GASOLINE ENGINE KE47

WORKSHOP MANUAL
For
CANTER, ROSA, JEEP

MITSUBISHI MOTORS CORPORATION

GASOLINE ENGINE KE47 WORKSHOP MANUAL

KE47-1110. ジープ用エンジン。オーストラリアから入手。

KE47

WORKSHOP MANUAL

FOREWORD

This Workshop Manual contains complete data and technical information concerning the construction, inspection, adjustment, maintenance, disassembly and reassembly of the Engine KE47 mounted on Canter, Jeep and Rosa.

It is recommended that mechanics engaged in the servicing of this vehicle carefully read and make full use of this manual so that they may carry out the correct measures quickly and competently, thereby bringing full satisfaction to customers.

GROUP INDEX

MITSUBISHI MOTORS CORPORATION

GROUP 1

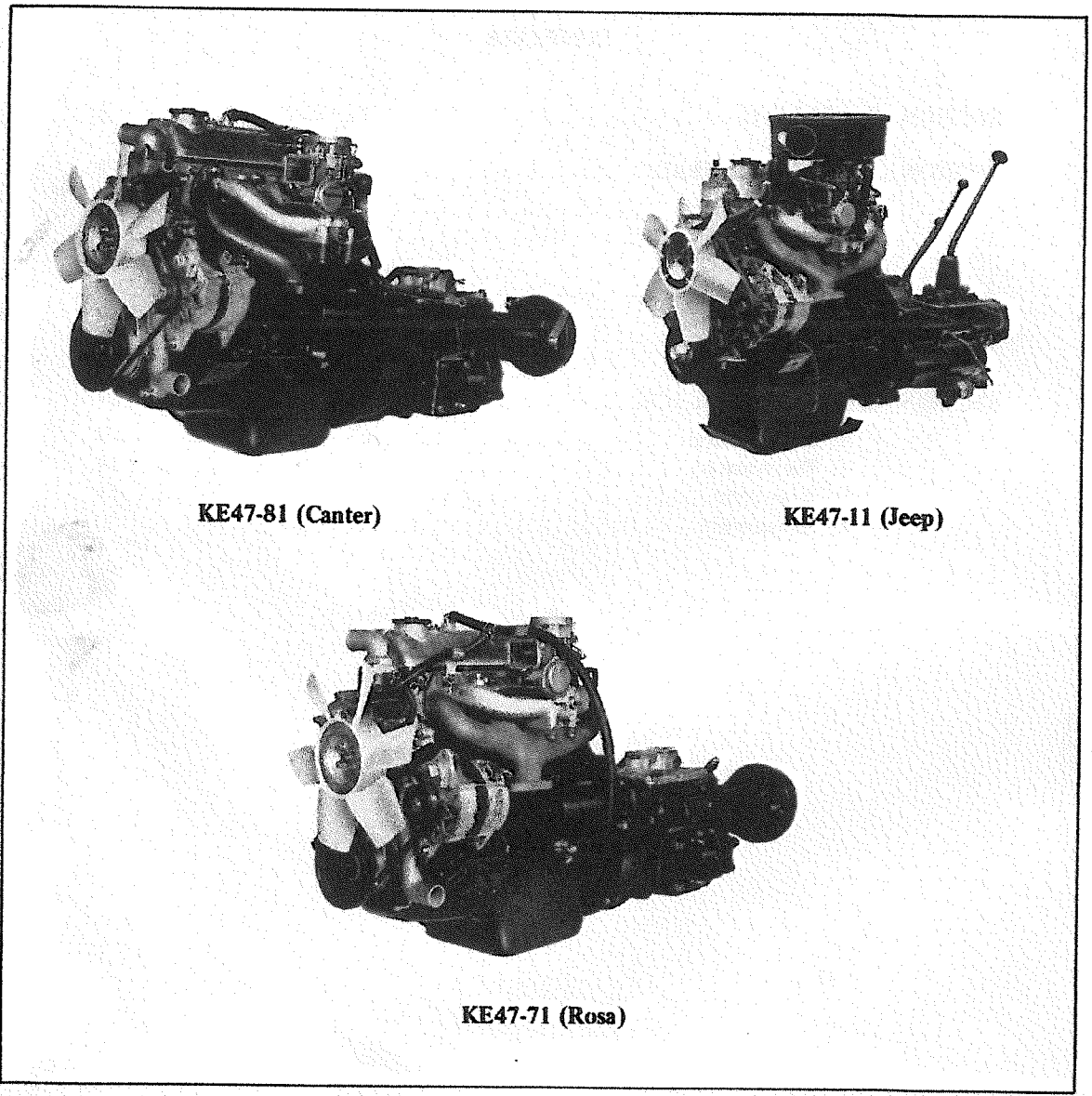
ENGINE

CONTENTS

The KE47 engine is a four-cylinder, four-stroke, overhead valve, water-cooled gasoline engine with a total displacement of 2,315 cc. (4.9 pt). It delivers the maximum output of 95 PS at 4,500rpm and the maximum torque of 17.5 kg-m (126.5 ft-lbs.) at 2,800 rpm.

The engine is mounted at the fore part of the chassis. The engine power is transmitted to the rear wheels through a transmission mounted at the rear of the engine.

For crankcase ventilation is employed a sealed crankcase ventilator system that blow-by gases are drawn into the air cleaner from the chain case and the rocker arm cover.



KE47-81 (Canter)

KE47-11 (Jeep)

KE47-71 (Rosa)

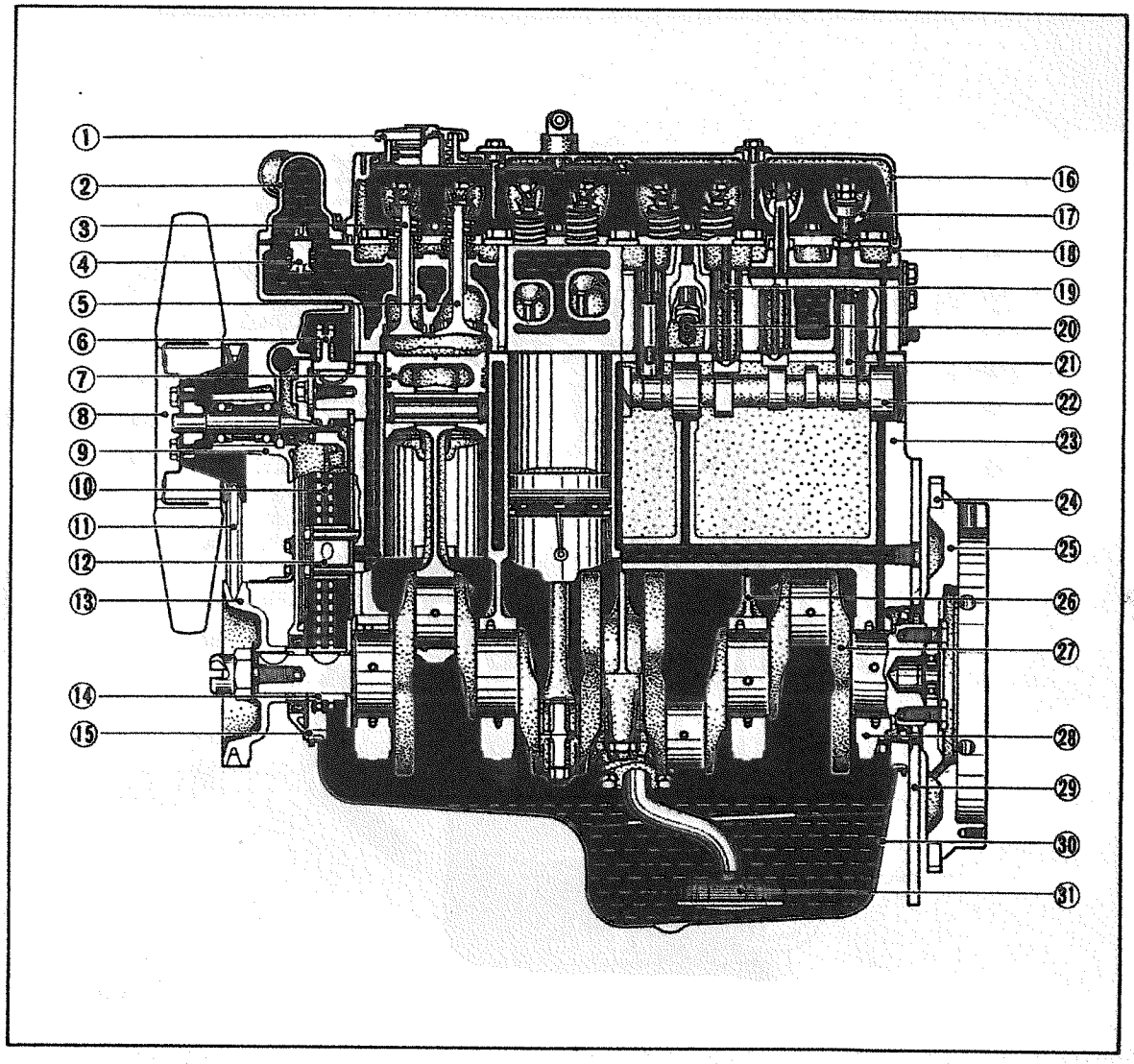
Fig. 1 Engine General View

Detailed Models for Engine and Vehicles

Vehicles name	Vehicles model	Engine model (Clutch transmission model)	Remarks (Differentials ratio)
Canter	T93B, T97B, T97A	KE47-81 (KM86D)	2 ton (5.714)
	T97AU, T97AUY	KE47-81A (KM86D)	2 ton (For CAL) (5.714)
	T93B-LH, T97A-LH	KE47-81L (KM86DL)	2 ton (5.714)
	T97AP	KE47-81P (KM86D)	2 ton (5.714)
	T93BZ	KE47-82 (KM86D1)	3 ton (6.333)
	$T93BZHY_1$	KE47-82A (KM86D1)	3 ton (For CAL) (6.333)
	$T93BZHY_1$	KE47-82C (KM86D1)	3 ton Bottle Car (6.333)
	T93BZ-LH	KE47-82L (KM86D1L)	3 ton (6.333)
	T93A, T93A(N), T93AD	KE47-83 (KM86C1)	2 ton (6.333)
	T93A-LH, T93A(N)-LH, T93AD-LH	KE47-83L (KM86C1L)	2 ton (6.333)
	T93BZ	KE47-84 (KM86D2)	3 ton (6.667)
	$T93BZHY_2$	KE47-84C (KM86D2)	3 ton Bottle Car (6.667)
	T93BZ-LH	KE47-84L (KM86D2L)	3 ton (6.667)
	T93AZ	KE47-85 (KM86D3)	3 ton (6.333)
	T93AZ-LH	KE47-85L (KM86D3L)	3 ton (6.333)
	T93AZ	KE47-86 (KM86D4)	3 ton (6.667)
	T93AZ-LH	KE47-86L (KM86D4L)	3 ton (6.667)
Rosa	B13, B13A	KE47-71 (KM86B)	Seating capacity persons 25
Jeep	J52	KE47-11 (KM4E)	Floor change
	J22, J22H, J34, J42	KE47-21 (KM6E)	Remote change
	J22, J34, J42	KE47-23 (KM4E)	Floor change

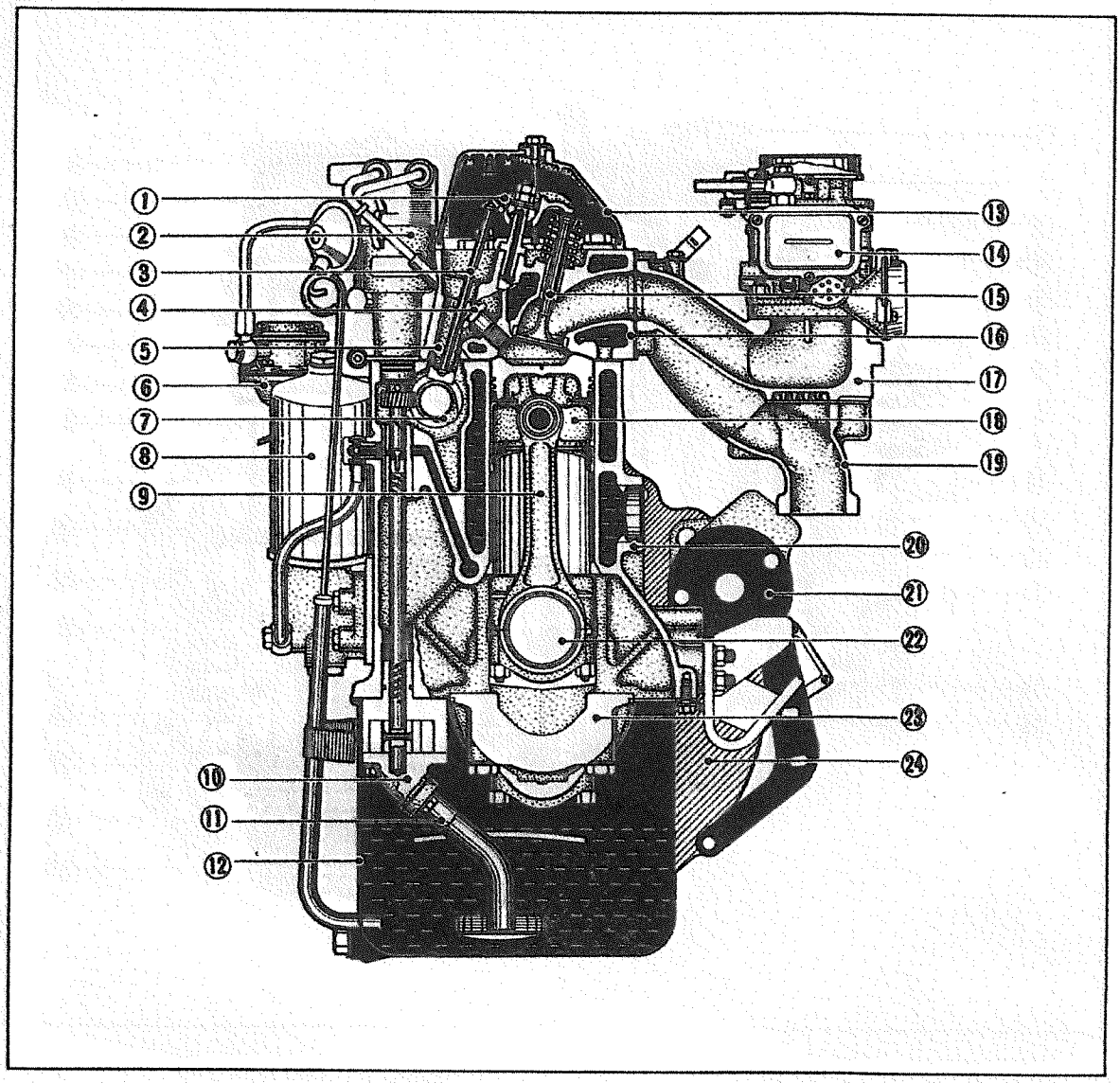
Engine Specifications

Type		Gasoline engine
Cooling system		Water cooling
Number and arrangement of cylinders		4, in-line
Cycle		4
Combustion chamber type		Wedge type
Valve arrangement		Overhead valve type
Bore × Stroke		85 × 102mm (3.35 × 4.02 in.)
Total displacement		2,315 cc (4.9 pt)
Compression ratio		8.0 : 1
Compression pressure		9.5 kg/cm² (135.1 psi) at 250 rpm
Max. mean effective pressure		9.5 kg/cm² (135.1 psi) at 2,800 rpm
Max. output		95 PS at 4,500 rpm
Max. torque		17.5 kg-m (126.5 ft-lbs.) at 2,800 rpm
Min. fuel consumption at full load		220 gr/PS-hr (7.8 oz/PS-hr) at 2,000 rpm
Dimensions (Length × Width × Height)	Canter	691 × 547 × 680mm (27.20 × 21.54 × 26.77 in.)
	Rosa	691 × 597 × 721mm (27.20 × 23.5 × 28.39 in.)
	Jeep	695 × 832 × 565mm (27.36 × 32.75 × 22.24 in.)
Weight with accessories	Canter	185 kg (407.9 lbs.)
	Rosa	185 kg (407.9 lbs.)
	Jeep	188 kg (414.5 lbs.)
Crankcase ventilator system		Sealed system



(1) Oil filler cap
(2) Water outlet fitting
(3) Exhaust valve
(4) Thermostat
(5) Intake valve
(6) Camshaft sprocket
(7) Piston
(8) Cooling fan
(9) Water pump
(10) Timing chain
(11) Fan belt
(12) Loose side tensioner
(13) Crankshaft pulley
(14) Crankshaft sprocket
(15) Timing chain cover
(16) Rocker arm cover
(17) Rocker arm
(18) Cylinder head
(19) Push rod
(20) Spark plug
(21) Tappet
(22) Camshaft
(23) Cylinder block
(24) Ring gear
(25) Flywheel
(26) Connecting rod
(27) Crankshaft
(28) Main bearing cap
(29) Rear plate
(30) Oil pan
(31) Oil screen

Fig. 2 Longitudinal Section of Engine (Model KE47-81)

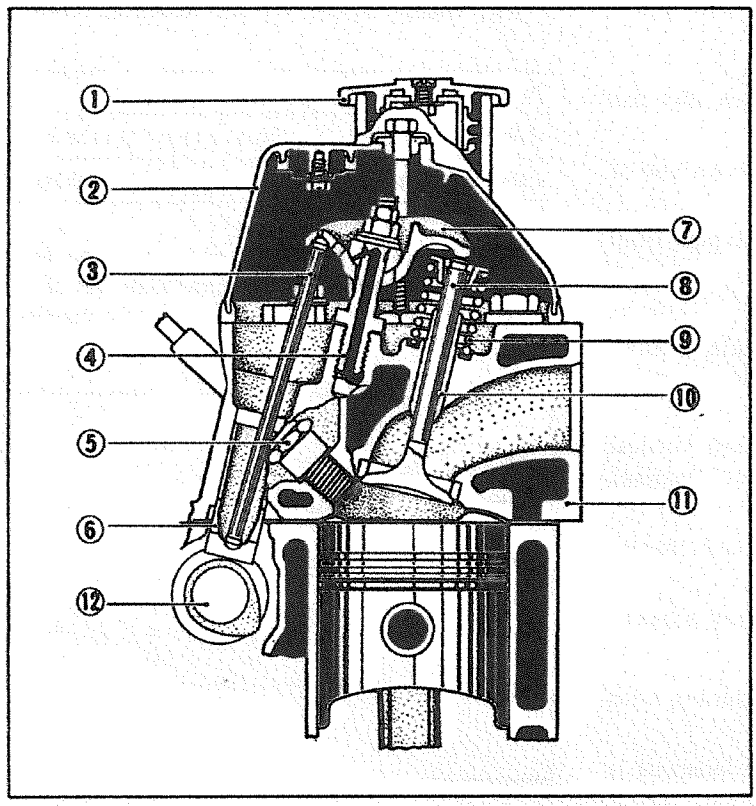


(1) Rocker arm
(2) Distributor
(3) Push rod
(4) Spark plug
(5) Tappet
(6) Fuel pump
(7) Camshaft
(8) Oil filter
(9) Connecting rod
(10) Oil pump
(11) Oil screen
(12) Oil pan
(13) Rocker arm cover
(14) Carburetor
(15) Intake valve
(16) Cylinder head
(17) Intake manifold
(18) Piston
(19) Exhaust manifold
(20) Cylinder block
(21) Starting motor
(22) Crankshaft
(23) Main bearing cap
(24) Rear plate

Fig. 3 Cross Section of Engine (Model KE47-81)

SECTION 1. CYLINDER HEAD

1. Construction



(1) Oil filler cap
(2) Rocker arm cover
(3) Push rod
(4) Rocker arm stud
(5) Spark plug
(6) Tappet
(7) Rocker arm
(8) Valve
(9) Valve spring
(10) Valve guide
(11) Cylinder head
(12) Camshaft

Fig. 4 Sectioned View of Cylinder Head

1-1 Cylinder Head and Rocker Arm Cover

1. The cylinder head is an overhead valve type aluminum alloy casting head which obtains a high cooling effect. Exhaust ports are cast integral with the head. The wedge type combustion chamber ensures excellent combustion efficiency and anti-knock property.
2. The rocker arm cover is made of aluminum casting. To remove blow-by gases, the rocker arm cover is connected by an emission hose with the air cleaner.

1-2 Rocker Arms, Valves, Valve Springs and Tappets

1. Rocker arms are made of forging and each supported by the spherical surface of the rocker ball.
2. Valves are made of heat-resistance steel. The exhaust valve head has been welded with a special heat-resistance steel so as to have a greater heat resistance and further the valve face reinforced with stellite to increase its resistance to heat.
3. Valve springs employed are single coil springs, which are so designed as to fully meet the requirements of the engine.
4. Tappets are tubular, hollow cast iron tappets, the bottom of which is nitrided after chill hardening.

1-3 Intake Manifold

The intake manifold, an aluminum alloy casting, is of the independent branch type which assures highly efficient distribution of fuel.

1-4 Exhaust Manifold

The exhaust manifold, an iron casting, is of the independent branch type which has an independent branch for each cylinder to prevent exhaust interference.

2. Removal

1. Loosen the carburetor side air hose clip and remove the air hose.
2. Remove the accelerator wire and choke wire of the carburetor.
3. Remove the vacuum pipe and fuel pipe from the carburetor side.
4. Remove the carburetor.

   Note: You can remove the manifold without removing the carburetor from the manifold.
5. Separate the exhaust manifold and exhaust pipe, and remove the intake exhaust manifold assembly.
6. Remove the rocker arm cover and remove rocker arms and push rod.
7. Remove push rod guides and then tappets.
8. Remove water bypass hoses.
9. Remove the cylinder head by loosening head bolts.

   The cylinder head bolts should be loosened in the sequence shown in Fig. 5

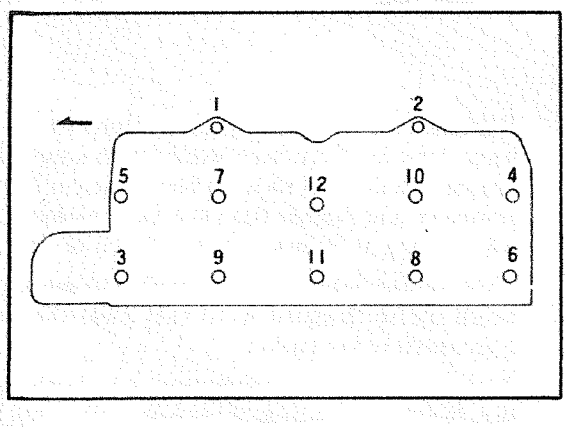


Fig. 5 Cylinder Head Bolt Loosening Sequence

3. Installation

1. Apply THREE-BOND 4A to the both sides of the head gasket and attach the gasket on the cylinder block.

   The gasket should be installed with the arrow mark up and at the front.
2. Install the cylinder head on the block by using two stud bolts as guides and tighten bolts in the sequence illustrated in Fig. 6. The bolts should be tightened in 3 to 4 stages, first weakly and finally firmly to the specified torque.

