6) Using universal grease pack the lower portion of the pump. At operating temperature, the grease becomes liquid which enables all moving parts to be lubricated. One indication that the diaphragm is leaking is when the rocker arm and the push rods are lacking oil or grease.

(7) Check if the rocker arm is seating correctly.




**Fuel Pump with Intermediate Flange and Push Rod.**

## 4. AIR CLEANER

The air cleaner is, in fact, a filter installed for filtering all dust and grit from the air prior to its entering the carburettor intake and thereby prolongs the life of the engine.

It is not sufficient to only have an air cleaner installed, but to ensure that it is at all times maintained in good condition by regular servicing.

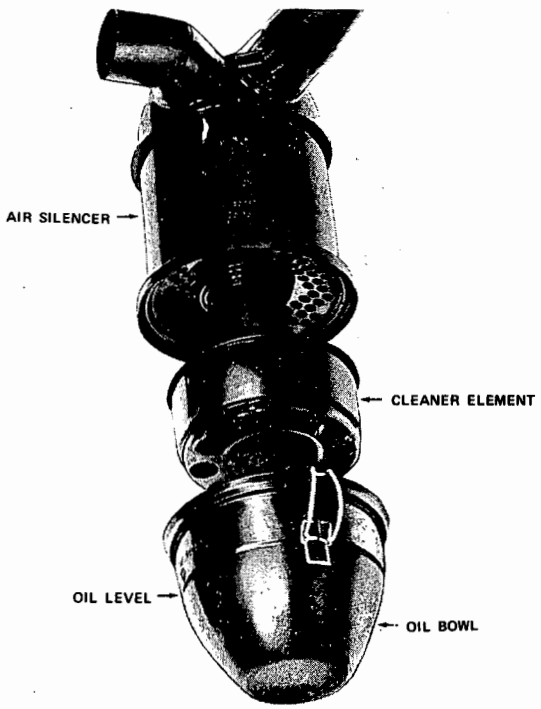
**OIL BATH AIR CLEANER**

This type of air cleaner requires regular servicing every 3500 miles while operating under normal conditions.

The contaminated oil should be emptied from the oil reservoir of the air cleaner, thoroughly clean the reservoir and fill with fresh engine oil SAE 20 up to the level mark.

(Do not exceed the level mark.) Rinse the filter element in fuel or any other cleaning solvent. Check the oil level regularly at every 1250 miles.

It is necessary to remove the air intake elbow before taking off the carburettor top cover.




Exploded View of Air Cleaner Assembly.

To avoid damaging the air intake tube, if removing the engine, first take off the air intake tube.

**TO REMOVE AIR INTAKE ELBOW**

(1) Detach the oil bath cleaner from the air intake elbow.

(2) Detach the air intake elbow from the carburettor by slackening the clamp screw.

(3) Remove the nut and bolt from the air intake mounting bracket and lift out the air intake elbow.

(4) After removing the ignition coil, the air intake elbow bracket can then be removed.

**TO INSTAL AIR INTAKE ELBOW**

Installation is a reversal of the removal procedure observing the following points:

(1) Ensure that gaskets are properly seated when installing the air intake elbow on the carburettor to avoid air leaks.

(2) Do not tighten the intake elbow too much otherwise the air horn of the carburettor top body is likely to be damaged.

## 5. ACCELERATOR CABLE

The accelerator cable passes below the body encased in a conduit and then through the engine fan housing. At the front end it is attached to a bolt in the accelerator pedal lever and at the rear end to a swivel pin in the throttle lever.

The conduit tube at the fan housing is within a coil spring, which serves as a return spring for the accelerator and also closes the choke.

Towards the carburettor end the spring is within a guide sleeve which prevents the spring from buckling.

**TO REMOVE**

(1) Raise the rear of the vehicle to facilitate removal and installation.

(2) Detach the accelerator cable from the carburettor throttle valve lever.

(3) Remove the spring seat by compressing the spring. Withdraw the spring and guide sleeve.

(4) Withdraw the accelerator cable from its conduit tube in the fan housing towards the forward end.

(5) Undo and take out the cover plate from below the pedal linkage.

(6) From the accelerator pedal lever undo the bolt and detach the cable from the bolt.

(7) Fully withdraw the accelerator cable towards the forward end.

**TO INSTAL**

Installation is a reversal of the removal procedure observing the following points:

(1) Apply universal grease to the accelerator cable.

(2) Ensure that the cables do not twist together above the transmission case. Correctly instal the accelerator cable in the conduit tube on the transmission case, to avoid possible damage to the transmission case.

(3) Exercise care when connecting the accelerator cable to the throttle lever, to avoid excessive tension occurring at full throttle and possible breakage of the cable. To overcome this possibility, open the throttle valve to allow for a clearance of approximately .040" between the throttle lever and the stop at the body of the carburettor. Press the accelerator pedal down to the limit and attach the cable to the throttle valve.

## 6. ACCELERATOR PEDAL LINKAGE (LEFT HAND DRIVE VEHICLES)

### TO REMOVE ACCELERATOR PEDAL

(1) Carefully take out the cab floor mat.

(2) Take off the retaining spring from the pedal bar, disconnect the pedal bar from the pedal and lift up the pedal on its hinge.

(3) From the pedal hinge pin remove the leaf spring and drive out the pin.

(4) On the side of the hinge pin is a flat surface which locks the pin in position with the leaf spring.

### TO INSTAL

Installation is a reversal of the removal procedure observing the following points:

(1) Use universal grease for lubricating the hinge pin and pedal bar.

(2) Position the leaf spring in the flat provided on the side of the hinge pin.

(3) Insert the end of the retaining spring into the ringed groove in the pedal bar.

(4) Seal the pedal bar with the rubber boot.

### TO REMOVE ACCELERATOR PEDAL BAR

(1) Extract the pedal bar retaining spring at the pedal end.

(2) From below the pedal linkage remove the cover plate.

(3) Remove the retainer spring from the pedal lever end of the pedal bar and withdraw the pedal bar.

### TO INSTAL

Installation is a reversal of the removal procedure observing the following points:

(1) Using universal grease, lubricate the ends of the pedal bar.

(2) Insert the retaining springs in the ringed groove in the pedal bar.

(3) See that the pedal bar is correctly positioned in the rubber boot.

### TO REMOVE ACCELERATOR PEDAL LEVER

(1) From below the pedal linkage remove the cover plate.

(2) Detach the pedal bar and the accelerator from their mountings on the pedal lever.

(3) Extract the split pin from the pedal lever mounting pin and detach the pedal lever.

### TO INSTAL

Installation is a reversal of the removal procedure observing the following points:

(1) Using universal grease lubricate all linkage joints.

(2) Position the pedal lever on its mounting, with the bent arm towards the pedal bar, and secure.

(3) Attach the pedal bar and the accelerator cable to the pedal lever, the pedal bar to the bent arm of the pedal lever and secure all attachments.

## 7. ACCELERATOR PEDAL LINKAGE (RIGHT HAND DRIVE VEHICLES)

The procedure for removing and installing the accelerator pedal and rod on right-hand-drive vehicles is similar to that for left-hand-drive vehicles.

### TO REMOVE ACCELERATOR PEDAL SHAFT AND LEVER

(1) Raise the vehicle and support on stands.

(2) From under the pedal linkage remove the splash shield.

(3) Extract the retainer spring from the pedal rod and detach the rod.

(4) Disconnect the accelerator cable from the operating lever.

(5) Turn the accelerator pedal shaft into position and using a small hammer and pin punch, tap out the operating lever locking pin.

(6) Withdraw the operating lever and slide out the accelerator pedal shaft.

(7) If necessary, slide the locating ring from the accelerator pedal shaft.

**TO INSTAL**

Installation is a reversal of the removal procedure observing the following points:

(1) Clean the accelerator linkage and, using universal grease, lubricate all bearing points.

(2) Slide the locating ring onto the pedal shaft and then instal the shaft.

(3) Secure the accelerator cable operating lever with a new locking pin.

(4) Using universal grease, lubricate the accelerator cable pin and hole in the accelerator pedal shaft at the pedal rod attachment.

## 8. CHOKE CONTROL CABLE (MANUAL CHOKE MODELS)

The choke control cable is encased in a flexible metal sleeve over which is provided a plastic casing. The top end of the metal sleeve is anchored at the front and then passes through the tool compartment. On the under side of the body it is secured by a clip to the accelerator cable conduit tube from where it is passed through the crossmember and the fan housing before being attached to the choke lever by a clamp screw. Operating the choke valve is done by pulling the knob located at the left of the heating control knob on the front side of the seat bench.

**TO REMOVE**

(1) Raise the vehicle and support on stands.

(2) Detach the cable from choke lever and also the cable sleeve from the carburettor.

(3) Remove the seat cushion and, from inside the seat bench, release the union nut. Unscrew the operating knob and, from the tool compartment, withdraw the choke control cable.

(4) Disconnect the choke control cable from the accelerator cable conduit tube.

(5) Toward the front, pull out the choke control cable and sleeve from the fan housing, the engine front cover plate and the rear crossmember.

(6) Pull the cable from its sleeve.

**TO INSTAL**

Installation is a reversal of the removal procedure observing the following points:

(1) Using universal grease, lubricate the choke control cable and then insert it into the flexible metal sleeve.

(2) Instal the cable and the cable sleeve by inserting them through the rear crossmember, the engine front cover plate and the fan housing. Insert the front end of the cable through the lower panel of the tool compartment, through to the front side of the seat bench. Correctly seat the rubber grommet in the lower panel of the tool compartment to prevent water entering into the compartment.

(3) As previously mentioned, exercise care to prevent the choke cable from getting twisted with the clutch or accelerator cables above the transmission case.

(4) Secure the choke control cable to the seat bench and screw on the knob.

(5) Connect the choke control cable to the choke lever, ensuring that the control knob is flush with the panel and the choke valve in the fully open position.

## 9. FUEL TANK

**DESCRIPTION**

To gain access to the fuel tank open up the engine compartment lid. The tank capacity is 8.8 Imp gallons. To remove or instal the fuel tank is only possible with the engine removed.

**TO REMOVE**

(1) Remove the engine as described in the appropriate section.

(2) After closing the fuel tap, detach the flexible fuel hose from the tap.

(3) Drain fuel from the tank.

(4) Take out the rubber seal from the fuel tank filler tube.

(5) Detach the fuel tap remote control cable.

(6) Undo the two securing bolts from the fuel tank retaining metal straps, lift up straps and remove the tank.

(7) Take off the fuel drain tap.

(8) Thoroughly clean the fuel tank by flushing it out with petrol and blow out with compressed air.

**TO INSTAL**

Installation is a reversal of the removal procedure observing the following points:

(1) Carefully position the anti-squeak felt packing.

(2) Instal fuel tap with new gaskets and check for leaks.

(3) Check the adjustment of the fuel tap remote control cable.

## 10. FUEL TANK REMOTE CONTROL CABLE — WHEN FITTED

The fuel tap is operated from the driver's seat through a remote control cable which is encased in a sleeve to protect it from dirt and water. A clamp screw secures the cable to the operating lever of the fuel tap. The flexible cable sleeve is mounted on the seat bench in the cab and located on the right side of the heating control knob. It passes through the tool compartment and by the side of the heating cable conduit tube before it is connected to the operating lever of the fuel tap.

**TO REMOVE**

(1) Raise the vehicle and support on stands.

(2) From the fuel tap operating lever, release the cable clamping screw.

(3) Slacken the clamp of the cable sleeve and take off the rubber boot at the sleeve end.

(4) Turn up the retaining loops of the cable sleeve beside the conduit tube of the heating cable to facilitate removal.

(5) To facilitate access from within the tool compartment, lift back the seat and undo the union nut. Unscrew the operating knob and, from below the vehicle, take out the cable sleeve.

**TO INSTAL**

Installation is a reversal of the removal procedure observing the following points:

(1) Withdraw the cable from the sleeve, lubricate with universal grease and insert cable into the sleeve.

(2) Route the cable sleeve to the clamp by inserting it from the front through the crossmember. From below, guide the front end of the sleeve through the bottom of the tool compartment and secure it to the seat bench. Ensure that the rubber grommet has been correctly installed in the bottom of the tool compartment.

(3) Screw on the cable operating knob.

(4) Secure sleeve clamp in the rear and slide the rubber boot into position on the end of the cable sleeve.

(5) Push the cable control knob in completely.

(6) The operating lever of the fuel tap should be turned to the open position.

(7) Connect control cable to the operating lever of the fuel tap by tightening the clamp screw.

**TO CHECK CABLE SLEEVE**

Sometimes difficulty is experienced in moving the fuel tap remote control cable. It is also difficult to operate the knob in or out. As a result of this defect the tap cannot be turned to the reserve position. In such an eventuality observe the following:

(1) Remove the kinked cable and renew.

(2) The remote control cable must always be kept as straight as possible when installed in position. If tightening of the cable sleeve becomes necessary commence from the cab end and work along to the fuel tap. Before commencing this operation, the cable sleeve should be detached from the guide bracket in front of the tap.

(3) Straighten the guide bracket, in such a manner that when operating the fuel tap with the cable straight, it works quite satisfactorily.

(4) Connect the cable sleeve to the guide bracket. If the sleeve projects beyond the sleeve clamp in such a manner as to interfere with the operation of the tap, reduce the length of the sleeve to prevent this happening.

(5) Apply universal grease, to the cable and insert it in the sleeve.

(6) In case it is considered necessary, additional sleeve clamps can be fitted, spacing them 10" apart. This will prevent the cable sleeve hanging through.

**TO CHECK FUEL TAP**

(1) Remove, dismantle and thoroughly clean fuel tap.

(2) If necessary, polish the friction faces of the tap with polishing linen and then apply, evenly, a light coat of sulphide of molybdenum paste or graphite grease, prior to assembling.

**FUEL LEAK AT FILLER ORIFICE**

In the event of fuel leaks at the filler cap, proceed as follows:

(1) Remove the filler cap and measure the thickness of

the cork gasket, which should be at least .090" and flexible. Renew any gasket which is not within these standards, when a new gasket is not readily available, an old gasket can be made serviceable temporarily by soaking it in warm water for a few minutes and then re-fit until a new replacement is available.

(2) Using a glass plate and a feeler gauge check condition of the edge of the filler orifice. Permissible unevenness is .004". Any variation from this limit or damage cannot be compensated by the filler cap gasket. Improvement in the condition can be effected by using a finishing file but in doing so, avoid filings from entering the tank.

(3) If the above measures do not remedy the defect, it is to be accepted, that the valve or the sealing in the cap is defective and replacement is the only solution.

## 11. FUEL SYSTEM FAULT DIAGNOSIS

**(1) Engine will not start.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Lack of fuel in float bowl. | – Check fuel pump delivery, sticking or clogged needle valve. |
| (b) | Engine flooded with fuel when cold, by excessive use of choke or accelerator | – Hold accelerator flat until engine starts and revise starting procedure. |
| (c) | Engine flooded when hot, as in (b above). | – Hold accelerator pedal flat until engine starts. |

**(2) Engine stalls at idling speed.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Incorrect adjustment of idling stop and/or mixture control screws. | – Check and adjust control screws. |
| (b) | Carburettor float bowl flooding. | – Check float level and for sticking needle valve or punctured float. Clean and blow out carburettor. |
| (c) | Carburettor starving for fuel. | – Check fuel delivery at needle valve. Clean and blow out carburettor. Check fuel pump. |
| (d) | Blocked idling tube (jet) or idle air bleed. | – Clean and blow out carburettor. |
| (e) | Carburettor to manifold attachment bolts loose. | – Check and tighten bolts. |
| (f) | Leaking carburettor flange or intake manifold gaskets. | – Check and renew faulty gaskets. |
| (g) | Faulty gasket or loose attachment screws, carburettor main body to top cover assemblies. | – Renew faulty gaskets and tighten securing screws. |

**(3) Flat spot on acceleration.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Blocked accelerator pump discharge jet or sticking check valve. | – Clean and blow out carburettor. |
| (b) | Leaking diaphragm accelerator pump. | – Instal new diaphragm assembly. |
| (c) | Faulty accelerator pump linkage. | – Check and rectify pump linkage. Check that link is correctly set according to operating conditions. |

**(4) Engine misfires or cuts out at high speed.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Obstruction in main or power jets. | – Dismantle and blow out jets. |
| (b) | Low fuel level in float chamber or float chamber starving for fuel. | – Check float level setting, check fuel pump and supply lines. |
| (c) | Failure of fuel pump to deliver sufficient fuel. | – Overhaul fuel pump. |
| (d) | Blockage in carburettor fuel gauze filter (if fitted). | – Remove and clean or renew filter gauze. |

| | | |
|---|---|---|
| (e) | Restriction in fuel pump filter bowl. | – Clean or renew filter. |
| (f) | Air leak between fuel pump and tank. | – Rectify air leak. |
| (g) | Air leak between carburettor top and main body assemblies. | – Check and renew gasket and tighten securing screws. |
| (h) | Water in carburettor. | – Drain and clean fuel system. |

**(5) Excessive fuel consumption.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Float level too high. | – Check and readjust float level. |
| (b) | Choke butterfly valve partially closed. Automatic choke out of adjustment. | – Check and rectify. Adjust automatic choke. |
| (c) | Air cleaner element dirty or requires renewal. | – Clean element or renew oil. |
| (d) | Accelerator pump link requires adjustment or in wrong position. | – Readjust accelerator pump stroke. |
| (e) | Fuel pump delivery pressure too high. | – Check and fit correct diaphragm spring, adjust fuel pressure. |
| (f) | Faulty fuel pump diaphragm. | – Overhaul fuel pump and renew as necessary. |
| (g) | Leaks between fuel pump and fuel tank and fuel pump and carburettor. | – Check and rectify leaks. |
| (h) | Fuel leaks at jet plug copper gaskets. | – Renew jet plug gaskets. |
| (i) | Faulty air correction jets. | – Check and renew faulty jets. |
| (j) | Worn or damaged main or air correction jets. | – Check and renew faulty components. |
| (k) | Excessive use of choke or accelerator pump. | – Revise driving habits. |

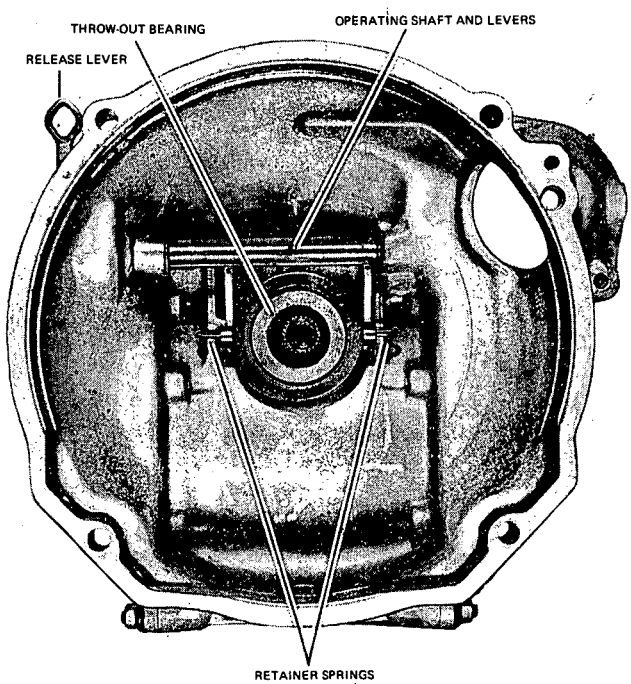
# CLUTCH

## SPECIFICATIONS

| | | |
|---|---|---|
| Type | Single dry plate | |
| Operation | Mechanical | |
| Type of driven plate hub | Spring segment | |
| Pedal free travel | 0.40" – 0.80" | |
| Adjustment | Adjusting nut on cable end | |
| Clutch diameter | To July 1962 | From July 1962 |
| | 7.0" | 7.8" |
| Driven plate linings: | | |
| Outside diameter | 7.04" – 7.12" | 7.834" – 7.914" |
| Inside diameter | 4.88" – 4.92" | 5.118" – 5.158" |
| Thickness | 0.14" | 0.146" – 0.154" |
| Total lining area | 41.5 sq in | 60.4 sq in |
| Type of pressure plate: | | |
| To June 1966 | Coil springs | |
| From June 1966 | Diaphragm spring | |
| Pressure plate springs: | 7.0" (Early) | 7.0" (Late) |
| Inner spring diameter | 0.698" | 0.698" |
| Inner spring length loaded 1.03" | 35-40 lbs | 40-44 lbs |
| Outer spring diameter | 1.0" | 1.0" |
| Outer spring length loaded 1.157" | 108-114 lbs | 110-120 lbs |

| | |
|---|---|
| Pressure plate springs: | |
| Spring diameter | 1.0" |
| Length loaded 1.148" | 98-108 lbs (when new) |
| | 88-98 lbs (when used) |
| Type of release bearing | Early models – carbon ring |
| | Subsequent models – ball thrust |
| Clutch pressure plate run out | .004" (max) |
| Release ring run out | .012" (max) |
| Clutch driven plate run out | .32" |
| Distance from flywheel to release ring | 1.06" |

## 1. DESCRIPTION




Clutch Housing for One Piece Transmission Case on Models subsequent to Late 1200.

The single dry plate clutch is comprised of a pressure plate and cover assembly and a driven plate to which the clutch facings are riveted.

The pressure plate assembly can be one of two types used, ie, on early models coil type pressure springs are located between the cover and pressure plate, whereas later models are fitted with the diaphragm spring type of pressure plate, the diaphragm spring replacing the coil springs.

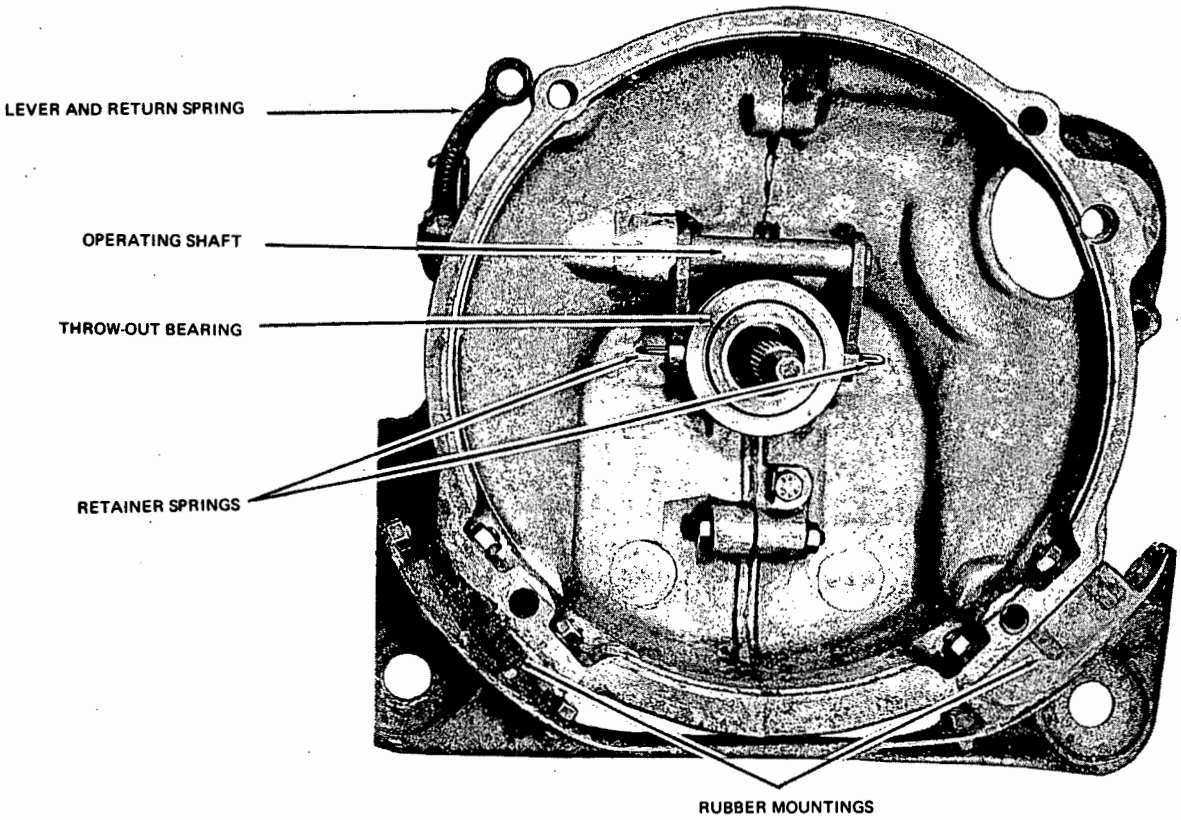
The release levers in the pressure plate assembly are adjustable, but they should not require adjustment in service. Release lever adjustment is carried out during initial assembly of the pressure plate and cover and is only necessary when the assembly is dismantled for reconditioning.

The driven plate hub is splined to slide on the gearbox input shaft.

The spigot bearing for the gearbox input shaft is located within the flywheel gland nut and is of the needle roller type.

The clutch release bearing on early models is of the carbon ring type which was subsequently replaced by the single row ball thrust type.

Clutch pedal free travel is adjusted at the adjusting nut located at the end of the operating cable.




Clutch Housing for Split Transmission Case fitted to early models.

## 2. CLUTCH ASSEMBLY

### TO REMOVE AND INSTAL

(1) Remove the engine assembly from the vehicle as described in the appropriate section.

(2) Mark the pressure plate cover in relation to the flywheel so that they may be assembled in their original positions.

(3) Take out the clutch pressure plate assembly securing bolts, releasing them evenly and diametrically opposite in turn to avoid stress in the assembly.

(4) Detach the pressure plate assembly and clutch driven plate from the flywheel.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Lubricate the needle bearing in the gland nut with a small quantity of universal grease.

(2) Using a clean dry cloth rub the gearbox input shaft splines with molybdenum disulphide powder.

(3) Instal the clutch driven plate and pressure plate assembly to the flywheel, using a used gearbox input shaft or special aligning tool to centre the driven plate hub with the spigot bearing.

(4) Ensure that the assembly is installed correctly in relation to the balance marks.

(5) Tighten the securing bolts evenly and diametrically opposite in turn to a torque of 18 ft/lb.

*NOTE: On early type pressure plates, note the correct position of the clutch cover locating lugs in the flywheel.*

### TO CHECK AND INSPECT

(1) Check that the driven plate facings are in serviceable condition and not worn, cracked, burned or contaminated with oil. Facings must be replaced for any of the given conditions.

(2) Check the driven plate and spring segments for cracks, and ensure that the plate hub is a sliding fit on the gearbox input shaft without excess radial play.

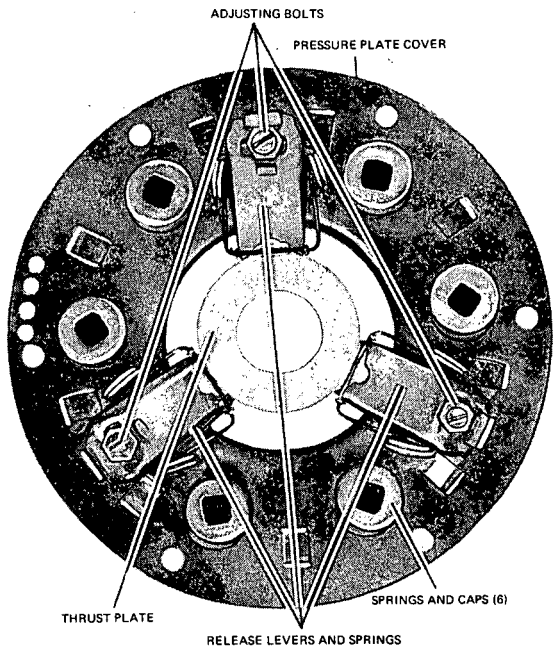
(3) Examine the flywheel and pressure plate faces for cracking and grooving. Light surface damage may be removed by machining.

(4) Ensure that the pressure plate assembly is not distorted otherwise clutch chatter or grab will result.

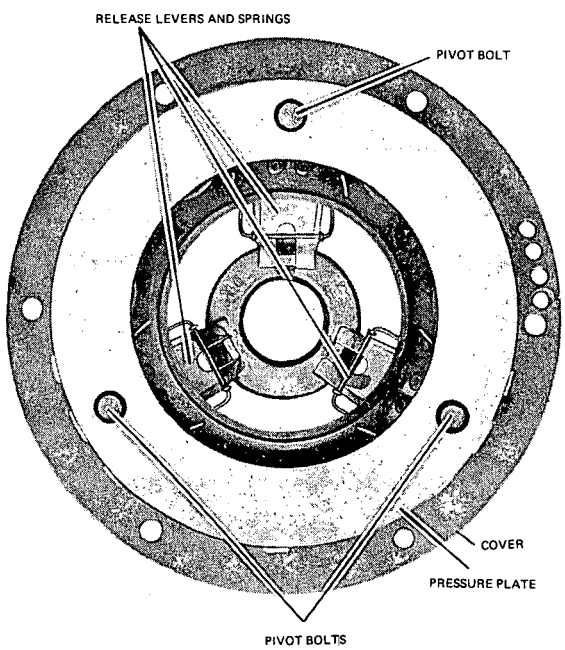
(5) Check the release plate, release fingers and pressure plate springs for wear or damage and replace as required.

(6) Ensure that the release bearing is in serviceable condition replacing it if necessary.

## 3. PRESSURE PLATE




Clutch Pressure Plate Assembly fitted to Early 1200 Models. Later models have Eye-bolt type Pivot Bolts, Ball Throw-out Bearing and Nine Pressure Springs.




Clutch Pressure Plate and Cover Assembly fitted to Early 1200 Models. Later models have Eye-bolt Type Pivot bolts.

### TO DISMANTLE

The following procedure applies to the coil spring type of pressure plate only. Overhaul of the diaphragm spring type pressure plate is not recommended and the assembly should be replaced as a unit when necessary.

(1) With the clutch driven plate and pressure plate assembly secured to the flywheel, mark all the components in such a way as to ensure assembly in their original positions to maintain balance.

(2) Remove the metal peening at the release lever adjusting nuts by use of a hacksaw.

(3) Remove the adjusting nuts and detach the release levers together with the springs and release plate.

(4) Take out the pressure plate assembly securing bolts, loosening them off evenly to avoid stress on the assembly.

(5) Remove the cover plate, spring caps, springs and spring seats. Detach the pressure plate from the flywheel.

### TO CHECK AND INSPECT

(1) Check the clutch cover for distortion and straighten if required.

(2) Check the pressure plate for distortion and the plate face for cracking or grooving. Machine or grind if necessary.

(3) Check and replace if necessary, worn, cracked or twisted release levers. Ensure that the release plate is in serviceable condition.

(4) Replace release lever return springs if weak.

(5) Check length of coil springs (see specifications), any difference should only be fractional. Springs should be replaced as sets rather than separately.

### TO ASSEMBLE

(1) Position the clutch driven plate and pressure plate in the flywheel.

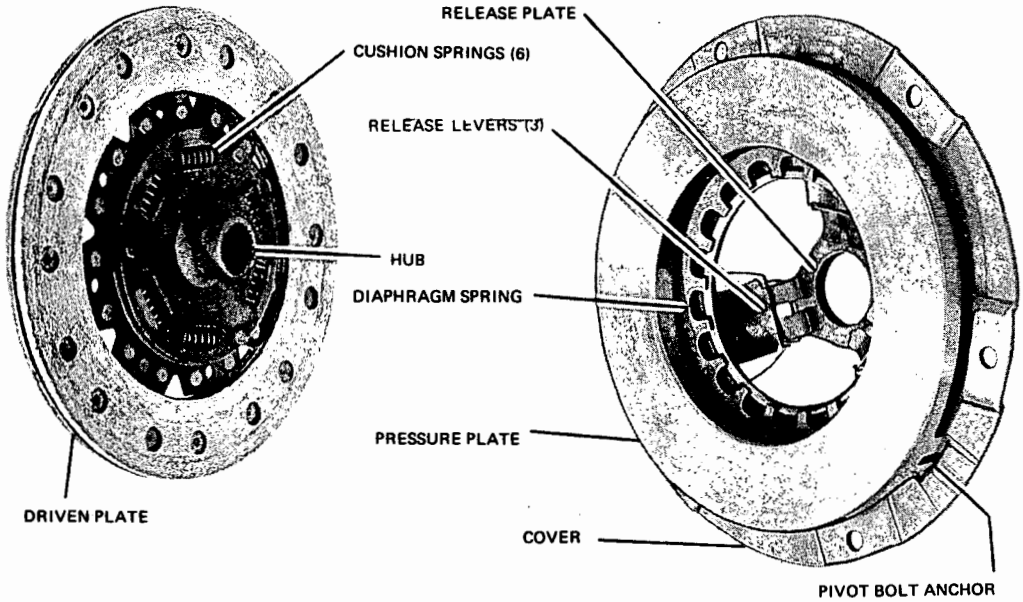
(2) Instal the spring caps, springs and spring seats into position with the clutch cover.

*NOTE: Ensure that all components are assembled in their original positions as marked on dismantling.*

(3) Instal the clutch assembly securing bolts tightening them evenly and diametrically opposite in turn to a torque of 18 ft/lb.

(4) Lubricate the release lever pivoting points with high melting point grease, instal the levers and secure provisionally with new adjusting nuts.

(5) Instal the release ring and locate the release lever return springs.




Diaphragm Spring type Pressure Plate Assembly with Spring Cushion Type Driven Plate fitted from June 1966.

(6) Using a depth gauge and straight edge, check the distance from the flywheel face to the release ring. This should be 1.06". If necessary adjust the release ring height at the lever adjusting nuts.

(7) Check the release ring run-out which should not exceed .012".

(8) Secure the adjusting nuts by peening or crimping at the shoulder.

## 4. DRIVEN PLATE

### TO INSPECT

The clutch driven plate has eight cushion segments on which the facings are mounted. The cushion segments are set alternatively concave and convex. It is essential for perfect operation of the clutch that the segments are equally set. Driven plates fitted with the diaphragm spring type pressure plate have double spring segments for the facings.

From Chassis No 548128 (Engine No 3478036) a modified clutch driven plate is fitted. To obtain torsional springing between the hub and plate six damper springs have been installed. The new plate can be service installed in previous vehicles.

Inspect the clutch facings. Renew the facings if they are oily, burnt, cracked or nearly worn to the rivet heads.

### FITTING NEW FACINGS

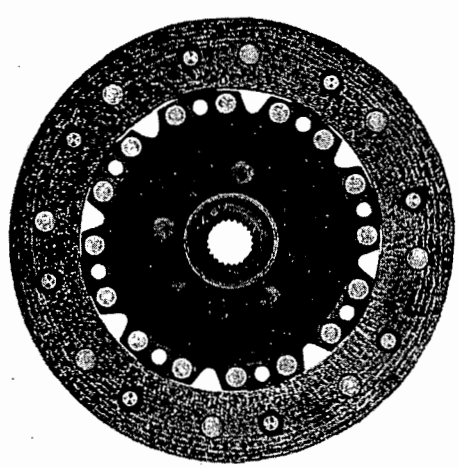
Old facings should be removed from the driven plate by drilling out the rivets.

When riveting facings to the segments, it should be noted that every second hole is countersunk. The clutch facings on either side of the plate are individually riveted to the segments, that is, each facing is attached to the plate with a separate set of rivets.

The facings are riveted to the convex side of the cushion segment.

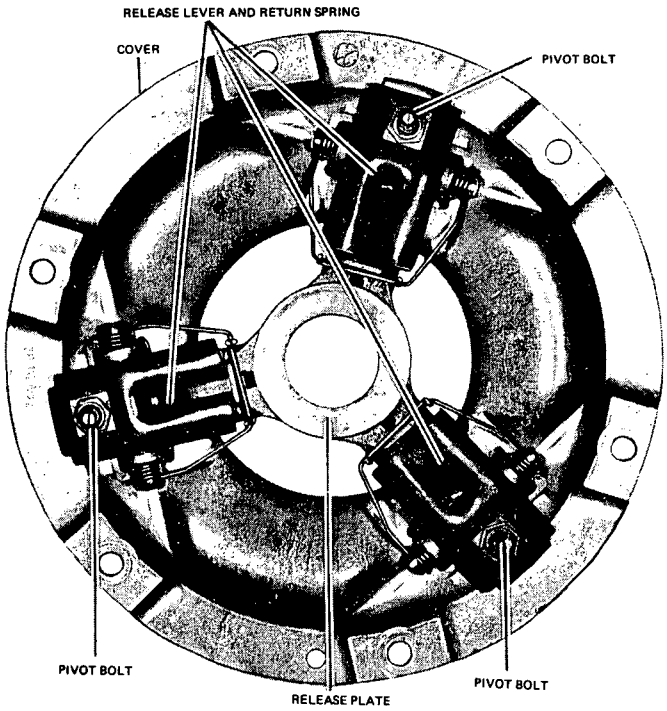
Check the distance between the friction faces of the clutch driven plate.

Check the clutch driven plate for run-out with the linings assembled. Maximum permissible run-out .020".



Driven Plate fitted to All Models except Diaphragm Spring type Clutch. Flywheel Side of Plate Shown.

## 5. RELEASE BEARING




Transmission side of Diaphragm Spring Type Clutch Pressure Plate and Cover Assembly.

### TO REMOVE AND INSTAL

(1) Remove the engine assembly from the vehicle as described in the appropriate section.

(2) Take out the release bearing retaining spring located at each end of the fork.

(3) Detach the release bearing from the fork.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Check the release bearing. On early models fitted with carbon ring type bearing, renew if the ring is worn or cracked.

Ball thrust release bearings should not be washed out with petrol or solvents, but should be replaced if the races are dirty, noisy or worn.

(2) Where the ball type release bearing is fitted with a plastic ring, use coarse emery cloth to roughen the plastic and rub in a lubricant of the molybdenum disulphide type.

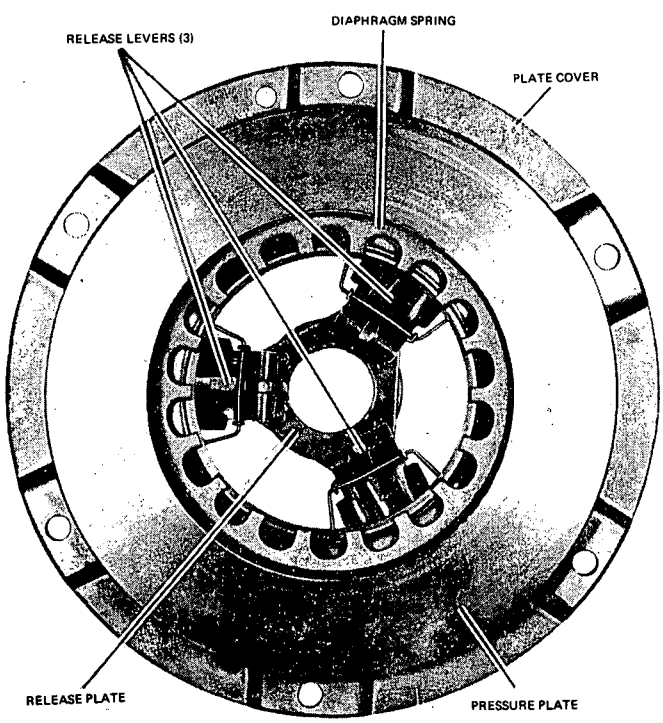
(3) Apply a smear of high melting point grease to the pivot points between the bearing and fork.

(4) Wipe the bearing clean with a dry clean cloth and instal in position in the fork.

(5) Instal the bearing retaining springs engaging the bent end of the springs at the rear of the fork hooked ends.

(6) Instal the engine assembly and check and adjust if necessary the clutch pedal free travel.

## 6. CLUTCH OPERATING SHAFT




Flywheel side of Pressure Plate Assembly. Diaphragm spring type Clutch.

### TO REMOVE AND INSTAL

(1) Loosen off and remove the starter motor.

(2) Take out the clutch release bearing retaining clips and detach the bearing from the fork.

(3) Remove the clutch operating lever securing nut and withdraw the lever, return spring and seat.

*NOTE: On later models a circlip is used to retain the operating lever to the shaft.*

(4) Take out the operating shaft bush locating bolt from the casing.

(5) Move the operating shaft to the left and withdraw the bush, washer and spacer.

(6) Remove the operating shaft to the right.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Examine the right hand bush in the transmission case and renew if necessary.

(2) Lubricate operating shaft bearing points with graphite grease and instal in position.

(3) Check the left hand bush and washer for wear and replace if necessary. Instal the bush, washer and spacer in the transmission case.

(4) With the hole in the bush in line with the locating bolt hole in the transmission case, instal the bolt and screw up to engage the bush.

(5) Ensure that the return spring is in serviceable condition and instal with the spring seat and operating lever.

(6) Secure the operating lever to the shaft with the bolt and nut, or circlip, depending upon the model.

(7) Carry out the adjustment operation for clutch pedal free travel and operating lever position as described under the section *CLUTCH ADJUSTMENT.*

## 7. CLUTCH CABLE

**TO REMOVE AND INSTAL**

(1) Raise the rear of the vehicle and support on stands, remove the left rear wheel.

(2) Loosen and remove the lock nut and adjusting nut at the cable end located in the operating lever on the transmission case. Detach the cable from the lever.

(3) Detach the rubber boot from the cable guide and withdraw the cable from the boot.

(4) Take out the securing screws and detach the cover plate from beneath the pedal linkage.

(5) Disconnect the operating cable at the cable operating lever and detach the cable.

(6) Detach the rubber boot from the guide tube and pull out the cable from the tube.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Ensure that the cable is in serviceable condition and check the threads for damage.

*NOTE: From Chassis No 539286 the thread size at the cable end was slightly increased. Installation of a new cable with increased thread diameter requires also the replacement of the adjusting nut and locknut.*

(2) Lubricate the cable with universal grease, slide the rubber boot over the cable and instal the cable in the guide tube.

(3) Instal the rubber boot at the transmission case end of the cable and ensure that the rubber boot at each end of the cable is correctly located to form an efficient seal.

(4) Lubricate the adjusting nut with universal grease, insert the threaded cable end through the operating lever eye and screw on the adjusting and lock nuts.

(5) Carry out the adjustment operation for clutch pedal free travel as described under the section *CLUTCH ADJUSTMENT.*

(6) It is essential that the cable guide has a downward bend of 1.0" as in the illustration. This adjustment can be effected by inserting washers between the end of the cable guide and the bracket on the transmission case.

*NOTE: Should the bend in the cable guide be excessive it can be reduced by shortening the rear guide tube after first removing the cable and cable guide. An excessive bend will bring about noises or stiffness during operation with possible cable breakage.*

## 8. CLUTCH PEDAL LINKAGE

**TO REMOVE AND INSTAL (Left Hand Drive)**

(1) Raise the vehicle and support on stands or place over a pit.

(2) Loosen and remove the lock nut and adjusting nut from the operating cable on the transmission case. Detach the cable from the lever.

(3) Take out the securing screws and detach the cover plate from beneath the pedal linkage.

(4) Disconnect the wires and remove the horn from its mounting.

(5) Take out the bolt and nut securing the clutch pedal arm to the clutch pedal rod.

(6) Loosen off and remove the retaining nut located at the end of the pedal arm shaft.

(7) Detach the clutch cable operating lever from the pedal arm shaft, and withdraw the shaft and pedal arm from the frame.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Inspect the pedal shaft bearing bushes for wear and replace if necessary.

*NOTE: The two bearing bushes are located in the sleeve. A pilot drift is required to remove or instal the bushes, this can be made up of the following dimensions:*

*Overall length – 5.5"*
*Overall diameter – .72"*
*Length of pilot – .7"*
*Diameter of pilot – .64"*

(2) Prior to shaft installation, lubricate the shaft and bushes with universal grease.

(3) Ensure that the felt seal and the rubber boots at each end of the cable are correctly located to form efficient seals.

(4) Carry out the adjustment operation for clutch pedal free travel as described under the section *CLUTCH ADJUSTMENT.*

**TO REMOVE AND INSTAL (Right Hand Drive)**

(1) Carry out operations 1, 2, 3 and 5 as described for left hand drive vehicles.

(2) Withdraw the clutch pedal from above.

(3) Disconnect the accelerator pedal shaft from the pedal rod and the accelerator cable from the operating lever. Turn the pedal shaft so that it is pointing downwards.

(4) Using circlip pliers, remove the circlip and washer from the pivot pin on which the clutch pedal arm is mounted, and slide the arm from the pivot pin.

(5) Loosen off and remove the pivot pin securing nut and washer, and withdraw the pivot pin and cap washer.

Installation is a reversal of the removal procedure with particular attention to the following points:

(1) Examine the bearing bush in the pedal arm for wear and replace if necessary.

(2) Ensure that the pivot pin and cap washer are in serviceable condition. Replace if required.

(3) Lubricate with universal grease the pivot pin and bearing bush before installing the pedal arm.

(4) Ensure that the seal between the push rod and floor plate is correctly seated.

(5) Carry out the adjustment operation for clutch pedal free travel as described under the section *CLUTCH ADJUSTMENT.*

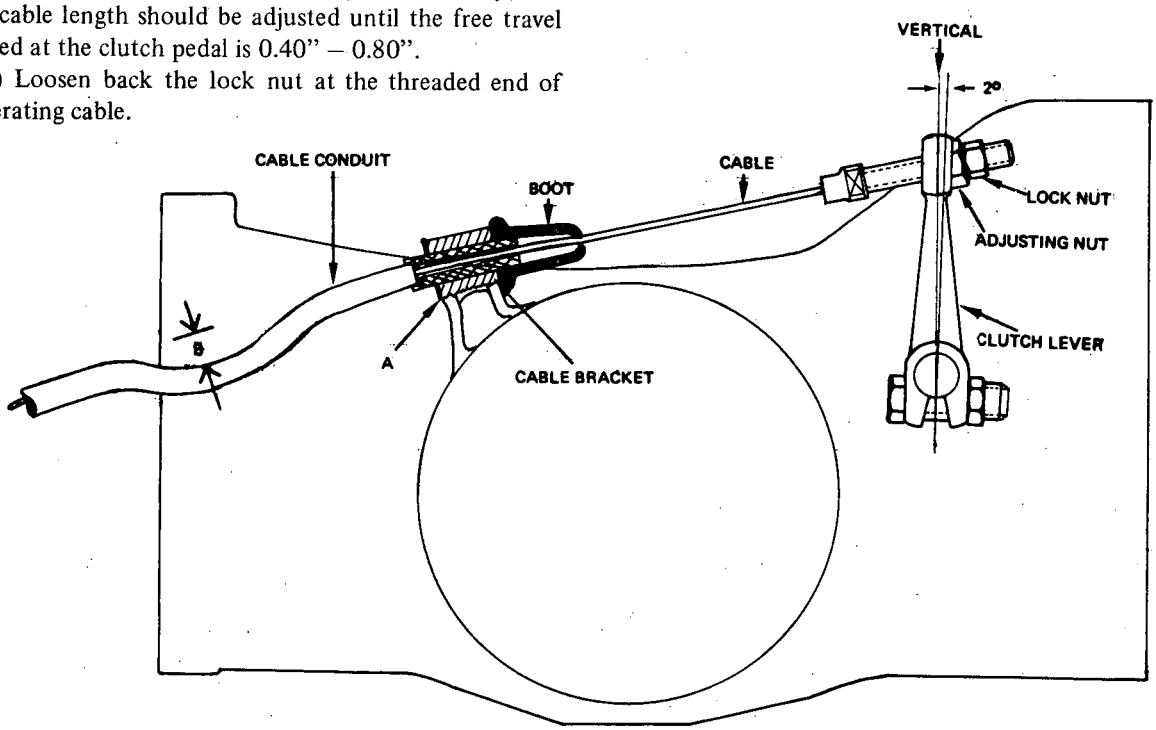
## 9. CLUTCH ADJUSTMENT

**TO ADJUST FREE TRAVEL**

To obtain the correct clearance of 0.04" – 0.08" between the thrust face of the release bearing and the release plate of the clutch pressure plate assembly, the clutch cable length should be adjusted until the free travel measured at the clutch pedal is 0.40" – 0.80".

(1) Loosen back the lock nut at the threaded end of the operating cable.

(2) Adjust the cable length at the adjusting nut on the cable until the clutch pedal moves freely through a distance of 0.40" – 0.80" measured from the fully off position.




Clutch Lever and Cable Adjustment. Adjust Swoop in Cable Conduit at B to .800"/1.200" by Inserting Washers at A. With Free Travel Removed, Inclination of Lever should not exceed 2 deg Forward of Vertical.

(3) Operate the clutch several times and recheck the measurement. Hold the adjusting nut whilst tightening the lock nut.

(4) Smear the adjusting nut with universal grease.

**CLUTCH OPERATING LEVER POSITION**

Check the position of the operating lever on the transmission case after adjustment of the clutch pedal free travel. The lever position is correct when:

(1) With the clutch engaged (pedal fully off), the threaded end of the clutch cable should be in only light contact with the lower edge of the countersunk hole in the lever.

(2) With the clutch released (pedal fully depressed), the threaded end of the clutch cable should not be pressed hard against the upper edge of the countersunk hole.

From Chassis No 225134863 (Engine No 812506) a modified clutch operating lever together with a wing nut are fitted. Ensure that the lugs on the wing nut engage in the clutch lever grooves. Coat the wing nut with universal grease after adjustment.

## 10. CLUTCH FAULT DIAGNOSIS

**(1) Clutch slipping.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Pedal free travel adjustment. | – Check pedal free travel and adjust as described. |
| (b) | Weak or broken pressure plate springs. | – Check pressure plate assembly and renew as necessary. |
| (c) | Oily or greasy clutch facings. | – Replace facings and check engine and transmission oil seals. |
| (d) | Worn facings and/or flywheel face. | – Replace facings, renew or machine flywheel face. |

**(2) Clutch not releasing.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Pedal free play excessive. | – Remedy. Adjust as described. |
| (b) | Downward bend of cable guide incorrect. | – Check and adjust as described. |
| (c) | Oily clutch plate facings. | – Check and renew driven plate. |
| (d) | Driven plate running out, or cushion segments unequally set. | – Straighten plate and reset cushion segments. |
| (e) | Driven plate sticking on gearbox input shaft. | – Check for dirt or burrs on splines. |
| (f) | Stiff operation of pedal and linkage. | – Free out and lubricate components. |

**(3) Clutch grabbing or chattering.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Loose transmission case mountings. | – Check and tighten the mounting bolts and nuts. |
| (b) | Downward bend of cable not sufficient. | – Check and adjust as described. |
| (c) | Oily or greasy clutch facings. | – Replace facings and check oil seals. |
| (d) | Faulty pressure plate assembly. | – Check and replace if necessary. |

**(4) Release bearing noise.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Needle bearing in the gland nut worn. | – Replace and lubricate with grease. |
| (b) | Dry, seized or worn release bearing. | – Check and renew bearing. |
| (c) | Driven plate fouling the pressure plate. | – Renew or straighten the driven plate. |
| (d) | Faulty or broken pressure plate springs. | – Check and replace as necessary. |

# TRANSMISSION AND REAR AXLE

## PART 1

## TWO-PIECE SPLIT TYPE TRANSMISSION CASE

### SPECIFICATIONS

| | | | |
|---|---|---|---|
| Type | 4 speed and reverse, incorporating rear axle and differential in split type case | Second | 1.88:1 |
| | | Third | 1.23:1 |
| | | Fourth | 0.82:1 |
| | | Reverse | 4.62:1 |
| Synchromesh | 2nd, 3rd and 4th gears | | |
| Gear ratios: | | Final drive ratios: | |
| First | 3.60:1 | Pinion and ring gear | 4.43:1 |
| | | Axle reduction gear | 1.40:1 |

### 1. DESCRIPTION

The gearbox, rear axle and engine are combined in the rear of the vehicle. The rear axle is of the swing half axle type. The rubber-cushioned transmission case is secured to the frame at three points. It incorporates the gearbox and the differential.

The transmission case is of light alloy and in two parts. It is important that when replacements are necessary, it is not permissible to fit a single half of the transmission case. They are machined in pairs to very close limits and in consequent replacements must be made in pairs.

The gearbox has four speeds forward and one reverse, which is provided with a stop. Synchromesh is obtained with the helical 2nd, 3rd and 4th gears, which are in constant mesh to ensure quiet operation.

The change rod in the frame tunnel links the gearbox to the gearchange lever, which is located on the tunnel beside the driver's seat. The changing of first and reverse is effected by sliding gears.

### 2. REAR AXLE ASSEMBLY

#### TO REMOVE

If it is intended to dismantle the rear axle upon its removal from the vehicle, loosen the axle shaft nuts and the wheel bolts before lifting the vehicle.

(1) Disconnect the battery earth cable.

(2) Lift the vehicle, support it on stands and remove the engine.

(3) Remove the rear wheels.

(4) If the rear axle is to be dismantled afterwards clean the assembly with solvent.

(5) Remove the axle shaft nut and withdraw the brake drum and oil deflector.

(6) Disconnect the brake line at the rear. Remove the brake shoe return springs, brake shoes, brake levers and brake cable brackets. Withdraw the brake cables from the back plates.

*NOTE: When replacing the rear axle, the brake cables and brake drums remain on the axle. Unhook the brake cables from the brake bar at the frame head and withdraw them from the conduit tube towards the rear. The brake lines between the back plates and the clamps on the rear axle tube should be removed.*

(7) Remove the bolts at the rear axle shaft bearing housing.

(8) Disconnect the clutch cable from the clutch operating shaft lever and withdraw it from the guide plate.

(9) Disconnect the cables from terminals at the starter motor.

(10) Remove the frame end cover plate. Remove the rear screw of the shifting rod coupling and move the gear change lever to withdraw the coupling from the transmission change rod.

(11) Remove the nuts at the transmission front rubber cushion.

(12) Remove the two bolts at the transmission carrier.

(13) Withdraw the axle assembly from the rear of the vehicle.

*NOTE: Take care not to damage the dust sleeves.*

**TO INSTAL**

This is accomplished by reversing the above procedure, but attention should be paid to the following points:

(1) Replacing the rear axle between the fork at the frame end can best be carried out by three mechanics.

*NOTE: Take care not to damage the dust sleeves.*

(2) Sufficiently grease the two mounting bolts and the transmission carrier.

(3) Tighten the nuts at the transmission front rubber cushion and then tighten the nuts of the screws that attach the transmission carrier to the rubber cushions.

(4) This order of tightening the nuts should be strictly followed to avoid distortion and premature wear of the rubber cushions.

(5) Make sure that the points of the coupling screws are correctly bedding in their recess. Secure the screws with a piece of wire.

(6) When the engine has been replaced, adjust the clutch pedal free play to .400" to .800".

(7) Securely tighten the shock absorber fixing screws.

(8) Check the splines in the hub of the brake drum.

(9) Renew the brake drum if the splines are worn or damaged.

(10) Tighten the rear axle shaft nuts to 202 to 224 ft/lb, and secure them with cotter pins. The nuts should be tightened after the vehicle has been lowered to the floor.

(11) Bleed and adjust the brake system.

**TO DISMANTLE**

It is recommended to adopt the following sequence of operations for the dismantling and assembly of the rear axle.

(1) Remove both drain plugs, the starter motor and the transmission carrier mounting.

(2) Remove the clutch release bearing.

(3) Remove the axle shaft nuts and withdraw the brake drums.

(4) Remove the brake backplates, the rear axle tubes and the gearchange housing.

(5) Dismantle the transmission case.

(6) Take off the main drive shaft and pinion.

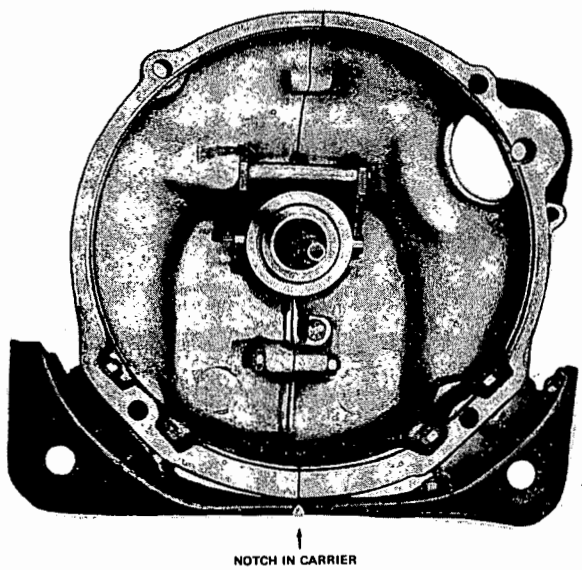
(7) Remove the differential housing and axle shafts.

(8) Remove the selector shafts, selector forks, detent balls and springs.

(9) Take off the reverse sliding gear shaft.

**TO ASSEMBLE**

Assembling the rear axle is a reversal of the above operations. Reference should be made however, to the following pages containing detailed information as to the correct removal and installation of the individual parts.




Ensure Correct Installation of Transmission in Carrier. Joint in case must Align with Notch in Carrier.

## 3. AXLE SHAFT OIL SEAL

**TO REMOVE**

(1) Remove the brake drum and oil deflector, if fitted.

(2) Remove the cover retaining screws and take off the cover and oil seal.

(3) Remove the brake backplate.

(4) Take off the outer spacer, gasket between the spacer and the ball bearing, the washer, and cover gasket.

(5) Remove the rear wheel bearing and take off the inner spacer.

**TO INSPECT AND INSTAL**

If the oil seal lip is uneven or damaged, the oil seal should be removed from the cover.

(1) Lightly coat the new oil seal with oil and press it in position.

(2) The seating depth is between .185" to .197".

(3) Check if the oil seal rests squarely in the cover. The depth is measured from the ball bearing contact face in the

cover. A tilted oil seal is in nearly all cases responsible for oil leaks.

(4) Examine the condition of the ball bearings, renew if worn or damaged.

(5) Renew the two gaskets.

(6) Replace the cover so that the oil drain points downwards.

(7) The spacer must not be scored, cracked or show signs of rust. To avoid damage to the oil seal by friction, the spacer should be lightly coated with oil. Make sure that all components to be fitted are absolutely clean.

(8) Clean the oil deflector before re-installing it. Make sure that the oil drip tube where fitted, is bearing tightly against the brake drum to prevent it fouling the brake hose.

(9) Check the splines in the brake drum hub. Replace the brake drum hub if the splines are worn.

(10) Tighten the rear axle shaft nut and secure it with a cotter pin.

## 4. AXLE SHAFT TUBES

### TO REMOVE

(1) Remove the brake drum and brake back plate.

(2) Remove the reduction gear assembly as detailed in Part 2 of this section.

(3) Remove the nuts at the axle tube retainer.

(4) Take off the rear axle tube, retainer and gasket.

(5) Drive out the lock pin in the axle shaft bearing housing.

(6) Remove the bearing housing from the axle tube.

*NOTE: Bearing housings become generally bent or damaged when removing them in an unskilled manner and tend to crack when attempting to straighten them. Damaged bearing housings should not be refitted.*

(7) Take off the brake cable retaining ring (rubber).

(8) Release the dust sleeve clips and withdraw the dust sleeve and axle tube retainer from the axle tube.

### TO INSTAL

This is accomplished by reversing the above procedure, but attention should be paid to the following points:

(1) Clean the axle tube retainer seating surface at the transmission case.

(2) Check the convex axle tube seating surface at the transmission case for wear. If burrs are present, remove them with a scraper.

(3) A modification in the form of a plastic shim at this point was introduced in September, 1958.

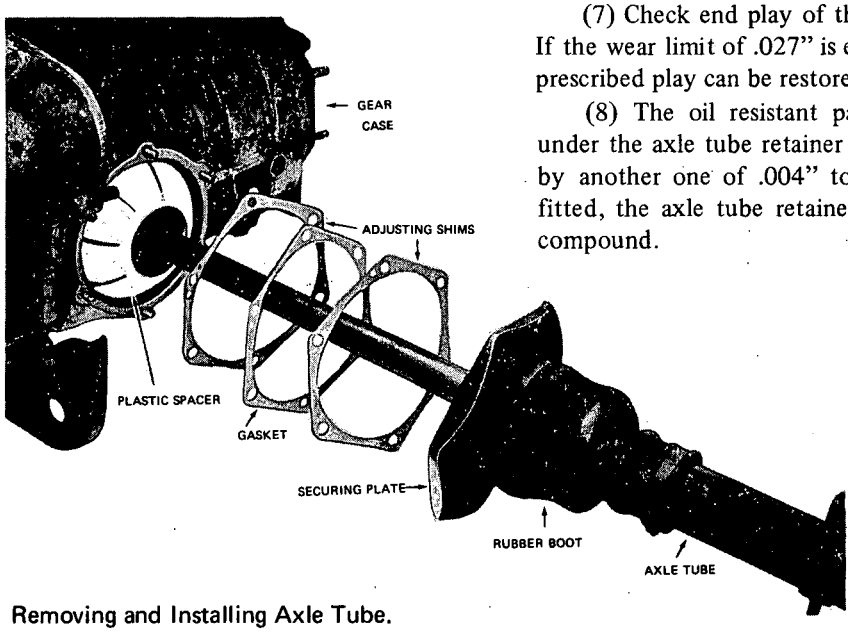
(4) Examine the dust sleeve, renew it if damage is apparent.

(5) Instal the brake cable retaining ring (rubber).

(6) Inspect the axle shaft bearing housing, renew it if damage is apparent. Before pressing the housing into place, thoroughly clean all seating surfaces and oil both housing and axle tube. Press the housing in place. With the axle tube in position on the car, the bearing housing should be installed.

(7) Check end play of the axle tube (.016" to .024"). If the wear limit of .027" is exceeded (source of noise), the prescribed play can be restored as follows:

(8) The oil resistant paper gasket (.010" to .012") under the axle tube retainer should be removed or replaced by another one of .004" to .006". If no paper gasket is fitted, the axle tube retainer must be coated with sealing compound.




Removing and Installing Axle Tube.

*NOTE: The above described reduction of the axle tube end play can also be carried out with the rear axle in the car.*

(9) Do not tighten the dust sleeve clips before the rear axle is installed. This will prevent the dust sleeve from becoming distorted and eventually damaged.

(10) Instal the reduction gear assembly as detailed in Part 2 of this section.

**TO RENEW DUST SLEEVE**

To avoid removal or dismantling the rear axle when renewing a damaged dust sleeve, a slotted dust sleeve is available.

(1) Remove both retaining clips.

(2) Cut the dust sleeve and remove it.

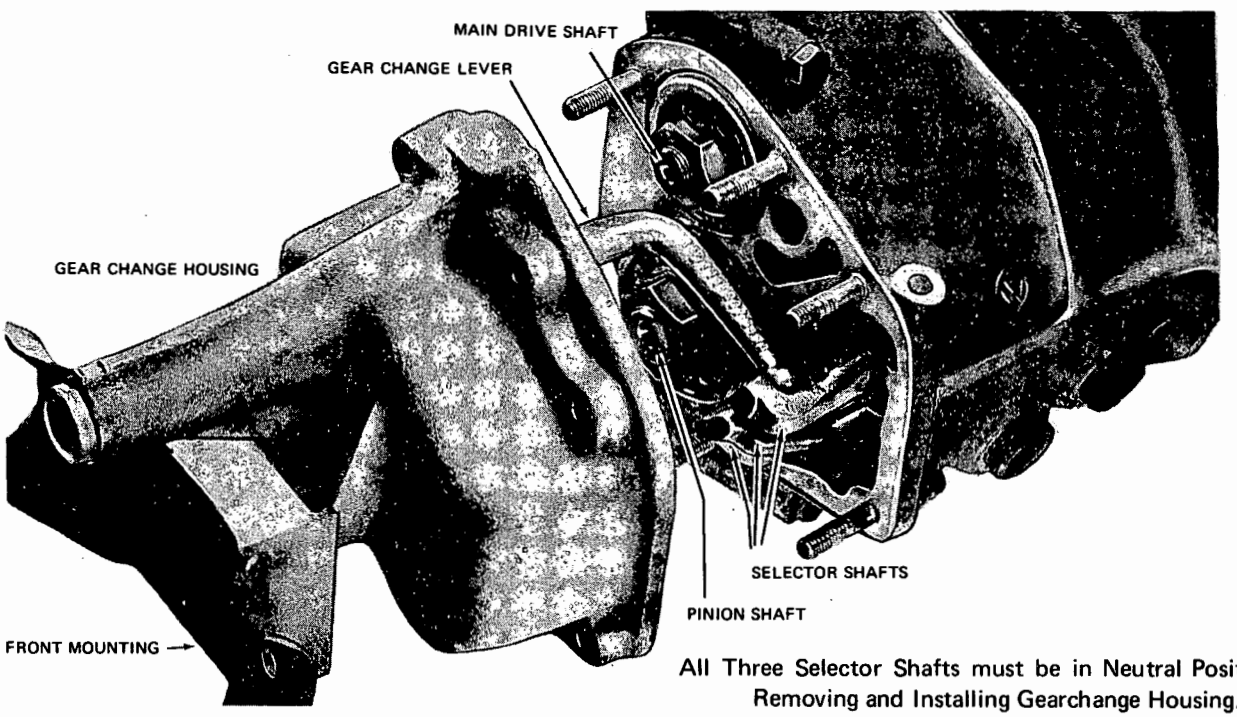
(3) Clean the axle tube and axle tube retainer.

(4) Lightly coat the joint faces of the slotted dust sleeve with sealing compound.

(5) The flange of the dust sleeve joint should be horizontally towards the rear. Tighten the screws.

(6) Tighten the retaining clips.

*NOTE: The dust sleeve screws and retaining clips should not be over-tightened. The tightening should be carried out with the rear axle in the loaded condition. Take care the dust sleeve is not distorted or strained.*




All Three Selector Shafts must be in Neutral Position for Removing and Installing Gearchange Housing.

## 5. GEAR CHANGE HOUSING

**TO REMOVE**

(1) Undo the gear change housing securing nuts and detach the earth lead.

(2) Withdraw the gear change housing and gear change lever.

(3) Remove and discard the gasket and thoroughly clean the jointing faces.

**TO INSTAL**

Installation is a reversal of the removal procedure, observing the following points:

(1) Inspect transmission bushes for wear and, if necessary, renew. New bushes, when fitted, should be reamed to .5925" – .5918".

(2) Carefully check the thickness of the gasket and paper ring between the gear change housing and the transmission case to ensure that the ball bearings are correctly pre-loaded. Excessively pre-loaded ball bearings are likely to cause noise and premature wear.

(3) When attaching the gear change housing, ensure that the three selector shafts are in the neutral position.

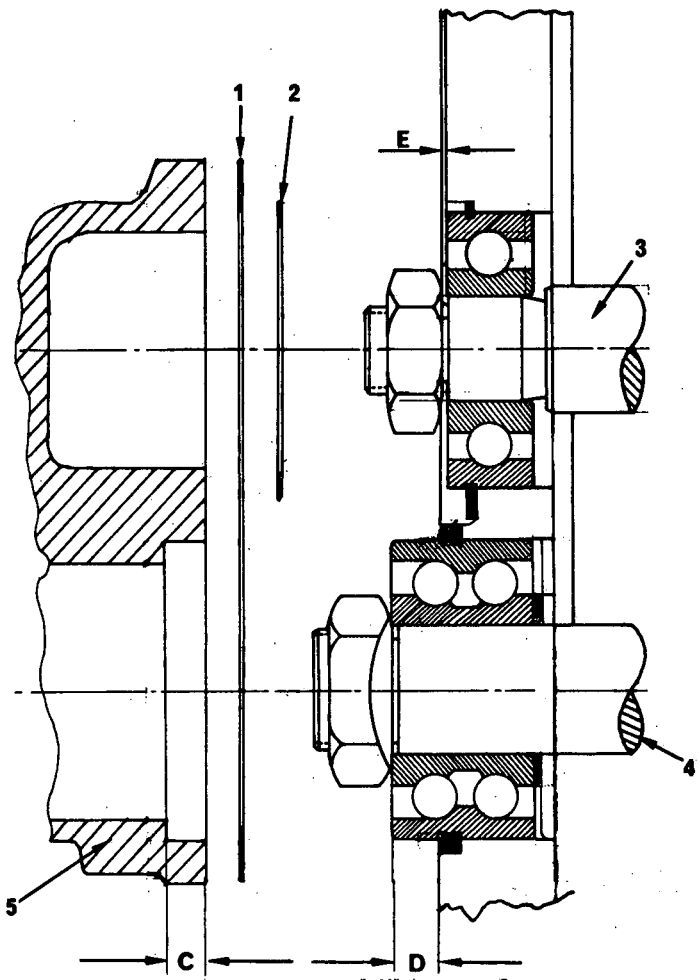
(4) Connect the earth lead to the stud from which it was detached.

## 6. BALL BEARING PRE-LOAD

When assembling the transmission case careful consideration should be given to the pre-load on the drive pinion double row bearing and the main drive shaft front bearing.

In later model vehicles, the main drive shaft intermediate bearing and the drive pinion rear bearing have been replaced by needle roller bearings.

The gear change housing is tightened in position to a pre-load of between .0008" and .0043" which is obtained by selecting the correct gasket or paper ring.




Checking Pre-load on Transmission Ball Bearings.

1. Gasket. 2. Paper ring.
3. Main drive (input) shaft.
4. Drive pinion shaft.
5. Gear change housing.

### TO ADJUST PRE-LOAD

Any end play of the drive pinion and main drive shaft should be eliminated by light taps with a soft head hammer, before measuring, preferably with a depth micrometer.

Check the following dimensions:

(a) Dimension D, the distance from the transmission case matching face to the drive pinion face.
Dimension C, the recess depth for the drive pinion bearing in the gear change housing.
Selective fitting of the gasket and the paper ring compensates for the difference between D and C to ensure the prescribed pre-load .0008" – .0043" on the double row ball bearing.

(b) Dimension E, the distance from the transmission case matching face to the main drive bearing face. This bearing must be subject to the same pre-load as the double row ball bearing. A selection of paper rings is serviced for correcting the pre-load on the main drive shaft bearing.
These rings must be glued to the gasket ensuring that they are concentric with the ball bearing.

(c) The depth of the recess for the double row ball bearing.

(d) The distance between the transmission case matching face to the double row ball bearing face.

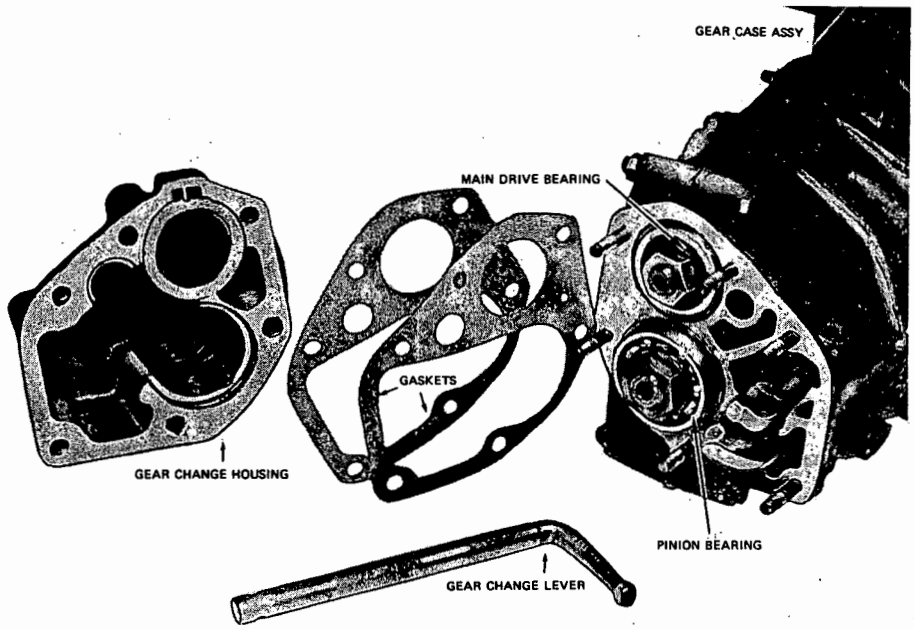
(e) The distance between the transmission case matching face and the main drive shaft ball bearing face.

| Example: | | mm |
|---|---|---|
| (a) | Dimension D . . . . . | 10.50 mm (.4134") |
| | Dimension C . . . . . | 10.25 mm (.4035") |
| | Difference . . . . . | 0.25 mm (.0099") |
| | Dimension of pre-load . . . . | - 0.05 mm (.002") |
| | Thickness of gasket . . . . . | 0.20 mm (.0079") |
| (b) | Dimension E . . . . . | 0.14 mm (.0055") |
| | Pre-load on main drive shaft ball bearing . . . . . | + 0.06 mm (.0024") |
| | Thickness of paper ring . . . | 0.20 mm (.0079") |

## 7. TRANSMISSION CASE

### TO DISMANTLE

Replacement of transmission case entails replacement of both halves as they are machined in pairs to very close limits. The gear change housing need not be replaced along with the transmission case as a matter of course, unless there is a reason to do so. The matching faces should be thoroughly cleaned and lightly coated with sealing compound. After replacing a transmission case it is necessary to re-adjust the pre-load on the differential ball




Gearchange Housing and Lever Removed to Show Bearing Pre-load Gaskets.

bearings by a careful selection and fitting of shims.

*NOTE: The rear axle number can be found stamped on the right half of the transmission case near the jointing face of the gearchange housing.*

(1) Undo the securing nuts and remove the gear change housing.

(2) Remove the clutch release bearing and detach the clutch operating lever return spring.

(3) Undo the securing nuts from the transmission case matching faces. Undo the nut on the stud located near the axle tube retainer at the left side half of the transmission case.

(4) Turn the transmission case over and withdraw the right half without damaging the jointing faces.

(5) From the left half of the transmission case remove the complete main drive shaft and drive pinion.

(6) From the left half of the transmission case and by using a soft head hammer, drive out the differential and rear axle shafts.

(7) Remove the locking pin from the reverse sliding gear shaft.

(8) Drive out the shaft and remove the reverse sliding gear.

(9) Undo the plug screws from the holes which give access to the selector fork locating screws.

(10) Slacken the locking screws of the first and second and the third and fourth selector forks.

(11) Remove the reverse selector fork locking screw.

(12) Remove the selector shafts while covering the holes to prevent detent balls from coming out.

(13) Take out the detent balls and springs.

(14) Remove the two selector shaft interlock pins.

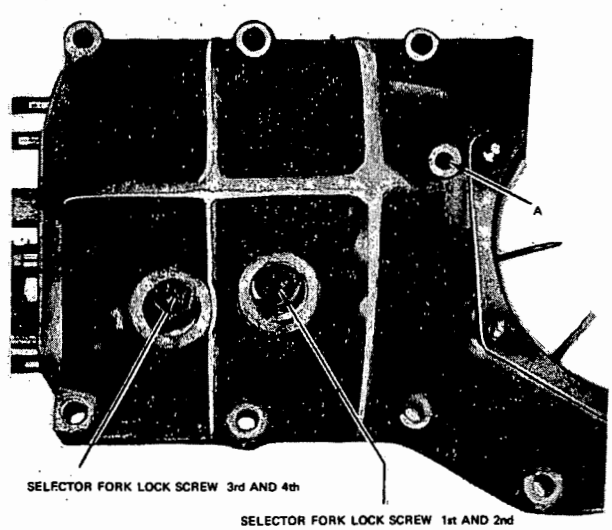
(15) Remove the clutch operating shaft and lever, return spring and seat.

(16) Take out the differential ball bearings.

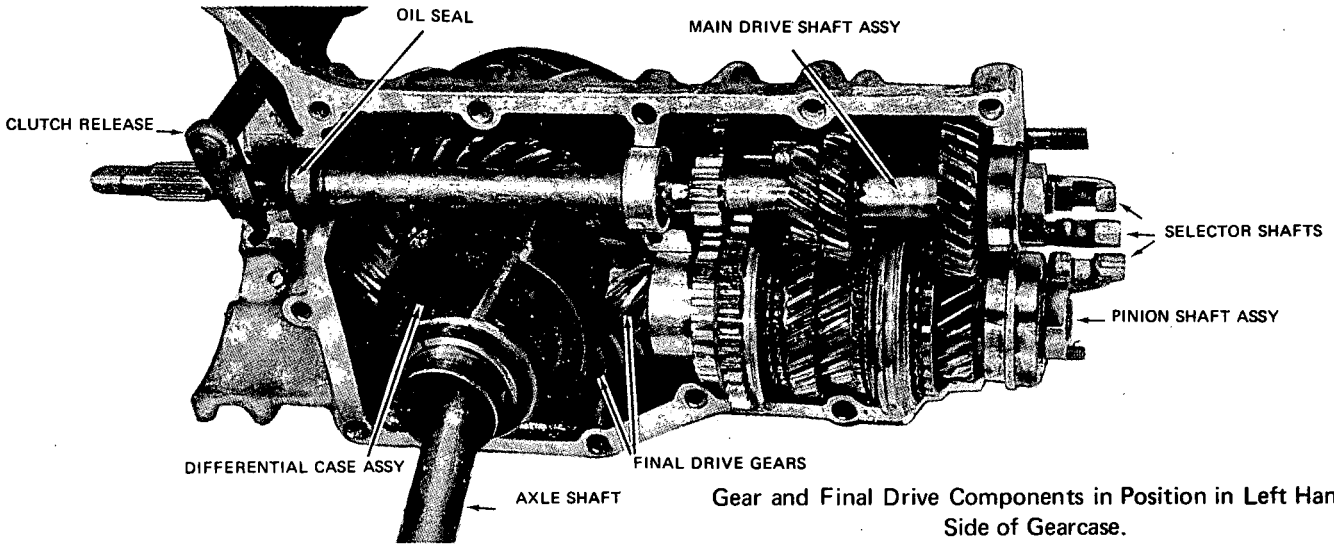
**TO ASSEMBLE**

Assembly is a reversal of the dismantling procedure observing the following points:

(1) Clean the transmission case throughly and check




Gearcase Plugs Removed to show Selector Fork Lock Screws. Bolt Indicated by Hole "A" must be Removed when Splitting Gearcase.




Gear and Final Drive Components in Position in Left Hand Side of Gearcase.

carefully for wear, cracks and external damage.

In the case of the drive pinion and ring gear, check the bores in the transmission case webs for alignment and renew the transmission case, if necessary.

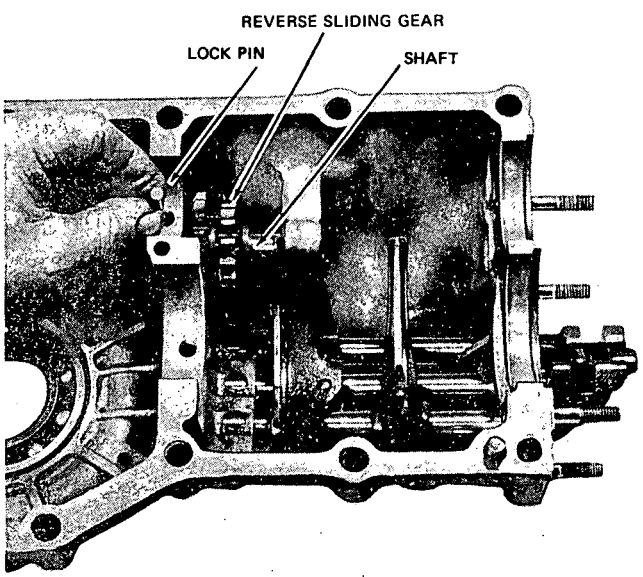
(2) Check the bush of the starter shaft for wear and renew if found necessary.

(3) Check the bushes of the clutch operating shaft for wear and replace if necessary.

*NOTE: Before the halves of the transmission case are secured together the clutch operating shaft must be installed.*

(4) Press the differential ball bearings into position.

(5) Check the square seating of the ball bearings allowing for a permissible tilt of .0008" to .0016".




Removing or Installing Reverse Sliding Gear Shaft Lock Pin in Left Half of Gear Case.

(6) Check the bush and shaft of the reverse sliding shaft and renew, if necessary.

(7) Peen the new bush securely in position and ream it .6329" to .6319".

(8) Check the condition of the detent springs for free length 1" and wear limit .090" and renew if necessary. The force applied to overcome the detent ball undercuts on the selector shafts should amount to approximately 35 to 45 lb. In case of difficulty in changing gears, conduct a test with the drive pinion removed.

(9) The order in which the selector shafts and forks should be installed and secured is as follows:

(a) Instal and secure the reverse gear selector shaft and fork.

(b) Secure the reverse sliding gear shaft.
The reverse sliding gear has been changed in later models. In case the later model part is being fitted to earlier gearboxes the upper end of the selector fork must be rounded off.
*NOTE: Care must be exercised, while turning the open type transmission case, that the reverse sliding gear shaft lock pin does not fall out of position.*

(c) Instal the selector shafts and forks for the first and second and for the third and fourth gears, not omitting the two interlock pins.

(10) Without tightening for the present, screw the selector fork locking screws in position.

(11) Engage a gear and check for proper interlocking. The selector shaft next to the one used must be locked. When engaging first or second gears (centre selector shaft), the other two selector shafts should be locked.

(12) Check the selector forks for wear or damage. The clearance between the selector fork and operating sleeve or

first gear should not exceed the permissible clearance. Renew worn parts if necessary.

(13) Carefully inspect the differential for worn or damaged parts and renew if necessary. Ensure that the differential shims are installed in their original positions.

(14) Carefully inspect the drive pinion, main drive shaft and the oil seal and if worn or damaged, renew as necessary.

(15) Apply oil lightly to the sealing lip of the oil seal before positioning it on the main drive shaft.

(16) Care must be exercised to ensure that the ball bearing retaining rings are properly seated in their ring grooves. Their gaps should be slightly above the jointing face of the left half of the transmission case. Lightly tap the drive pinion and main drive shaft towards the ring gear.

(17) Carefully adjust the first and second and the third and fourth selector forks as follows:

(a) Carefully position the first and second selector fork to ensure that the second and the first gears correctly change while conducting a gear changing check. In the event of the second gear only partly engaging, the selector fork should be positioned nearer to the second gear.

(b) Position the third and fourth selector fork to ensure that both gears equally engage. Any departure from that position should be corrected after checking the gear changing to ensure proper functioning of the synchro unit.

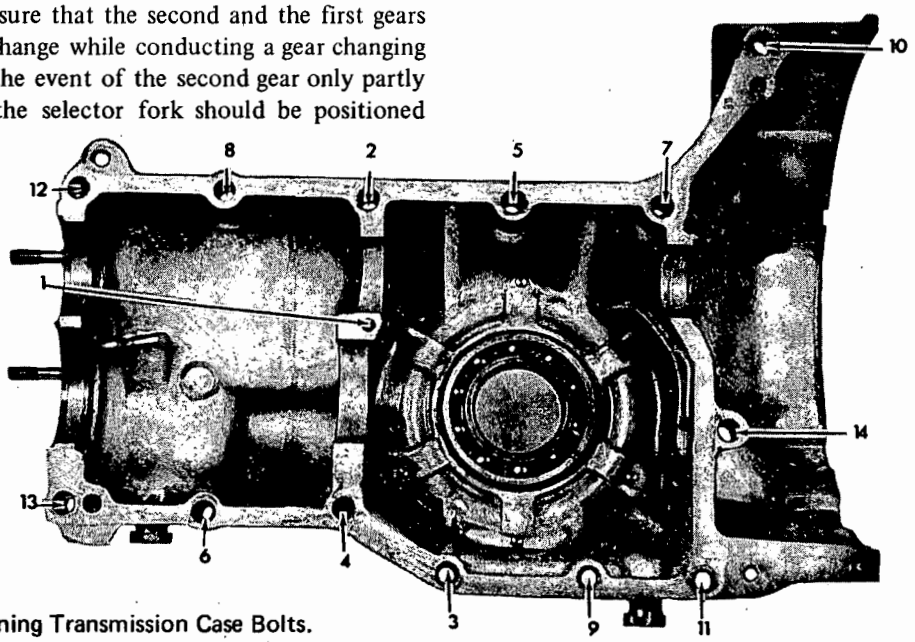
(c) On completion of the positioning of the selector forks, tighten the locking screws to a torque of 18 ft/lb.

(18) Plug the two adjustment holes in the transmission case.

(19) Before securing together the transmission case halves, check gear change and correct meshing of all gears.

(20) Thoroughly clean all jointing surfaces and oil seal seats and coat them lightly with sealing compound.

(21) Tighten the transmission case screws commencing with those near the centre and evenly working outwards to a torque of 14 ft/lb.




Sequence for Tightening Transmission Case Bolts.

## 8. MAINSHAFT OIL SEAL

### TO REMOVE WITH REAR AXLE IN POSITION

Without removing and dismantling the transmission, the oil seal can be replaced. The transmission case has been provided with a plain contact surface for the oil seal.

(1) As described in the appropriate section, remove the engine.

(2) Remove the clutch release bearing.

(3) Remove the oil seal from the transmission case, ensuring that damage to the case is avoided.

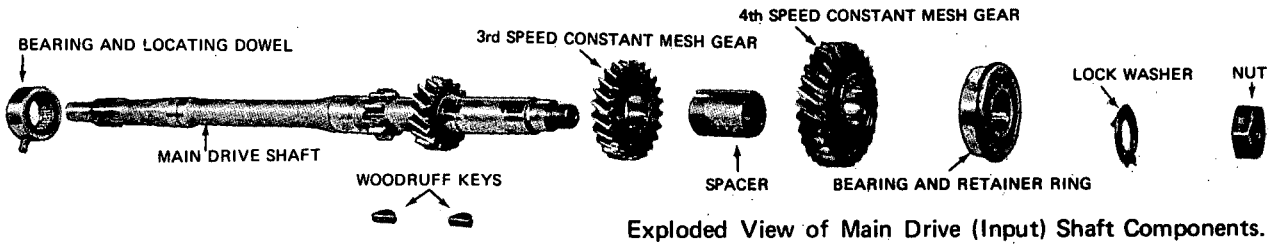
### TO INSTAL WITH REAR AXLE IN POSITION

Installation is a reversal of the procedure to replace, observing the following points:

(1) Use some sealing compound to lightly coat the outside of the oil seal. Apply a little oil to the main drive shaft and lip of the oil seal.

(2) Slide the oil seal on to the main drive shaft and seat it in position.

*NOTE: Be careful while sliding the oil seal on the main drive shaft to avoid dislodging the spring from around the lip. The lip edge must face towards the inside of the gearbox.*




Exploded View of Main Drive (Input) Shaft Components.

## 9. MAIN DRIVE SHAFT

### TO DISMANTLE

(1) Dismantle the transmission case and remove the main drive shaft.

(2) Remove the bearing retainer ring at the first speed gear.

(3) Bend down the ends of the locking plate and undo the nut.

(4) Remove the fourth speed gear and the ball bearing.

(5) Using a screw driver or any other suitable tool, remove the spacer from between the third and fourth gear.

(6) Remove the third speed gear.

(7) Take out the Woodruff keys from the main drive shaft.

(8) Remove the ball bearing at the first speed gear.

(9) Check for run-out of the main drive shaft. Check at the intermediate seat after placing the main drive shaft between centres. Permissible maximum run-out .002". In case the run-out exceeds the maximum limit, the shaft may be straightened while cold.

*NOTE: With the main drive shaft installed, the run-out (maximum .008") should be measured at the pilot.*

(10) Carefully inspect the ball bearings for wear and damage and renew if necessary.

### TO ASSEMBLE

(1) Press on the ball bearing adjacent to the first gear.

(2) Lubricate the main drive shaft and press on the retainer ring for the first gear.

(3) Position the third gear Woodruff key.

*NOTE: Heat the gears and ball bearings in an oil bath to 180°F and press fit in position on the main drive shaft.*

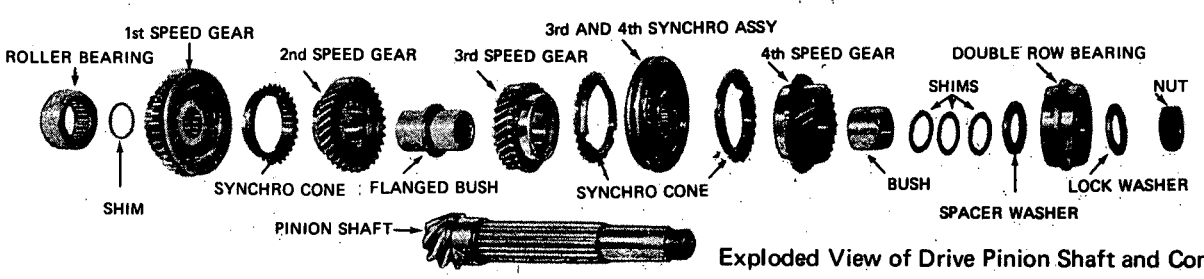
(4) Press the third gear into position, over its Woodruff key.

(5) The third gear must be flush against the second gear.

(6) Insert a screwdriver in the slot to expand the spacer and slide it on to the shaft. Instal the fourth gear Woodruff key.

(7) Press into position the fourth gear followed by the front ball bearing. When the ball bearing is replaced, do not forget to instal the retainer ring. The ring should be adjacent to the fourth gear.

(8) When fitting the lockplate on the shaft, ensure that the nose of the plate is snugly seated in the slot in the main drive shaft. Screw on the nut and tighten to a torque of 22 ft/lb. Lock the nut with the plate.