Parts to be tightened	Torque
Cylinder head bolts	10 to 11 kg-m (73 to 80 ft-lbs.)
Cylinder head nuts	2 to 3 kg-m (15 to 22 ft-lbs.)

Cylinder head bolts and nuts must be additionally tightened in a warm state [at water temperature of 80° C (176° F)] after lapping.

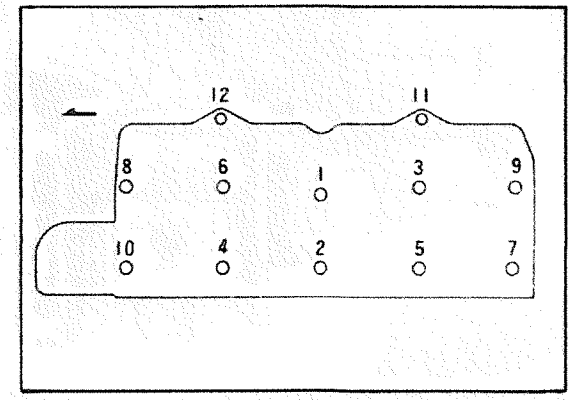


Fig. 6 Cylinder Head Bolt Tightening Sequence

3. Connect the water pump by a bypass hose to the cylinder head.
4. When inserting the tappet into the sleeve, apply oil to the tappet. After insertion, make sure that the tappet lightly moves.
5. Install the push rod guide and insert the push rod.
6. Install the rocker arm and rocker ball and temporarily tighten the nut. Then adjust the valve-to-rocker arm clearance (valve clearance) at the top dead center of compression of each cylinder by means of the rocker arm nut. (Fig. 7)

Description	Standard dimension
Valve clearance	0.2mm (0.008 in.) (warm), both intake and exhaust

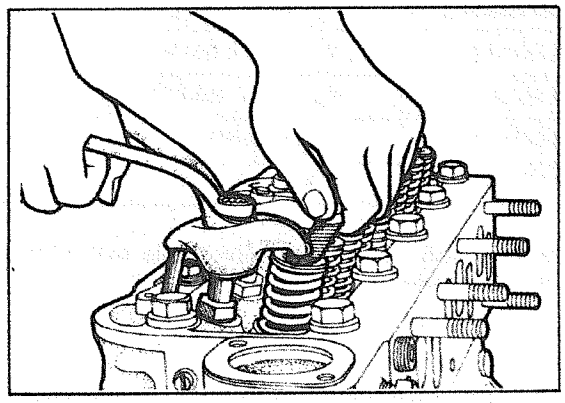


Fig. 7 Valve Clearance Adjustment

7. Install the rocker arm cover through rubber.
8. Installing the Manifold

   Reverse the removal procedures. Pay heed to the following points.

   Replace the manifold gasket by a new one. If you separated the intake manifold and exhaust manifold, apply THREE-BOND 4A to the gasket before tightening them together.

   Tighten the manifold firmly with the specified torque to prevent gas leak.

Description	Torque
Mounting the manifold to the cylinder head	1.5 to 2.0 kg-m (10.8 to 14.5 ft-lbs.)

4. Disassembly

Using a valve lifter, remove the valve retainer lock, the valve spring, the retainer and the oil seal. Then remove the valves.

Disassembled parts should be segregated by respective cylinders.

5. Inspection

5-1 Cylinder Head

1. Before washing, check the cylinder head for cracks, damages and water leaks.
2. Remove oil and grease, scale, sealant and carbon deposits completely. After washing oil passages, apply compressed air to make certain the passages are not clogged.
3. Cylinder Head Distortion

   Check the cylinder head for distortion by using a straight edge in the sequence of A, B, ... as illustrated in Fig. 8. If distortion exceeds the repair limit, correct it to less than the standard dimension by using a surface grinder.

Description	Standard dimension	Repair limit
Cylinder head distortion	Within 0.05mm (0.002 in.)	0.1mm (0.004 in.)

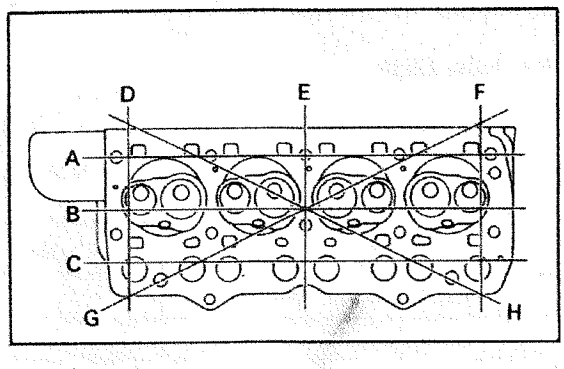


Fig. 8 Checking Cylinder Head Distortion

5-2 Valves

1. Check each valve for wear and deformation of head and stem. Repair or replace the valve if excessively worn or deformed. Grind the valve face with a valve refacer to correct face run-out and remove step wear B. In the event of stem end pitting, correct the stem end A by the valve refacer. In this case, correction should be limited to the minimum possible extent. The stem should be exactly at right angles to the head.

   Replace the valve with a new part if stem wear exceeds the service limit, or if the thickness (C) of the face has decreased to less than the service limit.

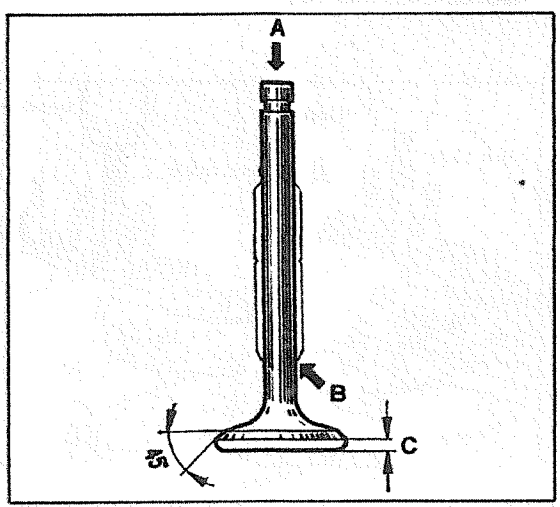


Fig. 9 Valve Check Points

Description		Standard dimension	Service limit
Valve stem O.D.	In.	8.7 mm (0.343 in.)	–0.1 mm (–0.004 in.)
	Ex.	8.7 mm (0.343 in.)	–0.15 mm (–0.0059 in.)
Thickness of valve head	In.	1.5 mm (0.059 in.)	1.0 mm (0.04 in.)
	Ex.	1.5 mm (0.059 in.)	1.0 mm (0.04 in.)

2. Replace the oil seal that has been damaged.

5-3 Valve Guide

If the valve-to-valve guide clearance exceeds the service limit, replace the valve guide with a new oversize part.

Valve Guide Oversizes

Size	Size mark	Cylinder head I.D.
O.S. 0.05 mm (0.0020 in.)	5	14.050 to 14.068 mm (0.5531 to 0.5538 in.)
O.S. 0.25 mm (0.0098 in.)	25	14.250 to 14.268 mm (0.5610 to 0.5617 in.)
O.S. 0.50 mm (0.0197 in.)	50	14.500 to 14.518 mm (0.5709 to 0.5716 in.)

Description		Standard dimension	Repair limit
Valve-to-valve guide clearance	In.	0.017 to 0.056 mm (0.00067 to 0.00220 in.)	0.1 mm (0.004 in.)
	Ex.	0.052 to 0.100 mm (0.00205 to 0.00394 in.)	0.15 mm (0.0059 in.)

Each valve guide is shrink-fitted. When replacing them, proceed as follows:

1. Using a special tool Valve Guide Installer MD998062 (ST8065-0), press or hammer out each old valve guide to be replaced.
2. Ream holes in the cylinder head to the specified size at room temperatures.
3. After heating the cylinder head to 250±25°C (437 to 527°F), insert intake and exhaust valves quickly and, by using a special tool, Valve Guide Installer MD998062 (ST8065-0), press them into the specified position.

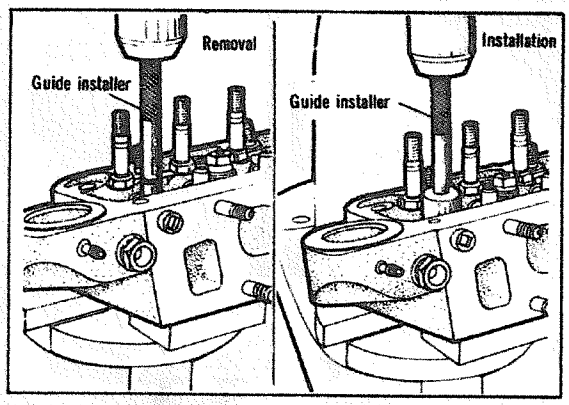


Fig. 10 Valve Guide Installation and Removal

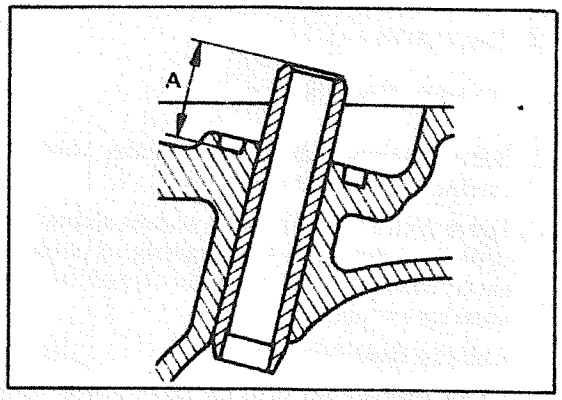


Fig. 11 Position of Installed Valve Guide

Description	Specified dimension
Height of exposed top end of valve guide	19.0 to 20.0 mm (0.768 to 0.788 in.)

After the installation of the valve guide, check to be sure that no burrs are present at the top end of the guide. If there exists any burr, remove it.

5-4 Valve Seat Ring

1. Check the valve seat for evidence of overhead and improper contact with the valve face. Correct the seat if necessary.

   When correcting, check the valve guide for wear. Replace the guide that is defective, and then correct the seat ring.

   Recondition the valve by means of a valve refacer and the valve seat ring by a seat grinder or a cutter. Subsequently the valve and valve seat shall be lapped lightly with a lapping compound (No. 400). Lapping should be limited to a minimum.

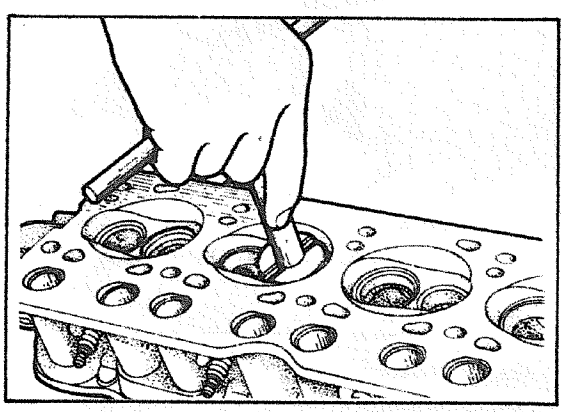


Fig. 12 Reconditioning the Seat Ring

Description		Standard dimension
Valve seat contact width	In.	0.9 to 1.3 mm (0.035 to 0.051 in.)
	Ex.	1.2 to 1.6 mm (0.047 to 0.063 in.)
Valve seat angle	Both in. and ex.	45°

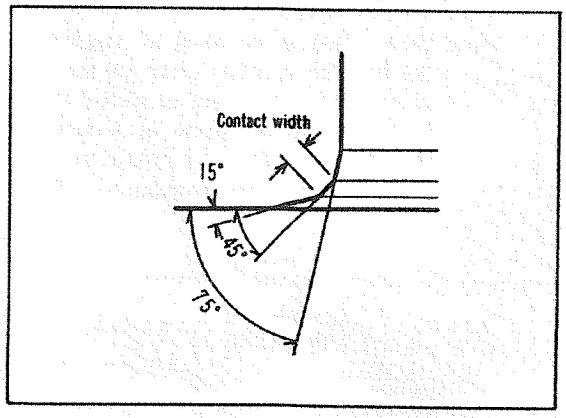


Fig. 13 Seat Ring Reconditioning Dimensions

2. Check the valve seat ring sinkage. If the sinkage exceeds the service limit, replace the ring with a standard or oversize part by the following procedure.

Description	Service limit
Valve seat ring sinkage	1.5 mm (0.059 in.)

Valve Seat Ring Oversizes

	Size	Size mark	Cylinder head I.D.	Seat ring height H
Ex.	S.T.D.	None	36.00 to 36.025 mm (1.4173 to 1.4183 in.)	7.7 mm (0.303 in.)
	O.S. 0.30 mm (0.0118 in.)	30	36.30 to 36.325 mm (1.4291 to 1.4301 in.)	8.0 mm (0.315 in.)
	O.S. 0.60 mm (0.0236 in.)	60	36.60 to 36.625 mm (1.4409 to 1.4419 in.)	8.3 mm (0.327 in.)
In.	S.T.D.	None	46.00 to 46.025 mm (1.8110 to 1.8120 in.)	7.7 mm (0.303 in.)
	O.S. 0.30 mm (0.0118 in.)	30	46.30 to 46.325 mm (1.8228 to 1.8238 in.)	8.0 mm (0.315 in.)
	O.S. 0.60 mm (0.0236 in.)	60	46.60 to 46.625 mm (1.8346 to 1.8356 in.)	8.3 mm (0.327 in.)

a. Removing the Valve Seat Ring

Any valve seat ring that has been worn away over the repair limit should be removed at room temperatures after thinning down the ring as shown in Fig. 14-A.

b. Correcting the Valve Seat Ring

After removing the seat ring, machine the seat ring bore by a cutter uniformly to the size given in the table above on the basis of the existing bore as shown in Fig. 14-B.

Note: Where this is no need of machining the bore by a cutter after the removal of the valve seat ring as stated above in paragraph a , press in a standard seat ring as instructed below in paragraph c after removing burrs or other defects if any.

c. Pressing in the Valve Seat Ring

Heat the cylinder head sub-assembly to 250°C (482°F). Then press in and calk a next larger oversize seat ring at room temperatures.

d. Correcting the Valve Seat

After installing a new valve seat, correct its surface as stated in paragraph 1.

5-5 Valve Springs

Check valve springs for presence of cracks and breakage. Check spring tension by using a spring tester. Those springs that exceed the service limit should be replaced with new parts.

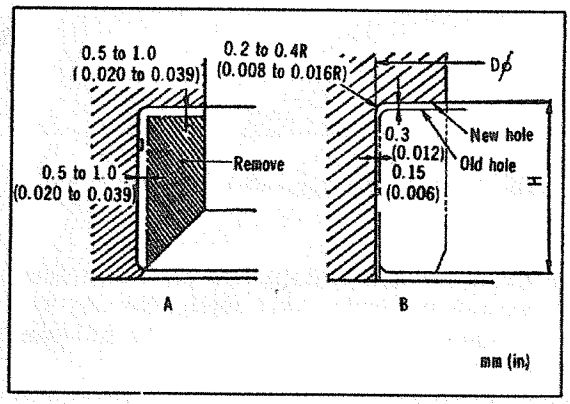


Fig. 14 Seat Ring Replacement

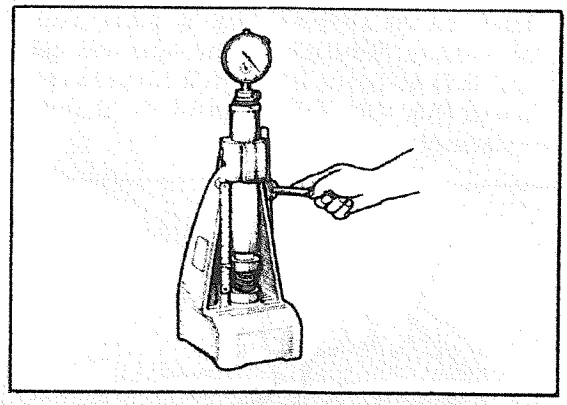


Fig. 15 Checking the Valve Spring

Description		Standard dimensions	Service limit
Free length		47.7 mm (1.878 in.)	46.7 mm (1.840 in.)
Load	When compressed to 40 mm (1.57 in.)	26 kg (57.3 lbs.)	21 kg (46.3 lbs.)
	When compressed to 31 mm (1.22 in.)	58 kg (127.9 lbs.)	47 kg (103.6 lbs.)
Out of square			3°

5-6 Rocker Arms

1. Check both ends of each rocker arm and rocker arm-to-ball contact surfaces for presence of uneven wear. Correct or replace the arm that is unevenly worn.
2. Check the rocker arm stud oil hole and the rocker arm oil hole for clogging. Clean them if necessary. (Fig. 16)

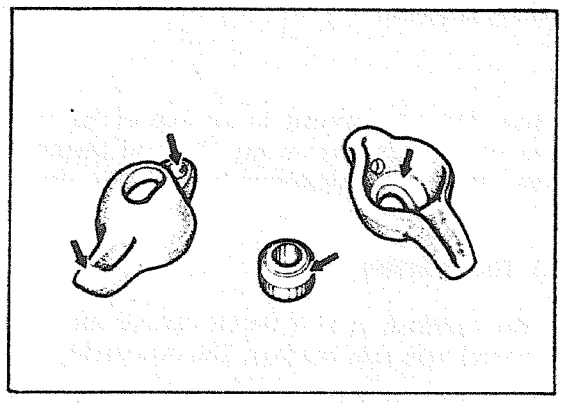


Fig. 16 Checking the Rocker Arm

5-7 Tappets

1. Check each tappet and its contact surfaces for wear or cracks. Replace any defective tappet.
2. Tappet-to-Tappet Sleeve Clearance

   Check the tappet O.D. and the tappet sleeve I.D. If the clearance between them is over the repair limit, replace the defective tappet with a new standard or oversize part.

Tappet Oversizes

Size	Mark	Tappet O.D.
S.T.D.	None	22mmϕ (0.86 in.ϕ)
O.S. 0.1 mm (0.004 in.)	Red enamel	22.1mmϕ (0.870 in.ϕ)

Description	Standard dimension	Repair limit
Tappet-to-tappet sleeve clearance	0.007 to 0.041 mm (0.00028 to 0.00161 in.)	0.2 mm (0.008 in.)

5-8 Manifold

1. Check each section for corrosion, damage or cracks. Correct or replace if defective.

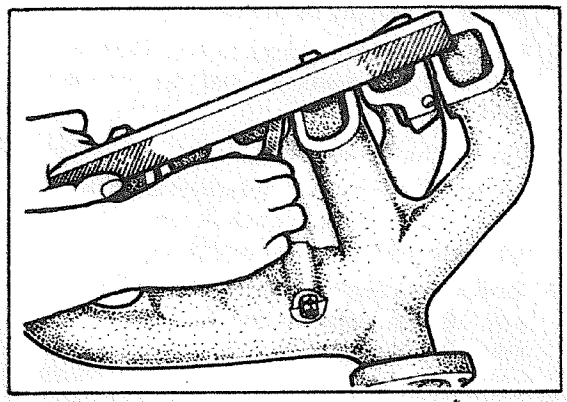


Fig. 17 Manifold Strain Measurement

2. Combine the manifold with the exhaust manifold, check for strain at the joining surfaces with the cylinder head, and correct or repair if the strain is over the repair limit. (Fig. 17)

Description	Standard dimension	Repair limit
Strain at joining surface of manifold	0.05 mm (0.0020 in.) or less	0.2 mm (0.008 in.)

6. Reassembly

1. Insert each valve, after applying oil, into the valve guide from under the cylinder head. Then install spring retainers.
2. Using a valve lifter, compress the spring, install an oil seal and install a retainer lock.

SECTION 2. CYLINDER BLOCK

1. Construction

1-1 Cylinder Block and Main Bearings

1. The cylinder block is a light-weight, rigid special alloy cast iron block of a unitary structure with cylinders of in-line arrangement. It has main bearing housings in the bottom and a 4 mm (0.16 in.) short skirt. The number of bearings used is five. The water jacket is of a full jacket type.
2. Main bearings are made of an aluminum bearing alloy lined with a back metal.

1-2 Main Moving Parts

1. The piston is a special aluminum alloy casting oval piston with three rings: two compression rings and one oil ring.
2. The piston pin is a hollow case hardened steel pin of fully floating type and installed off the center of piston [offset: 2.1 mm (0.083 in.)]
3. No. 1 and oil ring are chrome-plated.
4. The crankshaft is made of S50C steel precision forging. Pins and journals are case hardened. The counter weights are formed integral with the shaft.
5. The connecting rod is a forging. The big end joint face is horizontal to the axis of the rod to obtain a greater rigidity. The rod bearings are made of an aluminum bearing alloy lined with a back metal.

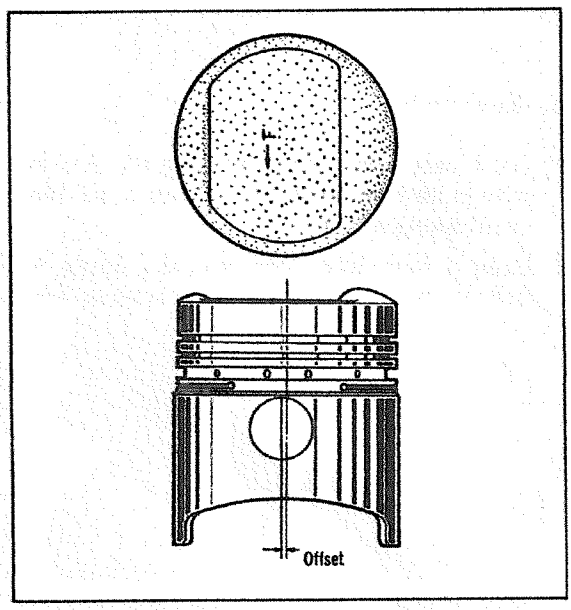


Fig. 18 Shape of Piston

1-3 Timing System

1. The camshaft is of a ductile casting and supported with four bearings. The cam profile has been chill-hardened, forming an ideal curve for high-speed operation.
2. The drive chain is a double-row roller chain. The proper tension is invariably maintained by means of the loose side tensioner and the side guide, which also prevent the chain from vibrating.

2. Disassembly

1. With the flywheel firmly held, loosen the pulley locking bolt by means of a special tool Crankshaft Bolt Wrench MD998063 (ST8041-1). Then remove the crankshaft pulley.
2. Remove the flywheel and then the rear plate.
3. Place the engine upside down. Remove the oil pan, oil screen and oil pump.
4. Remove the timing chain cover. Then remove the loose side tensioner and the tension side guide.
5. Remove the crankshaft spacer.
6. Loosen the camshaft sprocket attaching bolt and pull off the camshaft and crankshaft sprockets with the chain evenly.
7. Remove the camshaft thrust plate washer. Then pull off the camshaft straight so carefully as not to give damage to the bearing.
8. Remove the front plate.
9. With the cylinder block laid sideways, remove each connecting rod cap and push the piston upward out of the cylinder block.