Exploded View of Drive Pinion Shaft and Components.

## 10. PINION SHAFT

### TO DISMANTLE

(1) Dismantle the transmission case and take out the drive pinion, as previously described.

(2) Bend up the tabs of the lock plate and undo the nuts at the forward end of the shaft.

(3) Remove the double row ball bearing.

(4) Withdraw the shims and friction washer from behind the bearing.

(5) Remove the fourth gear, bush and the fourth gear synchronising stop ring.

(6) Remove the third and fourth speed gears complete synchro unit and dismantle the unit.

(7) Remove the third speed gear synchronising stop ring and also the third speed gear. Withdraw the second and third gear bush.

(8) Withdraw the second speed gear and synchronising stop ring. Take off the first sliding gear from the clutch gear synchro hub and remove the changing plates. Remove the clutch sliding gear.

(9) Slide off the pinion shim and take off the roller bearing.

(10) Thoroughly clean the drive pinion. Using compressed air blow through the oil passages to remove any obstruction.

**TO ASSEMBLE**

Assembling is a reversal of the dismantling procedure observing the following points:

Heat the roller bearing inner race in a container of oil to a temperature of 194°F and press it into position.

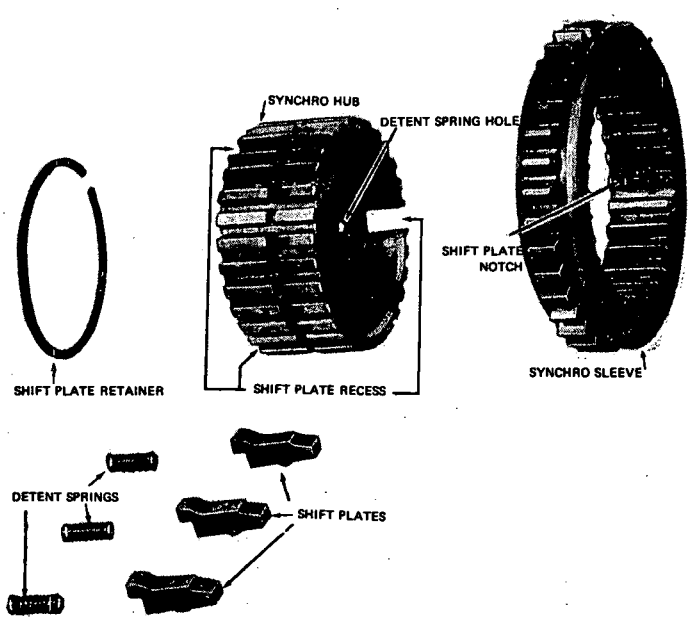
*NOTE: Ensure that the roller bearing inner race press fits on the drive pinion otherwise renew the parts.*

(1) To reduce the total end play of components assembled on the splined portion of the drive pinion, instal a shim. The thickness of the shim is to be determined after installing the synchro clutch gear for the third and fourth speeds.

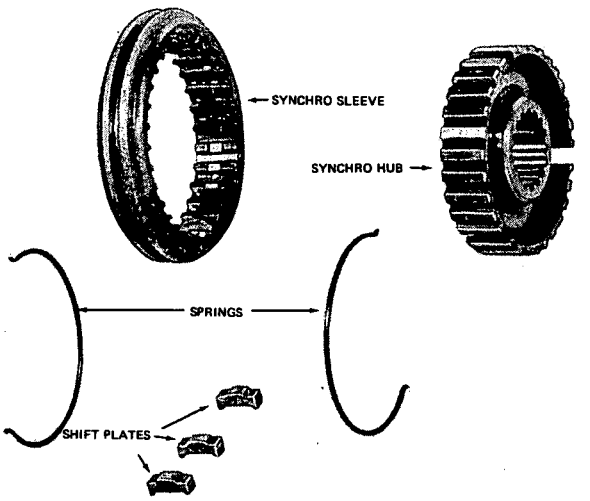
For selective fitting, shims of thicknesses of .004" and .008" are serviced by the manufacturers.

(2) Insert a snap ring in the third speed clutch gear and seat it in the recess cut for the purpose.

(3) Slide the second speed clutch gear in position on




Components of First and Second Synchroniser Assembly.




Components of Third and Fourth Speed Synchro Assembly.

the drive pinion shaft and instal the three coil springs. Position the three shifting plates so that the noses grip under the snap ring.

(4) Press the three spring-loaded shift plates into their slots and slide the first speed sliding gear on the clutch gear until such time as the plates engage in the circumferential recess within the gear.

Exercise care to ensure that the three chamfered splines grip over the shift plates, failing which, trouble will be experienced even to the extent of having to dismantle the transmission.

In case the plates happen to leave their recess, thereby causing the first sliding gear to slide down after the drive pinion has been assembled, it is still possible to re-position the first gear from the pinion side.

(5) Position the second speed stop ring on the clutch gear to enable the shift plates to engage with the three slots in the ring.

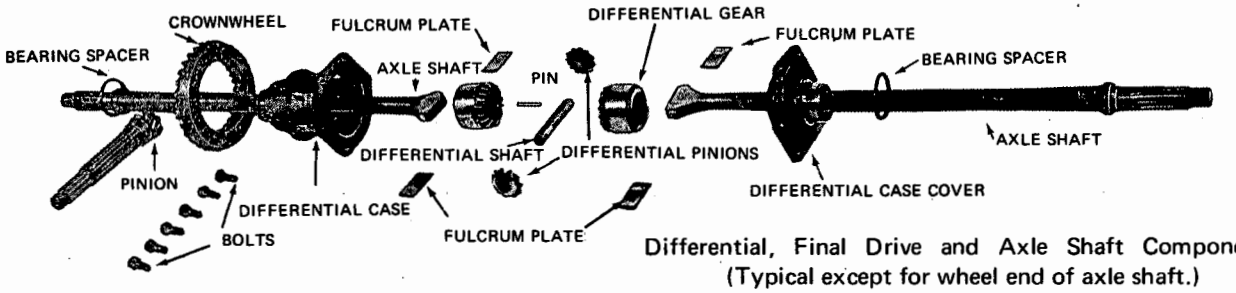
(6) Position the second and third speed gears on the bearing bush. Slide the bush carefully on the drive pinion shaft to avoid an upsetting and causing a reduction in the radial clearance of the gears.

(7) Position the third speed stop ring on the cone face of the gear. The third and fourth gears synchroniser stop rings are interchangeable.

(8) The synchro unit for third and fourth gears should be assembled as follows:

(9) On to the clutch gear, slide the operating sleeve, insert the three plates into position and fit both snap rings. Both ends of the ring must be in the same sector between two shift plates.

(10) The assembled synchro unit can now be placed on the drive pinion shaft, turning the third speed stop ring



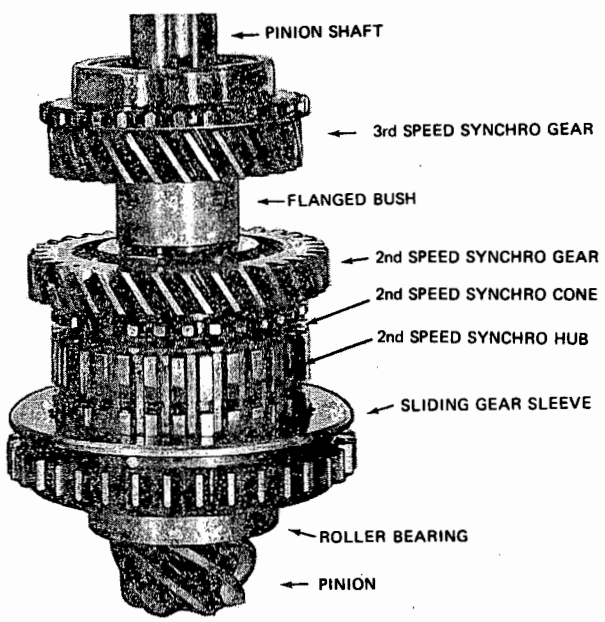

Differential, Final Drive and Axle Shaft Components. (Typical except for wheel end of axle shaft.)

until the shift plates engage with the slots in the ring.

Keep within the limit of ±.002" in the position of the clutch gear face in relation to, above or below the end of the splines on the pinion shaft.

In the event of exceeding the upper or lower tolerance limit of .002", correct the end play of the assembled parts on the splined portion of the drive pinion by installing a shim between the roller bearing and the second speed clutch gear or by altering the thickness of the shim. It should be ensured that the parts have to be assembled on the splined portion of the drive pinion shaft in the correct order.

(11) Position the fourth speed stop ring on the clutch gear for the shift plates engaging the slots in the ring.




Assembling Drive Pinion Components.

(12) Instal the fourth gear bush, the fourth gear and the friction washer.

(13) Instal the required thickness of shims on the drive pinion shaft for correct axial adjustment. Shims with the thickness of .008" and .012" are serviced by the manufacturers.

(a) When drive pinion assembly parts are being replaced and which do not affect the axial adjustment, it is not recommended to alter the total thickness of the shims to correct meshing of the drive pinion and ring gear.

(b) If the drive pinion or other parts are being replaced which can affect the axial adjustment, again determine the correct amount of shims to be installed. The standard thickness of the total amount of shims is .0275". Always take into consideration the plus or minus marking on the face of the drive pinion.

Example:

| | |
|---|---|
| Standard thickness of shims . . . . . | .0275" |
| Axial tolerance discrepancy –0.18 mm. This value is to be raised to the next tenth of a mm. viz . . . . . | .0078" |
| Total thickness of shims required . . . . . | .0196" |

Position the double row ball bearing, with machined channel for fitting the balls, facing towards the drive pinion nut and press bearing into position.

(14) Renew the lockplate and instal after applying grease.

(15) Instal and tighten the drive pinion nut to a torque of 45 ft/lb.

(16) Check the end play of the 2nd, 3rd and 4th gears. In each case end play should be .004" to .010".

(17) After checking the axial adjustment of the drive pinion, bend the tabs on the lock plate and secure the nut.

## 11. DIFFERENTIAL AND FINAL DRIVE

**TO DISMANTLE**

(1) As previously described, dismantle the transmission case and remove the differential and rear axle shafts.

(2) Take out the lock wire and undo the ring gear securing bolts.

(3) Take off the differential housing cover with rear axle shaft, differential side gear and fulcrum plates.

(4) Withdraw the ring gear.

(5) Extract the lock pin from the differential shaft.

(6) Remove the differential pinion shaft and pinions.

(7) Remove the rear axle shaft, the differential side gear and fulcrum plates from the differential housing.

**TO ASSEMBLE**

Assembling is a reversal of the dismantling procedure, observing the following points:

Thoroughly oil the differential housing before commencing assembling operations.

(1) Check the rear axle shaft, fulcrum plates and differential side gear. If any excessive clearance exists, correct it by fitting oversize fulcrum plates identified by a groove on their faces or renew the worn parts.

(2) Peen the differential pinion shaft lock pin in position.

(3) The differential housing and ring gear contact faces should be thoroughly cleaned to ensure even backlash.

(4) Tighten the ring gear securing bolts to a torque of 45 ft/lb and lock the heads with wire.

**TO ADJUST DRIVE PINION AND RING GEAR**

Proper adjustment of the drive pinion and the ring gear is the main factor for silent operation and final drive wear. At the time of production, drive pinions and ring gears are machined in pairs and within very close limits. Such being the case, when replacement becomes necessary, pairs should be replaced and not separately. Drive pinion and ring gear can both be moved to effect proper adjustment. Departures from the normal position and also the correct backlash (Sp and Z) are measured and marked on the drive pinion and ring gear respectively. Every drive pinion and ring gear is provided with corresponding numbers.

The rear axle adjustment is done to obtain the same gear meshing as done originally by the manufacturers by means of precision testing machines. This is guided by the values marked on the gears.

Measurement can be done with the aid of a rule, depth gauge and vernier caliper.

On each side of the differential is a shim which is installed to effect adjustment. After measuring the required dimensions the correct thickness of shims can be determined.

To determine the thickness of the shims, referred to as S1 and S2, the undermentioned dimensions are required:

| | | mm | Standard |
|---|---|---|---|
| A | Depth of left transmission case half ... | 72.55 | (2.8563") |
| B | Depth of right transmission case half ... | 72.55 | (2.8563") |
| J | Total depth of transmission case ..... | 145.00 | (5.7126") |
| L | Length of differential housing ..... | 138.00 | (5.4331") |
| G | Distance from the ring gear back face to the shim contact face ... | 28.95 | (1.1398") |

The readings should be taken to a tolerance of .0005". The dimension T, as illustrated, is the distance from the drive pinion centre line to the ring gear rear face and is constant at 1.575".

The plus or minus marks on the ring gear must be taken into consideration when determining the shims to be installed.

The pre-load V on the two ball bearings of the differential should be within .004" to .007". Therefore, with a mean value of .0055", it is necessary to add .0027" to each shim.

While installing the Gleason ring gear and drive pinion, observe the following points:

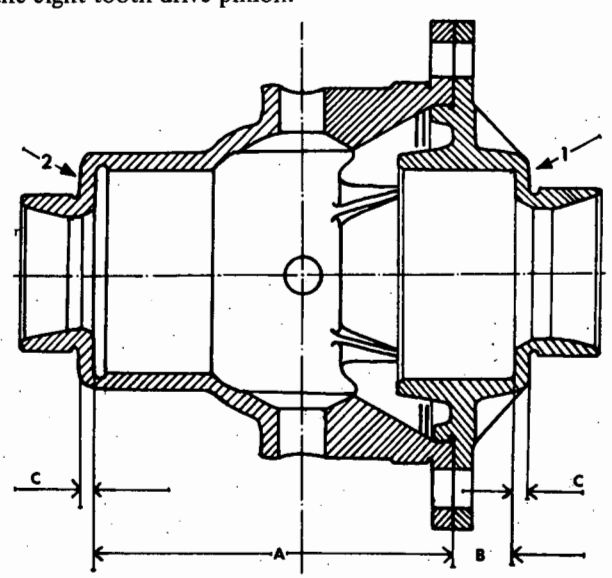
**DIFFERENCE BETWEEN OLD AND NEW GEAR SETS**

The new Gleason gear set drive pinion is 1.18" deep which is approximately 0.14" longer than the early Gleason and the current Klingelnberg drive pinions.

The ring gear is 1.04" deep and this is approximately 0.06" wider than the early type.

The meshing angle of the tooth is not the same on both sides. On the drive side of the tooth the angle is 14° whereas on the coasting side it is 26°. The early Gleason and the current Klingelnberg gear sets both have a symetrical meshing angle. As such, the new Gleason set can be distinguished from other gear sets by the saw-tooth formation.

The nominal dimension R represents the distance from the ring gear centre line to the face of the drive pinion is 2.1949" for the seven tooth drive pinion and 2.3315" on the eight tooth drive pinion.



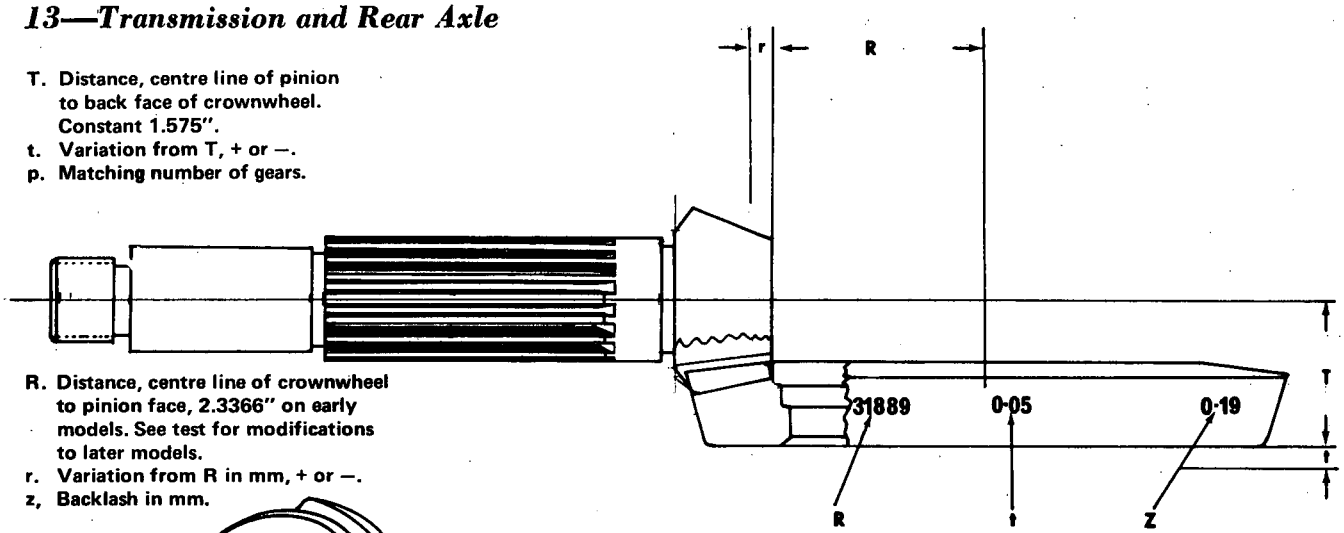

Detail of Differential Case Tolerances.

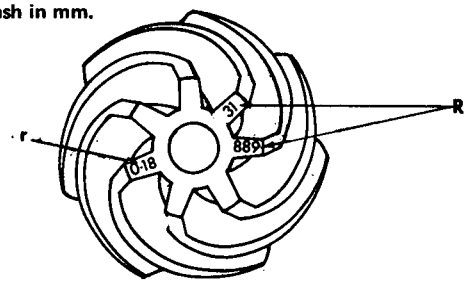
1. Contact face for bearing shim.
2. Contact face for bearing shim.

A. Depth of housing 4.290".
B. Depth of housing cover.
C. Minimum wall thickness.

T. Distance, centre line of pinion to back face of crownwheel. Constant 1.575".
t. Variation from T, + or —.
p. Matching number of gears.

R. Distance, centre line of crownwheel to pinion face, 2.3366" on early models. See test for modifications to later models.
r. Variation from R in mm, + or —.
z, Backlash in mm.

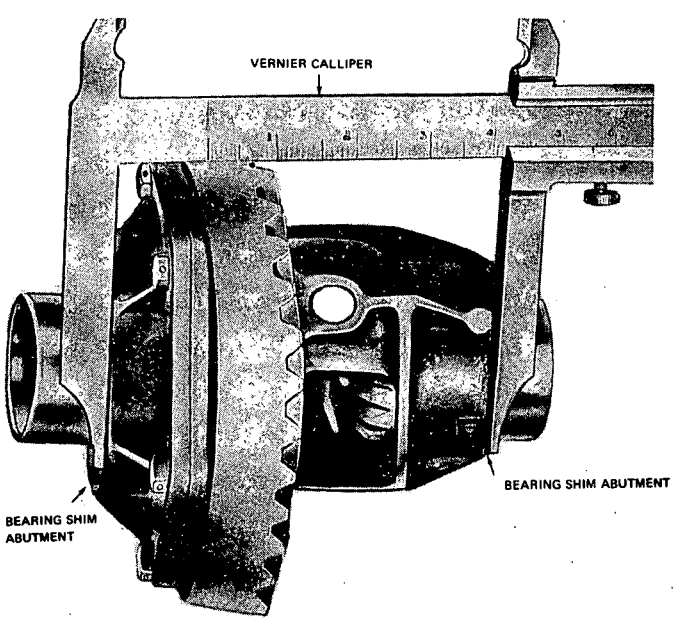



Typical Crownwheel and Pinion Markings.

**TOTAL DEPTH OF TRANSMISSION CASE J (see illustration):**

Measure the left and right transmission case halves **A** and B with a rule and a depth gauge as shown.




Method of Measuring Length of Differential Housing.

The depth gauge is to make contact with the inner race of the carrier ball bearing. Repeat measuring at different points.

Add the measured values of A and B to obtain the total depth J of the transmission case.

**LENGTH OF DIFFERENTIAL CASE L (See Illustration):**

The length of the differential case is measured with a vernier caliper, the dimension being the distance between the bearing register on each side.

**DISTANCE FROM RING GEAR BACK FACE TO SHIM CONTACT FACE G:**

The distance is measured with a depth gauge.

**HOW TO DETERMINE THICKNESS OF SHIMS:**

The thickness of the two differential shims (S1) and (S2) is determined as illustrated by the following example:

Formula: $S1 = J - B - (T \pm t) - G + \frac{V}{2}$

$S2 = J - L + V - S1$

**DEPTH OF RIGHT TRANSMISSION CASE HALF B (See Illustration):**

This dimension is to be ascertained by a rule and a depth micrometer or a depth gauge.

It is recommended to repeat the measuring at three points of the ball bearing inner race and ascertain the mean value.

**LENGTH OF DIFFERENTIAL HOUSING L AND DISTANCE FROM RING GEAR BACK FACE TO SHIM CONTACT FACE G**

The readings obtained are to be added to or subtracted from the standard dimensions as shown in the following example:

## 1. DIFFERENTIAL SHIM S1

| | | mm | |
|---|---|---|---|
| J | Total depth of transmission case | 145.20 | (5.7165") |
| −B | Depth of right transmission case half | − 72.55 | (2.8563") |
| | | 72.65 | (2.8602") |
| −(T ± t) | T Distance from drive pinion centre line to ring gear back face | 40.00 | (1.5748") |
| −t | departure from T (plus or minus marking on ring gear) | − 0.05 | ( .0019") |
| | | − 39.95 | (1.5728") |
| | | 32.70 | (1.2835") |
| −G | Distance from ring gear back face to shim contact face | 28.90 | (1.1378") |
| | | 3.80 | ( .1457") |
| $+\frac{V}{2}$ | Half the pre-load on ball bearing | + 0.07 | ( .0028") |
| S1 | Thickness of left differential shim | = 3.87 | ( .1485") |

## 2. DIFFERENTIAL SHIM S2

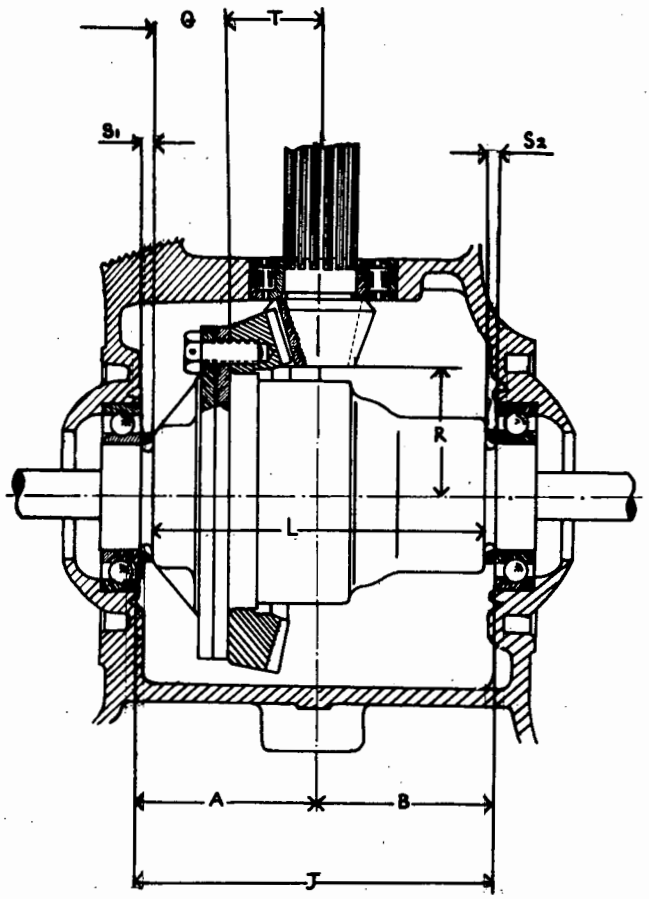
| | | | |
|---|---|---|---|
| J | Total depth of transmission case | 145.20 | (5.7165") |
| −L | Length of differential housing | −137.85 | (5.4272") |
| | | 7.35 | ( .2893") |
| +V | Pre-load | + 0.14 | ( .0055") |
| | | 7.49 | ( .2948") |
| −S1 | Thickness of left shim | − 3.87 | ( .1484") |
| S2 | Thickness of right shim | = 3.62 | ( .1464") |

There is a selection of shims serviced by the manufacturers in thicknesses from 2.9 to 4.5 mm in increments of .1 mm. There are also shims of the thickness of 0.25 mm serviced providing for adjustments in increments of 0.05 mm.

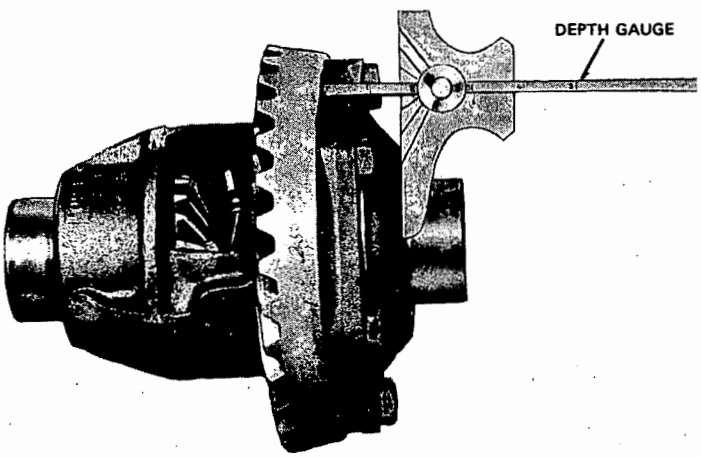
The determined shim thickness is to be increased or reduced to the next thickness which is similar to the shims serviced, but the total shim thickness of S1 and S2 must remain within the permissible tolerance to ensure that the two differential ball bearings are correctly pre-loaded.

With determined shim thickness as calculated, viz; S1 = 3.77 mm; S2 = 3.72 mm; S1 + S2 = 7.49 mm; use approximately shim thickness as follows: S1 = 3.80 mm; S2 = 3.70 mm; S1 + S2 = 7.50 mm.

Check the thickness of the shims with a micrometer, measuring at four different points. The permissible variation is 0.03 mm.




Dimensions for Correct Setting of Crownwheel and Pinion.




Method of Measuring Distance from Rear Face of Crownwheel to Bearing Shim Abutment Face on Differential Housing Cover.

## TO ADJUST DRIVE PINION

The fundamental adjustment has already been carried out by the installation of shims between the drive pinion head bearing and the clutch of the first speed gear, while assembling the drive pinion.

Using a special mandrel, measure the distance for the axial adjustment of the drive pinion after measuring the total depth of the transmission case (J) referred to previously, for the ring gear adjustment.

(1) Turn the mandrel until the arrow points to the gearshift housing. Slacken the knurl-headed screw until the tracer pin comes in contact with the face of the drive pinion.

(2) Tighten the knurl-headed screw and turn the mandrel 90° to prevent altering the tracer pin position when the transmission case is being opened.

(3) Remove the mandrel and, using a depth gauge, measure the length of the tracer pin.

(4) To the length of the tracer pin, add half the diameter of the mandrel. The value obtained must correspond with the distance R (standard 59.35 mm) after adding or subtracting the tolerance discrepancy, ie, plus or minus mark on the face of the drive pinion.

Ensure that a minus amount is added to and a plus amount is subtracted from the distance R.

| Example | | mm | |
|---|---|---|---|
| (a) | Standard dimension of R . | 59.35 | (2.3366") |
| | Tolerance discrepancy = 0.18 mm therefore add . . | + 0.18 | (.0071") |
| | Fitting dimension . . . . . | 59.53 | (2.3437") |
| | Approximately . . . . . | 59.5 | (2.3425") |
| (b) | Radius of mandrel . . . . . | 30.00 | (1.1811") |
| | Length of tracer pin . . . | 29.6 | (1.1653") |
| | Dimension measured . . . | 59.6 | (2.3465") |

While making comparison between the measured value of 59.6 mm and the fitting dimension of 59.5 mm, it will be seen that the total thickness of the drive pinion shims must be increased by 0.1 mm or .004".

## TO CHECK DIFFERENTIAL ADJUSTMENTS

Ensure that the axial adjustments of the drive pinion and ring gear are correct by measuring the backlash and checking the tooth contact.

(1) Position the differential in the left half of the transmission case, ensuring that the two differential shims are correctly fitted to the sides. The shim must be positioned with the chamfered face towards the differential housing. In case it is necessary to instal an additional shim of 0.25 mm, it should be positioned between the ball bearing and the other shim.

(2) Position the drive pinion and lightly tap it towards the ring gear to remove any existing end play.

(3) Mix some red lead with engine oil and apply a light coat on the ring gear teeth.

(4) Position the right half of the transmission case and secure with bolts.

(5) Attach the gearshift housing to the transmission case.

(6) Mount a dial gauge in the differential housing so that the tracer pin of the dial gauge is in contact with one of the axle tube retainer studs. Secure the gauge in position.

(7) The drive pinion should be prevented from movement and slightly move the dial gauge to take up the play in both directions. The deflection of the needle will indicate the amount of backlash.

(8) The measurement should be done a number of times but each time the ring gear should be turned 90°. The difference, while comparing one measurement with another, should not exceed .002". The backlash marked on the ring gear should be compared with the measured value.

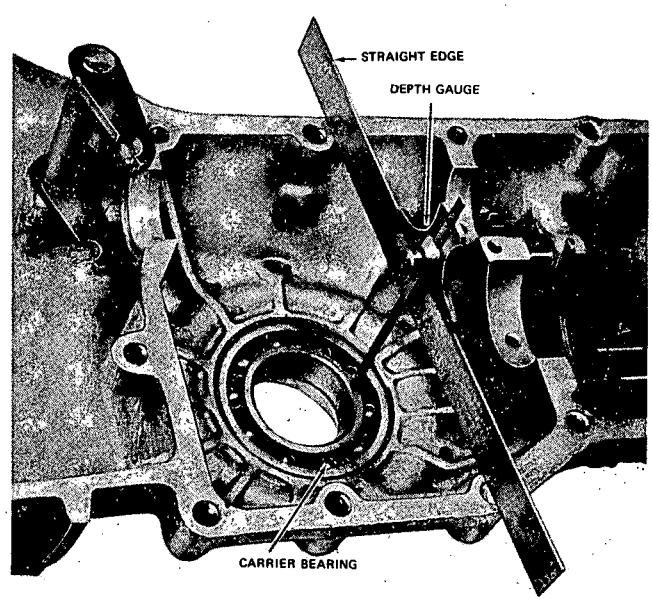
Any marked difference between the measured value and the prescribed backlash should be corrected by changing the shims S1 and S2 maintaining the total thickness of the shims. Again check the backlash.

(9) The ring gear and the differential should both be rotated at the axle shafts.

(10) Again open up the transmission case.

(11) Carefully check the tooth contact of the ring gear and correct the axial adjustment, if necessary. Check once again.

(12) When adjustments have been satisfactorily completed, finally assemble the transmission case.




Method of Measuring Depth of Half Transmission Case.

# PART 2

# ONE-PIECE TUNNEL TYPE TRANSMISSION CASE

## SPECIFICATIONS

| | |
|---|---|
| Type | 4 speed and reverse, incorporating rear axle and differential |
| Synchromesh | All forward gears |
| Gear ratios: | |
| First | 3.80:1 |
| Second | 2.06:1 |
| Third | 1.32:1 |
| Fourth | 0.89:1 |
| Reverse | 3.88:1 |
| Gear control | Manual; remote control shift linkage with ball-type lever |
| Rear axle ratios: | |
| Pinion and ring gear | 4.125:1 |
| Reduction gear ratio | 1.4:1 and 1.39:1 |

## 1. DESCRIPTION

The transmission, rear axle and the engine form one unit located in the rear of the vehicle. At the front end the gear carrier and gearshift housing is attached to the transmission case with bolts. In the rear the engine is bolted to the integral clutch housing flange. There are two magnetic oil drain plugs located in the bottom of the case. There are three rubber mounting points supporting the transmission case.

The rear axle is the swing half axle type and two final drive covers with ball-shaped surfaces are provided for mounting the rear axle tubes.

There are four forward speeds and reverse. All forward gears have synchromesh mechanism and helical cut gears for silent operation. The four forward gears are in constant mesh.

## 2. REAR AXLE

### TO REMOVE

(1) Disconnect the earth cable from the battery.

(2) Slacken the nuts of the axle shafts and road wheels.

(3) Raise the vehicle and support on stands.

(4) Remove the nuts from the axle shafts and road wheels and remove the road wheels.

(5) Withdraw the brake drum and rear hubs.

(6) At the rear disconnect the brake hoses, remove the shoe return springs, brake shoes, shoe levers and links. Take out brake cable retainers and withdraw cables from back plates.

(7) Slacken the dust sleeves.

(8) Remove the bolts from the lower shock absorber mounting.

(9) Tighten a suitable clamp on the axle shaft and spring plate.

*NOTE: When removing or fitting the spring plate to the reduction gear case always use a suitable clamp to avoid damage to the end of the mounting bolt threads due to the pre-load of the spring plate.*

(10) Remove the mounting bolts from the spring plate.

(11) From the clutch operating shaft lever detach the clutch cable. From the bracket on the final drive cover on the left, slide off the rubber boot and withdraw the cable and sleeve.

(12) Detach the accelerator cable from the gear carrier.

(13) Detach cables from the terminals on the starter motor.

(14) From the gear shifting rod coupling, take out the rear screw. Withdraw the coupling from the gearshift rod by moving the gear lever.

(15) From the transmission case front rubber mounting, take out the stud nuts.

(16) Using a trolley jack and suitable transmission cradle, under the vehicle, the cradle should be clamped to the rear axle.

(17) Remove the two bolts from the transmission carrier.

(18) The axle assembly should now be taken out from the rear of the vehicle with the trolley jack.

*NOTE: Exercise caution while lowering the transmission and rear axle to avoid the main drive shaft from striking the floor.*

**TO INSTAL**

Installation is a reversal of the removal procedure with reference to the following points:

(1) When installing the rear axle assembly always use a trolley jack with suitable cradle.

(2) When tightening the two transmission carrier bolts apply grease to the bolt threads.

(3) Mounting plate nuts should be tightened at the front end of the transmission case.

(4) Coupling securing bolts should be correctly seated in the recesses in the gearshift rod and secure heads with wire wrapped around the coupling.

(5) Attach the accelerator cable in retainer on the gear carrier case.

(6) Tighten a suitable clamp on the axle shaft and spring plate. Using a suitable tapered pin, line up the holes of the spring plate with the holes in the reduction gear case and screw in the bolts, tightening them to a torque of 72 ft/lb.

*NOTE: There are three bolts in line and one away to the side. The centre bolt of the three should be first tightened, next the one away and then those on either side of the centre bolt.*

(7) Turn up the lock plates to secure the four bolts.

(8) Correctly position the dust sleeves on the axle tubes and tighten the clips.

(9) Position the shock absorbers on the lower mountings, insert bolts and tighten.

(10) Check brake drum splines for wear or damage and renew if necessary.

(11) Instal brake drums and tighten castellated nuts to a torque of 220 ft/lb. Fit new split pins.

(12) Bleed the hydraulic brake and adjust.

**TO DISMANTLE**

(1) Mount the rear axle and transmission on a stand and secure.

(2) Remove the oil drain plugs from the transmission and reduction gear cases.

(3) Undo the mounting bolts and remove the starter motor.

(4) Extract the split pins from the castellated axle nuts, remove nuts and withdraw brake drum and hub assemblies.

(5) Disconnect the brake hoses; remove the shoe return springs, brake shoes, shoe levers and links. Take out the brake cable retainers and withdraw the cables from the back plates. Remove the back plates.

(6) Undo all mounting bolts and remove the reduction gear cases with the rear axle tubes and shafts.

(7) Undo the securing bolts and remove the gearshift housing.

(8) Undo the mounting bolts and remove the differential.

(9) Remove the rear main drive shaft.

(10) Remove the transmission.

(11) Carefully remove the reverse drive gear and the reverse sliding gear shaft.

(12) Take out the main drive shaft and drive pinion from the gear carrier.

(13) Take out the selector shafts and extract the detent balls and springs.

**TO ASSEMBLE**

To assemble is a reversal of the dismantling procedure but reference should be made to the appropriate sections in this manual describing dismantling and assembling procedures for each assembly.

## 3. REAR OIL SEAL AND WHEEL BEARING

**TO REMOVE**

(1) As previously described, remove the brake drum.

(2) Remove the brake shoe assembly including the wheel cylinder.

(3) Undo the bearing cover bolts and remove the cover with oil seal.

(4) Remove the back plate.

(5) Remove the outer spacer and also the gasket and washer.

(6) Using a special tool remove the wheel bearing and the inner spacer.

**TO INSTAL**

Installation is a reversal of the removal procedure, specially observing the following points:

(1) Carefully check the condition of the bearing for excessive wear or damage and renew if necessary.

(2) Discard old gaskets and fit new ones.

(3) Check condition of the outer spacer for damage by scoring, cracks or rust and renew, if necessary. Ensure that all components are thoroughly cleaned before installation and apply oil on the spacer to avoid damage to the oil seal.

(4) Carefully check the condition of the oil seal for

signs of damage and renew if necessary. Apply oil lightly to the oil seal before pressing into position. The seal should be pressed into a depth of approximately .185".

(5) Instal the bearing cover with the oil drain at the bottom.

(6) Secure the bearing cover bolts tightening to a torque of 40 ft/lb.

(7) Carefully check the brake drum hub splines for wear or damage and replace the drum if necessary.

(8) Instal the axle shaft castellated nut, tighten to a torque of 220 ft/lb and insert a new split pin.

(9) Insert .44 Imp pints of specified grade gear oil in the reduction gear case.

(10) Check the oil level in transmission and top up, if necessary.

(11) Bleed the hydraulic system and adjust brake.

## 4. REDUCTION GEAR

### TO REMOVE AND DISMANTLE

(1) As previously described remove the brake drum and back plate. Withdraw the outer spacer, gasket and washer. Using a special tool, extract the ball bearing and take off the inner spacer.

(2) Undo the reduction gear case bolts.

(3) Using a soft head hammer, lightly tap the reduction gear case cover and separate the cover from the case. Discard the gasket.

(4) Take off the snap ring from the axle shaft.

(5) Using a bearing puller, remove the outer ball bearing from the axle shaft.

(6) Remove the reduction gear and drive gear and shaft.

(7) Using a bearing puller, remove the inner ball bearing from the axle shaft.

(8) Using a bearing puller, remove the reduction gear shaft inner ball bearing.

### TO ASSEMBLE AND INSTAL

To assemble and instal is a reversal of the removal and dismantling procedure observing the following operations:

(1) The reduction gear case jointing surfaces must be thoroughly clean before assembling.

(2) Clean and carefully check all gears and bearings for wear or damage and renew, if necessary.

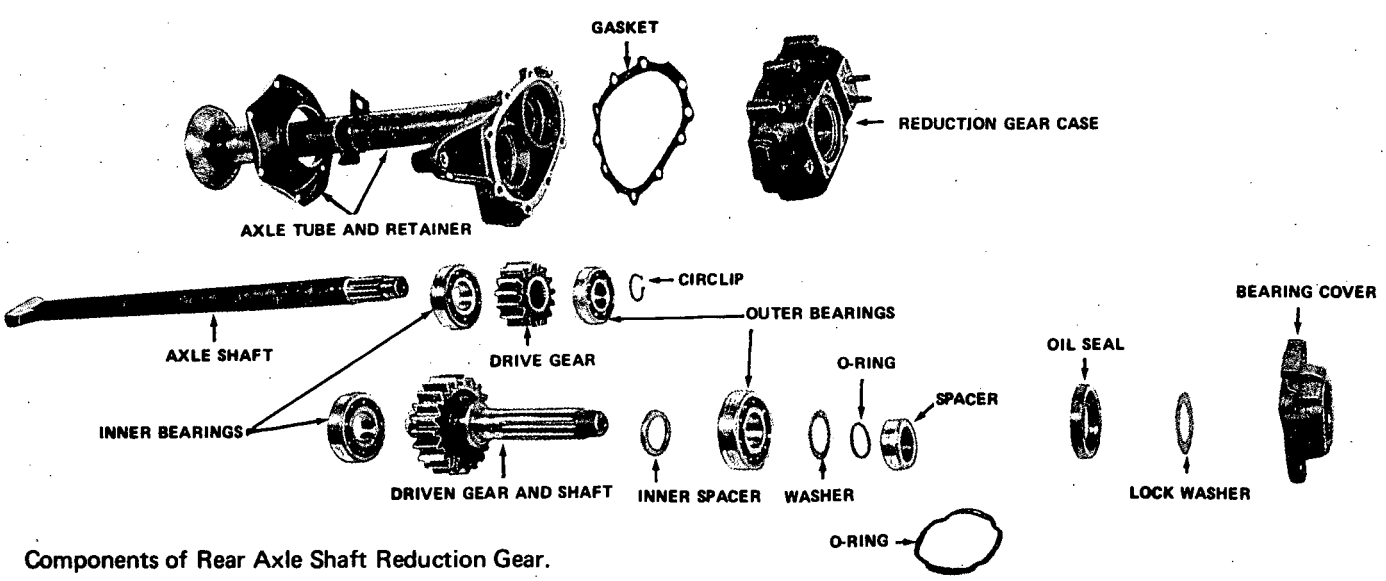
(3) Using a suitable drift, drive the rear axle shaft inner ball bearing into position.

(4) Using a suitable drift, drive the reduction gear shaft inner ball bearing into position within the reduction gear case.

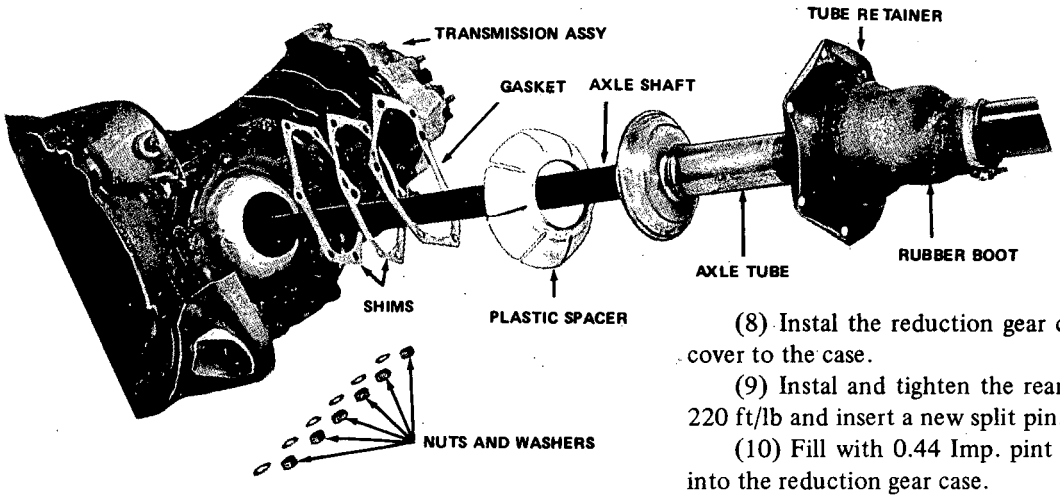
(5) Using a sleeve type drift, drive the rear axle shaft outer ball bearing into position on the shaft.

(6) Check that the snap ring has sufficient tension and renew, if necessary.

(7) Instal a new gasket between the jointing surfaces of the reduction gear case.




Components of Rear Axle Shaft Reduction Gear.




Components of Rear Axle Shaft Tube Attachment.

(8) Instal the reduction gear case bolts and secure the cover to the case.

(9) Instal and tighten the rear axle nut to a torque of 220 ft/lb and insert a new split pin.

(10) Fill with 0.44 Imp. pint of recommended gear oil into the reduction gear case.

(11) Check oil level in transmission and top up, if necessary.

(12) Bleed the hydraulic system and adjust brake.

## 5. REAR AXLE TUBE AND SHAFT

### TO REMOVE

(1) As previously described, take off the brake drum and shoes including the wheel cylinder. Undo the retaining bolts and remove the ball bearing cover and back plate. Using a suitable puller, extract the outer ball bearing and remove the reduction gear.

(2) Undo the brake pipe retaining clip and remove the brake pipe.

(3) Undo the axle tube retainer nuts.

(4) Detach the axle tube with retainer and remove the gasket and plastic packing.

(5) Extract the differential side gear snap ring.

(6) Withdraw the differential side gear thrust washer and remove the axle shaft.

(7) From the differential housing, take out the differential side gear and fulcrum plates.

(8) Remove the lock pin from the reduction gear case.

(9) Slacken the dust excluding sleeve.

(10) Position the reduction gear case on a press and, with the aid of a special tool, press the axle tube out of the reduction gear case.

*NOTE: Care should be exercised during the above operation to avoid damaging the reduction gear case. In the event of the flange being damaged, the case should be renewed.*

(11) Slide the dust excluding sleeve off the rear axle tube and take off the tube retainer.

### TO INSTAL

Installation is a reversal of the removal procedure observing the following points:

(1) Thoroughly clean the axle tube retainer and retainer seat on the final drive cover.

(2) Carefully check the condition of the dust excluding sleeve and if necessary, renew.

(3) Thoroughly clean, check and oil the seating faces of the reduction gear case before assembling. Position the case on a press and with the aid of spacers, press the case into place.

(4) Check the condition of the rear axle shaft, differential side gear and thrust washer and if worn or damaged, the components should be renewed, but consideration should be given to the following:

(a) Permissible clearance between the convex sides of the flat end of the rear axle shaft and the inner diameter of the differential side gear is from .0012" to .004".

(b) Rear axle shafts and differential side gears are in three tolerance groups and bear identifying paint marks viz: blue, pink and green for guiding correct mating. Only two tolerance groups are supplied as spares, ie, blue and pink.
The identification mark on the side gear is discernible by a paint dot on the recessed face. On the axle shaft the identification is a ring painted 6" from the flat end.

Avoid excessive clearance as this could cause noise in the rear axle assembly.

With effect from Chassis No. 589709 a modified axle shaft has been introduced which has a spring loaded ball in a slotted sleeve in one of the rear axle shaft flange faces. This modification has eliminated the play between the axle shaft and the differential side gear. When stocks of the previous type axle shafts are exhausted, only the modified type will be serviced for installation in transmissions up to Chassis No. 469447.

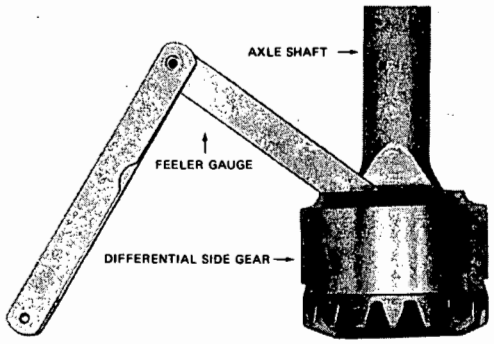
The chamfered edge of the side gears has been modified to provide a wider thrust face for the thrust washer. This has taken effect from Chassis No. 543946. These modified side gears can only be fitted to rear axles from Chassis No. 469447 of May, 1959.

(5) The rear axle shaft should be checked for run-out at the seat of the ball bearing and if found to be in excess of .002", which is the permissible limit, the axle shaft should be straightened.

(6) The fitting clearance of the rear axle shaft/fulcrum plates/differential side gear should be checked. The clearance preferred is .006" – .008", but if in excess of .012" fit oversize fulcrum plates which are provided with a groove on their faces otherwise renew the parts.

Modified fulcrum plates have been installed from Chassis No. 546150 for the purpose of reducing the clearance at the rear axle shaft/fulcrum plate/differential gear. On the curved side, these plates have a slightly rounded contour lengthwise. Wherever possible, the clearance should not be in excess of .002" as any excess clearance here can cause rear axle noise.

(7) Position the differential side gear, axle shaft and thrust washer in the differential housing and insert the lock ring.




Checking Axle Shaft Side Clearance in Gear.

Modifications have been made to obtain a backlash of .004" – .008" between the differential side gears and pinions, as follows:

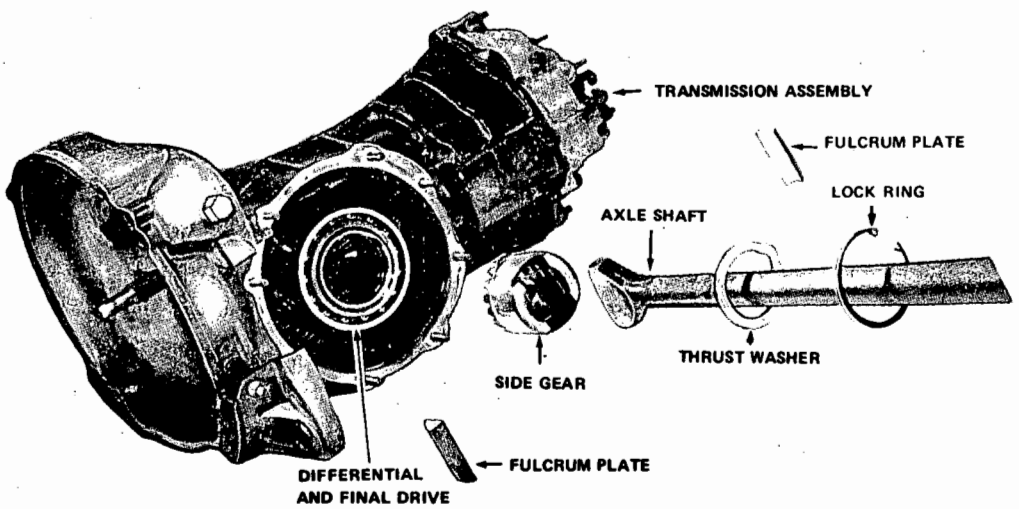
(a) From Chassis No. 522240 a .1259" differential side gear thrust washer has been fitted instead of the previous 3 mm.

(b) From Chassis No. 584155 the lock ring groove in the differential housing has been moved outwards .031". A .1574" thick thrust washer has replaced the .1259" thick thrust washer.

The modified differential housing has a 4 mark for identification. For previous differential housings a .1259" thick thrust washer is available.

(8) Select the correct thickness axle tube retainer gasket so that the rear axle tube should have no end play. Do not exceed the maximum end play of .008". Tighten the axle tube retainer nuts to a torque of 14 ft/lb.

(9) The dust excluder sleeve clips must not be tightened until the rear axle is installed to prevent the dust sleeve from being damaged due to twisting.




Axle Shaft and Side Gear Components.

## 6. REAR AXLE DUST SLEEVES

### TO REMOVE

A split dust excluding sleeve is available for service, the fitting of which does not necessitate dismantling the rear axle.

(1) Remove the two retaining clips.

(2) Using any suitable tool, cut and remove the dust sleeve.

(3) Thoroughly clean the axle tube and the tube retainer.

### TO INSTAL

(1) Use a good sealing compound, lightly applied on the jointing surfaces of the split dust seal.

(2) Position the dust seal with the flange pointing horizontally to the rear.

(3) Tighten the six screws on the dust sleeve flange and secure the dust sleeve with the two retaining clips.

*NOTE: Do not overtighten the dust sleeve screws and the retaining clips. The rear axle should be in the loaded condition when the tightening is being done.*

## 7. TRANSMISSION CARRIER MOUNTINGS

### TO REMOVE

(1) Undo the transmission carrier mounting bolts and remove the carrier.

(2) Undo the nuts from the transmission case bonded rubber mountings and remove the mountings.

### TO INSTAL

Installation is a reversal of the removal procedure observing the following points:

(1) Inspect the transmission carrier rubber mountings for signs of any damage and renew, if necessary.

(2) Before tightening the transmission carrier mounting bolts, the transmission must be installed and the nuts of the front rubber mounting tightened.

## 8. GEARSHIFT HOUSING

### TO REMOVE

(1) Undo the gearshift housing rubber mounting nuts and remove rubber mounting.

(2) Undo the gearshift housing nuts.

(3) Withdraw the gearshift housing and transmission shift lever.

(4) Take off the gasket and thoroughly clean jointing surfaces.

### TO INSTAL

Installation is a reversal of the removal procedure observing the following points:

(1) Inspect the transmission shift lever bushes for wear and renew if necessary.

Instal and ream the new bushes .5918" to .5925".

(2) When attaching the gearshift housing to the transmission case, ensure that the selector shafts are in the neutral position. Tighten the nuts to a torque of 14 ft/lb.

The breather passage in the gearshift housing and the oil return passage have been re-positioned commencing from Chassis No. 579727.

A channel has been cast in the mating surface of the gearshift housing extending from the previous double chamber with square breather hole to between the holes provided for the top two studs.

There is no provision for the oil return passage in the gear carrier between the selector shafts and the drive pinion needle bearing as this has been discontinued. Looking in the driving direction, the new passage is located between the needle bearing and the lower left gearshift housing stud.

## 9. DIFFERENTIAL AND TRANSMISSION ASSEMBLY

### TO REMOVE

(1) Undo the securing nuts and withdraw the gearshift housing.

(2) Bend back the lock plate tabs from the securing nuts of the drive pinion and the main drive shaft.

(3) Engage the reverse and third or fourth gears to lock the transmission.

(4) Undo the drive pinion and main drive shaft securing nuts and remove the lock plates. Discard used lock plates and fit new ones.

(5) Undo the gear carrier stud nuts, remove the ground

strap and the accelerator cable retainer.

(6) Turn the transmission case until the right hand final drive cover is facing up.

(7) Undo the right hand final drive cover stud nuts.

(8) Carefully remove the final drive cover. The thrust plate is located on the differential housing flange and the spindle is attached to two of the axle tube retaining studs.

(9) Place the spindle and the thrust plate in position on the left hand final drive cover and press out the differential.

*NOTE: While removing the differential specially observe the thickness and positioning of the differential shims to facilitate installation.*

(10) Loosen the retainer ring for the reverse gear on the main drive shaft and slide the reverse gear towards the rear and screw the main drive shaft apart.

(11) Remove the reverse gear and the retainer ring and pull the rear main shaft towards the rear but avoid damaging the oil seal.

(12) Remove the left hand final drive cover.

(13) Bend up the lock plate tabs of the ball bearing retainer securing bolts and undo the bolts.

(14) Using a suitable tool, push the transmission out of the case and note the thickness of the shims.

(15) From the reverse gear shaft, remove the snap ring and reverse drive gear.

(16) Extract the Woodruff key and remove the reverse gear shaft and thrust washer from the transmission case.

(17) Remove the reverse gear shaft needle bearing spacer sleeve securing screw.

(18) Using a suitable drift, drive out the needle bearings for the reverse gear shaft and spacer sleeve.

(19) Remove the needle bearing securing screw from the main drive shaft.

(20) Using a suitable drift, drive out the main drive shaft needle bearing.

(21) Using a press and suitable tools, remove the ball bearings from left and right final drive covers.

(22) Remove the clutch release bearing and the operating shaft.

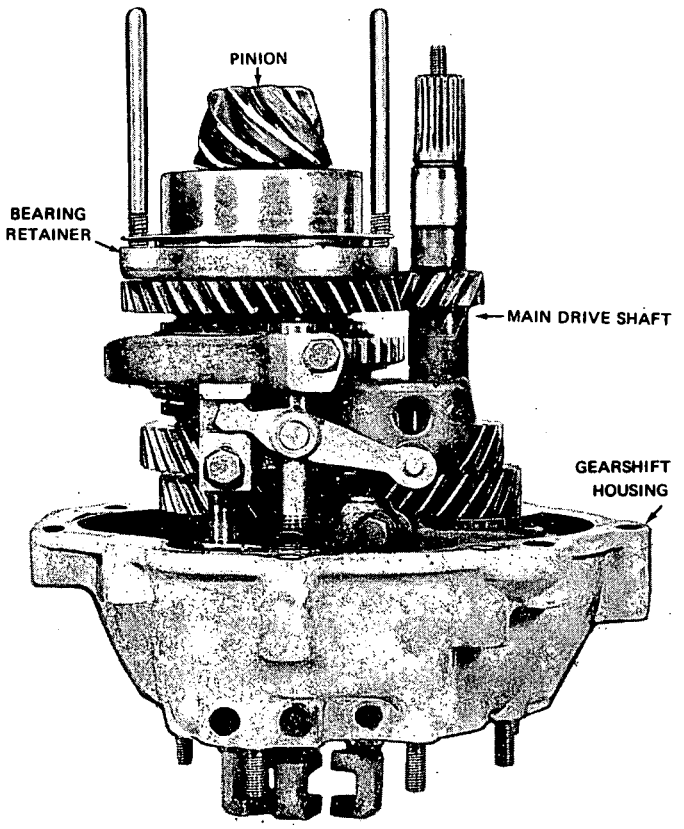
## TO INSTAL

Installation is a reversal of the removal procedure observing the following points:

(1) Thoroughly clean the transmission case and final drive covers and carefully inspect for damage. Renew any damaged components.

(2) Inspect the starter motor armature bush for wear and replace if necessary.

(3) Inspect the clutch operating shaft bush for excessive wear and renew if necessary. The free movement




**Guide Pins or Studs Fitting to Pinion Bearing Retainer to Prevent Rotation during Assembly.**

of the clutch operating shaft should be checked at every transmission repair.

(4) Carefully check all the bearings before installation.

(5) Using a suitable drift, insert the needle bearings for the reverse gear shaft and spacer sleeve.

(6) Insert the reverse gear shaft with the thrust washer and drive gear in the transmission case. Do not omit the Woodruff key. Check the snap ring tension.

(7) For drive pinion adjustment, place the shims over the ball bearing and turn the bearing retainer until one of its locating lugs points towards the drive shaft.

(8) Two 4" studs should be screwed into the ball bearing retainer to prevent the retainer from turning while installing the transmission.

(9) Position the reverse selector fork and sliding gear on the reverse lever and engage reverse gear.

(10) Instal the transmission in the transmission case, using a rubber head hammer to correctly position the pinion in the bearing seat.

(11) Using new lock plates, insert the ball bearing retainer bolts and tighten to a torque of 36 ft/lb. Bend up the lock plate tabs to lock the bolts.

(12) Tighten the gear carrier stud nuts to a torque of 14 ft/lb.

(13) Before installing the rear half of the main drive shaft, apply oil to the lip of the oil seal. Screw the halves of the drive shaft together backing them off until the splines of the reverse gear are in line. The halves of the main drive shaft must not be screwed tightly together. Check the tension of the reverse gear snap ring.

(14) Press the ball bearings into left and right final drive covers.

(15) Check whether reconditioning of the differential is necessary.

(16) Clean mating surfaces of the left final drive cover and transmission case, apply sealing compound and instal the cover. Tighten the securing nuts to a torque of 14 ft/lb.

From Chassis No. 605706 a paper gasket, .005" – .006" thick has been installed between the transmission case and the final drive cover on each side instead of sealing compound previously used. This measure will prevent oil leaks from occurring at this location.

*NOTE: New gaskets should always be used when carrying out repairs to the rear axle. When gaskets are service installed, the ring gear must be re-adjusted.*

On account of their tolerance, the gaskets must be installed at the time when taking measurements during the initial adjustment of the drive pinion and ring gear.

(17) Instal the differential in the transmission case and ensure that the shims are correctly positioned.

(18) Lock the transmission by engaging reverse and third or fourth gears.

(19) Fit new lock plates and the nuts to the drive pinion and main drive shaft and tighten to a torque of 36 ft/lb. Bend up the tabs on the lock plates.

(20) When attaching the gearshift housing, ensure that the three selector shafts are in neutral position.

## 10. GEAR CARRIER

### TO DISMANTLE

(1) From the reverse lever remove the reverse selector fork and the reverse sliding gear.

(2) From the outer race of the drive pinion ball bearing, take off the shims taking note of the thickness.

(3) Clamp the gear carrier in a vice with soft jaws and slacken the locking bolts of the first and second and also the third and fourth selector forks. Remove the selector for first and second gears.

(4) Fix a rubber band around the operating sleeve of the first and second gear and the main drive shaft.

(5) Using a suitable press, position the gear carrier and apply pressure to the main drive shaft and remove transmission from the gear carrier.

*NOTE: Lift the drive pinion slightly while pressing out the main drive shaft ball bearing. Exercise caution to ensure that the selector fork for third and fourth gears does not jam on the selector shaft.*

(6) Remove the drive pinion needle bearing securing bolt and press out the needle bearing.

(7) Using a suitable press, press out the main drive shaft ball bearing.

(8) Clamp the gear carrier in a vice with soft jaws and undo the bolt on the reverse lever guide.

(9) Take off the reverse gear selector shaft and remove the reverse lever guide.

(10) Take off the selector shaft for first and second gears and remove the reverse lever from its mounting.

(11) Remove the third and fourth gear selector shaft.

(12) Take out the plungers and detent balls and using a small screw driver or any other suitable tool, extract the detent springs.

### TO ASSEMBLE

Assembling is a reversal of the dismantling procedure observing the following points:

(1) Check the condition of the detent springs and renew, if necessary. The free length of the springs is 1" and the permissible wear is .90". The force applied to overcome the detent ball undercuts on the selector shafts should amount to approximately 33-44 lb. If difficult gear shifting is experienced, a test should be conducted with the drive pinion removed.

(2) Insert the detent springs in the gear case through the holes for the selector shafts.

(3) Instal the reverse selector shaft with lever and lever guide.

(4) Instal selector shafts for the first and second and for the third and fourth gears, ensuring that the two interlock plungers are not omitted. Engage a gear to check for correct interlocking. The selector shaft adjacent to the one engaged must be locked. While engaging the first or second gears, the other two selector shafts should be locked.

(5) Check the condition of drive pinion needle bearing and main drive shaft ball bearing and renew, if necessary. Secure the drive pinion needle bearing after it has been installed in the gear carrier.

(6) Place the gear carrier on a suitable support and press the main drive shaft ball bearing into position.

(7) Check the selector forks for wear. The permissible clearance between the selector forks and the operating sleeves should be .004" – .012". Renew any worn parts.

(8) Check the condition of the main drive shaft and drive pinion and recondition if necessary.

(9) Press the drive pinion and main drive shaft assemblies into the gear carrier. Position the selector fork for the third and fourth gears in the operating sleeve beforehand. The drive pinion should be lifted slightly when pressing and care should be exercised to ensure that the selector fork for the third and fourth gears does not get jammed on the selector shaft.

*NOTE: It is recommended that while pressing the shaft and gear assemblies into position, a rubber band should be placed round the operating sleeve for the first and second gears and the main drive shaft to hold the drive pinion and main drive shaft together.*

(10) Instal the first and second speed selector fork.

(11) Attach the reverse selector fork including the reverse sliding gear to the reverse lever.

(12) Adjust the selector forks.

**TO ADJUST SELECTOR FORKS**

Correct adjustment of the selector forks should only be undertaken when a special tool VW294 is available for the purpose. Since the adjustment of the drive pinion alters the adjustment of the first and second reverse selector forks, the adjustment of the drive pinion should be completed first. It is also to be noted that the drive pinion and main drive shaft nuts must be tightened to the prescribed torque, before adjusting the selector forks.

(1) Clamp the special tool in a vice and position the transmission with drive pinion shims and gear carrier gasket on the gear shift testing special tool and attach the gear carrier with four bolts.

(2) Attach the drive pinion ball bearing retainer with two bolts diagonally opposed to one another and tightened to a torque of 36 ft/lb.

(3) Fit the special tool crank on the main drive shaft splines, locking the main drive shaft by the crank handle. Engage the first or second gear.

(4) Tighten the drive pinion and main drive shaft nuts to a torque of 87 ft/lb. Slacken off the nuts and again tighten to a torque of 36 ft/lb.

(5) Set the selector shafts in the neutral position and attach the gearshift housing and shifting handle. Attaching the gearshift housing ensures a correct seating of the main drive shaft ball bearing in the gear carrier.

(6) Set the selector forks for the first and second and the third and fourth gears so that the forks move freely in the operating sleeve in neutral position as well as when different gears are engaged.

(7) Set the reverse gear selector fork in a position where the reverse sliding gear is in the centre, between the operating sleeve and the second gear of the main drive shaft. With the second gear engaged, the reverse gear on the drive pinion will be properly engaged with the reverse gear.

(8) Tighten the locking screws of the selector forks to a torque of 18 ft/lb. The reverse lever guide screw should be tightened to a torque of 14 ft/lb.

(9) Remove the gearshift housing and take off the transmission.

## 11. MAIN DRIVE SHAFT OIL SEAL

**TO REMOVE**

(1) As already described in the appropriate section, remove the engine.

(2) Remove the clutch release bearing.

(3) Using a suitable tool remove the damaged oil seal carefully from the transmission case.

**TO INSTAL**

Installation is a reversal of the removal procedure observing the following points:

(1) Apply a light coating of sealing compound to the outer periphery of the oil seal. Apply some oil on the main drive shaft and the oil seal lip.

(2) Slide the oil seal on to the main drive shaft and, using a suitable drift, drive the oil seal into position.

*NOTE: Use care when sliding the oil seal on the shaft to avoid dislodging the spring around the lip.*

## 12. DRIVE PINION

### TO DISMANTLE

(1) Press out the needle bearing inner race and the fourth gear.

(2) Extract the Woodruff key and remove the spacer sleeve and shim for the third gear. Take off the second and third speed gears with the needle bearing and synchroniser stop ring for the second gear.

(3) Remove the first and second gears, clutch gear with springs, shifting plates and operating sleeve and dismantle the unit.

If any difficulty is experienced in removing the clutch gear by hand, it should be pressed off. However, care should be exercised to ensure that the shoulder of the ball bearing does not foul the thrust plate.

(4) Take off the synchroniser stop ring, the first speed gear and the ball bearing retainer.

(5) Remove the two shims for the first gear.

(6) Using a special box wrench undo the round nut.

(7) Remove the first gear thrust washer and needle cage.

(8) Positioning the drive pinion on a press, remove the inner race of the needle bearing, first gear thrust washer and the ball bearing.

### TO INSPECT

(1) Carefully inspect the drive pinion for wear or damage and renew, if necessary. As the drive pinion and ring gear are only serviced in mated pairs, it will be necessary to renew the pair. Check for the matching number on both the drive pinion and the ring gear.

(2) Carefully check condition of the ball bearing and needle bearing and renew, if necessary.

*NOTE: Whenever a drive pinion or a ball bearing is renewed, the drive pinion and the ring gear must be re-adjusted.*

(3) Carefully check gears for wear or damage and renew if necessary.

*NOTE: Whenever a gear is renewed its mating gear must also be renewed. If first and second speed gears are worn or damaged and replacement is necessary, the main drive shaft should also be replaced.*

As from Chassis No. 614456 the number of teeth, and therefore the ratio, of the third and fourth speed gears have been altered as follows:

| Early models: | No. of teeth | Ratio |
|---|---|---|
| Third speed . . . . . | 29:22 | 1.32:1 |
| Fourth speed . . . . . | 24:27 | 0.89:1 |
| **Later models:** | **No. of teeth** | **Ratio** |
| Third speed . . . . . | 28:23 | 1.22:1 |
| Fourth speed . . . . . | 23:28 | 0.82:1 |

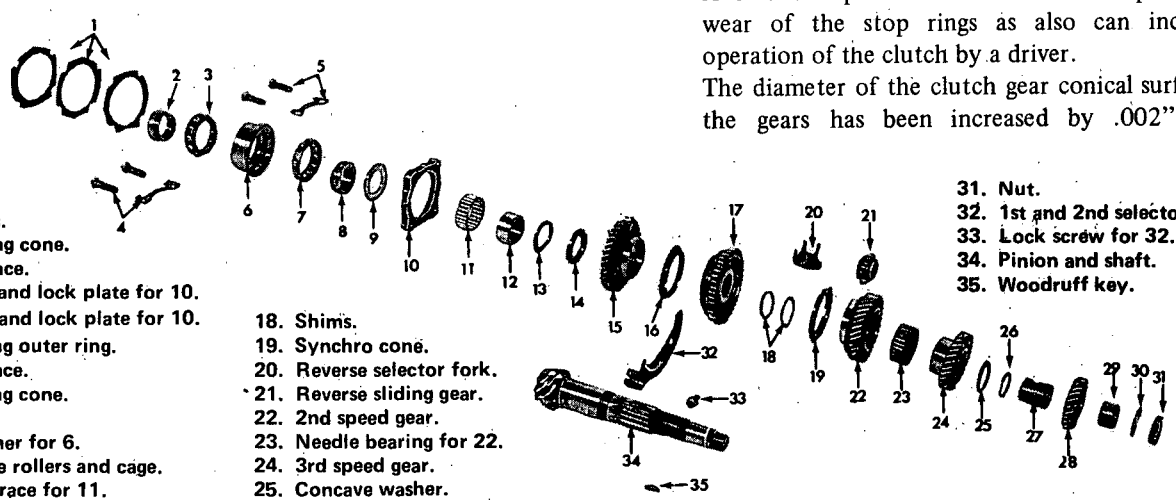
The modified gear trains can be identified by the groove in the teeth.

(4) Check the condition of all synchroniser parts.

(a) Using a suitable wire brush, clean the inner cone surface of the stop ring.

(b) Check the clearance between the face on the stop ring and the clutch teeth of the corresponding gear (normal .031"). If the wear limit is found to be reached (.012") the stop ring should be renewed. A clutch in poor condition can cause premature wear of the stop rings as also can incorrect operation of the clutch by a driver.

The diameter of the clutch gear conical surface of the gears has been increased by .002" from



1. Shims.
2. Bearing cone.
3. Ball race.
4. Bolts and lock plate for 10.
5. Bolts and lock plate for 10.
6. Bearing outer ring.
7. Ball race.
8. Bearing cone.
9. Shim.
10. Retainer for 6.
11. Needle rollers and cage.
12. Inner race for 11.
13. Thrust washer for 11.
14. Nut.
15. 1st speed gear.
16. Synchro cone.
17. 1st and 2nd synchro assy.
18. Shims.
19. Synchro cone.
20. Reverse selector fork.
21. Reverse sliding gear.
22. 2nd speed gear.
23. Needle bearing for 22.
24. 3rd speed gear.
25. Concave washer.
26. Shim for 25.
27. Spacer sleeve.
28. 4th speed gear.
29. Needle bearing.
30. Lock washer.
31. Nut.
32. 1st and 2nd selector fork.
33. Lock screw for 32.
34. Pinion and shaft.
35. Woodruff key.

Exploded View of Drive Pinion and Shaft Components.

approximate Chassis No. 560700 and the clearance between the synchroniser stop ring face and the gears has, therefore, been altered as follows: Normal .043". Wear limit: at least .024".

(c) If a clutch is fully released and a gear will not engage, it is possible that the teeth of the stop ring are too much out of line with the splines on the operating sleeve. Worn slots in the stop ring can cause this condition.

(d) Renew worn parts.

(5) Check condition of the thrust washers and shims and renew, if necessary.

**TO ASSEMBLE**

Assembling is a reversal of the dismantling procedure observing the following points:

(1) Heat the inner races of the ball bearing and the needle bearing inner race for the first gear in a container of oil heated to 194°F, before pressing them into position on the drive pinion.

(2) Slide one of the double row ball bearing inner cones onto the drive pinions with the collar end first.

(3) Slide the ball bearing on to the drive pinion with the collar towards the threaded end of the drive pinion and then slide the second inner cone on with the collar end away from the bearing so that when assembled on the drive pinion, the numbers indented in both the inner cone and the outer cone are exactly opposite to one another. Noisy bearing operation can result if the races are not correctly installed.

(4) Slide the first gear thrust washer and needle bearing inner race into position on the drive pinion.

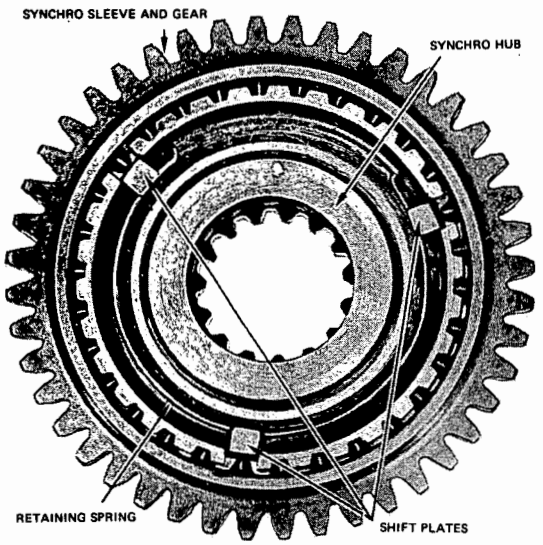
(5) All parts should now be pressed and secured in position with the round nut which should be tightened to a torque of 87 ft/lb.

(6) Instal the two shims for the first gear. After the clutch gear for the first and second gears has been installed, check the end play between the thrust washer and the first gear which should be .004" – .010". Correct if considered necessary.

The following thickness shims are serviced: 0.10, 0.15, 0.20, 0.25, 0.30 and 0.40 mm.

(7) Position the first speed stop ring on the cone surface of the gear. The synchroniser stop rings for first and second gears are not interchangeable.

(8) Position the synchro unit for first and second gears. Slide the operating sleeve on the clutch gear ensuring that its shifting plate slots line up with the slots in the clutch gear. Position the shifting plates and instal the two snap rings offset to one another. Ensure that the ends of each snap ring engage behind the same shifting plates.




First and Second Speed Synchro and Gear Assembly.

(9) With the synchro unit assembled, slide it into position on the drive pinion. The longer portion of the hub should face toward the drive pinion splines. Rotate the first speed stop ring until such time as the shifting plates engage with the slots.

In case it is not possible to slide the synchro unit on by hand, it should be pressed into position. During the pressing operation the first speed gear should be slightly lifted ensuring that the stop ring engages with the shifting plates.

(10) Position the second speed stop ring on the clutch gear engaging the shifting plates with the slots.

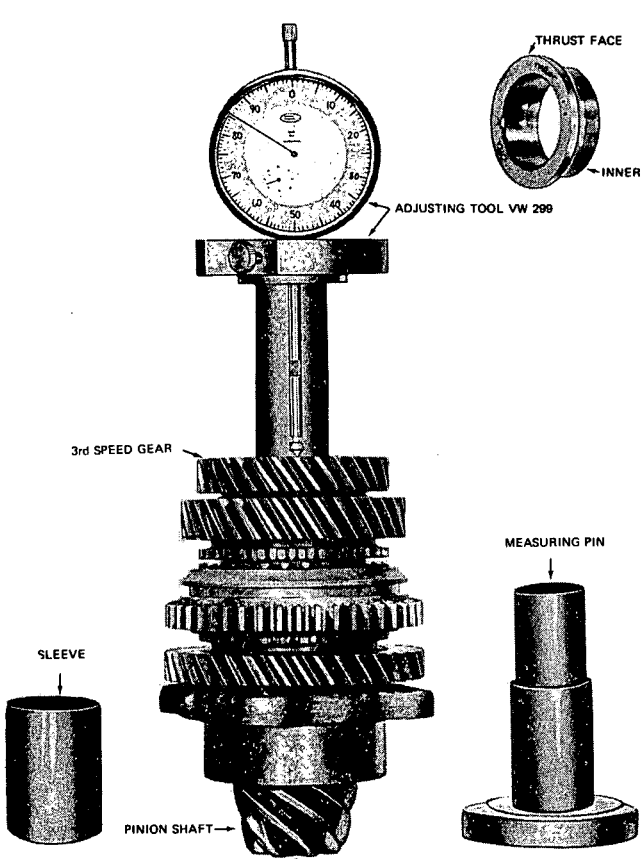
(11) It will be necessary to heat the fourth speed gear and needle bearing inner race to a temperature of 194°F in an oil bath before pressing them into position.

(12) Insert the Woodruff key and press the fourth speed gear and needle bearing inner race into position.

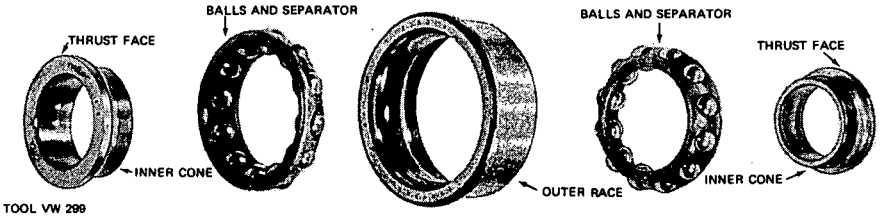
With effect from Chassis No. 607754, the shoulder on the forward side of the fourth speed gear wheel has been enlarged to 1.496" ± .020" diameter to facilitate installation. The larger shoulder of the gear wheel should face the spacer sleeve when installed.

The installation of earlier type gear wheel was guided by a black mark which had to be positioned facing the drive pinion nut. In the event of a gear wheel having an additional white mark on one of the sides, it should face the drive pinion nut.

(13) Carefully check the first gear end play and if it is not within the specified limit .004" to .010", correct by adjusting the shims.




Tool No VW299 Mounted on Pinion Shaft to Measure Spacer Sleeve and End-Float.




Drive Pinion Double Row Ball Bearing Components. Later Models have a Double Row Roller Bearing. (Inner cones are marked thrust on outer face.)

## TO ADJUST CONCAVE WASHER

From Chassis No. 602615 and rear axle No. 2996125 the third gear washer on the drive pinion was replaced by a concave washer. The length of the spacer sleeve fitted between the third and fourth gears was reduced. There has been an alteration in the space from the rear of the drive pinion head to the shoulder for the fourth gear and the splines, for the clutch gear and third gear so arranged that these components have a minimum backlash of .002" on the pinion.

By varying the thicknesses of the shims the concave washer can be adjusted to give a spring travel of .007" ± .0004" and the pressure exerted on the third gear and the clutch gear for the first and second gear is approximately 220 lb. The self-oscillations of these parts is thus reduced, thereby improving the silent operation of the rear axle.

## TO MEASURE ASSEMBLY

(1) Assemble the drive pinion to the stage which includes the third gear.

Do not tightly seat the clutch gear for first and second gear and the third gear on the drive pinion.

(2) Ensure that the clutch gear for the first and second gears and the third gear are correctly positioned. Recheck the end play of the first gear .004" to .010" and correct if necessary.

(3) Slide the sleeve of the adjusting tool onto the drive pinion to abut the shoulder for the fourth gear and zero the dial gauge. Replace the gauge plunger pin of the gauge by an extension piece 1.102" long.

(4) Slide the drive pinion spacer sleeve on the measuring pin of the adjusting gauge.

(5) Take off the measuring sleeve from the drive pinion and slide it on the measuring pin of the adjusting tool, securing it on the spacer sleeve.

The reading on the dial gauge shows the amount by which the spacer sleeve is shorter than the distance from the shoulder on the pinion for the fourth gear to the third gear.

## TO CALCULATE SHIM THICKNESS

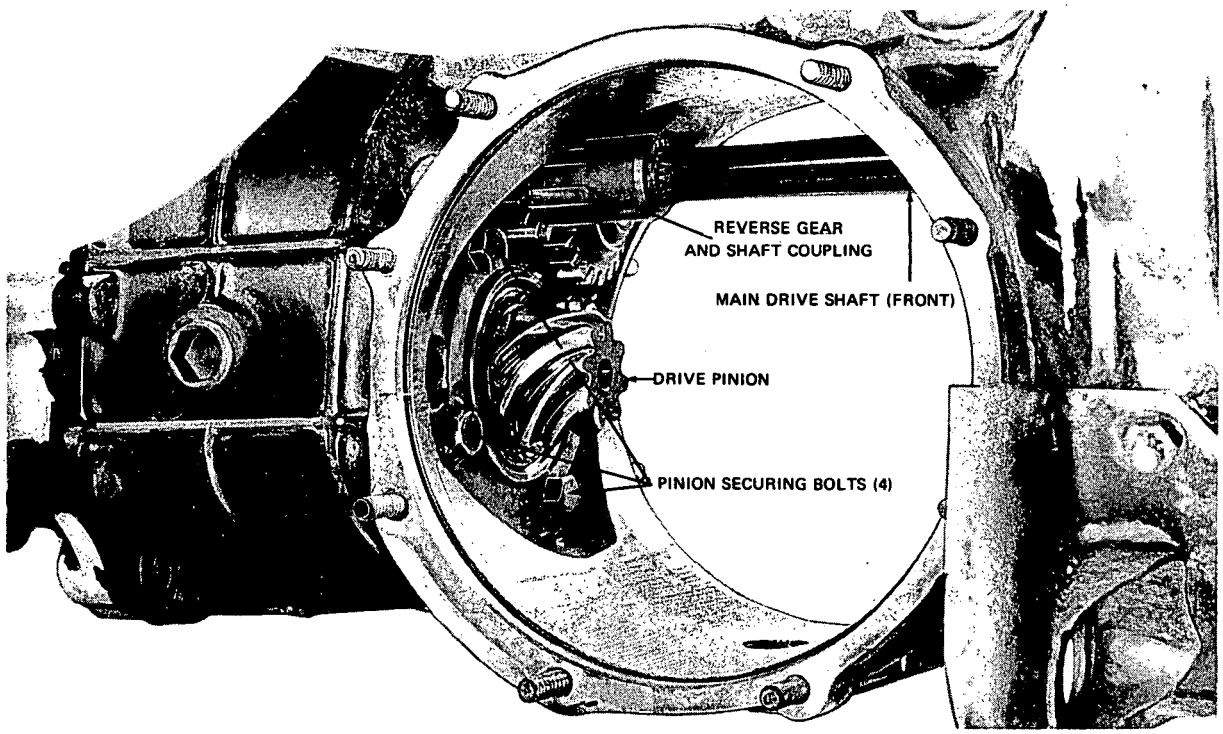
With the drive pinion fully assembled, press the fourth gear on to the pinion as far as the shoulder. Compensate the dial gauge reading by shims while taking into consideration the concave washer thickness .041" (constant), and the prescribed spring travel .007".

The serviced thicknesses of the shims are 0.15, 0.2, 0.25, 0.3, 0.4, 0.6, 0.8, 1.0 and 1.2 mm. Measure the shims carefully with a micrometer before use.

The shim thickness is finally checked by positioning the shims below the spacer sleeve on the measuring pin of the adjusting tool. Firmly press down the measuring sleeve. The dial gauge reading must not exceed .048" ± .0004" the thickness of the concave washer plus spring travel. The silent operation of the rear axle will be adversely affected if the clutch gear and third gear are tightly seated and no backlash is present due to the concave washer being too tightly adjusted.

The second gear is likely to jump out if the maximum spring travel is in excess of the specified amount.

*NOTE: The concave washer is only for installation with the modified drive pinion. In the event of any doubt arising measure the distance from the rear of the drive pinion head to the shoulder for the fourth gear, with a vernier gauge.*




Main Drive and Pinion Shaft Attachment.

## 13. MAIN DRIVE SHAFT

### TO DISMANTLE

(1) Remove the fourth speed gear thrust washer, the fourth speed gear, needle cage and stop ring.

(2) Remove the fourth speed needle bearing inner race, the clutch for third and fourth speeds and the third gear.

(3) Remove the third gear needle cage.

(4) Dismantle the synchro unit for the third and fourth gears.

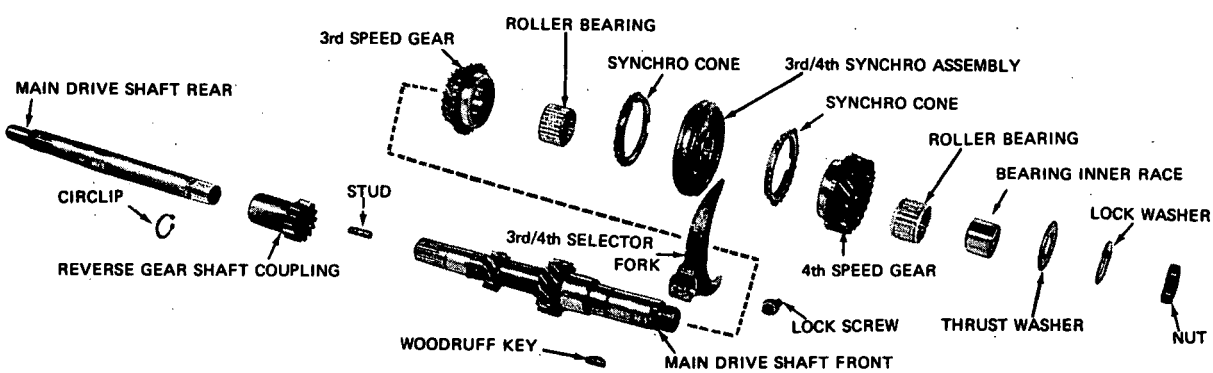
### TO INSPECT

Check the front half of the main drive shaft, for wear:

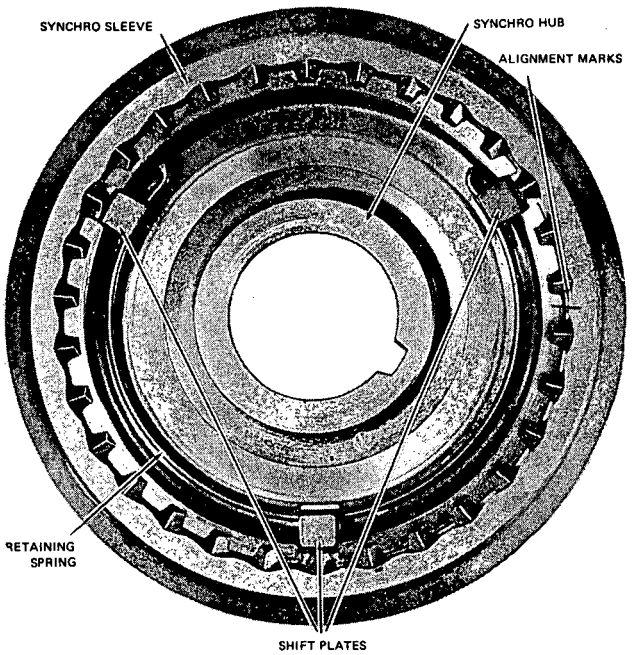
(1) Check the splines of the reverse sliding gear for wear or damage.

(2) Check the contact surfaces of the needle bearing for wear.

(3) Check the first and second gears for wear or damage.




Main Drive (Input) Shaft Components.




Third and Fourth Speed Synchroniser Assembly Showing Alignment Marks.

(4) Position the front main drive shaft between the two centres and carefully check at the contact surface of the third gear needle bearing for run-out. .0006" is the permissible run-out.

*NOTE: The front main drive shaft should be renewed if unduly worn or if the run-out is excessive. Gear wheels should only be renewed in pairs and as such, the gear wheels for the first and second speeds on the drive pinion must be renewed at the same time.*

(5) Carefully check the needle bearing and third and fourth gears for wear or damage and renew, if necessary.

With effect from Chassis No. 614456 there has been an alteration in the number of teeth and consequently the ratios of the third and fourth speed gears. See *DRIVE PINION – TO DISMANTLE.*

**TO CHECK REAR MAIN DRIVE SHAFT**

(1) Check the main drive shaft pilot for excessive wear.

(2) Check the splines of the shaft for excessive wear or damage.

(3) Check the oil seal seating surface for scoring and wear.

(4) Check the reverse gear for excessive wear or damage and renew, if necessary.

**TO ASSEMBLE**

Assembling is a reversal of the dismantling procedure observing the following points:

(1) Assemble the third and fourth gears synchro unit as follows: Slide the operating sleeve on the clutch gear so that its shifting plate slots line up with the slots in the clutch gear. Position the shifting plates and instal the two snap rings.

The clutch gear and operating sleeve for third and fourth gear have been modified from Chassis No. 596257. A groove has been made in the circumference of the teeth of the clutch gear and the driving sides of the teeth of the third gear side are slightly set back. The retaining shoulders in the operating sleeve teeth have been discontinued.

*NOTE: The clutch gear and the operating sleeve are matched together for silent operation and are marked with an etched line. These must be installed correctly and when necessary they must be renewed as a pair.*

*In the clutch gear is stamped a number 4 which is intended to indicate the installation direction. This number must be positioned facing the fourth gear wheel. The earlier type of clutch gear and operating sleeve can be fitted in vehicles up to Chassis No. 596256 and Rear Axle No. 2964943.*

(2) Insert the clutch gear Woodruff key in the main drive shaft and position the third gear synchroniser stop ring on the cone of the gear.

(3) Press the third and fourth speed clutch gear into position. Lift the third gear slightly, taking care to ensure that the stop ring engages in the shifting plates.

The thrust washer for the fourth speed gear on the main drive shaft has been provided with two oil pockets on each side from Chassis No. 632585.

(4) Press into position the needle bearing inner race of the fourth gear.

## 14. DIFFERENTIAL

**TO DISMANTLE**

(1) Clamp the differential in a suitable fixture or vice.

(2) Remove the locking wire and ring gear securing bolts.

(3) Withdraw the ring gear.

(4) Remove the lock pin, drive out the differential pinion shaft and take out the differential pinions.

**TO ASSEMBLE**

(1) Carefully check the differential concave pinion

contact surfaces in the housing for wear or damage and, if necessary, renew differential housing.

Commencing at Chassis No. 511907 a differential housing with two 1.89" holes was installed instead of the earlier closed type. This modification was introduced to improve lubrication in the differential, especially the fulcrum plates.

(2) Carefully check the ring gear for wear or damage. If replacement is necessary, both ring gear and drive pinion should be renewed as a mated pair as they are not serviced separately. The new ring gear and drive pinion should be carefully examined for the matching number.