Note: 1. Keep connecting rods and bearings removed, by each assembly so that they may not be confused with each other.

2. To remove the piston, push the rod cap-to-rod jointing surface with a soft tool such as a wooden piece or the like. Do NOT push the bearing surface, otherwise a damaged bearing will result.

10. Disassemble the piston and the connecting rod by the following procedure.
    a. Remove piston rings.
    b. Remove piston pin snap rings.
    c. Using a piston heater, heat the piston up to 40 to 50°C (104 to 122°F). Then pull off the piston pin and remove the connecting rod.

    Note: Piston, piston rings, piston pin and connecting rod should be kept properly by respective rod assembly so that they may not be confused with those of other cylinders.

11. Remove the main bearing caps and the crankshaft.
12. Remove the main bearings and the thrust bearing at No. 1 bearing.

    Note: The removed main bearings should be kept in order so as not to be confused with each other.

3. Inspection

Clean oil, scales, sealing compound, carbon deposits, etc. from each part. Apply blows of compressed air to the oil passage to make certain that the passage is not clogged.

3-1 Cylinder Block

1. Visual Inspection

   Visually check the cylinder block for scratches, rust, and corrosion. Repair or replace the block if it is defective.

2. Correcting the Top of Cylinder Block

   Check block distortion by using a straight edge and a feeler gage in the sequence of A, B, ... If distortion exceeds the repair limit, correct the block.

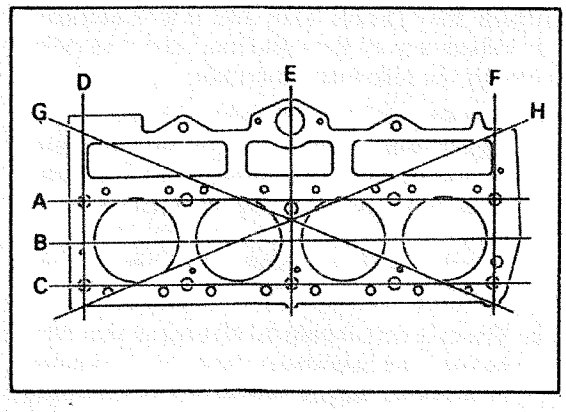


Fig. 19 Distortion Check Points

Description	Standard dimension	Repair limit
Distortion of top of cylinder block	Within 0.05 mm (0.0020 in.)	0.1 mm (0.004 in.)

3. Measuring the Cylinder Bore Size

   Using a cylinder gage, measure the cylinder bore size at four points, in the directions of A and B, as shown in Fig. 20. The difference between the maximum bore and the minimum bore is the amount of bore wear.

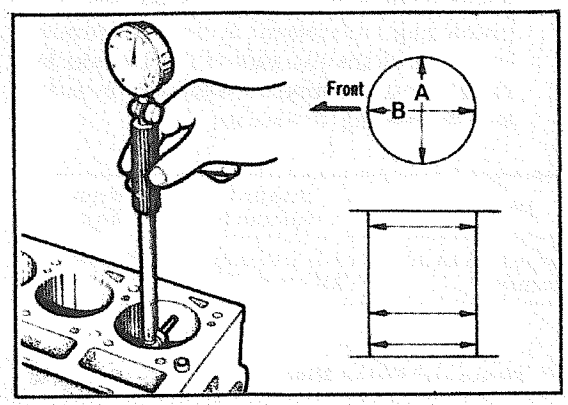


Fig. 20 Checking the Cylinder Bore Size

Description	Repair tolerance	Repair limit	Service limit
Cylinder bore size	85 mm (3.35 in.)	85.2 mm (3.358 in.)	86.2 mm (3.397 in.)
Difference in cylinder bore size	0.02 mm (0.0008 in.) or less		
Variation in bore size among cylinders	0.02 mm (0.0008 in.) or less	0.1 mm (0.004 in.)	

Check the cylinder bore size. If it is necessary to rebore any of the cylinders, rebore all cylinders by the following procedure.

a. Oversize shall be determined based on the largest wear. Check the outside diameter (at the skirt) of the piston across the thrust faces, and true up the cylinder bore by reboring and honing so that the piston-to-cylinder wall clearance will become the standard size.

b. The cylinders should be rebored so that after honing, the roundness, taper, and variation in diameter among cylinders may be within repair tolerances respectively. Honing must be performed to the minimum extent that traces of cutting tools are not present.

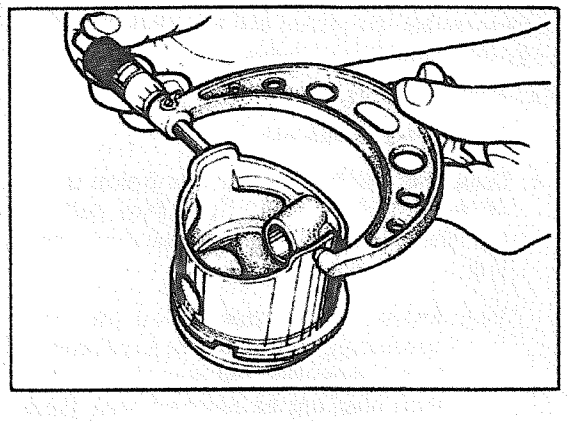


Fig. 21 Checking the Piston O.D.

Piston Oversizes

Size	Size mark	Piston O.D.
O.S. 0.25 mm (0.010 in.)	0.25	85.25 mm ϕ (3.3563 in. ϕ)
O.S. 0.50 mm (0.020 in.)	0.50	85.50 mm ϕ (3.3661 in. ϕ)
O.S. 0.75 mm (0.030 in.)	0.75	85.75 mm ϕ (3.3760 in. ϕ)
O.S. 1.00 mm (0.039 in.)	1.00	86.00 mm ϕ (3.3858 in. ϕ)

Where cylinder bore wear is slight and only piston ring replacement is required, remove step wear at the top part of the cylinder by using a ridge reamer. Finish the cylinder wall by honing if necessary.

Description	Standard dimension	Repair limit
Piston-to-cylinder clearance	0.03 to 0.05 mm (0.0012 to 0.0020 in.)	0.1 mm (0.004 in.)

3-2 Piston and Piston Rings

1. Visual Inspection

   a. Check the piston for seizure, streaks and wear. Replace the piston that is defective.

   b. Replace piston rings if they are broken, damaged or excessively worn or whenever the piston is replaced.

2. Piston Ring Side Clearance

   Check the piston ring side clearance. If the clearance is in excess of the repair limit, insert a new ring in a ring groove and measure the clearance between the ring and the ring groove. If the clearance still exceeds the repair limit, replace the piston. If it is less than the repair limit, replace the piston ring.

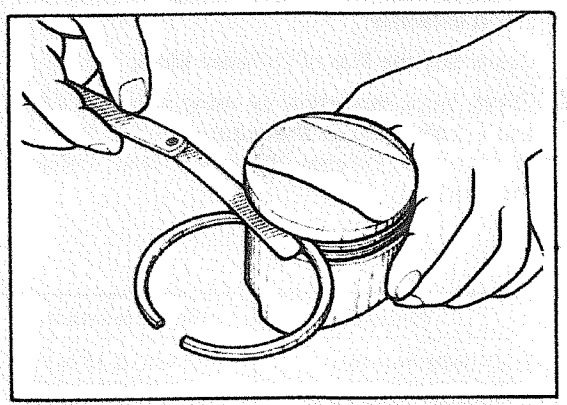


Fig. 22 Checking the Piston Ring Side Clearance

Description		Standard dimension	Repair limit
Piston ring side clearance	No. 1	0.051 to 0.089 mm (0.00201 to 0.00350 in.)	0.2 mm (0.008 in.)
	No. 2	0.035 to 0.078 mm (0.00138 to 0.00307 in.)	0.2 mm (0.008 in.)
	No. 3	0.027 to 0.064 mm (0.00106 to 0.00252 in.)	0.2 mm (0.008 in.)

3. Piston Ring End Gap

To measure the piston ring end gap, insert a piston ring deep into the skirt of the cylinder where bore wear is minimum. Correctly position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Draw the piston up out and then check the gap by using a feeler gage. If the gap exceeds the service limit, replace the piston ring.

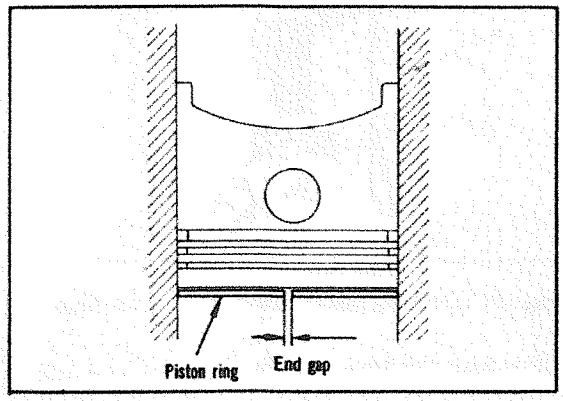


Fig. 23 Checking the Ring End Gap

Description		Standard dimension	Service limit
Piston ring end gap	Nos. 1,2	0.3 to 0.5 mm (0.012 to 0.020 in.)	1.5 mm (0.059 in.)
	No. 3	0.18 to 0.38 mm (0.0071 to 0.0150 in.)	1.5 mm (0.059 in.)

If the measured gap is less than the standard dimension, remove material from the ends of the ring by using a dead smooth-cut file or replace the ring. The filed end must be square.

When replacing a ring, be sure to use a ring of proper size fit to the piston.

Piston Ring Oversizes

Size	Size mark
S.T.D.	85.00
O.S. 0.25 mm (0.010 in.)	85.25
O.S. 0.50 mm (0.020 in.)	85.50
O.S. 0.75 mm (0.030 in.)	85.75
O.S. 1.00 mm (0.039 in.)	86.00

4. Checking Piston Pin-to-Piston Pin Hole Fit

Check the piston pin-to-piston pin hole fit. Replace either part that is defective.

The piston pin must be able to be smoothly pressed by hand into the pin hole of the piston heated to 40 to 50°C (104 to 122°F). When replacing the piston pin, select a pin which can be smoothly pressed by hand into the pin hole of the piston which is heated to 40 to 50°C (104 to 122°F).

3-3 Connecting Rod

1. Checking the Connecting Rod for Bend, Distortion and Damage.

Using a connecting rod aligner, check the connecting rod for bend, distortion and damage. If the rod is bent or distorted over the repair limit, correct the rod by means of a press. Any connecting rod that has been severely bent or distorted should be replaced.

The connecting rod that has a damage on the

thrust faces should be replaced.

Description	Repair limit
Connecting rod bend	0.15 mm (0.0059 in.)

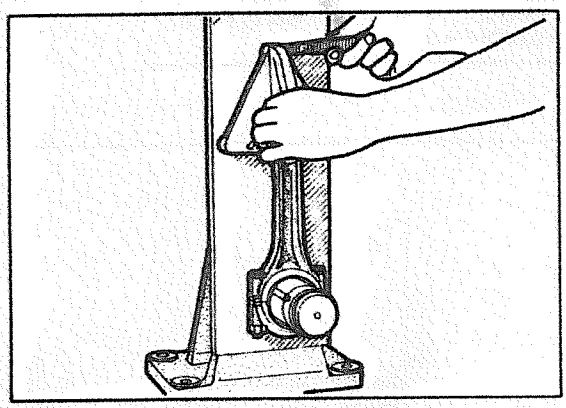


Fig. 24 Checking the Connecting Rod for Bend

2. Checking the Small End Bushing

Check the bushing for wear and damage. If it is worn or damaged, replace it by using a special tool, Connecting Rod Bushing Installer MD998077 (ST8014).

When installing the bushing, align the rod bushing oil hole with the oil hole of the rod.

After the replacement of the bushing, measure the inside diameter of the new bushing. If the inside diameter is smaller than the standard dimension, correct it to the standard size by machining.

Description	Standard dimension
Bushing I.D.	24.005 to 24.015 mm (0.945 to 0.946 in.)

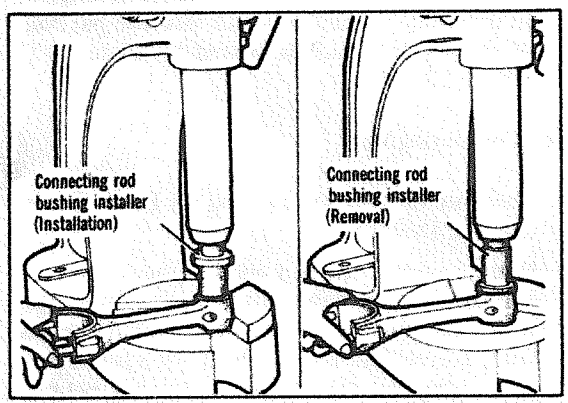


Fig. 25 Installing or Removing the Connecting Rod Small End Bushing

3. Checking the Piston Pin-to-Bushing Fit

Check to see if the piston pin applied with engine oil can be pressed by the thumb into the bushing at room temperature of 20°C (68°F). Replace the pin if it is too loose or too tight.

4. Checking the Connecting Rod Big End End Play

Attach bearings to respective connecting rods. Install each rod assembly to the crankpin. Check the rod big end end play. If the clearance exceeds the service limit, replace the part.

Description	Standard dimension	Service limit
Connecting rod big end end play	0.1 to 0.25 mm (0.004 to 0.0098 in.)	0.4 mm (0.016 in.)

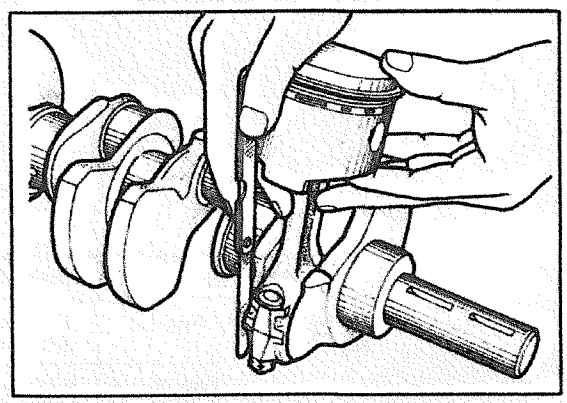


Fig. 26 Checking the Connecting Rod Big End End play

3-4 Crankshaft

Check the crankshaft journals, pins and oil seal contact surface for wear. Also check oil holes for clogging. Correct or replace any defective shaft.

1. Checking the Crankshaft for Bend

If the bend of the crankshaft exceeds the repair limit, correct it to less than the repair tolerance by a press. Replace the shaft if necessary. When the crankshaft journals and pins are to be ground to the undersize, it should be ground after the correction of bend. (Fig. 27)

Description	Standard dimension	Repair limit
Crankshaft bend	Less than 0.03 mm (0.0012 in.)	0.05 mm (0.0020 in.)

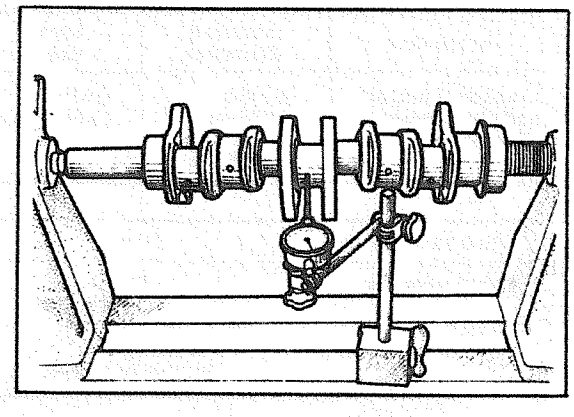


Fig. 27 Checking the Crankshaft for Bend

2. Checking Journals and Pins

Measure the size of the crankshaft journals and pins in the A and B directions at two positions, front and rear, as illustrated in Fig. 28. If they are excessively out of roundness, tapered or worn over the repair limit, grind the parts to the next undersize. Replace the part that has been worn away over the service limit.

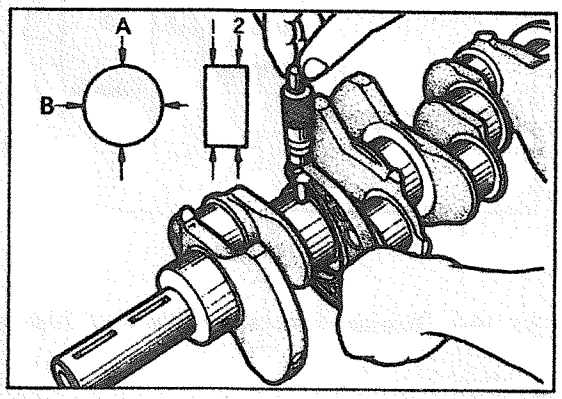


Fig. 28 Crankpin Outside Diameter Check Points

Crankshaft Undersizes

Size	Journal finishing dimension	Pin finishing dimension
U.S. 0.25 mm (0.010 in.)	67.735 to 67.750 mm (2.6667 to 2.6673 in.)	54.735 to 54.750 mm (2.1549 to 2.1555 in.)
U.S. 0.50 mm (0.020 in.)	67.485 to 67.500 mm (2.6569 to 2.6575 in.)	54.485 to 54.500 mm (2.1451 to 2.1457 in.)
U.S. 0.75 mm (0.030 in.)	67.235 to 67.250 mm (2.6470 to 2.6476 in.)	54.235 to 54.250 mm (2.1352 to 2.1358 in.)

Description	Standard dimension	Repair limit	Service limit
Crankshaft journal O.D.	67.985 to 68.00 mm (2.6794 to 2.6800 in.)	–0.15 mm (–0.0059 in.)	–0.9 mm (–0.035 in.)
Out of roundness, and taper	Less than 0.01 mm (0.0004 in.)	0.05mm (0.0020 in.)	
Crankshaft pin O.D.	54.985 to 55.00 mm (2.16941 to 2.1700 in.)	–0.15 mm (–0.0059 in.)	–0.9 mm (–0.035 in.)
Out of roundness, and taper	Less than 0.01 mm (0.0004 in.)	0.05 mm (0.0020 in.)	

When the crankshaft is to be ground to the undersize, each fillet R of the journals and pins should be as follows: (Fig. 29)

Description	Standard dimension
Fillet R	2.5R ± 0.2 mm (0.098R ± 0.008 in.)

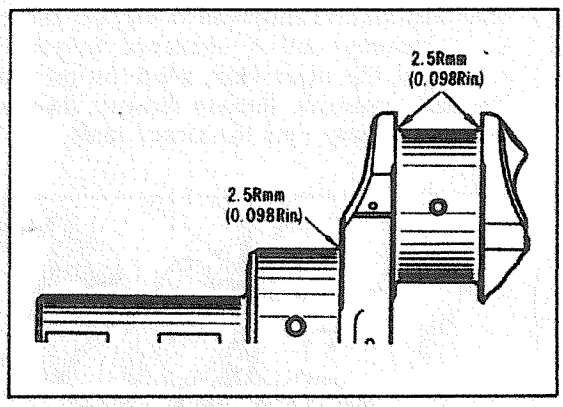


Fig. 29 Fillet R

3-5 Main Bearings and connecting Rod Bearing

1 Visual Inspection

Check the bearings for improper contact, melt and seizure. Replace any defective bearing.

2. Checking the Crankshaft Journal-to-Main Bearing Clearance and Crankshaft Pin-to-Connecting Rod Bearing.

Measure the outside diameter of the crankshaft journals and pin,and the inside diameter of the bearings. If the difference between the journal and pin outside diameter and the bearing inside diameter exceeds the repair limit, replace the bearing. Or where the crankshaft journals and pin are excessively worn, correct the journals and pin to the undersize. In either case, coat the journals and pin with machine blue or red lead, install the bearings to the cylinder block and connecting rod tighten the bearing caps to the specified torque. Where the contact area indicated by machine blue or red lead is more than 75% of the total area, they are in a good condition.

The bearing inside diameter should be measured in the A and B directions at two points, front and rear, as illustrated in Fig. 30.

CAUTION

Do NOT scrape the inner surface of the bearing with a scraper or the like.

Bearing Undersizes

Size	Size mark
U.S. 0.25 mm (0.010 in.)	U.S. 25
U.S. 0.50 mm (0.020 in.)	U.S. 50
U.S. 0.75 mm (0.030 in.)	U.S. 75

Description	Standard dimension	Repair limit
Crankshaft journal and pin-to-bearing clearance	0.038 to 0.073 mm (0.00150 to 0.00287 in.)	0.15 mm (0.0059 in.)

Parts to be tightened	Torque
Main bearing cap	11.5 to 12 kg-m (83.2 to 86.8 ft-lbs.)
Connecting rod cap	5 to 5.5 kg-m (36.2 to 39.8 ft-lbs.)

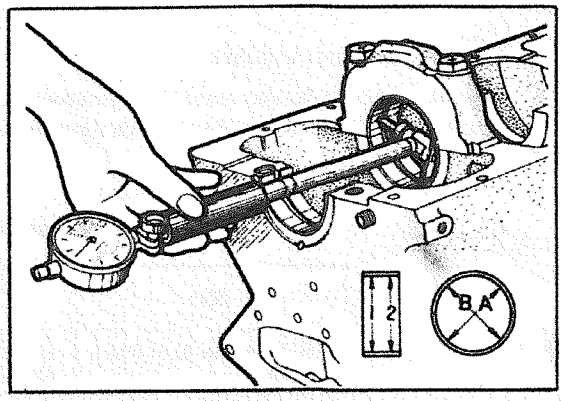


Fig. 30 Checking the Bearing Inside Diameter

3-6 Timing Chain Tensioner and Guide

Make the following inspections and replace any defective parts.

1. Check the timing chain tensioner rubber pad for wear and the spring for deterioration.
2. Check the timing chain guide for wear and damage.

3-7 Timing Sprockets

Check each sprocket for wear and damage. Replace the part if defective.

3-8 Flywheel

1. Check the flywheel friction surface for damage and wear. Correct or replace the flywheel if the surface has been excessively worn or damaged.

Check the friction surface for run-out. Replace the flywheel if the measured value exceeds the service limit.

Description	Standard dimension	Service limit
Flywheel run-out	Less than 0.13 mm (0.0051 in.)	0.2 mm (0.008 in.)

2. Recondition the ring gear by grinding if its teeth are damaged but are still within a repairable range. The ring gear teeth with which the starting motor pinion is meshed are liable to a damage. When assembling, therefore, the ring gear should be installed in a shifted position. Replace the gear that has been damaged on all teeth.

   The ring gear should be replaced at a temperature of 260 to 280°C (500 to 536°F).

3-9 Camshaft

1. If the distributor drive gear has been damaged or excessively worn, replace the camshaft.
2. Check the camshaft for bend. If the bend exceeds the repair limit, correct or replace the camshaft. (Fig. 31)

Description	Standard dimension	Repair limit
Camshaft bend	Less than 0.01 mm (0.0004 in.)	0.025 mm (0.0010 in.)

With a dial indicator set to No. 2 or No. 3 journal, turn the camshaft once and read the maximum indicator reading. A half of the reading equals the amount of bend.

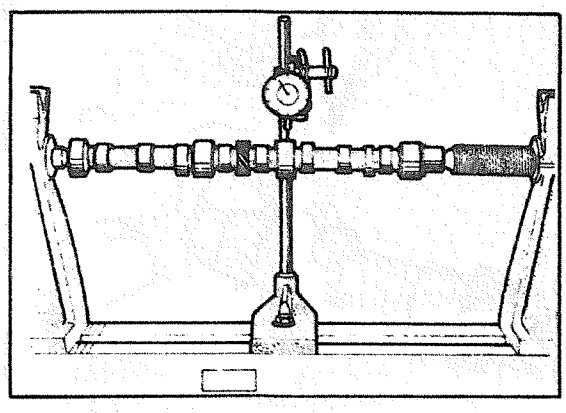


Fig. 31 Checking the Camshaft for Bend

3. Check the camshaft journals for uneven wear and damage. Replace the camshaft if the journals are excessively damaged or worn.

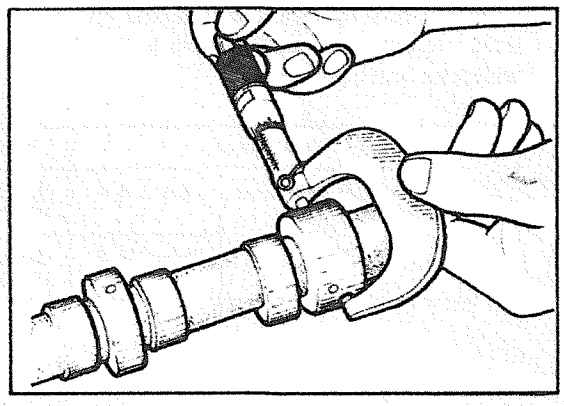


Fig. 32 Checking the Camshaft Journal

Description		Standard dimension	Repair limit	Service limit
Camshaft journal O.D.	No. 1	46.650 to 46.675 mm (1.8370 to 1.8380 in.)		-0.4 mm (-0.016 in.)
	No. 2	46.250 to 46.275 mm (1.8210 to 1.8220 in.)		-0.4 mm (-0.016 in.)
	No. 3	45.150 to 45.175 mm (1.7780 to 1.7790 in.)		-0.4 mm (-0.016 in.)
	No. 4	44.650 to 44.675 mm (1.7580 to 1.7590 in.)		-0.4 mm (-0.016 in.)
Camshaft taper and out of roundness		Less than 0.01 mm (0.0004 in.)	0.05 mm (0.0020 in.)	

4. Check each cam for damage. If the cam profile is severely damaged or worn, replace the camshaft. (Fig. 33)

Description	Standard dimension	Service limit
Camlobe wear (both intake and exhaust)	38.81 mm (1.5279 in.)	-0.5 mm (-0.020 in.)

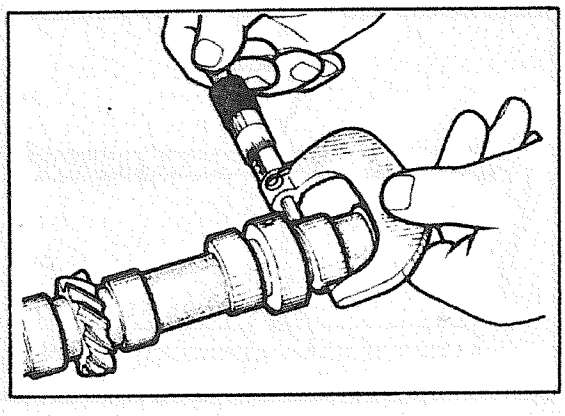


Fig. 33 Checking the Cam Height

3-10 Camshaft Bearings

1. Check the bearings. If any of them is damaged or defectively contacted, or if the camshaft journal-to-bearing clearance exceeds the repair limit, replace the bearing with a standard or undersize bearing.

Measurement of the inside diameter of No. 3 and No. 4 bearings shall be made after the removal of camshaft rear expansion plug.

Measurement of the camshaft bearing inside diameter should be made at two points in the A and B directions.

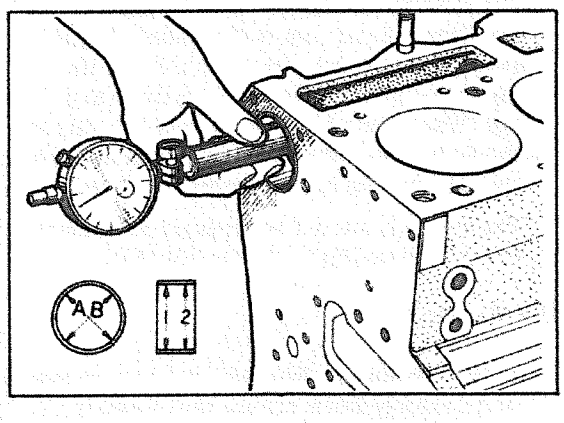


Fig. 34 Checking the Camshaft Bearing I.D.

Description		Standard dimension	Repair limit
Camshaft-to-bearing clearance	Nos. 1 & 4	0.025 to 0.075 mm (0.00098 to 0.00295 in.)	0.15 mm (0.0059 in.)
	Nos. 2 & 3	0.050 to 0.100 mm (0.00197 to 0.00394 in.)	0.20 mm (0.0079 in.)

Camshaft Bearing Undersizes

Bearing size	Journal outside diameter			
	No. 1	No. 2	No. 3	No. 4
U.S. 0.25mm (0.010 in.)	46.400 to 46.425 mm (1.82673 to 1.82773 in.)	46.000 to 46.025 mm (1.81093 to 1.81192 in.)	44.900 to 44.925 mm (1.76773 to 1.76872 in.)	44.400 to 44.425 mm (1.74803 to 1.74902 in.)

2. The camshaft to be replaced can be driven out by means of a special tool, Camshaft Bearing Installer MD 998080 (ST8033-0). A new bearing can be installed by using the same tool.

   Removal and installation of No. 3 and No. 4 bearings should be performed after the removal of the rear expansion plug.

   The new bearing should be installed with oil holes aligned.

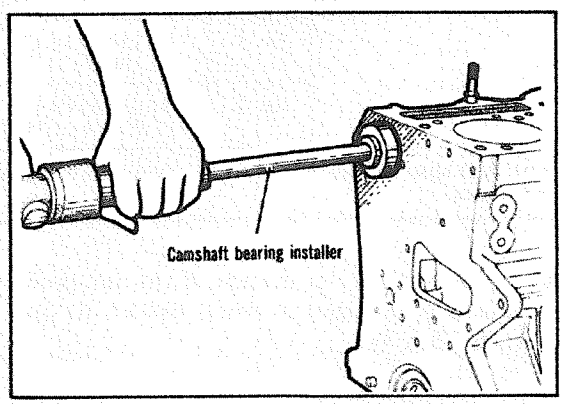


Fig. 35 Installing the Camshaft Bearing

4. Reassembly

When assembling the cylinder block, observe the following items.

- Sufficiently clean parts to be installed. Take a special care to oil holes, bearings, bearing housing, and cylinder wall.
- Replace gaskets and oil seals with new parts.
- Reassembly should be done after applying engine oil to all movable parts.
- Apply a sealer to packings and gaskets as necessary, specially to specified parts.
- Observe the tightening torque and order where specified. Check clearances during tightening.

1. Install main bearings to the cylinder block.

   Install the main bearings, when reused, to the original position before disassembly, with oil holes and dowel pin holes in proper positions, so that the bearings may never be floating.

2. Apply grease to the inner thrust bearing and install to the front, inner wall of the cylinder block with dowel pins registering the pin holes.
3. Insert the rear oil slinger onto the crankshaft after heating to about 80°C (176°F) by an oil heater.

   The oil slinger may be somewhat distorted at installation. If distorted, the slinger must be corrected after insertion by means of a pair of pliers.

4. Install the crankshaft and make certain that it rotates lightly.
5. After the insertion of the rear oil seal, install the bearing caps and then tighten center, No. 2, No. 3, front and rear cap bolts in the written order to the specified torque. Then make certain that the crankshaft rotates lightly.

   Install the cap with the arrow in the top directed forward.

   Apply THREE BOND 4A to the periphery of the oil seal.

Part to be tightened	Torque
Main bearing cap bolt	11.5 to 12 kg-m (83.2 to 86.8 ft-lbs.)

6. Install the outer thrust bearing shim, thrust washer, sprocket, spacer and crankshaft pulley onto the crankshaft. Tighten the crankshaft pulley lock nut to the specified torque. Check the crankshaft end play with the crankshaft pried as far as possible to either end, and adjust the end play by means of adjusting shims.

   Where the end play is still too large even after the removal of the shim, the thrust bearing must be replaced.

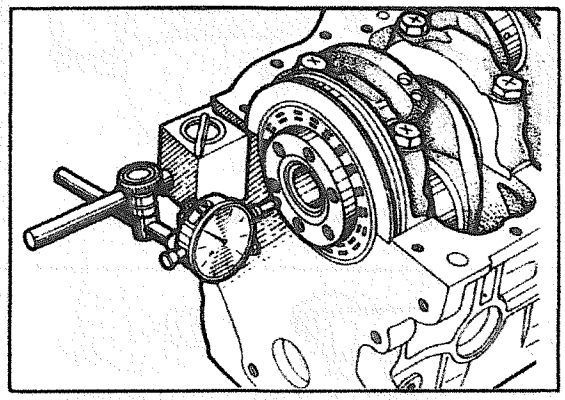


Fig. 36 Check the Crankshaft End Play

Description	Thickness
Adjusting shim	0.05 mm (0.0020 in.)

Description	Standard dimension
Crankshaft end play	0.1 to 0.15 mm (0.004 to 0.0059 in.)

Part to be tightened	Torque
Crankshaft pulley	6.0 to 7.0 kg-m (43.4 to 50.6 ft-lbs.)

7. Assemble the piston, piston pins and connecting rod for each cylinder by the following procedure.
   a. Heat the piston to 40 to 50°C (104 to 122°F) by using a piston heater. Insert the connecting rod into the piston and press the piston pin into the pin hole.

      The piston and the connecting rod should be assembled with "F" mark in the top of the piston and the part number of the rod in the same direction. (Fig. 37)

   b. Install the piston rings.
      The rings should be installed in the proper order.

      The rings should be installed with the size mark and the manufacturer's mark stamped at the ends facing up. (Fig. 38)

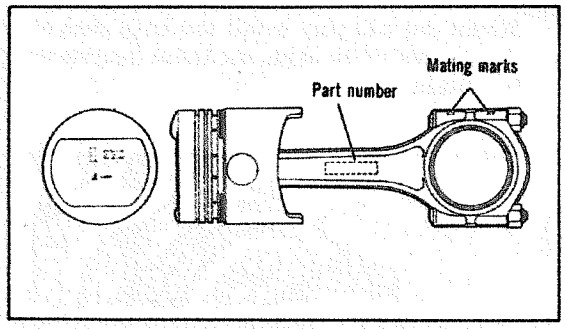


Fig. 37 Piston and Rod Assembly

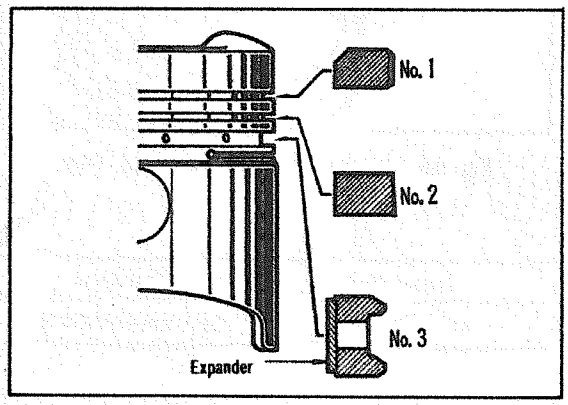


Fig. 38 Piston Ring Identification

8. Install the connecting rod and piston assembly into a proper cylinder, with "F" mark on the piston head directed to the front of the cylinder block. Piston ring ends shall be spaced at three equal spacings. Avoid installing the rings with their openings either in line with the piston pin bosses and the thrust direction. Then tighten the caps to the specified torque.

   The expander should be installed with its end placed on the opposite side of the end of No. 3 ring.

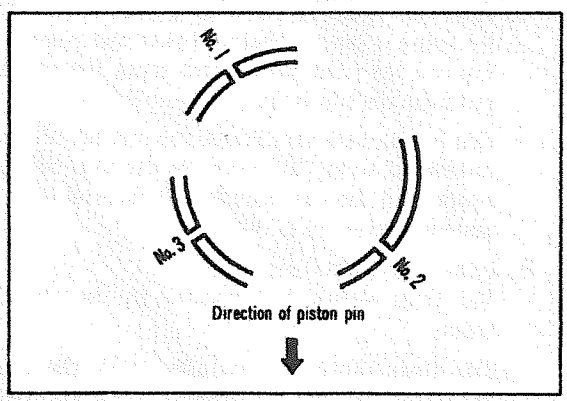


Fig. 39 Piston Ring Gap Position

Install pistons by pairs, i.e., No. 1 and No. 4 and then No. 2 and No. 3, with the mark on the rod aligned with that on the cap (cylinder number). Then recheck the end play.

Before installing the pistons, insert a copper pipe onto the stud so that the crankpin area will not be injured with the stud bolts at the rod end. Use the pipe as a guide for inserting the rod with ease.

Install the nut with the collar directed toward the rod cap.

Part to be tightened	Torque
Connecting rod cap	5 to 5.5 kg-m (36.2 to 39.8 ft-lbs.)

Description	Standard dimension
Connecting rod big end end play	0.1 to 0.25 mm (0.004 to 0.0098 in.)

9. Remove the crankshaft pulley and the spacer sprocket which were previously mounted for the adjustment of crankshaft end play. Install the front and rear plates.

   Note: Apply THREE-BOND 4A to the both sides of the front plate gasket.

10. Install the camshaft with care not to injure the bearings. Install the thrust plate and the spacer, tighten the camshaft to the specified torque. Check the camshaft end play by prying it as far as possible to either end.

    a. When the end play exceeds the repair limit, replace the thrust plate or grind the spacer by means of the surface grinder to correct the end play.

       Note: After end play adjustment, remove the sprocket.

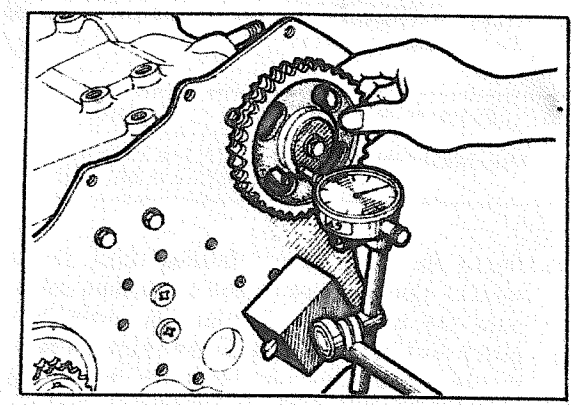


Fig. 40 Checking the Camshaft End Play

Part to be tightened	Torque
Camshaft sprocket	2.0 to 3.0 kg-m (14.5 to 21.7 ft-lbs.)

Description	Standard dimension	Repair limit
Camshaft end play	0.1 to 0.18 mm (0.004 to 0.0071 in.)	0.3 mm (0.012 in.)

11. Installing the Timing Sprockets and Chain
    a. Install the sprocket, at the top dead center of compression stroke of No. 1 cylinder, with the mating mark of the chain aligned with that of the sprocket and with the keyway in line with the key of the shaft.
    b. Tighten the camshaft sprocket to the specified torque.

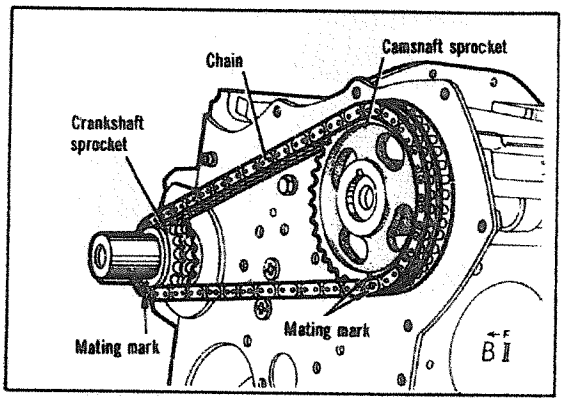


Fig. 41 Installing the Timing Chain

12. Install the tension side guide.
13. Install the loose side tensioner with its wide end up.
14. Attach a gasket to the timing cover after applying a sealer, Herdine F2.
15. Install the timing chain cover gasket after applying THREE-BOND 4A.

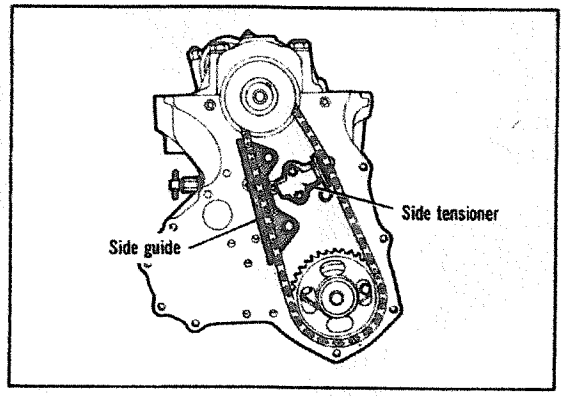


Fig. 42 Installing the Timing Chain Cover

16. With the cylinder block placed upside down, install the oil pump and screen.
17. Apply THREE-BOND 4A to the groove around the lower part of the timing chain case, the groove around the rear bearing cap and the cylinder block. Attach an oil pan gasket in proper position and install the oil pan.

    Tighten the front and rear bolts first. Make sure that the rubber gasket is in firm contact with the oil pan, and then tighten bolts in the criss-cross fashion, starting with one at the end.
18. Install the flywheel, insert a spacer and then install the crankshaft pulley.

Parts to be tightened	Torque
Flywheel	12 to 12.5 kg-m (86.8 to 90.4 ft-lbs.)
Crankshaft pulley	6.0 to 7.0 kg-m (43.4 to 50.6 ft-lbs.)

GROUP 2

ENGINE LUBRICATION

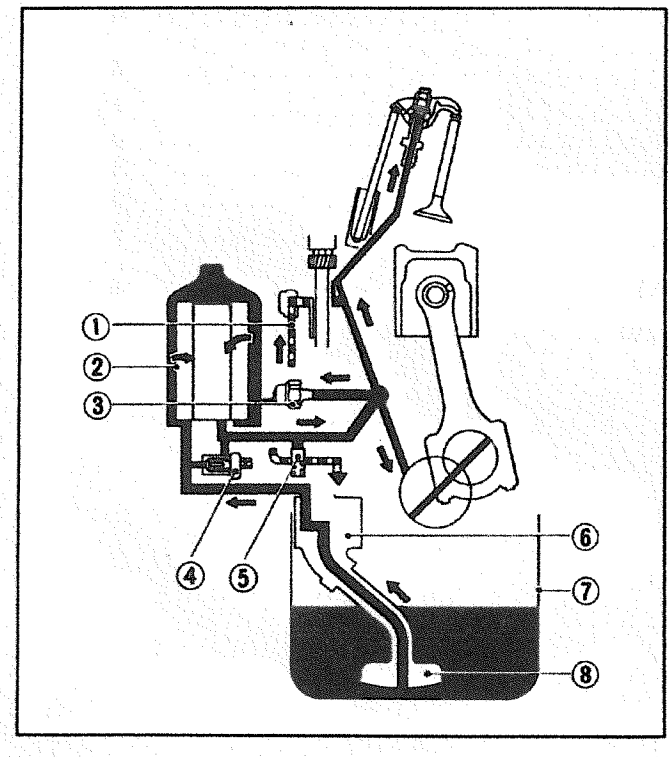
CONTENTS

The lubricating system is a full-force type using a trochoid gear pump fitted with a full-flow oil filter. The lubricating oil from the pump is filtered through the oil filter and is distributed to all parts through oil holes in the cylinder block.

If the oil filter element is fouled and deteriorates in filtering performance, or if the pressure difference between the inlet and outlet of the oil filter increases because of increased engine speed and oil pressure, the oil from the oil pump pushes the bypass alarm switch valve and flows directly into the oil holes without passing through the element. At the same time, operation of the bypass alarm switch lights the pilot lamp. The oil pressure switch is located in the oil path at the rear right of the cylinder block and is connected to the pilot lamp In the Model J52 jeeps, the oil pressure switch is connected by the oil pipe to the oil pressure gage.

Engine Lubrication Specifications

Lubricating method		Full-force type with full-flow oil filter
Oil filter		Filter paper type
Oil pump		Trochoid gear type
Oil pressure switch operating pressure		0.3 ± 0.1 kg/cm² (4.3 ± 1.4 psi) Except Model J52 jeeps
Oil quantity	Oil pan	4.5 lit. (1.2 U.S. gal.)
	Oil filter	0.8 lit. (0.2 U.S. gal.)



(1) Oil supply pipe
(2) Oil filter
(Faced down in Rosa)
(3) Oil pressure switch
(Not used in Model J52 jeep)
(4) Bypass alarm switch
(5) Oil relief valve
(6) Oil pump
(7) Oil pan
(8) Oil screen

Fig. 1 Engine Lubrication Construction

1. Oil

Using the engine oil is higher than Class MS and replace it every 4,000 km (2,400 miles).

Oil Classification by Atmospheric Temperature

Below 0°C (32°F)	SAE 10W-30
-10 to 10°C (14 to 50°F)	SAE 20W
0 to 40°C (32 to 104°F)	SAE 30
Above 30°C (86°F)	SAE 40

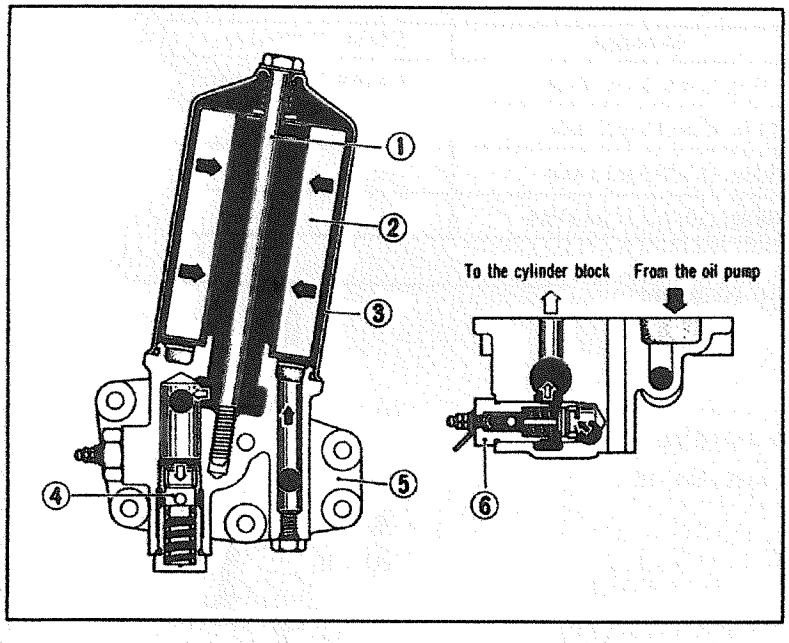
2. Checking and Resupplying Engine Oil

The oil in the oil pan should always be maintained near the upper limit of the oblique lines of the level gage by resupplying the same type of oil as the working oil.