If renewal of the drive pinion and ring gear or differential housing is undertaken, it will be necessary to re-adjust the transmission.

(3) The differential pinion shaft lock pin should be peened in position

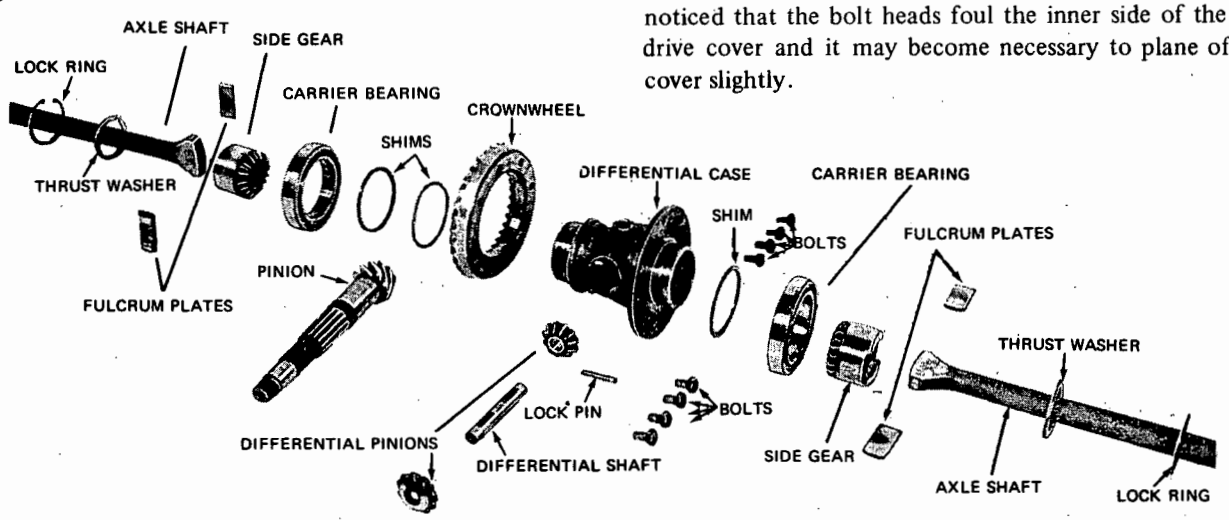
(4) Ensure that the contact surfaces of the differential and the ring gear are thoroughly cleaned to obtain a correct backlash setting.

(5) Position the ring gear securing bolts and tighten to a torque of 45 ft/lb.

(6) Insert the lock wire so that it imposes a tension on the bolts when inter-twining its ends.

From Chassis No. 556075 each ring gear securing bolt is fitted with a spring washer in addition to the locking wire. The bolt head recess has been deepened in the differential housing by .031" being sufficient to accommodate the spring washer.

When installing the spring washers in service, it may be noticed that the bolt heads foul the inner side of the final drive cover and it may become necessary to plane off the cover slightly.




Differential, Final Drive and Axle Shaft Components.

## 15. DRIVE PINION AND RING GEAR

Correct adjustment of the drive pinion and ring gear is very important for silent operation and minimum wear of the final drive. The drive pinion and ring gear are machined in sets at the time of production and correct tooth contact and silent meshing, in both turning directions, are ensured by inspections being conducted with the aid of special test appliances. Silent operation is obtained by adjusting the drive pinion end-wise with the ring gear lifted sufficiently out of the fully engaged position, without backlash, thereby ensuring that the backlash is within the prescribed tolerance of .0067" – .0098".

The standard fitting dimension between the ring gear centre line and the drive pinion face is as follows:

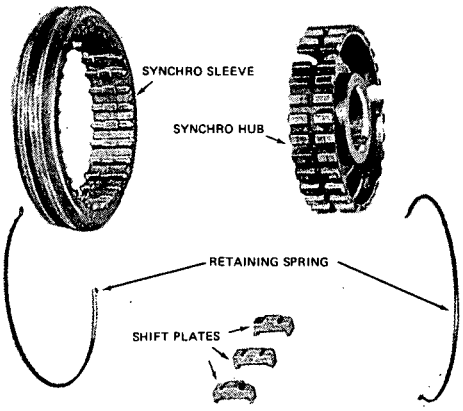
Klingelnberg gears – Number of teeth 8:33 up to approximately Chassis No. 572000 .... 2.35"

Gleeson gears – Number of teeth 8:33 up to approximately Chassis No. 614500 (intermittently installed) ..... 2.3110"

Strengthened Klingelnberg gears – Number of teeth 8:33 approximately from Chassis No. 572000 ..... 2.3110"

The matching number of the gear set is to be found on the outer edge of the ring gear and on the face of the drive pinion.

Re-adjustment of the ring gear and drive pinion is not usually necessary when carrying out repairs to the rear axle unless replaced parts directly affect adjustment. In the event of replacing the differential housing, a final drive cover or a differential bearing, it is sufficient to re-adjust the ring gear. Re-adjustment of the ring gear and drive




Components of Third and Fourth Speed Synchro Assembly.

pinion is essential after replacing the transmission case, the ring gear and drive pinion set or the drive pinion ball bearing.

The reason for having to re-adjust the ring gear and drive pinion is to maintain silent operation as was originally set with special appliance by the manufacturers of the vehicle.

When undertaking adjustment, silent operation can be obtained by following the following procedure:

The drive pinion must first of all be adjusted by the installation of shims between the double row bearing and the contact face at the transmission case, thereby ensuring that the distance from the ring gear centre line to the drive pinion face corresponds with the fitting dimension determined at the factory. The ring gear is then adjusted to give the proper backlash and the thickness of the shims for the differential housing determined. It is very important that both of the final drive covers must be installed with a pre-load of .0055". After determining the thickness of the shims to be installed, a pre-load of .0028" must be taken into consideration in both sides.

**TO ADJUST DRIVE PINION AND MEASURE DEPTH OF TRANSMISSION CASE BETWEEN DIFFERENTIAL BALL BEARINGS**

(1) Instal the transmission in the case less the shims for the drive pinion.

(2) Fit the four ball bearing retainer bolts with washers and tighten the bolts to a torque of 36 ft/lb.

(3) Check and ensure that the bearings are correctly seated in the final drive covers.

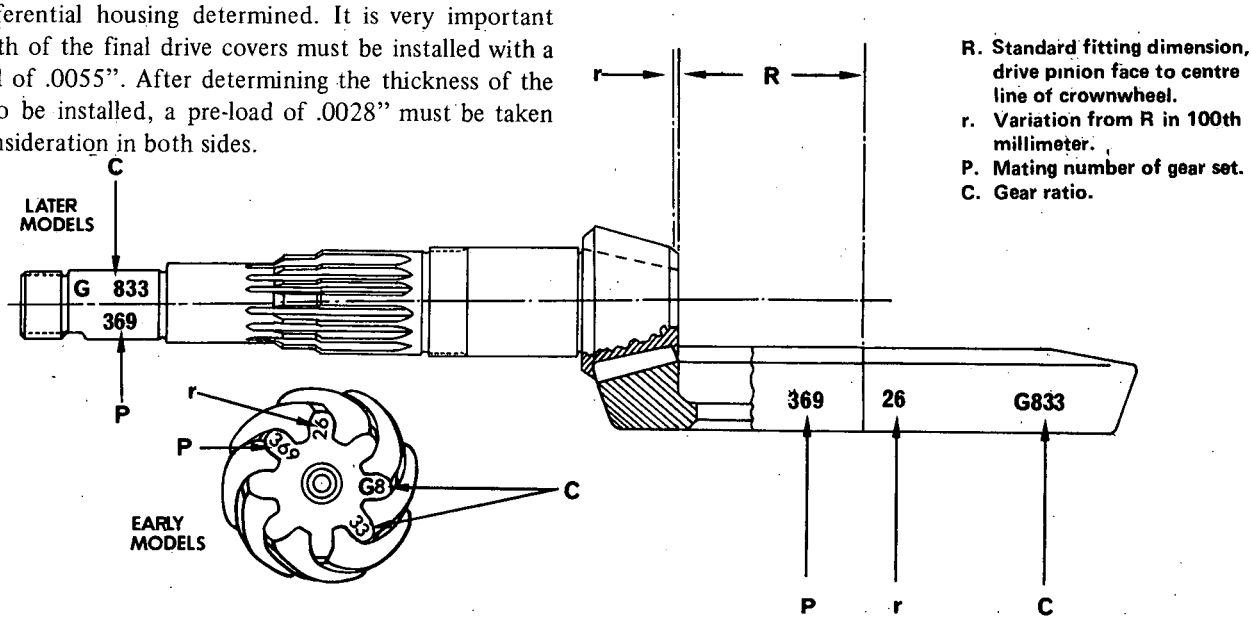
(4) Instal the left final drive cover with new gasket and evenly tighten the securing nuts.

*NOTE: Until the depth of the transmission case has been determined, the use of a hammer must not be resorted to for installing the final drive cover, as the hammer blows can loosen the bearings in the drive covers. Final drive cover securing nuts must be evenly tightened for correctly seating the drive covers in the transmission case.*

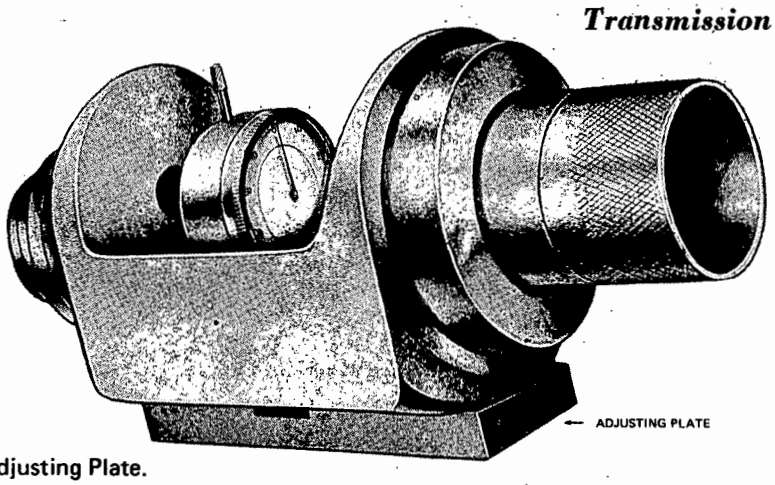
(5) Thoroughly clean the adjusting plate and the contact face of the mandrel, special tool VW289d, and position the mandrel in the adjusting plate. Fit a .1181" plunger to the dial gauge and position it in the mandrel and set the dial gauge to zero with a pre-load of .039".

(6) Position the mandrel in the transmission case, fit a new gasket and instal the right final drive cover and tighten the cover nuts.

(7) Check the dial gauge through the hole in the mandrel and allow the tracer pin of the dial gauge to carefully come into contact with the face of the pinion. Rotate the mandrel until the maximum reading registers on the dial gauge.




Crownwheel and Pinion Markings. Early 1200 Models have Markings on Pinion Head. Later Models have Markings on Pinion Shaft.




**Special tool VW289d on Adjusting Plate.**

To obtain the fitting dimension of the drive pinion without shims is to add the dial gauge reading to the nominal dimension of the mandrel with adjusting plate. In cases where the gear sets have a standard fitting dimension of 58.70 mm (Gleason and strengthened Klingelnberg gear sets), the dial gauge reading is subtracted from the nominal dimension of the mandrel whilst taking the pre-load into consideration. In other cases of Klingelnberg gear sets which have neither a P on the outer edge of the ring or a K on the face of the drive pinion (fitting dimension 59.70 mm) the dial gauge needle will move anti-clockwise. In the case of these gear sets, the dial gauge reading must be added to the nominal dimension of the mandrel.

Example:

| | |
|---|---|
| Nominal dimension of mandrel with adjustment plate | 58.70 mm |
| Dial gauge reading (1.0 mm pre-load of dial gauge taken into consideration) | .58 mm |
| Fitting dimension of pinion without shims | 58.12 mm |

The correct fitting dimension of the pinion is based on the standard fitting dimension R + the tolerance discrepancy. The difference between these two values denotes the thickness of the shims required.

Example:

| | |
|---|---|
| Standard fitting dimension of pinion R | 58.70 mm |
| ± Tolerance discrepancy | .18 mm |
| | 58.88 mm |
| Fitting dimension of pinion without shims | 58.12 mm |
| Thickness of shims required | .76 mm |

Carefully measure shims at different points with a micrometer.

Carefully select shims as near as possible to the thickness required. Thickness of shims must not differ more than ± .0008" from the calculated thickness.

Shims are available in thickness from .10 to 1 mm in increments of .1 mm plus .15 and 1.2 mm. The tolerance of the shims according to thickness is between .01 and .03 mm (.0004" and .00012").

(8) Mount the dial gauge bracket, special tool VW297, on one of the axle tube retainer studs. Position the dial gauge on the bracket and set to zero.

(9) Turn the transmission case 180° and by doing so the mandrel will slide across against the right final drive cover bearing. The reading registered on the dial gauge is added to the length of the mandrel and the total sum represents the depth of the transmission case (distance between differential carrier bearings) which is required for adjusting the ring gear.

Example:

| | |
|---|---|
| Normal length of mandrel | 107.88 mm |
| + Dial gauge reading | 2.02 mm |
| Depth of transmission case | 109.90 mm |

(10) Return the transmission case to the horizontal position and remove the dial gauge bracket. Undo the left final drive cover securing nuts.

(11) Position the spindle of the special tool VW297 on the left final drive cover and tighten it.

(12) Press off the right final drive cover with the spindle removing the mandrel from the transmission case.

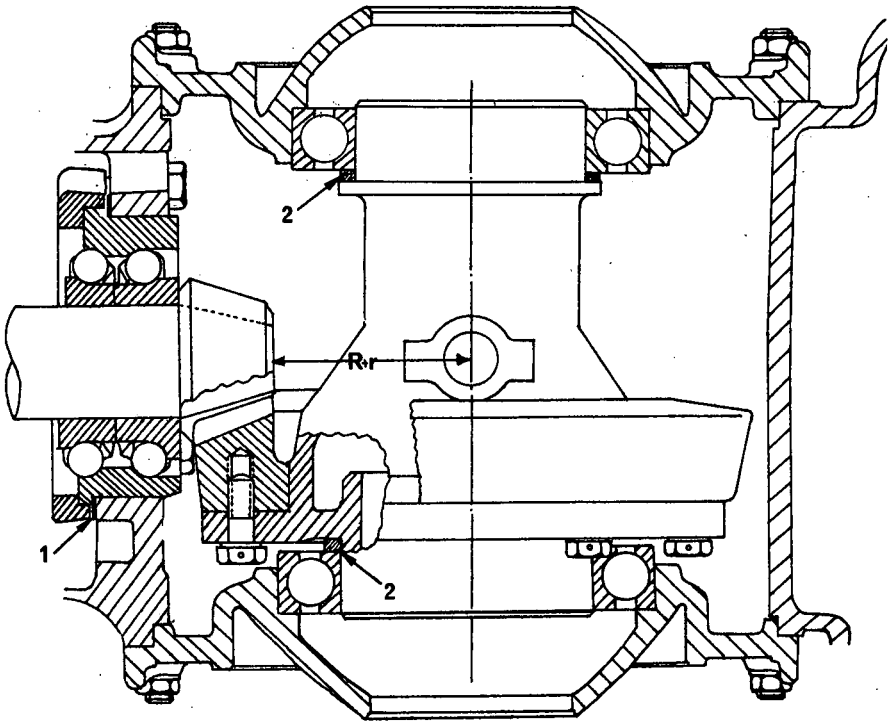
(13) Remove the left final drive cover and withdraw the left ball bearing retainer and press the transmission out of the case.

(14) Slip the shims into position on the ball bearing. Using the special gearshift test appliance VW294, adjust the selector forks and then instal the transmission in the case.

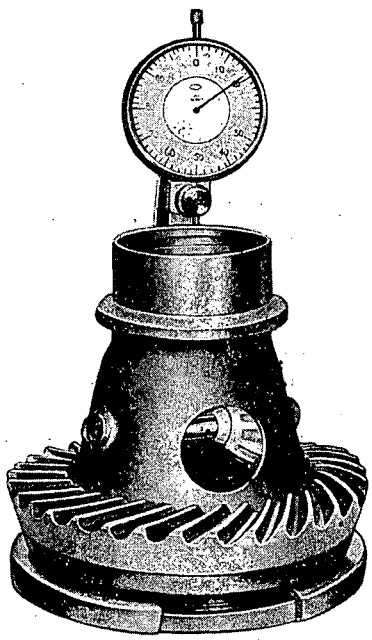
## TO ADJUST RING GEAR

(1) Into the special tool VW287a insert the dial gauge with a 28 mm plunger. On the polished surface for the differential case, position the adjusting plate and zero the dial gauge.

(2) Raise the gauge plunger and insert the differential and 2.8 mm special gauge ring, VW298, on the ring gear side of the tool.




Application of Crownwheel and Pinion Mating Marks to Differential.
**1. Pinion positioning shims. 2. Shims S1 and S2 for differential adjustment.**



Differential Case and Crownwheel Assembly on Special Measuring Device VW 287a in order to obtain Correct Length of Differential Housing.

Add the dial gauge reading to the nominal dimension of the adjusting plate and when taking into consideration the 2.8 mm gauge ring, this gives the length of the differential housing.

Example:

| | |
|---|---|
| Nominal dimension of adjusting plate | 102.51 mm |
| + Dial indicator reading | 3.19 mm |
| – Gauge ring | 2.80 mm |
| Length of differential housing | 102.90 mm |

*NOTE: If the special tool VW287a is not available, a vernier calliper can be used for measuring the length of the differential housing. It is important that the 2.8 mm gauge ring must be positioned on the ring gear side. Correct readings can be obtained with the use of a magnifying glass.*

(3) Using the special tool VW297, instal the differential into the transmission case as follows:

(a) Between the two thrust plates of the special tool, position the differential case assembly, insert the bolts from the ring gear side, fit and tighten the nuts.

(b) Fit a new gasket and instal the left final drive cover. Instal the differential assembly in the transmission case.

(c) Insert the special gauge ring on the ring gear side and instal the right final drive cover with a new

gasket. Tighten both final drive cover nuts evenly to a torque of 14 ft/lb.

(d) Position the spindle on the right final drive cover and tighten the securing nuts.

(e) Turn the transmission case 180° and attach the drive pinion retaining bracket to the gear carrier.

(f) Firmly mount the bracket of the dial gauge on the clamping bolts of the two thrust plates and secure with two of the axle tube retainer nuts, to measure the ring gear backlash.

(g) Attach the dial gauge bracket for carrying out the differential axial adjustment.

(h) Mount the dial gauges on the bracket.

(4) Using the spindle, pull the differential fully into the bearing in the right final drive cover. Undo the spindle and set the dial gauge for the differential axial adjustment to 2.8 mm which is the thickness of the gauge ring.

*NOTE: It is important when carrying out the following measurements, to avoid errors in measurement due to axial play in the differential bearings, that the ring gear side of the differential is at the bottom of the transmission case. Also ensure, when setting the dial gauge to 2.8 mm, that the bearing in the right final drive cover is properly seated. Again tighten the spindle, back it off and check the setting of the dial gauge.*

(5) Rotate the differential, as far as possible, in both directions. On the pinion nut, position a 32 mm socket and lock the pinion so that the differential is approximately mid-way between the two stop positions.

(6) Measure the backlash of the ring gear.

(7) Carefully adjust the differential with the spindle towards the drive pinion, until a backlash of between .0079" and .0087" is obtained.

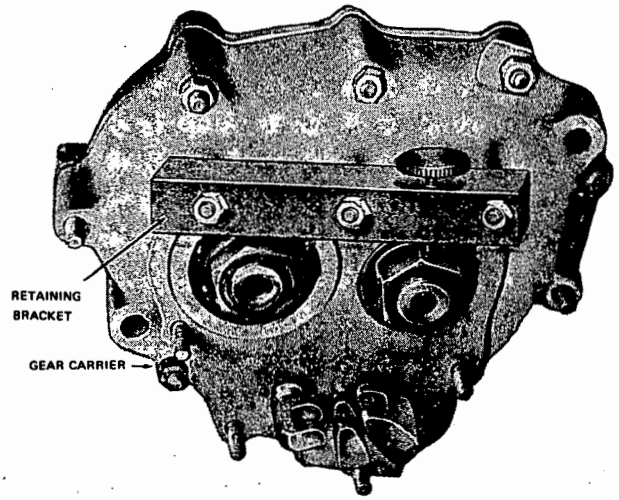
*NOTE: The spindle must be backed off each time when measuring the backlash. The axial movement of the differential will then correspond with the dial gauge reading.*

The thickness of the shim on the ring gear side, (S1), can be read direct from the dial indicator for the differential axial adjustment.

Example:

| | |
|---|---|
| Commencing position (reading) of dial gauge (thickness of gauge ring inserted) | 2.80 mm |
| Axial movement up to prescribed backlash | 0.40 mm |
| Final reading of dial gauge for ring gear side shim (S1) | 3.20 mm |

The shim thickness for the opposite side (S2) is calculated from the depth of the transmission case between the two differential bearings (J), the length of the differential housing (L), and the thickness of the ring gear side shim (S1).




Drive Pinion Retaining Bracket in Position.

Example:

| | |
|---|---|
| – J – (depth of case between bearings) | 109.90 |
| – L – (length of differential housing) | 102.90 |
| – S1 – (thickness of ring gear side shim) | 3.20 |
| – S2 – (shim thickness for opposite side) | 3.80 |

Finally on both sides the pre-load is considered with which the two final drive covers have to be installed. The pre-load for both final drive covers amounts to .14 mm so that .07 has still to be added on each side to the final shim thickness. The final shim thicknesses are given in the following examples:

S1 = 3.20 + .07 = 3.27 mm

S2 = 3.80 + .07 = 3.87 mm

Using a micrometer, measure the shims at various points. Shims are serviced in thicknesses ranging from 2.8 to 4.0 mm in increments of .10 mm. A washer provides for adjustments in units of .05 mm. It is quite possible that shim thickness may differ up to .03 mm from the marked thickness, ensure selected shims are as near as possible to the shim calculated thickness.

(8) Remove the dial gauge bracket and press off the right final drive cover. Position the spindle on the left final drive cover and press out the differential.

(9) Instal the rear main drive shaft.

(10) With the chamfered edges facing towards the differential, instal the shims S1 and S2. The washers should be positioned between the shims and the ball bearing.

(11) Evenly tighten the final drive cover securing nuts to a torque of 14 ft/lb.

(12) Once again check the ring gear backlash in various positions. The backlash tolerance should be between .007" – .010" and the measurements must not differ by more than .002".

(13) Remove the dial gauge brackets.

(14) Undo the retaining bolts and remove the thrust plates through the rear axle shafts openings.

## 16. GEAR SHIFT LEVER

### TO REMOVE

(1) Carefully take out the floor mat from the cab and undo the two bolts from the gearshift lever ball housing mounting on the floor panel.

(2) Withdraw the gearshift lever with spring and stop plate.

(3) Thoroughly clean all components.

### TO INSTAL

Installation is a reversal of the removal procedure, observing the following points:

(1) Carefully check the gearshift lever, stop plate and shifting rod end for wear, rust or damage. Renew parts, if necessary.

(2) Ensure that, while installing the stop plate, the turned-up edge on the plate is on the right-hand side when viewed from the rear to the front of the vehicle.

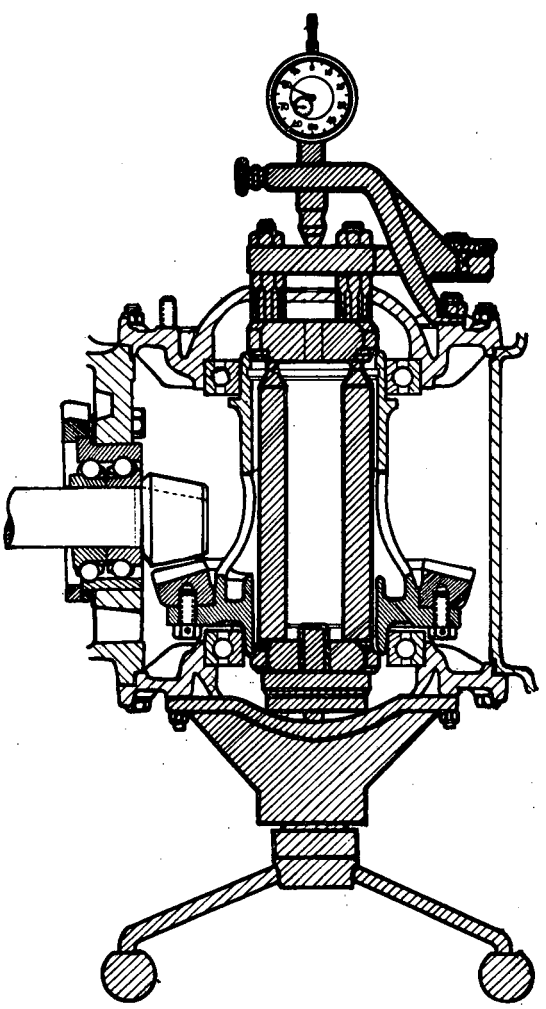
(3) All moving parts should be lubricated with multi-purpose grease.

(4) Position the gearshift ball housing so that the lever is vertical while in the neutral position. The stop plate should be fully seated in the hollow flange of the ball housing.

(5) Check the gearshift lever rubber boot for deterioration or damage and renew, if necessary.

(6) Check gearshift lever position by engaging gears and correct, if necessary.

## 17. GEAR SHIFT ROD AND GUIDE



Details of Adjusting Tool VW 297 in Position for Adjusting Final Drive Gears.

### TO REMOVE

(1) Raise the vehicle, support on stands and release the hand brake.

(2) Remove the gearshift lever as already described.

(3) Remove the cover plate under the pedal linkage.

(4) Undo the lock wire at the front shift rod coupling and remove the front screw.

(5) Disconnect the handbrake cables from the equaliser.

(6) Withdraw the gearshift rod toward the front end.

(7) Remove the guide from the shift rod.

### TO INSTAL

Installation is a reversal of the removal procedure observing the following points.

(1) Check the condition of the gearshift rod and guide for wear and alignment. Renew parts, if necessary.

(2) Lubricate the gearshift rod and guide, where required, with multi-purpose grease.

(3) Connect the shift rod coupling and lock with wire.

(4) Adjust the hand brake and check the effectiveness.

(5) Raise the vehicle and remove the supporting stands and lower the vehicle to the floor.

## 18. REAR GEAR SHIFT ROD

### TO REMOVE

(1) Raise the vehicle and support on stands.

(2) As previously described, remove the engine and transmission.

(3) Undo the lock wire of the front shift rod coupling and remove the rear screw.

(4) Withdraw the shift rod towards the rear end and take the front rubber boot off the protection sleeve.

(5) Remove the rear shift rod coupling.

(6) Remove the rear rubber boot and bushes from the shift rod.

### TO INSTAL

Installation is a reversal of the removal procedure, observing the following points:

(1) Check the bushes, rubber boots and shift rod for wear, deterioration and distortion. The coupling screw recesses must be lined-up to prevent difficult gear shifting.

(2) Instal the bushes on the shift rod and lubricate them with multi-purpose grease.

(3) Instal the shift rod and push the rubber boot on the protection sleeve.

(4) Connect the shift rod coupling and lock with wire.

(5) Bleed the hydraulic system and adjust brakes.

(6) Raise the vehicle, remove supporting stands and lower to the floor.

(7) Give the vehicle a road test.

With effect from Chassis No. 503026, the holes for the bonded rubber mounting studs in the gearshift housing have been positioned approximately .080" lower to prevent the rear gearshift rod from striking the bottom of the protective tube. The identification mark on the hardened mountings is a red paint spot.

# PART 3
# TUNNEL TYPE TRANSMISSION CASE WITH OPEN DRIVE SHAFTS

## SPECIFICATIONS

| | |
|---|---|
| Type | 4 speed and reverse, incorporating rear axle and differential. |
| Synchromesh | All forward gears. |
| Gear ratios: | |
| First | 3.80:1 |
| Second | 2.06:1 |
| Third | 1.22:1 and 1.26:1 |
| Fourth | 1.82:1 |
| Reverse | 3.88:1 and 3.62:1 |
| Gear control | Manual remote control shift linkage with ball-type lever |
| Rear axle ratios: | |
| Pinion and ring gear | 5.375:1 |

### TORQUE WRENCH SETTINGS

| | |
|---|---|
| Ring gear to differential housing bolts | 32 ft/lb |
| Nuts on gear carrier, transmission and clutch housing | 68 ft/lb |
| Final drive side cover nuts | 14 ft/lb |
| Double taper roller bearing retainer bolts | 22 ft/lb |
| Shift housing to gear carrier bolts | 11 ft/lb |
| Clamp sleeve to gear carrier bolts | 25 ft/lb |
| Shift fork to shift rod | 18 ft/lb |
| Support/rocker lever to gear carrier | 18 ft/lb |
| Bracket/reverse relay shaft on gear carrier | 18 ft/lb |
| Union nut/clamp sleeve | 22 ft/lb |
| Round nut/pinion | 144 ft/lb |
| Hub to axle shaft | 230-250 ft/lb |
| Back plate to housing | 25 ft/lb |
| Cover/spring plate mounting | 32 ft/lb |
| Shock absorber to frame and bearing housing | 14 ft/lb |
| Control arm to frame pivot bolt | 43 ft/lb |
| Control arm to bearing housing | 94 ft/lb |

## 1. DESCRIPTION

The transmission, rear axle and engine are bolted together as one unit and are located and supported in the rear of the vehicle on three rubber mountings.

At the front, the assembly is supported by a bonded rubber mounting between the chassis frame crossmember and the transmission, and at the rear end, a crossmember attached to the engine, secures it to the body through a rubber mounting on each side.

The transmission case is closed at the front end by the gear carrier and at the rear by the clutch housing, both of which are attached to the case by bolts.

Separating the transmission and the differential is a partition which serves as a mounting for the main drive and pinion shaft bearings. In this partition there are many holes for maintaining the same oil level in both portions of the case.

The final drive and the differential are located in the centre part of the transmission case.

The differential bearings are carried in two cover plates which are secured to the case. In the rear of the case, the clutch housing is bolted to the case. Within the housing, and to the left, is an oil filler plug which also serves to indicate correct oil level. At the bottom of the clutch housing is located the transmission case oil drain hole into which is screwed a plug incorporating a permanent magnet.

The drive is transferred from the final drive to the rear wheels through two open drive shafts, each incorporating a pair of constant velocity joints, one at each end of each drive shaft.

The reduction gear arrangement on previous models has been discontinued.

## 2. ENGINE AND TRANSMISSION ASSEMBLY

### TO REMOVE

When removing the transmission it is advisable to remove the engine and the transmission as a unit. It is, however, possible to remove the engine and transmission separately, if desired.

(1) Detach the earth lead from the battery.

(2) Take out the rear cross panel and remove the air cleaner with the inlet bent hose.

(3) Detach the electric leads from the generator, ignition coil, oil pressure gauge and the carburettor.

(4) Detach the accelerator cable and withdraw from the guide tube. Take off the petrol pipe and seal it to prevent leakage.

(5) Undo the heater flap cables and detach the heater hoses.

(6) From the clutch lever, disconnect the cable, undo the two support bracket nuts and remove the support bracket and cable guide.

(7) Detach the battery cables from the starter motor.

(8) From the drive shaft flanges, undo the Allen head screws.

*NOTE: Take off both drive shafts as assemblies when removing or installing the engine or transmission assemblies.*

(9) From the transmission case disconnect the earth strap and from the front mounting of the transmission remove the two screws.

(10) Unlock the shift rod coupling rear screw, remove the screw and from the inner shift lever, slide off the coupling.

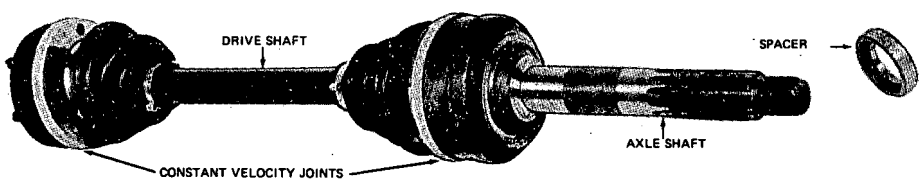
(11) Using a jack in conjunction with the special engine lifting plate and transmission case support, position them below and slightly raise the assemblies.

(12) Remove the engine rear mounting bolts.

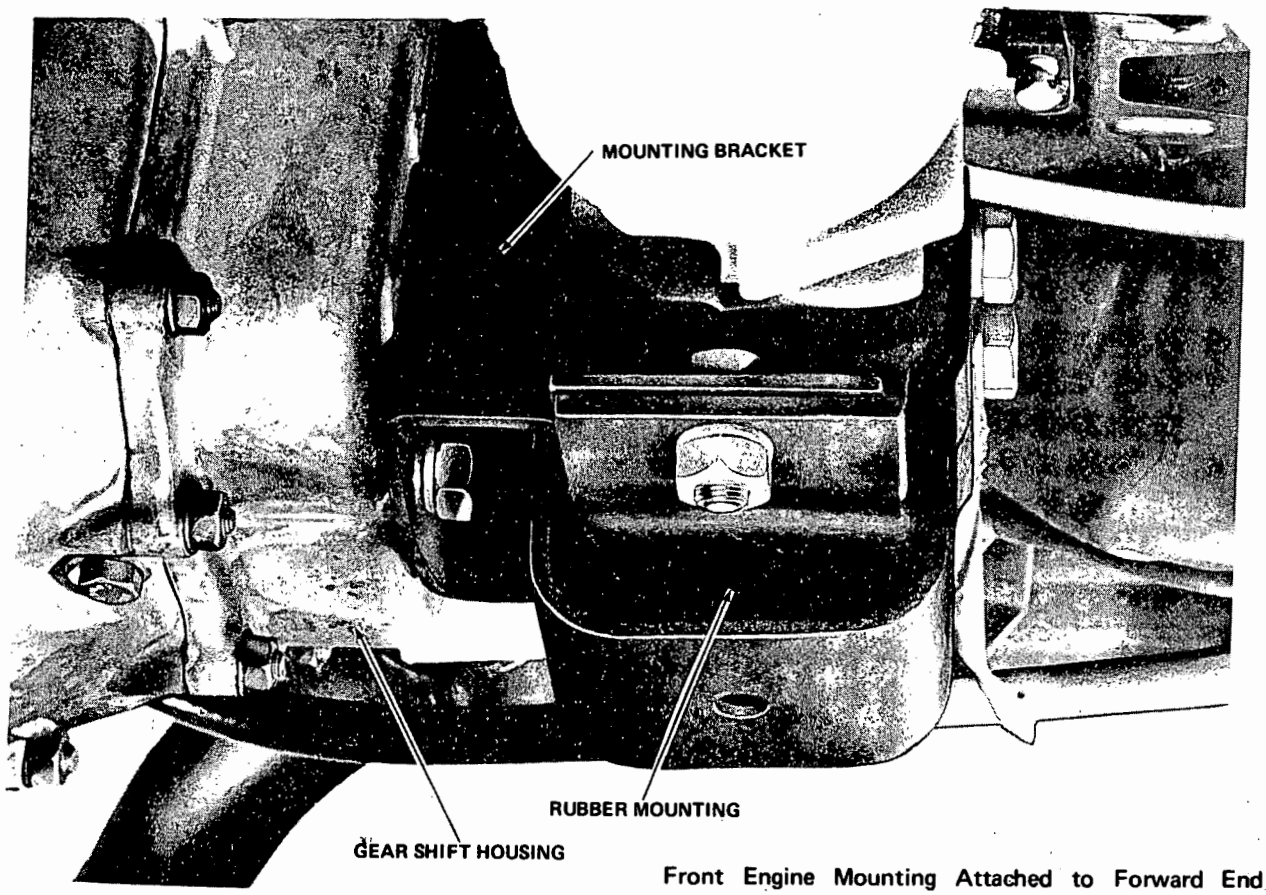
(13) Slightly raise the engine/transmission assembly, pull to the rear and lower for removal. Remove flange nuts and detach transmission from engine.

### TO INSTAL

(1) Bolt together the engine and the transmission. Position on a jack with the engine plate and transmission support specially used for lowering and lifting the engine and transmission case.




Drive Shaft and Axle Shaft Assembly.




**Front Engine Mounting Attached to Forward End of Transmission (1600 model).**

(2) Raise the jack until both assemblies are in position in the vehicle.

(3) Screw in the front transmission mounting bolts and then the engine mounting bolts. The front bolts must be tightened first to prevent possible longitudinal stress.

(4) Instal the shift rod coupling, insert the lock screw. Tighten and lock it. Attach the earth strap to the lower left hand nut on the gear carrier.

(5) Instal the axle drive shafts ensuring that there is no trace of grease and dirt on the contacting faces of the shafts and flanges. Diagonally tighten the securing bolts.

*NOTE: Before installing the rubber seals check for deterioration or damage, joints should be greased if necessary.*

(6) Connect up the starter motor cables. Instal the clutch operating cable bracket and guide and connect clutch cable. Adjust the free play of the clutch to .40" to .80".

(7) Connect the heater flap cables and instal heater hoses. Fit the fuel hose.

(8) Connect up all electric leads. Instal the air cleaner and the rear cross panel. Connect battery earth cable.

## TO REMOVE ENGINE AND TRANSMISSION SEPARATELY

(1) Raise the vehicle with a jack and fit the transmission case support bracket. First position the bracket on the left side member. It is then raised over the right side member, sliding it to the left until such time as the bracket becomes engaged.

(2) Detach the engine from the transmission case and, with the lifting plate and jack, lift out the engine.

(3) Detach both drive shafts and slightly raise the transmission using a jack. Detach the front mounting, shift rod coupling, earth strap and the clutch cable.

(4) The transmission support bracket should be unhooked and removed. Using a jack lift the transmission out of the vehicle.

## TO INSTAL

For installation refer to the section on *TO INSTAL* transmission/engine unit where this operation is fully described.

## 3. DRIVE SHAFTS

### TO REMOVE CONSTANT VELOCITY JOINTS

(1) Undo the Allen head bolts from the flanges of the drive shaft. Tilt the shafts downward and remove them complete.

(2) Slacken the hose clips from both ends of the rubber seals and slide the seals back along the shaft.

(3) From the front end of the ball hub, remove the cap and circlip.

(4) Using a punch, knock the protective cap back off the outer ring of the joint.

*NOTE: With the protective cap removed, avoid swinging the ball hub more than 20° in the outer ring of the joint as the balls can fall out.*

(5) Push the outer ring of the joint complete with balls on to the ball hub.

(6) Press the drive shaft from the ball hub and remove the dished washer.

### TO INSTAL CONSTANT VELOCITY JOINTS

(1) Carefully check the condition of the drive shafts, seals, constant velocity joints, protective caps and dished washers for wear or damage and renew parts if necessary.

(2) Discard old hose clips and position new clips on the shafts.

(3) Protect the seal from damage from the splines by sliding a sleeve on the splines and instal the seal.

(4) Using a rubber head hammer, drive the protective cap on to the shaft.

*NOTE: The joint, when being positioned, should have the face with the milled recess, towards the seal.*

(5) After positioning the dished washer, the constant velocity joint should be pressed on to the shaft.

(6) Position a new circlip and press it down until it snugly seats in the groove.

(7) Using adjustable pliers, squeeze the circlip until it is firmly seated in the groove.

(8) Pack the joint with special lithium grease. The joint capacity is 120 grams.

*NOTE: Eighty grams of grease is packed between the joint, protective cap and seal and forty grams is pressed into the open joint from the front end.*

(9) Fit the hose clips in position and tighten them ensuring that grease is not present on the sealing surfaces.

(10) Using the hand, lightly squeeze the seal for grease to enter the joint from the rear.

(11) Press in the dust cap and fit the plastic cap on the joint.

(12) Instal both drive shafts and secure the Allen head screws.

### TO DISMANTLE CONSTANT VELOCITY JOINTS

(1) As previously described press the constant velocity joint off the drive shaft.

(2) From one side of the outer ring of the joint, press out the ball hub and cage.

(3) With the ball hub and cage removed, remove the balls from the cage.

*NOTE: The ball hub and outer ring are not interchangeable as they are matched together. Five tolerance grades are marked by 1-5 spots on the reverse of the outer ring and also on the side of the hub. There are six balls in each joint which also belong to one tolerance group and, therefore, should only be renewed in sets.*

(4) Align two ball grooves in the ball hub with the ball cage face and remove the hub from the cage.

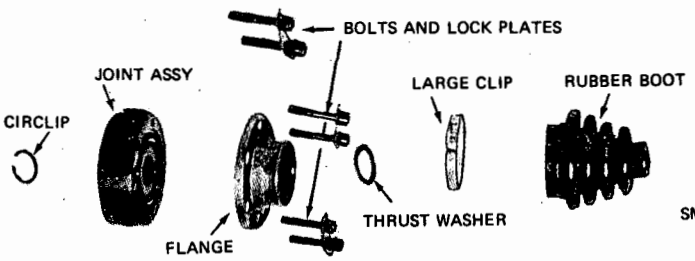
### TO ASSEMBLE CONSTANT VELOCITY JOINTS

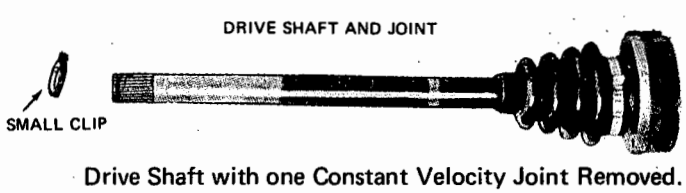
(1) Carefully check the joint outer ring, ball hub, cage and six balls for wear and renew parts if necessary.

*NOTE: There must be no radial play, over the full range of the sliding movement, between the ball hub and outer ring, after installation of the balls and the cage.*

(2) Insert the ball hub into the cage routing it through two ball grooves in the hub. Positioning is not so important.

(3) Using balls of a matched set, press them into the cage.




Drive Shaft with one Constant Velocity Joint Removed.

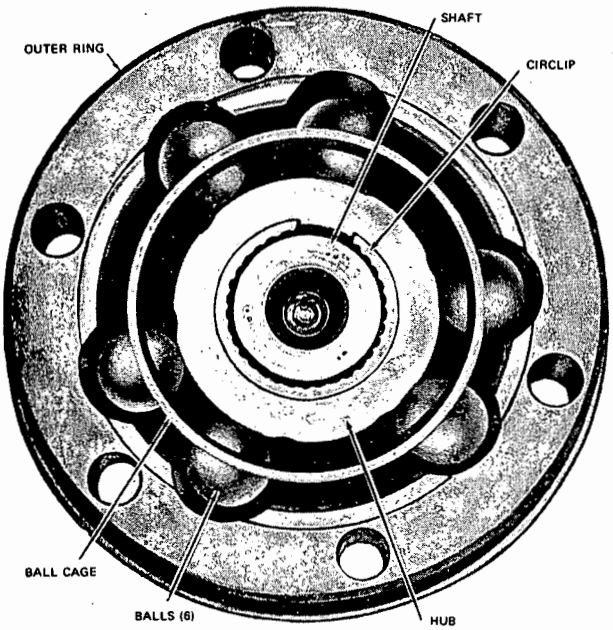
(4) Insert the ball hub into the matched outer ring. Ball hub and outer ring must be kept in matched sets.

(5) Maintain the cage and balls in an upright position, insert the ball hub into the outer ring. It is important that a wide ball groove in the outer ring and a narrow ball groove in the ball hub are together on one side when the ball hub has been swung into the outer ring.

(6) Swing the ball hub with the cage and six balls into the outer ring of the joint. At the time this is being done, swing the ball hub out of the cage sufficiently to space the balls to suit the grooves in the outer part.

(7) Apply pressure on the ball cage and swing the ball hub and balls fully into position.

(8) Check for proper operation of the joint. The assembly can be considered correct when the ball hub can be moved by hand in and out over the full range of axial movement.




End Face View of Constant Velocity Joint.

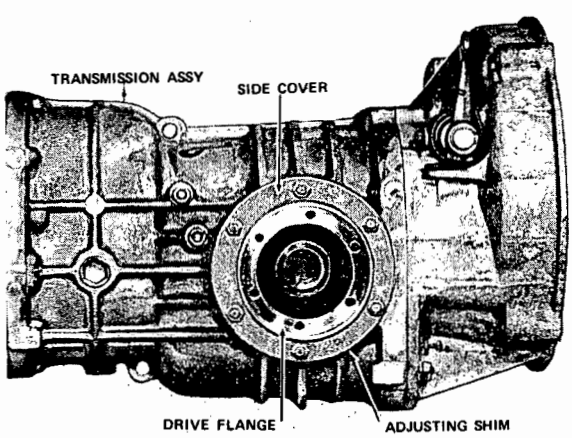
## 4. DIFFERENTIAL

### TO REMOVE

(1) Take off the starter motor and support and secure the transmission on a work bench or a repair stand.

(2) Lift out the sealing plug in the joint flange after piercing it with a screwdriver or any other suitable tool. Remove the circlips, lever off the flange with the aid of two suitable levers.

*NOTE: Relieve the pre-load from the transmission case by slackening the securing nuts on the final drive covers. It will, otherwise, not be possible to remove the clutch housing.*




Transmission Assembly Showing Drive Shaft Flange and Side Cover, Shim Adjustment Type.

(3) Undo the clutch housing securing nuts and, using a soft head hammer, tap the housing loose and off the dowels.

(4) Undo the cap nuts securing the final drive covers and, using a suitable puller, withdraw each cover.

(5) Remove the rear drive shaft by removing the circlip from the shaft, withdrawing the reverse gear and unscrew the rear drive shaft off the front shaft screwed dowel.

*NOTE: Identification marks should be made on the final drive covers and shims to facilitate installation on the same side from which they were removed.*

(6) To remove the differential and ring gear assembly from the housing, tilt the assembly so that one side clears the side cover hole and withdraw the assembly out of the clutch housing end.

(7) Press out the oil seals from the final drive covers.

(8) Position the final drive covers on a press and press out the bearing outer ring. During this operation an old shim or gasket should be placed between the final drive cover and the press base.

(9) Remove the O rings off the final drive covers and spacer rings from the differential housing.

### TO INSTAL

(1) Carefully check the taper roller bearings, oil seals, O rings and the circlips and renew if necessary.

(2) Position the differential housing with bearings and ring gear in the transmission case.

*NOTE: While executing repairs which need re-adjustment of the taper roller bearing pre-load and the gear backlash, only instal the differential in the first instance to enable the bearing pre-load to be checked. The oil seals must be removed from the side covers when pre-load has to be adjusted.*

(3) Using a suitable tool, press the taper roller bearing outer rings into the final drive covers.

(4) Apply oil lightly to the oil seals and press them into position. Fit new O rings.

(5) Instal the left side final drive cover, with shims and screw on the securing nuts and tighten.

(6) Turn the housing 180° while supporting the differential and locate it in the left bearing. The right hand final drive cover and shims can now be installed.

(7) Screw together the front and rear main drive shaft and then screw back one spline. Slide on the reverse gear and fit a new circlip.

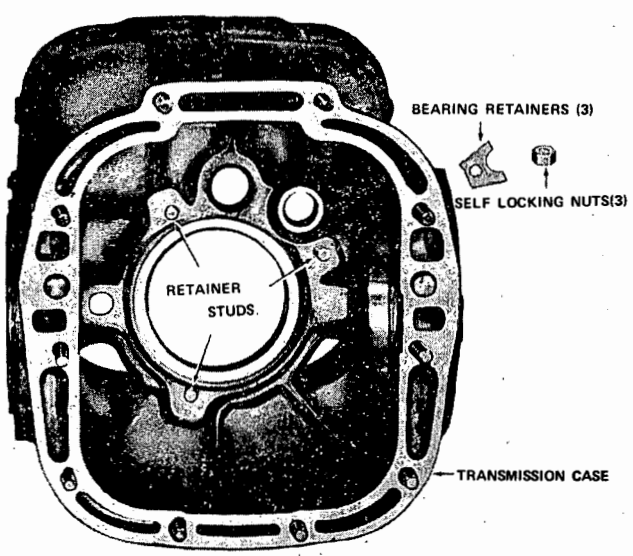
*NOTE: The right main drive cover cap nuts should not be tightened until the clutch housing has been fitted and secured with nuts.*

(8) Instal the clutch housing with new gasket and secure with nuts.

(9) Tighten the final drive cover cap nuts.

(10) Insert the spacer rings, slide on the flanges and instal new circlips. The side gear can be drawn into the flange splines using a bridge piece across the flange and a screw in the end of the gear shaft, until the spring ring is compressed sufficiently for the circlip to be fully seated.

(11) Drive the new sealing caps into position.




Pinion Double Row Bearing Retainers and Self Locking Nuts used on Earlier Models with Shim Adjusted Carrier Bearings.

**TO DISMANTLE**

(1) Clamp the differential housing in a suitable vice.

(2) Undo the ring gear mounting bolts and tap the gear off the housing.

(3) Press the end cover off the differential housing.

(4) Using a suitable puller, withdraw the taper roller bearing out of the end cover.

(5) Remove the taper roller bearing from the differential housing in the same manner.

(6) Drive out the retaining pin and differential shaft from the differential housing and remove the differential pinions and thrust washers.

**TO ASSEMBLE**

(1) Carefully check the differential housing thrust faces, thrust washers, gears, cover, ring gear and housing for wear or damage and renew parts where necessary.

(2) Into the differential, insert the differential shaft and side gear and pinions with thrust washers.

(3) Drive in the shaft, referred to in (2) above, using a new pin, lock the shaft and peen the housing over the end of the pin.

(4) Using a container of oil, immerse one of the taper roller bearings and heat it to approximately 100°C and immediately place it on the housing and press it firmly into position.

(5) Similarly heat the ring gear and, using two centering pins, instal it on the differential housing.

*NOTE: Check the contact faces for cleanliness which is most essential and any burrs should be removed with the aid of an oil stone.*

(6) Similar to (4) above, heat the second taper roller bearing and press it on to the end cover, using the same method of installation.

(7) Instal the end cover with the differential shaft and side gear and the thrust washer, insert ring gear mounting bolts with spring washers and tighten them diagonally to a **torque of 32 ft/lb.**

*NOTE: The correct type of bolts with spring washers should only be used.*

(8) Check the axial play by turning the differential gears. Turning the gears by hand they should rotate smoothly and without any binding. The axial play limit is .012".

## 5. TRANSMISSION ASSEMBLY

### TO REMOVE AND DISMANTLE

(1) Undo the three self-locking nuts and take off the three double row pinion bearing retainers.

(2) Remove the gearshift housing with the inner shift lever and take off the shift lever. Using a soft head hammer, lightly tap the drive pinion until it moves sufficiently forward to expose the double taper roller bearing circlip.

(3) From the pinion bearing take off the large outer circlip.

*NOTE: Do not over-stretch the circlip. To facilitate removal, insert a right-angled screwdriver under the circlip. Over-stretched circlips should be discarded.*

(4) Remove the pinion shims and make a note of the number and thickness.

(5) Undo the gear carrier securing nuts and remove the nuts and washers.

(6) Press out the gears using a special tool according to manufacturers instructions, levering against the end face of the pinion shaft.

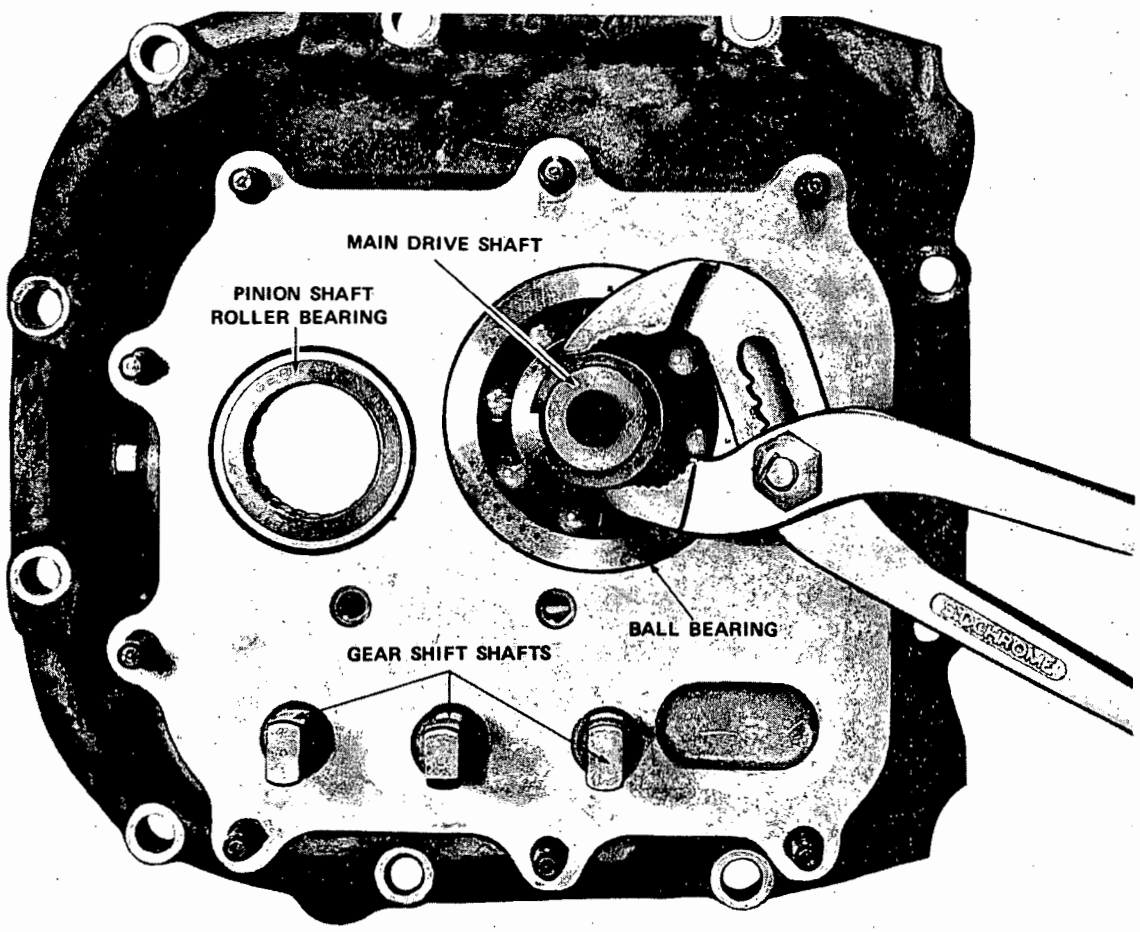
(7) Slacken the union nut for the rocker lever sleeve. Just swing the reverse gear shaft far enough to facilitate removal of the shift fork with reverse sliding gear.

(8) Slide the shift forks for the first and second and the third and fourth gears off the shift rods.

(9) Using circlip pliers, remove the circlip off the main drive shaft forward end, against the face of the gear carrier.

*NOTE: Use care taking out the circlip as the dish washer below the circlip is under considerable tension and if allowed to fly off it can cause injury.*

(10) Press out the drive shaft and pinion assembly from the gear carrier, carefully guide the pinion assembly to avoid damaging the gears.




Installing New Circlip to Retain Main Drive Shaft in Gear Carrier.

**TO ASSEMBLE AND INSTAL**

Assembling is a reversal of the dismantling procedure, observing the following points:

(1) Carefully check shift forks, dished washer and reverse gear for wear and damage and renew if necessary.

(2) Press the complete drive shaft and drive pinion into the gear carrier.

(3) Position the dished washer concave face down, on the drive shaft, slide on the circlip and press it down until it fits snugly in the groove.

(4) Using a suitable pliers, seat the circlip correctly in the bottom of the groove. Instal both the fork and reverse sliding gear.

(5) Using a special tool, instal the transmission and adjust shift forks for the first and second and the third and fourth gears and also for reverse. *See ADJUSTMENT OF SHIFT FORKS.*

(6) Tighten the union nut on the clamping sleeve and screws securing the shift forks.

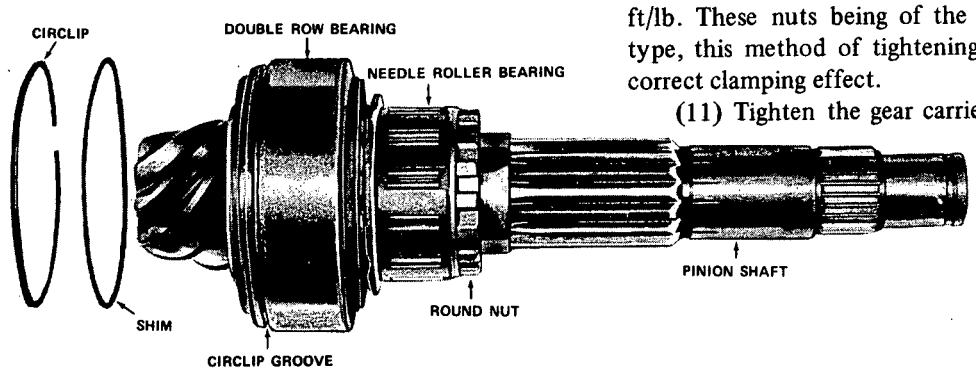
(7) Instal a new gasket on the gear carrier and insert the transmission into the transmission case. Drive in the transmission by using a soft head hammer tapping on the drive pinion and the drive shaft alternatively until fully seated.

(8) Using a soft head hammer, drive in the taper roller bearing by tapping on the face of the drive pinion sufficiently to fit the shim and the circlip.

(9) Position the three retainers, screw on the nuts and evenly press the bearing against the housing.

(10) In the first instance tighten the three nuts to a torque of 29 ft/lb and then slacken them slightly. The nuts should again be tightened and this time to a torque of 22 ft/lb. These nuts being of the special slotted self-locking type, this method of tightening is necessary to obtain the correct clamping effect.

(11) Tighten the gear carrier securing nuts diagonally.




**Drive Pinion and Double Row Bearing, Shim and Retaining Circlip (Early model shown).**

## 6. GEAR CARRIER

**TO DISMANTLE**

(1) Undo the two mounting screws and remove the shift lever with bracket. Press out the main drive shaft ball bearing.

(2) Remove the needle bearing locking screw and press out the bearing.

(3) Take out the shift rods one by one and extract the plunger and the detent balls.

(4) Drill out the plugs and carefully remove the interlock plungers and detent springs.

(5) Undo the screws from the reverse gear relay shaft and remove the shifter shaft and brackets.

(6) Unscrew the clamp sleeve and bracket with the rocker lever.

**TO ASSEMBLE**

Assembling is a reversal of the dismantling procedure observing the following points:

(1) Carefully check all parts for wear or damage and renew where necessary.

(2) Check the tension of the detent spring when gear shifting is difficult. The free length of the springs is .9055" – .9842". To overcome the detent balls the force required is 30 to 40 lbs.

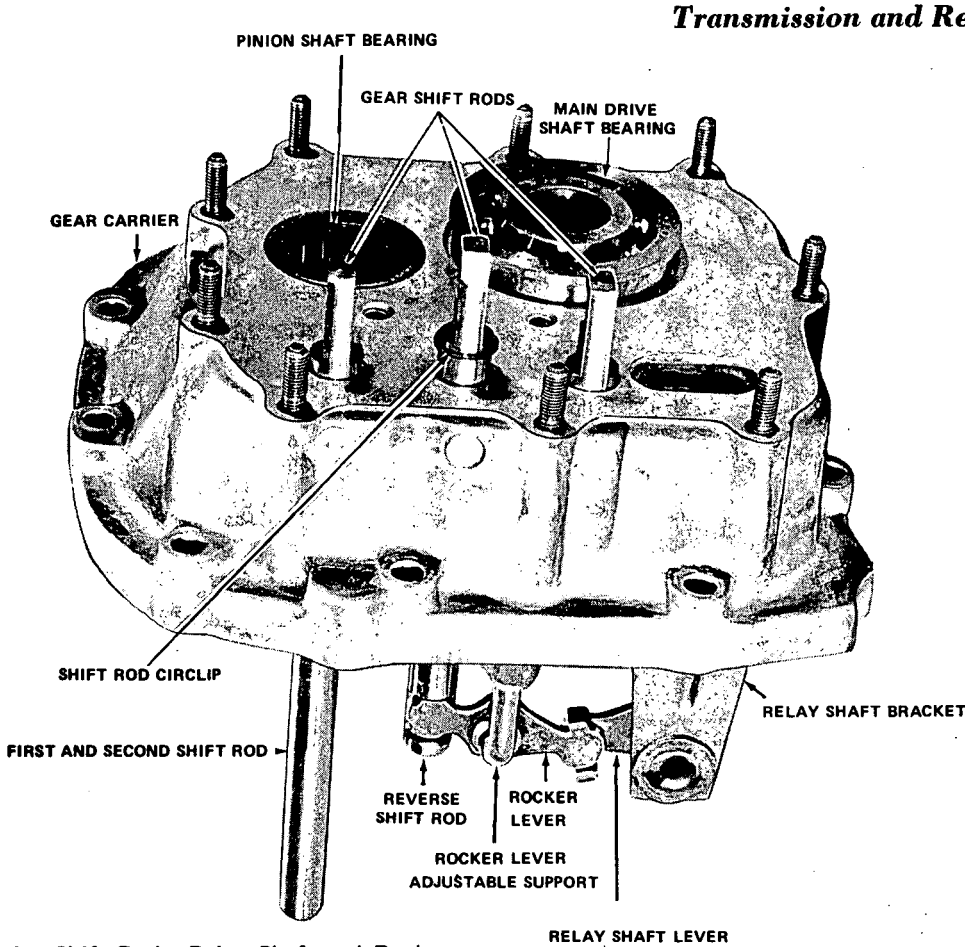
(3) Insert the springs, new if necessary, and knock in new plugs. Fit the detent balls and insert the shift rods. Remember to fit the interlock plungers and the centre shift rod pin. Check to ensure that the interlocking mechanism is functioning properly as it should not be possible to engage two gears simultaneously.

(4) Press in the pinion needle bearing and secure it in position with the lock screw.

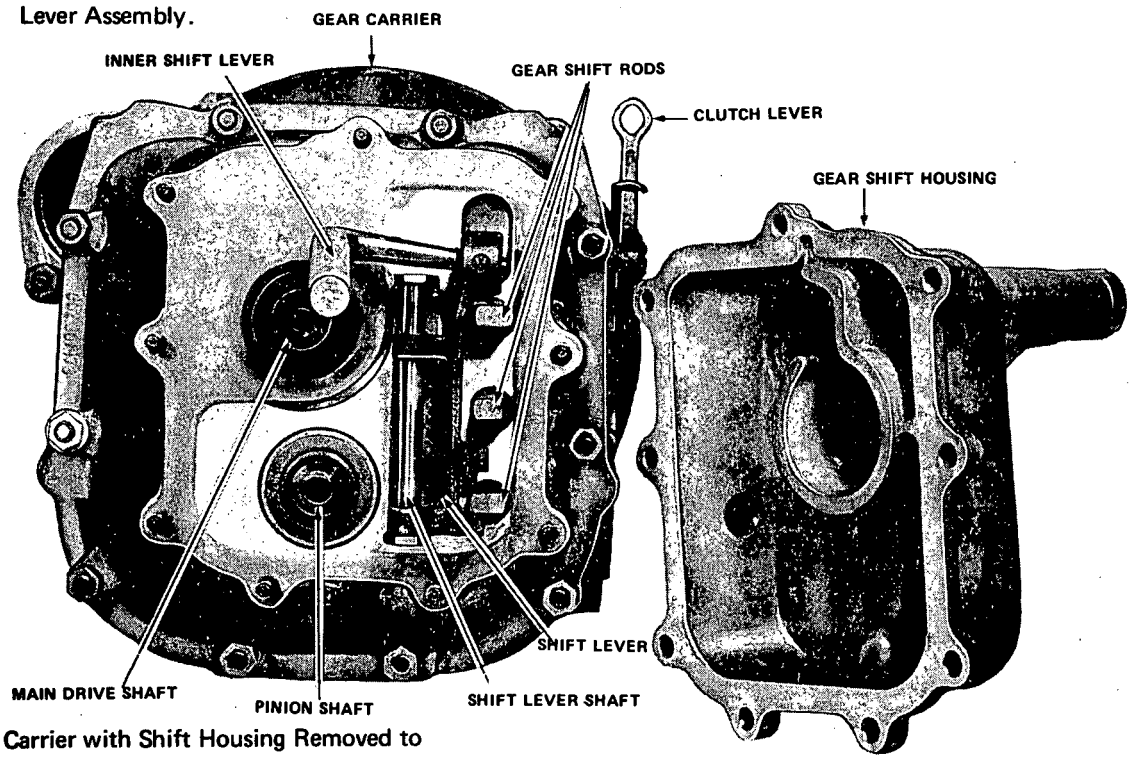
(5) Press in the main drive shaft bearing.

(6) Instal the clamp sleeve with bracket and rocker lever.

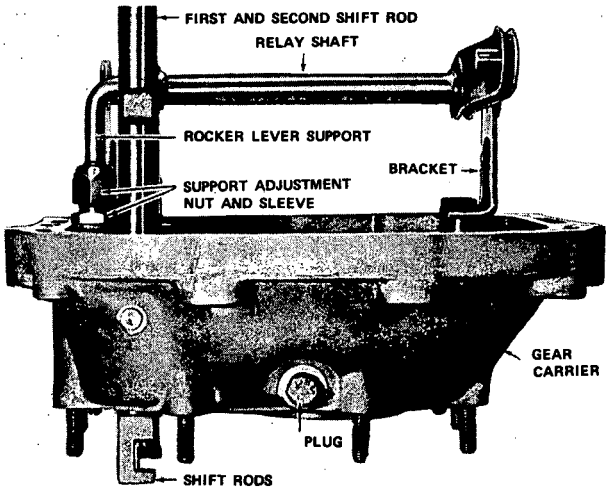
(7) Instal the relay shaft and brackets and adjust the shaft between the brackets to remove play. Play at the rocker lever can be eliminated by moving the shaft and brackets as necessary.




Gear Carrier Showing Shift Rods, Relay Shaft and Rocker Lever Assembly.




Front Face of Gear Carrier with Shift Housing Removed to Show Gear Shift Assy.




Gear Carrier Showing Rocker Lever Support Adjusting Union Nut and Clamp Sleeve.

**TO ADJUST AXIAL PLAY BETWEEN REVERSE SLIDING GEAR AND SHIFT FORK**

If for any reason the reverse relay shaft and brackets are removed, adjustment of play between the reverse sliding gear and shift fork must be carried out by axial movement of the shaft and brackets as follows:

(1) Using a setting appliance, instal the gear carrier with reverse gear and shift fork.

(2) Slacken the mounting screws of both brackets.

(3) Slide the shift fork side bracket on to the shaft until it abuts the reverse gear, then tighten the bracket mounting screws.

(4) Position the other bracket against the end of the shaft until the shaft is firmly fixed with no play and then tighten the bracket mounting screws.

(5) Remove the gear carrier from the setting appliance and assemble the transmission as previously described.

## 7. SHIFT HOUSING

**TO DISMANTLE**

(1) Clamp the shift housing in a vice with soft jaws and using an adjustable pliers, turn the bush and sealing ring to remove.

(2) Using a suitable drift, drive out the inner guide bush.

(3) Unscrew the plug/back-up light switch with washer and remove the shift housing from the vice.

**TO ASSEMBLE**

(1) Press in the inner guide bush.

(2) Press in the bush and sealing ring.

*NOTE: The bushes are finished to size and, therefore, reaming is not, normally, required. However, if the inner shift lever tends to be stiff in operation, open the bushes out from inside the housing with a (.6023" – .6102") reamer. Avoid damaging the sealing ring.*

(3) Screw in the plug/back-up light switch after fitting the washer.

## 8. TRANSMISSION CASE

**TO DISMANTLE**

(1) Take off the circlip from the reverse drive gear, press off the gear with levers and remove the Woodruff key from the reverse gear shaft.

(2) Withdraw reverse gear shaft and thrust washer from the housing.

(3) Remove the drive shaft needle bearing circlips. Using a suitable drift, drive out the needle bearing.

(4) Remove the reverse shaft needle bearing locking screw. Using a suitable drift, drive out the needle bearing and sleeve.

**TO ASSEMBLE**

(1) Carefully check the reverse gear shaft, gear and needle bearing for wear or damage and renew if necessary.

(2) Using a suitable drift, drive in the main drive shaft needle bearing. Insert circlips.

(3) Insert the reverse shaft spacer sleeve and lock it in position.

(4) Using a suitable drift, from either side drive in the needle bearings as far as the spacer sleeve. Position the needle bearing with the metal ring towards the spacer sleeve. Strike bearing on the lettered side only.

(5) From the transmission side insert the reverse gear shaft with thrust washer. Fit the Woodruff key, slide on the reverse drive gear and instal a new circlip.

## 9. CLUTCH HOUSING

### TO DISMANTLE

(1) Press off the retaining springs and remove release bearing.

(2) Press out the drive shaft oil seal.

*NOTE: The drive shaft oil seal can also be replaced with the shaft installed in position.*

(3) Using a suitable drift, drive out the oil return sleeve.

*NOTE: Ensure that the seat in the clutch housing is not damaged while driving out the oil return sleeve.*

(4) Extract the starter pinion bush.

(5) Remove the circlip on the clutch shaft and press off the lever.

(6) Undo the left bush locking screw, slide the clutch operating shaft to the left, take off the sleeve and remove clutch shaft from the inner side.

(7) Remove the operating shaft bush.

### TO ASSEMBLE

(1) Carefully check the clutch operating shaft, release bearing, bushes and rubber seals for wear or damage and renew if necessary.

*NOTE: The clutch release bearing must not be washed in cleaning solvent but should only be wiped dry with clean cloth. The clutch operating shaft should be greased before being installed.*

(2) Using a suitable drift, drive in the new right-hand side bush. From inside the housing, insert the operating shaft with bushes and seals. Slide in the guide sleeve and lock it in position with the lock screw.

(3) Position the spring locating washer, the return spring, the clutch lever and secure with the circlip.

(4) Instal the new oil return sleeve as follows:

(a) Using a suitable drift, drive in the sleeve as far as possible.

*NOTE: When renewing the oil return sleeve, the face in the housing should be scraped with a scraper at the point of contact between the face of the housing and the shoulder of the sleeve to remove any burrs before attempting to instal the sleeve. The sleeve should be so installed that the retaining claws do not engage in the old holes.*

(b) Using a special tool in conjunction with a suitable press, the sleeve should be pressed into position so that the claws are properly engaged.

*NOTE: It should be ensured that the oil return sleeve must be lined up with the clutch housing within tolerance of .008" which should not be exceeded. This will require checking with a precision square.*

(5) Using a suitable drift, drive in a new oil seal. While performing this operation, employ suitable methods to prevent damaging the oil return sleeve.

(6) Position the clutch release bearing and secure with the retaining springs.

## 10. FRONT MAIN DRIVE SHAFT

### TO DISMANTLE

(1) Remove the thrust washer, the fourth speed gear, needle bearing and the fourth gear synchroniser ring.

(2) Press off the needle bearing inner race synchroniser assembly, Woodruff key and third speed gear.

(3) Remove the third speed gear needle bearing. Remove both synchro rings from the synchro assembly.

(4) Remove the synchroniser operating sleeve, keys and the key springs.

### TO CHECK

(1) Carefully check the drive shaft, needle bearings, inner ring and the gears for wear or damage and renew if necessary.

(2) Lay the gears flat on the machined faces and press on the synchroniser rings over the cones and, using a feeler gauge, measure the gap between the synchroniser ring and the synchroniser teeth on the gear. The gap should be .044", with a wear limit of .024".

(3) Carefully check synchroniser teeth on the gears, synchroniser rings, operating sleeves and thrust washers.

### TO ASSEMBLE

(1) Instal the third and fourth speed synchroniser hub taking note of the matching marks on the synchroniser hub and the operating sleeve.

*NOTE: If renewal becomes necessary, the synchroniser hub and the operating sleeve must be replaced in sets as they are only serviced in matched sets.*

(2) Instal the synchroniser key springs so that the ends

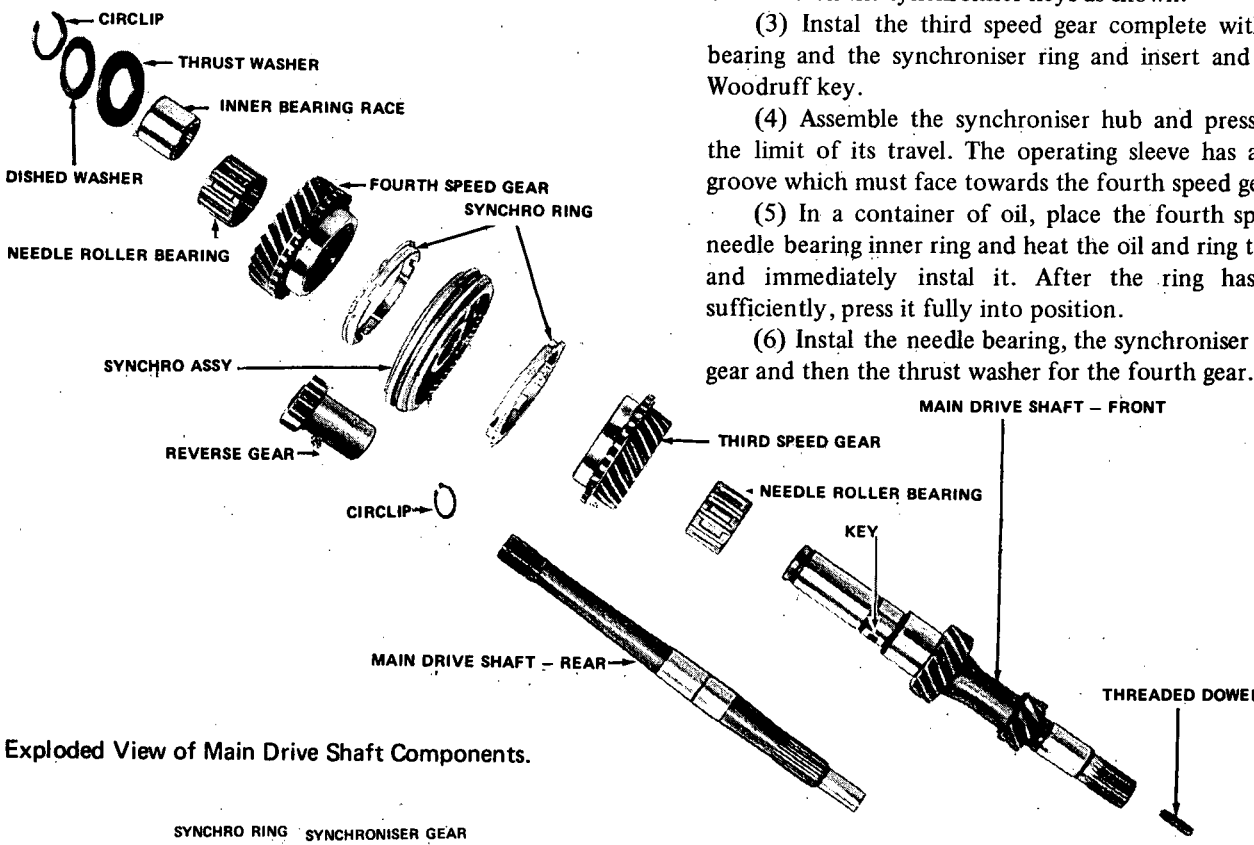
of the springs are offset 120°. The ends of the springs must be seated on the synchroniser keys as shown.

(3) Instal the third speed gear complete with needle bearing and the synchroniser ring and insert and seat the Woodruff key.

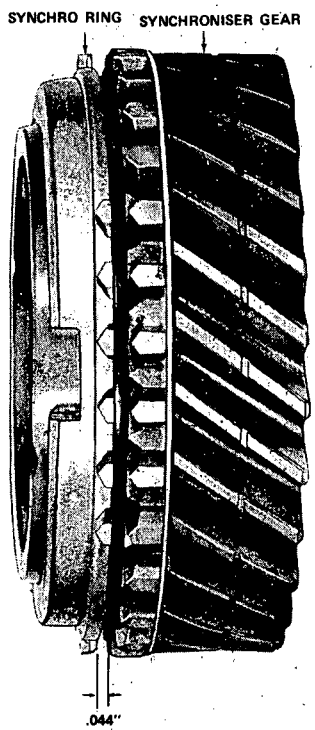
(4) Assemble the synchroniser hub and press it in to the limit of its travel. The operating sleeve has a .0393" groove which must face towards the fourth speed gear.

(5) In a container of oil, place the fourth speed gear needle bearing inner ring and heat the oil and ring to 100°C and immediately instal it. After the ring has cooled sufficiently, press it fully into position.

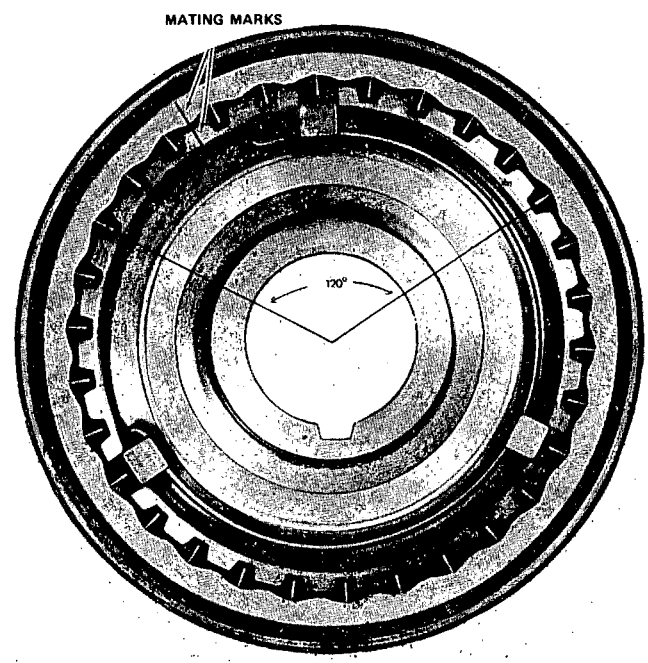
(6) Instal the needle bearing, the synchroniser ring, the gear and then the thrust washer for the fourth gear.




Exploded View of Main Drive Shaft Components.




Normal Clearance between Synchroniser Ring and Gear.




Synchro Sleeve and Hub are matched and have Mating Mark. Synchroniser Key Retaining Springs should be Fitted opposed at 120 deg to Each Other.

## 11. DRIVE PINION

### TO DISMANTLE

(1) Using a suitable pliers, remove the circlip and press off the needle bearing inner race and the fourth speed gear.

(2) Withdraw the spacer spring and with suitable pliers take off the third speed gear axial play circlip.

(3) Remove the third speed gear, the second speed gear, the synchroniser hub and the operating sleeve, synchroniser rings and the first speed gear.

(4) Using a special tool, undo the round nut and withdraw the first speed gear needle bearing.

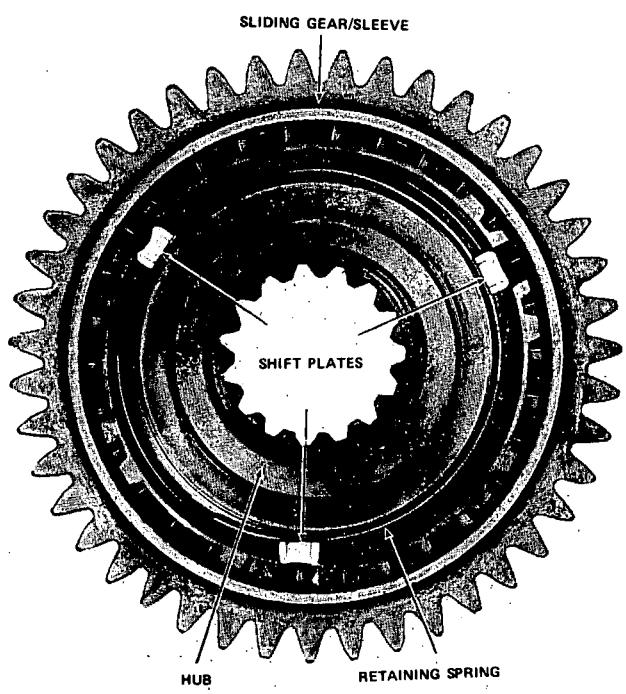
(5) Press off the double row tapered roller bearing together with the first speed gear needle bearing inner race and thrust washer.

(6) Remove the operating sleeve, synchroniser keys and springs.

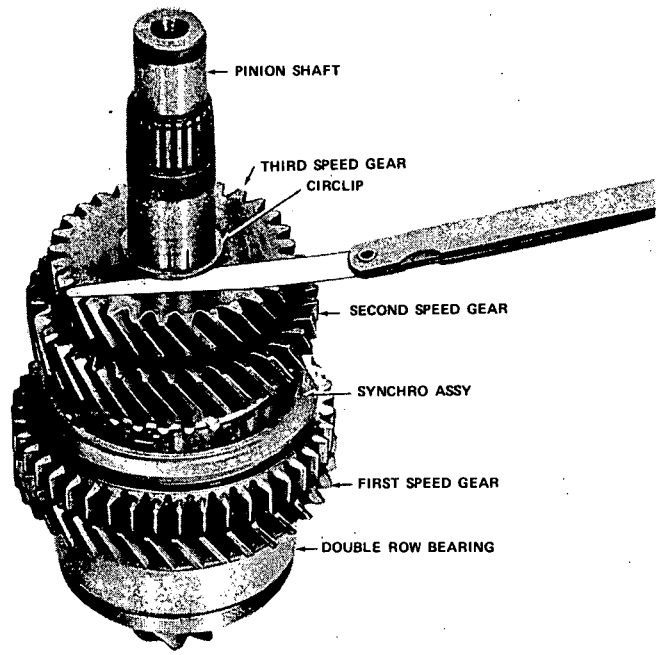
### TO CHECK

(1) Carefully check the drive pinion, the taper roller bearings, the needle bearings, the needle bearing inner races and the gears for wear or damage and renew where necessary.

(2) Lay the gears flat on the machined faces and place the synchroniser rings over the cones and, with a feeler gauge, measure the gap between the synchroniser ring and the synchroniser teeth on the gear. The gap should be .044", with a wear limit of .024".




First and Second Speed Synchro Assembly.




Third Speed Gear Axial Play is Adjusted by Selective Circlips and should be between .004" and .010".

(3) Check the condition of the synchroniser teeth on the gears, the synchroniser rings and the operating sleeve.

*NOTE: If third and fourth speed gears are worn or damaged and are to be renewed, they must be replaced in sets as these are matched and serviced in sets. The same does not apply to first and second speed gears which, being serviced in sets and separately, can be replaced individually except when teeth are damaged they must be replaced in sets.*

(4) Check the pre-load of the double taper roller bearing as described in the appropriate section.

### TO ASSEMBLE

(1) Place the inner races of the double row taper roller bearing and first gear needle bearing in oil heated to approximately 100°C and immediately instal on the drive pinion with the first gear thrust washer interposed between the two. When sufficiently cool, press fully into position.

(2) Instal the first speed gear needle bearing, fit a new nut and tighten to a torque of 144 ft/lb.

(3) Using a blunt chisel, at three points 120° apart on the special round nut, knock the locking shoulder into the drive pinion splines, ensuring that the shoulder does not get damaged with cracks or burrs.

*NOTE: Whenever the double row taper roller bearing, the*

*transmission case or the drive pinion are replaced, re-adjustment of the drive pinion is essential.*

(4) Check the pre-load of the double row taper roller bearing as described in the appropriate section.

(5) Instal the shims which govern the first gear axial play. Slide into position the first gear with synchroniser ring and the assembled synchroniser hub and, using a feeler gauge, check the axial play. The play should be between .004" and .010" but preferably on the lower side.

(6) Slide into position the second gear synchroniser ring, second speed gear with the needle bearing and the third speed gear.

(7) Using a feeler gauge, measure the third speed gear axial play and effect adjustment by selection of a suitable circlip. The axial play should be restricted to between .004" and .010" but preferably on the lower side in the range.

(8) Instal the spring spacer. As already described in this section, heat the needle bearing inner race to approximately 100°C and press it on with the fourth speed gear.

(9) Using a special circlip pliers, instal a new clip and ensure that it is properly seated.

## 12. ADJUSTMENT OF SHIFT FORKS

**TO ADJUST**

To effect proper adjustment of the shift forks a special setting tool VW294a is necessary. Before commencing adjustment, ensure that the pinion and the drive shaft must be positioned exactly as they are when installed in the transmission case. For this purpose, the axial location shims of the drive pinion must be decided before-hand, and also positioned in the setting tool. It is also necessary to take into consideration the thickness of the paper gasket which is fitted between the gear carrier and spacer bolts.

(1) In the event of it not being possible to obtain a special setting tool for this later model transmission, with certain modifications the earlier model VW294a can be converted for the purpose.

(2) Position the gear carrier with gasket, pinion, drive shaft and the reverse gear in the special tool and secure the four nuts of the tool. Slide the selected adjustment shims on to the double row taper roller bearing and insert the circlip in the groove.

(3) Instal the clamp flange and uniformly tighten with two bolts.

(4) Instal the shift forks for the first and second gears and the third and fourth gears.

*NOTE: The shift fork for the first and second gears (larger fork width) is installed with the offset towards the gear carrier. The offset of the third and fourth gear fork is away from the gear carrier.*

(5) Instal the support with the rocker lever and slightly tighten the union nut.

(6) Locate the lower shift rod for the first and second gear in the detent groove for the second gear. Slide the operating sleeve with fork over the synchronising teeth until it abuts the second speed gear. Position the shift fork in the centre of the groove in the operating sleeve and tighten the clamp screw.

*NOTE: The shift forks must be so positioned that, when in the neutral position or when a gear is engaged, they should not touch the sides or exert any pressure on the sides of the groove in the operating sleeve. There must always be some clearance.*

(7) While turning the transmission select both gears and neutral a number of times and, in each position, check the clearance between the shift fork and the operating sleeve. The shift fork position can be altered, if necessary, so that the same clearance exists between the fork and the sleeve groove with the shift rod in both the end positions. Tighten the clamp screw to a torque of 18 ft/lb.

(8) Locate the upper shift rod for the third and fourth gears in the detent groove for the third gear. Adjustment of the shift fork for third and fourth gears should be done as for the first and second gear.

(9) Tighten the clamp screw to a torque of 18 ft/lb.

*NOTE: For the adjustment of the third and fourth speed gears it is important that the ball bearing in the gear carrier is fully seated.*

(10) Push in the centre shift rod for the reverse gear until it abuts the circlip and then slightly tighten the union nut of the support for the rocker lever.

(11) Before tightening the union nut, press against the sliding reverse gear but not against the shift fork, then move it in the direction of the gear carrier so that a clearance of .0196" – .0393" exists between the reverse gear and the second speed gear on the drive shaft. In this position, tighten the union nut.

*NOTE: Ensure that there is no axial play while adjusting the reverse sliding gear.*

(12) Select the reverse gear and check the teeth engagement on both the sliding reverse gear and on the operating sleeve. This should be rectified, if necessary.

*NOTE: To improve engagement, adjustment may only take place in the inshift direction.*

(13) Disengage reverse gear and engage the second gear. In this position, check the clearance between the operating sleeve and the sliding reverse gear. If necessary, the position should be rectified as explained in (11) above. When completed, tighten the union nut to a torque of 14 ft/lb.

(14) Check the interlock mechanism. When one gear is engaged, it must not be possible to engage another gear. All shift rods are interlocked, one against the other.

## 13. FINAL DRIVE ADJUSTMENT

Adjustment of the drive pinion and the ring gear is absolutely necessary to ensure long rear axle service and silent operation. To obtain this performance the ring gear and the drive pinion are manufactured in sets and matched by a special testing machine on which the set is run for some time in both directions and the contact pattern and silent operation are carefully checked The most silent operating position is obtained by the drive pinion being moved axially and simultaneously moving the ring gear out of the meshing position until the backlash is within the tolerance range of .006" – .010". Every hypoid pinion and ring set has a matching number stamped to identify the set which must always be fitted together. For instance, a gear set may be stamped K843, which means a Klingelnberg pinion and ring gear set having a ratio of 8:43.

The matching number which must be stamped on the pinion as well as the gear identifies the set.