When the oil is cold, check the oil level approx. one minute after inserting the gage.

SECTION 1. OIL FILTER

The oil filter is of the separate type and is located at the rear right of the cylinder block. It uses a high performance element made of special filter paper. When the oil pressure is too low because of oil shortage or clogged element, the oil does not pass through the element but flows directly into the engine through the functioning of the bypass valve. At the same time, the alarm switch is operated and the pilot lamp lighted to warn the driver. If the oil pressure in the engine drops to 6.0±0.3 kg/cm^2 (85.3±4.3 psi), the relief valve is operated to supply oil directly into the engine.



(1) Center bolt
(2) Element
(3) Body
(4) Relief valve
(5) Block
(6) Bypass alarm switch

Fig. 2 Oil Filter Construction (Faced down in Rosa)

1. Removal

1. Remove the oil pipe linking the oil filter and cylinder block and then loosen the filter block tightening bolts and remove the filter assembly.
2. When you take out the element alone, remove the top center bolt and remove the element together with the body.

2. Inspection

1. Clean all the parts fully and blow air through the oil path to make sure that there is nothing hindering the flow of oil.
2. Check the "O" ring, body, alarm switch and center bolt for damage at the time of disassembly.

Alarm switch operating oil pressure	1.2 to 1.6 kg/cm² (17.1 to 22.8 psi)
	1.6 to 2.0 kg/cm² (22.8 to 24.4 psi)
Relief valve operating pressure	5.7 to 6.3 kg/cm² (81.0 to 89.6 psi)

Replace the filter element every 4,000 km (2,400 miles) and clean the interior of the body.

3. Installation

1. Reverse the removal procedures.
   The tightening torque, however, shall comply with the table below.

Description	Torque
Center bolt	2.3 to 2.7 kg-m (16.6 to 19.5 ft-lbs.)
Bypass alarm switch	2.0 to 2.5 kg-m (14.5 to 18.1 ft-lbs.)
Relief valve	3.0 to 4.0 kg-m (21.7 to 28.9 ft-lbs.)

SECTION 2. OIL PUMP

The oil pump is a highly durable trochoid gear type pump which is driven through a distributor from the camshaft.

Oil Pump Specifications

Pump speed	Discharge	Discharge pressure
500 rpm	7 lit. (1.8 U.S. gal.)/min	6 kg/cm² (85.3 psi)
1,500 rpm	22 lit. (5.8 U.S.gal.)/min	
2,000 rpm	30 lit. (5.9 U.S.gal.)/min.	
2,500 rpm	38 lit. (10.0 U.S. gal.)/min	

Relief valve operating pressure 8 to 10 kg/cm² (113.8 to 142.2 psi) (2,500 rpm).

1. Removal

1. Draw off the engine oil and remove the oil pan.
2. Remove the oil pump together with the oil screen.

2. Installation

Reverse the removal procedures.

3. Disassembly

1. Remove the cover bolt and disassemble it into the oil pump body (1), cover (4), inner rotor (2) and outer rotor (3).
2. Pull out the cotter pin of the body and remove the relief valve (5) and spring (6).

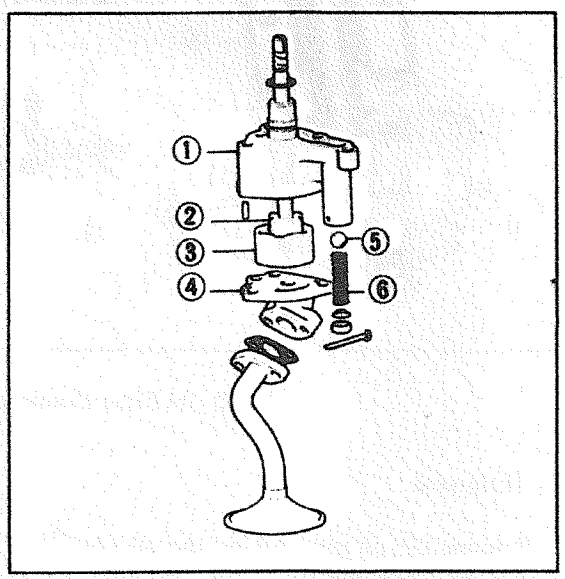


Fig. 3 Oil Pump Parts

4. Inspection

Clean and check all the parts as follows.

1. Checking the Rotor Shaft

Measure the outside diameter of the shaft. Replace if excessively worn or damaged.

Description	Standard dimensions	Service limit
Outside diameter of shaft	12.435 to 12.446 mm (0.48957 to 0.49043 in.)	
Clearance between shaft and cylinder block	0.032 to 0.070 mm (0.00126 to 0.00276 in.)	0.15 mm (0.0059 in.)
Clearance between shaft and pump body	0.036 to 0.065 mm (0.00142 to 0.00256 in.)	0.12 mm (0.0047 in.)

2. Checking the Rotor Clearance

Measure the clearance between the inner rotor and outer rotor. Replace both rotors if the clearance is over the service limit.

Description	Standard dimension	Service limit
Clearance between inner rotor and outer rotor	0.09 to 0.2mm (0.0035 to 0.008 in.)	0.25mm (0.0098 in.)

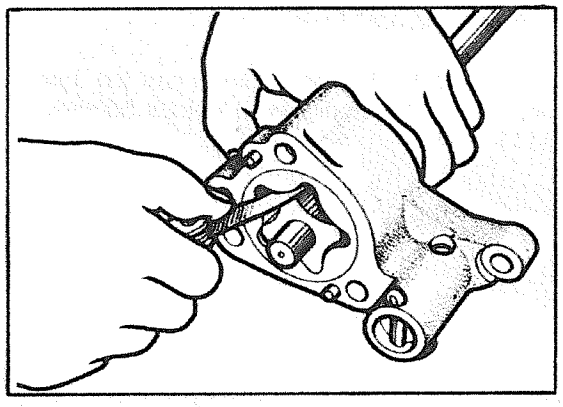


Fig. 4 Measuring the Clearance between the Inner and Outer Rotors

3. Adjusting the End Play between the Rotor and Cover

Measure the end play between the rotor and cover. Replace the rotor or cover if the end play is over the service limit.

Description	Standard dimension	Service limit
End play between rotor and cover	0.05 to 0.10mm (0.0020 to 0.0039 in.)	0.15mm (0.0059 in.)

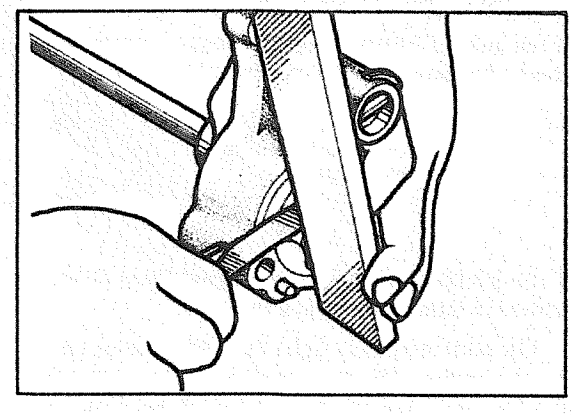


Fig. 5 Measuring the Rotor Side End Play

4. Checking the Clearance between the Outer Rotor and Body

Measure the clearance between the outer rotor and body. Replace if the clearance is over the service limit.

Description	Standard dimension	Service limit
Clearance between outer rotor and body	0.1 to 0.17mm (0.004to 0.0067 in.)	0.3mm (0.012 in.)

5. Checking the Relief Valve

Check that the steel ball is sliding smoothly, and check the oil path for damage. Replace if defective. In addition, check the valve spring for damage or wear, and replace it if defective.

Description	Standard dimension	Service limit
Free length	42.7mm (1.681in.)	
Load	12kg/34.5mm (26.5lbs./1.358in.)	10 kg (22.1lbs.)

6. Checking the Oil Screen

Replace the oil screen if cracked or damaged.

5. Reassembly

Reverse the disassembly procedures.

SECTION 3. OIL PRESSURE SWITCH
(not used Model J52 Jeep)

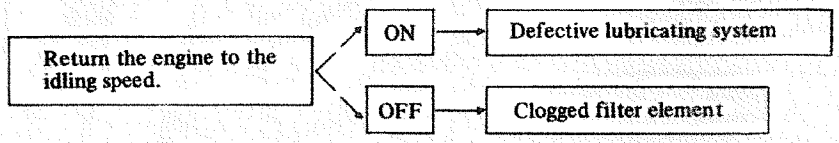
The oil pressure switch is located at the rear right of the engine. If the oil pressure of the lubricating system drops below 0.3 kg/cm^2 (4.3 psi) during a trip, this switch is operated and the pilot lamp lighted to warn the driver.

If the lamp is lighted, stop the engine immediately, check the cause, and take corrective actions.

The pilot lamp lights when:

* The oil pressure drops below 0.3 kg/cm^2 (4.3 psi).
* The filter element is clogged and the bypass alarm switch valve opened.

If the pilot lamp goes on during a trip.



If the probable cause is the clogged filter element, replace it immediately by a new one.

The pilot lamp may light for a while after cranking the engine. The lamp will be put out when the pressure and temperature of oil lubricating the interior of the engine rise. Even if the pilot lamp lights for a while after cranking the engine and until the water temperature rises, therefore, it means nothing wrong.

1. Removal and Installation

For removal and installation, use the special tool, the oil pressure switch wrench MD998012 (ST15044-1).

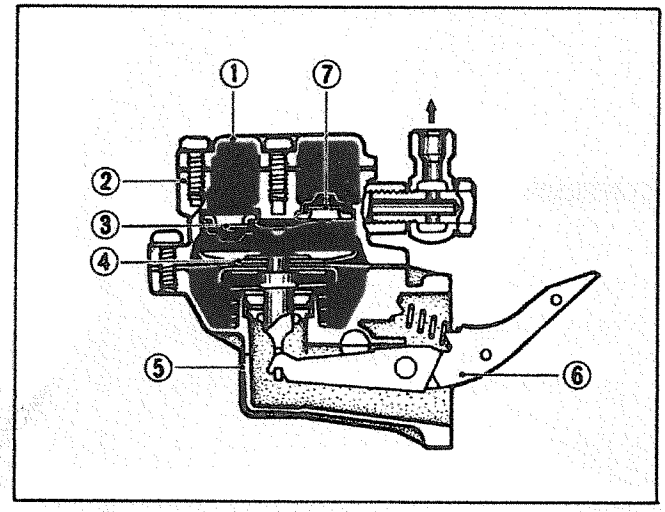
GROUP 3

FUEL SYSTEM

CONTENTS

SECTION 1. FUEL PUMP

The fuel pump is of a mechanical diaphragm type and is driven by the eccentric cam of the camshaft.



(1) Cover
(2) Upper body
(3) Inlet valve
(4) Diaphragm
(5) Lower body
(6) Rocker arm
(7) Outlet valve

Fig. 1 Fuel Pump Construction

Pump Performance

Camshaft speed	2,500 rpm
Delivery pressure (with outlet valve fully closed)	0.2 to 0.3 kg/cm² (2.8 to 4.3 psi)
Delivery (fully opened)	Over 1.8 lit. (0.5 U.S. gal.)/min
Suction pressure (with inlet valve fully closed)	Over 400 mmHg (15.7 in.Hg)

1. Removal

1. Disconnect the fuel pipes at both the inlet and outlet sides.
2. Bend up lock washers. Remove the fuel pump by loosening bolts.

2. Inspection

1. Performance Test by Tester

   Using a compression gage or a vacuum gage, check the delivery pressure and the suction pressure. If the pressures do not satisfy the pump performance standard, check each part of the fuel pump. Correct any defective part.
2. Check the disassembled diaphragm for cracks, damages and deterioration.
3. Check each valve seat for wear, damages and broken spring.
4. Check the frictional surfaces of the rocker arms and the camshaft for wear.

3. Installation

Installation can be done by the reverse order of removal.

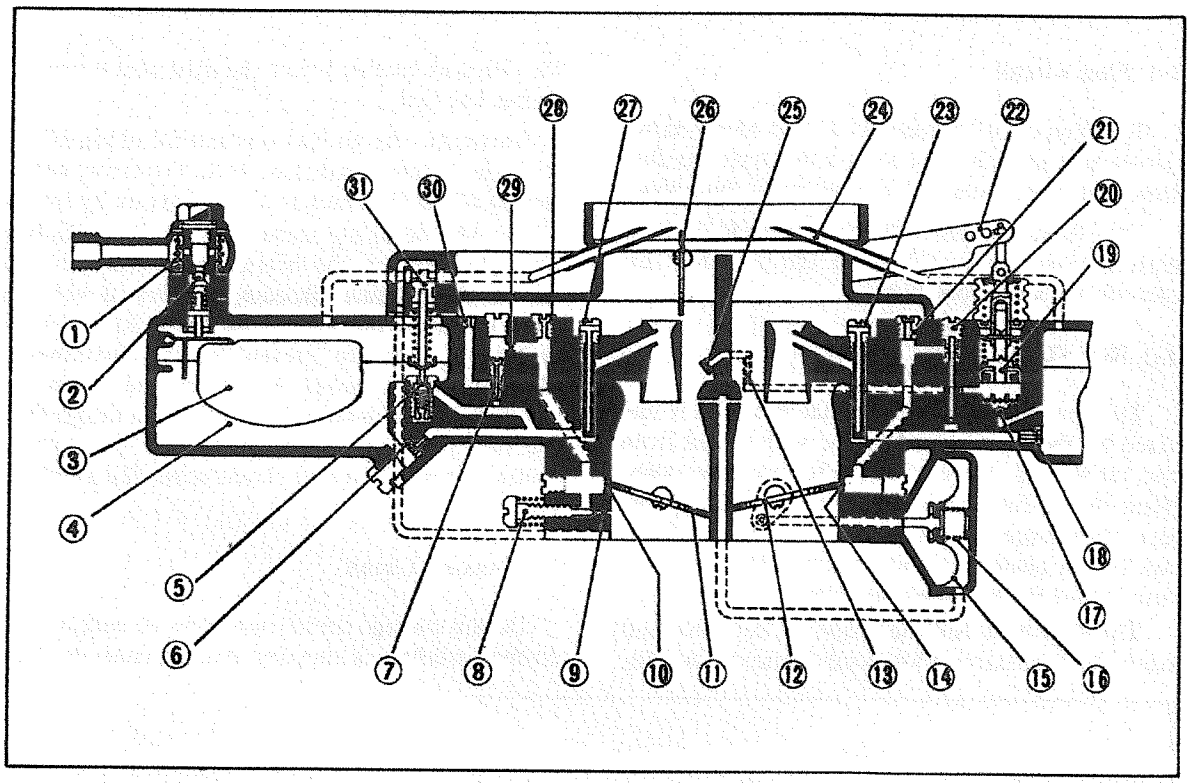
The gasket to be used shall be a new one and coated with the adhesive, THREE-BOND 4A, when it is installed.

After installation, make certain that neither fuel nor engine oil is leaked.

SECTION 2. CARBURETOR

1. Construction

The carburetor employed is a two-stage, double throw carburetor. At normal operating speeds, the primary side with a small-bore venturi is used for fuel economy and improved accelerability. But when the throttle valve is fully opened to supply additional quantities of fuel for acceleration or for full-throttle operation, the secondary side also is operated to supply the mixture in cooperation with the primary side.



(1) Strainer
(2) Float valve
(3) Float
(4) Float chamber
(5) Power valve
(6) Primary main jet
(7) Slow jet
(8) Idle adjusting screw
(9) Idle port
(10) Slow port
(11) Primary throttle valve
(12) Secondary throttle valve
(13) Discharge check valve
(14) Step port
(15) Diaphragm
(16) Diaphragm spring
(17) Inlet check valve
(18) Secondary main jet
(19) Accelerator pump piston
(20) Step jet
(21) Step air bleed
(22) Pump arm
(23) Secondary main air bleed
(24) Air vent
(25) Accelerator pump nozzle
(26) Choke valve
(27) Primary main air bleed
(28) Slow air bleed
(29) Slow economizer
(30) Primary slow air bleed
(31) Power piston

Fig. 2 Carburetor Construction

Carburetor Specifications

Description			Primary side	Secondary side
Jet bore size	Main jet	Canter	0.98 mm (0.0386 in.)	1.45 mm (0.0571 in.)
		Rosa	0.98 mm (0.0386 in.)	1.55 mm (0.0610 in.)
		Jeep	0.90 mm (0.0354 in.)	1.50 mm (0.0590 in.)
	Slow jet	Canter	0.48 mm (0.0189 in.)	0.80 mm (0.0315 in.)
		Rosa	0.48 mm (0.0189 in.)	0.80 mm (0.0315 in.)
		Jeep	0.50 mm (0.0196 in.)	0.80 mm (0.0315 in.)

1-1 Float Circuit

The float circuit consists of a float needle valve, needle seat and float to always maintain the fuel from the fuel pump at a prescribed fuel level.

The float chamber side wall is made of hard glass so that the fuel level in the chamber can directly be seen from outside.

1-2 Slow Circuit

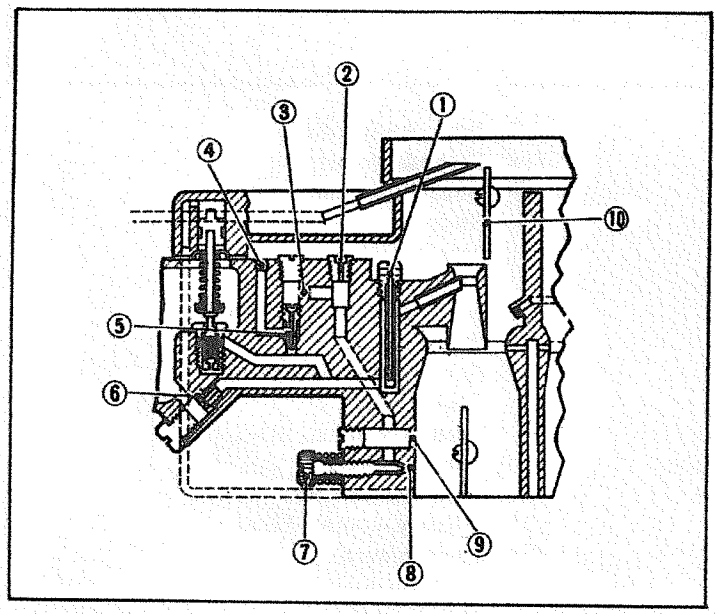
The fuel past the primary side main jet is metered by the slow jet and mixed with the air from the 1st slow air bleed jet into a form of fine mists. Then the air-fuel mixture is metered again by the slow economizer jet and mixed with the air from the 2nd air bleed jet, finally reaching the slow port from which the mixture is emitted.

The slow port has the shape of key hole and emits the fuel during a low-load operation. At idle, the idle port located below the slow port is used to deliver the fuel.

Generally, the air-fuel mixture for idling differs with the engine condition. It is, therefore, necessary to adjust the amount of the mixture by means of the idle adjusting screw. Turn in the adjusting screw to lean out the mixture and back it off to richen the mixture. Besides, a solenoid valve is used to close the fuel passageway to the slow system in order to prevent engine overrunning likely to occur when an overheated engine is stopped. The solenoid valve is of such a design that the fuel passageway is opened when the starting switch is turned on and closed when the switch is turned off.

1-3 Primary Circuit

During average speed operation of vehicle, the air-fuel mixture is supplied mainly from the pri-



(1) Primary main air bleed
(2) Slow air bleed
(3) Slow economizer
(4) Primary slow air bleed
(5) Slow jet
(6) Primary main jet
(7) Idle adjusting screw
(8) Idle port
(9) Slow port
(10) Choke valve

Fig. 3 Primary Circuit

mary side; therefore the fuel economy depends on this system.

The fuel is metered by the main jet located at the bottom of the float chamber, mixed with the air by means of the main air bleed located in the small venturi and jetted out from the main nozzle.

Fuel emission begins at the throttle valve opening of about 10°. This circuit, together with the main air bleed, improves engine accelerability with an extremely small amount of fuel delivered from the accelerator pump.

1-4 Secondary Circuit

Switching from the primary side to the secondary side is done by means of the diaphragm which is actuated with a venturi vacuum. For this purpose, a 1.5 mm (0.059 in.) diameter vacuum suction port is made in the throat of the primary venturi and a 1.2 mm (0.047 in.) diameter vacuum suction port in the throat of the secondary venturi. These ports are open to the outside of the diaphragm by means of a vacuum passage.

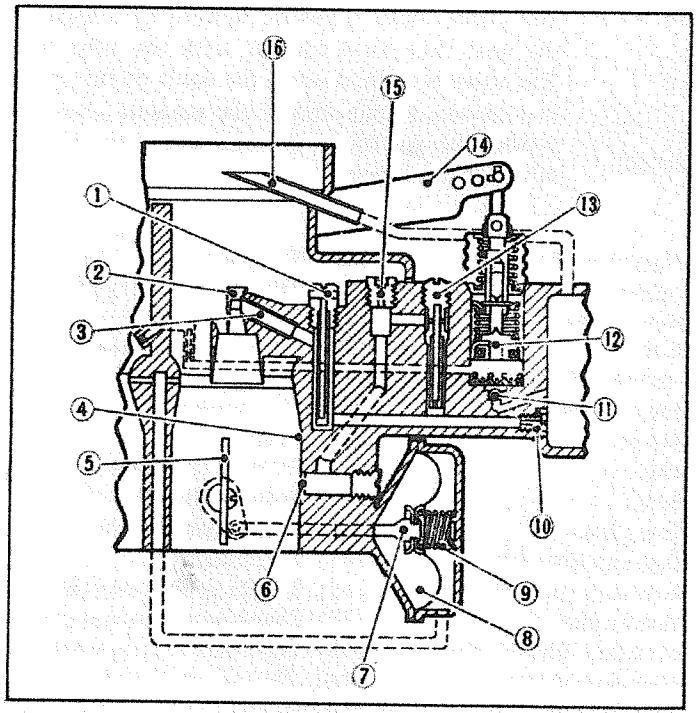
The diaphragm, made of an oil-resisting rubber with soft nylon, is secured at the periphery to the diaphragm case. At its central part is installed a rod. The other end of this rod is attached to the lever on the secondary valve shaft.

The secondary throttle valve shaft is installed in an offset manner; therefore when a vacuum acts under the throttle valve, the valve is operated toward closing. The periphery of this valve is in firm contact with the bore wall. The secondary side does not operate in this stage.