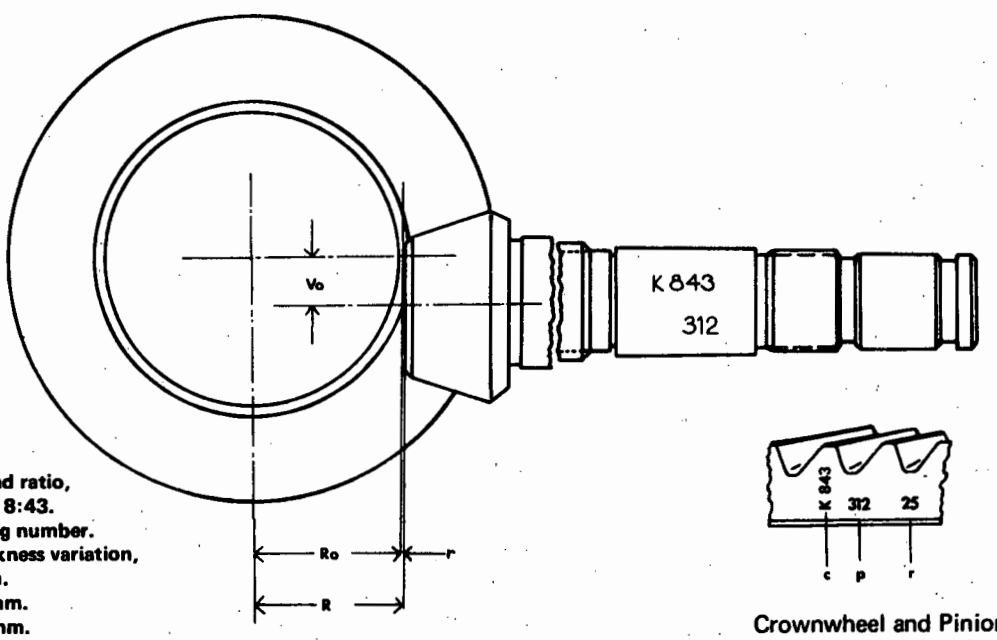
Readjustment of the pinion and gear set is usually only necessary after replacement of parts which directly effect the adjustment. In the event of replacement of the differential housing, a final drive cover or a differential taper roller bearing, the ring gear only should be reset. However, if the transmission case or the complete pinion and gear has been replaced, adjustment must be carried out. In case the double taper roller bearing for the drive pinion has been renewed, adjustment of the drive pinion only is necessary.

The main purpose for the adjustment is to maintain the same silent operating position set by the manufacturer during production.

The drive pinion must first be set in position by inserting shims between the circlip on the double row taper roller bearing and the transmission case so that the distance from the centre line of the ring gear to the pinion end face is exactly the same dimension as was obtained during production of the vehicle.

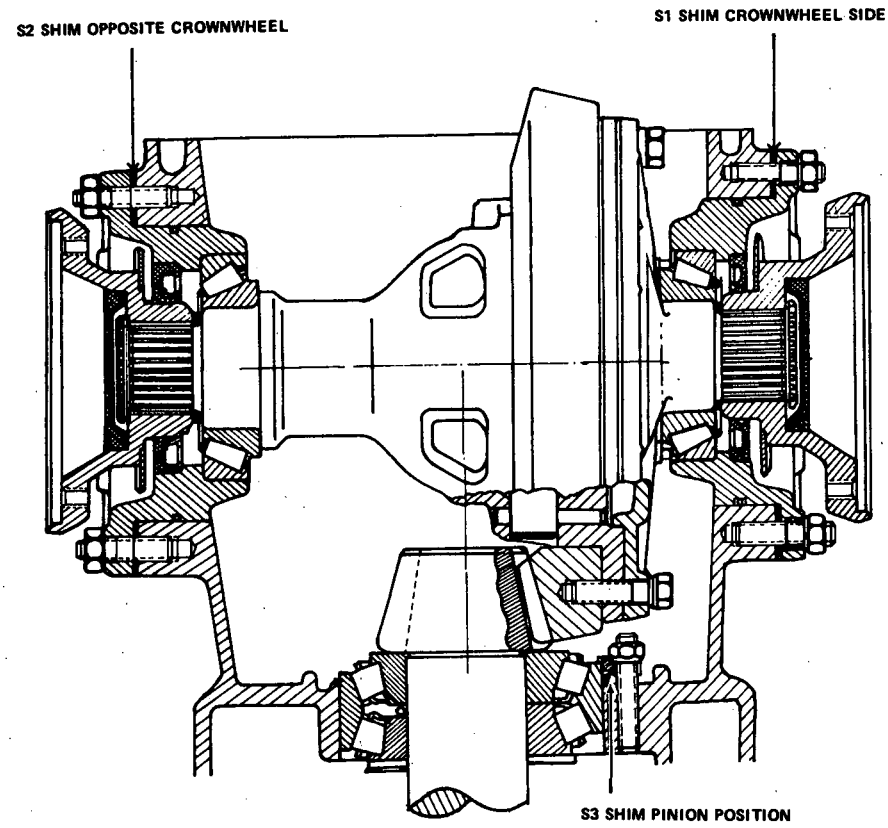
The ring gear is then installed and carefully adjusted to ensure that allowance is provided for the prescribed pre-load between the taper roller bearing and in addition the prescribed amount of backlash exists between the ring gear and the pinion teeth. To obtain this backlash, place suitable shims between the transmission case and the final drive covers.

By rotating the ring gear, the correct amount of




**C = Gear set make and ratio, e.g. Klingeinberg 8:43.**
**P = Gear set matching number.**
**n = Pinion head thickness variation, e.g. 25 is .25 mm.**
**Ro = Constant at 63 mm.**
**Vo = Gear offset, 10 mm.**

Crownwheel and Pinion Markings.




Location of Pinion Locating Shim S3 and Backlash Adjusting Shims S1-S2.

pre-load is measured from the friction in the taper roller bearings. Table for identifying shims:

1. Shims referred to as S3 are for the drive pinion axial adjustment.
2. Shims referred to as S1 are for the ring gear end adjustment of the differential case.
3. Shims referred to as S2 are for the end of the differential opposite to the ring gear end.

*NOTE: Observe extreme care and cleanliness during all assembling and measuring operations to obtain satisfactory results.*

Working sequence for adjusting gear set:

A. Adjust differential taper roller bearings.
B. Adjust drive pinion and check.
C. Adjust the ring gear backlash and check.

**TO ADJUST DRIVE PINION**

Adjustment of the drive pinion is essential in the event of replacement of the transmission case, the circlip, the double taper roller bearing or the ring gear and pinion.

(1) Assemble the pinion with all components up to and also including the first speed gear needle bearing. Tighten the round nut to the specified torque but, at this stage, do not lock the nut.

*NOTE: If a drive pinion is to be renewed without replacing the transmission case, the double taper roller bearing and the circlip, the new shim thickness can be calculated by taking the difference between the new and the old dimension and the thickness of the existing (S3) shim at the double row roller bearing.*

(2) Instal the drive pinion, assembled as in (1) above, in the housing but less shim S3, fit the circlip and pinion bearing retainers and tighten nuts to the specified torque.

(3) Using a special socket wrench and a pre-load gauge, turn the pinion to check the pre-load of the double row taper roller bearing. Pre-load should be 5 to 18 in/lb for new bearings or 2 to 6 in/lb for used bearings.

(4) Instal the ring gear side final drive cover with a special measuring shim VW381/10 and tighten the nuts to the specified torque.

*NOTE: Before inserting the special measuring shim, press the oil seals out of the side covers. Also remove the O rings during setting operations.*

(5) Insert the special setting mandrel VW381/2 in the transmission case with the mandrel measurement cylinder positioned on the reverse gear drive shaft side. Instal the right-hand final drive cover along with the second measuring washer. Instal the special ring gear setting tool

VW381/3 with the thrust piece VW381/4 and tighten the nuts to the prescribed torque.

(6) Using the special setting tool, press in the bearing outer race until it is possible to just turn the mandrel by hand in the bearing races.

(7) Positioned the setting pin VW381/6 on the drive pinion end face and properly seat it.

*NOTE: Throughly clean all surfaces to obtain accurate measurements.*

(8) Insert a dial indicator with a .6102" range with extension VW381/12 (3.346" long) in the measuring bar VW381/2.

(9) Set the dial indicator to zero on the setting pin without pre-load.

(10) By sliding the measuring bar, bring the dial indicator pin on the mandrel and locate the highest point. Note the dial reading.

(11) Read the deviation marked (r) on the pinion and subtract it from the measured amount. The difference between the two indicates the thickness of the pinion positioning shim (S3) which has to be installed.

(12) Take off the left end cover and remove the mandrel. Take out the pinion, lock the round nut, assemble and instal the transmission as already described in the appropriate section. Instal the shim S3 as measured.

(13) Again instal the mandrel, fit the left end cover and tighten nuts to prescribed torque.

(14) Once again check the measurements. Zero the dial indicator with the setting pin.

(15) Move the measuring bar bringing the dial indicator pin on the mandrel and locate on the highest point. The reading now obtained should correspond with the deviation marked on the pinion end face within a tolerance of ± .0015", if the positioning shims S3 have been correctly selected.

(16) Remove the differential side covers and lift out the mandrel. Remove the pinion assembly from the transmission case.

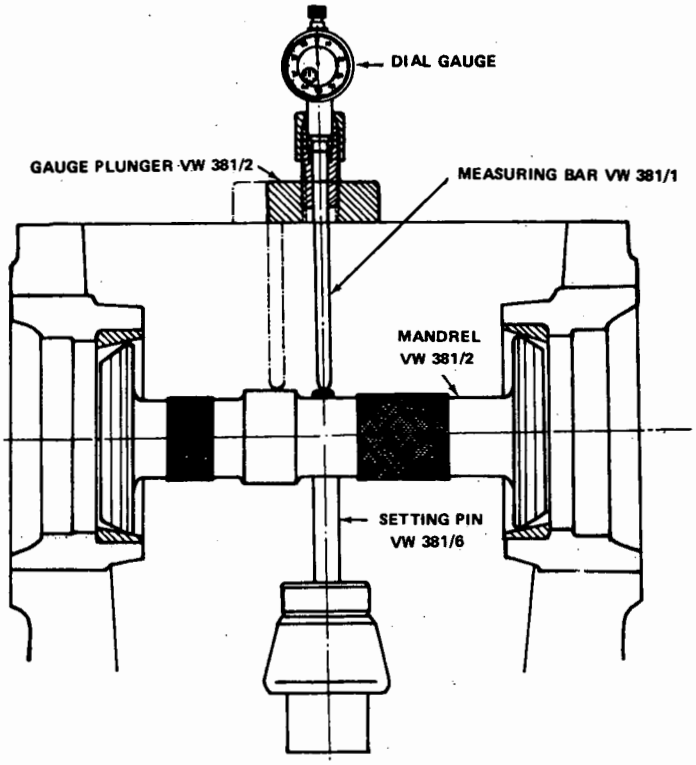
*NOTE: Keep the pinion position shims S3 intact for installation after the carrier side bearing pre-load has been adjusted.*

**TO ADJUST CARRIER BEARING PRE-LOAD**

(1) With the pinion assembly removed from the transmission case, instal the differential and ring gear assembly in the transmission case so that the ring gear will be to the left hand side.

(2) With the oil seals removed from the side covers and the bearing outer races pressed fully into position in the covers, remove the O-ring seal from each cover.

(3) Place a special measuring shim VW 381/10 in




Special Tools in Position to Establish Pinion Positioning Shim Thickness.

position on the left hand side of the transmission case and instal the left hand side cover, secure with nuts and washers tighten to a torque of 14 ft/lb.

*NOTE: The left hand side cover is adjacent to the ring gear.*

(4) Turn the transmission case so that the differential and ring gear assembly will be vertical with the ring gear side inner cone and rollers in contact with the outer race in the left hand side cover.

(5) Instal the right hand side cover, together with special measuring shim VW 381/10, but do not fit the securing nuts at this stage.

*NOTE: The special measuring shim VW 381/10 installed with each side cover has a constant thickness dimension of 1.30 mm.*

(6) Place special tool VW 381/3 with thrust collar VW 381/4 in position over the right hand side cover and secure with the six nuts.

*NOTE: Instal the tool VW 381/3 so that the clamp sleeve for the dial indicator in the flange of the tool is below the axis of the differential carrier bearings.*

(7) Carefully screw the spindle of tool VW 381/3 in until the thrust collar lightly contacts the back of the outer bearing race of the right hand side cover.

(8) Insert the dial indicator with 52 mm length plunger and lock in position in the clamp sleeve with the plunger

loaded by approximately 3 mm. Set the indicator dial to zero.

(9) Turn the transmission case so that the clutch cover end is up and fit the spacer bridge piece VW 381/8 on the dowels in the end face of the case.

*NOTE: The spacer bridge piece must be fitted to prevent the case from spreading and distorting when the necessary preload is applied.*

(10) Lubricate each carrier bearing sparingly with the correct grade of hypoid transmission oil.

(11) With the tool VW 381/3 with thrust collar set as in operation (7) and the dial indicator set as in operation (8), screw the tool spindle in a clockwise direction until all end float is removed in the differential carrier bearings but do not apply any preload.

(12) Fit the special clamping sleeve VW 381/5 to the left hand side differential side gear shaft, with the sleeve against the ring gear end of the differential case and the sleeve bolt screwed into the end of the gear shaft. Tighten the bolt lock nut securely.

(13) Using a suitable preload gauge tool on the hexagon bolt of the clamping sleeve, rotate differential in both directions to seat the bearings.

(14) Turn the differential in its normal direction of rotation, using the preload tool, and screw the spindle of tool VW 381/3 clockwise until the specified preload is recorded on the preload gauge.

*NOTE: The dimension by which the outer race of the right hand carrier bearing outer race has been moved towards the left to obtain the requisite preload will be recorded on the dial indicator gauge, which was set to zero when all end float was removed from the bearings in operation (8). Do not preload the bearings in excess of that specified or it will be necessary to remove the special tool and the right hand side cover and press the bearing back fully into the cover in order that the preload may be readjusted.*

(15) Record the dial indicator reading which should be within the limits of .50 to 1.60mm (.020" to .063"). The bearing preload should be 18 in/lb for new bearings or 2 to 6 in/lb for bearings that have been in use.

(16) Remove the special tool and bridge piece, take off the side covers and lift the differential assembly from the transmission case.

*NOTE: Mark the side covers so that they can be assembled on the correct sides as they must not be interchanged, once the preload on the carrier bearings has been adjusted.*

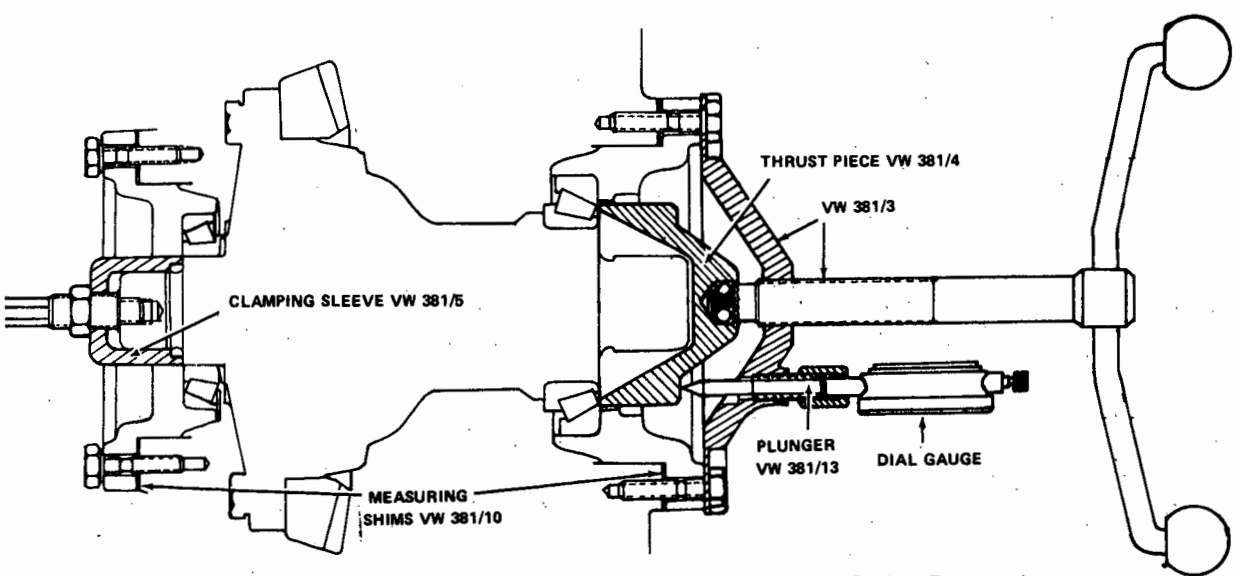
## TO ADJUST RING GEAR AND PINION BACKLASH

(1) With the transmission and gear carrier installed and the pinion positioning shims fitted, instal and secure the three pinion retainers and nuts.

(2) Instal the differential and ring gear assembly in the transmission case and fit left hand cover, with special measuring shims VW 381/10, ensuring that the covers are fitted to the correct sides as determined during the carrier bearing preload adjustment.

(3) Fit the right hand side cover, with special measuring shim VW 381/10, plus shims to the equivalent thickness of the dimension recorded on the dial indicator in operation (15) in the differential carrier bearing preload adjustment.

(4) Fit the special bridge piece on the clutch cover end dowels and with the fourth gear selected and rotating the




Special Tool in Position for Adjusting Carrier Bearing Pre-load with Drive Pinion Removed.

assembly by turning the main drive shaft, tighten the nuts securing both side covers to a torque of 14 ft/lb.

*NOTE: The carrier bearing preload is now correctly adjusted and any shims removed from one bearing cover to correct backlash adjustment must be transferred to the opposite side cover in order to maintain the preload adjustment.*

(5) Fit the pinion retaining bracket VW 381/11 on gear carrier end, using two existing studs, instal and tighten the two nuts finger tight.

(6) Fit a short plunger dial indicator and position the indicator gauge in the VW 381/9 holder bracket and secure with the knurled screw so that the end of the indicator clamping sleeve is flush with the face of the holder bracket.

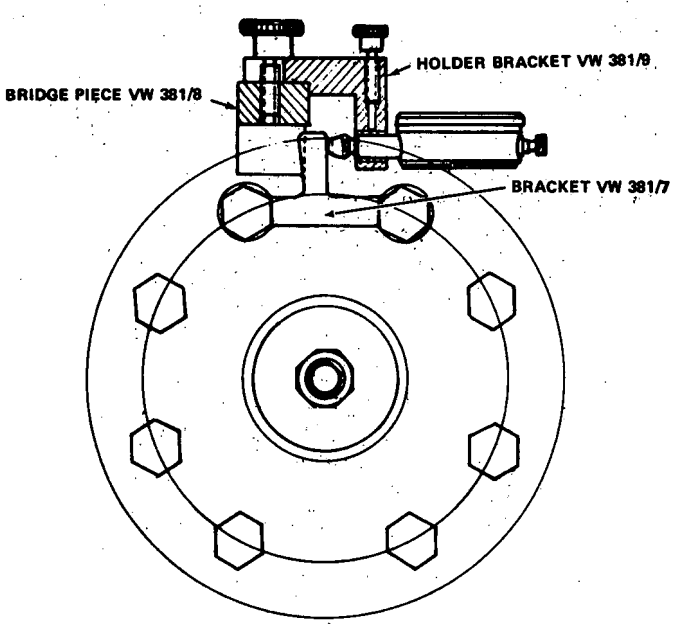
(7) Place the special bracket VW 381/7 on two of the ring gear securing bolts and press fully home.

(8) With the transmission in a vertical position with the gear carrier end down, slide the indicator holder bracket and indicator on to the bridge piece against the stop on the bracket and secure with the knurled screw.

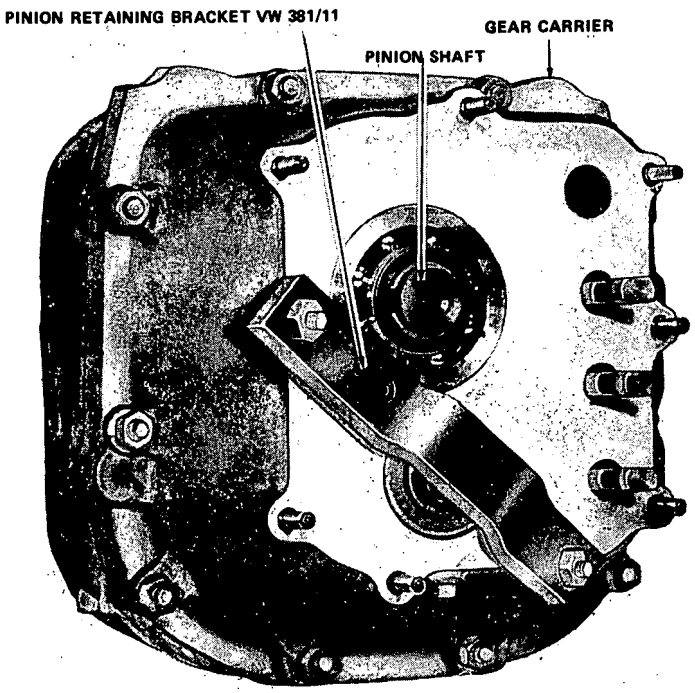
(9) Turn the ring gear and differential assembly so that the lug of the bracket VW 381/7 is vertical to the axis of the ring gear and in contact with the plunger on the dial indicator. In this position the indicator plunger should be loaded by approximately 1½mm.

(10) Tighten the nuts to secure the pinion retaining bracket on the gear carrier and prevent the pinion from rotating.

(11) Rotate the ring gear to stop against one side of the pinion teeth and, holding it in this position, set the dial indicator to zero.




**Diagrammatic View of Special Tools for Measuring Crownwheel Backlash.**




**Pinion Retaining Bracket Positioned on Forward End of Gear Carrier.**

(12) Turn the ring gear to the other side of the pinion teeth, through the gear backlash and record the backlash dimension on the indicator gauge.

(13) Using the above procedure, take three more backlash readings 90° apart around the ring gear, and record the readings.

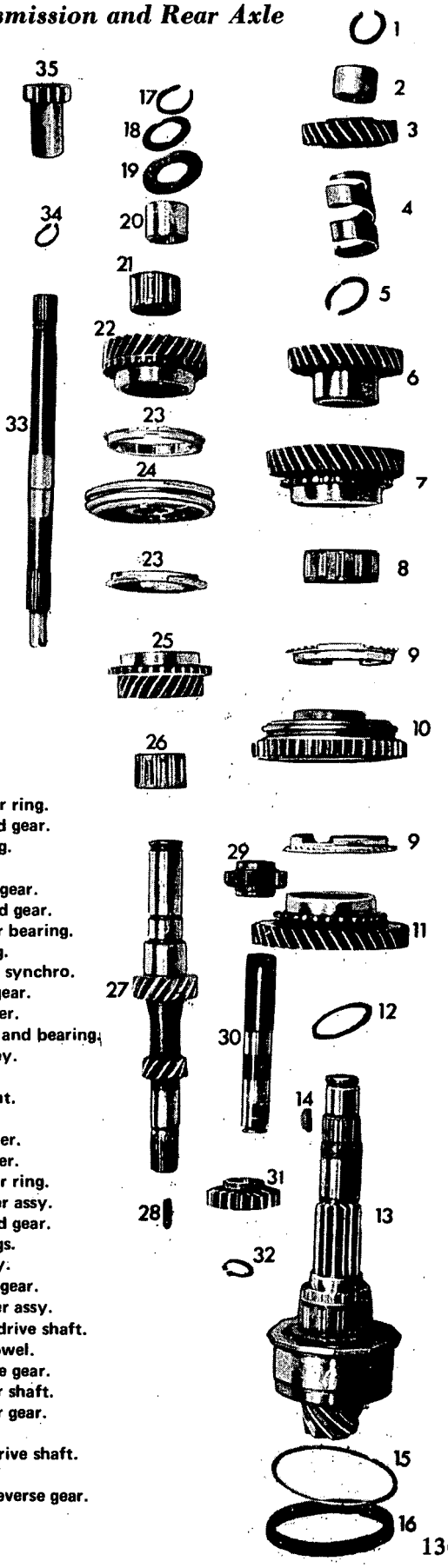
(14) Find a backlash average by adding the four readings together and dividing by four.

Example:

| | |
|---|---|
| 1st backlash reading | .55 mm |
| 2nd backlash reading | .53 mm |
| 3rd backlash reading | .54 mm |
| 4th backlash reading | .53 mm |
| | 2.15 mm |
| | 2.15 overall reading |
| | ÷4 |
| Average backlash | = .537 or 54 mm |

*NOTE: If a variation of more than .06mm exists between any two of the backlash readings taken in operation (13), the assembly should be removed and checked for dirt between the ring gear and mounting flange on the differential case. Check the run-out of the mounting flange and true up by taking a light cut across the face of the flange with the case mounted in a lathe.*

(15) In the above example shims will have to be



1. Circlip.
2. Bearing inner ring.
3. Fourth speed gear.
4. Spacer spring.
5. Circlip.
6. Third speed gear.
7. Second speed gear.
8. Needle roller bearing.
9. Synchro ring.
10. First/second synchro.
11. First speed gear.
12. Spacer washer.
13. Pinion shaft and bearing.
14. Woodruff key.
15. Pinion shim.
16. Retaining nut.
17. Circlip.
18. Dished washer.
19. Thrust washer.
20. Bearing inner ring.
21. Bearing roller assy.
22. Fourth speed gear.
23. Synchro rings.
24. Synchro assy.
25. Third speed gear.
26. Bearing roller assy.
27. Front main drive shaft.
28. Threaded dowel.
29. Reverse drive gear.
30. Reverse idler shaft.
31. Reverse idler gear.
32. Circlip.
33. Rear main drive shaft.
34. Circlip.
35. Main drive reverse gear.

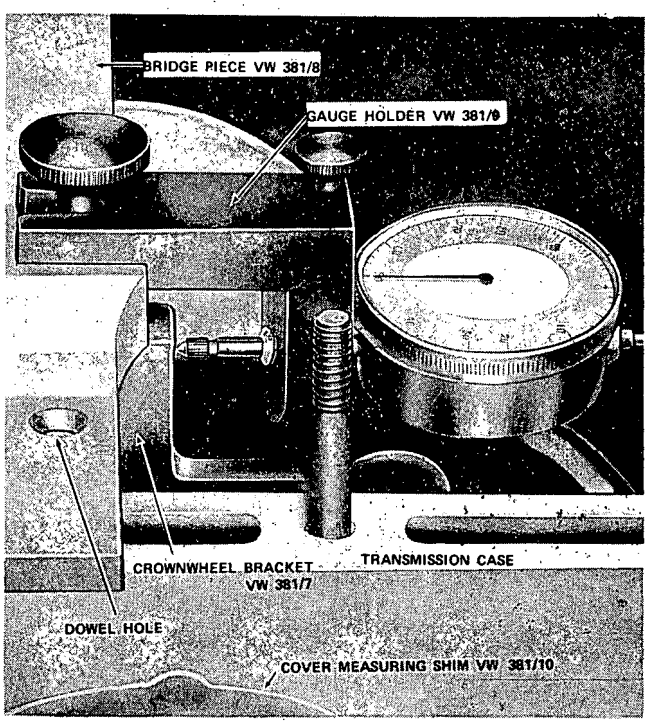
removed from the right hand side cover and transferred to the left hand side to reduce the backlash and maintain the carrier bearing preload. The specified backlash is .15mm (.006") to .25mm (.010").

(16) When a backlash setting is obtained within the specified tolerance, again take readings 90° apart and find the average as detailed in operations (13) and (14). The average setting must remain within the specified tolerance as in operation (15).

(17) When the final backlash adjustment is effected, loosen the side cover nuts and remove the bridge piece, dial indicator and bracket from the clutch cover face and remove the press bracket VW 381/7 from the rear face of the ring gear.

(18) Take off both side covers together with their separate shim pack, including the special measuring shim VW 381/10 on each side.

(19) Replace the special measuring shim in each pack with shims to the thickness of 1.30 mm in each case. Shims are available in the following thicknesses in mm: .10, .15, .20, .25, .40, .50, .60, .80 and 1.00. Use shims that are undamaged.




▲ Dial Indicator Mounted on Special Bridge Piece for Checking Crownwheel to Pinion Backlash.

◀ Internal Components of Transmission Case (Modified double row pinion bearing shown).

(20) Position each individual shim pack on the respective side cover studs and instal the side covers, tightening the nuts finger tight.

*NOTE: Ensure that each shim pack and side cover is fitted on the correct side and use new oil seals and O-rings.*

(21) Instal the bridge piece VW 381/8 on the end face dowels and tighten the side cover nuts to a torque of 14 ft/lb.

(22) Mark several of the ring gear teeth with a coating of engineer's blue on the contact faces.

(23) While restricting rotation of the ring gear, rotate the pinion in both directions, by engaging 4th gear and turning the main drive shaft so that the pinion will leave a pattern of tooth contact on both sides of the marked ring gear teeth.

(24) Check the tooth contact as in operation (23) at two or three positions around the ring gear and compare the contact markings. A satisfactory tooth marking should have the margin above and below the area of contact approximately equal and the margin of contact running approximately three quarters of the length of the tooth, with marking slightly closer to the toe of the ring gear tooth. Check the pattern of the tooth markings on both sides of the tooth.

(25) When the ring gear and pinion assembly has been satisfactorily adjusted, slacken the right hand side cover nuts and lift off the bridge piece VW 381/8.

*NOTE: The side cover nuts must be loosened to prevent the carrier bearing preload from expanding and distorting the transmission case with the clutch housing removed.*

(26) Instal the clutch housing on the open end of the transmission case and secure with spring washers and nuts. Tighten the nuts to 14 ft/lb.

(27) Tighten the right side cover securing nuts to 14 ft/lb and the transmission and rear axle assembly is ready for installation and further assembly of the drive shafts etc.

## 14. TRANSMISSION AND FINAL DRIVE MODIFICATIONS

### DESCRIPTION

The following modifications were incorporated in the 1969 Transporter models, commencing at chassis No. 219000001. The three retaining plates and studs used to secure the drive pinion double row roller bearing have been replaced by a retaining ring nut which screws on the rear threaded end of the bearing outer race and is locked by a lock plate attached to the gear case wall by a bolt.

The pinion positioning shim (S3) is located between the gear case wall and the flange on the forward end of the bearing outer race.

The differential case carrier bearings are located in the two threaded adjusting ring nuts screwed into the sides of the housing.

The carrier bearing preload and ring gear to pinion backlash are adjusted by the ring nuts and not by shims as previously. The ring nuts have an internal multi-hex by which they may be rotated using special tool VW 381/15.

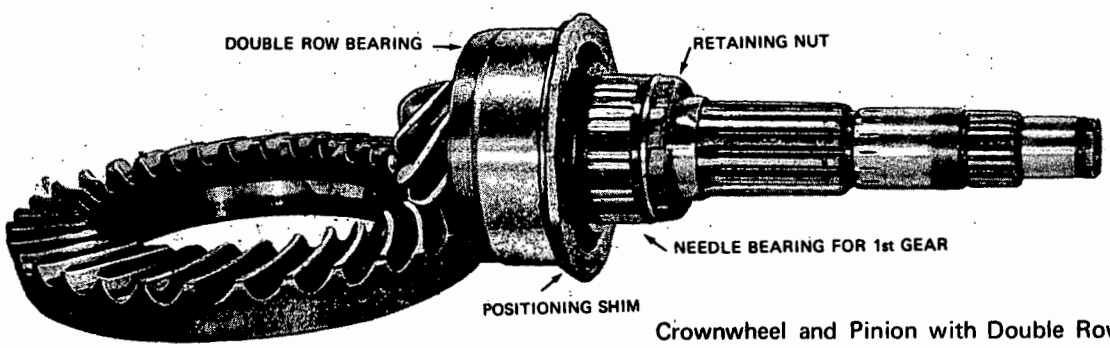
These modifications also change the procedure of the following operations in overhaul.

During removing and installing the transmission in the transmission case, shims S3, controlling the position of the pinion in relation to the ring gear axis, must be installed on the bearing outer race between the flange and the transmission case wall.

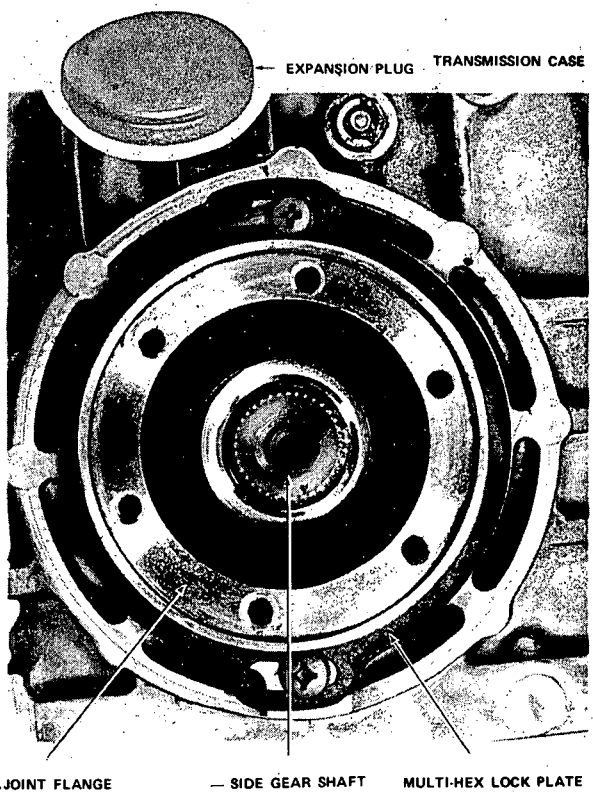
The threaded ring nut securing the bearing must be tightened to a torque of 160 ft/lb initially, then backed off and finally tightened to a torque of 108 ft/lb and secured with the small lock plate attached to the gear case wall.

*NOTE: Use care when installing the transmission in the case to ensure that the two flats on the shoulder of the bearing are correctly engaged with the two flats in the wall of the housing.*

If the shift forks are to be adjusted using special tool VW 294a, new spacer studs marked Type 2/69 must be used together with a special retaining ring nut for the




Crownwheel and Pinion with Double Row Bearing. (Later type assembly.)




Drive Shaft Flange with End Cap removed to Show End of Side Gear Shaft and Circlip.

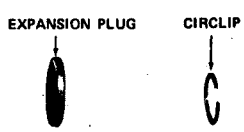
double row bearing. These parts are necessary to accomplish the adjustment with the new double row bearing and the relocated shim S3. A gasket between the gear carrier and the studs is unnecessary during the adjustment procedure. The ring nut must be tightened by hand with the shims S3 in position when adjusting the shift forks.

## TO REMOVE DIFFERENTIAL ASSEMBLY

(1) With the oil drained from the housing, pierce the plastic caps in the centre of each drive shaft flange and prise the caps off.

(2) Using suitable circlip pliers, remove the circlip securing each drive flange to the side gear shaft.

(3) Using suitable levers between the flange and the side of the housing, prise each flange off its shaft.




Screwed Type Carrier Bearing Ring Showing Lock Plate and Drive Shaft Flange.

(4) Take out the four Allen screws (2 each side) securing the lock plates in the adjuster rings and lift out the two plates.

*NOTE: If the nature of the repair being carried out does not require a new setting of the pinion position, ring gear backlash or bearing preload, mark the exact position of each carrier bearing adjuster ring and measure the depth to which each ring is screwed in, record the measurements and keep each ring to be installed in the same side, respectively.*

(5) Slacken off one side adjuster ring approximately one turn, take off the nuts and washers and remove the clutch housing from the end of the transmission housing.

(6) Remove the circlip from the rear half of the drive shaft, slide the reverse gear along the shaft splines and unscrew and remove the rear half of the main drive shaft.

(7) Unscrew and remove each side carrier bearing adjuster ring using special multi-hex tool VW 381/15 or similar tool.

(8) Manoeuvre the differential and ring gear assembly out of the transmission case. Remove the dished spacer washer from each side gear shaft.

(9) Press the oil seals out of the adjuster rings and remove and discard the O-ring from the groove in each adjuster ring.

## TO INSTAL DIFFERENTIAL ASSEMBLY

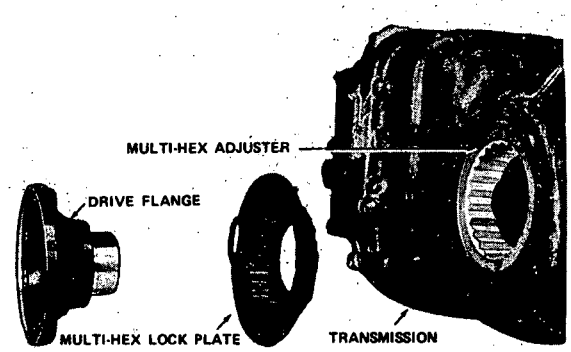
(1) Check all bearings and spacers and renew as necessary. Renew oil seals, O-rings and any gaskets that are fitted. Use genuine replacements at all times.

(2) Position the ring gear and differential case assembly in the transmission case with the ring gear to the left hand side.

(3) If the ring gear and differential carrier bearings do not require adjustment, fit each bearing retainer ring with oil seal and a new O-ring.

(4) Instal the left hand side retainer ring and screw it in to the correct depth and mark as noted on dismantling.

(5) Instal the right hand side retainer ring and screw it in lightly and just sufficiently to remove any end float in the bearings. Do not preload the bearings at this stage.



*NOTE: The threads of the retainers should be lightly coated with lithium base grease.*

(6) If removed, instal the reverse gear on the front end of the rear main drive shaft, screw the shaft onto the rear end of the front main drive shaft, back off the rear shaft by one spline and slide the reverse gear forward and instal a new circlip.

*NOTE: The teeth of the reverse gear must be to the forward end of the gear sleeve.*

(7) Using a new gasket, instal the clutch housing on the open end of the transmission case and secure with spring washers and nuts tightened to 14 ft/lb.

(8) With 4th gear engaged, rotate the ring gear and differential carrier bearings by turning the main drive shaft to properly seat the bearings at the same time tightening the right hand side retaining ring to the position as marked on dismantling. In this way the ring gear backlash and carrier bearing preload should be the same as before removing the ring gear and differential assembly.

*NOTE: Coat the machined and threaded faces of the retaining rings and the gear case with a suitable sealer to prevent corrosion of the exposed threads.*

(9) Instal the multi-hex locking plate in each retainer ring and secure each plate with two Philips screws.

(10) Instal the spacer washers and drive shaft flanges on the side gear shafts and fit new circlips.

*NOTE: If difficulty is experienced in seating the circlips in the groove in the shaft, use special bridge VW 201 with suitable stud to draw the flange down against the spacer washer.*

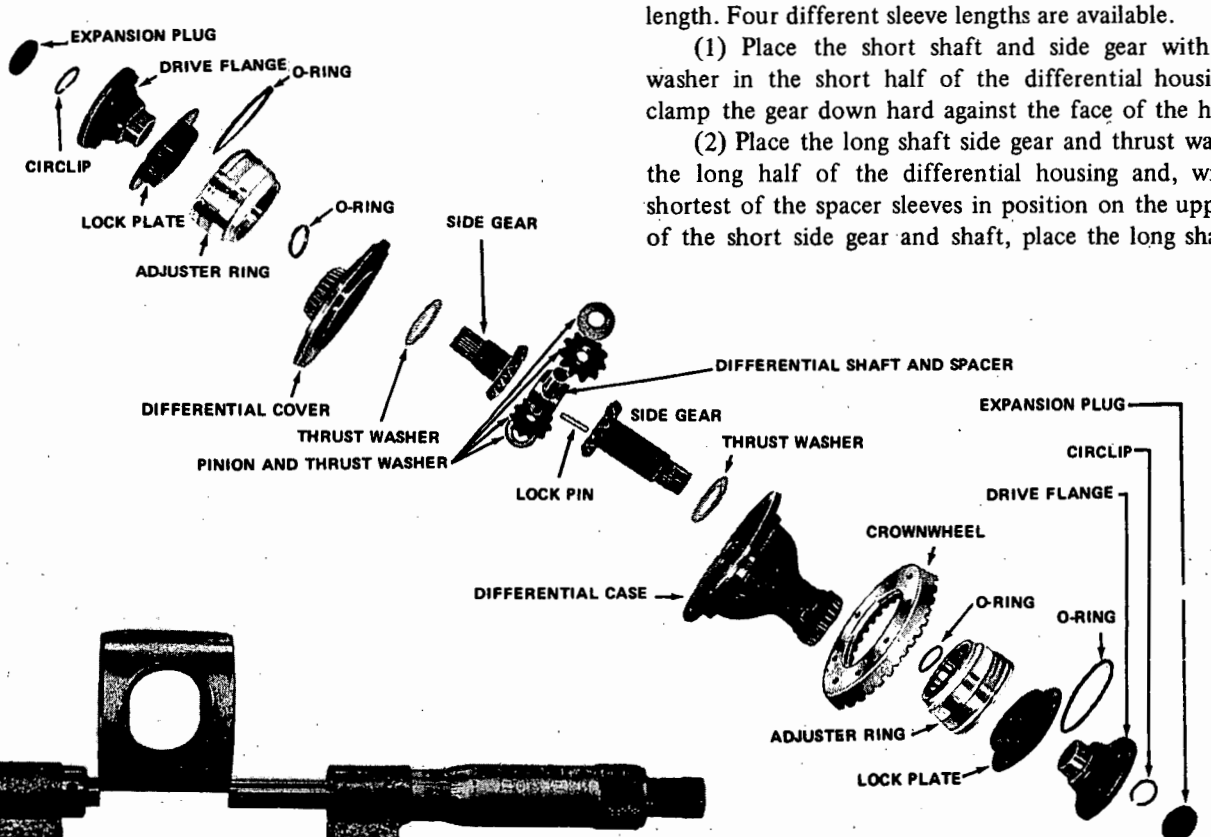
(11) Press new seal caps into the centre of the drive flanges.

## TO ADJUST DIFFERENTIAL SIDE GEAR END FLOAT

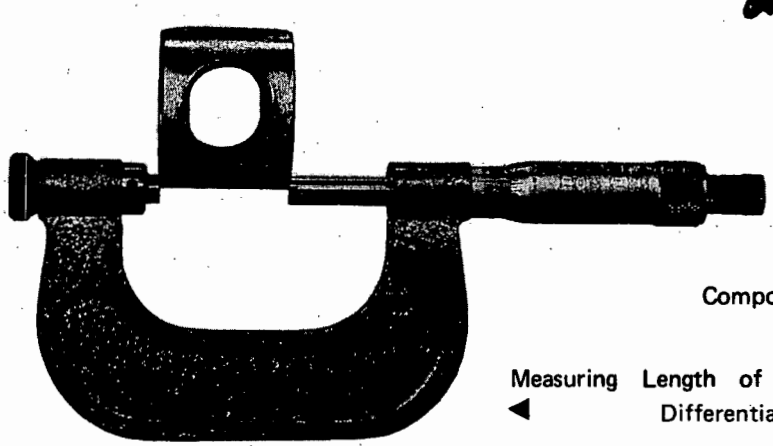
If any of the differential components are replaced, it is important that the side gear end float is correctly maintained, by installing a spacer sleeve of the correct length. Four different sleeve lengths are available.

(1) Place the short shaft and side gear with thrust washer in the short half of the differential housing and clamp the gear down hard against the face of the housing.

(2) Place the long shaft side gear and thrust washer in the long half of the differential housing and, with the shortest of the spacer sleeves in position on the upper face of the short side gear and shaft, place the long shaft side




▲ Components of Differential Case and Carrier Bearings with Screw Type Bearing Adjustment.



◀ Measuring Length of Spacer Sleeve when Adjusting Differential Side Gear End Float.

gear and half housing in position and bolt the two halves of the housing together.

(3) Using a dial indicator mounted on the end of the long side gear shaft with the indicator plunger contacting the end face of the differential housing, zero the indicator gauge.

(4) Raise the upper side gear and shaft as far as possible against the gear thrust washer and check the reading on the indicator gauge. This reading will denote the end float in the gears with the short spacer sleeve fitted. Record the end float.

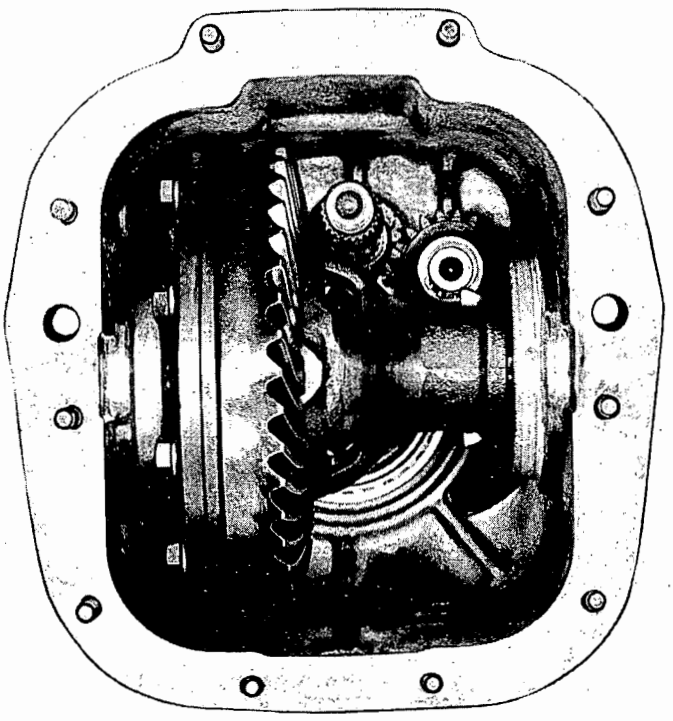
(5) Take out the bolts and remove the upper side gear and shaft and lift off the spacer sleeve. Measure the length of the sleeve, add the measured end float recorded in operation (4).

(6) Select a sleeve .05 mm less in length than the result of operation (5) and instal between the two side gears. This clearance of .05 mm is within the specified end float tolerance of 0 to .05 mm if the correct spacer sleeve is selected.

**TO ADJUST DRIVE PINION**

Adjusting the position of the drive pinion (Shim S3) is the same as that described for the previous model transmission except for the following modifications.

The pinion double row roller bearing is secured by tightening the threaded retainer ring nut first to a torque of 160 ft/lb, then backed off and finally tightened to a torque of 108 ft/lb.



Differential and Crownwheel Assembly in Position.

Screw in the left side carrier bearing adjuster until it is 1 mm below the surface of the housing, insert the setting mandrel through the hole for the right hand adjuster ring and screw in the right hand adjuster ring until the mandrel can just be turned by hand.

Using the dial indicator and measuring bar, measure and calculate the thickness of the pinion positioning shim S3 as described earlier for models with shim adjusted differential carrier bearings.

Calculating the thickness of the shim is somewhat different from that for the previous type double row roller bearing attachment.

This is due to the position of the positioning shim S3 being changed from the rear to the front of the transmission case wall. Use the special mandrel, gauge and setting pin as for the earlier type and work to the following example and formula: S3 = e + r.

Example:

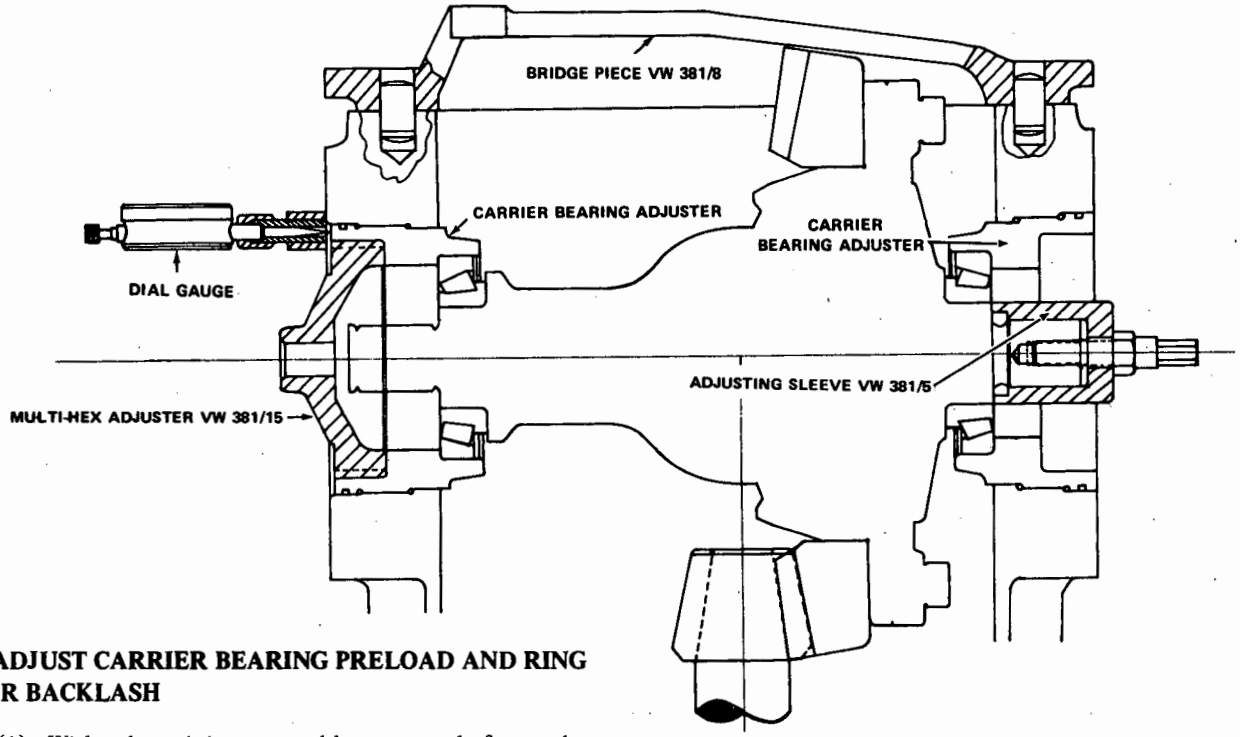
| | | |
|---|---|---|
| Length of setting pin, VW 381/6 | = | 83.00 mm |
| Subtract difference between pin and mandrel measurements (e) | = | .40 mm |
| Pinion dimension without shim S3 | = | 82.60 mm |
| Manufacturers pinion dimension (constant) | = | 63.00 mm |
| Add pinion head thickness variation (r) | = | .25 mm |
| Housing dimension | = | 63.25 mm |
| Add half diameter of mandrel cylinder | = | 20.00 mm |
| Nominal pinion dimension | = | 83.25 mm |
| Actual pinion dimension without shim S3 | = | 82.60 mm |
| Thickness of shim S3 | = | .65 mm |

Since 'e' represents the difference between the measurement taken on setting pin VW 381/6 and that on the highest point of the mandrel and 'r' represents pinion head variation from standard thickness, then:

S3 = e + r
= .40 + .25 mm
= .65 mm

Select shims from the range available for service and measure the thickness with a micrometer in several places.

With the shim S3 installed, recheck the setting, using the dial indicator, setting pin and mandrel as before. Set the indicator gauge to zero on the setting pin, move the measuring bar so that the indicator plunger is on the mandrel at the highest point. The reading obtained will represent the pinion head thickness variation 'r', and be within a tolerance of ± .04 mm if the setting is correct.




Diagrammatic View of Special Tools in Position for Adjusting Carrier Bearing Pre-load.

## TO ADJUST CARRIER BEARING PRELOAD AND RING GEAR BACKLASH

(1) With the pinion assembly removed from the transmission case, instal the differential and ring gear assembly in the case so that the ring gear will be on the left hand side.

(2) With the oil seals and O-rings removed from the bearing adjuster rings, ensure that the bearing outer races are pressed fully home in the adjuster rings.

(3) Fit the dial indicator with short plunger extension in the measuring bar and zero the gauge with the plunger loaded to 3 mm.

(4) Instal the left hand side adjuster ring on the ring gear side of the housing, and screw in until the face of the ring is approximately .15 mm below the upper surface of the case.

(5) Instal the right hand side adjuster ring and screw into position until all end float is removed from the differential bearings.

(6) Stand the transmission housing vertically with the open end to the top and fit the bridge piece VW 381/8 on the dowel pins.

(7) Fit the sleeve VW 381/5 on the left hand side end of the side gear shaft and lock with lock nut.

(8) Oil both roller bearings lightly with Hypoid gear oil while rotating the differential assembly in both directions alternately.

(9) Using a preload gauge to rotate the assembly, gradually tighten the right hand side adjuster ring until the correct bearing preload is obtained.

(10) Using the dial indicator as set on measuring bar VW 382/7 check the depth to which the adjuster rings are screwed in below the machined face of the housing on each side and record the measurements under S1 and S2. S1 is the side adjacent to, with S2 the side opposite to, the ring gear. Slacken the adjuster rings and remove the bridge piece VW 381/8.

(11) Remove the ring gear and differential assembly and instal the transmission gear assembly in the housing, using the pinion positioning shim as previously determined and tighten the pinion bearing retaining ring nut to the correct torque in two stages as previously described.

(12) Refit the ring gear and differential assembly with bearing adjuster rings set to the dimensions recorded in operations (9) and (10), and with the bridge piece VW 381/8 in position.

*NOTE: When the carrier bearing preload has been correctly adjusted, it is important in adjusting the ring gear to pinion backlash that if one adjuster ring is released to move the ring gear axially, the other adjuster ring must be tightened by exactly the same amount in order to maintain the correct bearing preload.*

(13) Ring gear to pinion backlash is adjusted using the same procedure as for the previous assembly except where shims were transposed from one side to the other in order to increase or reduce the backlash setting, the same effect is achieved by slackening one adjuster ring and tightening the other adjuster ring by the same amount.

(14) The backlash setting remains the same and must be within the tolerance of .15 to .25 mm.

(15) When the backlash adjustment is completed, loosen the right hand adjuster ring by a specific amount, remove the bridge piece and dial indicator, instal the clutch housing. Tighten the retaining bolts to 14 ft/lb and then retighten the right hand adjuster ring to its original position.

(16) Further assembly remains the same as for the previous type final drive, but do not omit to instal the adjuster ring multi-hex lock plates and secure each with the two Philips screws.

## 15. REAR WHEEL BEARINGS

### TO REMOVE

First slacken the rear wheel shaft castellated nuts, when the rear wheel bearings are to be dismantled.

*NOTE: Avoid slackening or tightening rear wheel axle nuts when a vehicle is raised on a lift as this practice can be the cause of accidents. It is always best to perform this operation when the vehicle is on the floor.*

(1) Remove the brake drum and detach the shock absorber from its lower mounting.

(2) Disconnect the brake fluid supply line and the handbrake cable.

*NOTE: Stamp identification marks on the wheel bearing housing and the spring plate at the top and bottom, before removing the bearing housing to facilitate correct positioning at the time of assembling.*

(3) Undo the mounting nuts and remove the complete drive shaft and the side cover constant velocity joints and cover the joints with plastic caps.

(4) Undo the nuts from the securing bolts of the bearing housing and the spring plate and remove the housing.

(5) Undo the mounting bolt of the diagonal control arm and remove the arm.

### TO INSTAL

Installation is a reversal of the removal procedure observing the following points:

(1) Check the diagonal control arm rubber bush for wear and if excessively worn, renew the complete arm since the bush is an integral part of the arm being vulcanised in position.

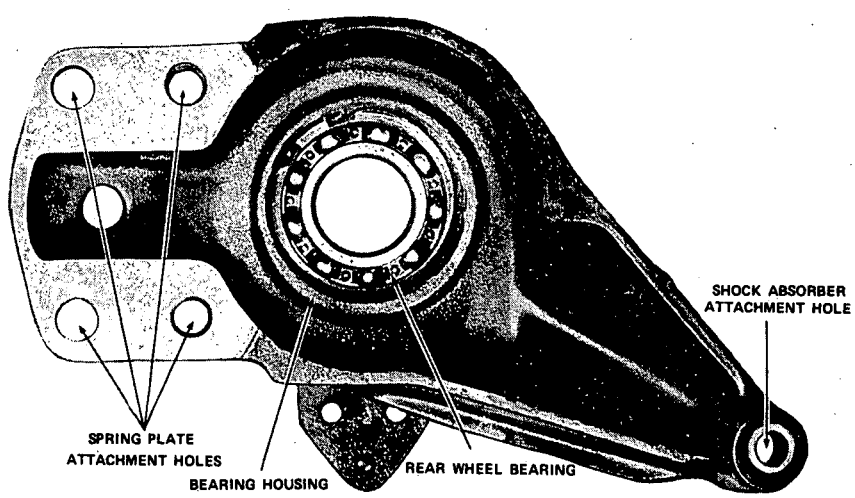
(2) Instal the control arm and secure the mounting bolt.

(3) Bolt together the control arm, spring plate and bearing housing and secure the nuts.

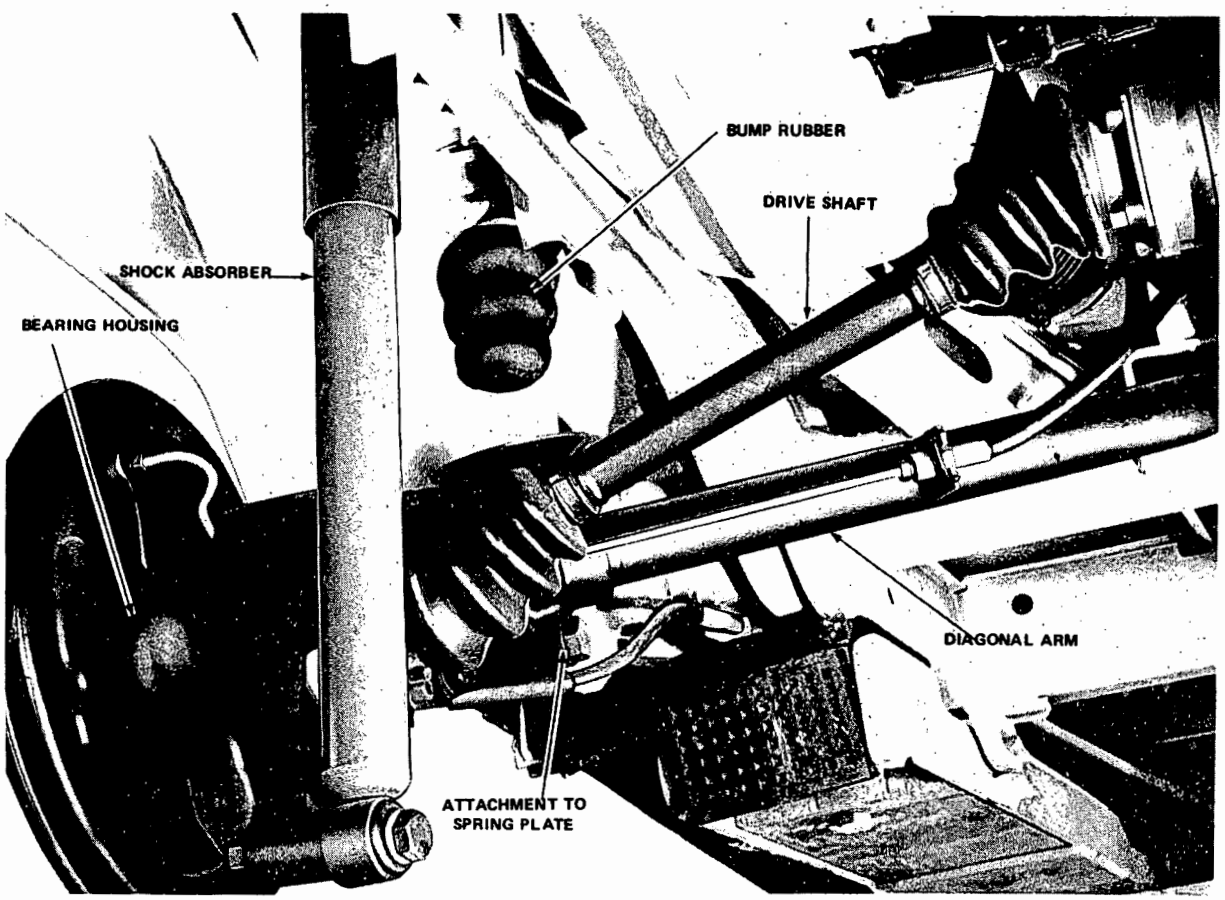
*NOTE: While bolting together the bearing housing and spring plate, first align the identification marks. In the event of replacing a spring plate, control arm or bearing housing, in the first instance, do not tighten the nuts fully. With the three components assembled together, using an axle alignment stand, check the position of the rear wheel and correct as required. Tighten the nuts fully.*

(4) Connect the brake fluid supply line and the handbrake cable. Instal the brake drums and secure. Bleed the hydraulic system and adjust the handbrake.

(5) Instal the drive shafts in position and secure with mounting bolts, tightening them diagonally. Ensure that the contact faces of the flanges are thoroughly clean and free




Rear Wheel Bearing Housing.




Open Type Drive Shaft and Bearing Housing Assembly.

from grease. Secure the shock absorber on its lower mounting.

## TO DISMANTLE

(1) Secure the bearing housing in the jaws of a vice.

*NOTE: It is possible to remove a wheel bearing without removing the bearing housing but it will be necessary to first take out the drive shaft.*

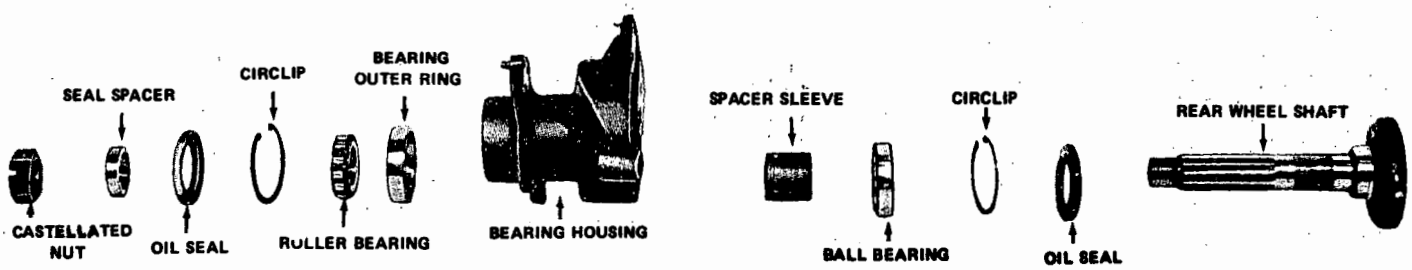
(2) Using a soft head hammer, knock out the rear wheel shaft and take out the spacer ring.

(3) Using a tyre lever or any other suitable tool, press out both the oil seals and take out the circlips.

(4) Extract the roller bearing inner ring and the distance sleeve.

(5) Using a suitable puller, pull out the ball bearing.

(6) Using a suitable drift, drive out the roller bearing outer ring.




Rear Wheel Axle Shaft and Bearing Housing Components.

**TO ASSEMBLE**

(1) Thoroughly clean all parts and check for wear or damage and renew if necessary.

(2) Pack the bearing housing with approximately 70 grams of lithium based grease.

(3) Using a suitable drift, drive the ball bearing into position.

(4) Insert the circlip and drift in the oil seal.

(5) Instal the roller bearing outer ring, spacer sleeve and roller bearing inner ring.

(6) Insert the outer circlip and, using a suitable drift, drive in the oil seal.

(7) From inside, drive in the rear wheel shaft and slide on the spacer ring.

(8) Instal the complete wheel bearing housing as previously described in the appropriate section.

## 16. FAULT DIAGNOSIS

**GEARBOX**

**1. Difficult gear change.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Bent or worn gear shift lever. | – Check and renew lever. |
| (b) | Faulty gear synchroniser mechanism. | – Overhaul gearbox. |
| (c) | Faulty clutch or clutch release bearing. | – Check and overhaul clutch and/or renew bearing. |
| (d) | Faulty clutch cable adjustment. | – Renew and/or adjust cable. |

**2. Gear clash on changing down.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Faulty clutch or clutch release mechanism. | – Overhaul and adjust. |
| (b) | Faulty synchroniser ring and clutch assemblies. | – Check and overhaul gearbox, renew components as required. |
| (c) | Broken or incorrect positioning of synchro retaining springs. | – Overhaul gearbox and renew components as required. |
| (d) | Faulty clutch cable adjustment. | – Check and adjust cable. |
| (e) | Gearbox lubricating oil too heavy. | – Drain gear case and rear axle assembly and refill with correct grade of oil. |

**3. Slipping out of gear, (1st and 2nd).**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Weak or broken selector shaft detent springs. | – Renew faulty components. |
| (b) | Worn pinion shaft sliding gear. | – Check and renew faulty components. |
| (c) | Excessive end float of pinion shaft gears. | – Check and renew faulty thrust washer and shims. |
| (d) | Worn main drive or pinion shaft bearings. | – Check and renew worn bearings. |
| (e) | Incorrectly adjusted gear shift mechanism. | – Check and re-adjust as required. |

**4. Slipping out of gear, (3rd and/or top).**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Weak or broken selector shaft detent springs. | – Check and renew faulty components. |
| (b) | Worn synchro teeth on 3rd or top speed sleeve. | – Check and renew worn components. |
| (c) | Excessive end float of main drive shaft gears. | – Check and renew thrust washers. |
| (d) | Worn bearings on main drive gear and pinion shafts. | – Check and renew worn bearings. |
| (e) | Incorrectly adjusted gear shift mechanism. | – Check and re-adjust as required. |

5. **Gearbox noise, (in neutral).**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Worn main drive shaft bearings. | – Overhaul and renew bearings. |
| (b) | Worn constant mesh gear needle roller bearings or bushes. | – Overhaul and renew components as necessary. |
| (c) | Excessive main drive shaft end float. | – Overhaul and renew thrust washers. |
| (d) | Lack of sufficient lubricant. | – Drain gear case and rear axle assembly and refill with correct grade of oil. |

6. **Gearbox noise, (forward gears engaged).**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Worn main drive shaft or pinion shaft bearings. | – Overhaul and renew bearings. |
| (b) | Chipped or pitted constant mesh gears. | – Overhaul and renew components as necessary. |
| (c) | Excessive main drive shaft or pinion shaft end float. | – Check and renew thrust washers. |
| (d) | Chipped or pitted reverse idler gear. | – Overhaul and renew components as required. |
| (e) | Lack of sufficient lubricant. | – Drain gear case and rear axle assembly and refill with correct grade of oil. |

**REAR AXLE**

1. **Rear wheel noise.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Wheel hub loose on axle shaft. | – Check condition of axle and hub and tighten or renew components. |
| (b) | Loose or faulty brake components. | – Check and renew faulty components. |
| (c) | Worn or faulty axle shaft bearing. | – Check and renew bearing. |
| (d) | Bent axle tube or shaft. | – Renew faulty components. |
| (e) | Wheel unbalance or bent. | – Check and renew or balance wheel. |

2. **Final drive gear noise.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Faulty pinion bearings. | – Renew pinion bearings and re-adjust gears. |
| (b) | Faulty differential carrier bearings. | – Renew carrier bearings and re-adjust gears. |
| (c) | Lack of sufficient lubricant. | – Check condition of assembly, flush and renew lubricant. |
| (d) | Incorrectly adjusted ring gear and pinion. | – Check condition of gears and re-adjust or renew as mated pair. |
| (e) | Incorrectly adjusted bearing pre-load, (pinion or carrier bearings). | – Check condition of assembly, adjust bearing pre-load or renew faulty components. |
| (f) | Excessive noise or grind under load. | – Overhaul assembly and renew faulty components. |
| (g) | Excessive noise or grind on overdrive. | – Overhaul assembly and renew faulty components. |
| (h) | Excessive noise on coast. | – Faulty final drive gears and adjustment. Renew and adjust. |
| (i) | Bent axle tube/s. | – Renew axle tube/s and faulty components. |

3. **Excessive backlash in differential.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Looseness between axle shafts and differential side gears. | – Check and renew axle shafts and/or side gears and fulcrum plates. |
| (b) | Worn differential side gears. | – Check and renew differential side gears and/or thrust washers. |

| | | |
|---|---|---|
| (c) | Worn differential pinions. | – Check and renew differential pinions. |
| (d) | Excessive backlash between differential side gears and pinions. | – Check condition of gear and pinion teeth and renew as necessary. |
| (e) | Excessive wear between differential shaft and pinions and/or shaft bore in carrier housing. | – Check and renew faulty components. |

4. **Noise in an axle tube but no drive at rear wheels (Earlier Models).**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Broken axle shaft. | – Check and renew axle shaft. |

5. **Repeated axle shaft breakage (Earlier Models).**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Bent axle tube/s. | – Check and renew axle tube/s. |
| (b) | Repeated over-loading. | – Revise load capacity. |
| (c) | Abnormal clutch operation. | – Revise driving habits and check condition of clutch. |
| (d) | Incorrectly torqued axle shaft hub retaining nut. | – Tighten axle shaft nut to specified torque. |

6. **Loss of rear axle lubricant.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Faulty axle shaft oil seals. | – Check and renew oil seals. |
| (b) | Leaking seals at inner end of axle tubes where applicable. | – Renew faulty seals. |
| (c) | Incorrect type of lubricant causing excessive foaming. | – Drain, flush and refill with recommended lubricant. |

# STEERING

## SPECIFICATIONS

| | |
|---|---|
| Type (all models) | Ross type worm and peg with drag link and intermediate lever and arm |
| Ratio | 15.1:1 |
| Turns, lock to lock | 2.8 |
| Lubricant | SAE 90 EP |
| Capacity | .44 Imp pt |

**TORQUE WRENCH SETTING**

| | |
|---|---|
| Steering wheel nut | 20 ft/lb |
| Steering case bracket | 25 ft/lb (early models) |
| Steering case bracket | 30 ft/lb (later models) |
| Pitman arm on lever shaft | 70 ft/lb |
| Ball joint on steering knuckle | 65 ft/lb |
| Tie rod on steering knuckle and swing lever | 20 ft/lb |
| Shock absorber, upper attachment | 35 ft/lb |
| Shock absorber, lower attachment | 20 ft/lb |
| Swing lever on shaft | 45 ft/lb |
| Locknut for grub screw | 25 ft/lb |
| Steering connecting rod on swing lever and pitman arm | 20 ft/lb |

## 1. DESCRIPTION

All models of the Type 2 range are equipped with the worm and peg steering.

On the early models the steering gear housing and the steering column are of one assembly but in the later models the housing and the column are two separate units joined together by a flexible coupling with a rubberised flexible disc.

On the early models the steering gear housing is mounted on a special chassis frame member by means of a gear case bracket whereas in the later models the steering gear housing is directly mounted on the chassis side member. The steering column tube is secured to the floor plate and the dash board.

The steering wheel, through the column and coupling, moves the worm which rotates inside the gear case in two ball thrust bearings, one each end of the worm. The peg is an integral part of a stud which is mounted on tapered rollers in an arm at the upper end of the sector shaft. The peg rolls in the groove of the worm and thereby transfers the movement to the pitman arm. Between the pitman arm and wheels are the steering connecting rod, swing lever and the tie-rods.

The peg mounted on tapered roller bearings and referred to above, was a two piece component in the early models but is now one piece.

## 2. LUBRICATION AND MAINTENANCE

To obtain the best performance of the steering, periodically check adjustments in the steering mechanism and ensure that backlash is removed but adjustment should not prevent self-centering of the steering after negotiating a turn. Correct steering adjustment, apart from being easier for the driver, will prolong the life of the components.

It is good policy to check the wheel alignment at regular intervals and more so if the front end of the vehicle has been involved in any accident.

To facilitate checking and adjustment of the steering, it is necessary to raise the front of the vehicle until the wheels are clear of the floor. Rotate the steering wheel from left lock to right lock and vice versa several times, thereby passing through the central position which should be discernible to the feel. This does not mean that it should tighten at this point but should smoothly glide through.

Front wheel alignment must be checked at regular intervals and setting be done as indicated under *TO ADJUST – TOE IN.*

On all models the recommended lubricating oil to use in the gear case housing is straight SAE 90 gear oil and in no case should any other type of oil or grease be used.

The oil filler plug for the steering gear housing is accessible from below the vehicle and the correct level for the oil is to the bottom of the oil filler hole so that the oil does not spill over.

In addition to the gear housing, all steering linkages should be regularly lubricated.

## 3. STEERING WHEEL

**TO REMOVE (All Models)**

(1) Prise the horn button, disconnect the horn wire and remove the horn button.

(2) Remove the trafficator switch.

(3) Slacken the steering wheel securing nut sufficiently so that the upper face of the nut is just above the top end of the column.

(4) Undo the direction indicator switch cancelling ring (later models only).

(5) Using a suitable puller withdraw the steering wheel and ensure that the end of the puller is seated on the nut and not on the column end.

*NOTE: To remove steering wheels from vehicles fitted with flashing type trafficators, a special puller is required to clear the projection on the trafficator switch flange.*

**TO INSTAL (All Models)**

Installation is a reversal of the removal procedure, taking special note of the following points:

(1) The Woodruff key must fit snugly in the keyway in the steering column and steering wheel but if it is worn, it must be renewed.

(2) The correct position of the steering wheel with the front wheels straight ahead, is for the wheel spokes to be in the horizontal position.

(3) Tighten the securing nut of the steering wheel to a torque of 20 ft/lb.

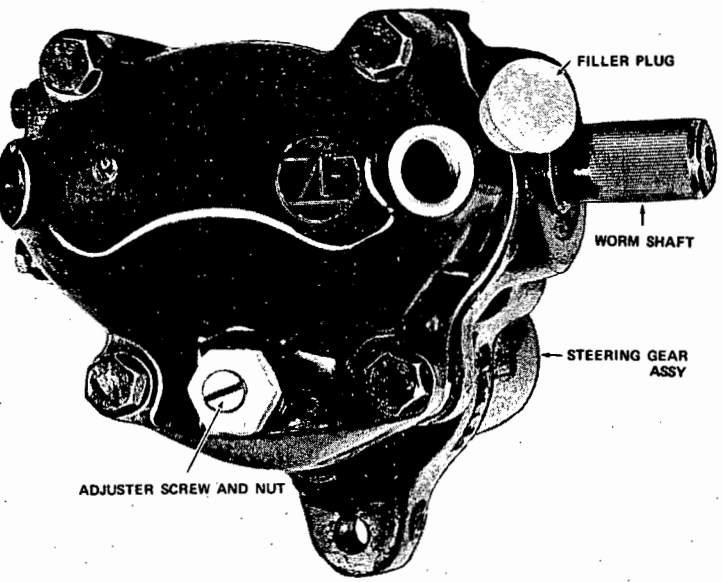
## 4. STEERING GEAR

**TO REMOVE (Early Models)**

(1) Prise out the horn button and detach the trafficator switch.

(2) Slacken the steering wheel securing nut sufficiently so that the upper face of the nut is just above the top end of the column. Fix a suitable puller, withdraw the steering wheel and ensure that the end of the puller screw seats on the nut.

(3) Slacken the screws of the tube rubber bush retainers.




Steering Box Assembly Showing Lever Shaft End Float Adjusting Screw and Lock Nut.

(4) Undo the screw from the steering column floor plate mounting.

(5) Raise the front of the vehicle and support on stands.

(6) From below the pedal cluster remove the cover plate.

(7) Extract the split pin and undo the castellated nut from the steering connecting rod balljoint. Using a suitable tool, disconnect the steering connecting rod balljoint from the pitman arm.

(8) Slacken the horn wire clip on the adjuster flange of the steering gear housing and withdraw the wire.

(9) From the side of the steering gear case mounting bracket, remove the three securing bolts.

(10) Similarly from below the mounting bracket, undo the two securing bolts and remove the steering gear case from below and at the same time, slide the tube rubber bush retainer off the column tube.

**TO INSTAL (Early Models)**

Installation is a reversal of the removal procedure with special reference to the following points:

(1) Check and top up oil level in the gear case.

(2) From below, push the steering column up into position and while doing so, slide on the floor cover plate and rubber seal and also the tube rubber bush retainer.

(3) With the steering case bracket positioned, insert the mounting bolts and tighten to a torque of 25 ft/lb.

In case the steering column has not been correctly positioned, slacken the mounting bracket pinch bolts and turn the steering gear in the bracket until the column is in

the correct position, then tighten the pinch bolts.

The parcel shelf bracket has slotted holes for side-wise adjustment if necessary to a position free of tension.

*NOTE: The pinch bolts in the steering gear casing bracket must always be tightened before attempting to secure the upper end of the steering column assembly.*

It is most essential that the above mentioned items are given due attention to prevent serious trouble developing later, even to the extent of fracture of the steering column.

(4) Position the pitman arm on the pitman shaft and secure with the castellated nut tightened to a torque of 70 ft/lb. Fit split pin.

(5) Check and adjust the length of the steering connecting rod, if necessary.

(6) Connect steering connecting rod ball nut to pitman arm and secure with castellated nut. Fit split pin.

(7) Insert the horn wire, position the clip and tighten the securing bolts and lock the heads with the outer ends of the clip.

(8) Tighten the steering wheel securing nut to a torque of 20 ft/lb and instal horn button.

**TO REMOVE (Later Models)**

(1) Undo the securing screws and remove trafficator switch.

(2) Remove the securing screws from the cover plate below the pedal cluster.

(3) Using a special tool, disconnect the steering connecting rod from the pitman arm.

(4) Using a puller, detach the pitman arm from the pitman shaft.

(5) Undo and remove the securing screw from the flange on the steering coupling.

(6) Undo the four bolts mounting the steering gear on the frame side member and remove the steering gear from the vehicle.

**TO INSTAL (Later Models)**

(1) Position the steering gear on the frame side member mounting and insert mounting bolts, tightening them to a torque of 25 ft/lb.

(2) Instal the pitman arm on the pitman shaft, fit castellated nut and tighten to a torque of 70 ft/lb. Insert the split pin.

(3) Connect the steering connecting rod to the pitman arm, fit the castellated nut and insert the split pin.

(4) Position the front wheels straight ahead and place the steering coupling flange on the shaft. The steering wheel spokes should be in the horizontal position and in this position, the tab on the cancelling ring must be on the left side. Secure the coupling flange with bolt and lock it with a new lock washer.

(5) Secure the trafficator switch, checking that the space between wheel hub and switch is approximately .012".

(6) Position the cover plate below the pedal cluster and secure with screws.

**TO DISMANTLE (Early Models)**

(1) Turn down the ends of the cable clip from the two top bolts on the adjuster plate and undo the bolts. Undo the two lower bolts and spring washers and remove the plate.

(2) Undo the four bolts from the gear housing cover and take off the cover.

(3) Lift out the pitman shaft and peg assembly.

(4) Extract the Woodruff key from the steering column and take off the spring and expanding ring.

(5) Instal the steering wheel nut on the column and screw it on until the top face of the nut is just above the top end of the column.

(6) Using a soft head hammer, tap lightly on the column and remove it from below.

(7) Remove the retaining ring and ball bearing from the upper end of the column jacket and from each end of the shaft worm.

**TO ASSEMBLE (Early Models)**

Assembly is a reversal of the dismantling procedure but the following points should be observed:

(1) Check the condition of the steering worm for wear or damage and, if necessary, renew the steering column.

(2) Check the condition of the lower and upper ball cups and tracks for wear on the ends of the steering shaft worm and if necessary renew the balls and cups.

*NOTE: There are fourteen balls in each set which should only be renewed as sets.*

(3) On each end of the steering worm, a light smear of grease should be applied to the ball tracks to hold the balls in position. Before installing the ball cups, ensure that the correct number of balls have been positioned in the track and then position the cups.

(4) Place the retaining ring on each cup and ensure that it is correctly seated in the groove in the steering worm shaft.

(5) Check condition of the pitman shaft for wear and, if necessary, replace with new shaft assembly. The shaft bushes should be renewed.

(6) Check the condition of the ball bearing located towards the upper end of the column jacket after

dismantling and cleaning. In case there are signs of wear or pitting, the bearing should be renewed.

(7) Instal the ball bearing in the steering column jacket.

(8) From below push the steering worm shaft up and through the gear housing as far as the bearing in the jacket and then carefully manoeuvre it through the bearing and apply a few taps to seat it in the case.

(9) From the top and on to the steering worm shaft, position the expanding ring and spring and insert the Woodruff key in the shaft keyway.

(10) Check the pitman shaft taper roller bearing adjustment and, if necessary, adjust if the wear is not within limits.

The adjustment of the bearing is to be considered correct when a slight drag can be felt while turning the stud. In case the drag is excessive, lightly tap the stud at both ends to seat the rollers but if this method fails to correct the adjustment or if there is no drag while turning the stud, readjustment is necessary.

(11) Instal the gear housing cover with a new gasket.

(12) Instal the adjuster plate and shims and tighten the four bolts.

(13) Adjust and check the steering.

(14) Turn up the ends of the cable clip and lock the two bolts in the adjuster plate.

*NOTE: Use SAE 90 gear oil in steering gear case.*

**TO DISMANTLE (Later Models)**

(1) Unscrew the four securing bolts from the gear case cover and remove cover.

(2) Lift out the pitman shaft from the case.

(3) Unscrew the four securing bolts from the end adjusting plate on the gear case.

(4) Remove the adjusting plate with shims.

(5) Using a soft head hammer, tap out the steering worm and bearings complete from the gear case through the adjusting plate end of the case.

**TO CHECK AND INSPECT**

(1) Check the lever shaft and peg assembly for wear and if necessary, renew as an assembly.

(2) Check the sealing surfaces of the gear case cover and the adjusting plate for any burrs or other damage and rectify.

(3) Check the peg tracks in the steering worm and replace if necessary.

(4) Renew the oil seals for the steering shaft and steering worm.

(5) Thoroughly clean the gear case.

**TO ASSEMBLE (Later Models)**

(1) Instal the steering worm shaft from the lower end of the case with spline end of the worm shaft foremost.

(2) Position the shims and instal the adjusting plate on the lower end of the gear case after coating the sealing surface with sealing compound, and secure with the four bolts.

(3) Instal the pitman shaft and, after applying sealing compound to the sealing surface, fit the steering gear case cover and secure with the four bolts.

(4) Instal new pitman shaft and steering worm oil seals in the gear case.

## 5. PITMAN SHAFT

**TO DISMANTLE (Early Models)**

(1) Hold the tapered end of the peg in a vice with protected jaws so that the peg nut will be uppermost.

(2) Release the lock washer, remove the nut and take off the washer.

(3) Release the assembly from the vice, tap lightly on the threaded end of the peg stud to remove the stud and tapered rollers from the pitman shaft.

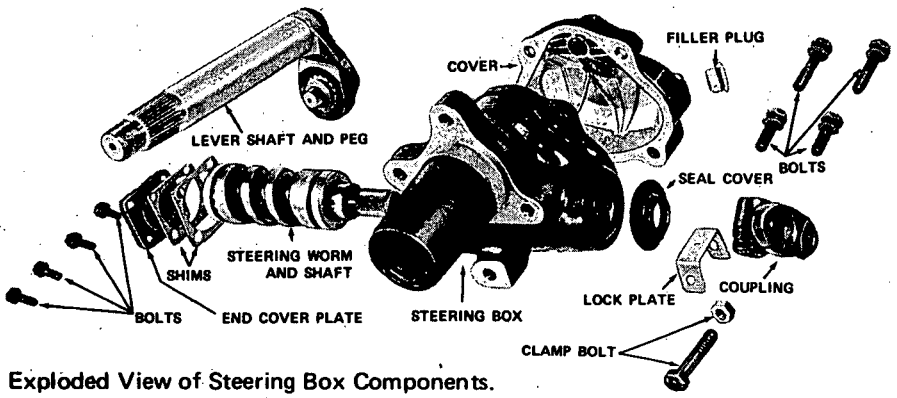
*NOTE: There are sixteen rollers in each bearing. Keep each set of rollers intact and do not mix the rollers between bearings.*

**TO ASSEMBLE (Early Models)**

(1) Wash all components in cleaning solvent and allow to dry. Inspect for wear or pitting of the rollers and bearing races.

(2) Smear some ball bearing grease on the tapered faces of the peg stud and arm of the pitman shaft and place one set of rollers in position on the cone and peg stud. Insert the threaded end of the stud through the arm of the pitman shaft from the shaft side of the arm.

(3) Place the other set of rollers in position from the top and instal the upper cone.




Exploded View of Steering Box Components.

(4) Instal the lock washer and nut, adjust the peg bearings as described and lock the nut by bending up the tag on the lock washer.

**TO ADJUST PEG BEARINGS (Early Models)**

(1) Clamp the cylindrical portion of the peg in a vice keeping the threaded end to the top.

(2) Tighten the nut at the top gradually so that by turning the peg, a slight drag can be felt.

(3) The method to check the adjustment is to apply light taps on the ends of the peg, and at the same time, tightening or slackening the nut to get the correct setting. If a new bearing is fitted the drag should be a little more than if a used one is being refitted.

(4) With the bearing adjustment set, bend up two of the tabs on the lock washer which should be diametrically opposite one another. It is always best to instal a new lock washer but in case an old one is being refitted, tabs which have once been bent, should be broken off.

**TO DISMANTLE (Later Models)**

(1) Clamp the lever shaft in a vice as indicated under *EARLY MODELS item (1).*

(2) Bend down the lock washer tab and remove the nut, lock washer, plain washer, spring washer and the special washer.

(3) Remove the outer rollers first by inverting the pitman shaft with the spline end up and turning the peg. By reversing the shaft, remove the peg with the remaining rollers being careful not to lose any of the rollers. Each set comprises sixteen rollers.

**TO ASSEMBLE (Later Models)**

(1) Wash all the dismantled parts with petrol and allow them to dry.

(2) Check the pitman shaft and peg for wear and replace if necessary.

(3) Check rollers for pitting or damage and replace, if necessary. Replacement of rollers must not be done individually but in full sets.

(4) Clamp the pitman shaft in a vice with the spline end down.

(5) Smear the tapered portions of the peg with ball bearing grease, and, keeping the collar end of the peg below, position sixteen rollers on the tapered portion abutting the collar and insert the peg with rollers in the pitman shaft arm. While supporting the peg in the arm, position the remaining sixteen rollers on the other tapered portion of the peg while turning the peg.

*NOTE: Rollers must always be positioned with the smaller diameters opposing each other on the peg.*

(6) From the threaded end of the peg, first position the special washer with the shoulder towards the rollers. Then position the spring washer, plain washer, lock washer and secure them with the nut. Tighten nut to a torque of 21 in/lb. The pre-load on the taper roller bearing must be 1.68 in/lb.

(7) Lock the hexagonal nut by bending up two of the lock washer tabs which are diametrically opposite one another.

(8) Instal the steering peg positioning it at an angle of 90° with the steering worm.

**TO ADJUST PEG BEARINGS (Later Models)**

(1) With the pitman shaft assembled, clamp the cylindrical portion of the peg in a soft jaw vice with the threaded end of the peg to the top. Tighten the hexagonal nut to a torque of 21 in/lb.

(2) Using a suitable tool, check the bearing pre-load which should be 1.68 in/lb. In case of any variation, correct by tightening or slackening the nut at the top of the peg.

(3) After completing the bearing adjustment, bend up two of the tabs on the lock washer diametrically opposite one another and lock the bolt.

## 6. STEERING GEAR CASE MOUNTING BRACKET (EARLY MODELS ONLY)

**TO REMOVE**

(1) Punch identification marks on the steering gear case and mounting bracket to obtain correct positioning at the time of installing.

(2) Undo the lock plates and remove the two pinch bolts from the mounting bracket.

(3) Remove the mounting bracket from the steering gear case.

**TO INSTAL**

Installation is a reversal of the removal procedure but the undermentioned points must be observed:

(1) Mount the bracket, lining up the identification marks punched at the time of removal.

(2) With a soft head hammer, drive the mounting bracket into position on the gear case until it abuts the case.

(3) Instal new lock plates and tighten the bolts to a torque of 28 ft/lb. The recommended torque setting must be adhered to while tightening the bolts to prevent the steering becoming stiff, otherwise the bushes may become seized on the pitman shaft.

## 7. GEAR CASE PITMAN SHAFT BUSHES

**TO REMOVE (Early Models)**

(1) Using two hooks, with one of them, lift the sealing lip of the seal and with the second hook extract the spring. With the spring removed, push out the seal with any suitable tool.

(2) Between the lever shaft bush seats, within the gear case, is a small shoulder separating the bush seats. The outer bush should be driven outwards and the inner bush driven inwards with a suitable tubular drift.

**TO INSTAL (Early Models)**

(1) Using a special tool and a press, press the bushes into position within the gear case.

(2) Using an adjustable reamer of .9842" diameter, ream out the bushes to a diameter of .99921" –1.00004".

(3) Insert the spring in the oil seal and instal the seal and check whether it is seating correctly. If not, renew the seal.

(4) Carefully press the lip of the seal outwards when installing the lever shaft to prevent the splines on the shaft causing damage to the seal.

## 8. STEERING CONNECTING ROD AND PITMAN ARM

**TO REMOVE (All Models)**

(1) Using a jack raise the vehicle off the floor and support on stands.

(2) From below the pedal cluster, remove the cover plate.

(3) Extract the split pins from the castellated nuts and undo the nuts from the tie-rod ends.

(4) Using a special tool, detach the tie-rod ends from their mountings on the pitman arm and intermediate swing lever.

(5) Extract the split pin from the castellated nut on the pitman arm mounting on the pitman shaft and undo the nut.

(6) Using a puller, disconnect the pitman arm from the shaft.

**TO INSTAL (All Models)**

Installation is a reversal of the removal procedure, with special reference to the following points:

(1) Carefully check the splines on the pitman shaft and arm to ensure that there is no wear or damage.

(2) While installing the pitman arm on the shaft, ensure that the identification marks are correctly aligned.

(3) The securing nut should be tightened to a torque of 72 ft/lb and insert the split pin to lock the castellated nut.

*NOTE: When installing the pitman arm on the pitman shaft, never hammer it into position.*

(4) Carefully check the condition of the tie-rod ball joints and also whether the threads are damaged on the ball

studs. If the removable end is only in bad condition, it should be removed from the rod and replaced.

(5) Check all rubber dust excluders and grease nipples and replace where necessary.

### TO ADJUST STEERING CONNECTING ROD

(1) Position the front wheels in the straight ahead position and also centre the steering gear position. It should be possible to insert the tie-rod end ball studs in the intermediate swing lever and pitman arm without disturbing the position of the steering gear or the front wheels. In the event of the length of the steering connecting rod being incorrect, the length can be corrected as follows:

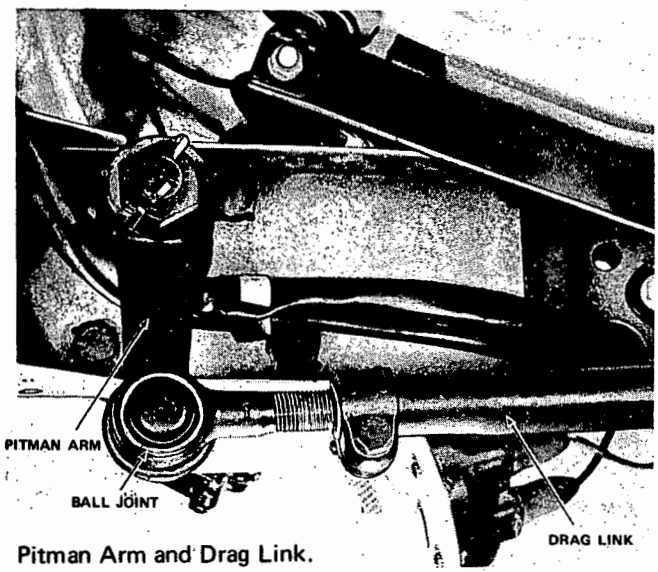
Early Models – Slacken the clamp bolt on the adjustable tie-rod end and screw the end in or out to obtain the desired length.

Later Models – Slacken both tie-rod end clamp bolts and turn the steering connecting rod to increase or decrease the length as required.

(2) When the adjustment is completed tighten the adjustable tie-rod end clamp bolt or bolts.

(3) Tighten the castellated nuts on the tie-rod end ball studs connected to the pitman arm and intermediate swing lever. Insert split pins.

(4) Raise the vehicle, remove the support stands and lower to the floor.



Pitman Arm and Drag Link.

## 9. STEERING GEAR ADJUSTMENT

### TO ADJUST WORM SHAFT END PLAY IN POSITION (Early Model)

(1) Remove the cover plate from below the pedal cluster.

(2) Disconnect the steering connecting rod from the pitman arm.

(3) Detach the horn wire from the horn button.

(4) Detach the wire clip and withdraw the wire.

(5) Remove the steering wheel as previously described.

(6) Undo the four securing bolts and remove the adjuster plate.

(7) Remove or add shims as required. A stiff steering indicates no end play whereas excessive end play causes axial movement of the wormshaft while turning the steering:

(8) After selecting the shims required to correct the end play, instal the adjuster plate with horn wire clip and secure with bolts. Lock bolt heads with ends of plate.

*NOTE: The adjuster flange bolts must be evenly tightened for proper functioning of the steering.*

(9) Turn the steering column from the top by hand when it should move freely from one lock to the other.

(10) Instal the steering wheel.

### TO ADJUST PLAY BETWEEN WORM AND PEG (Early Model)

(1) Raise the vehicle and position the front wheel straight ahead by locking the steering on one side and then turning it to the other lock, counting the number of turns. Return the steering half the number of turns to the central position.

(2) Loosen the adjusting screw lock nut in the steering gear case cover.

(3) Tighten the adjusting screw sufficiently so that a slight drag is felt in the central position while turning the steering.

(4) Instal the steering connecting rod on the pitman arm.

(5) From below fill the steering gear case with 0.44 Imp pints of SAE 90 gear oil.

(6) Using a suitable gauge, check the toe-in and adjust, if necessary.

(7) Instal the cover plate under the pedal cluster.

(8) Lower the vehicle to the floor.

## 10. STEERING COLUMN TUBE

**TO REMOVE (Early Models)**

It is only necessary to remove the column tube if it is bent or damaged or has become loose in the steering gear housing.

(1) As already described in the appropriate section, remove the steering gear.

(2) Dismantle the steering gear and withdraw the steering column and gear lever shaft.

(3) Position the gear case with steering tube on a repair press, after detaching the crossmember and, using a special tool and thrust pad, press out the tube.

**TO INSTAL (Early Models)**

Installation is a reversal of the removal procedure with special reference to the following points:

(1) Position the gear case, without the crossmember, on a press and using the special tool, press the tube into the gear case to a depth of 1.81".

(2) As already described in the appropriate section, assemble the steering gear.

(3) Adjust the steering gear as previously described.

**TO REMOVE (Later Models)**

(1) As already described remove the steering wheel.

(2) Turn ignition key to the start position, on vehicles fitted with combined steering and ignition lock.

(3) From the steering column rubber support remove the circlip.

(4) Undo the two securing screws, lift up the column tube with the steering column cover plate and, from the column tube, disconnect the horn earth wire from push-on terminal. Straighten the lip of the terminal.

(5) From the column tube, withdraw steering column cover plate and plastic ring.

(6) From the top end take the steering column tube out of the lock assembly.

**TO INSTAL (Later Models)**

(1) Line up the insulation on the steering column tube for both extended holes to exactly correspond with each other.

(2) Apply some french chalk to the rubber support and press the steering column with rubber support and insulation into the lock mounting.

(3) Working from below the floor board, fit the steering column cover plate and plastic ring to the steering column tube.

(4) Through the clamp on the column cover plate, pass the horn earth cable and connect up with the terminal. Bend the lip of the terminal at an angle of 90° with the steering column tube.

(5) Push down the steering column tube aligning the opening in the steering column tube with the lock pin in the steering ignition lock. Check engagement of lock pin.

(6) Line up the steering column cover plate with the floor plate ensuring that the steering column and the steering column tube are correctly positioned and then secure plate with the two screws.

(7) Position the rubber support washer and secure rubber support with circlip.

(8) Carefully check condition of steering column bearing and then instal. Insert the spring support ring with the shoulder facing the top.

(9) Fit the steering wheel, instal securing nut and tighten to a torque of 20 ft/lb.

## 11. STEERING COLUMN

**TO REMOVE (Later Models)**

(1) As already described, remove the steering wheel.

(2) Turn steering ignition key to the start position on vehicles fitted with this type of lock.

(3) Undo the two screws securing the steering column cover plate.

(4) From below the pedal cluster remove the steering column cover plate.

(5) From the lower steering coupling flange undo the securing bolt.

(6) As previously described undo the mounting bolts and remove the steering gear case.

(7) Remove the steering column and coupling by pulling downward and from below the vehicle.

**TO INSTAL (Later Models)**

(1) Insert the column in the steering column tube.

(2) Position the steering gear case on the side member location and, securing with the four mounting bolts, tighten them to a torque of 30 ft/lb.

(3) Instal the pitman arm on the pitman shaft after aligning the mounting notches. Fit securing nut and tighten

to a torque of 70 ft/lb. Insert the split pin to secure the nut.

(4) Connect the steering connecting rod with the pitman arm, fit castellated nut and tighten to a torque of 20 ft/lb. Insert the split pin to secure the nut.

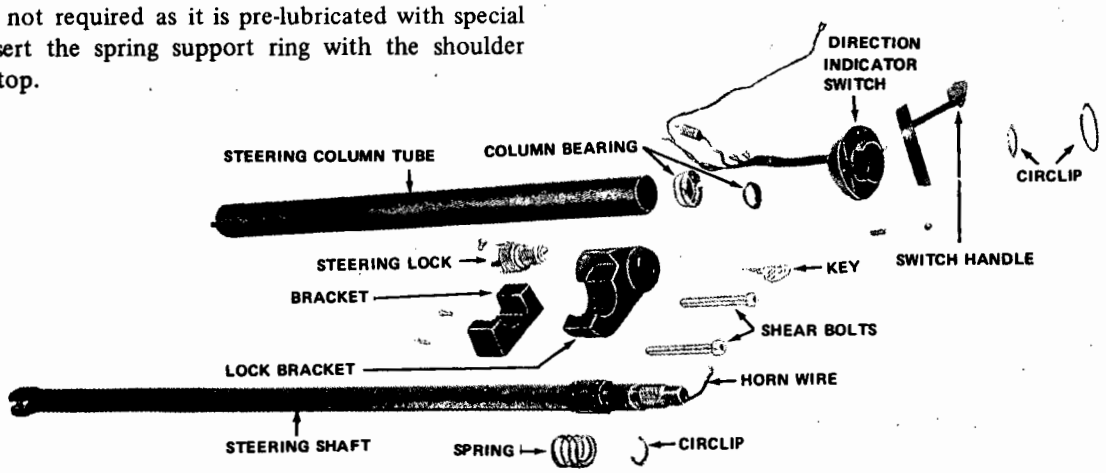
(5) Position front wheels straight ahead and instal the steering column on the steering worm. Position a new lock plate on the coupling flange and lock the bolts with the ends of the lock plate.

(6) Check condition of steering column bearing but greasing is not required as it is pre-lubricated with special grease. Insert the spring support ring with the shoulder facing the top.

(7) Position the steering wheel allowing a gap of .012" between the wheel hub and the trafficator switch. Fit the securing nut and tighten to a torque of 20 ft/lb.

(8) Ensuring that the steering column is correctly positioned within the column tube, instal the steering column cover plate and secure with two screws.

(9) Checking that the front wheels are in the straight ahead position, the steering wheel spokes should be horizontal. Check trafficator switch operation.




Exploded View of Steering Column and Shaft Components (1500-1600 model shown).

## 12. INTERMEDIATE SWING LEVER AND SHAFT

**TO REMOVE (Early Models)**

(1) Disconnect the steering damper from the intermediate swing lever.

(2) Disconnect the steering connecting rod and tie-rod ends from the swing lever.

(3) Remove the swing lever pinch bolt after bending back the lock plate tabs.

(4) Remove grease nipples.

(5) Using a special tool press down the intermediate swing lever shaft from the top and remove the lever and shaft.

**TO INSTAL (Early Models)**

Installation is a reversal of the removal procedure while observing the following points:

(1) Check the diametrical clearance of the intermediate swing lever shaft and, if necessary, replace bushes.

(2) Check the condition of the lever shaft for wear or damage and renew, if necessary.

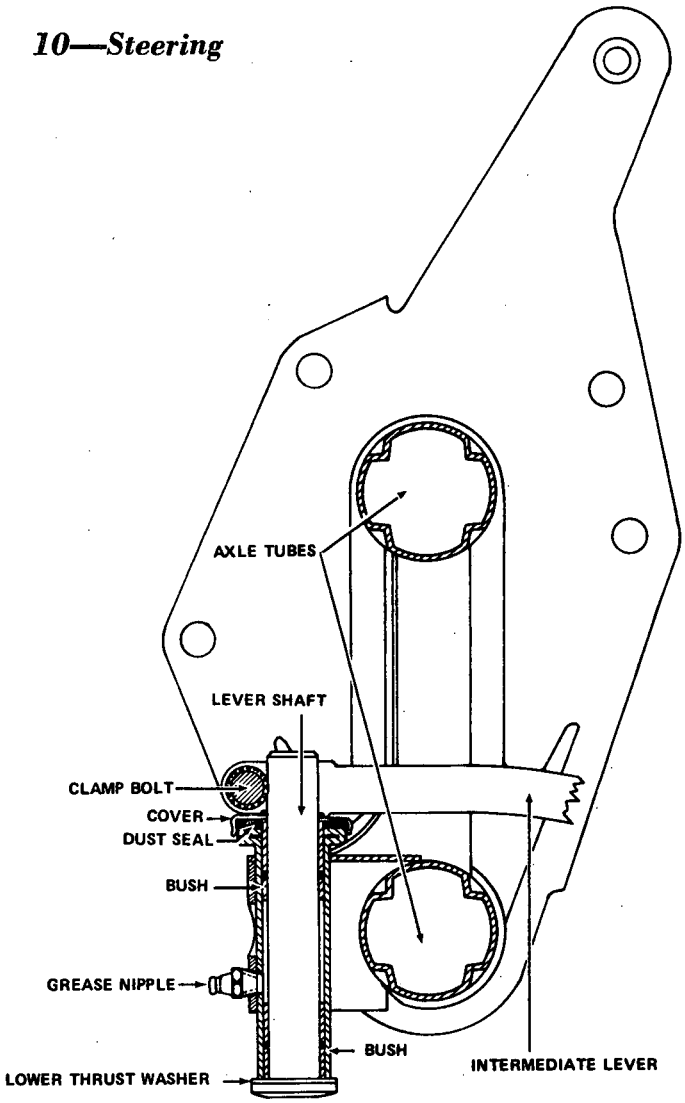
(3) Before finally assembling the intermediate swing lever and shaft it is essential to give sufficient pre-load to avoid rattling when the vehicle is being driven. The lever, when installed, should compress the spring washer at least .024" –.031". The spring washer compressed to this limit should exert a force of 260-300 lb which will not allow rattling to occur.

To check the condition of the spring washer for obtaining the correct pre-load, in the first instance, instal the lever and shaft with all components except the spring washer and in this case the clearance between the thrust washer and the swing lever should be a = b-c; while b is the free length of the spring washer and is equal to .189" ± .028" and c is the pre-load and is equal to .024" –.031".

If the measured clearance exceeds the value calculated for a, correct by inserting a further thrust washer .020" thick between the dust seal and spring washer. Replace a weak spring washer.

(4) Dismantle the swing lever and shaft and re-assemble with the spring washer after checking the condition of the lever shaft for wear or damage and renew, if necessary.

(5) Position the lower thrust washer on the swing lever shaft, instal the shaft in the mounting bushes. From the top end of the shaft slip the following components onto the lever shaft in this order; spring washer, dust seal and plastic seal.




Details of Intermediate Lever and Shaft Assembly.

(6) Position the swing lever on the shaft, lining up the pinch bolt bole with the recess on the lever shaft and after placing a lock plate on the pinch bolt, screw it in and tighten to a torque of 50 ft/lb. Bend back the tabs on the new lock plate and secure the pinch bolt.

**TO REMOVE (Later Models)**

Removal is the same as for earlier models except that before removing the shaft, lift out the cover from below the intermediate swing shaft.

**TO INSTAL (Later Models)**

Installation is a reversal of the removal procedure with special reference to the following points:

(1) Check the diametrical clearance of the lever shaft and, if necessary, replace the bushes.

(2) Check the condition of the lever shaft for wear or damage and renew, if necessary.

(3) Spring washer pre-load be given as described under *EARLY MODELS – Operation (3).*

(4) Before positioning the intermediate swing lever on the top end of the shaft, instal the following components on the shaft: – seal, special washer with plastic coated surface facing upward, protective dust cap, sealing washer and washer.

(5) Position the lever on the shaft, place a lock plate on the pinch bolt and after lining up the bolt hole with the recess in the shaft, screw in the pinch bolt and tighten to a torque of 50 ft/lb. Bend back the tabs of the lock plate and secure the pinch bolt.

## 13. INTERMEDIATE SWING LEVER SHAFT BUSHES

**TO REMOVE (Early Models)**

(1) Disconnect the steering damper from the intermediate swing lever.

(2) Disconnect the steering connecting rod and tie-rod ends from the lever.

(3) Remove intermediate swing lever and shaft as already described in the appropriate section.

(4) Remove the grease nipples.

(5) Using a suitable drift, drive out the old bushes.

**TO INSTAL (Early Models)**

Installation is a reversal of the removal procedure with special reference to the following points:

(1) Check the swing lever shaft for wear or damage and renew, if necessary.

(2) The inner oil grooves are off centre and as such the lower bush must be driven in with the oil groove nearer the top end and the upper bush with the oil groove nearer the lower end. The groove in the upper bush must also be

towards the grease nipple. The upper bush must protrude at the top by .055" –.067". The lower bush at the lower end must seat flush.

(3) Using a non-adjustable reamer with a diameter of .9449" –.9457", ream the bores of both bushes.

(4) Thoroughly clean the bores.

(5) Check condition of grease nipples, renew if necessary and re-fit.

(6) As already described in the appropriate section, instal swing lever and shaft.

(7) Apply specified grease to the swing lever shaft.

**TO REMOVE (Later Model)**

Remove as for items 1, 2, 3, 4 and 5 under *EARLY MODELS.*

**TO INSTAL (Later Models)**

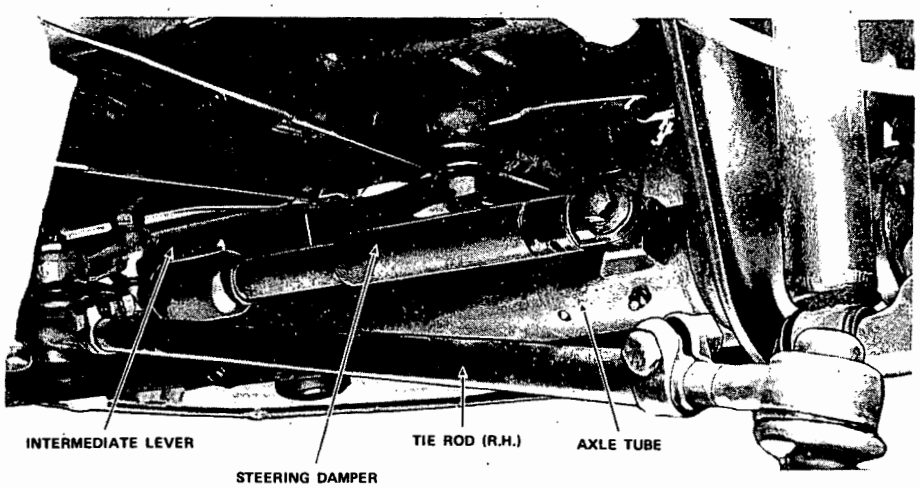
Installation is a reversal of the removal procedure with special reference to the following items:

(1) Using a special drift, drive out the upper and lower bushes.

(2) First drive in the lower bush from the top until it is seated flush at the bottom.

(3) Next drive in the upper bush to within .031" –.043" protruding at the top. The measurement indicated here is measured under the shoulder of the bush.

(4) Thoroughly clean the bores and instal the intermediate swing lever shaft and lever as already described in the appropriate section.




Steering Linkage, Damper and Intermediate Lever Assembly.

## 14. STEERING LINKAGE

**TO REMOVE TIE-RODS (Early Models)**

(1) Raise the front end of the vehicle with a jack and support on stands.

(2) Remove both front wheels.

(3) Extract split pins and undo castellated nuts from tie-rod end ball studs.

(4) Using a special extracting tool, disconnect tie-rods and remove.

**TO INSTAL TIE-RODS (Early Models)**

Installation is a reversal of the removal procedure with special reference to the following points:

(1) Check condition of tie-rods, specially for damage or bend and as it is unsafe to reclaim damaged or bent tie-rods, renew if necessary.

(2) Check tie-rod ends for wear or damage and renew if necessary. If the thread on the ball stud shows signs of damage, the unit should be discarded.

(3) Check all grease nipples and rubber dust seals and renew, if necessary.

(4) Instal tie-rods and tighten stud castellated nuts to a torque of 20 ft/lb. Fit split pins and lubricate joints.

(5) Check front wheel alignment and adjust, if required.

**TO REMOVE TIE-RODS (Later Models)**

(1) Raise the front of the vehicle and support on stands.

(2) Remove both front wheels.

(3) Unlock the nuts on the tie-rod ball studs and unscrew nuts.

(4) Using a special extractor tool, disconnect tie-rod ends.

*NOTE: Exercise care to avoid damaging rubber seals while removing tie-rod ends.*

**TO INSTAL TIE-RODS (Later Models)**

Installation is a reversal of the removal procedure with special reference to the following points:

(1) Check condition of tie-rods whether damaged or bent. Renew, if necessary.

*NOTE: Do not attempt to straighten bent tie-rods.*

(2) Check condition of tie-rod ends especially for wear or tightness. In case the ball is loose in the socket or that the ball is excessively tight in the socket, discard the tie-rod end. The ball stud thread must also be checked for wear or damage and renewed if necessary.

(3) Check condition of rubber seals and, if damaged sufficiently permitting entry of foreign matter into the ball and socket joint; replacement of the complete unit is necessary. In the event of the seal being damaged but able to keep the joint free of dirt, then the seal only should be replaced.

(4) Check the condition of the rubber bush in the steering damper and intermediate swing lever mounting and renew, if necessary.

(5) Instal the tie-rods keeping the left-hand thread on the left, when viewed from the driver's position.

(6) Fit ball stud nuts, tighten them to a torque of 20 ft/lb and secure the nuts with split pins.

(7) Slacken the clamp bolt nuts at both ends of the adjustable tie-rod. Tilt both the ends to the limit in the same direction, either to the front or rear and tighten clamp bolt nuts and lock them. In this manner the adjustable tie-rod ends are aligned with one another.

(8) Fit a new rubber bush and instal steering damper on the swing lever mounting.

(9) Check and adjust toe-in, if necessary.

## 15. WHEEL ALIGNMENT

To facilitate checking camber and toe-in, it will be necessary to have available the necessary gauges for this purpose and the following points should first be observed:

(1) Tyres must be inflated to specified pressures.

(2) The vehicle must be parked on a level surface.

(3) There should be no load in the vehicle except full fuel tank and the spare wheel.

(4) The steering gear adjustment must be correct.

(5) There should be no play in the steering linkage.

(6) Adjustment of the front wheel bearings must be correct.

(7) Bounce the vehicle to find its level.

**TO ADJUST TOE-IN (All Models)**

(1) Raise the front of the vehicle.

(2) Spin each wheel in turn and, using a piece of chalk, mark a line around the periphery of each tyre as near to the centre as possible.

(3) Lower the front of the vehicle to the floor and bounce the front and rear of the vehicle up and down and let it find its own height. Set the front wheels in the straight-ahead position.

(4) Mark the centre chalk line on both tyres at points approximately 8" to 10" above the floor and in front of the front axle.

(5) Using a suitable telescopic gauge, measure and record the distance between the two marks on the tyre centres.

(6) Maintain the wheels in the straight ahead position, roll the vehicle forward until the marks are the same distance above the floor but to the rear of the front axle.

(7) Again use the telescopic gauge to measure and record the distance between the marks on the tyres. The distance measured at the front of the wheels must be approximately .20" less than the measurement taken at the rear of the wheels.

(8) If adjustment of the toe-in is required, slacken the nuts of the clamp bolts on both ends of the adjustable tie-rod.

(9) Using a pipe wrench or any other suitable tool, turn the tie-rod to obtain the correct toe-in setting which is .20".

(10) Tighten the tie-rod clamp bolt nuts and again check the toe-in.

**TO CHECK CAMBER (Early Models)**

The camber is not adjustable but the same should be checked to ensure that it is correct (40' ± 15').

In the event of any deviation from this setting, proceed as follows:

(1) As previously described in the appropriate section, remove the steering knuckle.

(2) Check for excessive wear in the link pins, bushes, needle bearings, shims and rubber seal retainers. Renew if necessary.

(3) Check for wear or damage in the king pins and bushes and renew, if necessary.

(4) Using a suitable gauge, check condition of the steering knuckle.

(5) Check condition and setting of torsion arms and torsion arm eyes and renew, if necessary.

(6) At the time of installation, ensure that the shims are correctly arranged. No attempt should be made to correct the camber by arrangement of shims, as this can result in the torsion arm links becoming jammed and thereby causing damage.

*NOTE: The camber on both front wheels should be approximately the same.*

**TO CHECK CAMBER (Later Models)**

(1) Place the vehicle on a level surface, positioning the front wheels straight ahead.

(2) Using an optical gauge, check carefully according to the manufacturers instructions.

**TO ADJUST**

Located at the upper ball joint in the steering knuckle is an eccentric bush. The bush is provided with a notch and in the normal position it should be facing the front. To adjust the camber the notch should be turned up to 90° either side from the normal position until the correct camber setting is obtained.

**TO CHECK CASTOR**

(1) Using an optical instrument the inclination of the front axle should be checked after detaching the steering damper. Readings should be taken from both ends of the front axle tubes.

(2) In the event of any error check the front axle tubes for any damage and also check the setting of the rear axle torsion bars, as any incorrect setting can also affect castor.

## 16. STEERING DAMPER

**TO REMOVE (All Models)**

(1) Using a jack, raise the vehicle from the floor and support on blocks.

(2) Unscrew the nuts from the steering damper mounting bolts.

(3) Extract both mounting bolts and remove the steering damper.

**TO CHECK AND INSPECT**

(1) Clamp the mounting eye of the damper rod in a vice. With the hands, grasp the damper body and extend it fully upwards and then slowly press it down taking note whether there are any slack spots in the operation which should be the same in both directions. In case of any doubt, the action of a new damper may be compared.

(2) Check the eye bushes and metal sleeves to see whether they are worn or damaged and renew if found necessary.

(3) Using a press in conjunction with the special tool, press out the sleeves and rubber bushes.

(4) Apply french chalk to the new bushes and using the special tool, press them into the eyes. Also apply french chalk to the metal sleeves and press them into the bushes.

(5) Position the damper on its mounting, fit lock plate and secure with mounting bolts and nuts.

## 17. STEERING FAULT DIAGNOSIS

**(1) Excessive play or looseness in steering gear.**

| *Possible cause* | *Remedy* |
|---|---|
| (a) Steering gear worn or out of adjustment. | – Overhaul steering gear, renew faulty components and adjust. |
| (b) Steering linkage ball joints worn or loose. | – Tighten or renew faulty components. |
| (c) Pitman arm loose on shaft. | – Tighten pitman arm retaining nut. |
| (d) Intermediate swing lever bush and shaft worn. | – Renew lever assembly. |
| (e) Steering gear loose on frame mounting bolts. | – Tighten mounting bolts and check alignment of steering gear mounting. |
| (f) Front hub bearings out of adjustment. | – Check, adjust or renew as required. |

**(2) Heavy steering.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Low or uneven type pressure. | – Check tyres and inflate to recommended pressures. |
| (b) | Steering gear incorrectly adjusted. | – Check and re-adjust steering gear. |
| (c) | Lack of lubrication in steering box. | – Check and top up steering box with specified oil. |
| (d) | Front suspension worn or out of alignment. | – Check front end for wear renew worn components and re-align front end. |
| (e) | Mis-alignment between steering gear and column mountings. | – Check and align steering gear and column mounting. |
| (f) | Soft or sagging front torsion bars. | – Renew and/or adjust torsion bars and check front end alignment. |

**(3) Steering pulls to one side.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Uneven tyre wear or pressure. | – Check condition of tyres and inflate to recommended pressures. |
| (b) | Incorrect front end adjustment. | – Check front end alignment. |
| (c) | Dragging brakes. | – Check and adjust brake shoes. |
| (d) | Broken or sagging rear torsion bar/s. | – Renew faulty torsion bar/s. |
| (e) | Damaged front suspension or front axle-frame members. | – Check and renew damaged components. |
| (f) | Caster or camber setting incorrect. | – Check and rectify as necessary. |

**(4) Front wheel wobble or shimmy.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Looseness in steering gear. | – Rectify and adjust. |
| (b) | Uneven tyre wear or incorrect tyre pressures. | – Check condition of tyres and inflate to recommended pressures. |
| (c) | Tyre and/or wheel unbalance. | – Check and balance as necessary. |
| (d) | Front end damaged or out of alignment. | – Check and rectify front end damage and alignment. |
| (e) | Worn or badly adjusted front wheel bearing. | – Check condition and adjust wheel bearings. |
| (f) | Front wheel alignment incorrectly adjusted. | – Check and adjust front wheel toe-in (alignment). |
| (g) | Loose or worn tie-rod ends. | – Check and renew faulty components. |
| (h) | Faulty shock absorbers. | – Check and renew as a pair. |

**(5) Steering erratic or wandering.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Incorrect or uneven camber and or castor setting. | – Check and renew components to rectify. |
| (b) | Smooth front tyres. | – Check and renew tyres as necessary. |
| (c) | Excessive play in steering gear and/or linkage. | – Check and renew faulty components, readjust. |
| (d) | Excessively high or low tyre pressures. | – Check and inflate to recommended pressures. |
| (e) | Loose or incorrectly adjusted wheel bearings. | – Check and adjust front wheel bearings. |

# FRONT AXLE AND SUSPENSION

## SPECIFICATIONS

| | |
|---|---|
| Type | Independent, transverse torsion bars and trailing arms |
| Torsion bar type | Laminated square section, 9 leaves with centre anchor |
| Shock absorber type | Double acting – telescopic |
| Wheel alignment (toe-in toe-out): | |
| Up to chassis No 217148459 | -5' to ±15' |
| From chassis No 218000001 | -5' ± 10' |
| Wheel camber: | |
| Up to chassis No 217148459 | +40' ± 30' |
| From chassis No 218000001 | +40' ± 15' |
| Castor angle: | |
| Up to chassis No 217148459 | 1° max. |
| From chassis No 218000001 | 3° ± 40' |
| Toe-out at 20° either lock | –3° ± 20' |

### TORQUE WRENCH SETTINGS

| | |
|---|---|
| Side plate to side member bolts | 85 ft/lb |
| Steering connecting rod to swing lever | 20 ft/lb |
| Clamp nut socket head screw | 15 ft/lb |
| Stabiliser bar bolt and nut | 33 ft/lb |
| Ball joint stud nut | 72 ft/lb |
| Torsion arms grub screw lock nuts | 28 ft/lb |

## 1. DESCRIPTION

The load-carrying member of the front axle is the front axle beam which comprises two rigidly joined tubes secured to the chassis frame by two anchor plates welded on the outer ends of the tubes and secured to the chassis frame by eight bolts. The intermediate swing lever bracket is welded to the lower tube.

Within each tube is a torsion bar which is the laminated type consisting of nine plates supported in the centre of the tubes by a collar and secured by grub screws. Within the ends of the tubes, torsion arms are installed which also encase the ends of the torsion bars. These torsion arms are secured to the outer end of the torsion bars by grub screws. A stabiliser bar has been provided, the ends of which are rubber mounted on the lower torsion arms and secured by clamps.

The torsion arms are connected to the steering knuckles on early models by link pins and bushes and by ball joints on later models, the ball ends being mounted in special plastic bushes. The joints are protected against dust and moisture by special rubber dust excluders secured to the joint by metal retainers. The upper torsion arms are mounted to the top of the steering knuckles in eccentric metal bushes and from these bushes the caster and camber setting can be corrected by turning the bushes (later models only.)

Telescopic type hydraulic double-acting shock absorbers are provided and, at the top, they are mounted on the anchor plates and at the lower end to a stud on the lower torsion arm.

The steering arm is an integral part of the steering knuckle. The wheel hub and brake drum are cast as an assembly.

## 2. LUBRICATION

There are five greasing points in the front axle which require attention once a year or every 6000 miles when a vehicle is being operated under normal conditions. This applies only to later models. Earlier models should be greased at approximately 1000 to 1500 mile intervals.

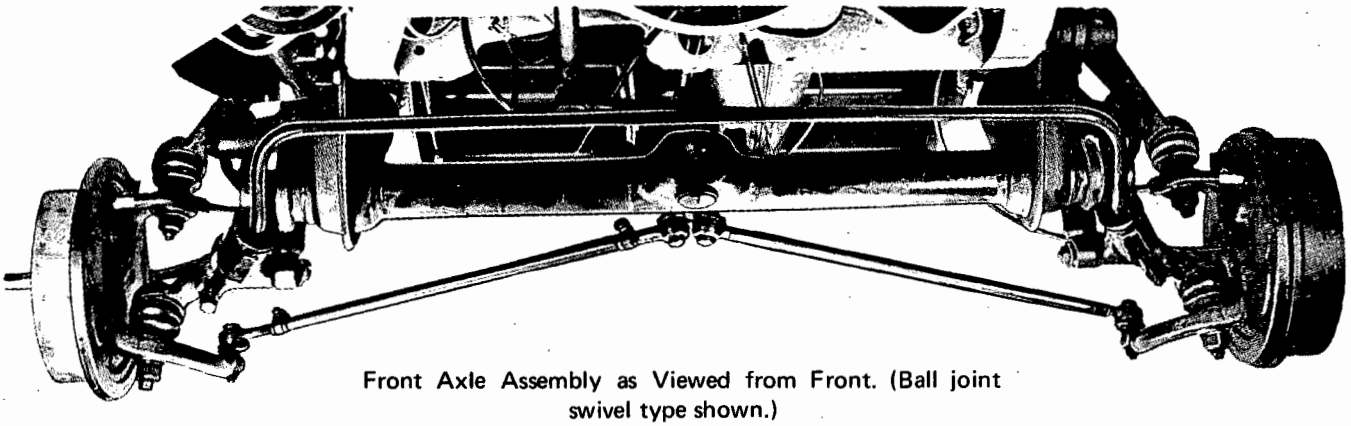
The ball joints on later vehicles do not require lubricating as they were greased at the time of manufacture and no further lubricating is necessary during service.

The grease recommended for lubrication should be multi-purpose lithium base grease.

## 3. AXLE ASSEMBLY

### TO REMOVE

(1) Slacken road wheel mounting bolts.
(2) Jack up the vehicle and support on suitable stands.
(3) Remove the wheel nuts and withdraw the wheel.
(4) Disconnect the brake hoses from the connector brackets and seal the ends with wooden plugs.
(5) Disconnect the speedometer drive cable from the left hand front wheel and remove the cable from the steering knuckle.



Front Axle Assembly as Viewed from Front. (Ball joint swivel type shown.)

(6) Remove the cover plate from below the pedal assembly.

(7) Engage the first or third gear and remove the front gear shift rod and detach the cable at the pedal cluster.

(8) Detach the hand brake cable from the hand brake lever.

(9) Using a suitable extractor, detach the drag link from the swing lever.

(10) Detach the steering damper from its outer mounting and press down.

(11) Place a jack with cradle under the axle and raise it until the axle tube rests on the cradle.

(12) Remove the eight bolts securing the side plates to the frame.

(13) Lower the jack and wheel out the axle.

**TO INSTAL**

Installation is a reversal of the removal procedure but the following points must be observed:

(1) When installing the front axle, if a gap is noticed between the anchor plate and the side member, this can be checked by installing compensating plates which are serviced in thicknesses of .0196" and .0393".

(2) The lock plates under the front axle securing bolts are to be positioned and tightened to a torque of 85 ft/lb.

*NOTE: Front axle attaching bolts should be checked for tightness at every maintenance service.*

(3) Connect the steering connecting rod to the intermediate swing lever and fit the castellated nut and tighten to a torque of 20 ft/lb. Insert the split pin.

(4) Instal the steering damper using a new lock washer.

(5) Lock the square head bolts in the coupling on the front gear shift rod.

(6) Connect and adjust clutch cable free travel.

(7) Check brake hoses and connect.

(8) Bleed and adjust brakes. Check toe-in and camber.

**TO DISMANTLE**

(1) Take off grease caps, extract split pin, undo axle nut and withdraw brake drum assembly.

(2) Undo the securing bolts and nuts and remove brake back plates.

(3) Disconnect the tie-rods.

(4) Disconnect the upper and lower ball joints and remove the steering knuckles. On early models, remove the link pins and remove shims and take off the steering knuckle and stub axle assembly.

(5) Undo the upper and lower mountings and remove the shock absorbers.

(6) On early models take out the king pin and separate the stub axle from the steering knuckle. On later models, separate the torsion arms and ball joints if required.

(7) Remove the intermediate swing lever and shaft.

(8) Remove the torsion bars from the axle tubes.

(9) Drive out the torsion arm bearings and metal bushes, if required.

Assembling is a reversal of the dismantling procedure after ensuring that all components are in good condition.

## 4. HUB AND BRAKE DRUM

**TO REMOVE**

(1) Remove the wheel dust cap and slacken the wheel mounting bolts.

(2) Jack up the vehicle and support it on suitable stands.

(3) Remove the wheel mounting bolts and withdraw the wheel.

(4) Extract the split pin from the end of the speedometer drive cable from the left front wheel and pull out the cable from the steering knuckle.

(5) On early models, release the lock washer, remove the lock nut and washer and remove the adjusting nut. On later models, slacken the socket head screw in the wheel bearing adjustment clamp nut and remove the clamp nut.

*NOTE: The left-hand clamp nut has left-hand thread corresponding to the steering knuckle thread on the same side.*

(6) Withdraw the brake drum and hub assembly.

**TO INSTAL**

Installation is a reversal of the removal procedure but the following points should be observed:

(1) Carefully check the brake drum for cracks, damaged threads in wheel bolt holes and the condition of the braking surface.

(2) Carefully clean the brake drum hub and front wheel bearing assembly. Lubricate the bearing with the specified grease.

(3) Instal brake drum and adjust the bearings as described in the section *WHEEL BEARINGS – TO REMOVE AND INSTAL.*

(4) Clean the inner hub cap.

## 5. HUB BEARINGS

**TO REMOVE**

(1) Remove the front brake drum assembly as previously described.

(2) Using a puller, pull off the spacer and the inner race of the bearing.

(3) Remove the oil seal and take out the roller and cage assembly.

(4) Remove the outer race of the inner bearing.

(5) Remove the outer race of the outer bearing.

**TO INSTAL**

Installation is a reversal of the removal procedure but the following points should be observed:

(1) Before installing the brake drum, clean the brake shoes and brake back plate thoroughly with compressed air. Dirt and dust produced by the wear of the linings, during operation, have an abrasive effect if allowed to enter the bearings and seats. If the outer bearing race is no longer a press fit in the drum, the latter must be renewed.

(2) Thoroughly clean the wheel spindle and bearing chambers, between the seating of the brake drum, with petrol and dry with a clean rag.

(3) Clean the old grease from the ball races, cages and balls of the bearings. The grease must be completely removed by washing the bearings thoroughly with petrol.

Carefully inspect the bearings for pitting, cracks or other signs of wear or damage. Use new bearings, if necessary.

*NOTE: Ball races or balls must never be replaced separately.*

(4) Inspect the inner bearing spacer for cracks or wear and replace, if necessary. Correct sealing of the brake drum oil seal is only ensured if the surface of the spacer is absolutely clean and smooth.

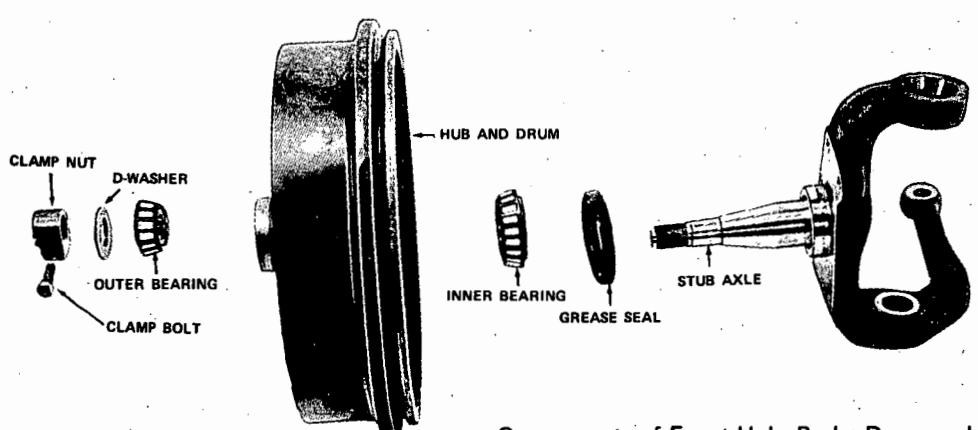
(5) Press in the outer race of the outer bearing.

(6) Press in the outer race of the inner bearing.

(7) Instal the inner bearing and the oil seal in the hub. Make sure that the seal is in good condition and correctly seated.

(8) If the seating surfaces have become worn by repeated removal and a sliding fit is no longer present, a new stub axle must be fitted.

(9) Lubricate the bearings with the specified grade of grease. Press the grease well into the cages and between the balls. Apply a light film to the seats and to the surfaces of the ball races.




Components of Front Hub, Brake Drum and Stub Axle.

(10) During lubrication and assembly take care to prevent dirt or foreign matter from entering.

(11) Instal the brake drum and drive in the inner race of the outer bearing.

(12) Make sure the D-washer is correctly positioned. A tilted washer causes maladjustment.

(13) Adjust the bearings as described under *TO CHECK AND ADJUST.*

**TO CHECK AND ADJUST**

(1) Brake drums must rotate freely and also be free from touching the brake linings.

(2) With suitable tool, take off the outer hub cap.

(3) Undo one of the wheel securing bolts. Using a suitable dial gauge, mount it by using the bolt hole threads to screw in the mounting pin of the gauge.

(4) Position the gauge so that the plunger is in contact with the steering knuckle clamp nut.

(5) Grasp the wheel with both hands, then pull out and push in and while doing so, note the axial play being registered by the gauge. This reading should be between .001" – .005". In case the setting varies from laid down limit, readjustment is necessary.

**TO ADJUST**

(1) Slacken the clamp nut tightening screw (adjusting nut, early models).

(2) Using a suitable spanner, gradually tighten the clamp nut until the taper rollers come in contact with the shoulder of the inner race. During this operation the wheel should be slowly rotated.

(3) Gradually slacken the clamp nut until the dial gauge registers the correct setting when the wheel is moved as indicated as (5) under *TO CHECK AND ADJUST.*

(4) While holding the clamp nut with the spanner, tighten the clamp nut screw to a torque of 12 ft/lb. The gap of the slot in the clamp nut should measure .098" ± .020".

On early models, adjust the adjusting nut, position the lock washer and instal and tighten the lock nut while holding the adjusting nut. Secure with the lock washer.

(5) Grasp the wheel again and check adjustment for correctness.

(6) Fit the inner hub cap but do not pack with grease.

## 6. STEERING KNUCKLE (BALL JOINT TYPE)

**TO REMOVE**

(1) Remove the outer hub cap and slacken the wheel securing bolts.

(2) Using a jack suitably placed, raise the front of the vehicle.

(3) Undo the securing nuts and withdraw the left side wheel.

(4) Remove the split pin from the end of the speedometer cable in the left front wheel and draw out the cable.

(5) Take off the inner hub cap, slacken the Allen head screw and remove the wheel bearing adjustment clamp nut.

(6) Withdraw brake drum assembly.

(7) Using a special tool disconnect the outer tie-rod end from steering arm.

(8) Without detaching the hydraulic brake pipe, undo the mounting bolts of the brake back plate.

(9) Disconnect the lower ball joint from the steering knuckle, by undoing the stud nut and fitting a cap nut temporarily. Fix the special tool and lightly tap the steering knuckle near the ball joint mounting to dislodge the ball joint.

*NOTE: The self-locking nuts removed from the ball joint studs should be renewed.*

(10) Remove the self-locking nut from the upper ball joint stud and using the special tool, dislodge the camber adjustment eccentric bush.

*NOTE: If it is necessary to repair the ball joint, the stud should be pressed out with the special tool. In case the stub axle is only being removed, the ball joint should be dislodged with the same special tool used in (9) above and the eccentric bush need not be removed from the ball joint stud.*

(11) Withdraw the steering knuckle and suspend the back plate by a piece of wire to the underframe to avoid damage to the brake pipe.

**TO CHECK**

(1) Check front wheel bearing seats on the stub axle to ascertain whether the wear and accuracy are within the following limits:

(a) Seat – outer bearing – .7493" – .7498" diameter
(b) Seat – inner bearing – 1.2493" – 1.2498" diameter
(c) Seat – spacer ring – 1.4967" – 1.4977" diameter

(2) Using a special gauge, check the condition of the steering knuckle. Set up the gauge flush with the flange on the steering and also the flange should be slightly turned to engage the dowel pins on the gauge with the two corresponding tapped holes in the flange.

*NOTE: It is not necessary to remove the steering knuckle to conduct the above check, as it can be done while fitted in position on the vehicle.*

The condition of the steering knuckle should be considered in order when the steering arm eye and the bore of the gauge are within the permissible tolerance and also when the gauge and the face of the steering arm eye are parellel to one another.

When, during the checking, a bent steering knuckle is detected, replacement is the only solution.

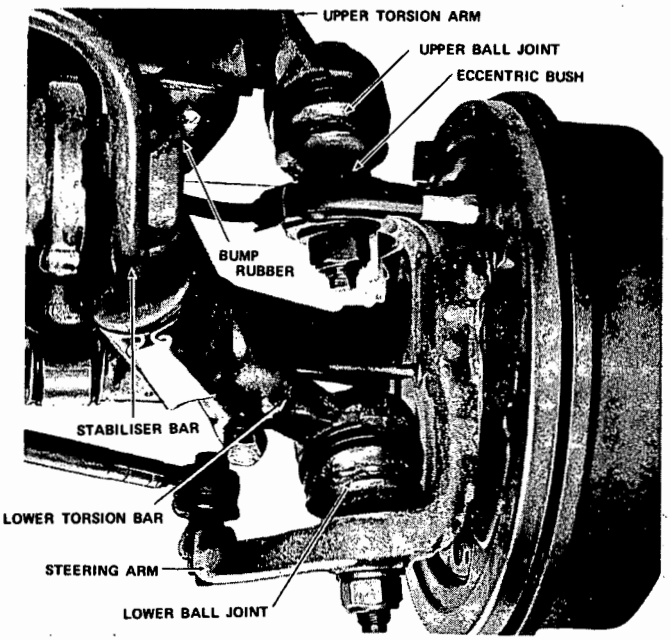
**TO INSTAL**

(1) Temporarily position the lower ball joint in its mounting on the steering knuckle.

(2) Instal the upper ball joint with eccentric bush in its mounting on the steering knuckle by using a special tool to raise the upper torsion arm. The tab on the eccentric bush should be positioned facing the front of the vehicle. Instal the brake hose clamp and special washer on the ball joint stud and secure with the self-locking nut tightened to a torque of 72 ft/lb.

(3) Similarly instal the special washer on the lower ball joint stud and secure with the self-locking nut and tighten to a torque of 72 ft/lb.

(4) Instal the tie-rod end in its mounting on the steering arm and secure with the castellated nut and tighten to a torque of 22 ft/lb. Insert a split pin.




**Ball Joint Type Swivel Assembly showing Eccentric Bush at Upper Joint for Camber Adjustment.**

(5) Position the brake back plate on the steering knuckle and secure with the four bolts and nuts.

(6) Instal brake drum assembly and adjust the bearings as already described under *WHEEL BEARINGS – TO CHECK AND ADJUST.*

(7) Adjust the camber and toe-in as described in the appropriate section.

## 7. TORSION ARM LINK PINS (EARLY MODELS)

**TO INSPECT AND ADJUST**

(1) Raise the front of the car and support on stands.

(2) Rock the road wheel by hand to check the play between the torsion arm link and the torsion arms. If excessive play is present it will be necessary to adjust the torsion arm link pins.

(3) Back off the pinch bolts in the torsion arm eyes and grease the link pins thoroughly, at the same time turning the pins in alternate directions to remove the old grease and dirt that may have accumulated.

(4) Tighten the torsion arm link pins to a degree which will allow a free movement between the torsion arms and the torsion arm link without perceptible play. To effect this adjustment, first fully tighten the torsion arm link pins and then back them off approximately 1/8 turn. Finally retighten the pins carefully until the first resistance is felt. If no correct adjustment can be effected, the shims are worn and should be replaced by new ones.

(5) Tighten the pinch bolts securely.

*NOTE: After the torsion arm link pins have been adjusted, it is necessary to check the toe-in.*

**TO REMOVE COMPLETE WITH STUB AXLE**

(1) Raise the front end of the car and support it behind the frame head.

(2) Remove the front wheels.

(3) On the left front wheel, detach the speedometer drive cable by removing the cap pin.

(4) Remove the brake drum and brake plate. It is not necessary to detach the brake hose from the back plate, but the pipe should be supported to prevent damage to the hose.

(5) Remove the outer tie rod ball joint.

(6) Remove the pinch bolts at the torsion arm eyes.

(7) Remove the torsion arm link and stub axle by equally driving out both torsion arm link pins. Retrieve the shims and dust seals.

**TO INSTAL COMPLETE WITH STUB AXLE**

This is a reversal of the above procedure, but the following points should be noted:

(1) Check the torsion arm link pins, torsion arm link pin bushes and shims for wear, and replace as necessary.

(2) Examine the faces of the torsion arm eyes for wear and roughness. If necessary, reface them.

(3) Measure any mis-alignment across the eye faces using a straight edge and a depth gauge. This should be approximately .280". Departures from this dimension must not be more than ± .080". Correct the displacement with shims of .020" thickness. There must always be eight shims and one retainer with dust shield fitted to one torsion arm link.

(4) If deviation exceeds the limits of ± .080", it is not permissible to add further shims. Misalignments can be determined by removing the torsion arms and checking them on a test plate. The front axle tubes should be checked for alignment. Twisted torsion arms must in all cases be renewed. No attempt should be made to straighten them.

(5) Grease the torsion arm link and shims with universal grease. If the mis-alignment has been corrected as outlined above, the torsion arm link pins can easily be pushed into the torsion arm eyes and the faces of the upper and lower torsion arms simultaneously make perfect contact with the shims.

(6) Adjust the torsion arm link pins.

(7) After installation of the brake backplate, secure the mounting bolts with a piece of wire.

(8) Check the camber and toe-in of the front wheels.

**TO REMOVE LINK PIN BUSHES**

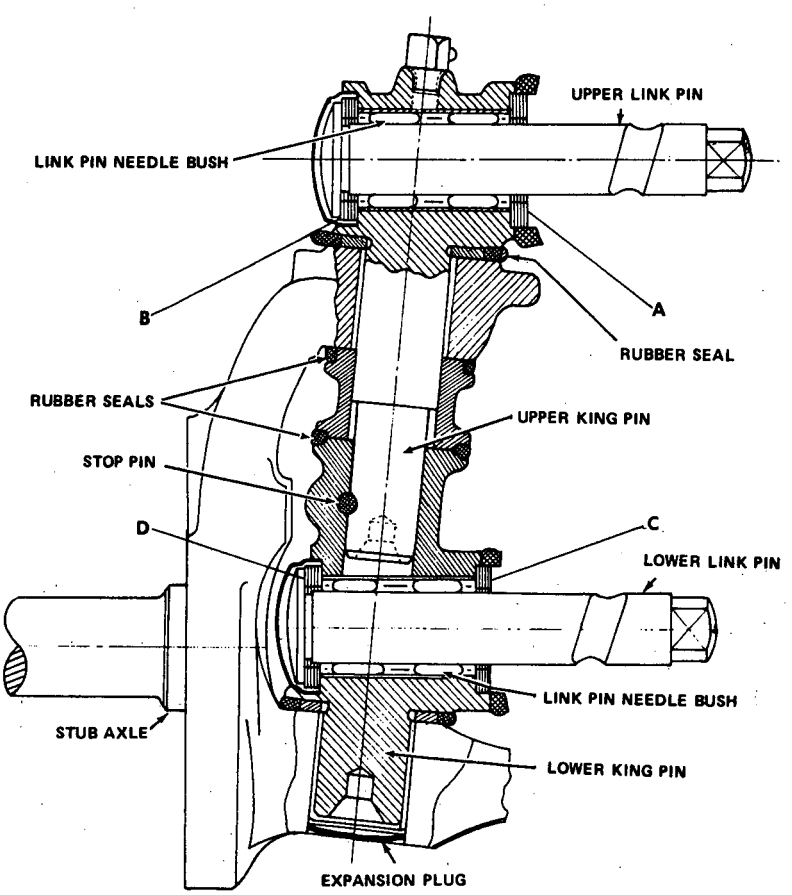
(1) Take off the stub axle, complete with king pins.

(2) Remove the link pin dust caps.

(3) Remove the torsion arm link pins and needle roller bearings.

(4) Take out the upper king pin stop screw.

(5) Drive out the needle bearing bushes.




Diagrammatic View of Link Pins and Stub Axle Assembly, showing Components and Position of Adjusting Shims at A, B, C & D.

### TO INSTAL LINK PIN BUSHES

Installation is a reversal of the removal procedure, but the following points should be observed:

(1) Check the king pin clearance. If the king pins show excessive diametral clearance in their bushes, correct by fitting new pins and bushes.

(2) Press in the link pin needle bearing bushes.

*NOTE: When replacing needle bearing bushes it should be borne in mind that bushes and needle cages must only be replaced as a pair.*

(3) At no point should the faces of the bush project over the internal shoulder in the receiving bore in the king pin. The bushes must be a tight fit in the king pins.

(4) Grease the link pins, shims, oil seals and retainers with universal grease before installing. If the torsion arm alignment has been corrected as described in the preceding paragraphs, there will be no difficulty in inserting the link pins into the torsion arm eyes and the pins will abut simultaneously against the faces of the upper and lower torsion arms.

(5) On the left wheel, insert both torsion arm pinch bolts from the bottom. On the right wheel, insert the lower pinch bolt from the bottom and the top one from the top.

(6) Adjust the torsion arm link pins.

(7) Tighten the pinch bolts and secure the lower bolts with cotter pins.

(8) Instal the link pin dust caps.

(9) Instal the backplate, wheel brake and the brake drum.

(10) Instal the brake hose clip with a distance piece and the grease nipple at the top king pin eye.

(11) Adjust and bleed the brakes.

(12) Check the camber angle and toe-in.

## 8. KING PINS

### TO REMOVE

(1) Take off the stub axle complete with king pins.

(2) Remove the stop screw and take out the link pins and needle bearings. Make a note of the position in which the shims are arranged.

(3) Unscrew the angle nipple in the upper king pin.

(4) Withdraw the upper king pin with an extractor. The extractor, which is used in conjunction with a bolt should be mounted on the stub axle in such a manner that the puller screw is in line with the longitudinal axis of the upper king pin.

(5) Push out the spacer between the lower king pin and the lower face of the upper stub axle boss.

(6) Withdraw the lower king pin from the stub axle.

### TO INSTAL

Installation is a reversal of the removal procedure, but the following points should be observed:

(1) Check the king pins, king pin bushes, rubber seals, spacer and thrust washers for wear, and replace as found necessary.

(2) Check the stub axle. If replacing the stub axle, spacer or lower king pin, first insert the spacer without rubber seals between the lower king pin and stub axle. The end play must not exceed .006". If necessary, use a spacer of the next oversize.

(3) Instal the lower king pin. Insert a thrust washer and rubber seal between each king pin and the stub axle. Lightly grease the thrust washers and rubber seals with universal grease before installing them.

(4) Clamp the stub axle in a vice and use a screwdriver as a lever to compress the lower king pin rubber seal. This facilitates the installation of the spacer. Check the king pin for freedom of movement; it should be possible to turn it by hand.

(5) Press in the upper king pin – after having fitted the thrust washer and rubber seal.

(6) Place the rubber seals in position and ensure a snug fit.

(7) Insert the stop screw – with its head to the rear – and tighten the nut.

*NOTE: If it becomes necessary to renew the stop screw, see that a new one of identical head pattern is fitted. The reason for this is that three different head sizes are used, depending on the tolerance in the steering lock.*

(8) Check the stub axle and king pins for free movement. It should be possible to turn the latter by hand, one against the other.

(9) Screw the angle grease nipple into the upper king pin.

### TO REMOVE KING PIN BUSHES

(1) Take out the king pins.

(2) Press the end plug cap out of the lower eye in the stub axle.

(3) Drive out king pin bushes.

### TO INSTAL KING PIN BUSHES

Installation is a reversal of the removal procedure, but the following points should be observed:

(1) Press in the king pin bushes. When pressing in, make sure the bushes are flush with the king pin eyes.

(2) Ream the bushes with a pilot reamer to finished size of .8677" to .8669". The taper sleeve of the reamer acts as a pilot. When correctly reamed, the bushes should be free from scoring and chatter marks, and should enable the king pins to be turned by hand without any obvious play being detected.

(3) Insert the end cap in the lower steering knuckle eye and peen over to obtain an oil-tight fit.

## 9. STABILISER BAR (WHEN FITTED)

### TO REMOVE

(1) Using a chisel, a light hammer or any other suitable tools, prise the lips on the inner ends of the clips and tap off the clips from the stabiliser rubber mounting clamps.

(2) Spread the ends of the clamps apart and remove them together with the small plates.

(3) Undo the nut from the stabiliser mounting bolts on the lower torsion arm and remove the stabiliser bar from the vehicle.

### TO CHECK

(1) Check the condition of the stabiliser bar to ensure that it has not been damaged or bent while in service.

*NOTE: No attempt should be made to straighten a bent stabiliser bar but replace if necessary.*

(2) Check rubber mounting pad for wear or deterioration.

(3) Check clamps, plates and retaining clips for rust or any other damage and renew where required.

### TO INSTAL

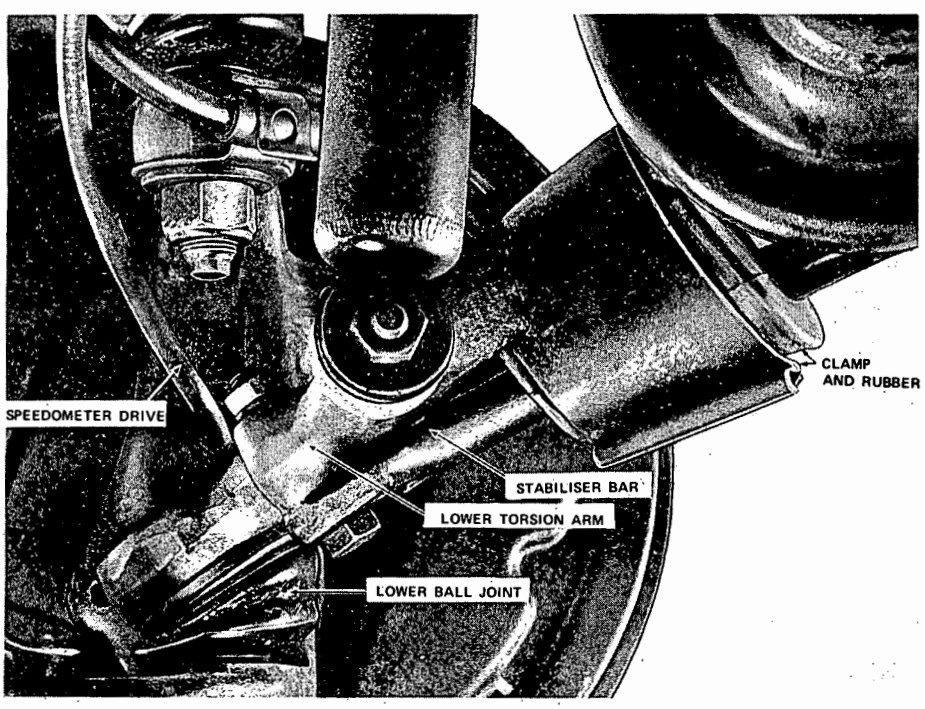
(1) Position the rubber pad on the stabiliser bar and mount the bar on the lower torsion arm, securing it in position with the mounting bolt and nut. Tighten the nut to a torque of 33 ft/lb.

*NOTE: The mounting bolt should be inserted from below and the nut fitted on top.*

(2) Instal the clamps and plates on the torsion arm and rubber pads with the tapering ends of the clamps facing the wheel.

(3) Using adjustable pliers, grip the ends of the clamps and draw together and slide and tap on the retaining clips with the lip towards the inner ends.

(4) Secure the retaining clip in position by knocking up the lip on the clips.




Lower Suspension Arm and Stabiliser Bar Attachment.

## 10. TORSION ARMS AND BALL JOINTS (LATER MODELS)

### TO REMOVE

(1) Remove brake and drum assembly and steering knuckle as previously described under *STEERING KNUCKLE – TO REMOVE.*

(2) Remove stabiliser bar as previously described under *STABILISER – TO REMOVE.*

(3) Remove the torsion arms by undoing the locking nuts of the grub screws and unscrewing the grub screws from the torsion arms.

(4) Withdraw the torsion arms from their mounting in the axle tubes.

### TO CLEAN AND CHECK (TORSION ARM)

(1) Moisten some clean cloth with cleaning solvent and wipe clean the torsion arms but do not apply to the ball joint rubber seal. Use a clean dry cloth for the ball joints.

(2) From the tops of the ball joints remove the grease nipple plugs and instal the tapered check pin of the special tool, VW 282d.

(3) To mount the torsion arm on the special tool, substitute the torsion arm inner bearing by fitting the bush and for the outer bearing the spacer ring from the special tool, VW 282d.

(4) With the torsion arm mounted on the special tool, push the arm down with the check pin below and see whether the pin comes in contact with the appropriate small boss on the face of the tool. If the check pin fails to make contact with the small boss, discard the torsion arm as it is obviously bent or distorted.

*NOTE: Torsion arms and ball joints should be treated as units and in the event of a torsion arm being discarded, renew the complete unit.*

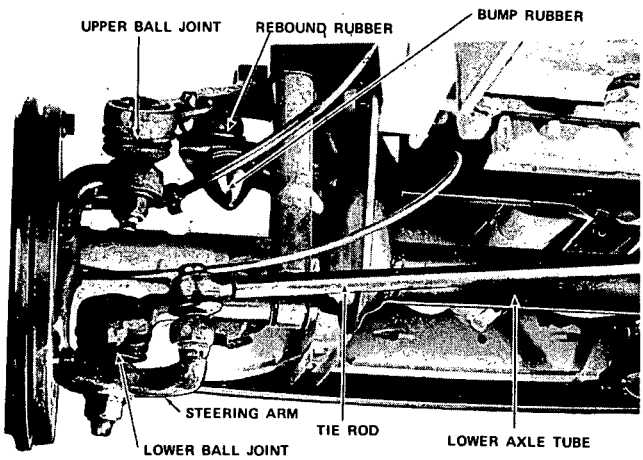
(5) Remove the special check pin from the top of the ball joint and refit original plug.

### TO CHECK (BALL JOINTS)

(1) Having cleaned the ball joints, using a vernier gauge, place one jaw on the plug at the top of the ball joint and the other jaw on the bottom of the ball joint stud. With the thumb and finger, move the stud in and out of the joint and simultaneously take the reading on the vernier gauge. The permitted axial play of a ball joint stud, new, is within the limit of .012" and the permissible limit of wear is .080".

*NOTE: Ball joints cannot be repaired and must be replaced as a unit.*

(2) In the event of the ball joint rubber seal being damaged, dirt will have entered the joint, take off the seal and at the top of the joint, replace the plug with a grease nipple. Using a grease gun containing lithium grease, thoroughly grease the joint, allowing the grease to remove the dirt.




View of Left Hand Side Suspension and Steering Linkage.

(3) To the lower end of the new dust seal, fit the small metal retainer ring and reasonably fill the seal with lithium grease.

(4) Ensure that the lower ring groove is clean, then fit the seal to the ball joint and secure with the lower retainer ring. Using a special sleeve, press the upper retainer ring on to the conical sleeve and then transfer it on to the seal.

(5) Remove the grease nipple from the top of the ball joint and screw in a new plug.

### TO REMOVE BALL JOINTS

(1) Position the lower ball joint and torsion arm on a press and, with the special tool, press the joint out of the torsion arm mounting.

(2) In a similar manner, press out the upper ball joint from the upper torsion arm.

*NOTE: Ball joints which have been pressed out of the torsion arms, should be discarded.*

(3) The eccentric bush on the upper ball joint stud can also be pressed out with the same special tool on the press but in this case a nut must be screwed on to the stud to prevent the ball joint stud being suddenly dislodged.

### TO INSTAL BALL JOINT

(1) Position the new lower ball joint in the top of the lower torsion arm mounting, ensuring that the serrations in the shoulder of the ball joint line up with the lugs on the torsion arm mounting.

After pressing the ball joints into the torsion arm mountings, it is necessary to peen the ball joint cover at six points 60° apart to secure them firmly in position.

**TO INSTAL**

(1) Slip the seal on the torsion arm followed by the seal retainer with the open end facing outwards and the two raised portions on the circumference, which are directly opposite one another, should be in the vertical position.

(2) Carefully insert the torsion arm into the axle tube, lining up the grub screw hole with the grub screw seat on the torsion bar.

(3) With the torsion arm in position in the axle tube, tighten the grub screw and secure with lock nut.

(4) Lubricate the torsion arm bearing through the appropriate greasing nipple on the axle tube with a lithium grease.

(5) Instal the ball joints as described under *STEERING KNUCKLE – TO INSTAL.*

(6) Instal the stabiliser bar as described under *STABILISER – TO INSTAL.*

(7) Instal the brake drum as described under *WHEEL BEARINGS – TO REMOVE AND INSTAL.*

(8) Instal the road wheel and secure with mounting bolts.

(9) Lower the vehicle to the floor.

(10) Using a suitable alignment gauge, check the toe-in on the front wheels and adjust if necessary.

(11) Using a suitable castor camber gauge, check the camber and if necessary adjust at the upper ball joint eccentric bush.

**TO RENEW SHOCK ABSORBER STUD**

In the event of it becoming necessary to replace a shock absorber mounting stud on the torsion arm proceed as follows:

(1) Raise the vehicle and remove the road wheel on the side concerned, as described previously.

(2) Remove the lower torsion arm concerned as described under *TORSION ARMS AND BALL JOINTS – TO REMOVE.*

(3) Extract the dowel pin and the shock absorber stud.

**TO INSTAL NEW STUD**

Oversize studs are serviced for replacing the original standard size.

(1) The stud hole should be drilled with a drill slightly thinner than the oversize stud to be fitted. Ream out the hole sufficiently to make the stud a press fit with a maximum interference of .002".

(2) Press in the stud until seated with a projection of 1.75" to serve as the mounting for the shock absorber.

(3) To secure the stud on its mounting, drill a hole in the stud the diameter of the dowel pin and drive in the dowel pin.

(4) Instal the torsion arm and mount the shock absorber on the stud.

(5) Instal the road wheel and lower the vehicle to the floor.

## 11. TORSION BARS

**TO REMOVE**

The laminated torsion bars comprise nine leaves each, six of which are narrow and three are wide. The three wide leaves are positioned with three narrow leaves on either side to make up each torsion bar. They fit into the anchorage within the axle tube in the horizontal position and are secured by the grub screw.

(1) Raise the vehicle and support on stands.

(2) Undo wheel mounting bolts and withdraw the road wheels.

(3) Detach the ball joints from their mountings on the steering knuckle.

(4) Disconnect the tie-rod end from the steering knuckles.

(5) Remove the shock absorbers.

(6) Using a suitable piece of wire, suspend the steering knuckles complete with brake drums and back plates from the front axle.

(7) Slacken the torsion bar anchorage grub screw lock nuts and take out the grub screws.

(8) From both sides remove the torsion arms.

(9) Disconnect the front gearshift rod from the shift rod coupling and move it to one side to avoid any obstruction while removing the upper torsion bar.

(10) Withdraw the torsion bars from the axle tubes.

**TO INSTAL**

(1) Check all leaves of the torsion bars to ensure that they are in order and not broken.

(2) Carefully check the needle bearings and bushes to ensure that they are not excessively worn or damaged.

(3) Liberally apply lithium grease to the torsion bars, needle bearings and bushes.


Laminated Type Torsion Bar.

(4) Check the torsion bars to ensure that they have been correctly assembled and the recess for the grub screws will line up with the screws when installed. Tape the forward end of the torsion bar and instal in position and secure by tightening the grub screw.

(5) Connect the front gearshift rod to shift rod coupling.

(6) Instal the torsion arms in the axle tubes, lubricate bearings and secure the grub screw lock nut.

(7) Instal the shock absorbers.

(8) Instal the ball joints in their mountings on the steering knuckle.

(9) Instal the road wheel and secure with mounting bolts.

(10) Lower the vehicle to the floor.

## 12. TORSION ARM NEEDLE BEARINGS AND INNER BUSHES

### TO REMOVE

The torsion arm is mounted within the axle tube on two bearings, the inner being a metal bush with a plastic bearing seat and the outer is a needle roller bearing. The wear on the inner metal bushes is very slight and renewal should only become necessary when the contact point on the torsion bar shows signs of excessive wear.

(1) Raise the vehicle and support on stands.

(2) Remove the outer hub cap, wheel mounting bolts and withdraw both road wheels.

(3) Disconnect the brake hose pipes and plug the ends.

(4) Extract the split pin from the speedometer cable and remove inner hub cap.

(5) Undo the locking screw, remove the clamp nut and withdraw the hub and drum assembly.

(6) Disconnect the front gear shift rod at the rod coupling.

(7) Remove the shock absorber.

(8) Disconnect the ball joint and remove torsion arms from axle tubes.

(9) Undo the axle tube grub screws and remove the torsion bars.

(10) Using a suitable gauge, measure the inner metal bushes in the lower and upper axle tubes. If wear limit registers more than 1.692" renew metal bushes.

(11) Using a special tool, extract the needle bearings from the axle tubes.

(12) Using a special tool, extract the metal bushes from both axle tubes.

### TO INSTAL

(1) Before installing the needle roller bearings and metal bushes thoroughly clean out the axle tubes.

(2) Using a suitable internal gauge, measure the bores of the needle roller bearing seats in the axle tubes and also check their condition. The diameter of the seat of needle roller bearings in both axle tubes should be 2.244" and bearings should be 2.243".

*NOTE: If the bearing seats, in the axle tubes show excessive wear, and as it is not possible to rectify the wear, the axle tubes must be replaced.*

(3) Clean the needle roller bearings and check very carefully for any signs of wear or damage. If not in good condition, renew.

(4) Apply a light smear of lithium grease to the needle roller bearing seats and using a special drift, drive the bearing into the tube, with bearing shoulder marking on the outside. The bearing is correctly seated when the shoulder of the drift is up against the axle tube end.

(5) Using a special tool, drive the metal bushes through the needle roller bearings, using the bearing to serve as a pilot for the drift. The bush should be driven in until the shoulder of the drift is in contact with the tube.

(6) Instal the seal retainers in the tubes with the lugs in the vertical position.

(7) Instal the torsion bars as previously described and lubricate the grease nipples.

(8) Position the seal on the torsion arm and instal the arm and secure the grub screws and lock nuts and lubricate the grease nipples.

(9) Connect the front gearshift rod to rod coupling.

(10) Instal the shock absorbers.

(11) Instal the ball joints on the steering knuckle and lubricate the joints.

(12) Mount the tie-rod on the steering arm.

(13) Instal the hub and drum assembly, adjust wheel bearings and secure clamp nut pinch bolt.

(14) Connect the brake hose and bleed system.

(15) Fit inner hub cap.

(16) Instal the speedometer cable and insert split pin.

(17) Instal road wheel and secure with mounting bolts.

(18) Lower vehicle to the floor.

## 13. SHOCK ABSORBERS

### TO REMOVE

The shock absorbers fitted to the front axle are hydraulic double acting telescopic type and, being sealed, they require no maintenance.

When replacing shock absorbers, the main consideration is to procure shock absorbers with the same suspension characteristics as the original.

(1) Raise the front of the vehicle and remove the front wheels.

(2) Detach the shock absorbers from the upper and lower mountings on the side plate and torsion arm respectively.

### TO CHECK

Lock the lower bush eye of the shock absorber in the jaws of a vice and, in the vertical position, grasp the upper portion with the hands, slowly pulling up and pushing down, check for any slack spots. If there are no slack spots in the up and down motion, the condition is satisfactory for further service. This method of checking does not indicate the degree of efficiency in operation which can only be checked if the necessary equipment is available.

Check the condition of the rubber bushes for wear or deterioration and renew if necessary.

Check mounting studs and bolts for wear and replace if necessary.

### TO INSTAL

(1) Position the shock absorbers on the upper and lower mounting and secure with nuts and bolts.

(2) Tighten the lower mounting stud nut to a torque of 25 ft/lb and the upper bolt and nut to a torque of 35 ft/lb.

(3) Instal the wheels and lower the vehicle.

## 14. FRONT SUSPENSION FAULT DIAGNOSIS

**(1) Front end noise.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Loose or worn upper steering knuckle ball joint or link pin. | – Tighten or renew ball joint or link pin. |
| (b) | Loose or worn steering lower knuckle ball joint or link pin. | – Tighten or renew lower ball joint or link pin. |
| (c) | Noise in shock absorber and/or mountings. | – Renew shock absorber unit and/or mountings. |
| (d) | Worn steering linkage or intermediate lever components. | – Renew worn components. |
| (e) | Mal-adjusted hub bearings. | – Readjust or renew hub bearings. |

**(2) Poor or erratic road holding ability.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Low or uneven tyre pressure. | – Inflate tyres to recommended pressures. |
| (b) | Defective shock absorber operation. | – Check and renew faulty shock absorbers. |
| (c) | Incorrect front end alignment. | – Check and adjust alignment. |
| (d) | Loose or defective front wheel bearings. | – Adjust or renew wheel hub bearings. |
| (e) | Faulty or incorrectly adjusted steering gear. | – Adjust or renew faulty components. |
| (f) | Defective tyres or front wheel unbalance. | – Renew front tyres and balance front wheels. |

**(3) Heavy steering.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Low or uneven tyre pressures. | – Check and inflate tyres to recommended pressures. |
| (b) | Incorrect front end alignment. | – Check and adjust alignment. |
| (c) | Lack of lubricant in steering gear and components. | – Check and lubricate as necessary. |
| (d) | Worn or damaged suspension components. | – Check and renew worn or damaged components and adjust suspension alignment. |
| (e) | Incorrect steering gear adjustment. | – Check and adjust steering gear. |

**(4) Front wheel wobble or shimmy.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Tyre and/or wheel unbalance. | – Check and balance tyre and wheel as a unit. |
| (b) | Rapid and uneven tyre wear. | – Check front end alignment (see Wheels and Tyres). |
| (c) | Worn or loose hub bearings. | – Check and renew or adjust hub bearings. |
| (d) | Worn or damaged steering linkage. | – Check and renew faulty components and adjust. |
| (e) | Incorrect front end alignment. | – Adjust and/or renew front end components. |
| (f) | Mal-adjusted or worn steering gear. | – Renew and/or adjust steering gear components. |
| (g) | Steering gear loose on frame mounting or off centre. | – Check and tighten mounting and/or centre steering gear. |

**(5) Vehicle pulls to one side.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Low or uneven tyre pressure. | – Check and inflate tyres to recommended pressures. |
| (b) | Incorrect or unequal front end alignment – side to side. | – Check and adjust to restore correct alignment. |
| (c) | Weak or incorrectly adjusted torsion bars. | – Adjust torsion bars. |
| (d) | Front brake dragging. | – Adjust or rectify cause. |
| (e) | Steering gear off centre. | – Check and re-centre steering gear. |

# REAR SUSPENSION

## SPECIFICATIONS

| | |
|---|---|
| Type | Independent, swing axles with longitudinal spring plates. Open drive shafts on later models. |
| Springs | One round torsion bar on each side. |

| | |
|---|---|
| Torsion bars: | |
| Length | 23.2" |
| Diameter | 1.14" |
| Spring plate adjustment (unladen) | 20° ± 30' inclination of the spring plate |
| Ambulance | 18°40' ± 20' |
| Fire Truck | 21°30' ± 20' |
| Rear wheel alignment | −20' ± 15' (toe-out) |
| Shock absorbers | Double acting, telescopic |

## 1. EARLY TYPE SUSPENSION

The rear wheels are sprung independently. The inner ends of the two torsion bars are anchored in the centre of the frame cross tube by a spline engagement. The outer ends of the torsion bars, which are also provided with splines, carry the spring plates (radius arms), the hubs of which are rubber-cushioned. The rear ends of the spring plates are bolted to the reduction gear cases on early models and to the rear wheel bearing housing on later models. The suspension is adjustable by means of the splines. Double-acting telescopic shock absorbers prevent excessive rebound.

### TO REMOVE TORSION BAR (Except Open Drive Shaft Models)

(1) Loosen the rear wheel mounting bolts.

(2) Support the vehicle in a horizontal position and remove the rear wheel.

(3) Remove the lower shock absorber mounting bolt.

(4) Pry up the lock plates and remove the spring plate mounting bolts.

(5) Pull the rear axle tube towards the rear.

(6) Remove the screws that attach the spring plate hub cover and take off the cover.

(7) Withdraw the spring plate and both rubber cushions.

(8) Withdraw the torsion bar from the frame cross tube.

*NOTE: In the case of a broken torsion bar, push the broken end from the splined centre anchor by means of a steel rod after having removed the torsion bar.*

### TO INSTAL TORSION BAR (Except Open Drive Shaft Model)

When installing, the following points should be observed:

(1) Inspect the torsion bar splined ends and paint for damage. Make sure there are no signs of rust, replace if necessary.

(2) Grease the splines of the torsion bar.

(3) Apply some graphite when installing the rubber cushions.

(4) Instal the torsion bar and spring plate and adjust as necessary.

(5) Hook the torsion bar tensioner VW655 to the rear cross tube flange and push the sliding part of the tensioner upwards against the lower end of the spring plate.

(6) By turning the nut, lift the spring plate until its lower edge is higher than the lower stop in the cross tube flange.

(7) Screw the spring plate installing tool VW656 to the cross tube flange in place of the spring plate hub cover.

Place the thrust pad on the spring plate hub and press in the spring plate by tightening the thrust screw.

(8) Remove the tools and instal the spring plate hub cover.

*NOTE: To facilitate the installation of the hub cover and to avoid damage to the threads, it is recommended to screw two tapered guide pins (approximately 1.8" long) in two of the tapped holes, diagonally opposite. The cover is then pushed over the two guide pins, allowing two of the cover bolts to be screwed in. After this the two guide pins are removed and the remaining two bolts screwed in.*

(9) Clean the mating faces between the spring plate and reduction gear case (traces of paint and rust). Tighten the spring plate mounting bolts to a torque of 72-87 ft/lb. Use new lock plates.

*NOTE: When checking all bolts and nuts for tightness at routine servicing, special attention should be paid to the spring plate mounting bolts.*

**SPRING PLATES**

It is a point of major importance that there is no difference in the inclinations of both spring plates to ensure satisfactory riding qualities under all conditions of load. When adjusting one spring plate, the inclination of the other should in all cases be checked too.

An accurate adjustment of the rear suspension is effected by measuring the inclination of the spring plate with the frame in the horizontal position and spring plate in an unloaded condition.

The inclination of the unloaded spring plate in the case of all models with the exception of the ambulance and the fire truck should be 20° ± 30'.

The inclination of the unloaded spring plate in the ambulance is 18°40' ±20'.

The inclination of the unloaded spring plate in the fire truck is 20°30' ± 20'.

**TO ADJUST**

(1) Check the horizontal position of the vehicle by placing protractor VW245a on one of the frame side members.

(2) Insert the inner end of the torsion bar in the centre anchor.

(3) Press the spring plate on the outer end of the torsion bar.

(4) Place the protractor VW245a on the unloaded spring plate. To obtain a correct reading, the half axle must be supported.

(5) Adjust the protractor until the bubble is in the centre position.

If the protractor indicates a departure from the prescribed inclination, the adjustment is to be corrected. An accurate adjustment is possible by the splines cut in both ends of the torsion bar in different numbers.

Inner end: 44 splines; Outer end: 48 splines.

If the inner end of the bar is turned by one spline, the adjustment is altered by 8°10'. If the spring plate is displaced by one spline, the adjustment is altered by 7°30'. Thus, the inclination of the spring plate can be corrected by 0°40'.

*NOTE: When removing both torsion bars, it is not necessary to mark the left or right torsion bar for reassembly, as an alteration in the direction of torsion imposed on the bars has no bearing on their service life.*

**REAR WHEEL TRACK AND ALIGNMENT**

The rear wheel position is important to the roadholding and cornering stability of the vehicle and to the tyre life.

If the vehicle should act strangely on the road, show signs of tyre wear, or it is thought that the wheel alignment has been affected by accidental damage, the vehicle should be checked as regards steering geometry and wheel alignment and, if necessary.

Departures from the prescribed wheel alignment values or a faulty suspension can adversely affect a wheel of the other axle. The measurements of the rear wheel alignment can only be taken by means of an axle tester which is accurate and operates independently of the vehicle.

The vehicle should only be checked under the following conditions:

(a) Correct tyre pressures.

(b) Vehicle unladen.

(c) Correct adjustment of the spring plates.

The following points are of importance when checking the rear axle:

(1) Rear axle track.

(2) Position of the rear wheels.

(3) Camber angles.

The following readings are correct for all models with correct spring plate adjustment unladen: Toe-out −20' ± 15'.

The values for the rear wheel position influence the wheel alignment. Plus or minus values for both wheels should be added. If the values differ, ie, (±), subtract the smaller value from the other.

The alignment can only be altered by correcting the wheel position. Even with the proper rear wheel alignment, the rear wheel positions may be incorrect. For this reason the measurements of the wheel positions are of great importance.

**TO ALIGN REAR WHEELS**

(1) The rear wheel total alignment must be in accordance with the specified nominal values.

(2) The departure of the wheel from positions parallel to the longitudinal centre line of the vehicle must not vary by more than 10' from the specified dimensions.

*NOTE: Any departure from the dimensions as in (2) above of the rear wheels to the vehicle centreline may be caused by one wheel having a toe-in (+) and the other a toe-out (−), or one wheel being straight-sheed and the other not.*

For example:

left + 10' (toe-in) and right −20' (toe-out)

left −25' (toe-out) and right 0.

Both rear wheels should have approximately the same toe-out values, for example: left −5' (toe-out) and right −10' (toe-out'.)

A correction of the wheel angularity is carried out by machining the holes in the spring plates, or by installing a suitable piece of sheet metal between the centre flange of the rear cross member and the front transmission mounting.

Depending on the amount of variation, it may be necessary to either correct the alignment of both wheels or to carry out different operations on both wheels. Elongating the holes in the spring plates towards the front results in toe-in, towards the rear in toe-out. Machining the holes as much as .040"-.050" alters the alignment approximately 10'.

## 2. LATER TYPE SUSPENSION (OPEN DRIVE SHAFT)

### TO REMOVE

(1) Undo the shock absorber mounting bolts and remove the shock absorber.

*NOTE: Stamp alignment marks on the wheel bearing housing and the spring plate at the top and bottom before removing the bearing housing, to facilitate correct positioning at the time of assembling. If any of the components is replaced, using an axle alignment stand, check the position of the rear wheels and rectify if required.*

(2) Remove the complete drive shaft and fit plastic caps to the constant velocity joints.

(3) Remove the brake drum.

(4) Disconnect the brake fluid supply line and the hand brake cable.

(5) Undo the nuts from the bearing housing and remove the housing.

(6) Undo the spring plate hub cover securing bolts and remove the cover.

(7) Using a suitable tool, lever off the spring plate from the lower stop to relieve tension.

(8) Extract the rubber bush and withdraw the torsion bar carefully from the cross tube. Avoid damaging the protective paint.

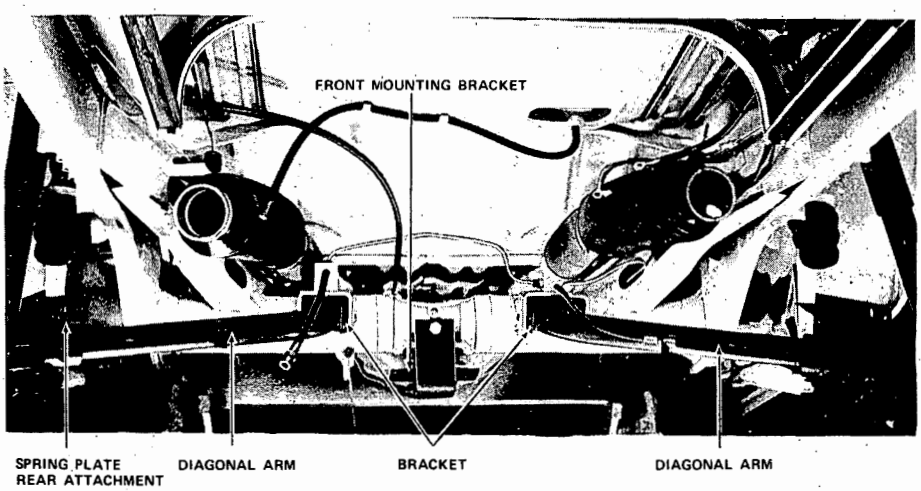
*NOTE: A broken piece of the torsion bar can be removed with a tube, the end of which has been opened into a conical shape with a suitable punch. In the event of the piece being too short, remove the other torsion bar and, using a rod, push the broken piece through with the bar.*

### TO INSTAL

Installation is a reversal of the removal procedure observing the following points:

(1) Carefully check the torsion bar, the rubber bush and the spring plate for wear, deterioration or damage and renew parts if necessary.

*NOTE: During manufacture torsion bars are pre-stressed in a right or left working direction and therefore they must*




Rear Suspension Diagonal Control Arms and Spring Plates. (Open Drive Shaft Type Suspension.)

*not be interchanged. The letters L or R are stamped on the end face of each bar to indicate LEFT or RIGHT hand fitting.*

(2) Smear grease on the torsion bar serrations and carefully insert the bar into the cross tube and avoid damage to the paint on the bar.

*NOTE: In the event of the paint on the torsion bar being damaged, ensure that it is touched up before installation to prevent the formation of rust which can cause minute cracks on the surface of the bar and eventually cause fractures due to fatigue.*

(3) Apply french chalk to the spring plate mounting, rubber bush and the spring plate hub. Instal and adjust the spring plate as previously described in the appropriate section.

(4) Loosely secure the spring plate bearing cover.

(5) Using tool VW 655/3, lift the spring plate on to the lower stop.

(6) Fully tighten the spring plate bearing cover bolts.

(7) Align the identification marks and bolt the wheel bearing housing, control arm and spring plate together.

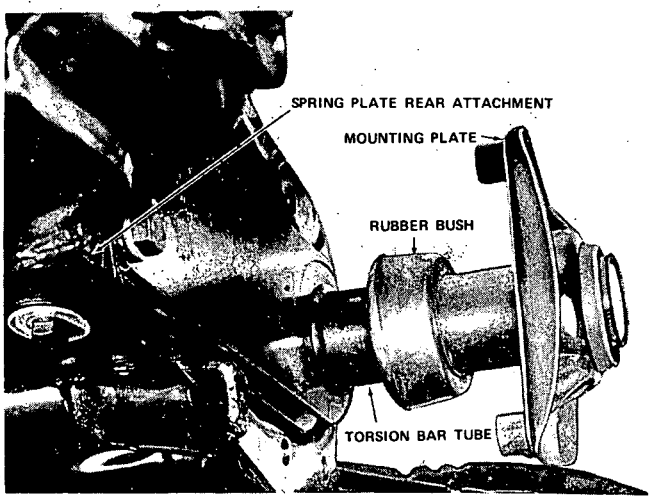
*NOTE: In case of replacement of the spring plate, the bearing housing or the control arm, check the position of the rear wheels on an axle alignment stand and rectify as required.*

(8) Connect the hydraulic brake fluid supply pipe and hand brake cable. Instal the brake drums, drive shafts and shock absorbers, bleed the hydraulic system and adjust the hand brake.

With the torsion bar free of tension, the setting angle is given in degrees from the vehicle longitudinal axis. The deviation between the vehicle axis and the true horizontal must first be determined and taken into account in the setting angle when using the protractor VW 261 which has a spirit level working from the horizontal plane.

There are a different number of splines on each end of the torsion bar: Inner end 44 splines and Outer end 48 splines.

By turning the inner end by one spline, the angle is altered by 8°10' and if the spring plate is turned back one outer spline, this will alter the angle by 7°30'. This indicates that the least alteration possible is 40'.




Spring Plate and Torsion Bar Forward Pivot Bearing Components. (Open Drive Shaft Type.)

After a vehicle has been in operation for a long period, both torsion bars must be adjusted since the torsion bars settle down while the vehicle is in service.

**TO ADJUST**

(1) Ascertain the deviation of the vehicle longitudinal axis from the horizontal and take note of the figure.

(2) Instal the spring plate on the torsion bar and using protractor VW 261, position it on the spring plate and check the angle. The spring plate should be lifted while measuring to remove all play in the splines.

(3) After checking, if it is found that the angle is in excess of 40' from the specified figure, correct the setting.

(4) To rectify setting, turn the torsion bar (44 inner splines) one tooth forward or one tooth back and the spring plate (48 outer splines) turn one tooth in the opposite direction.

(5) Instal the spring plate bearing cover, tension the torsion bar and instal all the parts previously removed. Refer to the appropriate section to instal.

## 3. REAR SHOCK ABSORBERS

Correctly operating rear shock absorbers are, besides a proper adjustment of spring plates, of great importance to satisfactory suspension and road-holding of the car. The compression and re-bound actions of the shock absorbers correspond to the springing characteristics of the car. The shock absorber prevents the spring plate from striking the lower stop at the crossmember flange during re-bound.

The shock absorbers require no maintenance and have an adequate fluid reservoir. A more accurate check of the efficiency of the shock absorbers can be made by means of special testing appliances. Shock absorber action may be roughly checked by bouncing each corner of the car in turn

or by riding the car over an uneven road. A check by compressing the removed shock absorber by hand will only give indication whether or not there is a resistance. The degree of efficiency of the compression and re-bound strokes cannot be determined by this method.

**TO REMOVE**

(1) Lift the vehicle on a jack or hoist.

(2) Remove the two nuts from shock absorber mounting bolts.

(3) Take off the shock absorber.

**TO INSTAL**

(1) Test the shock absorber and replace it if necessary.

*NOTE: The rear shock absorbers are painted grey for easy identification as the shock absorbers for the front axle are of the same size, but have different operation characteristics.*

(2) Inspect the bushes and rubber grommets for wear. Replace if necessary.

Replace damaged rubbers.

(3) Securely tighten the mounting bolt nuts.