The primary side throttle valve shaft is located at the center of the bore and moved by the throttle lever which is interlocked with the accelerator pedal. As the primary throttle valve is gradually opened to increase the amount of suction air, the venturi vacuum also increases. But since no air flows into the secondary venturi, the venturi pressure will hardly decrease. The vacuum acting on the diaphragm is the total of the primary and secondary venturi vacuums. Until the secondary throttle valve operates, the secondary venturi vacuum outlet functions as a kind of air bleed to decrease the primary venturi vacuum.

On the vacuum side of the diaphragm is installed a diaphragm spring, by which the diaphragm is held from moving until the vacuum reaches a prescribed amount. As the primary throttle valve is opened further to admit the flow of a great deal of air, the vacuum acting on the diaphragm gradually increases to pull the diaphragm further outward. Thus the secondary throttle valve is opened little by little, finally reaching its wide-open position.

During average speed operation, the primary side only is used. It is not necessary to operate the secondary side up to the throttle valve opening of about 50°; therefore the secondary throttle valve



(1) Secondary main air bleed
(2) Secondary small venturi
(3) Secondary main nozzle
(4) Secondary large venturi
(5) Secondary throttle valve
(6) Step port
(7) Diaphragm rod
(8) Diaphragm
(9) Diaphragm spring
(10) Secondary main jet
(11) Inlet check valve
(12) Accelerator pump piston
(13) Step jet
(14) Pump arm
(15) Step air bleed
(16) Air vent

Fig. 4 Secondary Circuit

is kept closed by means of a cam mechanism.

This cam mechanism is installed on the opposite side of the carburetor float chamber. The secondary throttle arm pin calked to the secondary throttle valve shaft is in contact with the cam on the primary side throttle arm, thus holding the secondary throttle valve shaft from moving.

When the primary throttle valve has opened more than 50°, the cam is released from the pin and becomes freely movable with the diaphragm vacuum.

Subsequently, when the primary throttle valve is closed from a wide-open position, the secondary throttle valve arm pin is raised by the cam installed on the primary throttle valve arm, closing the secondary throttle valve. Thus the manifold vacuum grows larger to fully close the valve to ensure smooth reduction of engine speeds.

Switching from the primary side to the secondary side is performed as described above. The second throttle valve that began to be opened with the suction air is in a considerably widely opened position when the main fuel is jetted out. For controlling the amount of the air-fuel mixture during this period, a step port is installed near the forward end of the throttle valve.

Part of the fuel is branched off from the main system after passing through the secondary main jet, metered by the step jet, atomized with the air from the step air bleed and jetted out from the step port.

1-5 Power Circuit

When the engine is running at a constant speed, the relationship between the manifold vacuum and the throttle valve opening is as shown by a hyperbola.

When load increases irrespective of the throttle valve opening and the engine speed until the manifold pressure rises, the power valve is opened to deliver additional quantities of air-fuel mixture to prevent engine knocking and further to obtain a greater output power even when the throttle valve is in slightly opened position.

This power valve is located at the center of the float chamber. Just above the valve is a push rod which is interlocked with the piston. To the top of the piston is led a manifold vacuum from under the throttle valve. While this vacuum is higher than 120 to 140 mm (4.72 to 5.51 in.) of mercury column, the push rod is held in up position against the force of the piston spring installed on the push rod. However, when the vacuum drops to 60 to 90 mm (2.36 to 3.54 in.)of mercury column, the push rod pushes the end of the power valve with its end, thus the power valve being opened.

The power valve is of such construction that when the rod-like valve is pushed, the fuel flows in through a gap at the valve seat, is metered by a 0.65 mm (0.0256 in.) diameter hole located at the valve seat, and then goes through the passage of the power valve, finally flowing out into the vertical fuel passage of the main system at which the main air bleed emulsion hole pipe is provided. The power valve is pushed upward by a spring in the seat into firm contact with the valve seat. The valve is opened when the force of this spring is overcome by the sum of the pressure above the piston, the gravity of the piston, and the tension of the piston spring.

Key to Fig. 4

(1) Choke valve shaft
(2) Choke valve
(3) Air horn
(4) Choke wire bracket
(5) Throttle return screw
(6) Accelerator pump arm
(7) Strainer
(8) Float valve seat
(9) Needle valve
(10) Packing
(11) Power valve
(12) Power valve jet
(13) Accelerator pump
(14) Inlet check valve
(15) Secondary main air bleed
(16) Secondary small venturi
(17) Primary air bleed
(18) Primary small venturi
(19) Solenoid valve
(20) Slow air bleed
(21) Slow jet
(22) Discharge check valve
(23) Step air bleed
(24) Step jet
(25) Body
(26) Float
(27) Float glass
(28) Float chamber sash
(29) Secondary main jet
(30) Primary main jet
(31) Secondary throttle shaft
(32) Secondary throttle
(33) Throttle lever
(34) Throttle shaft arm
(35) Starting throttle lever
(36) Throttle adjusting screw
(37) Pump connecting rod
(38) Idle adjusting screw
(39) Spring
(40) Idle stopper
(41) Flange
(42) Primary throttle shaft
(43) Primary throttle valve
(44) Diaphragm chamber
(45) Diaphragm
(46) Diaphragm spring (outer)
(47) Diaphragm chamber cover
(48) Diaphragm spring (inner)
(49) Throttle shaft lever
(50) Spacer
(51) Heat insulator gasket

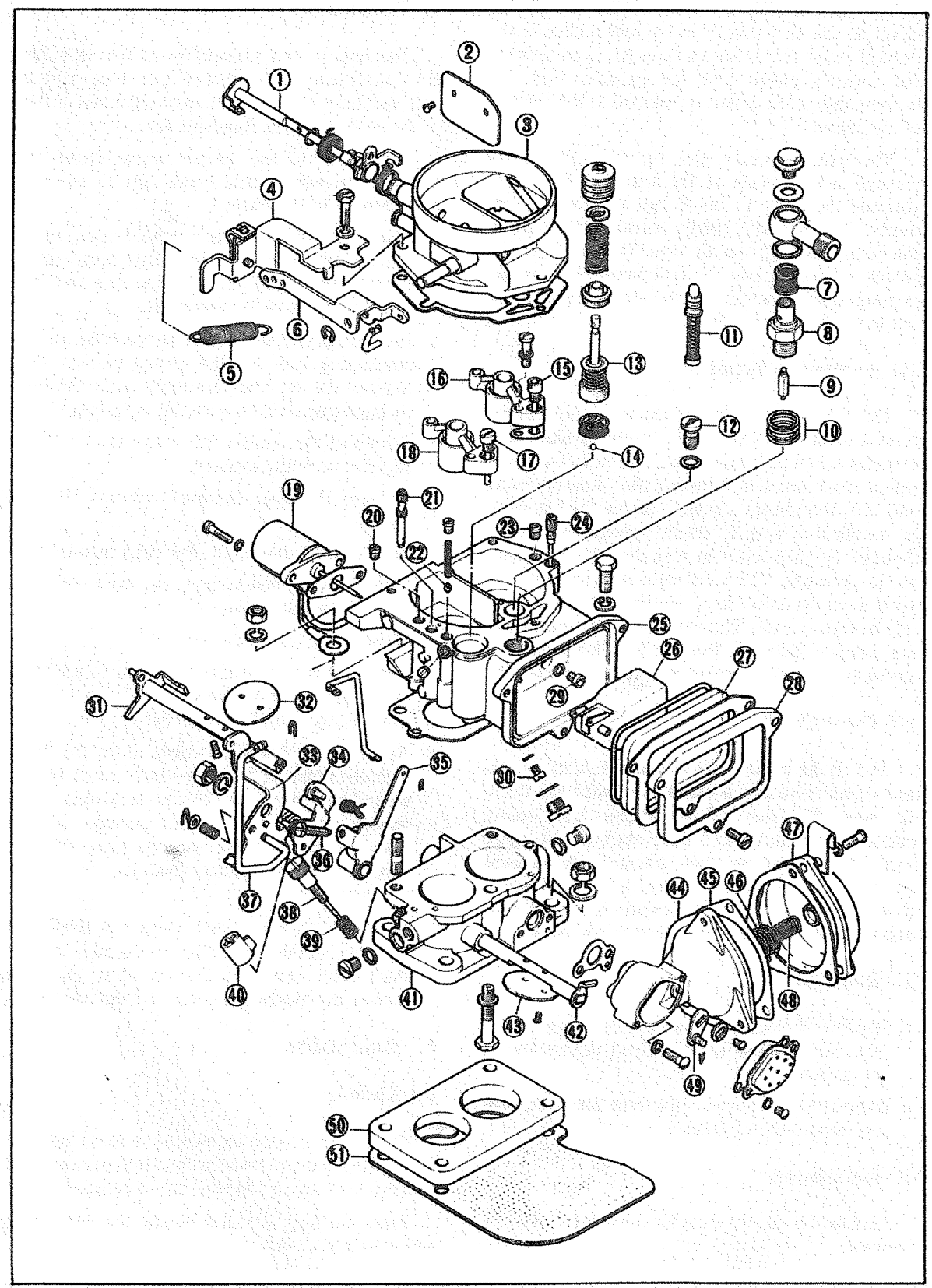


Fig. 5 Disassembly of the Carburetor

The suction pressure of the engine will give an effect to the air pressure on the fuel surface in the float chamber if it is leaked through a gap between the vacuum piston and the cylinder wall. To prevent this, a felt gasket is installed at the bottom of the piston.

The vacuum under the throttle valve flows through a hole made at the center of the screw securing the body to the flange and further goes upward to the body, finally reaching space above the piston through the air horn. The fuel from the power valve goes into the fuel passageway on the primary side, is metered by the main jet and jetted out from the main nozzle.

1-6 Acceleration Circuit

The inlet check valve of the accelerator pump is of a steel ball type. The bottom of the piston cylinder serves as a valve seat. The outlet valve is a nylon valve installed between the pump cylinder and the accelerator nozzle. Above the ball valve is installed a weight, which prevents an excess amount of fuel from leaking during a constant-speed operation. The accelerator pump piston is of such a construction as a leather stretched from inside with springs. The piston and the piston rod are integral. Between them is installed a damper spring to prevent a sudden shut-off of fuel supply.

1-7 Choke Circuit

The choke circuit uses a semi-automatic eccentric choke valve and is interlocked with the throttle valve. The duty of this circuit is to deliver additional quantities of fuel to start a cold engine easily during cold weather. When the driver pulls out the choke button, the throttle valve is opened to a position in which the engine is started with ease without the help of the accelerator pump.

2. Removal

1. Remove the air horn, accelerator ring, choke wire, fuel pipe and vacuum pipe from the top of the carburetor.
2. Subsequently remove carburetor attaching nuts and remove the carburetor.

3. Installation

Installation can be done by the reverse order of removal.

4. Disassembly

Disassembly and reassembly of the carburetor for Canter only are described here. Note that the link and lever of this carburetor differ from those of the carburetor for Rosa and Jeep.

Remember to use proper screw drivers and wrenches to remove and install jets so as not to give damage to the parts.

1. After the removal of the solenoid valve, remove the throttle lever, throttle shaft arm, starting throttle lever and pump connecting rod from the primary throttle valve shaft.
2. Disconnect the accelerator pump lever and the connecting rod of the pump piston. Then remove the air horn assembly from the body by loosening air horn assembly attaching screws.
3. Subsequently remove the fuel pipe connector together with the strainer.
4. Remove the float chamber sash and then the glass.
5. Then gently draw out the float toward you.

   Note: Use care not to drop the float collar and the needle valve.
6. Remove the float valve seat.
7. Remove screws attaching the body to the flange and remove the flange. (One of the screws is installed from under the flange.)
8. Remove the following parts from the body: Primary main air bleed, primary small venturi, secondary main air bleed, secondary small venturi, power valve, main passage, primary main jet, pump valve, passage plug, slow jet, slow air bleed, secondary main jet, step jet, and step air bleed.
9. Remove the dust cover from the diaphragm chamber. Disconnect the secondary throttle shaft lever from the throttle shaft and then remove the diaphragm cover and the diaphragm.

5. Reassembly

5-1 Cleaning

Every part should be washed in clean gasoline. Particularly narrow areas such as fuel passages shall be cleaned of dirt by application of compressed air.

When cleaning jets and bleeds, do avoid using metal such as a wire.

5-2 Inspection

Inspect the following parts. Repair or replace the part that is defective.

1. Check the needle valve of the float for wear and the valve seat for contact. If they are defective, replace both of them as a set.
2. Check the inlet strainer for clogging and damage.
3. Check jets for clogging and damage.
4. Check the power valve for evidence of leakage and operating condition.
5. Check the pump piston for movement and the leather for turn-ups and deterioration.
6. Check the accelerator pump check ball for leakage and rust.
7. Check the idle adjusting screw for presence of damage in the seat contacting area.
8. Check the throttle valve and throttle shaft for wear.
9. Check the linkage for presence of any defect.
10. Check the interior of the float chamber for corrosion.

5-3 Reassembly

Reassembly can be done by reversing the order of disassembly. When reassembling, observe the following items.

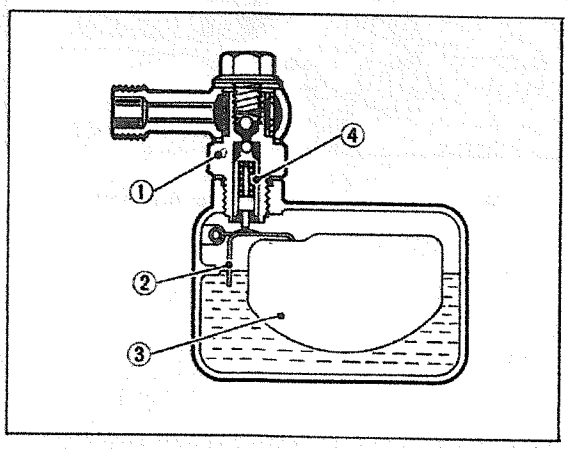
When installing nuts and screws, use proper wrenches and screw drivers carefully so as not to give damages to the parts.

- Replace all gaskets and packings with new ones.
- Install small venturi and plugs properly.

6. Adjustment

6-1 Float Level Adjustment

The specified float level is 22 mm (0.866 in.) above the body. Generally, however, as the level mark is on the bowl cover, the inspection must be made with the cover not removed. To adjust, first raise the float to push the needle valve and then lower it to the level position. In this case, when the float level is proper, the valve touches the valve seat when the float is lowered. If the float can not be maintained at the level position, it is necessary to adjust it by increasing or decreasing metal packing under the valve seat. The low position of the float can be adjusted by adjusting the clearance from the bottom of the float chamber to the bottom of the float to 0.6 mm (0.024 in.) by means of the float arm.



(1) Needle seat
(2) Float arm
(3) Float
(4) Needle valve

Fig. 6 Float Level Adjustment

6-2 Operation Adjustment

1. First, with the engine at a stop, turn the idle adjusting screw fully in. From this position, back off by a 1½ turns. Set the screw in the position.
2. Subsequently, after warming up the engine sufficiently, adjust the engine speed to 600 rpm by means of the throttle adjusting screw and tighten the screw, while watching the tachometer, to a position in which the engine speed just begins to drop. From this position, back off a 1/8 turn. (Fig. 7)
3. Finally, readjust the speed to 600 to 650 rpm by means of the throttle adjusting screw. (Fig. 8)

Note: In the summer, the idling speed should be adjusted to 550 rpm.

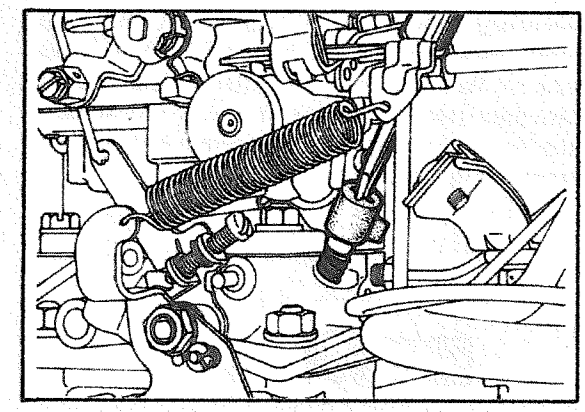


Fig. 7 Idle Adjusting Screw Adjustment

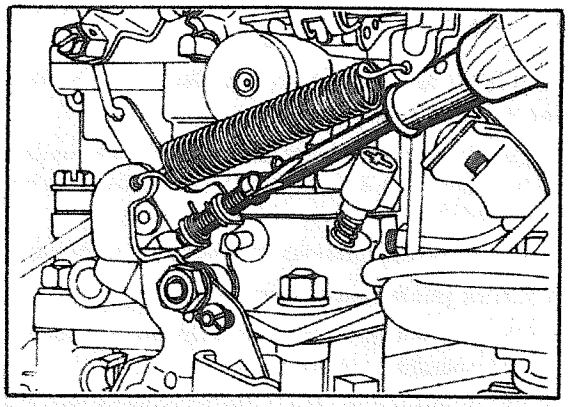


Fig. 8 Throttle Adjusting Screw Adjustment

GROUP 4

COOLING SYSTEM

CONTENTS

For the cooling system is employed forced water recirculation system which comprises a large capacity water pump, corrugated fin type radiator of high radiation efficiency, wax type thermostat that assures accurate functioning, full scale water jacket on the cylinder block through the cylinder head, and a nylon blade fan free of whistling while in operation.

Cooling water, of which temperature is reduced by the radiator, recirculates to the radiator after passing the water pump, cylinder block water jacket, cylinder head water jacket and the thermostat. When the thermostat is closed, cooling water does not flow into the radiator; it is led to the water pump through a bypass hose until such time as the engine is warmed up to a proper operating temperature.

Cooling System Specifications

Cooling method			Forced water recirculation type
Radiator			Pressure type
Water pump			Centrifugal type
Volume of water	Total	Canter, Rosa	9.9 lit. (2.6 U.S. gal.)
		Jeep	8.0 lit. (2.1 U.S. gal.)
	Engine		4.9 lit. (1.3 U.S. gal.)
	Radiator	Canter, Rosa	5.0 lit. (1.3 U.S. gal.)
		Jeep	2.5 lit. (0.7 U.S. gal.)

1. Cooling Water

Replacement of cooling water should be done in the manner as follows: Drain cooling water by loosening the drain cocks under the radiator and of the engine cylinder block, and after completely flushing the cooling system, fill water and anti-corrosion agent or anti-freezer to a specified volume.

Anti-freezer

Name		Dia Queen Long Life Coolant
Volume	Canter, Rosa	3 lit. (0.8 U.S. gal.) (volume ratio 30%) or more
	Jeep	2.5 lit. (0.7 U.S. gal.) (volume ratio 30%) or more

1. Since the above anti-freezer is for all-season use, it is not necessary to replace with anti-corrosion agent in summer.
2. Anti-corrosion effect of the above anti-freezer will be lessened if its volume ratio drops below 30%.

Anti-corrosion Agent

Name		Dia Queen Radiator Conditioner
Volume	Canter, Rosa	1 lit. (0.3 U.S. gal.) (volume ratio 10%) or more
	Jeep	0.8 lit. (0.25 U.S. gal.) (volume ratio 10%) or more

1. Anti-corrosion effect extremely reduces if its volume ratio below 10%.
2. To avoid chemical change in coolant, do not allow mixed use of anti-corrosion agent and anti-freezer.

2. Measuring Specific Gravity of Cooling Water

Extract cooling water (anti-freezer mixed) in a test tube and measure temperature and specific gravity. Use the below table as guide to determine adequacy. Replenish anti-freezer as necessary.

Relations between Anti-freezer Volume Ratio and Specific Gravity

Safety temperature °C (°F)	Volume ratio of anti-freezer	Coolant temperature and specific gravity measured									Freezing Temperature °C (°F)
		10°C (50°F)	15°C (59°F)	20°C (68°F)	25°C (77°F)	30°C (80°F)	35°C (95°F)	40°C (104°F)	45°C (113°F)	50°C (122°F)	
Up to -11 (12.2)	30%	1.047	1.045	1.043	1.041	1.039	1.037	1.034	1.032	1.029	-16.0 (3.2)
Up to -16 (3.2)	35%	1.055	1.053	1.051	1.049	1.046	1.043	1.041	1.038	1.035	-20.0 (-4.0)
Up to -20 (-4)	40%	1.063	1.060	1.058	1.055	1.053	1.050	1.048	1.045	1.042	-24.5 (-12.1)
Up to -26 (-14.8)	45%	1.070	1.068	1.066	1.063	1.060	1.057	1.054	1.051	1.048	-30.0 (-22.0)
Up to -33 (-27.4)	50%	1.078	1.075	1.072	1.069	1.067	1.064	1.061	1.058	1.055	-36.5 (-33.7)
Up to -40 (-40)	55%	1.083	1.080	1.078	1.075	1.072	1.069	1.066	1.063	1.059	-45.0 (-49.0)

1. The above table applies only to the case of using "Dia Queen Long Life Coolant (CCI #1200)."
2. This table is for study of the safety temperature of cooling water mixed with anti-freezer solutions.

Example of Application: If a specific gravity of 1.051 is measured with the cooling water temperature of 20°C (68°F), the anti-freezer mixed cooling water will not freeze up to a temperature as low as −16°C (3.2°F).

SECTION 1. FAN AND FAN BELT

1. Removal

1. Remove fan installation bolts and demount the fan.
2. After moving the generator closer to the engine block, remove the fan belt.

2. Inspection

1. Check the fan belt for cracks by aging and for loss of tightness. Replace the belt as necessary.
2. Check fan blades for breakage and replace if necessary.

3. Installation

Reverse the sequence of installation work, with the fan belt tension adjustment after installation as follows:

Adjust the belt tension by moving the generator to such an extent as the center of the belt between the water pump pulley and the generator pulley flexes by 7 to 9 mm (0.28 to 0.35 in.) when this point is pulled in 90 degree direction with a force of 10 kg (22.0 lbs.).

Description	Standard dimension
Fan belt deflection	7 to 9mm (0.28 to 0.35 in.)