## 4. REAR SUSPENSION FAULT DIAGNOSIS

**1. Noise in suspension.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Defective shock absorber and/or mounting. | – Renew faulty component. |
| (b) | Loose spring plate pivot bushes. | – Overhaul and renew bushes. |
| (c) | Loose spring plate to bearing housing bolts. | – Renew and tighten bolts and align rear wheels. |
| (d) | Loose or worn axle tube inner attachments (except open drive shaft model). | – Tighten or renew faulty components. |
| (e) | Loose or worn diagonal arm bushes (open drive shaft models). | – Tighten or renew faulty components. |
| (f) | Incorrect alignment of rear wheels. | – Check and re-align rear wheels. |

**2. Low or uneven rear suspension height.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Incorrect spring plate angle or torsion bar adjustment. | – Check and adjust spring plate/s as necessary. |
| (b) | Weak or sagging torsion bar/s. | – Adjust or renew torsion bar/s. |

# BRAKES

## SPECIFICATIONS

**UP TO CHASSIS No 117901**

| | |
|---|---|
| Type: | |
| Front | Duplex – two leading shoes |
| Rear | Simplex – leading and trailing shoes |
| Operation: | |
| Footbrake | Hydraulic – all wheels |
| Handbrake | Mechanical – rear wheels |
| Front brakes: | |
| Drum diameter | 9.05" ± .008" |
| Lining width | 1.16" |
| Lining thickness | .15" – .16" |
| Wheel cylinder bore diameter | .874" |
| Rear brakes: | |
| Drum diameter | 9.05" ± .008" |
| Lining width | 1.16" |
| Lining thickness | .15" – .16" |
| Wheel cylinder bore diameter | .750" |
| Master cylinder: | |
| Diameter | .750" |
| Stroke | 1.18" |
| Pushrod length | 2.05" – 2.09" |
| Adjustment: | |
| Front and rear assemblies | Access hole in the brake drum to adjusting nuts |
| Handbrake | At brake cables |
| Hydraulic fluid | VW/Lockheed |

**FROM CHASSIS No 117902**

| | |
|---|---|
| Type: | |
| Front | Duplex – two leading shoes |
| Rear | Simplex – leading and trailing shoes |
| Operation: | |
| Footbrake | Hydraulic – all wheels |
| Handbrake | Mechanical – rear wheels |
| Front brakes: | |
| Drum diameter | 9.062" ± .012" |
| Lining width | 2" |
| Lining thickness | .19" – .2" |
| Wheel cylinder bore diameter | 1" |
| Rear brakes: | |
| Drum diameter | 9.055" ± .008" |
| Lining width | 1.6" |
| Lining thickness | .19" – .2" |
| Wheel cylinder bore diameter | .874" |
| Master cylinder: | |
| Diameter | .874" |
| Stroke | 1.18" |
| Push rod length | 2.32" – 2.36" |
| Adjustment: | |
| Front and rear assemblies | Access hole in the brake drum to adjusting nuts |
| Handbrake | At brake cables |
| Hydraulic fluid | VW/Lockheed |

**FROM CHASSIS No 1144303**

| | |
|---|---|
| Type: | |
| Front | Duplex – two leading shoes |
| Rear | Simplex – leading and trailing shoes |
| Operation: | |
| Footbrake | Hydraulic – all wheels |
| Handbrake | Mechanical – rear wheels |
| Front brakes: | |
| Drum diameter | 9.842" ± .008" |
| Lining width | 2.16" |
| Lining thickness | .18" – .2" |
| Wheel cylinder bore diameter | 1" |
| Rear brakes: | |
| Drum diameter | 9.842" ± .008" |
| Lining width | 1.77" |
| Lining thickness | .18" – .2" |
| Wheel cylinder bore diameter | .874" |
| Master cylinder: | |
| Diameter | .874" |
| Stroke | 1.417" |
| Push rod length | 2.735" – 2.774" |
| Adjustment: | |
| Front and rear assemblies | Access hole in the brake drum to adjusting nuts |
| Handbrake | At brake cables |
| Hydraulic fluid | VW/Lockheed |

**FROM CHASSIS No 217019488**

As above with the exception of the master cylinder.

Master cylinder:

| | |
|---|---|
| Type | Tandem |
| Front wheel circuit stroke | .748" |
| Rear wheel circuit stroke | .511" |
| Diameter | .874" |

**FROM CHASSIS No 218000001**

As above with the exception of the master cylinder.

Master cylinder:

| | |
|---|---|
| Front wheel circuit stroke | .944" |
| Rear wheel circuit stroke | .551" |

**TORQUE WRENCH SETTING**

| | |
|---|---|
| Brake hose/line to wheel cylinder union | 12 ft/lb |
| Back plate securing bolts/nuts | 42 ft/lb |
| Front wheel cylinders connecting pipe unions | 18 ft/lb |
| Wheel cylinder securing bolts | 40 ft/lb |

## 1. DESCRIPTION

Hydraulically operated drum brakes are fitted to all models, with two leading shoe type brakes on the front wheels, and leading and trailing shoe type on the rear wheels.

The front brakes have a separate wheel cylinder for each shoe, while the rear wheel shoes are operated by a single cylinder fitted with two opposed pistons.

Adjustment for each of the front brake shoes is effected by a toothed adjusting nut located on a screw at the end of each wheel cylinder. The adjuster for each rear brake shoe, also of the toothed adjusting nut type, is located in a block anchored to the back plate opposite the wheel cylinder. Access to the adjusters is gained by a drilling in each of the brake drums through which a screwdriver can be inserted to rotate the toothed adjusting nut.

The handbrake is connected to each rear wheel assembly by cable, the cable is attached to and operates a pivotted lever linked to the leading shoe of each assembly. A push bar is interposed between the leading shoe and lever at one end and the trailing shoe at the opposite end, movement of the lever is transmitted through the push bar to the trailing shoe.

The hydraulic system consists of a master cylinder and a fluid reservoir, and hydraulic lines and hoses which carry the pressure generated in the master cylinder to each of the wheel cylinders. The master cylinder is attached to the frame beneath the vehicle floor and is connected by push rod to the brake pedal lever. A bleeder valve for each wheel assembly is located at the rear of the brake back plates.

Application of the brake pedal forces the piston into the master cylinder by means of the push rod, the pressure generated is fed equally to each of the wheel cylinders and remains constant with the pedal pressure. The hydraulic fluid pressure compels the pistons in each wheel cylinder to move outwards causing the brake shoes to contact the drum. On release of the pedal pressure, the fluid returns to the master cylinder by pressure created at the brake shoe return springs which pull the shoes from the drum and return the wheel cylinder pistons to the off position.

From Chassis No 1144303 a heavy duty braking system is fitted to all models. Although of basically similar design to models prior to that Chassis number, the heavy duty system involves an increase in size of master cylinder stroke, brake drum and linings etc, (refer to Specifications). The heavy duty braking system cannot be installed to models with the normal system unless modifications are carried out to front and rear axles.

From Chassis No 217019488 a dual circuit hydraulic system is fitted, operated by a tandem type master cylinder. The master cylinder is fitted with two piston and spring assemblies, one assembly operating the front brakes whilst the other operates the rear brakes. In the event of a fault or failure in one of the circuits, the remaining circuit will continue to operate although there will be an obvious increase in brake pedal travel.

## 2. MASTER CYLINDER

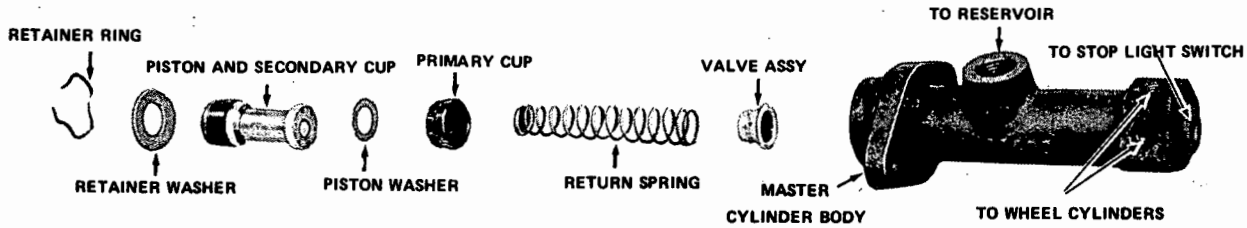
**TO REMOVE AND INSTAL (Single Circuit)**

(1) Raise the vehicle on a lift or place over a pit.

(2) Remove the cover plate located under the pedal linkage.

(3) Take out the split pin and remove the push rod clevis pin and washer attaching the push rod to the brake pedal lever.

(4) Disconnect the stop lamp wires at the stop lamp switch located on the end of the master cylinder.




Components of Master Cylinder Single Circuit Type.

(5) Disconnect the hydraulic fluid pipes at the connections on the master cylinder and plug the pipes to prevent the entry of dirt into the hydraulic system.

(6) Loosen and remove the two master cylinder securing bolts and nuts and withdraw the master cylinder towards the rear of the vehicle.

Installation is a reversal of the removal procedure, with special attention to the following points:

(1) Check the length of the piston push rod from the piston end (convex) of the rod to the inner face (towards the master cylinder) of the adjusting nut. Adjust if necessary.

*NOTE: On normal braking system with a master cylinder stroke of 1.18" the push rod length should be 2.32" to 2.36".*

*On heavy duty braking system with a master cylinder stroke of 1.4" the push rod length should be 2.74" to 2.77".*

(2) With the master cylinder installed, check the free play between the push rod and piston which should be .040". If necessary adjust the clearance by bending the stop plate in the direction required, by use of a hammer if necessary.

*NOTE: The brake push rod stop plate is located at the rear of the clevis pin end of the push rod and brake pedal lever.*

(3) It will be necessary to bleed the system on completion of the installation, see under *HYDRAULIC SYSTEM – TO BLEED* for description.

(4) Use care not to spill hydraulic fluid on any lacquered surface.

**TO DISMANTLE (Single Circuit)**

(1) With the master cylinder removed from the vehicle, drain off the fluid from the reservoir into a suitable container.

(2) Unscrew the fluid reservoir from the master cylinder body.

(3) Pull the push rod from the rubber boot and ease the rubber boot off the open end of the master cylinder.

(4) Take out the retaining ring at the end of the cylinder and remove the piston stop washer.

(5) Withdraw the piston, washer, main cup, return spring and check valve assembly from the cylinder bore in that order.

*NOTE: On earlier models a different type of check valve may be fitted with a seat at the cylinder end, remove the check valve seat also.*

(6) Unscrew the stop lamp switch from the end of the master cylinder.

**TO CLEAN AND INSPECT**

(1) Thoroughly clean the master cylinder components and the inside of the master cylinder bore with methylated spirits. Do not use petrol or other mineral spirits.

(2) Check the inside of the bore for wear and/or pitting. If necessary, gently hone the cylinder bore.

(3) Remove the secondary cup from the piston and examine the piston for wear.

(4) Check the condition of the cups, check valve, and rubber boot, and renew if perished or deteriorated. It is advisable in any case to renew all rubber components.

(5) Ensure that the intake and compensation ports are clear and free of any obstruction.

(6) Check that the reservoir filter is clean and remove any sediment that may have accumulated in the bottom of the reservoir.

(7) Ensure that the breather hole in the fluid reservoir cover is clean.

**TO ASSEMBLE (Single Circuit)**

(1) Dip the master cylinder components in clean hydraulic fluid and instal the secondary cup on the piston with the lip of the cup facing towards the closed end of the piston.

(2) Ensure that the cup is seating squarely in the piston seal groove.

(3) Instal the check valve assembly at the open end of the return spring and insert in the cylinder bore, check valve first.

*NOTE: If the master cylinder is fitted with a check valve and seat, position the seat at the end of the bore prior to inserting the valve.*

(4) Insert the main cup in the cylinder bore with the lip of the cup towards the outlet end of the cylinder, taking care that the cup lip is not turned back or damaged on entry.

(5) Position the main cup in the bore so that the return spring seat is located in the centre of the cup, instal the piston washer against the face of the seal.

(6) Enter the piston and secondary cup into the bore taking care not to turn back or damage the cup lip as it enters the bore.

(7) Push the assembly in until it clears the end of the master cylinder bore and instal the piston stop washer and retaining ring. Ensure that the retaining ring is seated correctly in the groove at the end of the bore.

(8) Using a new gasket instal the reservoir on the master cylinder body.

*NOTE: On the earlier models, ensure that the mark on the bottom of the reservoir points to the stop lamp switch.*

(9) Instal and tighten the stop lamp switch.

(10) Instal the large end of the rubber boot over the open end of the master cylinder and ensure that it seats correctly.

(11) Insert the push rod through the boot and engage the end in the piston bore, the adjusting nut should be inside the rubber boot with the hole of the boot seated on the plain part of the push rod.

(12) Pour a small quantity of clean hydraulic fluid in the reservoir and pump the push rod until fluid begins to emerge from the cylinder outlet.

## TO REMOVE AND INSTAL (Dual Circuit)

(1) Raise the vehicle on a lift or place over a pit.

(2) Disconnect the hydraulic brake pipes to the front and rear brakes and drain the fluid from the master cylinder and fluid reservoir into a suitable container.

(3) Take out the master cylinder securing bolts and withdraw the master cylinder from the end of the push rod.

Installation is a reversal of the removal procedure with special attention to the following points:

(1) Instal the master cylinder, locating the small end of the rubber boot over the push rod.

(2) Fit and tighten the master cylinder securing bolts.

(3) Connect the hydraulic pipes and tighten securely.

(4) Refill the fluid reservoir and bleed the system in the normal way.

## TO DISMANTLE (Dual Circuit)

(1) Remove the master cylinder rubber boot and the stop screw for the front brake piston and spring assembly.

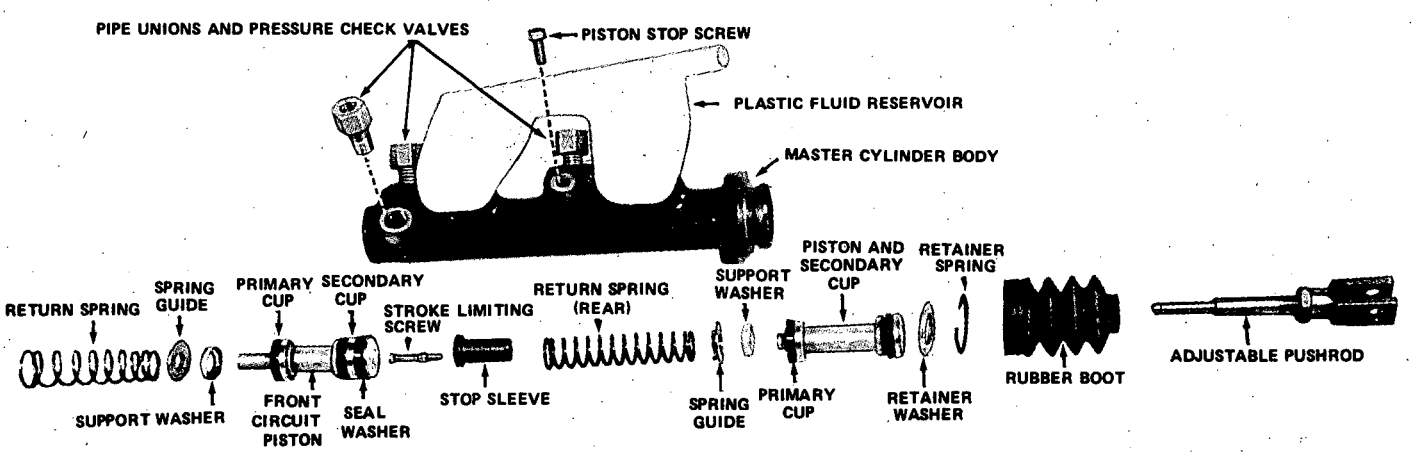
(2) Take out the spring ring and stop washer from the open end of the master cylinder and withdraw the rear circuit piston with washer and primary cup, the support washer, spring guide and rear circuit piston return spring, stop sleeve and stroke limiting screw as an assembly.

(3) Withdraw the front circuit piston, secondary cup and seal assembly with primary cup and washer, support washer and front circuit piston return spring and guide plate.

(4) If necessary, unscrew and remove the three outlet unions and seals containing the residual pressure check valves.

## TO CLEAN AND INSPECT

(1) Thoroughly clean the master cylinder components and the inside of the master cylinder bore with methylated spirits. Do not use petrol or other mineral spirits.




Components of Master Cylinder Dual Circuit Type.

(2) Check the inside of the bore for wear and/or pitting. If necessary, gently hone the cylinder bore.

(3) Check the condition of the rubber cups, seals and rubber boot and renew if perished, deteriorated or damaged.

(4) Ensure that the compensating ports in the cylinder are free from any obstruction.

**TO ASSEMBLE (Dual Circuit)**

(1) Lubricate all the hydraulic brake components with clean hydraulic fluid.

(2) Instal a new secondary cup and rubber seal on the front circuit piston, so that the lipped edge of the cup is toward the spigot end of the piston.

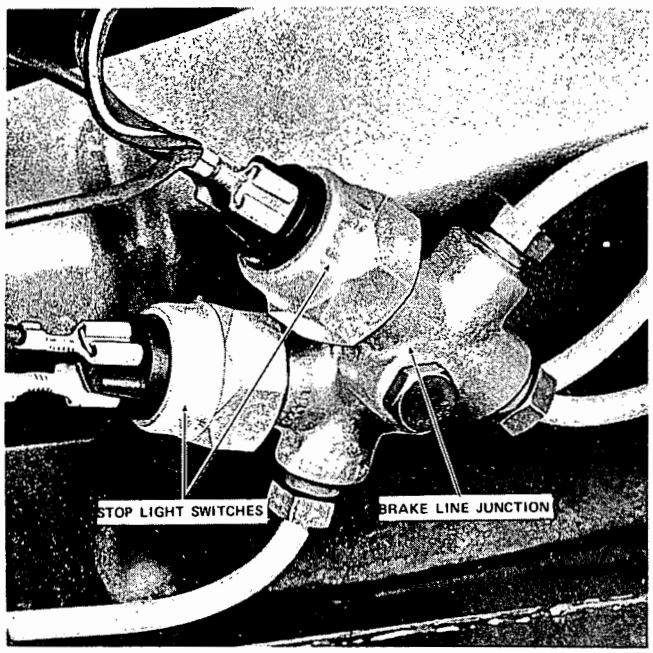
(3) Place the cup washer, primary cup (lipped edge forward), support washer, spring guide plate and spring on the spigot end of the front circuit piston.

(4) Insert the forward piston, so assembled, into the cylinder bore and push it down until the spring contacts the blind end of the cylinder bore. Ensure that the lips of the primary and secondary cups are not turned back or damaged.

(5) Instal a new secondary cup in the groove in the main piston so that the lipped edge of the cup is to the spigot end of the piston.

(6) Place the cup washer, primary cup, support washer, guide plate, stop sleeve, spring and stroke limiting screw on the spigot end of the main piston and insert the main piston assembly into the cylinder bore, taking care not to turn back or damage the lip of the primary or secondary cup.

(7) Push the main piston down the cylinder bore, position the stop washer and instal the retaining spring clip.




Brake Pipe Junction with Stop Light Switch for each Circuit. Dual Circuit System.

(8) Push the main piston down the master cylinder bore and instal the front brake circuit piston stop screw and washer in the cylinder body.

(9) Instal the pipe union and check valve assemblies and seals and tighten securely.

(10) Instal the rubber boot over the open end of the master cylinder.

## 3. FRONT BRAKE ASSEMBLY

**TO REMOVE BRAKE SHOES**

(1) Raise the front of the vehicle and support on stands.

(2) Take out the split pin retaining the speedo cable in the left front hub cap and withdraw the cable rearwards from the steering knuckle.

(3) Remove the front hub caps, loosen and remove the hub assembly securing nut and locking assembly, draw the brake drum and hub assembly from the stub axle.

*NOTE: Refer to FRONT SUSPENSION – TO REMOVE AND INSTAL FRONT HUBS for description of operation (3) which differs on some models.*

It may be necessary to back off each brake shoe from the drum at the toothed adjusting nuts in order to facilitate removal of the assembly.

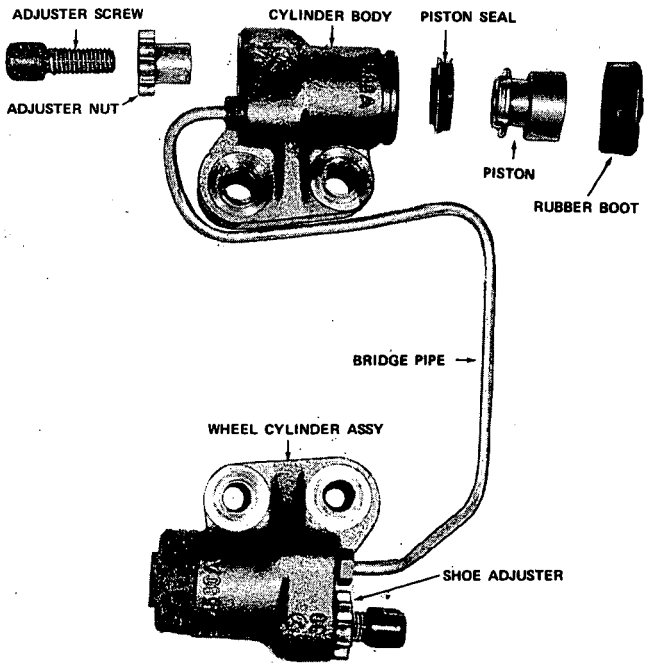
(4) Mark each shoe for correct assembly, using a screwdriver as a lever, ease each end of the brake shoes out of the slots in the adjusting screws taking care not to damage the leaf spring on the adjuster.

(5) Remove the shoe assemblies from the back plate, if necessary unhook the return springs from the shoes.

**TO REMOVE WHEEL CYLINDERS AND BACK PLATE**

(1) Carry out the procedure previously described to remove the brake shoes.

(2) Loosen off the brake line union at the support




Front Wheel Cylinders and Bridge Pipe Arrangement.

bracket on the side member, remove the flexible hose retainer and withdraw the hose from the support bracket. Plug the pipes to prevent the entry of dirt to the hydraulic system.

(3) Disconnect the flexible hose from the support bracket attached to the steering knuckle.

(4) Unscrew the flexible hose at the union attaching it to the wheel cylinder.

(5) Loosen off and remove the connecting pipe between the two wheel cylinders on the back plate.

(6) Take out the four securing bolts attaching the wheel cylinders and back plate to the steering knuckle.

(7) Detach the wheel cylinders from the back plate which can now be removed over the stub axle.

## TO CLEAN AND INSPECT

(1) Check the shoe linings for wear and renew as necessary.

(2) Check the shoe linings for oil saturation or gumminess and renew as required.

*NOTE: Linings must be renewed as sets only, with the corresponding linings on the other front wheel.*

(3) Check the brake drums for cracks or scoring and renew or regrind as necessary.

(4) Ensure that the toothed adjusting nuts are free on the threads of the adjusting screws, smear the threads lightly with high melting point graphite grease.

(5) Check the leaf spring tension on the anchor block, if necessary bend the spring to increase the tension.

(6) Check the tension of the brake shoe return springs by comparison with new springs and renew if required.

(7) Ensure that the wheel cylinder rubber boots are not perished or deteriorated. Renew if required.

(8) Check the flexible brake hoses for signs of chafing or damage and renew if required.

(9) Ensure that the back plate and steering knuckle contact faces are clean and free of burrs.

## TO ASSEMBLE AND INSTAL

(1) Position the back plate over the stub axle and on the steering knuckle.

(2) Place the wheel cylinders on the back plate face, instal and tighten evenly the securing bolts to a torque of 42 ft/lb.

(3) Instal the connecting pipe between the wheel cylinders and tighten the unions to a torque of 18 ft/lb.

(4) Screw in the flexible brake hose at the wheel cylinder and tighten the union to a torque of 12 ft/lb.

(5) Connect the flexible hose to the support bracket on the steering knuckle and ensure that the hose is not twisted or kinked.

(6) Insert the flexible hose threaded end through the support bracket on the side member, fit the hose retainer, screw the brake line union onto the end of the flexible hose and tighten to a torque of 12 ft/lb.

(7) Check for proper positioning of the hose by turning the steering from lock to lock, ensure that the hose has adequate clearance and is not twisted or pulled when the wheels are on full lock.

(8) Engage the return springs into the rear shoe from the back plate side, position the shoe on the back plate with the ends of the shoe located at the wheel cylinders.

(9) Engage the free ends of the return springs in the front shoe from the back plate side, using a screwdriver as a lever ease the shoe ends into location on the wheel cylinders.

(10) Centralize the shoes on the back plate and check that the return springs are not bearing on either the wheel cylinder connecting pipe or the spacer on the stub axle.

(11) Prior to installing the brake drum, check the seal for wear or damage, instal the drum and hub assembly and adjust the front wheel bearings as described in the *FRONT SUSPENSION* section.

(12) Adjust the brake shoes and bleed the hydraulic system as described under the appropriate sections.

## 4. REAR BRAKE ASSEMBLY

### TO REMOVE BRAKE SHOES

(1) Raise the rear of the vehicle and support on stands.

(2) Remove rear wheels, release the handbrake, remove the rear brake drums as described under the *REAR SUSPENSION* section.

*NOTE: It may be necessary to back off each brake shoe from the drum at the toothed adjusting nuts in order to facilitate removal.*

(3) Disconnect the handbrake cable from the pivoted lever on the primary shoe by moving the lever towards the axle shaft and unhooking the cable eye from the lever end.

On models with 9.842" drum diameter:

(4) Remove the brake shoe hold-down spring assemblies located at the centre of the shoe web, press down the spring seat and rotate through 90 degrees to release the seat, spring and pin.

(5) Mark each shoe for correct reassembly, using a suitable pair of brake spring pliers unhook the upper brake shoe return spring from the shoe web.

(6) Ease the brake shoe ends from location in the adjuster screw slots and the wheel cylinder piston ends, detach the assembly from the back plate.

(7) Open the shoes sufficiently to take out the handbrake push bar, unhook the lower return spring from the shoe web and remove.

On models with 9.055" drum diameter:

(8) Mark each shoe for correct reassembly, ease the brake shoe ends from the slots of the adjuster screws at the top of the back plate.

(9) Unhook the two upper return springs from the holes in the back plate and detach from the brake shoe webs.

(10) Open the shoes at the bottom sufficiently to take out the handbrake push bar.

(11) Unhook the two lower return springs from the holes in the back plate and remove the brake shoes and detach the springs from the webs.

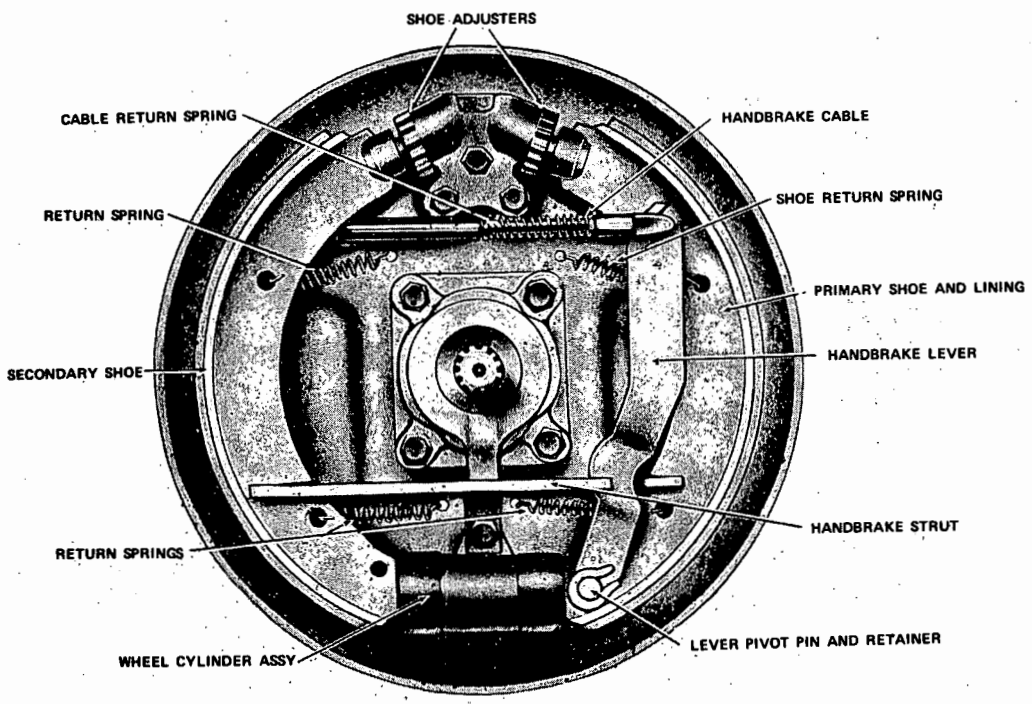
On both types:

(12) Remove the circlip retaining the pivoted lever to the pin in the primary shoe and detach the lever.

### TO REMOVE WHEEL CYLINDERS AND BACK PLATE

(1) Carry out the procedure previously described to remove the brake shoes.

(2) Remove the handbrake cable retainer from the back plate and withdraw the cable from the rear of the back plate.




Left Hand Rear Brake Back Plate and Shoe Assembly. (230 mm Diameter brakes.)

(3) Take out the toothed adjusting nuts and slotted screws from their location at each end of the adjuster block.

(4) Disconnect the hydraulic line at its union with the wheel cylinder, plug the line end to prevent the entry of dirt to the hydraulic system. Take out the bleeder valve from the cylinder.

(5) Loosen and remove the wheel cylinder securing bolt and detach the cylinder from the back plate.

(6) Loosen and remove the adjuster block securing nuts and detach the block from the back plate.

(7) Take out the four securing bolts at the rear wheel bearing cover and detach the cover and back plate sliding them over the axle shaft.

**TO CLEAN AND INSPECT**

(1) Check the shoe linings for wear and renew as necessary.

(2) Check the shoe linings for oil saturation or gumminess and renew as required.

*NOTE: Linings must be renewed as sets only, with the corresponding linings on the other rear wheel.*

(3) Check the brake drums for cracks or scoring and renew or regrind as necessary.

(4) Ensure that the toothed adjusting nuts are free on the threads of the adjusting screws, smear the threads lightly with high melting point graphite grease.

(5) Check the leaf spring tension on the adjuster, if necessary bend the spring to increase the tension.

(6) Check he tension of the brake shoe return springs by comparison with new springs and renew if required.

(7) Ensure that the wheel cylinder rubber boots are not perished or deteriorated. Renew if required.

(8) Thoroughly clean the contact faces of the back plate, bearing flange and cover, renew the gasket and check the oil seal for wear or damage.

**TO ASSEMBLE AND INSTAL**

(1) Position the back plate and bearing cover with new gasket over the axle shaft and against the bearing flange.

(2) Ensure that the oil drip is pointing downwards, instal and tighten the four securing bolts to a torque of 42 ft/lb.

(3) Instal the wheel cylinder and securing bolt in position on the back plate and tighten the bolt to a torque of 42 ft/lb.

*NOTE: On earlier types ensure that the leaf spring for the push bar is positioned correctly.*

(4) Instal the adjuster block on the back plate and tighten the securing nuts to a torque of 42 ft/lb. Refit the adjusting screws and nuts at each end of the adjuster block.

(5) Connect the hydraulic line to the wheel cylinder and instal the bleeder valve.

(6) Insert the handbrake cable through the back plate guide and secure in position with the retainer.

(7) Refit the pivoted lever to the primary shoe and secure with the circlip.

On models with 9.842" drum diameter:

(8) Connect the two brake shoes at the bottom with the return spring ends entered from the back plate side.

*NOTE: The lower return spring is identified by the spring coil located at each end.*

(9) Open the brake shoes sufficiently to insert the push bar between the shoe webs, instal the spring clip over the push bar and around the spring.

(10) Position the assembly on the back plate and engage the ends of the shoes in the wheel cylinder piston slots, and the adjusting screw slots.

(11) Using a suitable pair of brake spring pliers instal the upper return spring in position.

(12) Instal the hold-down pin, spring and seat, press the seat down against the spring tension and rotate 90 degrees to lock on the hold-down pin.

On models with 9.055" drum diameter:

(13) Instal the brake shoes in position on the back plate engaging the shoe ends in the adjusting screw slots and the wheel cylinder piston slots.

(14) Insert the push bar between the shoe webs and ensure that the push bar is located between the bearing cover and the top of the leaf spring.

(15) Hook the lower return springs into the brake shoe web from the back plate side, using brake spring pliers engage the free ends of the springs in their respective holes in the back plate.

(16) Carry out the same procedure to instal the upper return springs to the brake shoes.

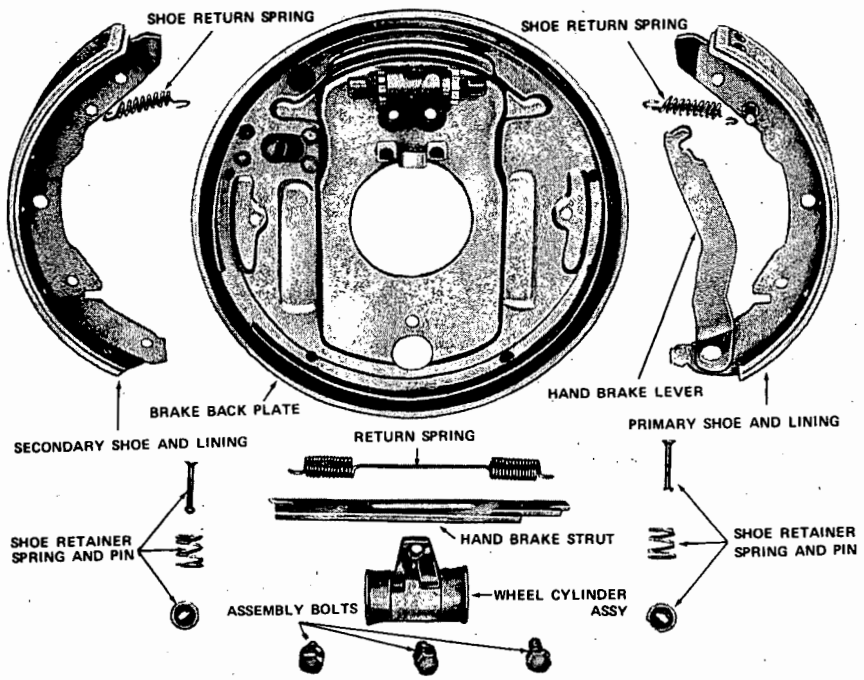
(17) Ensure that the ends of the shoes are correctly located in the slots of the adjusting screws and pistons.

On both types:

(18) Engage the handbrake cable eye on the pivoted lever end, operate the lever and check the shoe movement.

(19) Instal the brake drums and tighten the axle shaft nuts to the specified torque. Secure the nut with a new split pin.

(20) Adjust the brake shoes and bleed the hydraulic system as described under the appropriate sections.




Rear Brake Back Plate and Shoe Assembly (1500-1600 Model shown).

## 5. BRAKE LININGS

Brake linings require replacement when worn down to a thickness of .1", or if the linings are oil saturated. Cleaning the linings with a solvent is not effective, heat generated through braking action will cause the oil to reappear on the lining surface.

Linings must be fitted in sets of the same quality to both wheels on one axle to ensure uniform and effective braking.

(1) Remove the brake shoes as previously described for the appropriate axle.

(2) Carefully remove the lining rivets to avoid damage and distortion to the brake shoe.

(3) Clean the brake shoes and remove any burrs from the surface of the shoe or the rivet holes.

(4) Position the lining on the shoe and align the rivet holes, working from the centre outwards rivet the lining to the shoe, with the rivets pressed in vertically to avoid tension in the lining.

*NOTE: The rivets must be a neat fit in the drillings of the linings and shoes.*

*The lining must be fitted to the shoe without distortion, and should be a uniform snug fit. There should be no lining overhang at the sides of the shoes.*

(5) Each end of the brake lining should be chamfered .2" if not already done in manufacture, round off the sharp corners on leading edges.

*NOTE: Refer to the specifications for the correct brake lining dimensions. It is essential that aluminium rivets are not used to attach the linings to the shoes.*

## 6. HANDBRAKE ASSEMBLY

### TO REMOVE AND INSTAL HANDBRAKE LEVER (Early Type)

(1) Raise the rear of the vehicle and support on stands.

(2) Remove the cover plate located under the pedal linkage.

(3) Release the handbrake and disconnect the brake cables at the equalizer located at the base of the handbrake lever, remove the two nuts at the end of each cable and withdraw the cables from the equalizer.

(4) Remove the retaining circlip from the end of the handbrake lever pivot pin and knock out the pin towards the left side, as viewed in the driving direction.

(5) Withdraw the handbrake lever assembly from below the vehicle.

(6) If necessary, remove the retaining circlip from the

equalizer pivot pin, knock out the pin and detach the equalizer from the lever.

(7) Press down the handbrake release button and withdraw the ratchet from the lever, remove the pawl pin and take out the pawl rod, spring and release button.

Installation is a reversal of the removal procedure with attention to the following points:

(1) Clean and lubricate the handbrake lever parts prior to reassembly, ensure that the pawl and ratchet teeth are in serviceable condition.

(2) Instal the ratchet so that the retaining slot protrudes from the front of the lever, and with the radius at the base of the ratchet located over the lever pivot pin bearing bush.

(3) Ensure that the pawl nose is positioned in the pawl rod end and that the teeth of the pawl and ratchet are meshed.

(4) Instal the handbrake lever so that the retaining slot in the ratchet engages in the mounting bracket.

(5) Lubricate pivot pins and equalizer, adjust the brake cables as described under the appropriate heading.

**TO REMOVE AND INSTAL HANDBRAKE LEVER (Later Type)**

(1) Raise the rear of the vehicle and support on stands.

(2) Take the rubber boot up and off the handbrake lever.

(3) Release the handbrake and disconnect the brake cables at each side of the handbrake lever by removing the two nuts on each cable end.

(4) Remove the cover plate located under the pedal linkage.

(5) Pull the brake cables out clear of the lever assembly.

(6) Take off accelerator lever spring and pull the push rod out of the accelerator lever.

(7) Remove the retaining circlip from the end of the handbrake lever pivot pin and withdraw the pin from the mounting.

(8) Pull out the handbrake lever assembly from the mounting.

(9) Press down the handbrake release button and withdraw the ratchet, remove the pawl rod, spring and release button.

Installation is a reversal of the removal procedure with attention to the following points:

(1) Clean and lubricate the handbrake lever parts prior to reassembly, ensure that the pawl and ratchet teeth are in serviceable condition.

(2) Instal the ratchet so that the retaining slot protrudes from the front of the lever, and with the radius at the base of the ratchet located over the lever pivot pin bearing bush.

(3) Ensure that the pawl nose is positioned in the pawl rod end and that the teeth of the pawl and ratchet are meshed.

(4) Instal the handbrake lever so that the retaining slot in the ratchet engages in the mounting bracket.

(5) Lubricate pivot pins, adjust the brake cables as described under the appropriate heading.

**TO REMOVE AND INSTAL BRAKE CABLES (Both Types)**

(1) Raise the vehicle and support on stands.

(2) Release the handbrake cables at the handbrake lever assembly using the procedure described previously – *TO REMOVE AND INSTAL HANDBRAKE LEVER.*

(3) Remove the rear wheels and brake drums, dismantle the rear brake assemblies as previously described in the rear brake section.

(4) Remove the retainer attaching the cable to the back plate and withdraw the cable from the rear of the back plate and guide tube.

Installation is a reversal of the removal procedure with attention to the following points:

(1) Check the cable length if a new cable is to be installed.

(2) Clean the brake cable guide tubes, thoroughly grease the cable prior to installation.

(3) Tighten the rear axle shaft nut to the specified torque.

(4) Adjust the handbrake cables as described under the appropriate heading.

## 7. BRAKE ADJUSTMENT

**TO ADJUST BRAKE SHOES**

(1) Raise the vehicle, support on stands and release the handbrake.

(2) Operate the brake pedal several times to centralize the shoe assemblies in the brake drum.

(3) Rotate the brake drums to align the access hole in the drum face with each of the toothed adjusting nuts.

(4) Insert a screwdriver through the access hole in the brake drum engaging the end of the screwdriver in the teeth of the adjusting nut, turn the adjusting nut using the screwdriver as a lever until the brake shoe contacts the drum. This can be established by turning the wheel by hand and noting the drag.

(5) Back off the adjusting nut just sufficiently to allow the wheel to turn freely, this may require a movement of 3 to 4 teeth.

(6) Repeat operations (4) and (5) at the other adjusting nut and at each of the two adjusters in each of the other wheel assemblies.

*NOTE: The two adjusting nuts in each brake assembly rotate in the opposite direction to each other.*

(7) Lower the vehicle and road test to check the braking efficiency.

**TO ADJUST HANDBRAKE**

(1) Raise the rear of the vehicle and support on stands, release the handbrake.

(2) On early types remove the cover located under the pedal linkage. On later types remove the handbrake lever rubber boot.

(3) Loosen back the locknuts at the handbrake lever end of the cables, screw up the adjusting nuts to tension the cables but ensure that the rear wheels still turn freely.

(4) Apply the handbrake one or two notches and check by turning the rear wheels that the drag is the same at each wheel.

*NOTE: When correctly adjusted the handbrake should fully lock the rear wheels when applied four notches.*

(5) Release the handbrake and check that both rear wheels turn freely, tighten up the cable locknuts without moving the position of the adjusting nuts.

(6) Instal the lever boot or pedal linkage cover plate whichever is applicable.

(7) Lower the vehicle and road test to check the efficiency of the handbrake when the vehicle is parked on a steep incline.

## 8. BRAKE PEDAL ASSEMBLY

**TO REMOVE AND INSTAL BRAKE PEDAL AND OPERATING LEVER (L/H Drive Vehicles – Early Type)**

(1) Raise the front of the vehicle and support on stands.

(2) Remove the cover plate located under the pedal linkage.

(3) Take out the split pin and clevis pin attaching the master cylinder push rod to the operating lever.

(4) Remove the securing nut and detach the brake pedal from the operating lever.

(5) Loosen and remove the operating lever pivot pin securing nut, unhook the return spring from the lever and withdraw the pin and lever from the frame.

Installation is a reversal of the removal procedure with attention to the following points:

(1) Ensure that the bush in the operating lever is in serviceable condition, replace if worn.

(2) With the securing nut tight on the lever pivot pin, check that the return spring seat moves freely prior to connecting it to the operating lever.

(3) Lubricate the push rod clevis pin and instal a new split pin.

(4) Check the free play between the master cylinder piston and push rod which should be .040", if necessary adjust the clearance by knocking the stop plate in the direction required.

**TO REMOVE AND INSTAL BRAKE PEDAL AND OPERATING LEVER (L/H Drive Vehicles – Later Models)**

(1) Raise the front of the vehicle and support on stands.

(2) Remove the cover plate located under the pedal linkage.

(3) Take out the split pin and clevis pin attaching the master cylinder push rod to the operating lever.

(4) Disconnect the brake pedal return spring.

(5) Loosen and remove the securing nut attaching the brake pedal lever to the operating lever and take out the screw.

(6) Loosen and remove the operating lever pivot pin securing nut, and withdraw the pin and lever from the frame.

Installation is a reversal of the removal procedure with attention to the following points:

(1) Ensure that the bush in the operating lever is in serviceable condition, replace if worn.

(2) Lubricate with grease the operating lever bush and pivot pin and the push rod clevis pin prior to installing.

(3) With the securing nut tight on the lever pivot pin, check that the return spring seat moves freely prior to connecting the spring to the operating lever.

(4) Check the free play between the master cylinder piston and push rod which should be .040", if necessary

adjust the clearance by knocking the stop plate in the direction required.

**TO REMOVE AND INSTAL BRAKE PEDAL LINKAGE (R/H Drive Vehicles)**

(1) Raise the front of the vehicle and support on stands.

(2) Remove the cover plate located under the pedal linkage.

(3) Take out the split pin and clevis pin at the master cylinder pushrod.

(4) Loosen off the master cylinder securing bolts and nuts sufficiently to allow the master cylinder to be pulled back and the pushrod withdrawn.

(5) On early types, detach the brake pedal arm from the brake pedal rod and withdraw the rod towards the top. On later types, loosen the nut on the pedal lever, screw out the pushrod and remove the screw. Pull the pushrod upwards out of the floor plate.

(6) Detach the accelerator pedal rod from its connection with the accelerator pedal shaft.

(7) Disconnect the accelerator cable from the operating lever and turn the accelerator pedal shaft downwards.

(8) Disconnect the wires at the horn, loosen and remove the horn.

(9) Unhook the return spring from the brake pedal arm.

(10) Loosen and remove the clamp bolt in the brake operating lever.

(11) Remove the brake operating lever from the pedal shaft, if necessary remove the key by knocking at one end with a hammer and punch.

(12) Withdraw the brake pedal shaft and return spring.

Installation is a reversal of the removal procedure with attention to the following points:

(1) Clean and lubricate with grease the brake pedal shaft bearing.

(2) Ensure that the return spring is positioned, remove any burrs from the key and smear with grease before installing.

(3) Check that the master cylinder rubber boot is correctly located after installing the pushrod, grease the pushrod clevis pin.

(4) Check the free play between the master cylinder piston and pushrod which should be .040", if necessary adjust the clearance by knocking the stop plate in the direction required.

## 9. WHEEL CYLINDERS

**TO REMOVE AND DISMANTLE (Front)**

(1) Dismantle brake assembly and remove the wheel cylinders as described under *FRONT BRAKE ASSEMBLY*

(2) Pull off the rubber boot from the end of the wheel cylinder.

(3) Withdraw the piston and seal assembly from the cylinder, if necessary use a low pressure of air at the hydraulic pipe hole in the cylinder to push out the piston.

(4) Screw out the bleeder valve from the rear of the cylinder body.

(5) Ease the piston seal cup from its location on the piston.

**TO CLEAN AND INSPECT**

(1) Clean the wheel cylinder components in denatured alcohol or brake fluid.

(2) Check the rubber boot and piston cup for perishing or deteroriation, renew if required.

(3) Examine the wheel cylinder bore and piston for wear or pitting, check that the piston is a suction fit in the cylinder bore, renew if necessary.

**TO ASSEMBLE AND INSTAL**

(1) Lubricate the wheel cylinder bore with clean hydraulic fluid, dip the piston and seal in the fluid or smear with brake cylinder paste.

(2) Instal the new piston seal on the piston and ensure that the seal is seated correctly.

*NOTE: Ensure that the correct piston seal cup is used for the wheel cylinder bore diameter.*

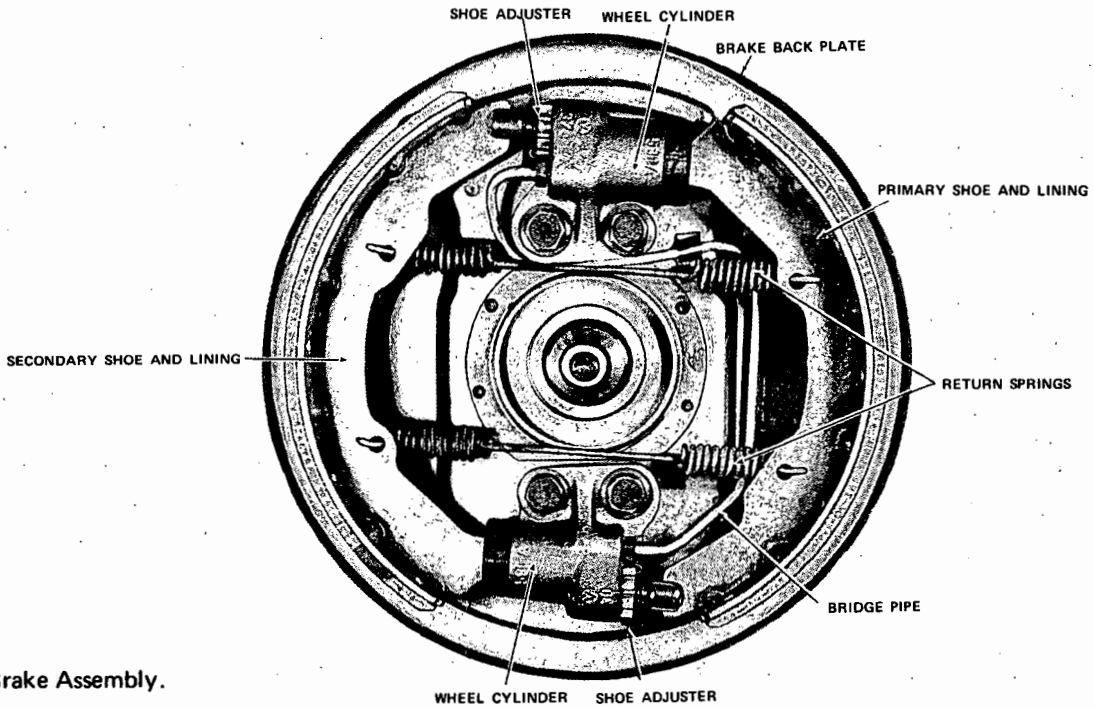
(3) Insert the piston and seal assembly in the bore taking care not to turn back or damage the edges of the cup.

(4) Position the rubber boot over the end of the cylinder locating the edge of the boot in the groove at the end of the body.

(5) Screw in the bleeder valve, and check that the adjuster is operating freely.

(6) Instal the wheel cylinders and assemble the brakes as described under *FRONT BRAKE ASSEMBLY.*

(7) Adjust the brake shoes and bleed the hydraulic system, lower the vehicle and road test.




Front Wheel Brake Assembly.

**TO REMOVE AND DISMANTLE (Rear)**

(1) Dismantle the brake assembly and remove the wheel cylinder as described under *REAR BRAKE ASSEMBLY.*

(2) Pull off the rubber boot at each end of the wheel cylinder.

(3) Withdraw both piston and seal assemblies from the cylinder, if necessary use a low pressure of air at the hydraulic pipe hole in the cylinder to push out the piston.

(4) Screw out the bleeder valve from the rear of the cylinder body.

(5) Ease the piston cup seal from each of the pistons.

**TO CLEAN AND INSPECT**

(1) Clean the wheel cylinder components in denatured alcohol or brake fluid.

(2) Check the rubber boot and piston cup for perishing or deterioration, renew if required.

(3) Examine the wheel cylinder bore and piston for wear or pitting, check that the piston is a suction fit in the cylinder bore, renew if necessary.

**TO ASSEMBLE AND INSTAL**

(1) Lubricate wheel cylinder bore with clean hydraulic brake fluid, dip the pistons and seals in the fluid or smear with brake cylinder paste.

(2) Instal the new piston seals on the pistons and ensure that the seals seat correctly in the grooves.

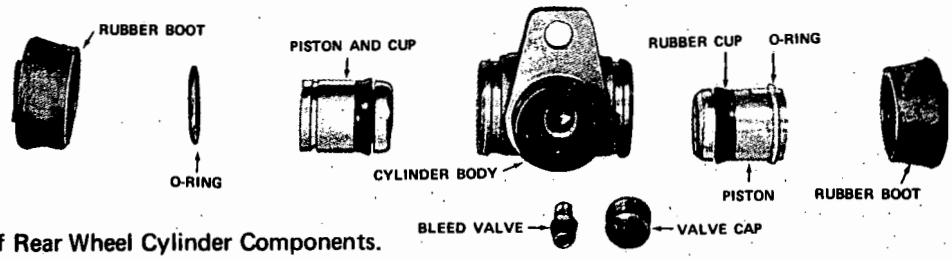
*NOTE: Ensure that the correct piston seal cups are used for the wheel cylinder bore diameter.*

(3) Insert the pistons and seals into the bore taking care not to turn back or damage the edges of the cup.

(4) Position the rubber boots over the ends of the wheel cylinder engaging the edges of the boots in the grooves at each end of the body.

(5) Screw in the bleeder valve and instal the wheel cylinder as described under *REAR BRAKE ASSEMBLY.*

(6) Adjust the brake shoes and bleed the hydraulic system, lower the vehicle and road test.




Exploded View of Rear Wheel Cylinder Components.

## 10. HYDRAULIC SYSTEM

### TO BLEED

Bleeding the hydraulic system is not a routine maintenance operation and will only be necessary when some portion of the hydraulic equipment has been disconnected or fluid drained off, thereby allowing air to enter the system.

(1) Fill the fluid reservoir with clean hydraulic brake fluid and maintain it at least half full throughout the entire bleeding operation.

(2) Remove the bleeder valve dust cap on the right hand rear brake, attach a rubber bleeder tube to the valve and allow the other end of the tube to be immersed in a small amount of fluid contained in a clean glass jar.

(3) Unscrew the bleeder valve one complete turn.

(4) Depress the brake pedal slowly the full extent of its travel and allow it to return without assistance.

(5) Repeat operation (4) until a constant stream of clean fluid, without any air bubbles, is being discharged into the glass jar, hold the brake pedal down and tighten the bleeder valve.

(6) Carry out the bleeding operations on the other rear wheel, the right hand front wheel and the remaining front wheel in that order.

*NOTE: Do not allow the fluid level in the reservoir to fall below the half full level at any time during the bleeding operation or air may enter the system. Always use new fluid for topping up the reservoir.*

(7) Finally, remove the bleeder tube, refit the dust covers to the bleeder valves and top up the fluid in the reservoir to within ¾" of the filler cap level.

## 11. BRAKE FAULT DIAGNOSIS

**(1) Brake pedal hard.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Incorrect shoe linings fitted. | – Check and renew linings to recommended type. |
| (b) | Frozen pedal linkage. | – Rectify or renew pedal linkage. |
| (c) | Restricted brake line from master cylinder. | – Check brake line and remove restriction or renew. |

**(2) Brake drag due to pressure build-up.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Incorrectly adjusted master cylinder push rod to piston clearance. | – Check and adjust push rod stop plate to give recommended pedal free travel. |
| (b) | Clogged master cylinder compensating port. | – Check and remove foreign matter from port. |
| (c) | Frozen wheel cylinder piston/s. | – Check and free up or renew wheel cylinder pistons. |
| (d) | Frozen brake shoe linkage. | – Free up or renew brake shoes. |
| (e) | Broken or stretched brake shoe return springs. | – Renew defective springs. |
| (f) | Frozen handbrake cables. | – Free up or renew. |
| (g) | Blocked vent in fluid reservoir cap. | – Check vent and remove obstruction. |

**(3) Low or spongy brake pedal.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Incorrectly adjusted brake shoes. | – Check and adjust brake shoes. |
| (b) | Lack of sufficient fluid in system. | – Check for leaks, replenish fluid to specified level and bleed brake system. |
| (c) | Air in brake hydraulic system. | – Bleed hydraulic system. |

**(4) Brake locks on application.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Gummy linings due to oil or fluid contamination. | – Clean and renew linings. |
| (b) | Incorrect shoe adjustment. | – Check and adjust shoes. |

| | | |
|---|---|---|
| (c) | Bent or eccentric brake drum/s. | – Check and renew faulty drum/s. |
| (d) | Incorrect linings fitted. | – Check and renew linings in pairs with recommended type. |
| (e) | Broken or stretched brake shoe return spring/s. | – Check and renew faulty spring/s. |
| (f) | Linings not chamfered at the ends. | – Check and chamfer linings. |

**(5) Brake pedal pulsates.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Bent or eccentric brake drum. | – Check and renew drum as required. |
| (b) | Loose or worn front hub bearings. | – Adjust or renew front hub bearings. |
| (c) | Bent rear axle shaft. | – Check and renew faulty components. |

**(6) Brake fade at high speed.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Incorrect shoe adjustment. | – Check and adjust shoe to drum clearance. |
| (b) | Eccentric or bent brake drum. | – Check and renew faulty component. |
| (c) | Lining/s saturated with hydraulic fluid. | – Renew contaminated lining/s. |
| (d) | Incorrect linings fitted. | – Check and instal recommended linings in sets. |

**(7) Brakes overheat.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Incorrect shoe adjustment. | – Check and adjust shoe to drum clearance. |
| (b) | Broken shoe return spring/s. | – Renew faulty spring/s. |
| (c) | Faulty handbrake cables and/or adjustment. | – Check cables, renew or adjust. |
| (d) | Frozen wheel cylinder pistons. | – Free up or renew faulty components. |
| (e) | Obstructed or damaged hydraulic-hose or line. | – Remove obstruction or renew hydraulic-hose or line. |
| (f) | Obstructed master cylinder compensating port. | – Clear compensating port. |
| (g) | Blocked vent in master cylinder reservoir cap. | – Check and remove obstruction in vent. |
| (h) | Broken rear spring main leaf or centre bolt. | – Check and renew faulty components. |

**(8) Brakes squeak.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Linings not chamfered at the ends. | – Check and chamfer linings. |
| (b) | Linings loose on shoes. | – Replace rivets or renew linings. |
| (c) | Lining distorted on shoe. | – Check and replace lining. |
| (d) | Brakes dirty or dusty. | – Clean out assemblies. |
| (e) | Distorted brake back plate. | – Check and renew if necessary. |

# ELECTRICAL SYSTEM

## SPECIFICATIONS

### BATTERY

| | |
|---|---|
| Type | 6 volt, from chassis No 217000001 12 volt |
| Capacity | 6 volt, 84 amp/hr, from chassis No 117902 77 amp/hr then 12 volt, 45 amp/hr |
| Polarity | Negative to earth |

### GENERATOR

**EARLY 1200**

| | |
|---|---|
| Make | Bosch |
| Type | LJ/REG 180/6/L2 |
| Voltage | 6 volts |
| Output | 180 watts at 2500 rpm |
| Cut-in speed | 1600-1950 rpm (generator) |

**LATE 1200**

| | |
|---|---|
| Make | VW |
| Type | 113 903 02 1A |
| Voltage | 6 volts |
| Output | 180 watts at 2400 rpm (generator) |
| Cut-in speed | 1600 rpm (generator) |

**1500 (UP TO CHASSIS No 117901)**

| | |
|---|---|
| Make | Bosch LJ/REG/80/6/2500 L3 Intermittently VW 113903 021C |
| Output | 200 watts at 2600 rpm (generator) |
| Cut-in speed | 1800-1850 rpm (generator) |

**1500 CHASSIS No 117902 ON, AND 1600 12 VOLT SYSTEM**

| | |
|---|---|
| Make | Bosch |
| Type | G(L) 14V-30A.20 A19 |
| Cut-in speed | 1800-1850 rpm (generator) 800-825 rpm (crankshaft) |

### REGULATOR

**EARLY 1200**

| | |
|---|---|
| Make | Bosch |
| Type | RS/TA 180/6/A3 |
| Test voltage | 7.2-8.2 at 1890 to 2160 engine rpm at 68°F |

**LATE 1200**

| | |
|---|---|
| Make | VW |
| Type | 211 903 801 |
| Test voltage | 7.2-8.2 at 1890-2160 rpm (crankshaft) at 68°F |

**1500 UP TO CHASSIS No 117901**

| | |
|---|---|
| Make and type | Bosch RS/JPA/180/6/4 VW 113 905 805C |
| Cut-in speed | 1800-1850 generator rpm |

**1500 CHASSIS No 117902 ON AND 1600 12 VOLT SYSTEM**

| | |
|---|---|
| Make | Bosch |
| Type | VA 14V 30A |
| Cut-in speed | 1800-1850 (generator rpm) |
| Drop-out speed | 1400-1450 (generator rpm) |

### STARTER

**EARLY 1200**

| | |
|---|---|
| Type | Bosch EED 0.5/6 L 44 |
| No load current | 50 to 60 amp at 4000 to 5000 rpm |
| Torque at 1200 rpm | 4 ft/lb at 280 amp and 5 volts |
| Lock torque | 11.6 ft/lb at 500 amp and 4 volts |

**LATE 1200**

| | |
|---|---|
| Types | VW 113 911 021 A or 111 911 021D; Bosch EEF 0.5/6 L1 or EED 0.5/6 L49 |
| No load current | 40 to 80 amp at 4000 to 5000 rpm |
| Brush length | .8125" |
| Torque at 1200 rpm | 4 ft/lb at 280 amp and 4.5 to 5 volts |
| Lock torque | 11.6 ft/lb at 500 amp and 3.5 to 4 volts |

**1500 UP TO CHASSIS No 117901**

| | |
|---|---|
| Make | Bosch or VW |
| Type | EEF 0.5/6 L1 or VW 113911021A |
| Lock test | 6 volts 400-500 amps |
| Solenoid pull in voltage | Bosch 3.5 39 amps max<br>VW 3.5 43 amps max |
| Hold in coil | Bosch 18 amps max<br>VW 23 amps max |
| Brush length | .814"; min .300" |

**1500-1600 12 VOLT SYSTEM**

| | |
|---|---|
| Make | Bosch or VW |
| Type | Bosch EF (L) 12VO 7PS or VW 311911023B |
| No load test | 35-45 amps 12 volts at 7400-9100 rpm |
| Load test | 170-205 amps 9 volts at 900-1300 rpm |
| Solenoid pull in voltage | Bosch 7 volts 35 amps max<br>VW 7 volts 30 amps max |
| Solenoid hold in coil | Bosch 11 amps max<br>VW 12 amps max |
| Brush length | .814"; min .300" |

## DISTRIBUTOR

**EARLY MODELS**

| | |
|---|---|
| Make | Bosch or VW |
| Type | Bosch VJR4BR.25 or VW 211,905.205H |
| Breaker arm spring tension | 15-17.5 oz |
| Breaker point gap | .016" |
| Cam angle, dwell | 48-53° |
| Ignition timing (static) | 7.5 btdc |
| Centrifugal advance | Commences 420 rpm; ends 1450 rpm |
| Firing order | 1-4-3-2 |

**LATE MODELS**

| | |
|---|---|
| Make | Bosch or VW |
| Type | Bosch ZV/PAU 4R 2 MK ZV/PAU 4R 1 MK or VW/113 905 205B |
| Breaker arm spring tension | 14-17.5 oz |
| Contact breaker gap | .016" |
| Cam angle, dwell | 47-53° |
| Ignition timing (static) | 10° btdc |
| Vacuum advance | Commences 5/8" – 1" Hg ends 1¾" – 2" Hg |
| Firing order | 1-4-3-2 |

**1500 UP TO 12 VOLT SYSTEM**

| | |
|---|---|
| Make | Bosch or VV 113 905 205B |
| Contact arm spring tension | 15-17.5 oz |
| Contact breaker gap | .016" |
| Cam angle dwell | 51-55° |
| Timing (Static) 53 bhp | 7.5° btdc |
| 51 bhp | 10° btdc |
| 49 bhp | 7.5° btdc |
| Advance | Vacuum |

**1500-1600 12 VOLT SYSTEM**

| | |
|---|---|
| Make | Bosch |
| Type | JUR 4 VW211 905 205P |
| Contact arm spring tension | 15-17.5 oz |
| Contact breaker gap | .016" |
| Cam angle dwell | 47-53° |
| Timing (static) | tdc |
| Vacuum advance | Commences 1000 rpm; ends 2400 rpm |

## SPARK PLUGS

**1200**

| | |
|---|---|
| Size | 14 mm |
| Make and type | Bosch W175T1 |
| Heat range | 175 (Bosch) |
| Electrode gap | .024" to .028" |

**1500-1600**

| | |
|---|---|
| Size | 14 mm |
| Make and type | Bosch W1451 |
| Heat range | 145 |
| Electrode gap | 0.24 – 0.28 |
| Firing order | 1-4-3-2 |

**IGNITION COIL**

**EARLY 1200**

| | |
|---|---|
| Type | Bosch TE 6 B1 |
| Voltage | 6 |
| Primary current | 2 amps |
| Primary resistance | 1.1-1.3 ohms |
| Spark length | 12 mm –(.480") |

**LATE 1200**

| | |
|---|---|
| Type | Bosch TE 6 B4<br>VW 111 905 105F |
| Voltage | 6 volts |
| Primary current | 2.0 amps |
| Primary resistance | 1.1-1.3 ohms |
| Spark length | 12 mm –(.480") |

**1500**

| | |
|---|---|
| Type | Bosch TE 6 B4 |
| Voltage | 6 volts |
| Primary current | 2 amps |
| Primary resistance | 1.1-1.3 ohms |
| Spark length | 12 mm –(.480") |

**1500-1600 12 VOLT**

| | |
|---|---|
| Type | Bosch |
| Voltage | 12 volts |
| Primary current | 2.0 amps |
| Primary resistance | 1.1-1.3 ohms |
| Spark length | .472" |

## 1. BATTERY

Maintenance consists mainly of regular inspection and servicing.

(1) The battery should be inspected every two weeks or 1000 miles whichever is the sooner and the electrolite topped up as necessary with distilled water.

The correct level is just over the top of the separators or perforated plate. Do not over-fill or acid will escape through the vent holes and cause corrosion to surrounding parts of the vehicle.

(2) Ensure that the vent holes in the cell caps are clear.

*NOTE: Never use a naked light when examining the battery as the gasses given off by the charging process can be dangerously explosive.*

(3) Keep the battery and its surroundings clean and dry. Give the top of the battery particular attention.

(4) Check the terminal connections at the battery for tightness and freedom from corrosion. If corrosion is found to be present, remove the terminals and clean both the terminals and the battery posts. Apply petroleum jelly or other suitable corrosion preventative sparingly to each terminal and battery post.

*NOTE: Where large deposits of corrosion exist, use water to remove. Application of water will also assist in freeing corroded terminal bolts.*

(5) If the battery requires an excessive amount of topping up, the cause should be sought. If over charging is suspected, check the regulator setting (see appropriate section). Never transfer electrolite from one cell to another.

(6) Ensure that the battery is securely held in the correct position, loose or left-off brackets can result in damage to the battery casing during rough travel conditions.

## 2. GENERATOR

**TO REMOVE**

(1) Remove the engine, where necessary, (see engine section).

(2) Disconnect the wires from the regulator (from generator 12 volt).

(3) Remove the intake elbow together with the oil bath air cleaner.

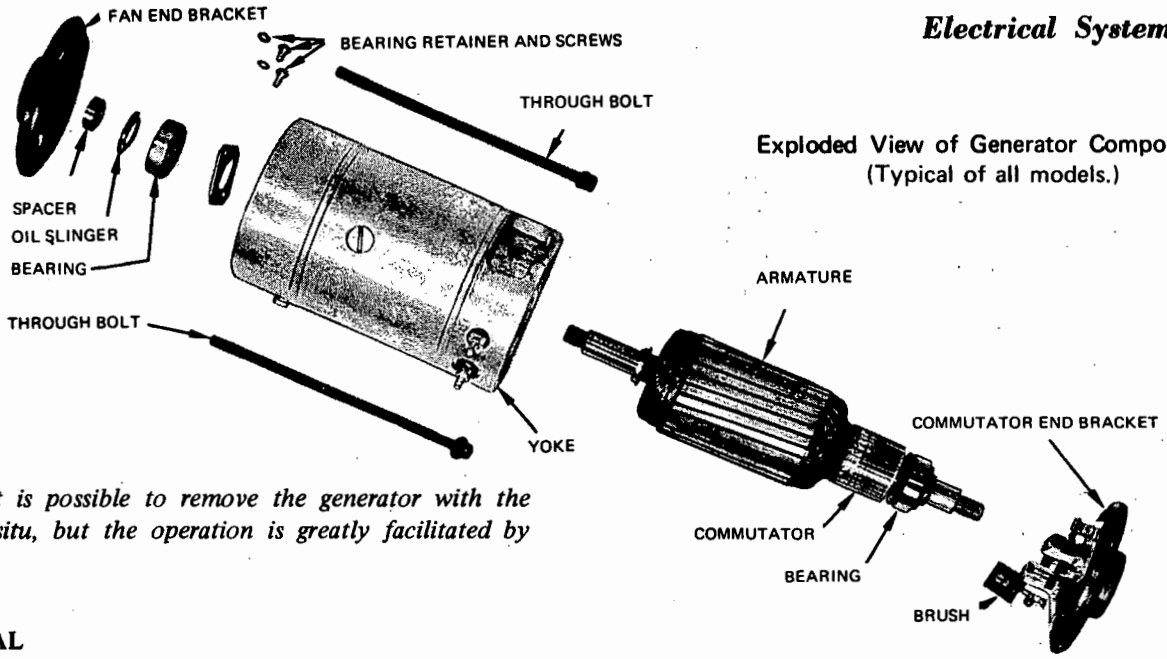
(4) Remove the carburettor.

(5) Remove the fan belt.

(6) Disconnect the generator-mounting strap.

(7) Remove the throttle ring (early models), and the screws on both sides of the fan housing. Lift the housing a few inches.

(8) Remove four screws on the fan cover and remove the generator and fan.




Exploded View of Generator Components.
(Typical of all models.)

*NOTE: It is possible to remove the generator with the engine insitu, but the operation is greatly facilitated by removal.*

## TO INSTAL

The installation procedure is the reverse of the removal operations with the inclusion of the following:

(1) When installing the fan housing ensure that it seats correctly against the cylinder cover plates all round.

(2) Note the concentric position of the throttle ring on early models.

(3) Adjust the fan belt to the correct tension. Over tensioning will cause premature failure of the generator bearings. Insufficient tension will result in slipping and drop off in charging rate and also over heating of the engine.

## TO DISMANTLE

(1) Remove the generator drive pulley and adjusting washers and nut.

(2) Remove the nut and remove the fan and spacers, fan hub and Woodruff key. The fan should be held in position by hand during the foregoing operation.

(3) Remove the cover and reinforcement flange.

(4) Remove the generator regulator.

(5) Disconnect the field coil terminal from the brush holder of the positive brush.

(6) Remove the two through bolts.

(7) Lift up the brushes and remove the ball bearing thrust washer.

(8) Withdraw the end plate and armature from the frame.

(9) Using a suitable type puller, remove the ball bearing from the commutator end including flange, oil slinger and spacer.

(10) Remove the end plate on the fan end.

(11) Remove the ball bearing oil slinger from the end plate and screw off the flange.

(12) Remove the ball bearing thrust ring and oil slinger from the end plate.

(13) If necessary, remove the field coils using a wheel operated screw driver or other appliance suitable for the purpose.

## TO ASSEMBLE

Assembly is the reverse of the dismantling procedure.

(1) Instal the ball bearing in the fan end plate and instal flange and end plate on the armature shaft.

(2) Press the oil slinger and bearing onto the commutator end of the armature shaft.

(3) Insert the armature complete with end plate and armature into the body so that the dowel engages in the groove.

(4) Connect the field coil lead to brush holder of the positive brush.

(5) Instal the two through bolts and tighten securely.

(6) Instal the two spacers on the armature shaft.

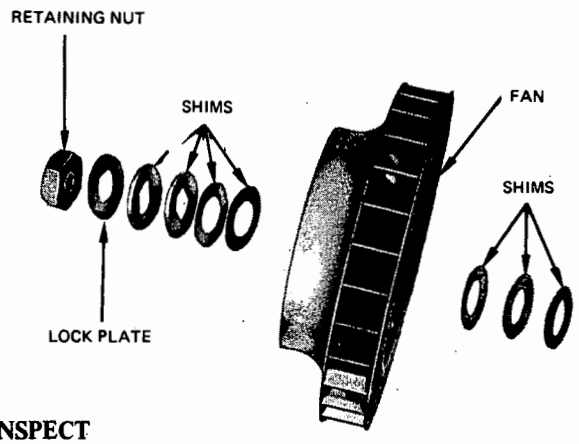
(7) Hold the brushes down against the commutator to ensure that the brushes and springs are correctly seated.

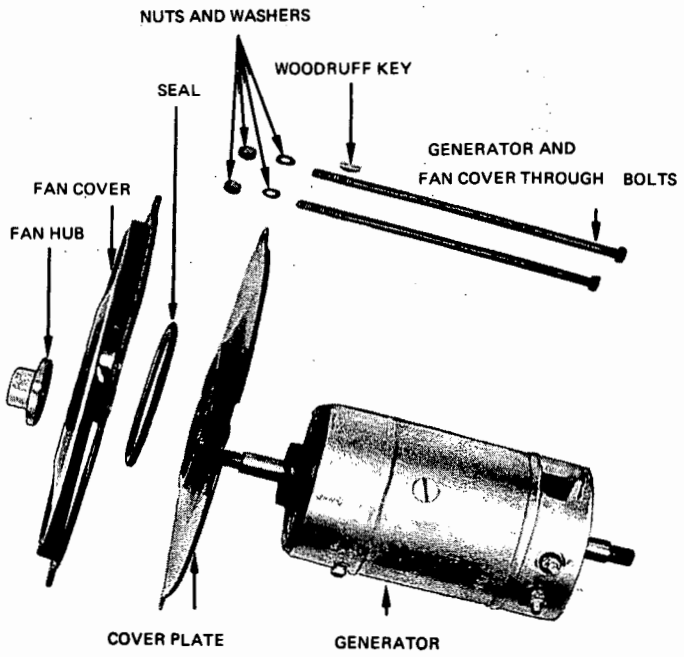
(8) Connect the generator to regulator leads as follows:
The heavy lead to the D+ terminal on the regulator.
The other cable to the DF on the regulator.

*NOTE: The regulator on 12 volt systems is fitted with a variode resistance unit in series with the control winding to support the output wire.*

(9) Instal the fan ensuring that it does not foul the housing or cover.

(10) Tighten the fan nut to 40-47 ft/lbs.




Generator and Fan Components showing Shims for Adjusting Clearance Between Backs of Fan and Fan Cover. This Clearance must be .060" to .070".

**TO INSPECT**

Thoroughly clean the unit with suitable solvent and inspect as follows:

(1) Inspect the field coils for condition of insulation.

(2) Commutator for out of round, burning or pitting.

(3) Ball bearings for wear or roughness.

(4) Armature for damaged windings, thrown solder etc.

(5) Armature shaft for trueness.

(6) Brushes for wear (see *TO CHECK BRUSHES AND COMMUTATOR).*

(7) End plates for warping.

(8) Brush holders for loose rivets.

(9) Leads and brush terminals for broken or loose connections.

**TO CHECK BRUSHES AND COMMUTATOR**

(1) Examine the brushes for wear. Brushes that are very deep in the holders should be replaced. Check length against specifications.

(2) Check brush spring tension with suitable spring scale and compare with specifications. Renew weak springs.

(3) Check for neat but free fit of the brushes in the holders. If necessary dress with a suitable file.

(4) Check the commutator for out of round or burnt surface. A commutator in good condition should be smooth and clean. If necessary remove the armature and mount in a lathe, rotate at a high speed and take a light cut with a very sharp tool. Do not remove more material than necessary. Polish the machined surface with fine glass paper. Undercut the mica between segments to a depth of .062".

**TO TEST IN POSITION**

(1) Check that the driving belt is not slipping, adjust if necessary.

(2) Check that the generator and regulator are connected correctly.

(3) Switch off all lights etc. Disconnect the cables from the generator and connect the two terminals with a short length of wire.

(4) Start the engine and adjust to normal idling speed. Switch off engine.

(5) Clip the negative lead of the moving coil type voltmeter, calibrated 0-20 volts to one generator terminal and the other lead to a good earth on the generator body.

(6) Start the engine.

(7) Gradually increase the engine speed when the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltage to reach 10 volts, six volt systems or 20 volts, 12 volt system and do not race the engine in an attempt to increase the voltage. It will be sufficient to run the generator to 1000 rpm.

(8) If there is a low reading of approximately 2-3 volts, six volt systems or 4-5 volts, 12 volt system, the armature may be at fault.

(9) Examine the commutator and brushes. Hold each of the brush springs back and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by gently polishing on a smooth file. Always replace the brushes in their original positions.

(10) Test the spring tension and compare with specifications.

(11) Check the commutator in accordance with *TO CHECK BRUSHES AND COMMUTATOR.*

(12) If the generator test is satisfactory it will be obvious that the fault lies elsewhere, in this case proceed as follows:

(13) Disconnect instruments.

(14) Remove the bridging wire and reconnect the generator to control leads.

(15) Remove the lead from the armature or D+ terminal on the regulator and connect the voltmeter between the cable and a good earth on the vehicle.

(16) Run the engine as before and the reading of the voltmeter should be the same as that taken directly on the generator. No reading indicates a break in the lead to the generator.

(17) Repeat the test on the DF lead, connecting the voltmeter to the lead and a good earth, when the result should be the same.

**TO TEST FIELD COILS**

The field coils are tested for open circuits, short circuit, resistance and ground.

(1) Test each coil individually for open circuit by connecting their ends with a 220 volt test lamp or a battery in series with a 6 volt test lamp. Connect the field coils in circuit with the test lamp. The lamp should light, if it does not there is an open circuit in the windings.

(2) Short circuits in the windings can be checked by connecting an ohmmeter to the ends of each coil and comparing the readings. If an ohmmeter is not available, connect a 6 or 12 volt battery in series with an ammeter to the coil leads and compare the current drain of the two coils. The ammeter readings should be uniform within 0.5 amperes. If not there is a short circuit or high resistance in the windings.

(3) To test for grounded field coils, connect one lead of a 220 volt or other suitable test lamp to one of the field coil leads and the other to the generator body. If the lamp lights the field coil is grounded.

(4) The field coil resistance is measured by connecting a suitable ohmmeter to each of the coil leads. The resistance should be as per specifications for the particular unit.

**TO TEST ARMATURE**

In a large number of cases the armature does not give visible evidence of trouble. The armature is tested for open circuits or short circuits.

(1) Open circuits are usually readily apparent, since this condition causes burned spots between the commutator segments due to brush deposits bridging the segments across the inter-segment insulations. Open circuits can also be determined by the use of a growler.

(2) A shorted winding can be tested by means of a growler. Place the armature on the growler, turn the armature slowly and hold a thin steel strip or hacksaw blade over it. Short-circuits in the armature cause the steel strip or hacksaw blade to vibrate against the core when it is held above the slot containing the shorted winding.

## 3. GENERATOR REGULATOR

**TO REMOVE**

(1) Disconnect the cables from the terminals 61 and 51 on the regulator.

(2) On models where the control box is attached to the generator, remove the attaching screws, lift away the unit sufficiently to disconnect the terminals D+ and DF at the bottom of the regulator.

(3) On models where the control unit is mounted to the body, remove the D+ and DF terminals and then remove the screws securing the bracket to the body.

**TO INSTAL**

Installation is the reversal of the removal procedure with particular attention to the following:

(1) Ensure that all leads are connected to the correct terminals.

(2) The thicker cable comes from the positive generator brush and must be connected to the D+ terminal of the regulator.

(3) The thinner cable is connected to the field coils and must be connected to the DF terminal on the regulator.

(4) Terminal 61 on the regulator must be connected to the warning light lead which is of a smaller diameter than the main lead which must be connected to terminal 51 on the regulator.

*NOTE: Some models have the main circuit lead connected to the solenoid switch terminal at the starter motor. On such models there is only one lead connected to terminal 51. Where this arrangement is not incorporated there will be two leads attached to the regulator terminal 51.*

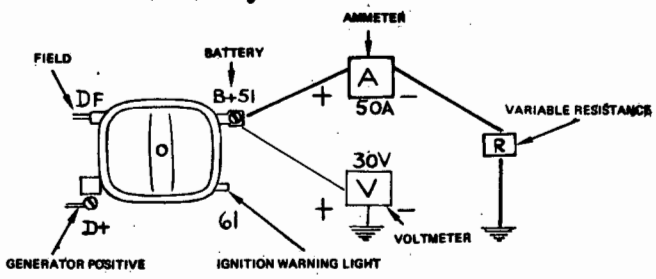
**TO TEST VOLTAGE**

(1) Remove the lead from the regulator terminal 51.

(2) Connect the positive lead of a suitable voltmeter to the terminal 51 at the regulator and ground the negative lead.

(3) Start the engine.

(4) Increase the speed gradually to 1890-2160 rpm.




Connections for Testing and Adjusting Current Output.

(5) The voltmeter reading should jump from 0 to 6.7** 12.5-13* at the increased speed and then register a steady 7.2-8.2** 12-14*.

(6) Stop the engine and note the flicking back of the voltmeter needle which indicates the operation of the cut-out relay.

** 6 volts system

* 12 volts system

## TO TEST CHARGING CURRENT

(1) Disconnect the battery cable and connect a suitable ammeter between the removed cable and the positive battery terminal. Check the meter. The needle should remain on zero.

(2) Switch on head or other lamps and note meter to ensure that current is flowing.

(3) Start the engine and note the ammeter reading, speed up the engine. The needle should move from the discharge side to the charge side of the meter.

(4) If the needle remains in the discharge position the cut-out relay is not closing.

*NOTE: The indicated value of the current obtained during the above test is not evidence of whether or not the regulator is correctly set, as the amount of the charging current depends on the state of charge of the battery.*

## TO TEST CURRENT REGULATOR

To check the operation of the current regulator irrespective of the state of charge of the battery, the following equipment is required:

(a) A moving coil-type ammeter with a range of 30.0.30 scale.

(b) A moving coil-type voltmeter with a range of 0-30 volts.

(c) A resistance of .276 ohms, suitable for a load of 25 amperes.

(1) Disconnect the cable from the regulator terminal.

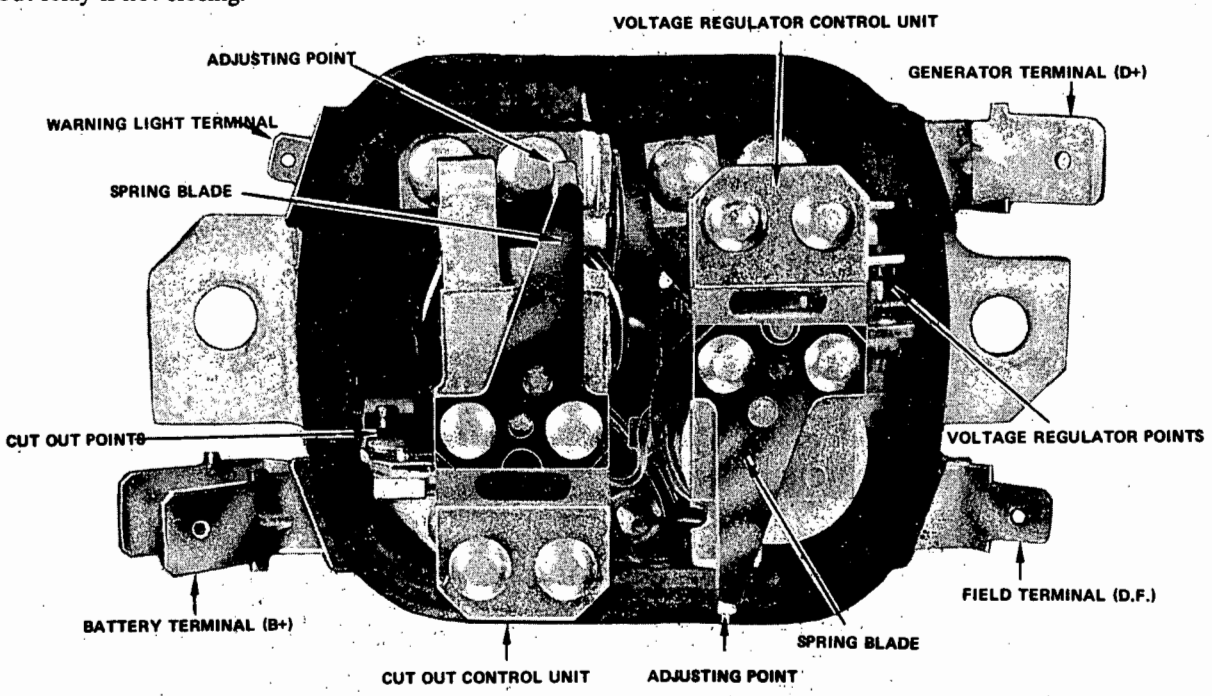
(2) Connect the resistance in series with the ammeter between the regulator terminal 51 and a good earth.

(3) Connect the positive lead of the voltmeter to terminal 51 at the regulator and the negative lead to a good earth.

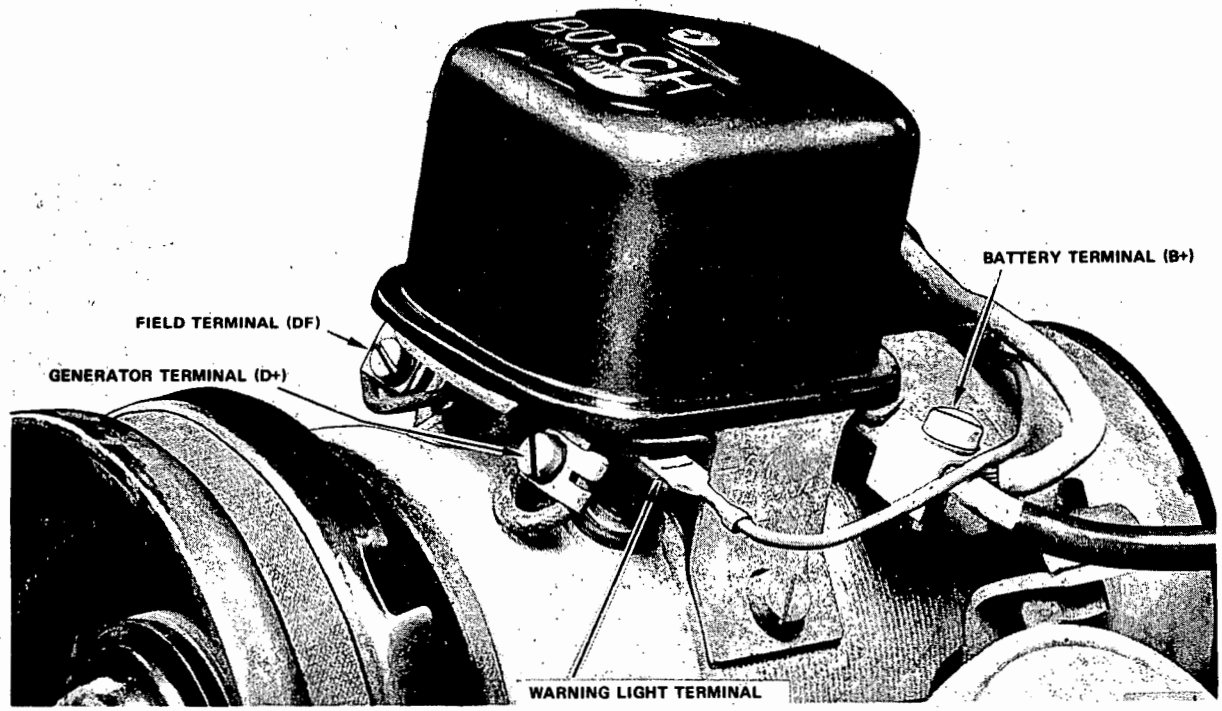
(4) Start the engine.

(5) With the engine adjusted to approximately 1850 rpm or generator speed of 3250-3700 rpm the load should be approximately within 23-26.5 amperes at voltage between 6.4-7.3 (12.5-13*).

(6) The regulator is a sealed unit and if found to be faulty should be replaced.




Generator Regulator with Cover Removed.



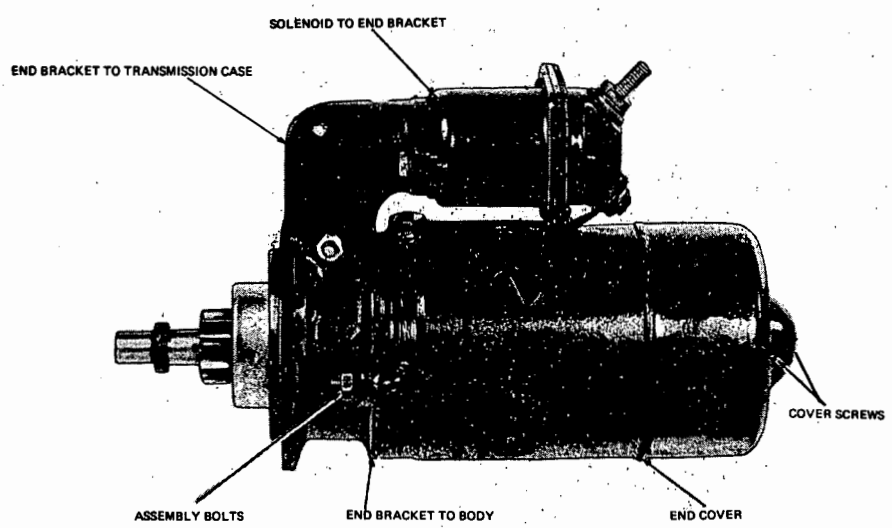

Generator Regulator in Position (Except 1500-1600 models.)

## 4. STARTER MOTOR

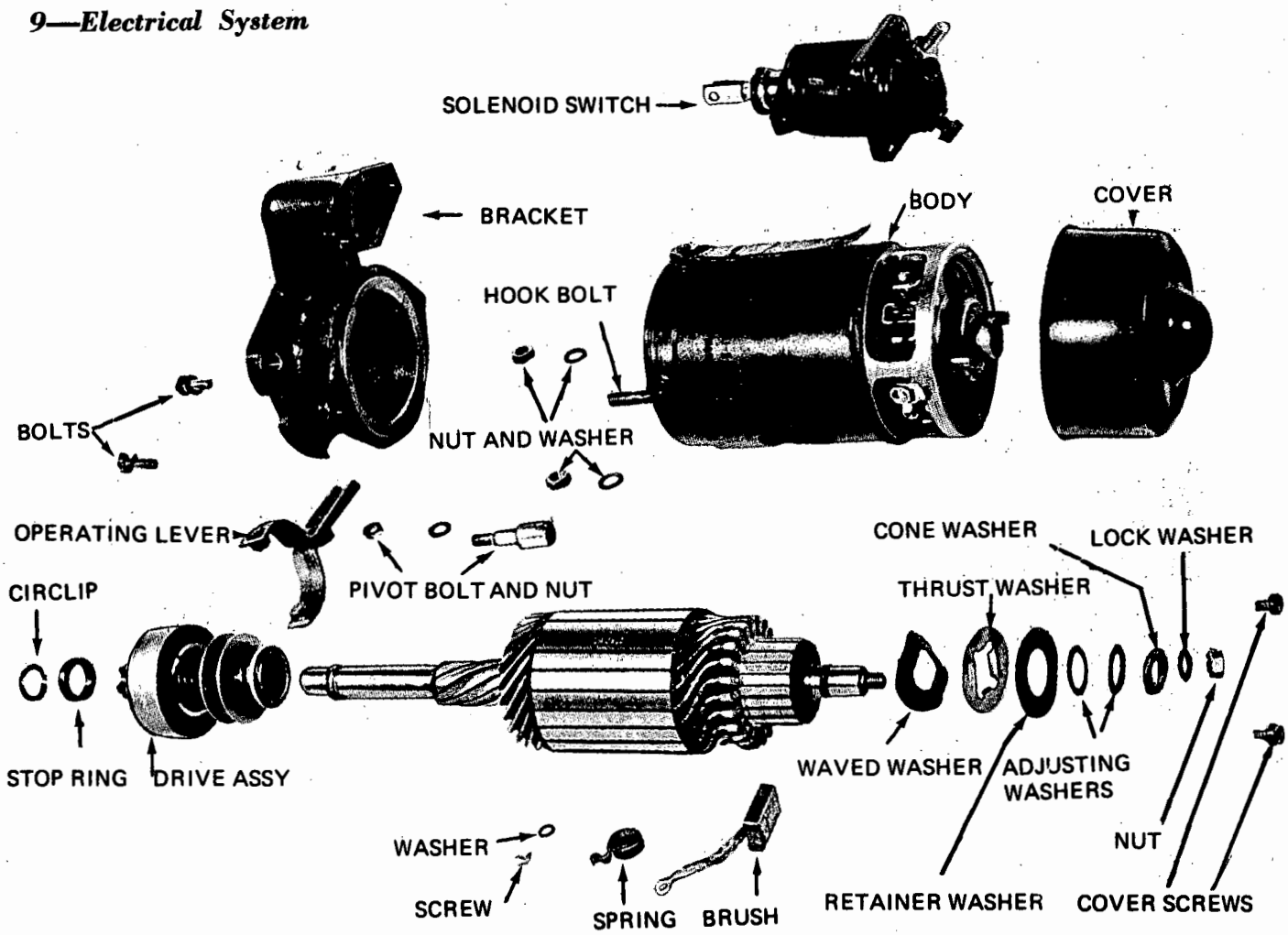
### DESCRIPTION

On all vehicles the starter is flange mounted on the right hand side of the engine and being a pre-engagement type, is operated by an ignition key controlled solenoid switch mounted on the starter body. The unit incorporates an over-run clutch to prevent the starter being run too fast when the engine starts.

The design of the starter ensures gradual engagement of the pinion by means of a circuit arrangement whereby only a part of the main circuit is used for initial movement of




Bosch EED Type Starter Motor fitted to Earlier Models. Showing Sealing Points.




**Exploded View of Bosch EED Type Starter Motor Components.**

the pinion. When the pinion reaches the position where it is in full mesh with the flywheel ring gear, the full circuit is completed and the initial pull in circuit is circuited out. A further protection device is provided by the non-repeat feature of the ignition switch. Once the engine is started, the starter circuit will not operate until the key is returned to the off position.

There are slight differences regarding dismantling and assembling and for this reason separate descriptions of these procedures have been included where applicable.

## TO REMOVE

(1) Disconnect the negative and positive leads from the battery.

(2) Disconnect the battery cable and other leads from the solenoid switch terminal.

(3) Disconnect starter switch to solenoid cable (small clip on connection).

(4) Remove the nut from the bolt securing the top portion of the flange to the engine housing and remove the stud at the bottom of the flange.

(5) Withdraw the starter from the engine housing.

## TO INSTAL

Installation is the reversal of the removal procedure, with attention to the following:

(1) Check the condition of the drive end bush which is located in the transmission housing.

*NOTE: If the housing bush is renewed it should be immersed in engine oil heated to approximately 200-212°F and allowed to stand until the oil has returned to normal temperature.*

(2) Apply a light application of suitable grease to the end of the starter shaft.

(3) Apply an application of suitable sealing compound to the starter between the flange and the housing.

(4) Ensure that all leads are installed on correct terminals.

**TO REMOVE THE SOLENOID SWITCH**

(1) Remove the starter assembly from the engine.

(2) Remove the nut and washers attaching the connector strap or lead to the lower terminal at the rear of the solenoid. Bend back the strap until it clears the terminal.

(3) Remove the screws securing the solenoid unit to the drive end bracket of the starter.

(4) Withdraw the solenoid away from the end bracket sufficiently to raise the unit up far enough to disengage the plunger link from the top of the pinion engagement lever.

(5) Withdraw the switch assembly from the starter unit.

**TO INSTAL THE SOLENOID SWITCH**

(1) Ensure that the gasket on the solenoid mounting bracket is in good condition and correctly positioned.

(2) Check that the terminal studs have not been turned by use of too much force during replacement of terminals.

(3) Check and adjust the plunger arm distance.

(a) Place the solenoid plunger in the body and press it down against the bottom of the solenoid housing.

(b) Measure the distance from the face of the solenoid body to the inside top end section of the oblong eye of the link. The correct distance is .748" ± .005" for starter types EEF(L)12VO 7PS and EEF 5/61. On starters of type EED 0.5/6 L44 proceed as indicated in (a) above, but the measurement is taken from the face of the solenoid body to the top face of the plunger and should be .8125" ± .005".

(c) Ensure that the adjustment nut on the threaded section is locked tight against the end of the plunger.

**TO DISMANTLE**

*Starter types EEF(L)12VO 7PS, EEF 0.5/6 1 and EED 0.5/6 L44*

(1) Remove the two screws from the end cover.

(2) Remove the nut, spring washer and two steel and one fibre thrust washers from the end of the armature shaft.

(3) Remove the nut and strap from the bottom solenoid terminal.

(4) Remove the nut from the solenoid shift lever fulcrum pin and withdraw pin.

(5) Remove the two screws securing the solenoid body to the starter intermediate bracket (front end bracket).

(6) Slightly tilt the solenoid assembly to disconnect the plunger link from the operating lever and withdraw the solenoid switch unit.

(7) Remove the two nuts or through bolts securing the end bracket to the starter main body and withdraw the bracket complete with the armature and pinion assembly.

(8) Remove the steel thrust washer and steel washer (armature brake) from the commutator end of the armature shaft. (Starter type EED 0.5/6 L44).

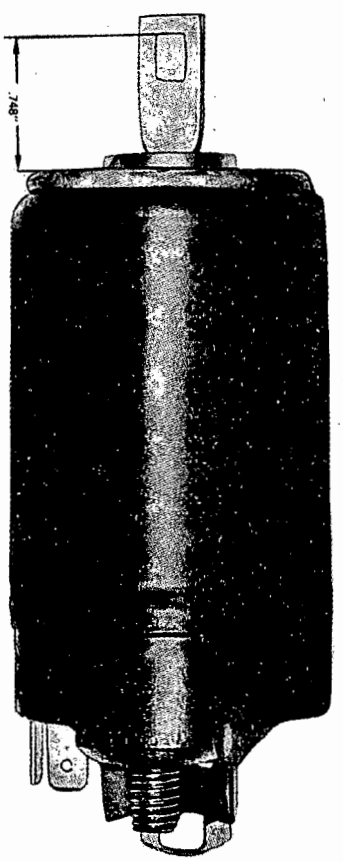
(9) Using a suitable sleeve press back the thrust collar or stop ring sufficiently to reveal the circlip on the front end of the armature shaft.

(10) Remove the circlip from the armature shaft and withdraw drive pinion assembly, lift out shift lever and remove the intermediate bracket from the body.

(11) Remove the two screws from the field connections at the brush holders and remove the end plate where applicable.

(12) Hold back the springs and remove the brushes.

(13) Remove the four pole screws, remove the pole shoes and field windings.




Dimension for Solenoid Link Adjustment with Plunger Engaged.

**TO ASSEMBLE**

The assembly procedure is the reverse of the dismantling procedure with attention to the following points:

(1) Ensure that the brushes are free in the holders and seating correctly on the armature commutator.

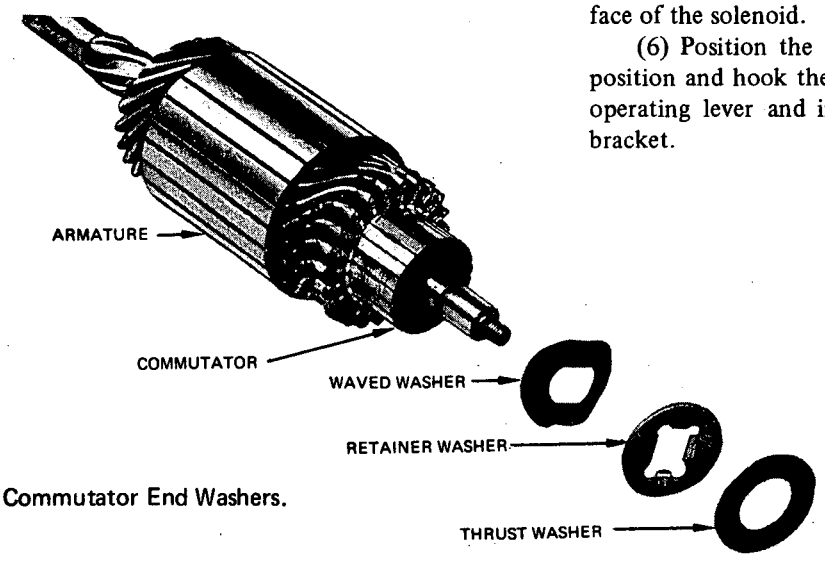
(2) Lubricate the front section of the armature shaft with suitable grease. (The bush is located in the transmission housing).

(3) Ensure where applicable that the steel washer mentioned in operation (8) of *TO DISMANTLE*, is installed with the concave side away from the commutator and that the fibre washer is between the two steel thrust washers.

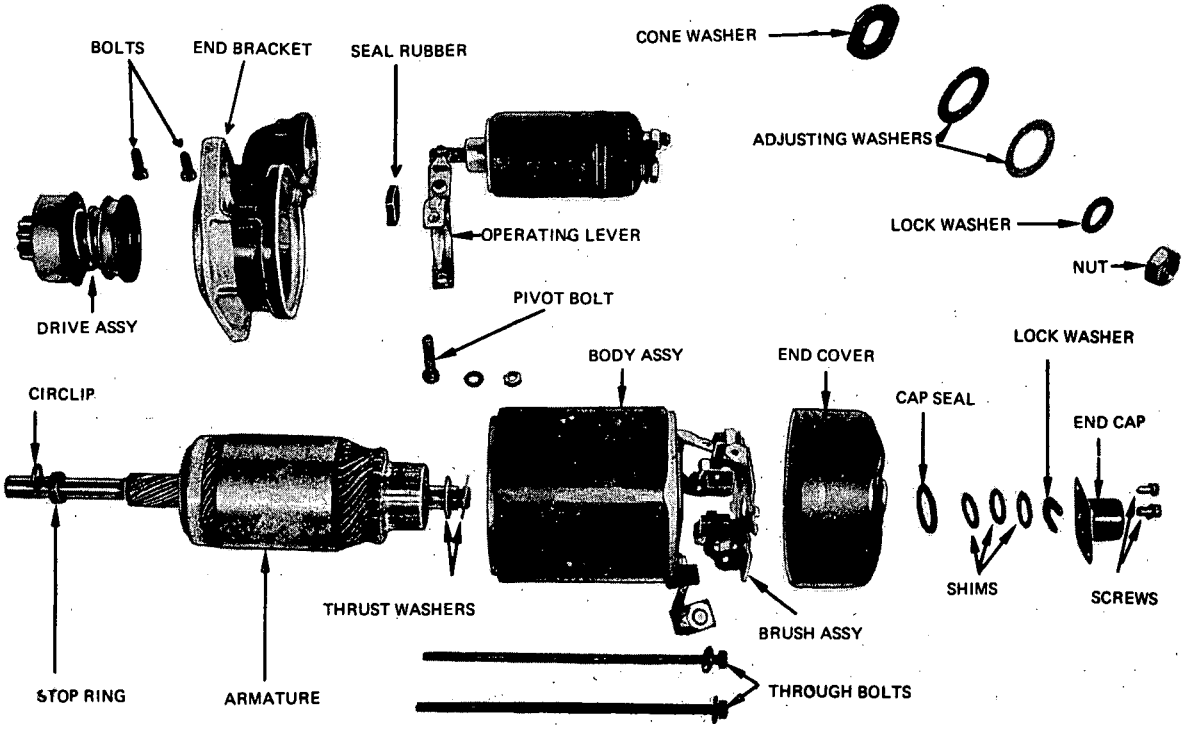
(4) Check the operation of the solenoid by connecting a jumper lead from the body to the negative terminal of a battery. Connect another lead from the small terminal (ignition switch terminal) and after positioning the plunger partly in the body connect the second lead to the positive pole of the battery. The plunger should snap fully into the body.

(5) Apply a light application of sealer to the mounting face of the solenoid.

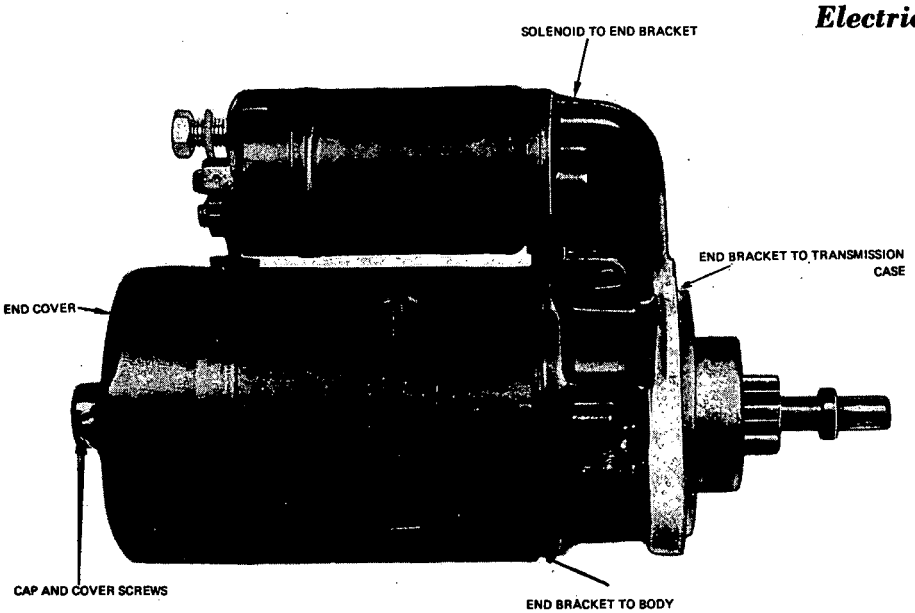
(6) Position the drive pinion assembly in the engaged position and hook the solenoid link on the top end of the operating lever and instal the securing screws to the end bracket.




Armature Commutator End Washers.




Exploded View of Bosch EEF Type Starter Motor components.




**Bosch EEF Type Starter Motor fitted to Later 1200 and Subsequent Models, Showing Sealing Points.**

**TO DISMANTLE**

*Starter types V W 111911-021D*

(1) Remove the two nuts from the solenoid body securing bolts.

(2) Remove the solenoid housing.

(3) Disconnect the cable between the contact bridge and the field coil.

(4) Remove the metal cover from the commutator end.

(5) Remove the circlip from the armature shaft and remove the steel and bronze washers.

(6) Remove the brush inspection cover, lift up the brushes and suitably fix them in the raised position.

(7) Remove the two screws from the frame.

(8) Withdraw the pinion housing and armature from the body section. Note the position and number of shims for correct reassembly.

(9) Disconnect the field coil lead from the brush holder of the positive brush.

(10) Remove the end plate.

(11) Remove the brake washer and thrust ring.

(12) Remove the two clips from the solenoid pivot pins and remove the pins from the pinion housing.

(13) Remove the insulating separator and turn the solenoid plunger 90° to permit the contact plate to pass between the terminal contacts.

(14) Withdraw the armature, shifting linkage and solenoid plunger as a unit from the housing.

(15) Remove the circlip and cup washers from the shaft at the drive end.

(16) Withdraw the shift collar slightly from the over running clutch and remove the complete assembly by turning it clockwise. The assembly can not be dismantled and if faulty must be replaced as a unit.

**TO ASSEMBLE**

The assembling procedure is basically the reverse of the dismantling operations with attention to the following points:

(1) Ensure that the brushes are free in the holders and correctly seated on the commutator.

(2) Lubricate with suitable grease, sparingly applied to the bearing section of the armature shaft particularly the front section which fits into the support bush located in the transmission case.

(3) Apply where necessary suitable sealing compound and correctly fit inspection covers.

## 5. DISTRIBUTOR

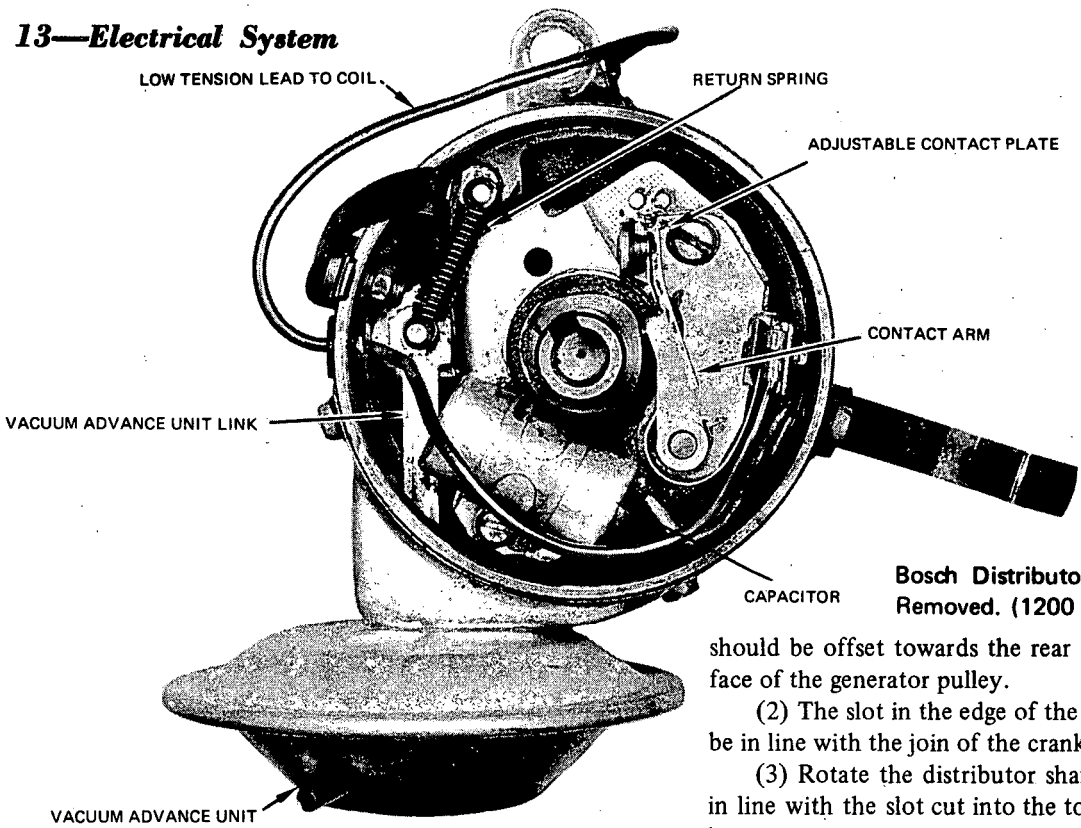
**TO REMOVE**

(1) Disconnect the cable from the primary terminal at distributor.

(2) Remove the distributor cap or remove high tension leads from the cap.

*NOTE: If leads are removed from the cap, installation will be facilitated by marking the relative cylinder numbers on the cap.*

(3) Remove the nut or stud securing the distributor lock plate to the engine crankcase.




**Bosch Distributor with Cap and Rotor Removed. (1200 Models).**

(4) Disconnect the vacuum line where applicable.

(5) Lift the distributor out.

## TO INSTAL

Installation is a reversal of the removal procedure with the attention of the following:

(1) Crank the engine until it is in position for firing on No 1 cylinder. The slot of the distributor drive pinion should be offset towards the rear and nearly parallel to the face of the generator pulley.

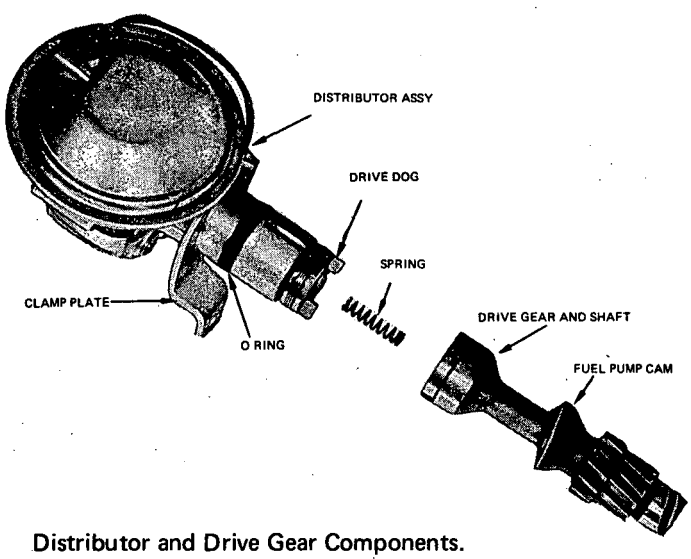
(2) The slot in the edge of the crankshaft pulley should be in line with the join of the crankcase.

(3) Rotate the distributor shaft until the rotor point is in line with the slot cut into the top edge of the distributor housing.

(4) Insert the distributor into the crankcase turning the shaft back and forth slightly to assist location of the drive dog and pinion.

(5) Instal the distributor locking plate stud or nut.

(6) Adjust ignition points and timing.




**Distributor and Drive Gear Components.**

## TO DISMANTLE

*Bosch VJR 4 BR 25*

(1) Remove the cap and rotor.

(2) Remove the nut from the primary terminal and the capacitor lead. Remove the screw securing the capacitor to the distributor body.

(3) Lift out the breaker arm assembly.

(4) Remove the retaining screw securing the adjustable contact plate.

(5) Remove the screws from the breaker plate and lift out the retainer springs.

Withdraw the breaker plate from the distributor body and remove the fibre washer and the shims from the distributor cam.

(6) Drive out the pin from the driving dog and remove the dog, steel and fibre washer.

(7) Withdraw the shaft, centrifugal weights and cam from the housing as a unit and remove the steel and fibre washers.

(8) Disconnect the weight springs and slide the cam block off the shaft. Lift the lubricating felt from the cam

hole. Note the position of the weight springs and cam to facilitate reassembly.

(9) Remove the two weight snap rings and remove the weights and fibre washer.

(10) Lift the weight contact plate off the weight carrying plate.

(11) Remove the distributor lock plate and the rubber sealer ring from the base of the body.

## TO ASSEMBLE

*Bosch VJR 4 BR 25*

Assembly is the reversal of the dismantling procedure, with attention to the following points:

(1) Lubricate the distributor shaft, cam (felt) and distributor bore, and the centrifugal weight mechanism.

(2) Ensure that the steel and fibre washers are replaced in their original order and position.

(3) Ensure that the drive dog is installed correctly in relation to the rotor slot in the top of the shaft. To do this proceed as follows:

(a) Rotate the shaft until the slot for the rotor lug is in line with the groove cut into the top edge of the distributor housing.

(b) Instal the steel and fibre washers and slide the drive dog onto the shaft and position so that the tongues are offset towards the mark indicated in (a) above. Drive in the coupling pin and instal the retaining spring, if fitted.

(4) Ensure the correct installation of the primary terminal insulation parts.

(5) Sparingly lubricate the breaker arm fibre block and the cam with suitable grease.

(6) The cap spring clamp that sticks up above the housing rim must be on the primary terminal side.

## TO DISMANTLE

*VW 211 905 205H*

(1) Remove the distributor from engine.

(2) Remove the cap and rotor.

(3) Remove the primary wire and capacitor lead.

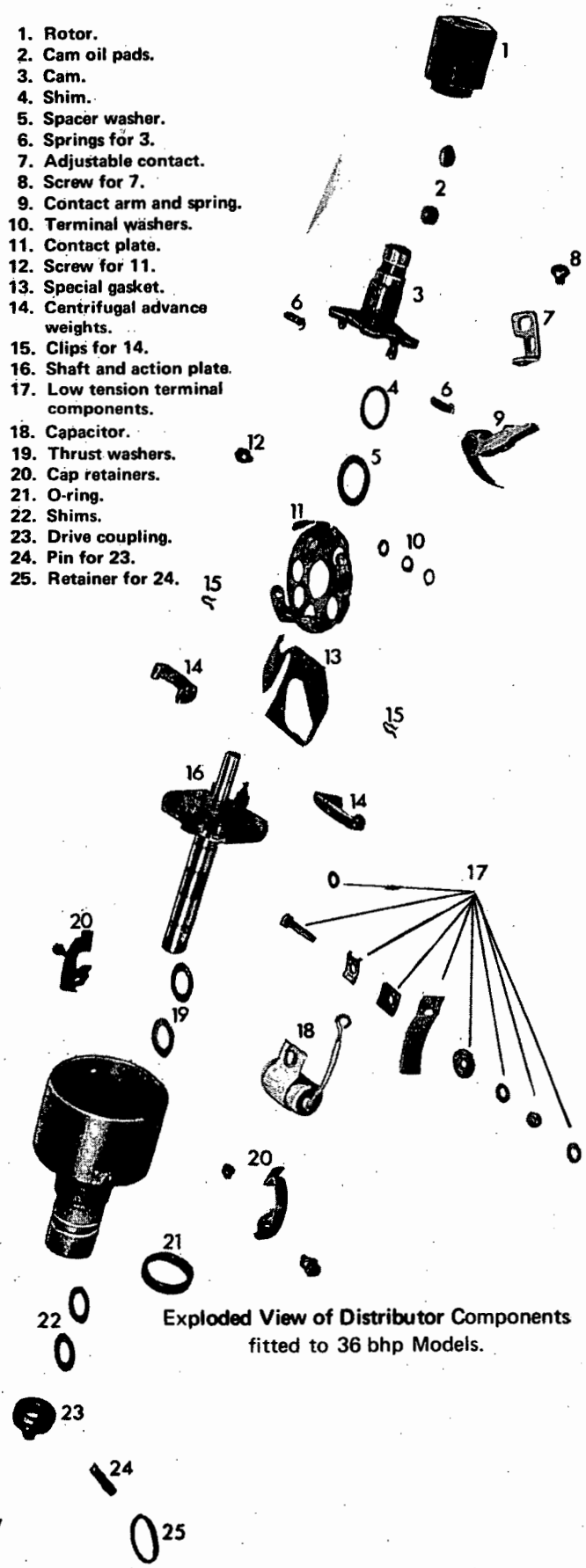
(4) Lift out the breaker arm.

(5) Remove the screw securing the adjustable contact plate and remove the plate and lift out.

(6) Remove the securing screw and capacitor from the outside of the distributor body.

(7) Remove the second nut and insulators from the primary terminal and remove the terminal screw.

1. Rotor.
2. Cam oil pads.
3. Cam.
4. Shim.
5. Spacer washer.
6. Springs for 3.
7. Adjustable contact.
8. Screw for 7.
9. Contact arm and spring.
10. Terminal washers.
11. Contact plate.
12. Screw for 11.
13. Special gasket.
14. Centrifugal advance weights.
15. Clips for 14.
16. Shaft and action plate.
17. Low tension terminal components.
18. Capacitor.
19. Thrust washers.
20. Cap retainers.
21. O-ring.
22. Shims.
23. Drive coupling.
24. Pin for 23.
25. Retainer for 24.



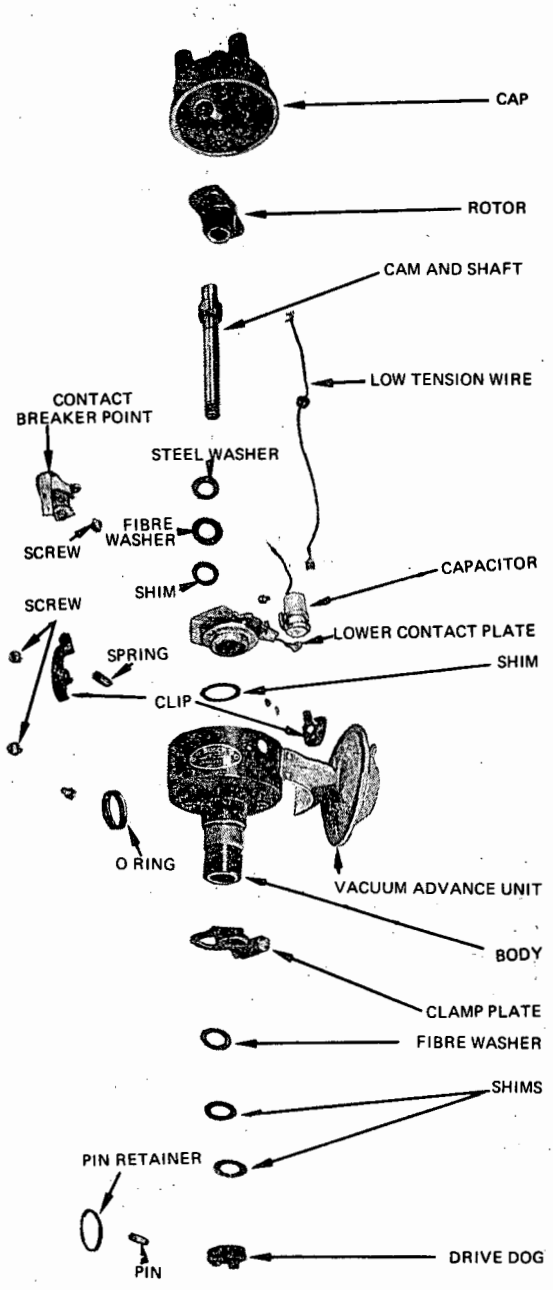
Exploded View of Distributor Components fitted to 36 bhp Models.

(8) Remove the two screws securing the breaker plate and lift out of body.

(9) Drive out the pin from the drive dog and remove the dog and fibre washer from the shaft.

(10) Withdraw the shaft from the housing and remove the steel and fibre washers from the top inner bush of the housing.

(11) Unhook the centrifugal weight springs and remove cam block. Note the position of the cam and springs for correct reassembly.




Exploded View of Distributor Components. (1200 Models.)

**TO ASSEMBLE**

*VW 211 905 205H*

Assembly is the reversal of the dismantling procedure with attention to the following points:

(1) Oil the distributor shaft and wick in the cam bearing.

(2) Apply a smear of grease to the cam lobes, weight pins and weight sliding ribs on the base plate. Fill the space between the bearing bushes in the distributor housing bore with the same grease.

(3) Ensure that the fibre and steel washers are replaced in the correct order.

(4) Ensure that the drive dog is installed correctly in relation to the rotor slot at the top of the shaft. The procedure for this operation is covered in paragraph (3), (a) and (b) of *TO ASSEMBLY VJR 4 BR 25.*

From Chassis No 614456 all vehicles were equipped with new vacuum advance type distributors.

The following distributors have been intermittently installed:

(1) *Bosch ZV PAU 4R1 MK.* This unit is larger than the former type with centrifugal advance and the capacitor is attached to the contact breaker plate inside the distributor housing.

(2) *Bosch ZV PAU 4R2 MK* This unit is identical with distributor ZV PAU 4R1 MK with the exception of a slight alteration in the mounting of the drive shaft and breaker plate.

(3) *VW Type 113 905 205B.* This distributor is smaller than the Bosch type and the capacitor is attached to the outside of the housing in the same manner as the earlier centrifugal advance type.

**TO DISMANTLE**

*Bosch ZV PAU 4R2 MK.*

(1) Remove the distributor from the engine.

(2) Remove the cap and rotor.

(3) Disconnect the low tension lead at the terminal inside the housing at the contact breaker arm and remove the lead complete with rubber grommet.

(4) Lift out breaker arm.

(5) Remove screw from the adjustable contact plate and lift plate out of the housing.

(6) Remove the capacitor.

(7) Remove the screws securing the vacuum advance unit to the housing.

(8) Disconnect the breaker plate earth cable on the housing and remove the retaining spring.

(9) Remove the vacuum unit return spring, lift off the vacuum unit actuating arm and withdraw the unit from the distributor body.

(10) Remove the retaining spring clip from the drive dog, drive out the retaining pin and remove the dog, shim washers, fibre washer and rubber seal.

(11) Withdraw the shaft from the housing and remove the fibre and steel washers from the cam end of the shaft.

**TO ASSEMBLE**

*Bosch ZV PAU 4R2 MK.*

Assembly is the reversal of the dismantling procedure with attention to the following points:

(1) Oil the distributor shaft and felt ring for the breaker plate.

(2) Check the correct order and quantity of steel and fibre washers on the shaft. If there is greater than .010" end play in the shaft compensate by adding extra shim washers.

(3) Ensure that the drive dog is installed in correct relation to the rotor groove in the top of the shaft. Proceed as indicated in sections (a) and (b) of Item (3) of *TO ASSEMBLE, DISTRIBUTOR VJR 4BR 25.*

(4) The retaining spring with the guide piece for the distributor cap should be on the same side as the breaker plate ground connection.

(5) Lubricate the fibre block and cam with a smear of grease.

**TO DISMANTLE**

*VW TYPE 113 905 205B*

(1) Remove the distributor from the engine.

(2) Remove the lead from the primary terminal at the distributor.

(3) Remove the capacitor from the outside of the housing.

(4) Loosen the screw securing the breaker spring to the insulated support bracket.

(5) Push the vacuum advance unit operating rod out of the ball joint by inserting a suitably bent wire hook in the hole provided in the pull rod.

(6) Remove the nut with the threaded pin and securing screw from the vacuum advance unit.

(7) Remove the vacuum advance unit.

(8) Remove the screw holding the breaker plate retaining bracket. Take the breaker plate and stop bracket out of the housing.

(9) Remove the low tension cable.

(10) Drive out the driving dog pin and remove the driving dog and fibre washer.

*NOTE: The pin securing the drive dog is normally peened over at each end and therefore it is necessary to drill off the peened area on one side to facilitate removal.*

(11) Remove the shaft from the housing and remove the fibre washer from the rotor end of the shaft.

(12) Remove the rubber sealer and clamp from the base of the housing.

**TO ASSEMBLE**

*VW TYPE 113 905 205B*

Assembly is the reversal of the dismantling procedure with attention to the following points:

(1) Oil the distributor shaft and fill the space between the bushes in the housing with suitable grease.

(2) Ensure that the steel and fibre washers are installed in their correct positions. If after assembly there is found to be more than .010" end play in the shaft, compensate by adding shim washers to the bottom end.

(3) When fitting the driving dog, proceed as indicated in paragraph (3), (a) and (b) of *TO ASSEMBLE VJR 4BR 25.*

(4) Ensure that the drive dog pin is peened over at both ends.

*NOTE: When securing the vacuum advance unit, the threaded rod must only be screwed into the stop on the spring. The adjustment of the spring influences the spark advance curve of the distributor. Whenever the distributor is overhauled the advanced curve must be readjusted on a distributor test stand by altering the spring tension.*

**TO DISMANTLE**

*BOSCH JUR4. VW211 905 205P*

(1) Remove the cap and rotor.

(2) Remove screw from breaker point assembly.

(3) Disconnect the low tension lead bayonet type connector from inside the body.

(4) Lift off the contact breaker set complete.

(5) Remove the screw securing the capacitor and breaker plate to the body.

(6) Disconnect the return spring and vacuum control unit arm from breaker plate.

(7) Remove the screws from the vacuum advance unit and remove from the body.

(8) Remove the spring clip from the drive dog and remove the pin securing the dog to the shaft.

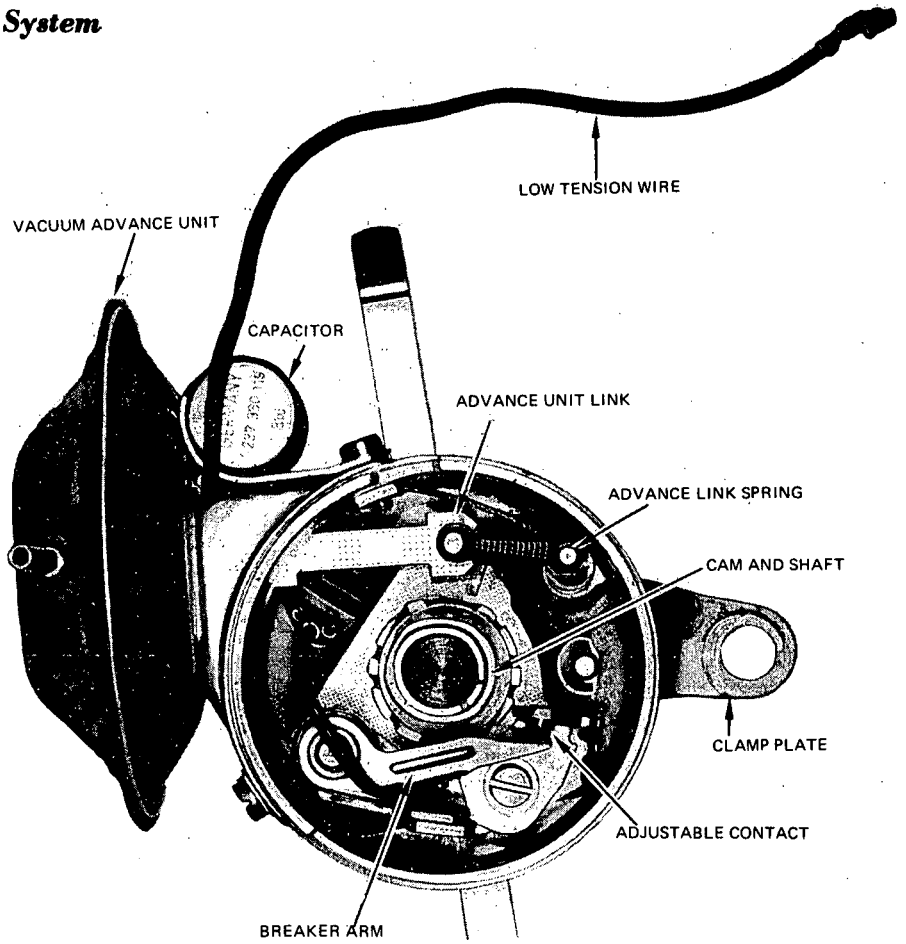
(9) Remove the steel shim adjusting washers.

(10) Withdraw the shaft from the body.

(11) Remove the terminal nut, capacitor and coil low tension leads, insulators and terminal from the base of the body.

(12) Lift out breaker plate and thrust washers from between the plate and the body.

(13) Remove the rubber seal and clamp from bottom of body.




Distributor with Cap and Rotor Removed (1500-1600 models).

**TO ASSEMBLE**

*BOSCH JUR4. VW211 905 205P*

The assembly procedure is the reversal of the dismantling operations with the inclusion of the lubrication of the parts.

**TO ADJUST BREAKER POINTS**

(1) Remove the distributor cap and rotor.

(2) Rotate the crankshaft until the breaker arm fibre block is on the highest point of one of the cam lobes.

(3) Loosen the screw holding the adjustable contact plate and using a clean feeler gauge of the correct size, (refer to specifications for correct setting) adjust the points by moving the adjustable contact plate until the feeler gauge is a neat fit between the points.

(4) Tighten the plate securing screw.

(5) Rotate the crankshaft and check the point setting on each lobe. The setting should remain reasonably constant on all lobes. Where a variation of more than .004" is found to exist, the distributor should be removed and inspected for worn bearings, bent shaft or a worn cam lobe.

*NOTE: Worn or otherwise uneven points should be suitably dressed and aligned or replaced. Otherwise incorrect gap setting will result.*

**TO CHECK THE IGNITION POINTS**

The ignition points operate in conjunction with the coil, capacitor, high and low tension circuits and any incorrect setting, condition or operation will effect the general performance of the system.

Carefully examine the ignition points for the following:

(1) That the two faces of the points are in alignment and free from build-up or extraction of metal from either face.

Presence of build-up etc, can indicate over or under capacitor capacity.

(2) Burned or blackened surfaces. This condition can result from a faulty capacitor or from grease or oil fumes coming into contact with the points during operation. An indication of fumes as the source is the presence of a black line formed on the fixed breaker arm and in line with the breaker faces.

(3) Breaker arm spring for correct tension (check specifications). Breaker arm spring tension too weak or strong will effect the high speed performance either by floating which is caused by weak tension or bouncing which is a result of over tension.

(4) That the pivot post is free but firm and the fibre insulation washer or sleeve is in good condition.

(5) Low tension terminal and lead for tightness and condition of insulation.

(6) Breaker arm fibre block for wear and seating on cam.

(7) Correct gap.

## TO CHECK CAPACITOR

A faulty capacitor is usually indicated by burnt or otherwise damaged points, weak ignition spark or erratic performance of the engine. To conclusively test a capacitor, a special tester unit is required. Where this unit is available the capacitor should be tested for:

(1) Grounding or shorting.

(2) Insulation breakdown under load.

(3) High series resistance.

(4) Capacity test.

(5) Leakage test.

If a tester unit is not available the best method is by substitution.

## TO SET IGNITION TIMING

(1) Before attempting to set the timing, check and if necessary, adjust the breaker points to the correct gaps.

(2) Loosen the distributor clamp or screws.

(3) Connect one lead of a suitable test lamp to the low tension lead terminal at the distributor and the other to a good earth on the crankcase.

(4) Rotate the crankshaft until number one cylinder is at tdc on compression stroke and the appropriate mark on the fan pulley lines up with the join of the crankcase (see specifications).

(5) Switch on the ignition.

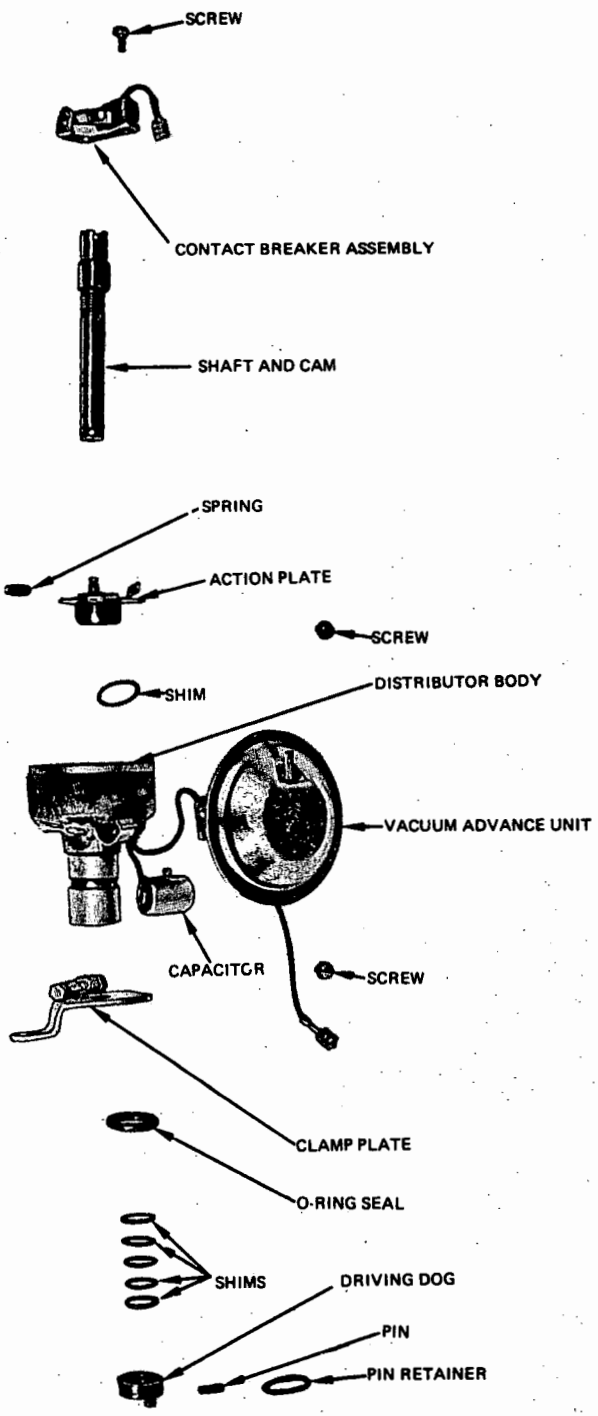
(6) Rotate the distributor body clockwise until the points close.

(7) Rotate the distributor body anti-clockwise until the breaker points just open and the lamp lights.

(8) Tighten the clamp or screw.

*NOTE: If it is desired to add additional degree marks to the pulley, the following basic equivalent of the extreme outside diameter of the pulley may be used.*

One sixteenth of an inch (.0625") equals 2.5 degrees advance.




**Exploded View of Distributor Components (1500-1600 Models).**

## 6. SPARK PLUGS

(1) The sparking plugs should be removed for inspection, cleaning and resetting at intervals of 3000 to 4000 miles. Sparking plugs removed from an engine in good mechanical condition, operating under normal conditions, should have light powdery deposit ranging in colour from light brown to greyish tan. After considerable service the electrodes will show signs of wear or normal burning.

(2) Sparking plugs showing a thick black oily deposit indicates an engine in poor mechanical condition or possibly that a plug with too low a heat range has been fitted.

(3) Sparking plugs showing a white or yellowish deposit indicates sustained high speed driving or possibly that plugs of too high heat range have been fitted, particularly when these deposits are accompanied by blistering of the porcelain and burning of the electrodes. Check the recommended heat range for the engine (see specifications) and select the correct heat range if operating conditions are abnormal.

(4) If the heat range is correct, clean the plugs on a sanding machine, and blow clean with compressed air. Set the electrode gap (see specifications) by bending the earthing electrode and test the plugs on a reliable testing machine.

*NOTE: Never attempt to set the electrode gap by bending the centre electrode, or a cracked insulator will result.*

(5) Clean the sparking plug threads and, using new gaskets, fit the plugs, screwing up finger tight.

(6) Using a torque wrench, tighten the sparking plugs to the recommended torque.

## 7. SWITCH ASSEMBLIES

### OIL PRESSURE SWITCH AND WARNING LIGHT

The oil pressure switch is installed in the main oil line between the oil pump and the oil cooler unit. When the ignition is switched on, current flows through the warning light and pressure switch to earth completing the circuit and causing the warning lamp to light.

When the engine is running the oil pressure actuates the diaphragm holding the contacts apart interrupting the circuit and extinguishing the warning light. Accordingly any failure in the oil system that results in the reduction of the oil pressure to a point below 8 psi is indicated by the lighting up of the warning light.

### TO TEST AND ADJUST PRESSURE SWITCH

(1) Remove the pressure switch from the crankcase and instal a suitable T piece to enable an oil pressure gauge to be installed in conjunction with the pressure switch.

(2) Reconnect the pressure switch to the warning lamp or other suitable lamp and start the engine.

(3) Reduce the idling speed to approximately 300 rpm.

(4) Increase the engine speed to 550 rpm and note the pressure gauge reading which should be close to 8 psi and the warning light should go out at that pressure.

(5) If the engine has to be speeded up considerably to obtain 8 lbs psi pressure, it is an indication of either a faulty oil pump or worn engine bearings or other fault allowing excessive oil to escape from the oil feed system. Refer to engine section specifications regards normal operating pressure.

(6) If the pressure reading is around 8 lbs psi at the correct engine speed and the switch does not cut out the warning lamp, it could require adjustment.

(7) Remove the terminal screw from the switch. Insert a suitable screwdriver into the slot of the adjuster screw. Turn the screw clockwise to increase the spring loading, if the warning light is coming on too early and anti-clockwise to reduce the loading when the switch is operating too late.

*NOTE: The sealing of the switch is effected by a tapered thread and care must be taken not to over-tighten when installing the unit to the crankcase*

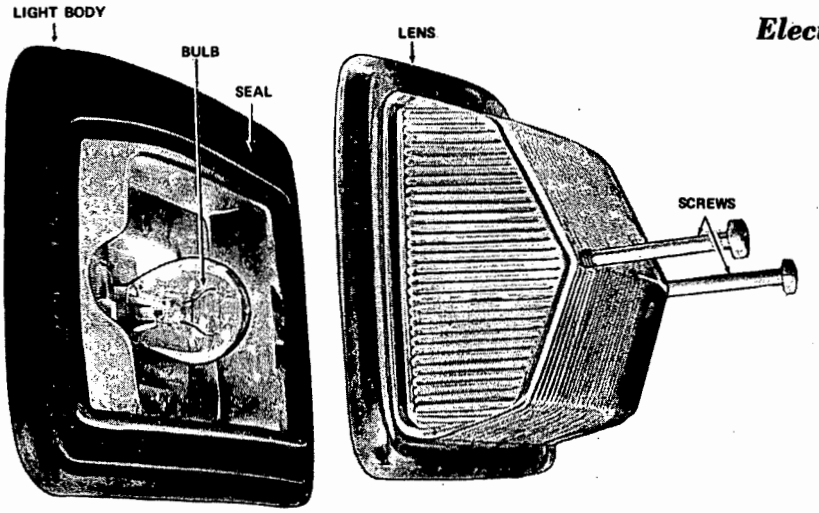
(8) The green warning light is connected to the ignition switch and apart from replacement of the 1.2 watt bulb, there is no maintenance involved.

## 8. DIRECTION INDICATOR UNITS

### DIRECTION INDICATORS (Early Models)

The units which are recessed into the body on either side of the vehicle just to the rear of the door pillar are connected to a warning light located in the speedometer housing.

The signal units are electro-magnetically operated and controlled by a switch below the steering wheel. As the units are exposed to the weather they require maintenance in the form of removal and cleaning and lubricating from time to time.




**Front Direction Indicator Light (Left Side).**

**TO REMOVE**

(1) Raise the indicator arm.
(2) Remove the mounting screw from the door pillar.
(3) Withdraw the unit from the pillar.
(4) Remove the two wires.

**TO INSTAL**

Installation is the reversal of the removal procedure with attention to the following points:

(1) Reconnect the wires: The blue wire to the upper terminal and the black and white or green and black to the lower terminal.

(2) To re-instal the indicator arm, slide the bracket on the back of the arm in an upward direction into the slot of the pillar as far as it will go. Hold the arm in that position while tightening the fixing screw.

(3) The indicator arm must not rub against the sides of the recess. If necessary, bend the arm carefully until the arm can move freely.

**TO REMOVE INDICATOR SWITCH**

(1) Remove the knob from the operating lever.
(2) Remove the screws from the switch housing and take off the housing.
(3) Remove the strap after taking out the clamp screw.
(4) Remove the wires noting their relative positions.

**TO INSTAL**

(1) Connect the wires to the switch as noted on removal.
(2) Check the switch for correct operation before proceeding further.
(3) Position the strap and instal the securing screws.
(4) Position the housing and instal the securing screw.
(5) Replace the lever knob.

**FLASHING TURN INDICATORS (From Chassis No 6414456)**

From Chassis number 6414456 all vehicles were fitted with flashing type turn indicator lamps as standard equipment.

Although the shape and positioning of the lamps vary to some extent on the different models, the basic system has remained throughout the range.

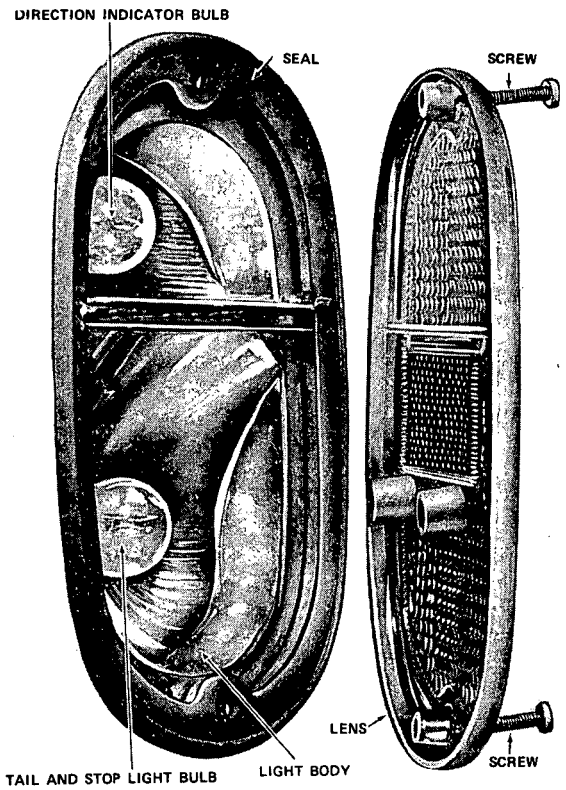
The front lamps are mounted separate to other units but the rear are incorporated in the combined stop and tail lamp unit.

Operation of the flashers is by a sealed relay switch (not repairable) and controlled by a self cancelling selector switch mounted on the steering column. The selector switch is connected to indicator warning lamps mounted either in the speedometer housing or the dash panel.

The flashing action takes place as a result of the heating of a thermostatic blade or wire in the flasher switch unit. When the blade or wire gets hot (because of the current flowing through the flasher winding) it warps or lengthens and opens a pair of contacts opening the circuit. This action is repeated rapidly to produce the flashing action of the lights. The flasher unit current draw is balanced against the bulb wattage and this factor determines the number of flashes per second of the system in accordance with the laws of the region of operation.

**TO REMOVE CONTROL SWITCH**

(1) Disconnect the battery lead.
(2) Remove the left hand trim panel.
(3) Disconnect two wires from connector and one from the flasher unit.




(4) Remove the two clamp screws from the switch and remove the clamp.

(5) Lift up wire clip at the body and take off the switch complete with wires.

(6) Screw off the switch lever knob.

(7) Remove the two screws from the switch cover and remove cover from the switch.

**TO INSTAL**

Reverse the removal procedure with attention to the following:

(1) Ensure that the cables are not strained at the switch and at the body.

(2) The distance between the upper edge of the direction indicator switch and the lower edge of the steering wheel hub should be .040"-.080" to align the self cancelling mechanism.

(3) Ensure that the switch is cancelling correctly in relation to the steering wheel position. If the steering shaft has not been disturbed, adjustment can be made by loosening the clamp and turning the switch clockwise or anti-clockwise on the steering column.

Rear Stop, Side and Direction Indicator Lights.

## 9. HEADLAMPS

**BUILT IN TYPE HEADLIGHTS (Early Models)**

The built in type headlamp units incorporate high and low beam and parking lights. The outer rim, glass and reflector assemblies are detachable being assembled to a reflector retainer by means of clips. The headlight double filament and parking light bulbs are mounted on a holder which clips into the reflector unit. Vertical and horizontal adjustment is provided by two adjuster screws located in the upper and lower side of the rim area nearest the centre of the vehicle.

**TO REMOVE**

(1) Remove the screw from the bracket located on the inner side of the headlamp assemblies. Lift the assembly slightly at that point and pull to the side to disengage the securing tab from the opposite side and withdraw the complete assembly.

(2) Remove the tension spring and remove the bulb holder from the reflector.

**TO DISMANTLE**

(1) Remove the spring clips retaining the glass to the rim by means of a screwdriver.

(2) Lift away the reflector unit and remove gaskets and glass.

**TO ASSEMBLE AND INSTAL**

Reverse the procedures above, with attention to the following:

(1) Do not touch the reflector surface with the bare hands.

(2) Ensure that the gaskets between the reflector units and the glass are correctly seated.

(3) Ensure that the rubber inserts positioning the adjuster screws are in place.

**SEALED BEAM TYPE HEADLAMPS**

Vehicles exported to some countries are equipped with sealed beams instead of the usual detachable type glass and

reflector. Minor alterations have been made to the assembly to incorporate the beam unit. With the seal beam unit fitted to the light assembly the lamp in effect has two glasses. To accommodate the parking lamp it has been attached to an aperture in the top of the headlamp shell. Also an adaptor type connector replaces the screwed terminals to allow connection to the blade type terminals of the sealed beam and the parking light wires are extended to the new location of the parking light bulb socket.

**TO REMOVE**

(1) Remove the front rim retaining screw and pull out the complete headlamp assembly.

(2) Remove the bayonet connection adaptor from the rear of beam unit and the wire from the parking light socket.

(3) Remove the parking light socket.

**TO INSTAL**

Installation is the reversal of the removal procedure.

**TO DISMANTLE**

(1) Remove the glass retaining springs from the sealed beam unit and withdraw.

(2) Unscrew the adjusting screws as far as possible and detach the clip.

(3) Lift the retaining ring unit away and remove headlamp gaskets and glass.

**TO ASSEMBLE**

Assembly is the reversal of the dismantling procedure, with the inclusion of the adjustment of the beam.

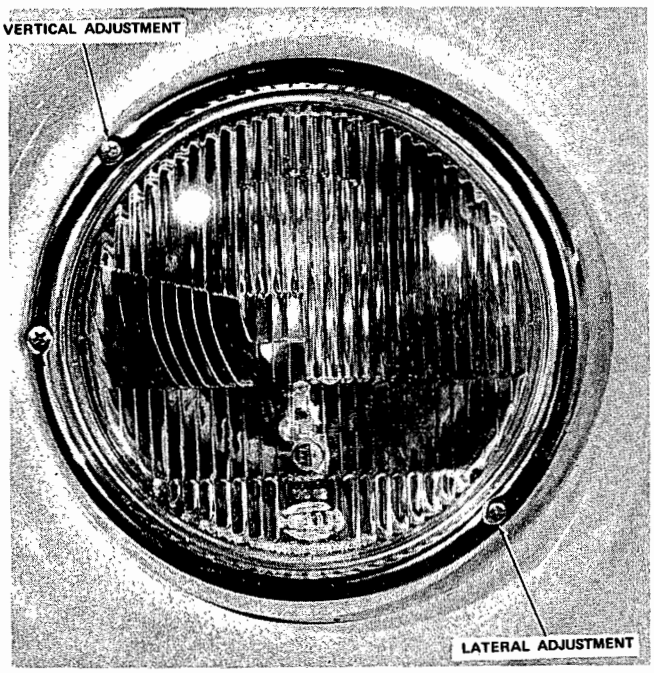
**TO REMOVE HEADLAMPS (Late Models)**

(1) Remove the single Philips screw positioned approximately half way down the side of the headlamp rim closest to the centre of the vehicle.

*NOTE: The securing screw can be recognised by its size, being almost twice the size of the two adjusting screws also situated on the rim area.*

(2) Withdraw the unit outwards and slightly towards the centre of the vehicle to clear the tongue clip on the opposite side from the securing screw.

(3) Remove the bulb assembly by turning the holder slightly anti-clockwise and withdrawing.




Left Hand Side Headlight Showing Beam Adjustment Screws.

**TO INSTAL**

Reverse the removal procedure.

**TO DISMANTLE**

(1) Remove the four thumb clips from the plastic inner body.

(2) Withdraw the two adjusting screw pins from the rubber grommets located in holes in the side of the plastic body and separate the reflector unit from the body.

(3) Separate the glass from the plastic body and remove the rubber seal from around the glass.

(4) Remove the bulb from the plastic holder by withdrawing the socket from the bayonet connections.

*NOTE: When removing the socket it is essential to hold both units owing to the spring positioned between the bulb and the holder, which will propel the bulb out of the holder with subsequent damage.*

(5) Remove the parking light bulb from the reflector by pressing in and turning, but particular care must be taken not to touch the reflector surface.

**TO ASSEMBLE**

Reverse the dismantling operations with particular attention to the following points:

(1) That the glass is correctly aligned with the assembly.

(2) Ensure that the adjuster screw grommets are correctly seated in their respective holes in the body and that the pins are pressed completely into the slots in the grommets.

(3) That the glass sealing rubber is properly seated in the body.

## 10. WINDSCREEN WIPER

### DESCRIPTION

The windscreen wipers are two blade tandem drive electrically operated type, mounted at the forked end of the hot air duct of the windscreen. The motors on the early models were of the one speed operation but later versions have been fitted with two speed type. The drive to the arms on all models are through mechanical linkage.

### TO REMOVE AND INSTAL MOTOR AND SHAFTS (Early 6 Volt Models)

(1) Disconnect the right hand link rod at the ball joints and remove rods.

(2) Disconnect the left hand link rod from wiper shaft ball joint.

(3) Remove the two studs from the motor mounting bracket.

(4) Move the motor outwards sufficiently to disconnect the wires.

(5) Withdraw the unit.

(6) Lift up the wiper blade arms and loosen the screws locking the arms to the wiper shafts.

(7) Lift off the arms.

(8) Lift off the pivot bearing caps.

(9) Remove the nuts securing the wiper arms and lift off the cap washer and rubber grommets.

(10) Withdraw the shafts from the cowling from inside the vehicle.

(11) Remove the small circlips from the shafts near the serrated area and remove the holding sleeve from the shaft.

Installation is the reversal of the removal procedure with the inclusion of the lubrication of the moving parts.

### TO REMOVE MOTOR AND SHAFTS (Later Models)

(1) Disconnect the wires from the switch.

(2) Remove the distribution connection pipes by first removing the two centre air outlet plates from the interior panel just below the windscreen and withdraw complete with pipes.

(3) Remove the dome nuts and wave washers from the drive shafts.

(4) Prise the arms off the splines and remove same, together with plastic cover seal.

(5) Remove the hexagonal nut from each shaft and remove the steel washer leaving the cowling seal grommet in position.

(6) Remove the single hexagonal head stud securing the motor body bracket to the cowling. This stud is located near the fork of the air distribution pipes.

(7) Withdraw the wiper assembly complete with bracket and drive shafts out from under the facia panel taking care not to foul the rear of the instruments and other units.

### TO INSTAL

The installation procedure is the reversal of the removal operations with attention to the following:

(1) Ensure that both the rubber cowling grommet seal and the plastic seal cover is correctly seated.

(2) Position the arms so that when in the parked position the blades are lying to the right hand side of the screen and approximately three inches from the bottom of the screen measuring from the centre of the blade.

(3) Lubricate the ball joint connections of the drive arm assemblies.

## 11. ELECTRICAL FAULT DIAGNOSIS

### BATTERY AND GENERATOR SYSTEM

**(1) Battery undercharged.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Loose or broken generator drive belt. | – Adjust or renew belt. |
| (b) | Faulty or incorrectly adjusted generator regulator. | – Renew or adjust regulator unit. |
| (c) | Faulty battery. | – Renew or repair battery. |
| (d) | Faulty generator. | – Overhaul or renew generator. |
| (e) | Fault in charging circuit wiring. | – Check and repair or renew wiring harness. |
| (f) | Faulty connections in charging circuits. | – Check and renew or repair component/s. |

**(2) Battery overcharged.**

| *Possible cause* | *Remedy* |
|---|---|
| (a) Faulty or incorrectly adjusted generator regulator unit. | – Renew or adjust regulator. |
| (b) Faulty battery. | – Renew or repair battery. |
| (c) Faulty generator. | – Overhaul or renew generator. |
| (d) Faulty charging circuit wiring or connections. | – Check and renew or repair faulty components. |
| (e) Shorted field wire. | – Renew field. |
| (f) Grounded field wire. | – Repair field. |
| (g) Shorted cell in battery. | – Renew battery. |

**(3) Charge indicator light remains on.**

| *Possible cause* | *Remedy* |
|---|---|
| (a) Loose or broken generator drive belt. | – Adjust or renew drive belt. |
| (b) Faulty or incorrectly adjusted generator regulator unit. | – Check and renew or adjust regulator unit. |
| (c) Faulty generator. | – Check and overhaul generator. |
| (d) Low regulator voltage setting. | – Check and adjust voltage setting on regulator unit. |
| (e) Sticking brushes in generator. | – Free up or renew. |
| (f) Grounded field coil. | – Overhaul generator. |
| (g) Open circuit in field. | – Overhaul generator. |

**(4) Charge indicator light does not operate.**

| *Possible cause* | *Remedy* |
|---|---|
| (a) Light bulb blown. | – Check and renew faulty bulb. |
| (b) Open circuit in wiring or bulb socket. | – Check and rectify open circuit. |

**(5) Noise in drive belt or generator.**

| *Possible cause* | *Remedy* |
|---|---|
| (a) Drive belt frayed or out of alignment with pulleys. | – Renew drive belt and/or align pulleys. |
| (b) Loose generator mounting bolts or worn bearings. | – Tighten mounting bolts and/or renew bearings. |
| (c) Loose generator pulley. | – Tighten pulley retaining nut. |
| (d) Faulty generator. | – Overhaul or renew generator. |
| (e) Fan belt too tight. | – Adjust correctly. |
| (f) Incorrectly seated brushes. | – Dress brushes. |
| (g) High mica between commutator bars. | – Undercut mica. |

**(6) Arcing at generator brushes.**

| *Possible cause* | *Remedy* |
|---|---|
| (a) Out of round commutator. | – Machine commutator. |
| (b) Dirty or glazed commutator. | – Clean commutator. |
| (c) Weak brush springs. | – Renew springs. |
| (d) Excessive voltage output. | – Adjust voltage control. |

**BATTERY AND STARTING SYSTEM**

**(1) Starter lacks power to crank engine.**

| *Possible cause* | *Remedy* |
|---|---|
| (a) Battery undercharged. | – Check charging system and rectify as necessary. |
| (b) Battery faulty, will not hold charge. | – Check and repair or renew battery. |

| | | |
|---|---|---|
| (c) | Battery terminals loose or corroded. | – Clean and tighten terminals. |
| (d) | Faulty starter motor. | – Check and overhaul starter motor. |
| (e) | Faulty starter solenoid switch or contacts. | – Check and renew solenoid as necessary. |
| (f) | Worn or dirty starter brushes. | – Renew or clean. |
| (g) | Sticking brushes. | – Free, clean or renew brushes. |

**(2) Starter will not attempt to crank engine.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Open circuit in starting system. | – Check for: Dirty or loose terminal, dirty commutator, faulty solenoid, faulty switch. |
| (b) | Discharged battery. | – Check for fault or short circuit in system. |
| (c) | Battery fully charged but will not crank engine. | – Check for: Locked drive and ring gears, internal starter fault or seized engine. |
| (d) | Weak cell in battery. | – Renew battery. |

**HEADLAMP SYSTEM**

**(1) Lamps fail to light.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Burnt out sealed beam unit/s. | – Check and renew faulty unit/s. |
| (b) | Open circuit in wiring or connections. | – Check and rectify. |
| (c) | Faulty light switch. | – Check and renew switch. |
| (d) | Burnt out fuse, if fitted. | – Eliminate cause and renew. |

**(2) Lamps flare with engine speed increase.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Faulty battery. | – Check and renew or repair battery. |
| (b) | Battery in low state of charge. | – Recharge battery and check charging system. |
| (c) | High resistance or faulty connections between generator and battery. | – Check circuit and rectify condition. |
| (d) | Poor earth connection between battery and engine or generator. | – Check battery earth lead and strap between engine and body. |
| (e) | Voltage regulator setting too high or unit inoperative. | – Check and adjust voltage regulator setting. |

**DIRECTION INDICATOR LIGHT SYSTEM.**

**(1) Indicator warning light does not burn and no audible clicking from flasher unit, when turn is selected on switch lever.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Fuse blown. | – Rectify fault and renew fuse. |
| (b) | Bulb blown on one or both sides. | – Check system and renew bulb/s. |
| (c) | Faulty flasher unit. | – Renew flasher unit. Do not attempt repair. |
| (d) | Faulty direction indicator switch. | – Renew or repair switch. |
| (e) | Fault in wiring circuit. | – Check and repair fault. |

**(2) Indicator light operates at a very slow rate.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Faulty or incorrect flasher unit. | – Renew unit. |
| (b) | One bulb blown or break in circuit. | – Renew or repair circuit. |
| (c) | High resistance in circuit. | – Check earth connections. |
| (d) | Incorrect bulbs fitted. | – Renew with correct wattage bulbs. |

**(3) Indicator warning light does not flash but audible clocking from flasher unit, when turn is selected on switch lever.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Warning light bulb blown. | – Check and renew bulb. |
| (b) | Front bulb blown on opposite side to turn selected. | – Check and renew bulb. |

**(4) Both warning lights flash weakly and at greater than normal speed when turn is selected on switch lever.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Front bulb blown on turn side. | – Check and renew bulb. |
| (b) | Rear bulb blown on turn side. | – Check and renew bulb. |
| (c) | Faulty flasher unit. | – Check and renew flasher unit. |

**(5) Both indicator warning lights burn constantly when turn is selected on switch lever.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Front and rear bulbs blown on turn side. | – Check and renew bulbs. |
| (b) | Faulty flasher unit. | – Check and renew flasher unit. |

## IGNITION SYSTEM

**(1) Engine will not start.**

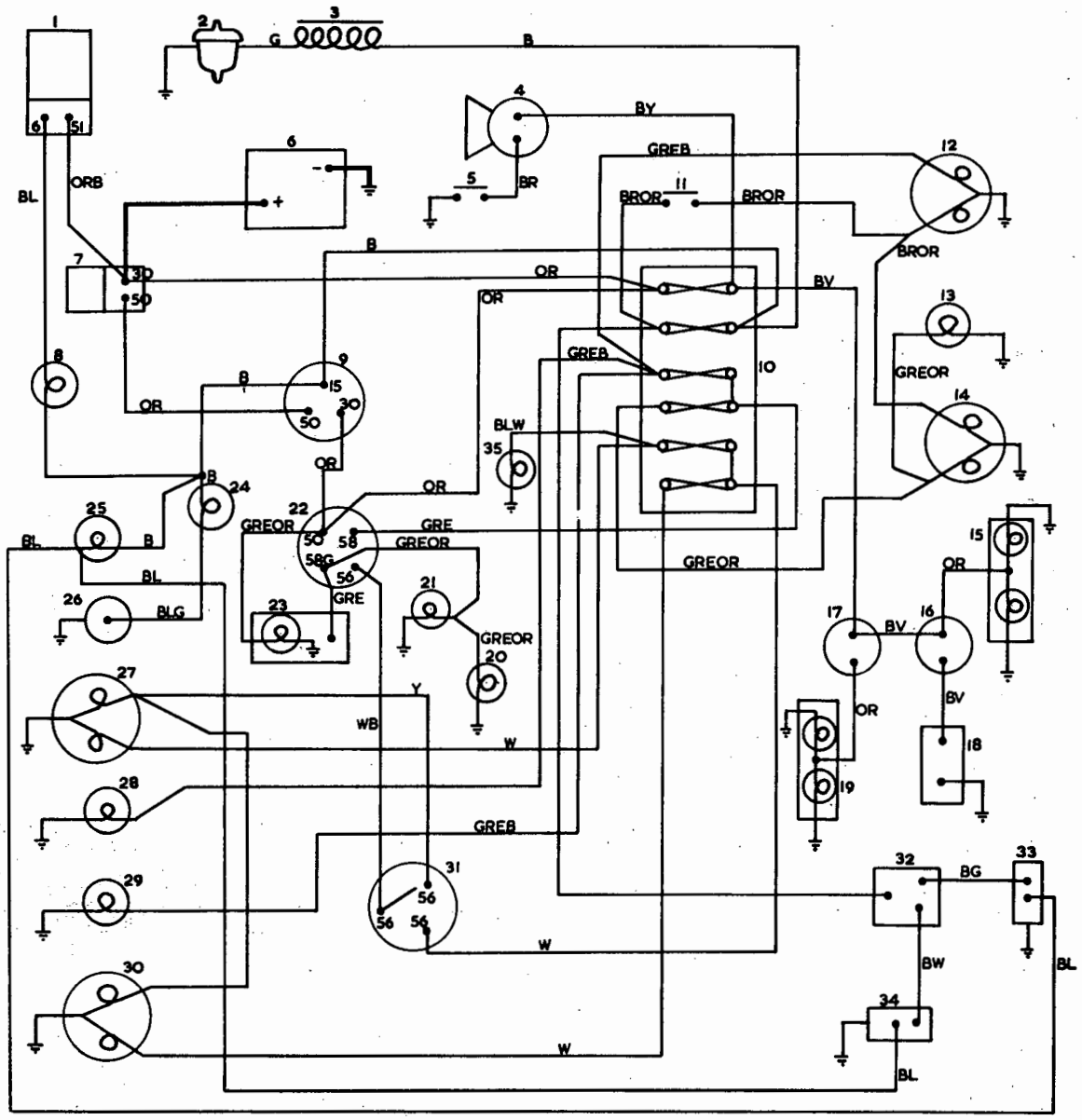
| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Fault in ignition primary circuit wiring. | – Check circuit and repair as necessary. |
| (b) | Faulty ignition switch. | – Renew ignition switch. |
| (c) | Fault in coil primary winding. | – Renew coil. |
| (d) | Burnt or dirty contact breaker points. | – Clean or renew and adjust points. |
| (e) | Faulty capacitor or capacitor lead. | – Check and renew capacitor. |
| (f) | Fused or broken low tension wire from breaker arm to low tension terminal. | – Renew low tension terminal block and wire. |
| (g) | Fault in coil high tension circuit. | – Test and renew coil as necessary. |
| (h) | Cracks in distributor cap. | – Renew distributor cap. |
| (i) | Crack in distributor rotor. | – Renew distributor rotor. |
| (j) | Faulty high tension leads. | – Check and renew leads. |
| (k) | Faulty or incorrectly adjusted spark plugs. | – Renew or clean and adjust spark plugs. |

**(2) Engine starts but misfires under load.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Faulty, dirty or incorrectly adjusted spark plugs. | – Renew and/or clean and adjust spark plugs. |
| (b) | Dirty or incorrectly adjusted contact points. | – Clean, adjust or renew points. |
| (c) | Uneven wear on distributor cam. | – Check and overhaul distributor. |
| (d) | Condensation moisture in distributor cap. | – Check and dry out and examine cap for cracks. |
| (e) | Cracked spark plug insulator/s. | – Renew faulty spark plug/s. |
| (f) | Faulty ignition coil. | – Check and renew coil. |

**(3) Engine runs but lacks power.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Ignition timing incorrectly set or contact points require adjusting. | – Check and readjust timing and/or contact points. |
| (b) | Centrifugal advance machanism seized or excessively worn. | – Overhaul distributor. |
| (c) | Vacuum advance unit inoperative. | – Check for broken vacuum pipe or faulty unit. |
| (d) | Vacuum advance unit operates but ineffective. | – Advance unit link disconnected or broken. |



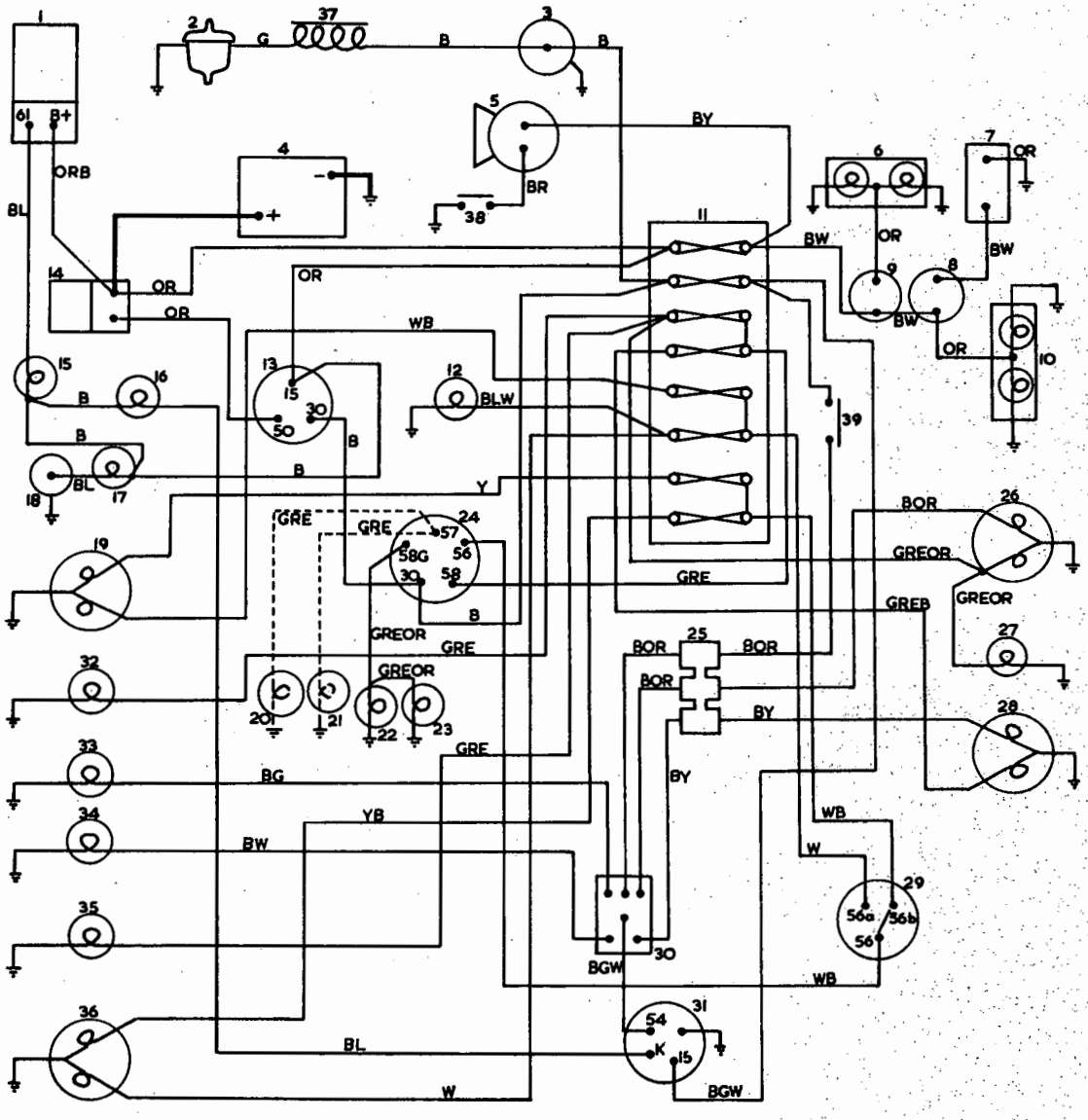

Wiring Diagram — Early 36 bhp Models.

KEY

1. Generator and regulator.
2. Distributor.
3. Ignition coil.
4. Horn.
5. Horn push.
6. Battery.
7. Starter motor and solenoid.
8. Generator warning light.
9. Ignition switch.
10. Fuse panel.
11. Stop light switch.
12. RH, stop and tail lights.
13. Number plate light.
14. LH, stop and tail lights.
15. Front dome light.
16. Windscreen wiper switch.
17. Dome light switch.
18. Windscreen wiper.
19. Rear dome light.
20, 21. Speedometer lights.
22. Lighting switch.
23. Clock and light (Micro Bus Deluxe only).
24. Oil pressure warning light.
25. Direction indicator warning light.
26. Oil pressure switch.
27. RH headlight.
28. RH parking light.
29. LH parking light.
30. LH headlight.
31. Dipper switch.
32. Direction indicator switch.
33. RH direction indicator.
34. LH direction indicator.
35. High beam warning light.

COLOR CODE

| | |
|---|---|
| G | — Green. |
| B | — Black. |
| Y | — Yellow. |
| W | — White. |
| WB | — White/black tracer. |
| BY | — Black/yellow tracer. |
| OR | — Orange. |
| BV | — Black/violet tracer. |
| BG | — Black/green tracer. |
| BL | — Blue. |
| BR | — Brown. |
| BW | — Black/white tracer. |
| ORB | — Orange/black tracer. |
| BLW | — Blue/white tracer. |
| BLG | — Blue/green tracer. |
| GRE | — Grey. |
| GREB | — Grey/black tracer. |
| BROR | — Brown/orange tracer. |
| GREOR | — Grey/orange tracer. |




Wiring Diagram — 40 bhp Models.

KEY

1. Generator and regulator.
2. Distributor.
3. Automatic choke.
4. Battery.
5. Horn.
6. Rear dome light.
7. Windscreen wiper.
8. Windscreen wiper switch.
9. Dome light switch.
10. Front dome light.
11. Fuse panel.
12. High beam warning light.
13. Ignition switch.
14. Starter motor and solenoid.
15. Generator warning light.
16. Direction indicator warning light.
17. Oil pressure warning light.
18. Oil pressure switch.
19. RH headlight.
20, 21. Parking lights (sealed beam only).
22, 23. Speedometer lights.
24. Lighting switch.
25. Connector.
26. RH stop, tail and indicator lights.
27. Number plate light.
28. LH stop, tail and indicator lights.
29. Dipper switch.
30. Direction indicator switch.
31. Flasher unit.
32. RH parking light.
33. RH direction indicator light.
34. LH direction indicator light.
35. LH parking light.
36. LH headlight.
37. Ignition coil.
38. Horn push.
39. Stop light switch.

COLOR CODE

| | |
|---|---|
| G | — Green. |
| B | — Black. |
| Y | — Yellow. |
| W | — White. |
| WB | — White/black tracer. |
| BY | — Black/yellow tracer. |
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| BV | — Black/violet tracer. |
| BG | — Black/green tracer. |
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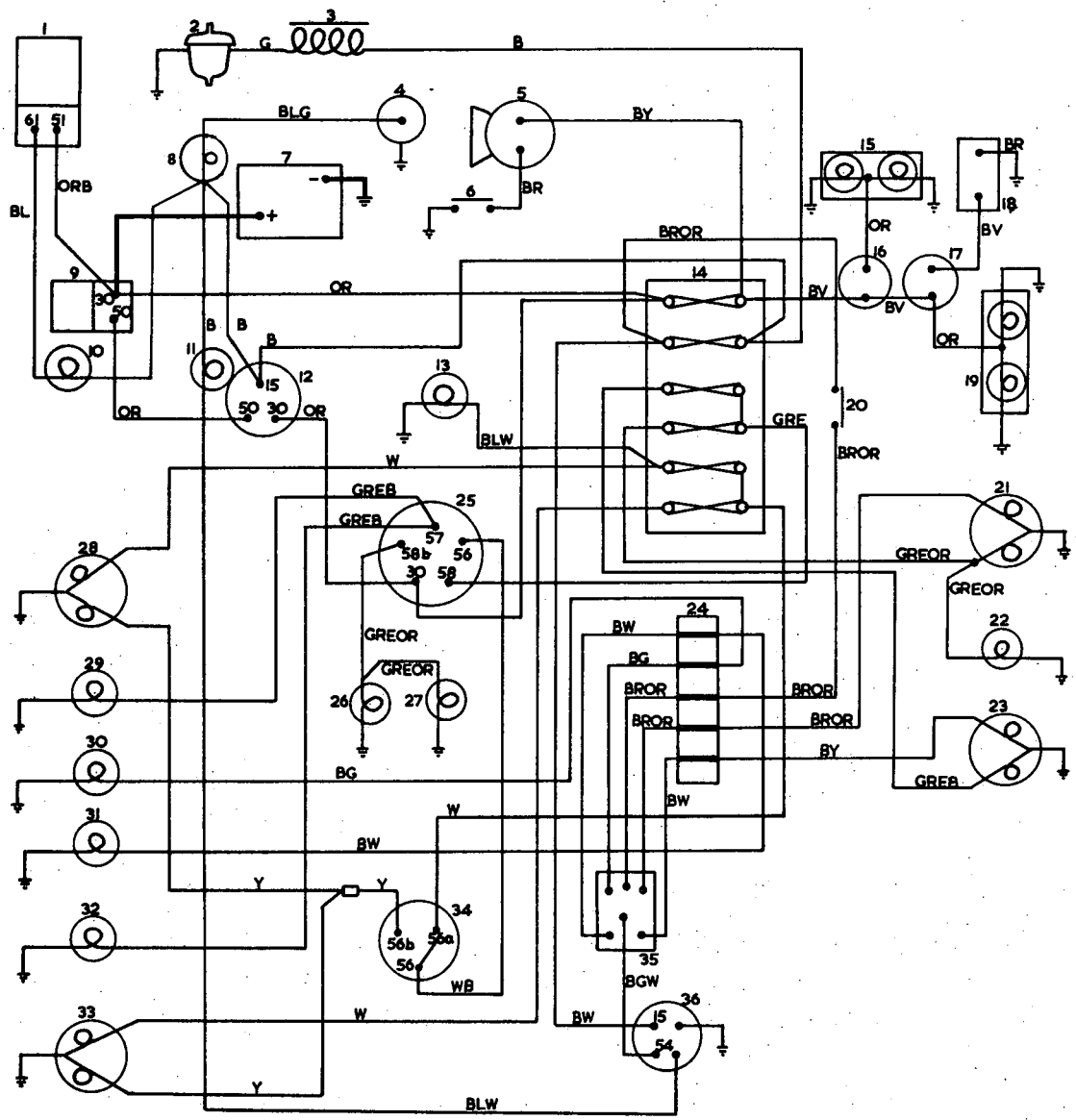
| BR | — Brown. |
| BW | — Black/white tracer. |
| ORB | — Orange/black tracer. |
| BLW | — Blue/white tracer. |
| BLG | — Blue/green tracer. |
| GRE | — Grey. |
| GREB | — Grey/black tracer. |
| BROR | — Brown/orange tracer. |
| GREOR | — Grey/orange tracer. |
| YB | — Yellow/black tracer. |
| BOR | — Black/orange tracer. |




Wiring Diagram — Early US Models.

KEY

1. Generator and regulator.
2. Distributor.
3. Ignition coil.
4. Oil pressure switch.
5. Horn.
6. Horn push.
7. Battery.
8. Oil pressure warning light.
9. Starter motor and solenoid.
10. Generator warning light.
11. Direction indicator warning light.
12. Ignition switch.
13. High beam warning light.
14. Fuse panel.
15. Rear dome light.
16. Dome light switch.
17. Windscreen wiper switch.
18. Windscreen wiper.
19. Front dome light.
20. Stop light switch.
21. RH stop, tail and direction indicator lights.
22. Number plate light.
23. LH stop, tail and direction indicator lights.
24. Connector.
25. Lighting switch.
26, 27. Speedometer lights.
28. RH headlight.
29. RH parking light.
30. RH direction indicator light.
31. LH direction indicator light.
32. LH parking light.
33. LH headlight.
34. Dipper switch.
35. Direction indicator switch.
36. Flasher unit.

COLOR CODE

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|---|---|
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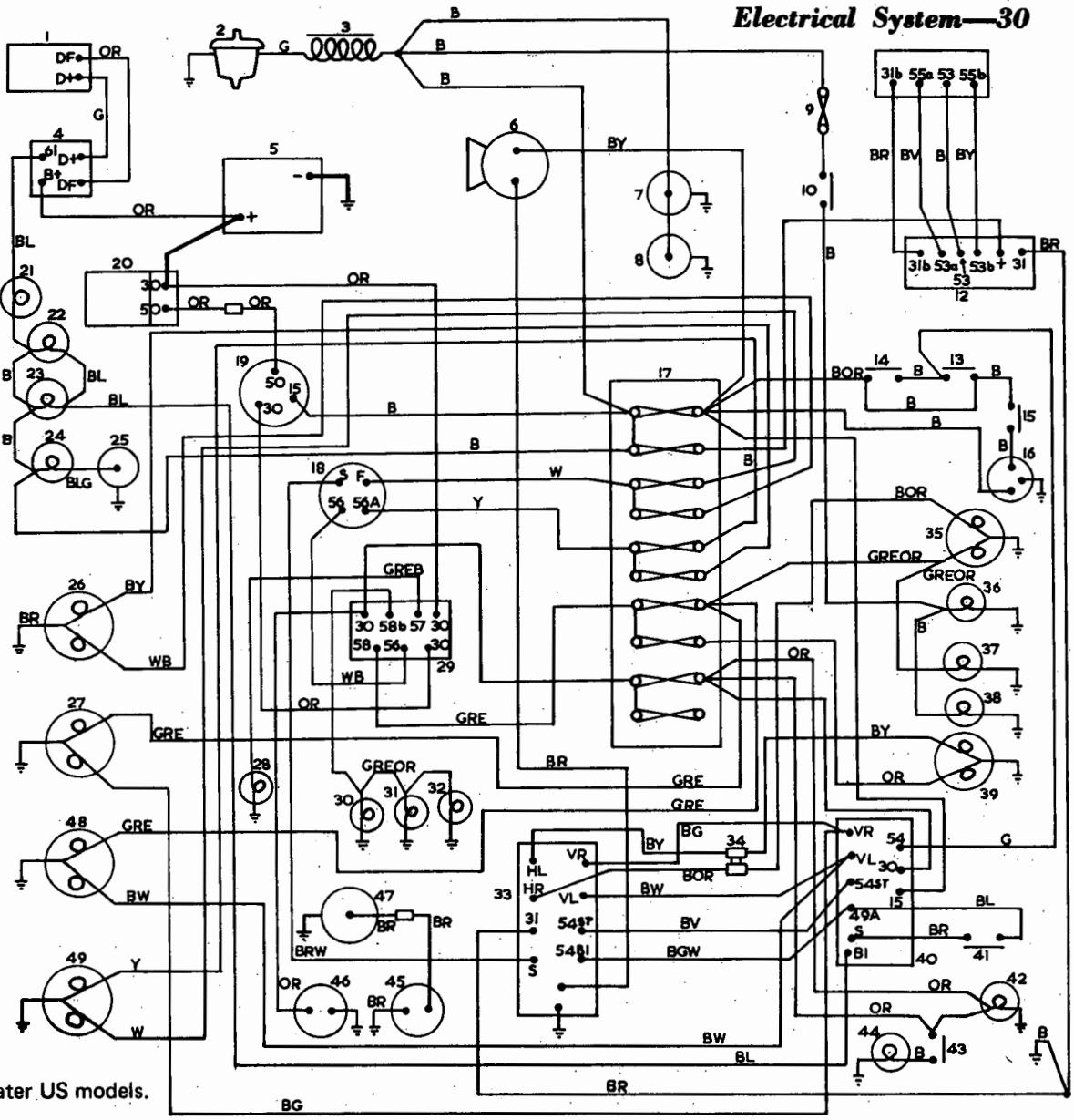
| BW | — Black/white tracer. |
| ORB | — Orange/black tracer. |
| BLW | — Blue/white tracer. |
| BLG | — Blue/green tracer. |
| GRE | — Grey. |
| GREB | — Grey/black tracer. |
| BROR | — Brown/orange tracer. |
| GREOR | — Grey/orange tracer. |
| BGW | — Black/green and white tracer. |




Wiring Diagram — Later US models.