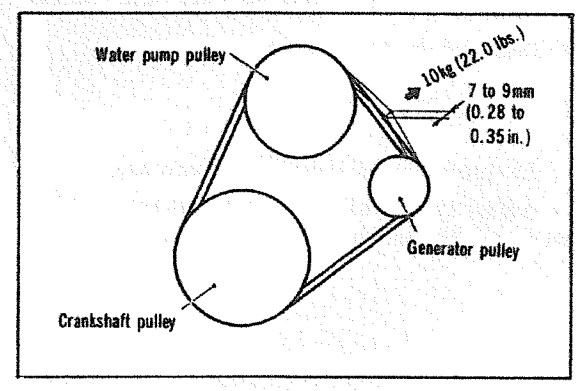
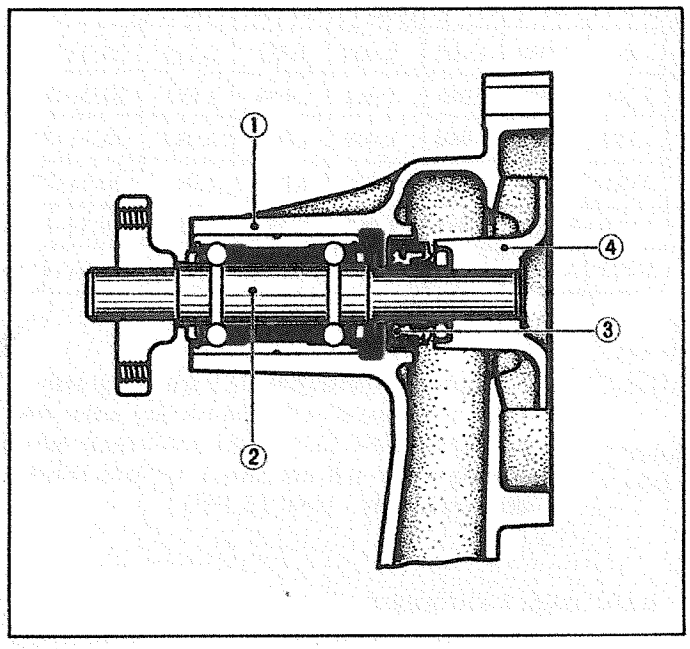


Fig. 1 Adjusting the Fan Belt Tension

SECTION 2. WATER PUMP

The water pump, being centrifugal impeller type, permits flow of cooling water well even to the farthest end of the cooling system, or the rear end of the cylinder block water jacket.

The water pump housing is made of aluminum alloy. The impeller shaft is supported with tandem radial ball bearings which permanently pack grease of high melting point.



(1) Pump body
(2) Shaft assembly
(3) Seal unit
(4) Impeller

Fig. 2 Water Pump Construction

1. Removal

1. Drain cooling water and disconnect the radiator hose.
2. Remove the fan belt.
3. Remove the fan and the fan belt pulley.
4. Demount the water pump.

2. Installation

Reverse the work sequence of removal.

Adjust the fan belt tension as prescribed under section 1, fan and fan belt.

3. Disassembly

1. Remove the impeller using Impeller Extractor, a special tool DM998013. (ST 8101-2)
2. If the seal unit assembly needs to be replaced, remove it by prying up using a screw driver. Also remove the impeller seat.
3. Heat the pump housing to a temperature of 60° to 80°C (140° to 176°F) for one to three minutes, and using a ram press force out the impeller shaft assembly from the pulley side. (Figs. 3 and 4)

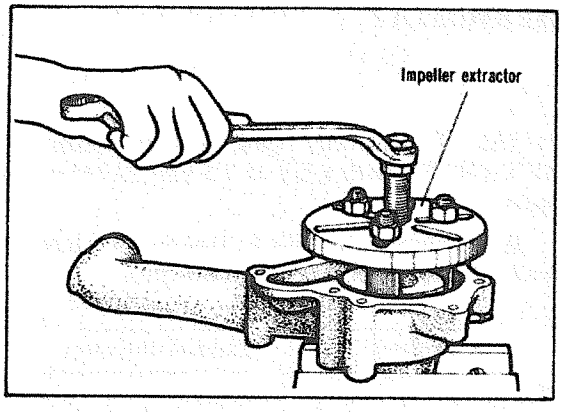


Fig. 3 Disassembling Water Pump (1)

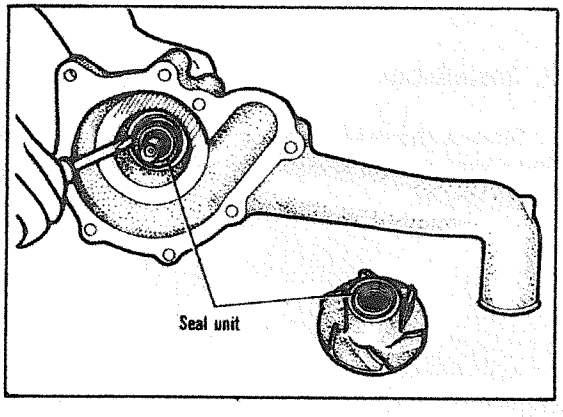


Fig. 4 Disassembling Water Pump (2)

4. Inspection

1. Check all components for cracks, flaws and excessive wear. Replace any defective parts as necessary.
2. Check the bearings for damage, unusual noise and irregular rotation. If such defects are detected, replace the pump shaft assembly.
3. If water leakage is present because of incomplete sealing of the pump housing, replace the seal unit assembly.

5. Reassembly

1. Heat the pump housing to 60° to 80°C (140° to 176°F) for one to three minutes and install the pump shaft assembly using a ram press.

   Note: Pack grease after thoroughly cleaning the bearings, grease pocket and seal to be free from dust and any other foreign material.
2. Install a new seal unit.

   Note: Coat liquid packing over the exterior surfaces of the seal unit assembly and then force in until its flange tightly seats on the pump housing.
3. Install the impeller to the following specifications.

Description	Standard dimension
Impeller to housing flange clearance	0.5mm (0.020 in.)

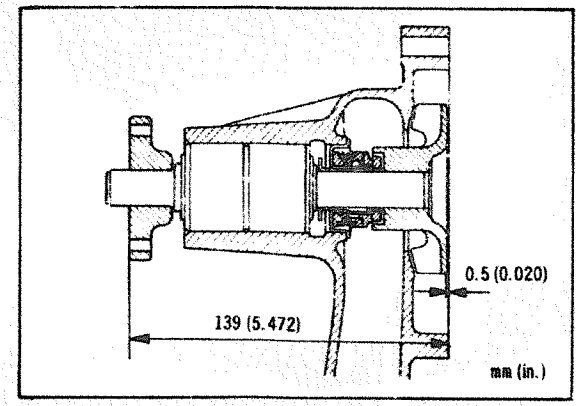


Fig. 5 Measuring Impeller Installation

SECTION 3. THERMOSTAT

The thermostat is of wax pellet type; it starts opening at a water temperature and fully opens without regard to the pressure built in the water jacket.

1. Removal

1. Remove the radiator hose connected to the outlet.
2. Remove the water outlet fitting and then the thermostat.

2. Inspection

Place the thermostat and a thermometer in water of a container and heat the water well stirring while temperatures rise. If the thermostat is sound, it starts opening (expanding the wax section) at a water temperature of 82 ± 1.5°C (176.9 to 182.3°F) and fully opens at a temperature of 95°C (203°F) with a lift of 7.5 mm (0.295 in.) or more.

If the thermostat fails to function as above or badly damaged, replace with a new part.

Description	Standard dimension
Beginning of opening	82± 1.5°C (176.9 to 182.3°F)
End of opening	95°C (203°F)
Valve lift	7.5mm (0.295 in.) or more

3. Installation

Reverse the work sequence of removal.
Make sure to coat phenol resin on the water outlet fitting gasket.

GROUP 6

ENGINE
ELECTRICAL SYSTEM

CONTENTS

The engine electrical system is divided largely into an ignition system (ignition coil, distributor, spark plugs and the like), a charging system (generator, regulator and the like), a starting system (starting motor and the like), and a battery as power source.

Types of Devices used in the Engine Electrical System

Starting motor	Canter, Rosa	MS-A_2R
	Jeep	MV-A_4L
Generator	Canter, Jeep	AB2040K_2
	Rosa	AA2040F
Regulator	Canter, Rosa	QB2220D
	Jeep	RL2122S
Distributor		TVA-4ZR
Ignition coil		HU-13A
Spark plug		B6E

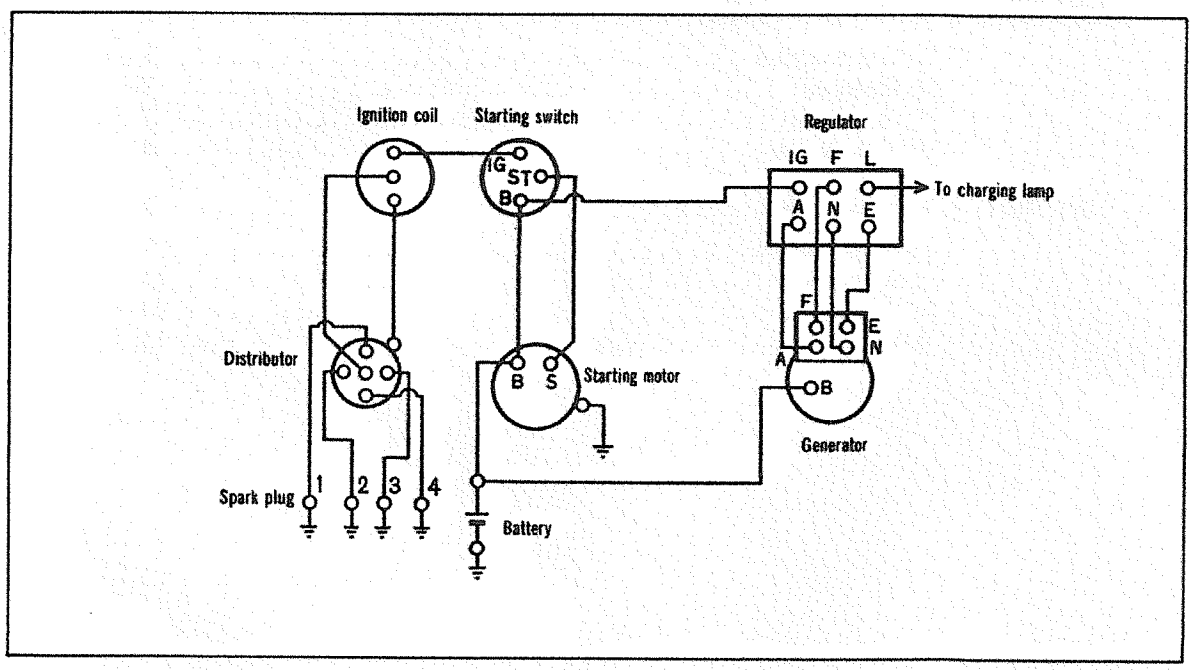


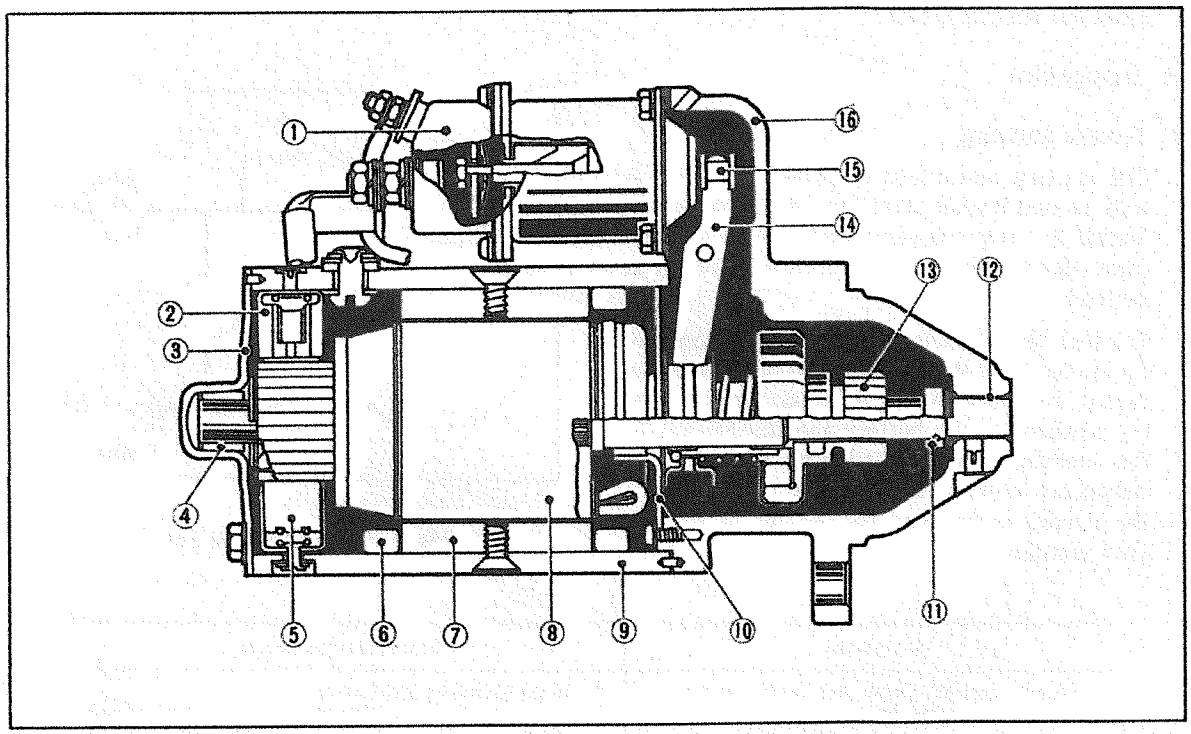
Fig. 1 Engine Electrical System Wiring Diagram

1. Construction

Starting Motor Specifications

Model	Canter, Rosa	MS-A_2R
	Jeep	MV-A_4L
Type		Solenoid push-in type (with built-in roller clutch)
Exciting system		Compound system
Rated output		12V, 1.4KW
Turning direction		Clockwise (as viewed from pinion side)

1. The stationary section of this starting motor consists of a yoke, pole piece, field coil, rear bracket, metal, front bracket, center bracket and solenoid switch, while the rotary section consists of an armature and overrunning clutch assembly. On the yoke are fitted brush holders.
2. On the outer surface of the yoke assembly, the solenoid switch is located. The switch mainly consists of a magnetic core, magnetic coils and terminals (S), (B) and (M).



(1) Magnetic switch
(2) Brush holder
(3) Rear bracket
(4) Metal
(5) Brush
(6) Field coil
(7) Pole piece
(8) Armature
(9) Yoke
(10) Center bracket
(11) Stopper
(12) Metal
(13) Overrunning clutch
(14) Lever
(15) Plunger
(16) Front bracket

Fig. 2 Starting Motor Construction (MS-A_2R)

Starting Motor Characteristics

	When non-loaded			When loaded			Solenoid switch operating voltage	
	Voltage	Current	Speed	Voltage	Current	Torque	Switched in	Switched off
MS-A_2R	11.5 V	55A or less	4,500rpm or more	6V	670A or less	2.4 kg-m (17.4ft-lbs.) or more	9V or less	As soon as the circuit is cut off
MV-A_4L	12V	50A or less	3,700rpm or more	5V	500A or less	1.3 kg-m (9.4ft-lbs.) or more	11V or less	As soon as the circuit is cut off

2. Removal

1. Disconnect the battery cables from the battery terminals and remove the ground strap.
2. Disconnect the starting motor wirings and remove the starting motor.

3. Inspection

1. Trouble Shooting

The starting motor can be tested in loaded as well as non-loaded condition. Since, however, loaded test requires considerable testing equipment, here is a description of how to test it at no load.

Connect the ammeter to the (+) terminal of the battery and the terminal (B) of the starting motor, and connect a conductor between the (-) terminal of the battery and the bracket of the starting motor. Furthermore, connect a conductor between the terminals (B) and (S) of the starting motor, and the starting motor will start rotation.

Note: Use a conductor about 3 mm^2 (0.005 $in.^2$) for the connections where large current flows. In the above test, check the rotating speed and current and get the rough idea of where trouble is.

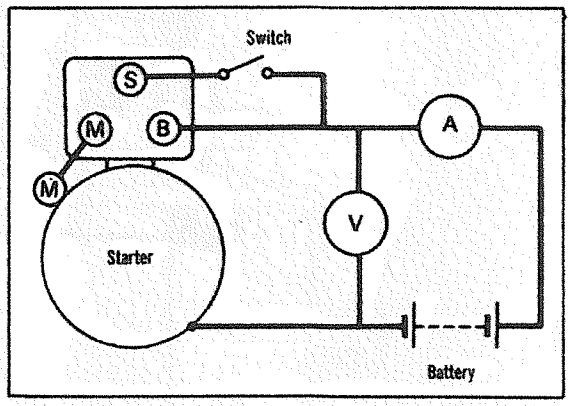


Fig. 3 Starting Motor Test (1)

Symptoms	Locations and causes
Large current flows but speed is low (Torque is also low)	1. Metal fouled or short of oil 2. Armature core and pole piece rubbing against each other 3. Armature coil and field coil grounded 4. Armature coil shorted
Large current flows but motor fails to rotate	1. Solenoid switch grounded 2. Armature coil and field coil grounded 3. Metal seizure
No current flows and motor remains stationary	1. Armature and field coil wires broken 2. Brush pigtail wires broken 3. Defective contact between brush and commutator due to fouled commutator or high mica
Little current flows and motor turns slowly (Sufficient torque unavailable)	1. Defective connection of field coil (When only shunt coil wire is broken or loosely connected, however, motor speed is increased)
Large current flows and motor speed is high	1. Field coil shorted

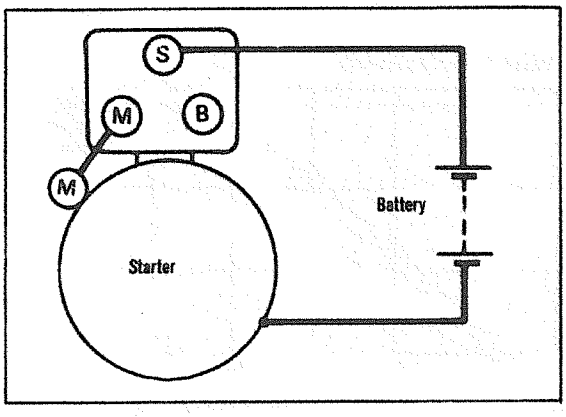


Fig. 4 Starting Motor Test (2)

2. Replace the brush that has been worn over the service limit.

Description	Standard dimension	Service limit
Dimension of brush	17 mm (0.67 in.)	9 mm (0.35 in.)

3. Checking the Position of the Solenoid Switch Pinion

   Connect the battery and check by operating the switch. With the pinion in the projecting position, measure the dimension between the pinion end and stopper and check that the measured value shows the standard dimension.

   Note: Push the pinion lightly in the opposite direction the pinion jumps out, to eliminate pinion play before measuring the dimension.

Description	Standard dimension
Clearance between pinion end and stopper	0.5 to 2.0 mm (0.020 to 0.079 in.)

4. Installation

Reverse the removal procedures. For installation, however, the following additional operations shall be performed.

1. When installing the starting motor to the engine, clean the joining surfaces of both the motor and the engine. Be sure to remove paint, oil, grease, rust or any other foreign substances before tightening the mounting bolts.
2. Securely tighten bolts so that the starting motor shaft will be perfectly parallel to the central axis of the engine and that the starting motor will not move when cranking the engine.

   If the bolts are not firmly tightened, cracked housing or cracked pinion will result; or in some cases the engine will not crank.

SECTION 2. IGNITION SYSTEM

1. Construction

1-1 Distributor

Distributor Specifications

Model	TVD-4ZR
Type	Type A (with gear)
Turning direction	Clockwise (as viewed from cap side)
Condenser capacity	0.15 μF ± 10%

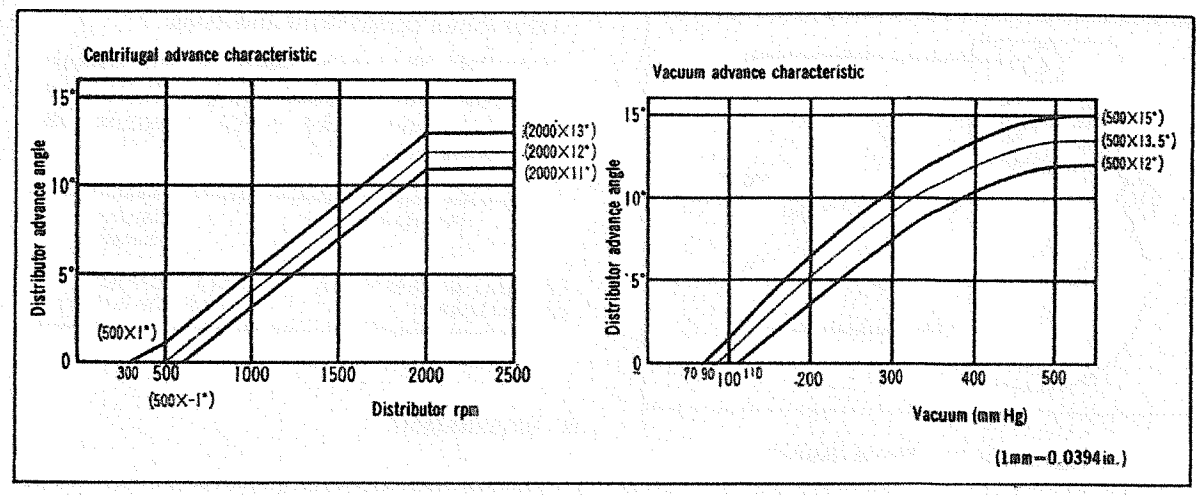
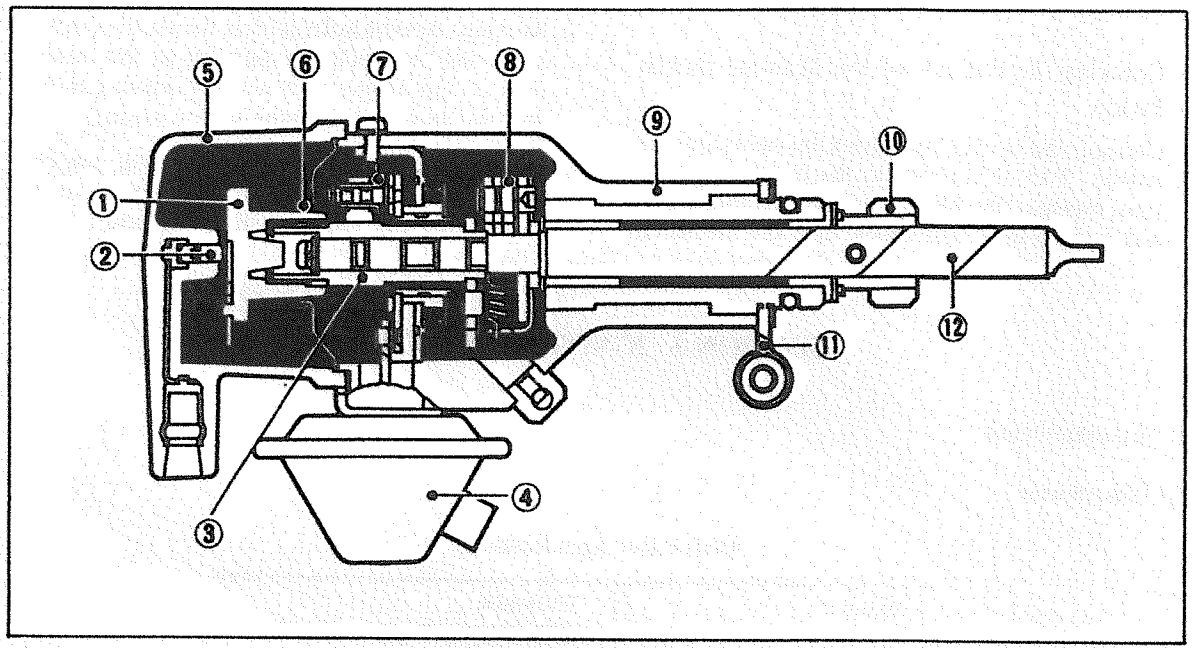


Fig. 5 Advance Characteristic

The distributor consists of a power distributing unit (cap, rotor, interrupter, cam, cam follower and condenser), centrifugal advance unit and vacuum advance unit.