KEY

1. Generator.
2. Distributor.
3. Ignition coil.
4. Regulator.
5. Battery.
6. Horn.
7. Automatic choke.
8. Electro-magnetic pilot jet.
9. Reversing light fuse.
10. Reversing light switch.
11. Windscreen wiper.
12. Windscreen wiper switch.
13, 14. Stop light switches.
15. Brake warning light switch.
16. Brake warning light.
17. Fuse panel.
18. Dipper switch relay.
19. Ignition switch.
20. Starter motor and solenoid.
21. Generator warning light.
22, 23. Direction indicator wanring lights.
24. Oil pressure warning light.
25. Oil pressure switch.
26. RH headlight.
27. RH parking and direction indicator.
28. Panel light.
29. Lighting switch.
30. Clock light.
31. Speedometer light.
32. Fuel gauge light.
33. Direction, indicator switch, dipper switch and horn push.
34. Connector.
35. RH stop, tail and direction indicator lights.
36. RH reversing light.
37. Number plate light.
38. LH reversing light.
39. LH stop, tail and direction indicator lights.
40. Emergency light relay.
41. Emergency light switch.
42. Front dome light.
43. Dome light switch.
44. Rear dome light.
45. Fuel gauge tank unit.
46. Clock.
47. Fuel gauge.
48. LH parking and direction indicator lights.
49. LH headlight.

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| BROR | — Brown/orange tracer. |
| GREOR | — Grey/orange tracer. |
| YB | — Yellow/black tracer. |
| BOR | — Black/orange tracer. |
| BRW | — Brown/white tracer. |
| BLG | — Blue/green tracer. |

# BODY

## SPECIFICATIONS

Key:

| | | | | | |
|---|---|---|---|---|---|
| A | = | Delivery Van | D | = | Micro Bus De-Luxe |
| B | = | Micro Bus | E | = | Pick Up |
| C | = | Kombi | F | = | Ambulance |

### (PART 1 EARLY MODELS)

| | | |
|---|---|---|
| Wheel base: | | |
| All | 94.5" | |
| Track: | Front | Rear |
| All | 53.9" | 53.5" |
| Length: | | |
| A, B, C, E and F | 165" | |
| D | 166" | |
| Width: | | |
| A, B, C and F | 68" | |
| E | 67" | |
| D | 69" | |
| Height: | | |
| A, B, C, D and F | 76.4" | |
| E | 75.6" | |
| Turning circle: | | |
| All | 39' | |
| Weight (unladen): | | |
| A | 2028 lbs | |
| B | 2392 lbs | |
| C | 2072 lbs | |
| E | 2094 lbs | |
| F | 2612 lbs | |

### (PART 2 LATER MODELS)

| | | |
|---|---|---|
| Wheel base: | | |
| All | 94.5" | |
| Track: | Front | Rear |
| All | 53.9" | 53.5" |
| Length: | | |
| A, B, C and F | 168.5" | |
| D, E | 169.8" | |
| Width: | | |
| A, B, C, E, F | 80.9" | |
| D | 82.9" | |
| Height unladen: | | |
| A, B, C, D, F | 76.4" | |
| E | 75.6" | |
| Turning circle | 39' | |
| Weight unladen: | | |
| A | 2359 lbs | |
| High roofed | 2446 lbs | |
| C | 2513 lbs | |
| B, D | 2534 lbs | |
| E | 2392 lbs | |
| F | 2753 lbs | |

# PART 1 (EARLY MODELS)

## 1. DESCRIPTION

The all steel, mainly spot welded body is of mono-construction incorporating a forward control type cab. The various models differ from one another as to windows and equipment. The door and window openings are framed by hollow pressed metal parts and the cambered roof and drip channel is of a one piece mould.

In general all panels and the roof are reinforced by box type supports spot welded into position. The floor area and body inner panels are strengthened by ribs. Side and crossmembers are welded to the floor plate and form the frame, which supports the axle, engine, front end and control linkage.

The cabin extends over the complete width of the vehicle providing maximum utilization of available space. The partition panel between the cabin and loading space extends to the waist level. With the delivery van a partition panel of fibre board extending from the metal panel up to the roof closes the cabin. Seating for three persons is provided by the bench type seat of which the squab is interchangeable with the seat cushion, located above and attached to the wheel boxes. Under the seat and between the wheel boxes, space is provided for the storing of tools etc. Seating arrangement varies considerably regards the different models, the above being a broad outline only.

The spare wheel is mounted behind the cab seat back. A fresh air regulator above the windscreen provides ventilation for the exterior when the vehicle is in motion.

Both cabin doors on most models are equipped with draftless vent wings and sliding glass panels which can be secured in any position desired. Late models are fitted with mechanised windows.

The micro bus and Kombi have three windows in each

side panel, the rear ones being hinged outwards to assist ventilation. Micro Bus Deluxe is equipped with heat resistant safety glass panes along the curved sides of the roof. All glass used in the vehicle is of the safety type except the rear window glass of the Delivery Van, Kombi and Micro Bus.

Loading space on the Delivery Ban and Kombi extends from behind the cab partition to the rear panel with the floor stepped up over the engine compartment. Easy access is afforded by the side double door and the hinged rear panel. The Delivery Van can be provided with a double door on both sides.

With the Micro Bus, the space above the engine compartment provides luggage accommodation and the front portion of the loading space is equipped with bench seats.

The Micro Bus Deluxe is equipped with a sliding roof. This feature is also available, on the Micro Bus and Kombi as an optional extra.

The engine compartment is separated from the loading area by reinforced panels and access to the engine is provided by a hinged door which opens upwards. This compartment also houses the battery and fuel tank. Ventilation is provided by air intake slots in the side panels.

Heating of the passenger areas of the vehicle is achieved by use of the air flow, warmed by the engine and guided via mufflers into the body. The warm air outlet at the cab front panel can be regulated. There are two vents positioned at the windscreen for demisting purposes. The Micro Bus and Micro Bus Deluxe passenger compartments are heated by additional vents under the seats. The system is controlled by a rotary knob in the drivers cabin. (Levers on the instrument panel centre, later models).

The basic design of the Pick-Up Utility is similar to that of the other transporter models. The body is closed by panels below the floor level. The load area platform and inner panels are reinforced by ribs and supported by crossmembers.

Below the platform there is an additional fully enclosed lockable loading space, the fuel tank compartment and the engine component.

## 2. WINDSCREEN

### TO REMOVE

(1) Remove the windscreen wiper arms and blades.

(2) Using a thin bladed blunt tool, preferably wedge shaped, loosen the weatherstrip from the body taking care not to damage the paintwork.

(3) Working from within the body carefully push out the windscreen complete with weatherstrip, commencing at one side and working across the screen to the opposite side. Have a second operator to support the glass.

(4) After removing the glass from the vehicle remove the rubber weatherstrip from the glass starting at one corner and progressing around the glass forcing the rubber up and off the glass edge by thumb pressure. Do not attempt to pull the rubber from the glass as this can stretch or tear the rubber.

### TO INSTAL

(1) Remove all traces of old sealing compound from the body opening and sealing rubber and glass.

(2) Examine condition of weatherstrip and replace if perished, torn or cracked.

(3) Apply a smear of sealer to the glass edge and fit the rubber strip to the glass. The join of the rubber strip should be positioned half way between the upper corners.

(4) Insert an insulated cable approximately .080" diameter into the outer groove around the weatherstrip. The cable ends should protrude in the middle of the lower side inside the cabin.

(5) Coat the inside of the outer flap of the weatherstrip with a suitable sealer.

(6) Coat the lower corners of the body opening with suitable sealer.

(7) Apply a smear of glycerine to the inner side of the weatherstrip.

(8) Position the glass and weatherstrip in the body opening with the ends of the cable protruding into the vehicle.

(9) Apply pressure to the glass with both hands and at the same time have one end of the cable pulled parallel to the glass and around the edge of the body opening. The rubber strip flap will rise up and over the edge of the body frame.

(10) Remove traces of any surplus sealer with spirits or petrol.

(11) Instal windscreen wiper arms.

*NOTE: The laminated safety glass is branded by one of the following: Sigla, Kinon or Delog. On vehicles fitted with heat treated glass the driver's side screen has a 'clear vision' area and is marked 'visunil'.*

The instructions for removal and installation of the windscreen also apply to the other glass panels fitted to the vehicles.

## 3. DOOR GLASS

### TO REMOVE

To remove the door glass it is necessary to remove the top frame from the door.

(1) Remove the inside door handle and door trim panel.

(2) Remove the two rubber grommets from the forward face of the door just below the top hinge.

(3) Remove the two studs from the inner panel of the door.

(4) Remove the two Philips headed screws from the lock face of the door.

(5) Lift out the door frame complete with wing vent window and door glass channels.

(6) Remove the four screws from the lower glass run channel.

(7) Lift out the glass run channel retainer, centre bar and glass as a unit.

(8) Remove the catch bar from the sliding glass.

(9) Remove the glass run channel from the door window frame and the lower run channel retainer.

(10) Remove the lower glass runner after removal of the four catch bar retainer screws.

### TO INSTAL

Reverse the foregoing procedure with attention to the following:

(1) Remove all traces of cement from the door window frame and lower glass run channel retainer.

(2) Cement new glass run channels into position with suitable cement.

(3) Coat glass run channels with french chalk.

(4) Check sliding glass for free movement and proper operation of locking catch.

(5) Check condition of weatherstrip between window frame and door.

### TO REMOVE VENT GLASS

(1) Remove the inside door handle and trim panel.

(2) Pry up lock plate, remove vent pivot nut and take off lock plate, spring and special washer and the two lower friction washers.

(3) Remove the rivet from the upper pivot point.

(4) Lift out the vent and remove the friction washer and special washer from the lower pivot point.

(5) Hold the frame securely in a vice and remove the glass from the frame.

### TO INSTAL VENT GLASS

(1) Remove all traces of cement from the frame and weatherstrip.

(2) Apply suitable cement to the channels of the frame.

(3) Position the weatherstrip in the frame.

(4) Slide the glass into the frame as far as it will go by hand.

(5) Using a suitable type of clamp, force the glass fully into the frame.

(6) Trim off any excess weatherstrip level with the edge of the frame.

(7) Reverse operations (1) to (4) inclusive of the removal procedure.

### TO REMOVE HINGED SIDE WINDOW AND GLASS (Micro Bus Deluxe, Kombi and Ambulance)

(1) Remove the screws that attach the window toggle bracket to the body inner panel.

(2) Remove the weatherstrip from the body opening.

(3) Remove the five screws from the hinge and remove the toggle bracket.

(4) Remove the screw attaching the toggle bracket to the glass frame.

(5) Remove the four countersunk screws from the glass frame.

(6) Open up the frame and remove the glass and weatherstrip.

### TO INSTAL

(1) Check the condition of the weatherstrip.

(2) Position the weatherstrip on the glass and insert one end of the glass and strip in the frame and work completely around the frame. The two ends of the weatherstrip should meet in the middle of the vertical hinge side.

(3) Carry out operation (1) to (5) inclusive of the removal procedure in reverse order.

## 4. DOORS

### TO REMOVE CABIN DOORS

(1) Loosen the Philips headed studs in each hinge.

*NOTE: After considerable service it may be necessary to use an impact type screw driver to release the hinge screws.*

(2) Remove the screws from the hinges and at the same time suitably support the door.

(3) Lift the door complete from the body.

### TO INSTAL

(1) Replace the studs in the hinges and tighten just sufficiently to hold the door in the selected position.

(2) Remove the lock striker plate from the door pillar.

(3) Carefully carry out a trial closing of the door. Do not use any extreme force.

(4) Adjust the position of the hinges on a trial and error basis until the door is properly aligned with the body aperture and the gaps between the body and the door are uniform.

(5) Instal the striker plate and adjust to align with the door lock and provide a firm but free locking action.

(6) Check that the weather seal is evenly compressed all round the door sufficiently to provide the required seal.

### TO REMOVE HINGED REAR DOOR

(1) Remove the nine screws securing the hinge to the body.

(2) Remove the door panel prop.

(3) Remove the T-handle, gasket, escutcheon plate and packing washer.

(4) Remove the four screws attaching the lock unit.

### TO INSTAL

(1) Reverse the removal procedure.

(2) Check the alignment of the door.

(3) Lubricate lock and hinges.

### TO REMOVE (AMBULANCE)

(1) Remove the screws attaching the protection panel to the door and remove the panel.

(2) Remove the nine screws and washers and lift off trim panel.

(3) Remove the hexagonal nut and remove the T-handle gasket, plate and packing washer.

(4) Remove the four screws from the lock assembly.

(5) Remove the four hinge screws.

(6) Remove the screws from the check chains and remove from door.

(7) Remove the beading.

### TO INSTAL

(1) Reverse the removal procedure.

(2) Lubricate hinges, locks etc.

(3) Check door alignment.

### TO REMOVE SIDE DOOR

(1) Remove the check strap pin.

(2) Remove the two screws at the check strap retainer and remove the retainer and strap.

(3) Remove the rubber plugs from each door pillar and remove the Philips head screws.

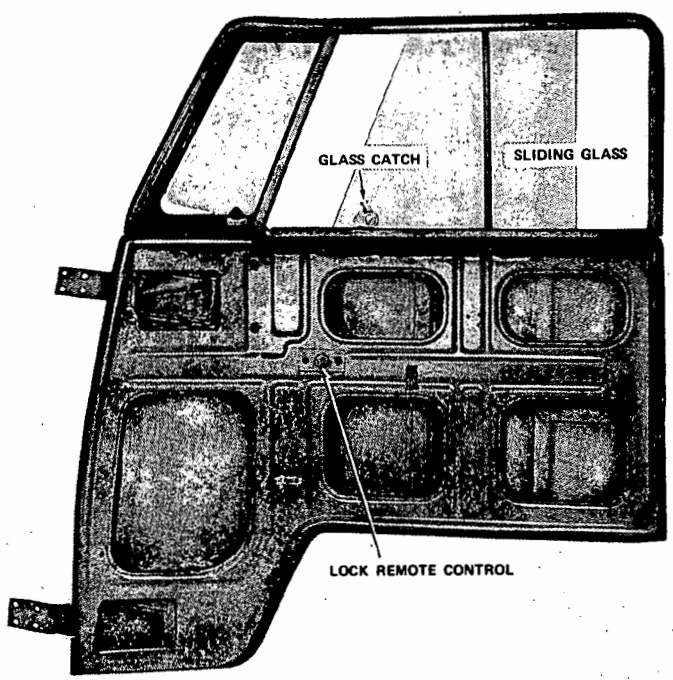
(4) Remove the weatherstrip from door and body.

### TO INSTAL

(1) Reverse the removal procedure.

(2) Lubricate moving parts.

(3) Check door alignment.




Driver's Side Cabin Door with Trim Panel Removed, Early Model with Sliding Glass.

## 5. DOOR LOCKS AND HANDLES

### TO REMOVE CABIN DOOR LOCK

(1) Press the escutcheon plate inwards to reveal the pin and drive out the .125" diameter pin.

(2) Lift off the handle and escutcheon plate.

(3) Remove the door trim panel.

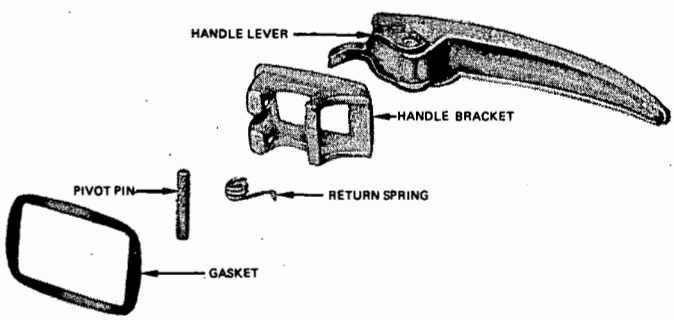
(4) Remove the four Philip head screws at the door latch and take off the outside door handle complete with rubber seal.

(5) Remove the two Philips head screws securing the lock assembly to the inside door panel.

(6) Remove the two screws securing the remote control assembly to the door inner panel.

(7) Push the remote control unit back into the door cavity.

(8) Pull the complete assembly towards the front end of the door sufficiently for the lock assembly to clear the end section of the door and lift out through the oblong aperture in the inner door panel.




Exterior Handle for Wedge Type Door Lock.

### TO INSTAL

(1) Carry out the removal procedure in reverse order.

(2) Lubricate the two assemblies.

### TO REMOVE SIDE DOOR LOCK

(1) Remove the door handle attaching screw.

(2) Remove the handle complete with escutcheon plate and rubber seal.

(3) Remove the screws from the upper and lower lock bars.

(4) Remove the four Philips head screws securing the lock assembly to the door frame.

(5) Slide the lock bars up or down withdrawing them from the door.

*NOTE: The slide lock bars are not interchangeable and must be fitted to their original positions.*

### TO INSTAL

(1) Carry out the removal procedure in reverse order.

(2) Lubricate the assembly.

## 6. HEAD LINING (MICRO BUS AND AMBULANCE)

### TO REMOVE (Micro Bus)

(1) Remove the three securing screws and remove the sun visor.

(2) Bend the retaining strip up at the windscreen and pull out the headlining.

(3) Remove the screws and take off the trim panel.

(4) Remove the backrest of the rear seat.

(5) Remove the passenger compartment interior light.

(6) Remove the fresh air outlet at the rear of the roof ventilator.

(7) Remove the attaching screws and take out both luggage compartment side trim panels.

(8) Remove left and right upper rear side trim panels.

(9) Detach cemented portions of the headlining.

(10) Bend up the metal tabs spot welded to the roof and remove the lining.

(11) Detach the lining from the right and left side rails, along the side panels up to the cab partition panel, by lifting the cardboard strip sewn to the headlining edges.

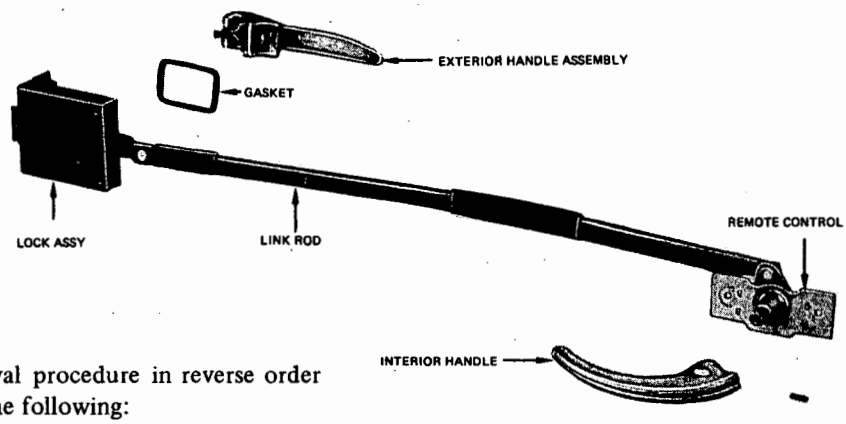
(12) Loosen the edges of the headlining cemented to the front panel.

(13) Using a suitable screwdriver, bend up the retaining strips above the cabin doors and pull out the lining.

(14) Bend up the retaining strips at the roof ventilator and pull out the lining.

(15) Carefully detach the cemented edges of the headlining from the roof ventilator channel.

(16) Disconnect the headlining bows from the right and left side roof rails and remove the entire lining from the body.




Wedge Type Door Lock and Remote Control Fitted to Early Models.

**TO INSTAL**

(1) Carry out the removal procedure in reverse order with particular attention to the following:

(2) Check the headlining for damage prior to installation.

(3) Inspect the cardboard strips sewn to the headlining edges.

(4) Place rubber grommets over the ends of the bows prior to inserting into the side roof rails.

*NOTE: The rubber grommets are fitted to prevent rattling when the vehicle is in motion and should be replaced if showing any signs of perishing or other damage.*

**TO REMOVE (Ambulance)**

The headlining in the ambulance compartment can not be refitted after removal. It is tacked to wooden trim sticks and bows along and across the roof. The surplus material needed to obtain proper tension on the headlining is cut off after the tacks have been inserted and damage can not be avoided when removing the tacks.

The headlining tacking area is accessible after removing the cover strips. To remove the headlining pull out the tacks and take off the wooden bow at the front.

**TO INSTAL**

(1) Tack the front of the lining to the front bow positioned at the partition panel.

(2) Position the front bow in its retainer which is welded to the roof and insert the holding screws.

(3) The rear bow is not screwed to its metal retainer, but is held in place by the trim sticks in the roof side rails.

(4) Commencing at the front, insert the headlining steel bows behind the side trim sticks and temporarily tack the headlining to the rear bow using only three or four tacks.

*NOTE: Ensure that the rubber grommets are over the ends of the steel bows prior to fitting to avoid rattle when vehicle is in motion.*

(5) Warm up the headlining by placing an electric heater in the compartment. When uniformally warm the material becomes pliable and can be stretched.

(6) Starting at the centre, remove the temporary tacks mentioned in operation (4) and stretch the headlining towards the rear and again temporarily tack it to the rear bow.

(7) After allowing a further ten minutes of heat-up time, again stretch the headlining and, commencing at the centre and working alternatively to the left and right, tack the material to the rear bow.

(8) Check all bows etc for correct positions and angles.

(9) Working from the centre bow and alternating in both directions (front and rear) and from one side of the compartment to the other, progressively tack one bow section at a time to the side trim sticks ensuring that no creases or folds remain in either side of the bow section.

(10) Trim off surplus material from edge of trim sticks and instal cover strips.

## 7. FRESH AIR REGULATOR

The vehicle is ventilated by a fresh air system controlled by a regulator situated in the cabin roof. With the vehicle in motion, air enters the cowl above the windscreen and flows into the air channel. There are five control positions of the throttle plate. Deflector plates in the air guide channel allows ventilation of either the cab or loading space or both.

The operating lever for the throttle plate is positioned at the left hand side of the air guide channel. With the lever in the forward position, the throttle plate is fully open. The further the lever is shifted towards the rear of the vehicle the greater the restriction of air intake. With the lever in the rearmost position the intake channel is fully closed.

The handle at the bottom of the air guide channel regulates the air distribution as follows:

(1) Handle in transverse position, cab is ventilated.

(2) Handle in forward position, loading or passenger space compartment ventilated.

(3) Handle in oblique position, both cab and loading (or passenger compartment) ventilated.

### TO REMOVE THROTTLE PLATE

(1) Remove the Philips head screws attaching the cover plate to the channel panel.

(2) Remove lock-ring and washer from the end of the throttle shaft.

(3) Loosen locking nuts and screws securing the shaft to the throttle plate.

(4) Pull out the throttle plate shaft and remove the plate from the channel panel.

(5) Remove the plunger and spring from the throttle plate.

### TO INSTAL

(1) Reverse the removal procedure with particular attention to the following:

(2) Check the condition of the vane rubber for damage and correct seating.

(3) Lubricate the moving parts excluding the rubber vane.

(4) Insert the throttle shaft so that the flat portions abut against the flats in the throttle plate brackets.

(5) Make sure that the cover gasket is properly positioned.

### TO REMOVE DEFLECTOR PLATES

(1) Remove the cover plate and fully open the throttle plate.

(2) Remove the upper half of the partition panel.

(3) Remove the roof trim panels.

(4) Remove the screw from the control handle and remove the handle, washer, spring and friction washer.

(5) Remove the four deflector plate hinge screws and lift out deflector plates, linkage and friction washer.

### TO INSTAL

(1) Reverse the removal procedure, with attention to the following:

(2) Check the deflector plates and rubber sheets for damage.

(3) Care must be taken when inserting the deflector plates into the guide channel that the deflector plate hinges are accepted by the angle plates provided in the air guide channel.

(4) Position the deflector plate link in the air guide channel prior to tightening the deflector hinge screws.

(5) Check the tension of the handle spring. If necessary slightly stretch it to increase the tension.

# PART 2 (LATE MODELS)

## 1. WINDSCREEN

### TO REMOVE

(1) Remove the windscreen wiper arms and blades.

(2) Remove the sunvisors and rear vision mirror to provide clear access to the screen.

(3) Commence approximately half way along one end of the screen, using a blunt instrument and working upwards and across the top of the screen tuck the interior side lip of the weatherstrip over the body aperture flange and at the same time apply outward pressure to the screen.

(4) Having released the ends and top section of the weatherstrip press the screen outwards and lift slightly to release the strip from the bottom section of the flange.

(5) Lift the screen complete with weatherstrip from the vehicle.

(6) Remove the weatherstrip from the screen by applying thumb pressure around the edges of the glass and at the same time carefully lifting the strip from the screen.

*NOTE: Do not attempt to pull the weatherstrip from the glass as stretching or damage can occur.*

### TO INSTAL

(1) Clean any remains of sealer from both the screen and the weatherstrip channels.

(2) Position the weatherstrip on the screen and insert a suitable cord approximately .125" –.197" into the body aperture flange channel of the weatherstrip leaving sufficient protruding from the top centre of the screen to provide a suitable grip.

(3) Position the screen assembly in the body aperture and apply pressure inwards.

(4) Maintain the pressure on the screen and slowly pull the cord back against and out of the channel. Progress around the screen, bumping the screen either with the hand

or soft rubber mallet as the lip of the strip curls over the flange.

(5) If necessary apply sealer compound to screen channels using correct type gun applicator.

(6) Clean all surplus sealer from the screen and weatherstrip.

(7) Re-instal accessories indicated in item (2) of *TO REMOVE.*

## 2. DOOR TRIM PANEL AND WINDOW GLASS

### TO REMOVE DOOR GLASS

(1) Remove the strap type door pull.

(2) Remove the glass regulator handle by lifting up the trim strip and removing Philips head screw from the centre of the handle.

(3) Remove the rim cover from behind the remote control handle and remove the Philips head screws.

(4) Remove the handle and escutcheon plate.

(5) Remove the door trim panel by placing a screw driver or other suitable tool under the edge of the panel close to each spring type clip and prising outwards.

*NOTE: Use a suitable pad of cloth under the instrument to prevent damage to the paint work. The trim panel is also hooked to a hole in the door inner panel by a tongue attached to the panel.*

Do not endeavour to pull clips clear by pulling on the panel or damage to the trim panel will result.

(6) Remove the plastic weather sheet from the door panel.

(7) Remove the two studs securing the regulator plate to the glass lift channel and allow the glass to rest on the bottom of the door.

(8) Pull down the channel strip at the top of the door frame at the point where it meets the quarter vent glass frame and remove the screw from the upright securing clip.

(9) Remove the screw securing the bottom end of the quarter vent glass frame upright. This screw is accessible through a hole in the inner door panel and located just to the rear of the glass regulator handle.

(10) Remove the inner weatherstrip from the door glass aperture. This strip is held by snap type wire clips.

(11) Pull the quarter vent glass assembly towards the rear of the vehicle and downwards to angle the bottom of the glass away from the door frame.

(12) Lift the vent glass assembly upwards and out of the door frame.

(13) Move the door glass towards the front of the vehicle to clear the run channel and lift the glass up through the door aperture tilting it slightly to clear the top of the door frame.

### TO INSTAL

Installation is the reversal of the removal procedure.

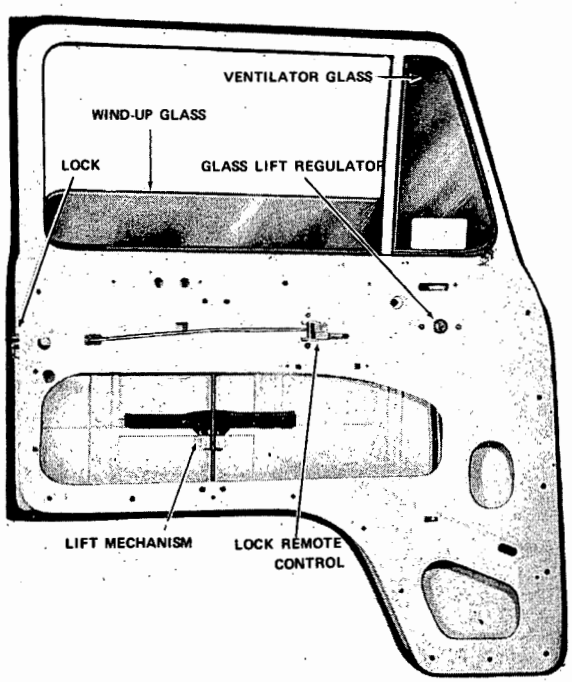
### TO REMOVE SLIDING DOOR GLASS

(1) Apply outward pressure to the glass from inside the vehicle.

(2) Using a blunt instrument such as a screwdriver, work the outer edge of the rubber over the door frame flange while maintaining hand pressure on the glass.

(3) Progress around the glass until the glass and weatherstrip comes away from the door frame.

(4) Remove weatherstrip from the glass by simply applying thumb pressure to the lower edge of the strip and forcing it outwards.




Cabin Door with Trim Panel Removed. Later Models with Wind-up Glass.

Removing Wind-up Door Glass on Later Models.

**TO INSTAL**

(1) Clean any sealer from both the weatherstrip and the glass.

(2) Fit the weatherstrip to the glass ensuring that the moulded corners are in correct position.

(3) Insert a suitable cable approximately .125" diameter in the interior side outer rubber channel leaving sufficient exposed at one end to provide a firm grip.

(4) Apply pressure from the outside inwards and at the same time slowly pull the cable back against and out of the weatherstrip and progress around the glass, bumping the glass gently with either the hand or a soft rubber mallet as the lip of the strip curls over the flange.

*NOTE: The removal and installation of the rear door and other windows are identical with the foregoing operations.*

**TO REMOVE VENT WING GLASS (CABIN DOORS Hinged Type)**

(1) Remove the rivet from the upper hinge bracket.

(2) Tilt the window outwards and lift the spindle out of the clamp.

**TO INSTAL**

(1) Place the spindle in the clamp and position the vent wing, re-rivet the upper hinge bracket.

(2) Remove the door trim where applicable and adjust the spindle clamp by tightening the screw which is accessible through a hole in the door frame panel. The tension should be firm but free.

(3) Lubricate the spindle with a small application of grease.

**TO REMOVE QUARTER GLASS (Front Door Fixed)**

(1) Remove the door handles.

(2) Remove the door trim panel as previously described.

(3) Remove the screw from the bottom of the quarter glass frame support through the hole provided in the door panel located just to the rear of the regulator handle.

(4) Remove the two screws securing the door glass metal channel to the lifter cable bracket and allow the door glass to rest on the bottom of the door.

(5) Pull down the channel at the point where it meets the quarter glass frame at the top of the door frame and remove the screw from the bracket revealed.

(6) Pull the quarter glass frame towards the rear of the vehicle and slightly downwards at the same time and manipulate the frame runner from the door by lifting the assembly upwards and out of the door frame.

**TO INSTAL**

Installation is the reversal of the removal procedure.

**TO REMOVE SLIDING DOOR VENT GLASS**

(1) The vent glass can only be removed complete with the frame and this operation can be facilitated by prior removal of the large window.

(2) Straighten the two metal tongues connecting the vent glass frame to the inside edge of the door which are revealed by lifting the inside edge of the weatherstrip.

(3) Press outwards on the wing glass and remove the assembly complete with weatherstrip.

(4) Remove the Philips head screw from the pivot shaft

clamp and withdraw glass complete with the frame and opening stop.

### TO INSTAL

(1) Thread a suitable cord into the outer lip of the interior side of the weatherstrip.

(2) Refit the glass to the frame and instal the pivot shaft clamp tightening the screw sufficiently to provide tension to the extent of allowing firm but free movement.

(3) Place the assembly squarely in the door frame aperture.

(4) Apply even pressure towards the door frame and lift the weatherstrip over the flange by slowly pulling the cord against and out of the weatherstrip lip.

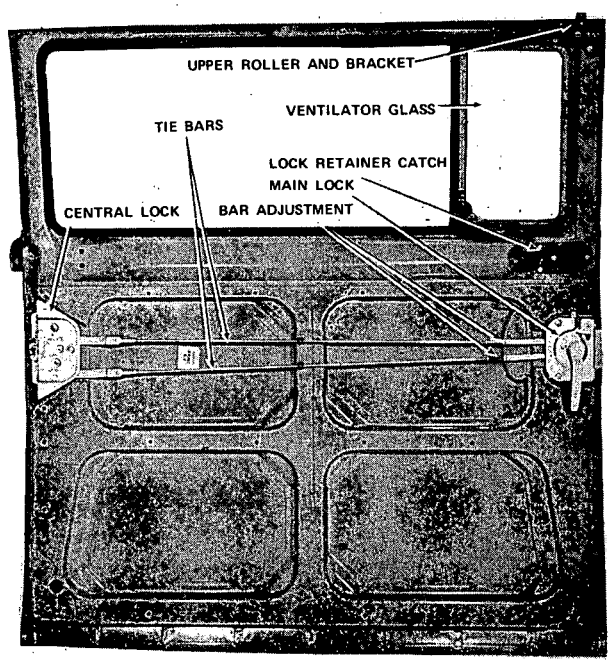
(5) Bend over the two retaining tongues and using a piece of cloth rolled into a ball and placed against the glass, bump the glass with a closed hand or soft rubber mallet to ensure correct seating of the assembly.

## 3. DOORS

### SLIDING DOOR

The sliding door is mounted on four rollers in upper, centre and lower runners. When the door is in the open position, it is held by a retainer hook which engages a bracket on the side panel.

The door is closed by a remote control mechanism which incorporates an external, lockable handle which is connected by pull rods to the central lock. When the door is closed the central lock is operated by raising the door handle. This in conjunction with the action of the over-centre runner hinge pulls the rear part of the sliding door against the body so that the latch on the central lock can engage the striker plate.

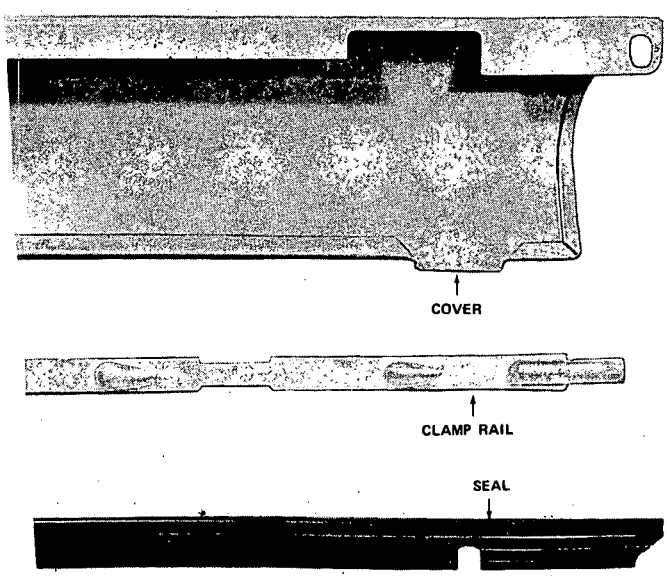



Sliding Door with Trim Panel Removed.

### TO REMOVE

(1) Remove the door trim panel.

(2) Remove the three Philips screws from along the bottom and the two from the end section of the central cover strip and remove the clamp rail.




Sliding Door Runner Cover and Components.

(3) Push the door back far enough to enable the guide and roller of the hinge fittings to be lifted sideways out of the recess in the centre runner.

(4) Move the door fully back and lift until the upper roller can be removed from the guide.

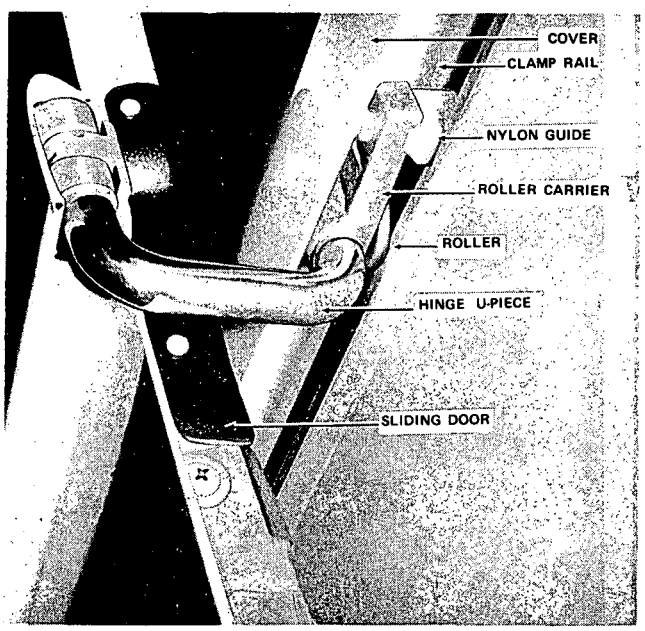
(5) Swing the door outwards and take lower roller out of recess in runner.

### TO INSTAL

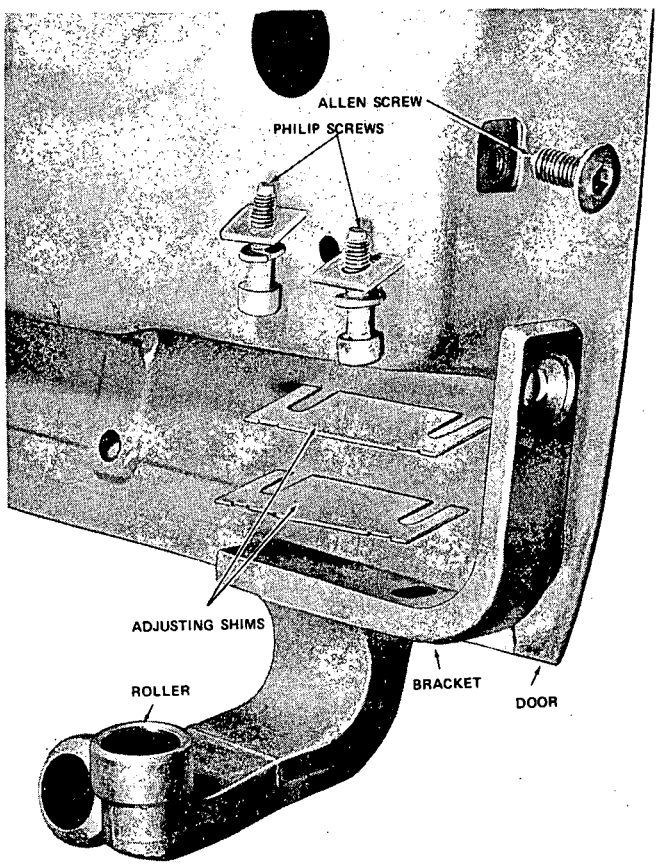
(1) Lubricate the rollers as necessary.

(2) Insert the door first in the lower and then in the upper runner.

(3) Slide the door forward until the roller and guide can be inserted in the recess of the centre runner.




Sliding Door Hinge as Viewed From Below with Cover in Position.




Sliding Door Lower Roller and Bracket Components.

(4) Check door operation and adjust as required. Instal the runner cover and door trim panel where applicable.

## TO ADJUST

(1) Check that the door is in the centre of the body aperture, with the door closed. There must be an even gap all around the door.

(2) Check that the waist rail of the door is in correct alignment with that of the body panels.

(3) Check that the outer panel of the door and that of the body are in correct alignment when the door is properly closed.

(4) If the lower edge of the door is too high or low or too far out or in, align the door assembly by loosening the single Philips screw and two Allen screws attaching the lower roller and bracket assembly to the door, move the assembly either in or out or remove or instal shims between the bracket and the lower edge of the door until the alignment is correct. Tighten the three screws securely.

(5) If the top of the door is not in correct alignment with the body outer panel, loosen the securing bolt attaching the roller to the bracket at the top of the door and reposition the roller in the elongated hole in the bracket. Tighten the bolt securely.

(6) Check and adjust the height of the upper roller so that the roller is just free to operate in the runner, by loosening the three Philips screws and adjusting the bracket attachment to the top corner of the door.

(7) Loosen the Philips screws and adjust the striker plate so that no movement is felt when pushing against the outside of the door near the hinge position. Tighten the screws.

(8) Adjust the retainer and bracket by movement in the elongated holes of the mounting screws.

(9) Loosen the remote control lock striker plate attachment slightly and close the door. Open the door and retighten the striker plate attaching screws. This allows the striker plate to find its own position.

## CABIN DOORS

The doors are attached to the body by concealed adjustable type hinges which incorporate a covered oil chamber. Hinge pins are serviced in certain sizes. Rotary type latch locks have a striker plate which is attached by two screws to the body pillar. The pin of the striker plate has a shoulder which holds the door closed in such a manner that it cannot open in an accident but can be opened later.

**TO REMOVE**

(1) Take out the retaining pin and pull the check strap out of the bracket on the pillar.

(2) Remove the screws from upper and lower door hinges.

*NOTE: After considerable service it will most likely be necessary to use an impact type screw driver to loosen the hinge screws.*

**TO INSTAL**

(1) Check that the water holes in the bottom of the door are clear.

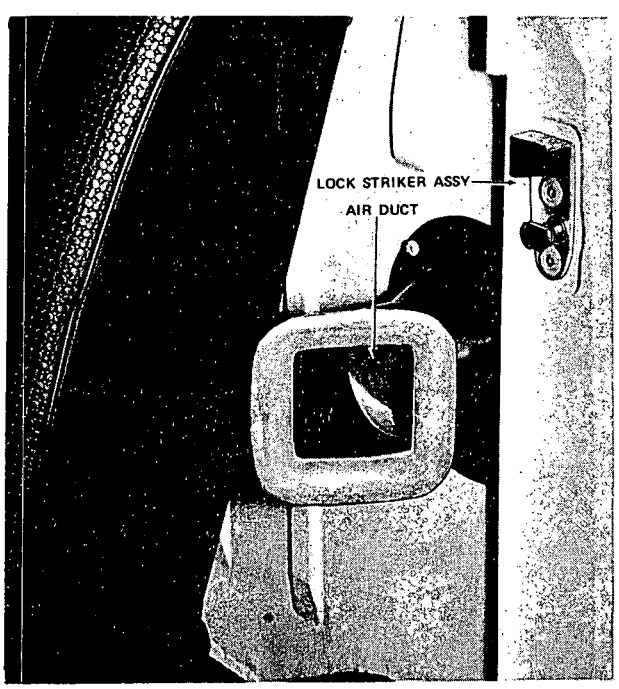
(2) Remove the hinge oil chamber cap and clean out and refill the chamber with a heavy type lubricant.

(3) Remove the striker plate from the pillar.

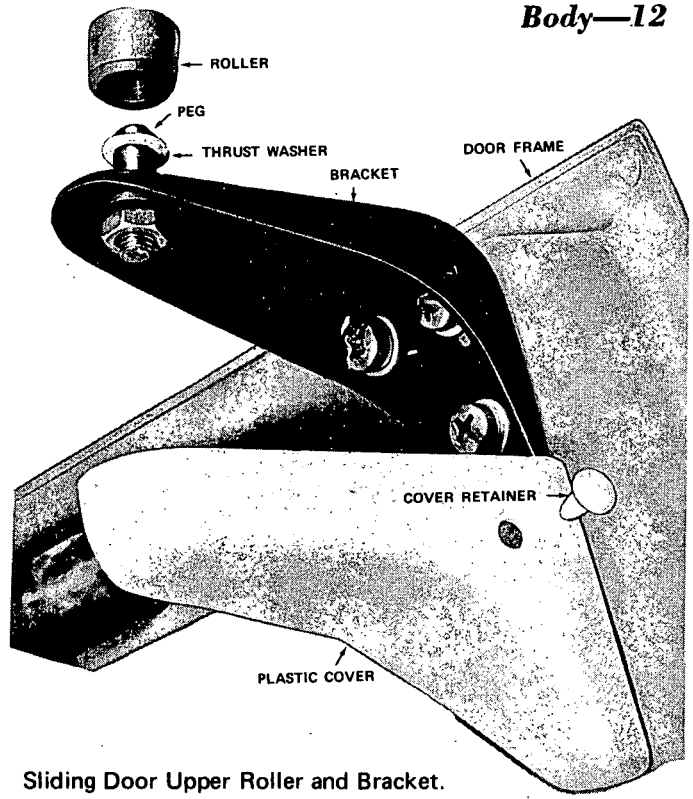
(4) Instal the four hinge screws and just tighten sufficiently to hold the door in position. Carefully attempt a trial closing of the door. Note misalignment and adjust hinges accordingly. Repeat this operation until the gap between the door and body is uniform at top, bottom and at each end.

(5) Instal the striker plate and adjust to align with door catch.

(6) Check the opening and closing of the door. This should be attained without too much force but the door must compress the sealing rubbers sufficiently to provide a seal. Adjust hinges in or out to obtain this condition.




Lock Striker in Position.




Sliding Door Upper Roller and Bracket.

**TO REMOVE REAR DOOR**

(1) Remove the two studs from each of the hinge levers where they attach to the door frame and remove the door from the vehicle.

(2) Remove the circlip from the secondary hinge lever.

(3) Slide the torsion bar in the opposite direction (towards the other side of the vehicle) sufficiently to allow the bar to clear the bracket at that end.

(4) Lift the end near the secondary lever from the slot and withdraw the bar.

(5) Repeat operations (2) to (4) inclusive, to remove the other hinge and torsion bar.

**TO INSTAL**

(1) Carry out the removal operations in reverse order.

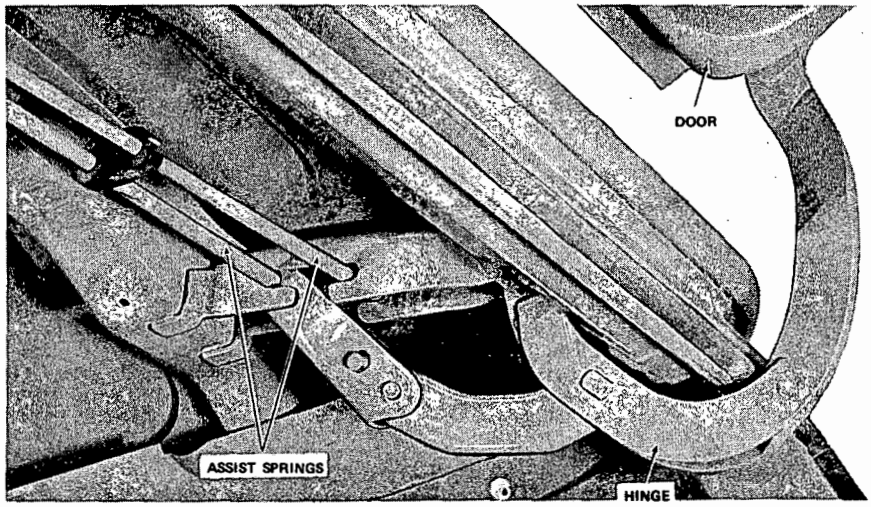
(2) Adjust the door so that the gap between the frame and body aperture is uniform.

(3) Adjust the lock striker plate to align with the door position obtained.

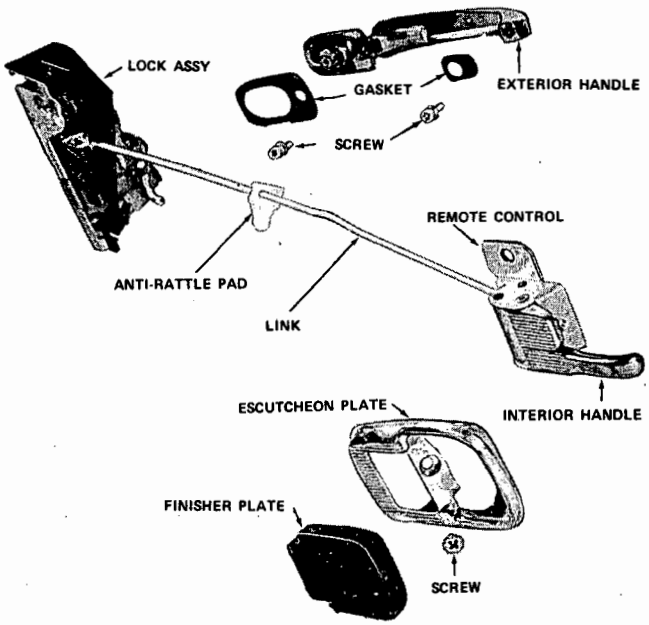
**TO REMOVE EXTERIOR DOOR HANDLE (Cabin)**

(1) Remove the door trim as described in *TO REMOVE DOOR TRIM PANEL.*

(2) Remove the plastic sealer sheet sufficiently to allow access to area concerned.




Rear Door Hinge and Assist Springs.




Driver's Cabin Door Lock, Remote Control and Exterior Handle.

(3) Remove the two 5mm Allen head screws.
(4) Withdraw the handle from the outside of the door.

**TO INSTAL**

Installation is a reversal of the removal procedure.

**TO REMOVE DOOR LOCK (Cabin)**

(1) Remove the door handles.
(2) Remove the rear glass run channel and lock release lever.
(3) Remove the door lock knob from the window ledge.
(4) Disconnect the pull rod spring at the door lock and pull rod out of the door inner panel.
(5) Remove the three Philips screws from the lock and remove the assembly by positioning in a vertical position and withdraw downwards.

**TO INSTAL**

Installation is a reversal of the removal procedure.

## 4. SLIDING DOOR LOCKS AND HINGES

**TO REMOVE MAIN AND CENTRAL LOCKS**

(1) With the door removed from the vehicle, remove the door trim panel.
(2) Take out the three securing screws and prise the pin of the safety lock assembly off the lock connecting link and remove the safety lock.
(3) Take out the Philips screw in the centre of the inside lock handle and remove the handle and escutcheon plate and spring.
(4) Withdraw the exterior lock handle with escutcheon, packing and seal washer.
(5) Release the lock nuts on the remote control rod attachments and screw each sleeve off the lock bars.

(6) Remove the four Philips screws and detach the lock by withdrawing out and downwards to clear the lock connecting link.

(7) Remove the two Philips screws attaching the central lock to the door face and single Philips screw attaching the lock to the door inner panel and remove the central lock and two remote control rods from the door.

## TO INSTAL MAIN AND CENTRAL LOCKS

(1) Ensure that the mechanism of both locks is clean and lubricated.

(2) Check the rubber buffers of the main lock and the retainer bracket.

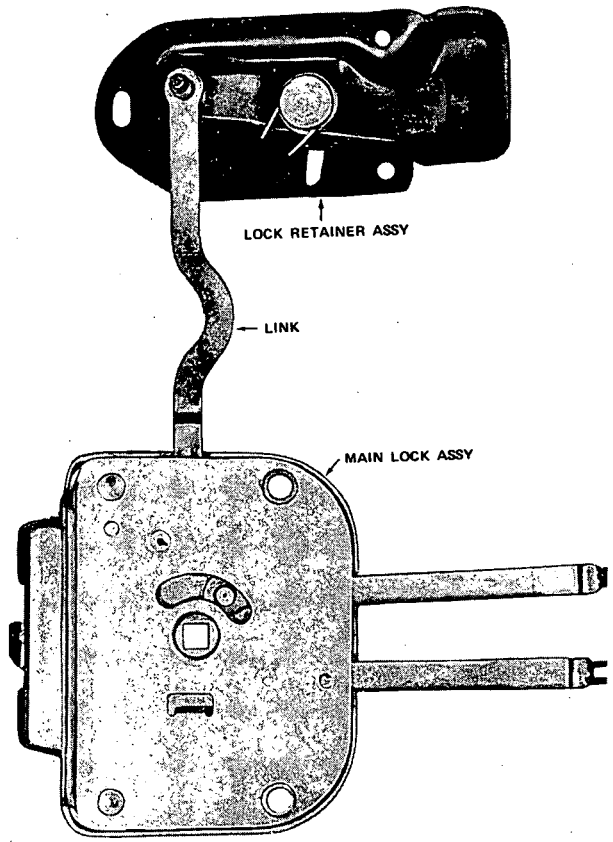
(3) Position the main lock on the door face and inner panel, passing the lock connecting link up through the small aperture in the inner panel.

(4) Instal and tighten the four Philips screws to secure the lock to the door.

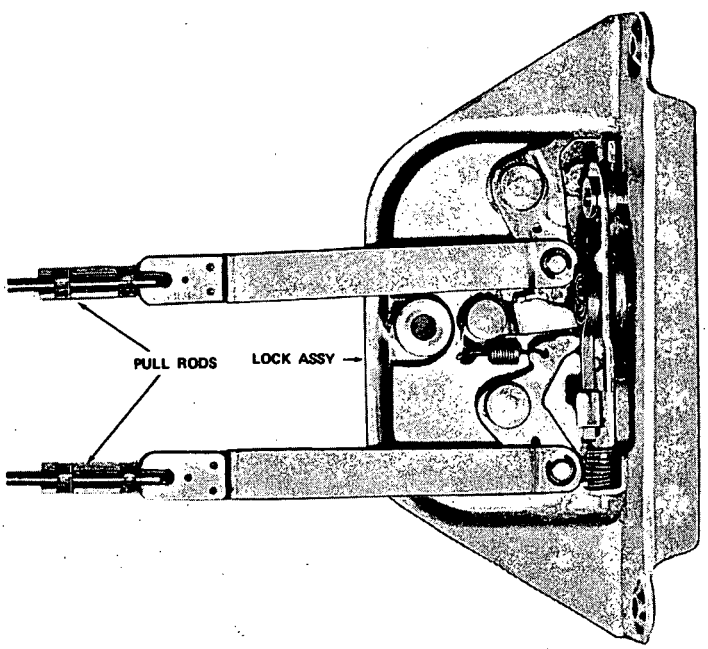
(5) Position the safety lock assembly on the inner panel, engaging the pin on the hole in the upper end of the connecting link and secure the lock assembly with the three Philips screws. Align the assembly bracket and tighten the screws securely.

(6) Position the central lock on the opposite door face and inner panel, hold the two remote control rods in a horizontal position, instal and tighten the three Philips screws.

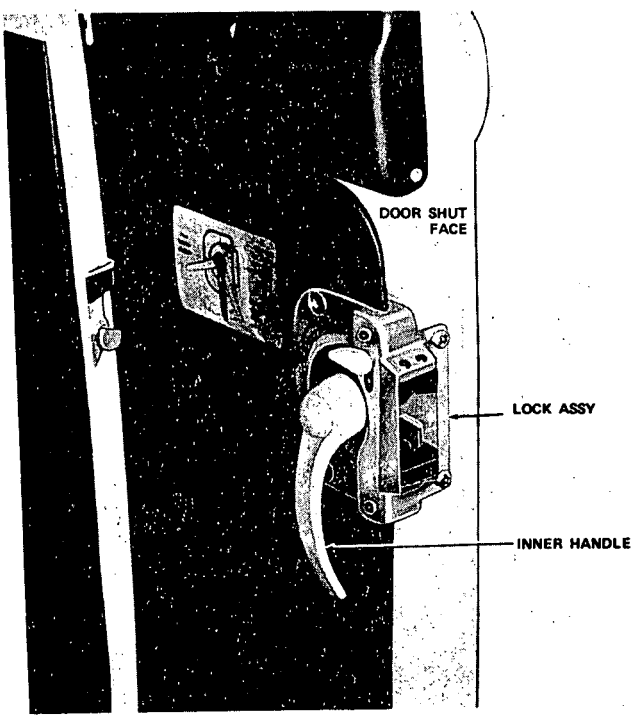
(7) Connect each remote control rod to its respective bar on the main lock and use the following procedure to adjust the rods.



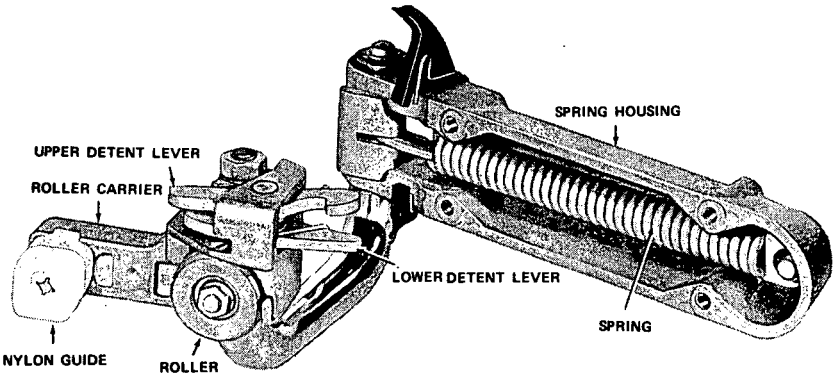

Sliding Door Remote Control (Main) Lock and Retainer Assembly.



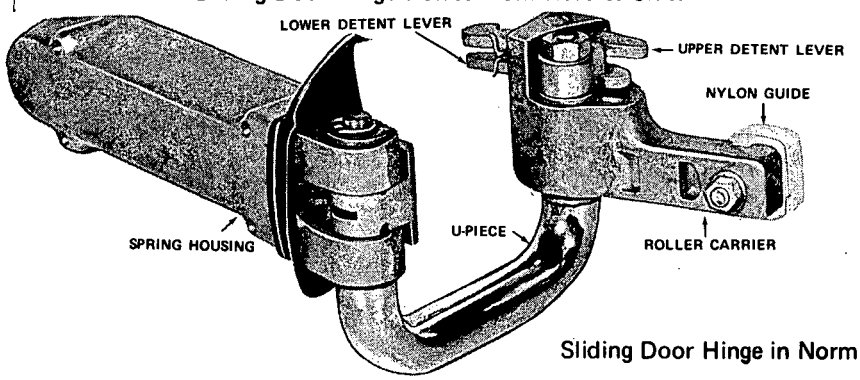

Internal View of Central Lock Assembly.




Sliding Door Main Lock viewed from Interior of Vehicle.




Sliding Door Hinge viewed from Reverse Side.




Sliding Door Hinge in Normal Open Position.

(a) Lock the central lock by installing a 4 mm screw in each of the two holes provided for this purpose on the lock face adjacent to the door inner panel. These screws are screwed into the lock operating levers attached to the remote control rods.

(b) Lock the main lock by installing a 4 mm screw in the hole in the lock face and screwing it into the lower remote control rod attachment.

(c) Connect the remote control rods to the bars on the main lock by adjusting the threaded sleeves and secure each with the lock nut.

(d) Remove the screws locking both locks and check the operation of each assembly.

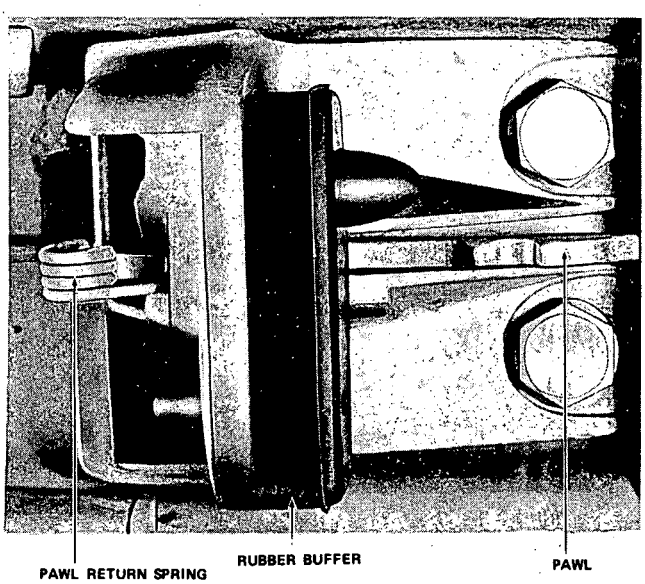
(8) Position the sliding door on the vehicle and instal on the door runners as described under *SLIDING DOOR – TO INSTAL.*

(9) Check the alignment of the central lock and the lock striker.

(10) Check the operation of the door, for opening and closing and if necessary readjust the remote control rods. See *SLIDING DOOR – TO ADJUST.*

(11) Instal the door trim panel and lock handles.

(12) Instal the door runner cover.




Sliding Door Retainer Bracket.

**TO REMOVE AND INSTAL LOCK BRACKET.**

(1) With the sliding door removed from the vehicle, lay back the rear side of the trim in the passengers compartment and remove the Philips screw.

(2) Take out the two bolts and remove the bracket.

(3) Check the spring and the rubber buffer and renew if necessary.

(4) Instal and correctly position the bracket on the side panel.

(5) Fit the sliding door and readjust the bracket, if necessary.

### TO REMOVE AND INSTAL HINGE

(1) Remove the door trim panel and the door assembly from the body.

(2) Take out the four hexagon bolts and slide the hinge assembly out between the inner and outer door panels.

(3) Lubricate the hinge components where necessary and check the nylon guide and roller for wear. Use universal grease on the roller and return spring.

(4) Slide the hinge into position in the door and secure with the four bolts.

(5) Instal the door on the vehicle and adjust if necessary.

## 5. DOOR TRIM PANEL

### TO REMOVE

(1) Remove the two Philips head screws at the front and rear air duct.

(2) Remove the two Philips head screws from the strap type inner door pull.

(3) Remove the Philips screw from the centre of the window regulator handle. To do this it is necessary to lift off the plastic dress cover to reveal the screw.

(4) Remove the finger plate of the door lock release lever by levering it off with a screw driver to reveal the securing screw.

(5) Remove the Philips screw from the lock release lever escutcheon.

(6) Prise out the trim clips from around the edge of the trim and inner door panel. Care must be taken during this operation to avoid damage to the trim panel and paint work.

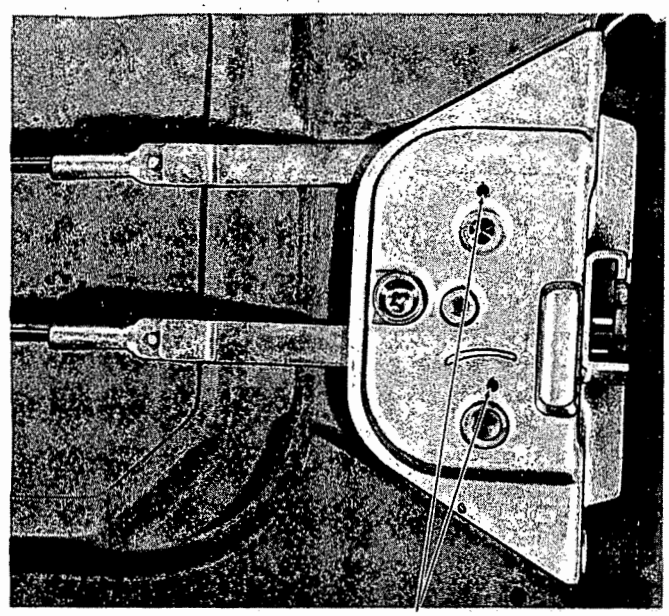
(7) Pull the trim away from the door frame slightly and lift upwards to release the metal tongue type clips which are situated near the centre of the panel.

(8) Remove the plastic sheet from the door inner panel and the clip seals.

Sliding Door Control Lock In Position on Door.

### TO INSTAL

Installation is a reversal of the removal procedure with the inclusion of gluing the plastic sheet to the door panel as necessary to ensure an effective seal.



LOCK SCREW HOLES FOR ADJUSTMENT

## 6. FRESH AIR SYSTEM

### DESCRIPTION

The fresh air enters the front panel through a screened louvre and the volume is controlled by two flaps, operated by levers positioned in the instrument panel.

Attached to the front body panel there is an air hose from which any accumulated water that may be drawn in with the air, is drained away.

In the drivers cabin, on the left and right behind the windshield, there is an air vent and two outlets on the left and right of the instrument panel. These vents can be regulated.

On Station Wagon-Bus type units, there is an extended duct leading through the arm rest of the cabin doors and fresh air flows through these ducts into the front of the passenger compartment.

**TO REMOVE AIR LOUVRE AND SCREEN**

(1) Remove the six Philips screws which are accessible through the front of the grill.

(2) Lift off the screen.

**TO INSTAL**

Installation is a reversal of the removal procedure ensuring that the cut out section faces downwards.

**TO REMOVE FRESH AIR FLAP**

(1) Remove the air louvre cover and screen.

(2) Open the flap and, after removing the spring, withdraw the connecting rod.

(3) Remove the two screws from the support. Remove the flap.

**TO INSTAL**

(1) Check the plastic support.

(2) Reverse the removal procedure.

**TO REMOVE FRESH AIR AND HEATING CONTROLS**

(1) Press out the four plastic plugs from the levers.

(2) Withdraw control levers from the instrument panel and remove the leaf springs.

(3) Remove springs and press connecting rods out of the control levers.

(4) Remove the three Philips head screws and lift off controls.

*NOTE: If the controls are dismantled it is essential that particular attention be given to the sequence of the levers and washers.*

**TO INSTAL**

(1) Installation is a reversal of the removal procedure with attention to the following:

(2) With the fresh air control levers in their uppermost positions, the fresh air flaps must be fully closed.

(3) Adjustment of the flap is by selecting another hole or adjusting the connecting rods.

**TO REMOVE FRESH AIR DUCT (Front panel)**

(1) Remove the three screws and lift off the front panel trim.

(2) Remove the six Philips screws and take off the half round part of the duct together with the air duct connection and seal.

(3) Unscrew the cover from the air vent below the windscreen.

(4) Withdraw downward the distribution duct of the fresh air vent and connection for the outlet.

(5) Withdraw downwards the fresh air vent.

(6) Pull the fresh air outlet out of the connection.

(7) Press the connection towards the front and out of the instrument panel.

**TO INSTAL**

Installation is a reversal of the removal procedure.

**TO REMOVE FRESH AIR DUCT (Drivers Cab)**

(1) Remove the fresh air outlet from the connection.

(2) Take the trim panel off the partition.

(3) Remove the four Philips screws and nuts and remove the fresh air duct.

(4) Press the connection out in the direction of the rear of the vehicle.

**TO INSTAL**

Installation is a reversal of the removal procedure.

# WHEELS AND TYRES

## SPECIFICATIONS

| | |
|---|---|
| Wheels: | |
| Type | Pressed metal with drop centre rim |
| Number of securing studs | 5 |
| Stud tightening torque | 80-90 ft/lb |
| Wheel size: | |
| Up to chassis No. 20-177901 (15 cwt) | 3.50D x 16 |
| Up to chassis No. 1222025 | 4.5K x 15 |
| From chassis No. 1222026 | 5JK x 14 |

| Wheel | Tyre | Front (psi) | Rear (psi) |
|---|---|---|---|
| 3.50D x 16 | 3.50 x 16.6 (tubed) | 28 | 39 |
| 4.5K x 15 | 6.40 x 15.6 (tubed) | 26 | 35 |
| 5JK x 14 | 7.00 x 14.6 (tubeless) | 26 | 33/41 |
| 5JK x 14 | 7.00 x 16.8 (tubeless) | 26 | 41 |
| 5JK x 14 | 185R x 14 (tubed) | 20 | 20 |

## 1. WHEEL AND TYRE ASSEMBLY

### TO REMOVE

(1) Apply the handbrake and whenever possible place a chock at the front and rear of one of the other wheels.

(2) Remove the hub cap with suitable tool ensuring that the cap does not strike the ground and damage the chrome surface.

(3) Slacken the studs approximately three quarters of a turn.

(4) After suitably positioning the jack correctly, raise the required section of the vehicle.

(5) Remove the studs and lift off the wheel.

### TO INSTAL

Installation is the reversal of the removal procedure with attention to the following:

(1) Tighten the wheel studs in the order of 1, 3, 5, 2, 4 rotation. Do not overtighten.

(2) Correct tension is 80-90 ft/lbs.

### TO MAINTAIN

Proper tyre and wheel maintenance is essential for economical and safe operation.

(1) Maintain correct tyre pressures.

(2) Properly tighten wheel mounting nuts.

(3) Periodically inspect tyres for damage or abnormal wear.

(4) Periodically inspect rims for damage, especially to the flange and shoulders.

(5) Periodically rotate tyres (approximately every 3,000 miles).

(6) Maintain proper wheel balance.

### TO REPLACE HUB CAP RETAINING SPRINGS

(1) Remove the wheel from the vehicle.

(2) Cut off the broken spring securing rivet using a flat chisel and drive out the remainder of the rivet.

(3) Place a suitable dolly in a vice and position a rivet and the retaining clip on the outside of the wheel.

(4) Place the wheel horizontally (outside downwards) over the dolly so that the rivet enters the corresponding hole in the wheel.

(5) Peen over the rivet, holding the retaining spring in the correct position.

(6) Suitably paint the retaining clip and worked area on both sides to prevent corrosion.

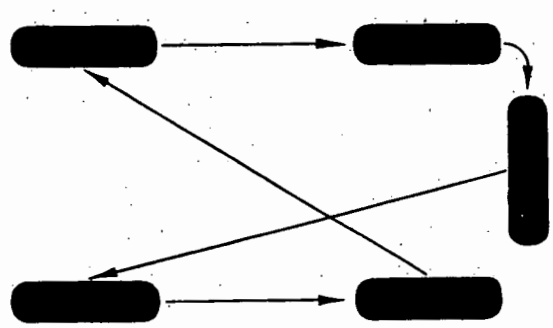


Diagram for Correct Wheel Rotation to Prolong Tyre Life and Minimise Tyre Wear.

## 2. TUBED TYRES

### TO REMOVE

(1) Remove the wheel from the vehicle.

(2) Remove the valve cap and valve core.

(3) Separate the inside bead from the inside wheel flange and, using tyre irons with rounded edges, lever the bead of the tyre over the inside flange of the wheel.

*NOTE: Use care during operation (3) to ensure that the tyre irons do not damage the inner tube against the edge of the wheel flange.*

(4) Push the valve of the inner tube into the interior of the tyre and withdraw the inner tube out between the inner bead of the tyre and the wheel inner flange.

(5) Separate the outside bead of the tyre from the outside flange of the wheel and using tyre irons with rounded edges, lever the bead of the tyre over the inside flange of the wheel to separate the two components.

### TO INSTAL

(1) Remove any loose or excessive scale or rust from the wheel flanges and clean with a wire brush or emery cloth.

(2) Position the inside flange of the wheel partly inside one of the tyre beads and using tyre irons in good condition, lever the remainder of the tyre bead over the wheel flange onto the wheel.

*NOTE: During operation (2), ensure that the tyre bead opposite the side where the levers are applied is seated in the wellbase of the wheel rim.*

(3) Position the inner tube inside the tyre and insert the valve through the hole in the wheel. Screw a valve core removing tool on the end of the valve to prevent the valve from slipping into the interior of the tyre when the other tyre bead is being positioned on the wheel.

(4) Fit the second bead of the tyre over the wheel inner flange, using the tyre irons or a rubber mallet, and ensure that the side of the bead adjacent to the valve goes over the wheel flange last.

*NOTE: Position any dots on one side of the tyre adjacent to the valve to maintain correct tyre balance.*

(5) Stand the wheel and tyre upright, fit the valve core, inflate the tube until the tyre beads just commence to position themselves on the wheel flanges.

(6) Bounce the tyre on the floor several times to position the tyre beads evenly over the wheel flanges, then inflate the tyre and tube to the recommended pressure.

(7) Check the valve core for leakage and instal the valve cap.

## 3. TUBELESS TYRES

### TO REMOVE

(1) Remove the wheel from the vehicle.

(2) Remove the valve cap and valve core.

(3) Separate both the inside and outside beads from the wheel flanges so that both beads are in the base of the rim.

(4) Using tyre irons with rounded edges, lever the beads of the tyre, one at a time, off the inner flange of the wheel.

Use a soap solution on the beads and wheel flange and see that the bead, diametrically opposite the point of leverage is seating on the bottom of the wheel base.

### TO RENEW A VALVE

(1) Remove the old valve from the valve hole in the wheel and clean around the hole.

(2) Wet the new valve and the valve hole with a soap solution and insert the valve in the hole from the inside of the wheel.

(3) Using Schrader tool No 553, screw the tool on the valve and pull the valve through the hole until the inner flange on the rubber base of the valve is in full contact with the inner rim surface. No attempt should be made to fit the valve with pliers.

### TO INSTAL

(1) Remove any loose or excessive scale or rust from the wheel, taking care not to damage the paint.

(2) Hammer out any dents in the rim flanges.

(3) Clean the rim bead seats and flanges thoroughly. Use emery cloth, steel wool, a wire brush or a file depending on the amount of dirt, rust, rubber and surface irregularities to be removed. Smooth paint need not be removed.

(4) File or buff away any high spots at the welded joint.

(5) Wipe clean with moist rag.

*NOTE: The tyre beads and their tyre surfaces must not be damaged during fitting. Do not use a hammer or mallet.*

(6) Wipe the tyre beads with a damp cloth.

(7) Moisten tyre beads, rim surfaces and fitting levers with clean water or soap solution.

(8) Fit the tyre in the normal way, using narrow levers which are in good condition and free from sharp edges. Take small bites so as not to strain or damage the beads. Take particular care not to tear the rubber bead toes when they are lifted over the inner rim flange.

(9) Fit the second bead so that the part of the bead nearest the valve goes over the rim flange last.

*NOTE: The white balance spots near the tyre bead should be at the valve position.*

**TO INFLATE TYRE**

(1) Holding the tyre and wheel upright, bounce the tread of the tyre on the ground at several points around its circumference. This will help to snap the beads onto the tapered rim seats and provide a partial seal.

(2) Connect an air line with the valve core still removed, inflate with the wheel and tyre upright. If the first rush of air does not seal the beads, continue to bounce the tyre with the air line attached.

(3) Continue to inflate until both beads are fully home against the rim flanges.

(4) Remove the air line and fit the valve core. Then inflate to 40 psi.

(5) Test the tyre for leaks and deflate to correct running pressure.

**TO INFLATE TYRE USING A TOURNIQUET**

The Dunlop Tubeless Tyre Tourniquet is very suitable for assisting the inflation of tubeless tyres. Its purpose is to contract the centre of the treads so that the beads are forced outwards against the rim seats and so provide a partial seal for inflation.

(1) With the tool in the open position, buckle the strap centrally around the tread of the deflated tyre and wheel assembly. Pull the strap through the buckle as tight as possible. The strap must be threaded between the buckle bar and teeth on the clip and not between the clip and the end of the buckle.

(2) Thread the loose end of the strap through the gap between the rivet and roller on the link mechanism and compress the tread by pulling the handle through 180°

(3) With the valve core removed attach the air line and inflate until the beads are sealed against the flanges. If they fail to seal at the first attempt, move the handle back and re-tighten the strap.

(4) When the beads are home, disconnect the air supply and fit the valve core. Then remove the tourniquet before final inflation.

(5) To remove the tourniquet, move the handle back and press the thumb on the end of the buckle, pushing the slider bar on the buckle inwards and upwards.

(6) Inflate to 40 psi and test. Deflate to correct running pressure.

*NOTE: When an air line is not available, the tourniquet enables tubeless tyres to be inflated with an efficient foot or hand pump.*

In necessary cases, a tourniquet may be improvised from a piece of rope and a twisting bar.

**TO TEST FOR LEAKS**

A few minutes after inflation, immerse the tyre and wheel in a water tank and check for leaks.

If a water tank without submerging tool is being used, proceed as follows:

(1) Place the assembly in a tank with the valve uppermost. Submerge the valve and check.

(2) Release and allow the assembly to float, with the channel between the rim flange and the tyre filled with water. Check carefully for air bubbles above the rim flange.

(3) Turn the wheel assembly over and submerge the wheel rivets if they are not already under water. Check for leaks at the rivets.

(4) Submerge the assembly to fill the channel between the flange and tyre and then allow to float. Repeat as in (2).

Check for leaks at the valve, rivets, and each flange in turn.

**TO SEAL LEAKS**

*Leak at Top of Rim Flange:*

(1) Mark on the tyre and rim the position of the leak and deflate the tyre. The leak may be caused by dirt, rust, a high weld or chipped paint.

(2) By holding the bead away from the rim seat, the cause of the leak can often be detected and removed without removal of the tyre.

(3) Make sure that the rim is clean after treatment.

*Leak at Wheel Rivet:*

(1) Mark the position of the leak on the rim. Deflate and remove the tyre. The leak should be sealed by peening over the rivet head with a ball peen hammer, backed up by another hammer or a solid resistance such as an anvil.

*Leak at Valve Base:*

(1) In the case of a metal clamp-in valve, if the valve has been fitted correctly and the valve hole is in good condition, the leak can be stopped by tightening the nut.

*NOTE: After testing at 40 psi, make sure that the inflation pressure is adjusted to the correct running figure.*

## 4. TYRE WEAR DIAGNOSIS

**1. Abnormal wear on both sides of tread.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Under inflation of tyres. | – Check and inflate to recommended pressures. |
| (b) | Over-loading. | – Reduce maximum loading. |

**2. Abnormal wear in centre of tread.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Over inflation of tyres. | – Check and reduce to recommended pressures. |

**3. Abnormal wear on inside of tyres.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Insufficient camber angle. | – Check front end alignment and adjust as necessary. |
| (b) | Sagging front torsion bars. | – Check and renew faulty components. |
| (c) | Loose or worn front hub bearings. | – Check and adjust or renew hub bearings. |
| (d) | Bent stub axle or steering knuckle support. | – Check and renew faulty components. |
| (e) | Loose or worn torsion arm components. | – Check and renew faulty components. Align front end. |

**4. Abnormal wear on outside of tread.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Excessive camber angle. | – Check front end alignment and adjust as necessary. |
| (b) | Incorrect link pin shims fitted. | – Check and instal recommended shim packs. |

**5. Spotty or irregular wear.**

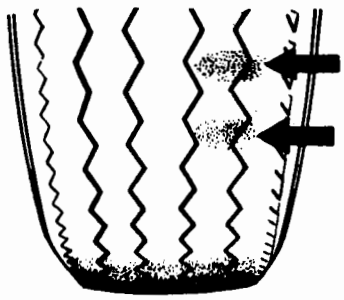
| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Static or dynamic unbalance of wheel and tyre assembly. | – Check and balance wheel and tyre assembly. |
| (b) | Lateral run-out of wheel. | – Check and true-up or renew wheel. |
| (c) | Excessive play in wheel hub bearing. | – Check and adjust or renew hub bearing. |
| (d) | Excessive play in steering knuckle ball joints link pins. | – Check and renew ball joints or link pins. |

**6. Lightly worn spots at centre of tread.**

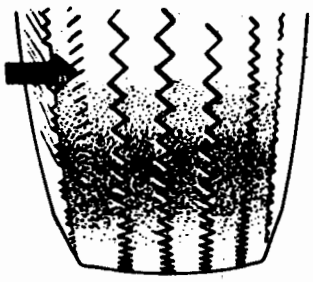
| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Static unbalance of wheel and tyre assembly. | – Check and balance wheel and tyre assembly. |
| (b) | Radial run-out (eccentricity) of wheel. | – Check and renew wheel. |

**7. Flat spots at centre of tread.**

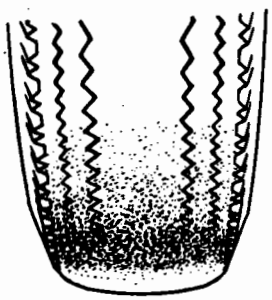
| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Eccentric brake drum. | – Check and renew brake drum. |
| (b) | Repeated severe brake application. | – Revise driving habits. |
| (c) | Lack of tyre rotation. | – Periodically change tyres by rotation of wheel/tyre assembly. |



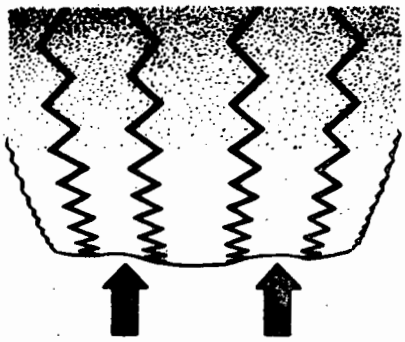
Spotty or Irregular Wear Due to Misalignment.



Wear Due to Incorrect Camber Angle.



Wear In Centre of Tread Due to Over Inflation.



Wear Due to Under Inflation.

8. **Heel and toe wear (saw tooth effect).**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Over-loading. | – Revise maximum loading. |
| (b) | High speed driving. | – Avoid as far as possible. |
| (c) | Excessive braking. | – Revise driving habits. |

9. **Feathered edge on one side of tread pattern.**

| | *Possible cause* | *Remedy* |
|---|---|---|
| (a) | Sharp inside edge – excessive toe-in. | – Check and adjust wheel alignment. |
| (b) | One tyre sharp inside edge, other tyre sharp outside edge. | – Check for bent steering arm and renew. |

# LUBRICATION AND MAINTENANCE

## SPECIFICATIONS

### LUBRICANTS

| Lubricant | Lubrication point | Temperature (°F) | SAE No |
|---|---|---|---|
| Engine oil (HD) | Engine, oil bath air cleaner, carburettor controls, door hinges, felt ring in distributor | above +86<br>+32 to +86<br>below +32<br>below −13 | 30<br>20 or 20W<br>10W<br>5W |
| Gear oil | Transmission case | above +32<br>below +32 | 90<br>80 |
| | Steering gear | | 90 |
| Universal grease | Torsion arms, king pins, torsion arm link pins, tie rod ends, brake cables, pedal cluster bearing, gearshift lever, distributor fibre block, door and hood locks. | Low freezing and water repellent grease | |
| Lithium grease | Front wheel bearings | Multi-purpose grease | |

### CAPACITIES

Crankcase . . . . . 5.5 Imp pts (6.6 US pts)
Oil bath air cleaner . . . . . .4 Imp pts (.5 US pts)
*Transmission . . . . . 5.5 Imp pts (6.6 US pts)
Reduction gears . . . . . .4 Imp pts (.5 US pts)
Steering gear . . . . . .4 Imp pts (.5 US pts)
*From chassis No 218000001 6.1 Imp pts (7.4 US pts)

## 1. LUBRICATION

**Initial 300 Miles Lubrication Service**

(1) Engine: Drain when hot and renew oil.
(2) Remove and clean oil strainer.
(3) Lubricate torsion arms.
(4) Lubricate king pins and torsion arm link pins.
(5) Lubricate tie rod ends.
(6) Oil door hinges.
(7) Steering gear: Check oil level, top up if necessary.
(8) Lubricate brake cables.
(9) Lubricate pedal linkage.
(10) Oil carburettor linkage.
(11) Lubricate door and lid locks.
(12) Transmission: Change oil, clean magnetic oil drain plugs.
(13) Reduction gear cases: Change oil.

**First 1200 Miles Lubrication Service**

(1) Engine: Drain when hot and renew oil.
(2) Remove and clean oil strainer.
(3) Lubricate torsion arms.
(4) Lubricate king pins and torsion arm link pins.
(5) Lubricate tie rod ends.
(6) Oil door hinges.
(7) Transmission: Clean magnetic oil drain plugs.
(8) Transmission: Check oil level, top up if necessary.
(9) Reduction gear cases: Change oil.

**First 2400 Miles Lubrication Service**

(1) Engine: Drain when hot and renew oil.
(2) Remove and clean oil strainer.
(3) Clean carburettor air cleaner.
(4) Lubricate torsion arms.
(5) Lubricate king pins and torsion arm link pins.
(6) Lubricate tie rod ends.
(7) Oil door hinges.
(8) Steering gear: Check oil level, top up if necessary.
(9) Lubricate brake cables.
(10) Lubricate pedal linkage.

(11) Oil carburettor linkage.
(12) Lubricate door and lid locks.
(13) Transmission: Clean magnetic oil drain plugs, check oil level, top up if necessary.

**Every 1200 Miles Lubrication Service**

(1) Engine: Check oil level, top up if necessary.
(2) Lubricate torsion arms.
(3) Lubricate king pins and torsion arm link pins.
(4) Lubricate tie rod ends.
(5) Oil door hinges.
(6) Transmission: Clean magnetic drain plugs, check oil level and top up if necessary.

**Every 2400 Miles Lubrication Service**

(1) Carry out 1500 mile lubrication service.
(2) Engine: Change oil and clean oil strainer.
(3) Clean carburettor air cleaner.
(4) Transmission: Check oil, top up if necessary.
(5) Steering gear: Check oil, top up if necessary.
(6) Lubricate brake cables.
(7) Lubricate pedal linkage.
(8) Oil carburettor linkage.
(9) Lubricate door and lid locks.

**Every 7200 Miles Lubrication Service**

(1) Carry out 2400 miles lubrication service.
(2) Transmission: Change oil, clean magnetic drain plugs.
(3) Reduction gear cases: Change oil.
(4) Lubricate felt in ignition distributor cam.

**Every 14,400 Miles Lubrication Service**

(1) Lubricate front wheel bearings.

## 2. MAINTENANCE

**Initial 300 Miles Maintenance Service**

(1) Check adjustment of automatic air intake control, correct if necessary.
(2) Check nuts and bolts on engine, exhaust and inlet manifold, carburettor, and fuel pump, tighten if necessary.
(3) Check tyre pressures and wheel mounting bolts.
(4) Check fan belt for tension, adjust if necessary.
(5) Clean fuel pump filter.
(6) Clean contact breaker points, check breaker arm fibre block for lubrication.
(7) Check contact breaker gap and ignition timing, adjust if necessary with engine cold.
(8) Check valve clearance, if necessary adjust with engine cold.
(9) Check engine and rear axle for oil leaks.
(10) Check clutch pedal free-play, adjust if necessary.
(11) Check steering adjustment, correct if necessary.
(12) Check torsion arm link pins, front wheel bearing play, tie rod ends, steering damper mounting and toe-in, tighten or adjust as necessary.
(13) Check brake system for leaks. Check fluid level in reservoir. Check foot and hand brake, adjust if necessary.
(14) Check shock absorber mountings for tightness.
(15) Check battery specific gravity, add distilled water if necessary. Clean and grease terminals.
(16) Check all lights, horn, windscreen wiper, and flashing indicators, correct as necessary.
(17) Check adjustment of door striker plates, adjust as necessary.
(18) Road test vehicle. Check idling speed, adjust as necessary.
(19) Check nuts and bolts on chassis, body, rear axle, front axle and steering, tighten as necessary.

**Every 3000 Miles Maintenance Service**

(1) Check fan belt tension, adjust as required.
(2) Check throttle ring for proper contact on fan housing.
(3) Clean fuel pump filter.
(4) Lubricate felt ring in contact breaker base plate.
(5) Clean contact breaker points, check lubrication of fibre block.
(6) Check contact breaker gap and ignition timing, adjust as necessary with engine cold.
(7) Check valve clearance, adjust as necessary with engine cold.
(8) Clean and check spark plugs, adjust gap if necessary. Check compression.
(9) Check engine and rear axle for oil leaks.
(10) Check intake and exhaust systems for damage.
(11) Check clutch pedal free play, adjust as necessary.
(12) Check steering adjustment, correct as required.
(13) Check torsion arm link pins, front wheel bearing play, tie rod ends, steering damper mounting and toe-in, tighten or adjust as necessary.
(14) Rotate wheels. Check for abnormal wear or damage. Correct tyre pressure.
(15) Check brake system for leaks. Check fluid level in reservoir. Check foot and hand brakes, adjust as necessary.
(16) Check thickness of brake lining through inspection hole.
(17) Check shock absorber mountings.

(18) Check battery specific gravity, add distilled water as necessary. Clean and grease terminals.

(19) Check all lights, horn, windscreen wiper, and flashing indicators, correct as necessary.

(20) Check door lock striker plates, adjust if necessary.

(21) Road test vehicle. Check idling speed, adjust as required.

**Every 30,000 Miles Maintenance Service**

(1) Carry out 3000 miles maintenance service.

(2) Clean, grease and adjust front wheel bearings.

# INDEX

PAGE 257