(1) Rotor
(2) Contact carbon
(3) Cam assembly
(4) Vacuum advance unit
(5) Cap
(6) Cover
(7) Interrupter
(8) Centrifugal advance unit
(9) Housing
(10) Gear
(11) Lock plate
(12) Shaft

Fig. 6 Distributor Construction

1-2 Ignition Coil

Ignition Coil Specifications

Model	HU-13A
Primary voltage	12V
Primary resistance	3.5Ω ± 10% [20°C (68°F)]
Spark gap (Distributor rpm)	6mm (0.24 in.) or more (3,000rpm)

1-3 Spark Plug

Type B-6ES (NGK)

2. Removal

1. Remove the distributor spark plug cords and ignition coil cord.
2. Disconnect the primary wire of the distributor.
3. Remove the vacuum pipe.
4. Remove the bolts and remove the distributor from the engine.
5. Remove the spark plug, using the spark plug wrench.

3. Inspection

3-1 Distributor

1. Trouble Shooting

It is not only the ignition system but also the fuel system that affects the condition of the engine, but following are the causes of defective engine condition attributable to the ignition system.

Symptoms	Probable causes
Hard to start	1. Defective plug 2. Insufficient spark 3. Incorrect ignition timing 4. Faulty battery
Poor acceleration	1. Too wide spark gap 2. Incorrect timing by automatic advance unit 3. Incorrect point gap
Insufficient output, overheated engine, excessive consumption of fuel	1. Insufficient spark 2. Incorrect timing

The above table will help you get the rough idea of where trouble is. Check the probable causes on an individual basis. Disconnect the high tension cord from the distributor side, space the cord end approx. 5 mm (0.20 in.) from the engine, and check spark by cranking the engine.

Spark condition	Probable causes
No spark at all	1. Defective key switch 2. Defective ignition coil 3. Condenser punctured 4. Defective conduction of contact point
Very weak spark	1. Loose connection of primary circuit 2. Loose contact of point surface 3. Defective insulation of condenser 4. Defective ignition coil
Very strong spark	1. Defective plug 2. Defective insulation of distributor cap 3. Loose connection of high tension cord

2. Check for oil, dust and dirt on the point surface and clean foreign substances from the point surface with a clean cloth. Polish the burnt or roughened surface flat with an oil stone.
3. Check for oil, dust, crack, flaw and burn on the cap rotor. Furthermore, check that the high tension cord is securely connected.
4. Condenser

   When there is too strong spark across the points, it is likely that the condenser is defective. To test the condenser, connect a 500V megger between the (+) terminal of the condenser and the case and turn the handle. If the megger reading is over 5MΩ, the condenser may be considered satisfactory.

3-2 Spark Plug

In regard to the spark plug, check the following points and replace any defective plug.

1. Broken Insulator
2. Worn Electrode
3. Deposited Carbon

   Use a plug cleaner or wire brush for cleaning. Clean the upper portion of porcelain insulator, too.
4. Damaged or Worn Gasket
5. Burnt Condition of Firing Portion of Porcelain Insulator

   If the portion is blackened with carbon, the probable causes are too thick air-fuel mixture, too little suction air and misfiring due to too wide spark gap.

   If the portion is burnt white, the probable causes are too thin air-fuel mixture, too early ignition timing, and loosely tightened spark plug.

Description	Standard dimension
Plug gap	0.7 to 0.8mm (0.028 to 0.031 in.)

4. Installation

1. Turn the crankshaft to bring the No. 1 cylinder piston to the top dead center of compression stroke. Adjust the crankshaft pulley timing mark (arrow) to the position 8° on the timing indicator.
2. Set the distributor rotor to the position of the ignition cable of No. 1 cylinder.
3. Align the splined top end of the oil pump shaft with the oil pump shaft fitting part at the lower end of the distributor shaft.

   Note: The oil pump shaft can be turned easily with a screw driver.
4. Insert the distributor proper in the cylinder with care on the fitting of the shaft.
5. Adjust the position of the housing so that the point will begin to open at the set position 8° (see Item 1) before the top dead center of compression stroke of the No. 1 cylinder.
6. Install the primary wire and vacuum pipe.
7. Install the distributor cap and install the spark plug cables in conformance with the corresponding numbers on the cap, and insert the coil cord.
8. Crank the engine and, by using a timing lamp, check to see if ignition is properly timed to 8° before the top dead center of compression stroke of the No. 1 cylinder at an engine speed of 600 rpm. Readjust if necessary.

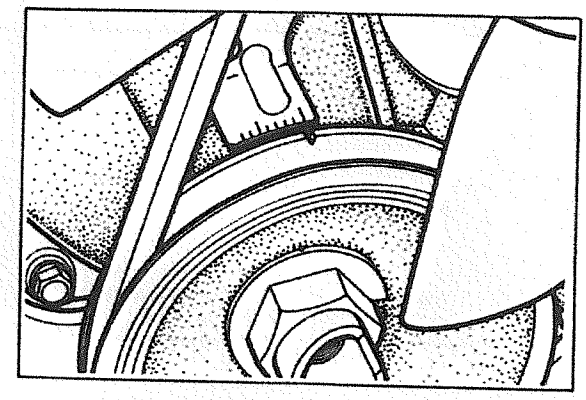


Fig. 7 Distributor Installation (1)

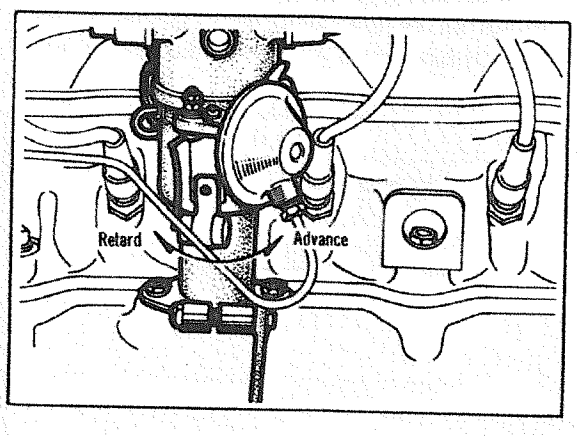


Fig. 8 Distributor Installation (2)

SECTION 3. GENERATING

1. Construction

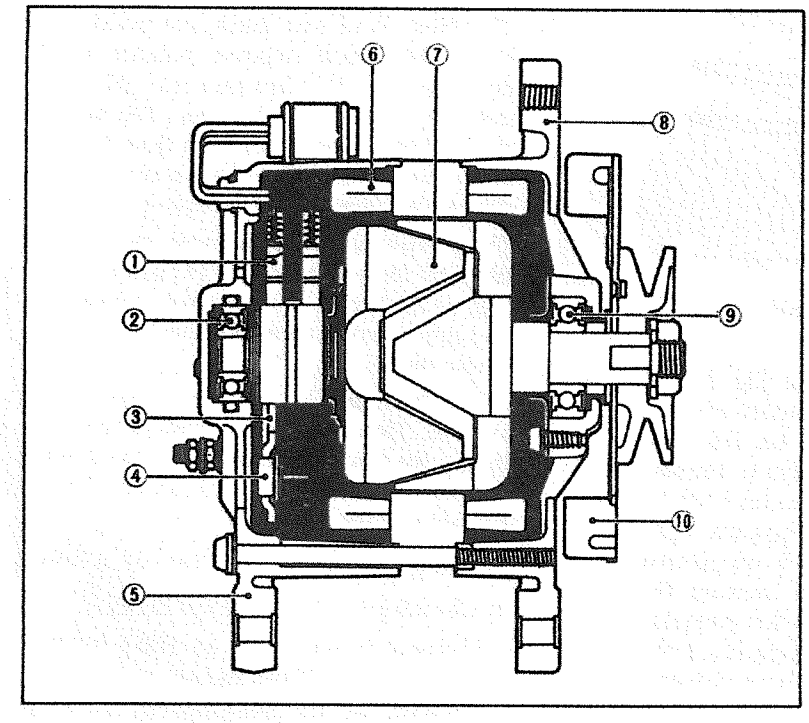
Generator Specifications

Model	AB2040K$_2$ (Canter, Jeep) AA2040F (Rosa)
Type	Constant-voltage type
Excitation	Separately excited
Polarity	Negative grounding
Rated output	12V, 40A (480W)
Turning direction	Clockwise (as viewed from the front side)

Regulator Specifications

Model	RLA2220D$_2$ RL2122S (Jeep J52 model only)
Type	Tirrill type
Polarity	Negative grounding
Elements	Constant voltage relay and pilot lamp relay (RLA2220D$_2$)
	Constant voltage relay (RL2122S)

The generator consists of a rotary and fixed sections. The rotary section consists of a rotor assembly, ball bearing and a pulley with a fan. The fixed section consists of a stator assembly, front bracket, rear bracket, brush, diode mount and diode.



(1) Brush
(2) Ball bearing
(3) Diode mount
(4) Diode
(5) Rear bracket
(6) Armature assembly
(7) Rotor assembly
(8) Front bracket
(9) Ball bearing
(10) Pulley with a fan

Fig. 9 Generator Construction

Generator Characteristics

	When non-loaded			When loaded (battery + resistance load)		
	Voltage	Current	Speed	Voltage	Current	Speed
AB2040K_2	14 V	16.5A	1,300 rpm or less	14 V	32A	2,500 rpm or less
AA2040F	14 V	0A	1,000 rpm or less	14 V	35.7A	2,400 rpm or less

2. Removal

1. Disconnect the battery terminals and disconnect the connector, output terminal and ground wire.
2. Remove the generator bracing bolts.
3. Remove the generator mounting bolts and remove the generator.

3. Inspection

1. Checking the Generator Output

   The generator output can be conveniently checked by fitting the connector (CN-4P-AF) such as shown to the generator connector.

   Use a fully-charged battery with the specified capacity.

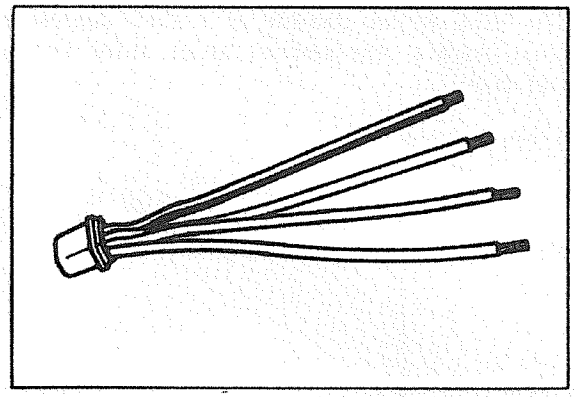


Fig. 10 Generator Inspection (1)

a. Make connections as shown in Fig. 11 and turn on the switch K1 to supply exciting current from the battery to the field coil of the generator. In this condition, increase the rotating speed of the generator little by little until reverse current (approx. 2A) ceases to flow through the field coil. At that point, turn off the K1 and increase the generator speed further. Read the generator speed at a point where the pointer of the voltmeter indicates 14V. That is a non-loaded value.

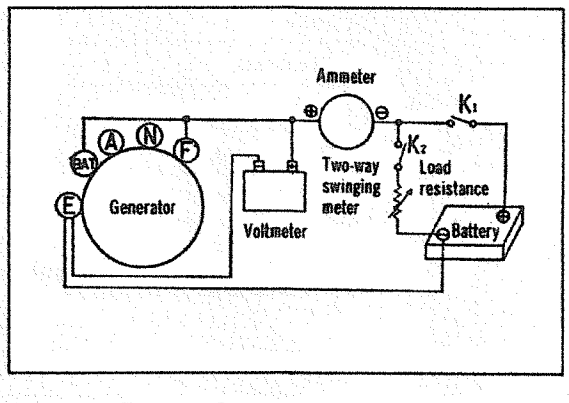


Fig. 11 Generator Inspection (2)

b. Next, increase the load resistance to a maximum so that practically no current will flow. In this condition, turn on the switches K1 and K2, increase the load current to the specified value, and check the rotating speed at that time. That is a loaded value.

2. Checking the Diode

   a. The diode is of two kinds, the positive polarity diode and negative polarity diode, depending on the direction the silicon element is mounted in the case. The positive type permits current to flow from the lead to the case, while the negative type permits current to flow from the case to the lead.

   The positive and negative types can be identified by the colors [red for (+) and black for (−)] of the letters on the bottom of the case. This generator has three positive and negative diodes each.

   Diode trouble occurs when opened and shorted. The opened state is where the diode blocks the flow of current, while the shorted state is where the diode permits the flow of current in both directions.

   b. Checking the Diode by Use of a Lamp

      i. Checking the Positive Type Diode

      Connect a lamp (2W to 10W) between (−) terminal of the battery and the (A) terminal of the generator as shown in

illustration A. If the lamp lights when the positive terminal of the battery and the terminal (N) of the generator are connected, and if the lamp does not light when the connections are reversed as shown in illustration B, the positive diode may be considered satisfactory. If the lamp lights in both cases, the diode is shorted. If the lamp does not light in both cases, the diode is open.

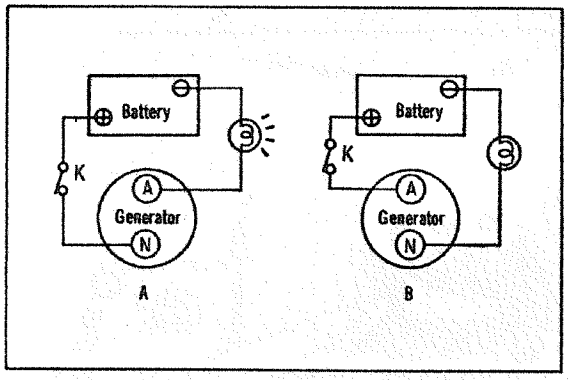


Fig. 12 Checking the Positive Type Diode

ii. Checking the Negative Type Diode

Connect a lamp between the negative terminal of the battery and the terminal (N) of the generator as shown in illustration A. If the lamp lights when the positive terminal of the battery and the terminal (E) of the generator are connected, and if the lamp does not light when the connections are reversed as shown in illustration B, the negative type diode may be considered satisfactory. If the lamp lights in both cases, the diode is shorted. If the lamp does not light in both cases, the diode is open.

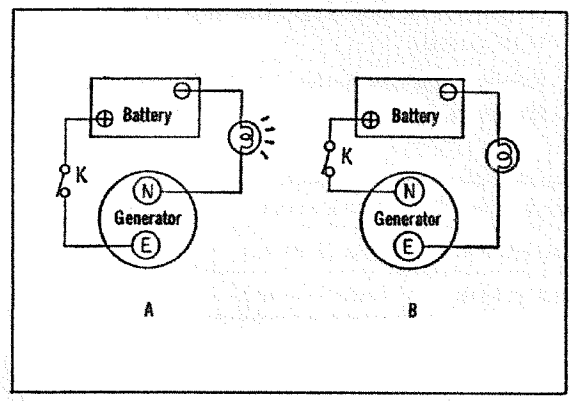


Fig. 13 Checking the Negative Type Diode

c. Checking the Diode by Use of a Tester

i. Checking the Positive Type Diode

If the diode shows small resistance in the conducting direction as in illustration A and large resistance in the opposite direction as in illustration B as measured between the terminals (A) and (N) with the tester, the positive type diode may be considered satisfactory.

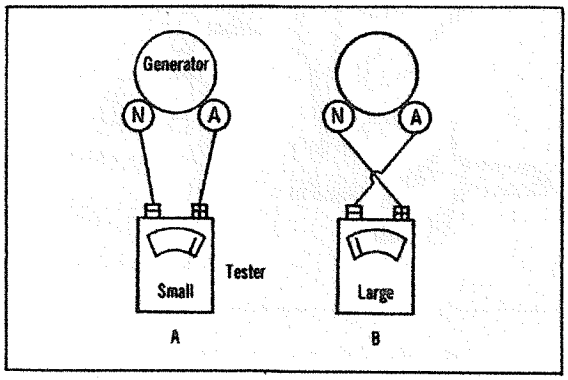


Fig. 14 Checking the Positive Type Diode

ii. Checking the Negative Type Diode

If the diode shows small resistance in the conducting direction as in illustration A and large resistance in the opposite direction as in illustration B as measured between the terminals (N) and (E) with the tester, the negative type diode may be considered satisfactory.

Note: If it shows small resistance in both directions, the diode is shorted. If it shows large resistance, it is open.

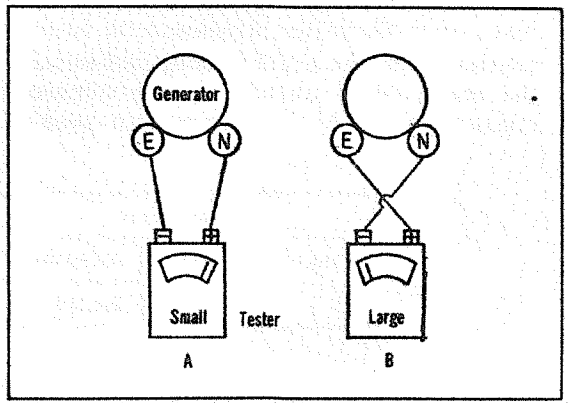


Fig. 15 Checking the Negative Type Diode

3. Checking the Field Coil

Apply both terminals of the tester to the slip ring of the rotor. If the tester shows the specified resistance, there is nothing wrong.

Description	Standard value
Resistance value of rotor	5.3 Ω

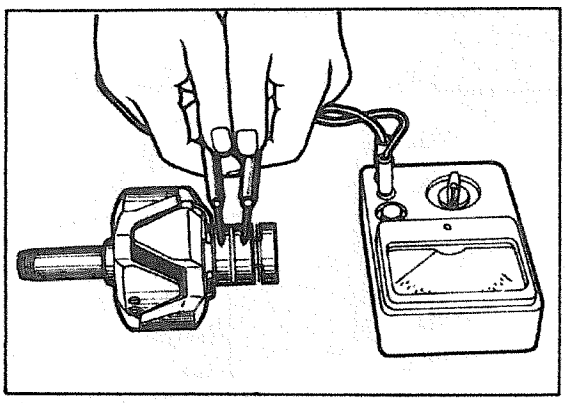


Fig. 16 Checking the Field Coil

4. Continuity Test of Armature

Insert the tester between one end of the coil connected to the diode and the stator core and check that there is no continuity. Next, as shown in Figs. 17 and 18, insert the tester between one end of the coil and the terminal connected to the terminal (N). If the tester shows continuity, the armature is not grounded wire.

5. Checking the Adjusted Value of the Constant Voltage Relay (mounted on the engine)

With the engine in stationary condition, connect a voltmeter between the terminals (A) and (E) of the regulator. At this point, check that the voltmeter is indicating the battery voltage. Next, crank the engine, disconnect the battery terminals while the engine is idling, and increase the engine speed gradually. If the voltmeter indicates 14.0 to 15.5V at a generator speed of 4,000 rpm, it means that there is nothing wrong.

Note: Disconnect the battery terminals while the engine is idling.

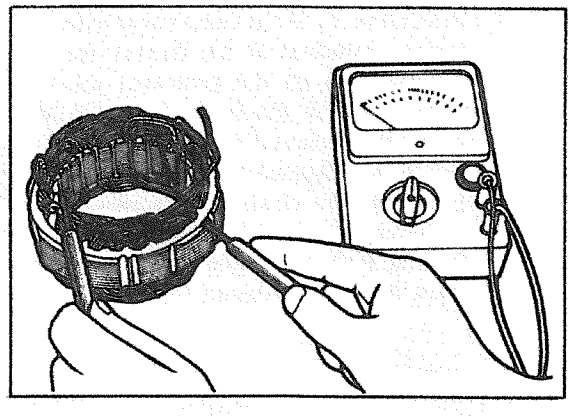


Fig. 17 Continuity Test of Armature (A)

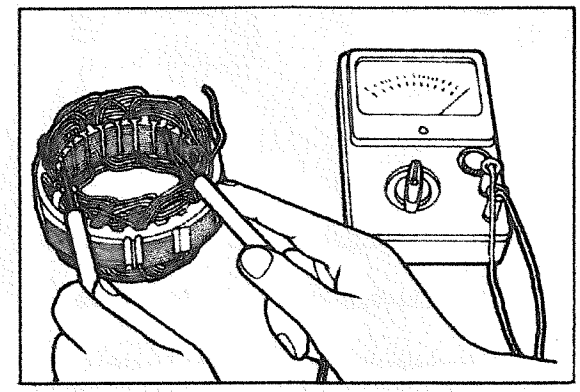


Fig. 18 Continuity Test of Armature (B)

6. If there is oil, dust or any other foreign substance on the slip ring, the continuity between the brush and slip ring is lost so that no power is generated. So clean the slip ring carefully with a cloth.

7. Replace the brush that has been worn over the service limit.

Description		Standard dimension	Service limit
Dimension of brush	AB2040K_2	19 mm (0.75 in.)	6 mm (0.24 in.)
	AA2040F	12 mm (0.47 in.)	5 mm (0.20 in.)

8. Sealed ball bearings are used on both sides of the metal section of the generator. There is no need for the lubrication of the bearings. Replace the bearing if short of oil.

4. Installation

Reverse the removal procedures. Pay heed to the following points.

1. When installing the generator, use washers [0.198 mm (0.00780 in.) thick] to eliminate any clearance between the support and generator bracket before tightening.
2. After mounting the generator, adjust the tension of the fan belt.
3. Connect the generator, regulator and battery correctly.

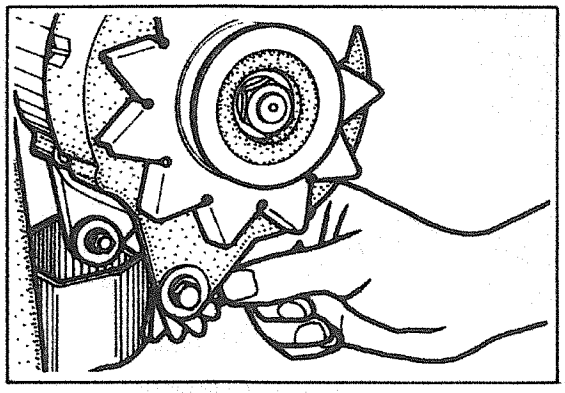


Fig. 19 Generator Installation

4. Be sure to ground the regulator perfectly.

GROUP 8

CLUTCH

CONTENTS

SECTION 0. GENERAL

The clutch is of a hydraulically operated single plate dry type.

When the clutch pedal is depressed, hydraulic pressure builds up in the clutch master cylinder and operates the clutch release cylinder, which drives the release bearing via the clutch shift fork.

A disc is provided between the flywheel and the pressure plate assembly and engine torque is transmitted by means of this disc. Clutch specifications are listed below:

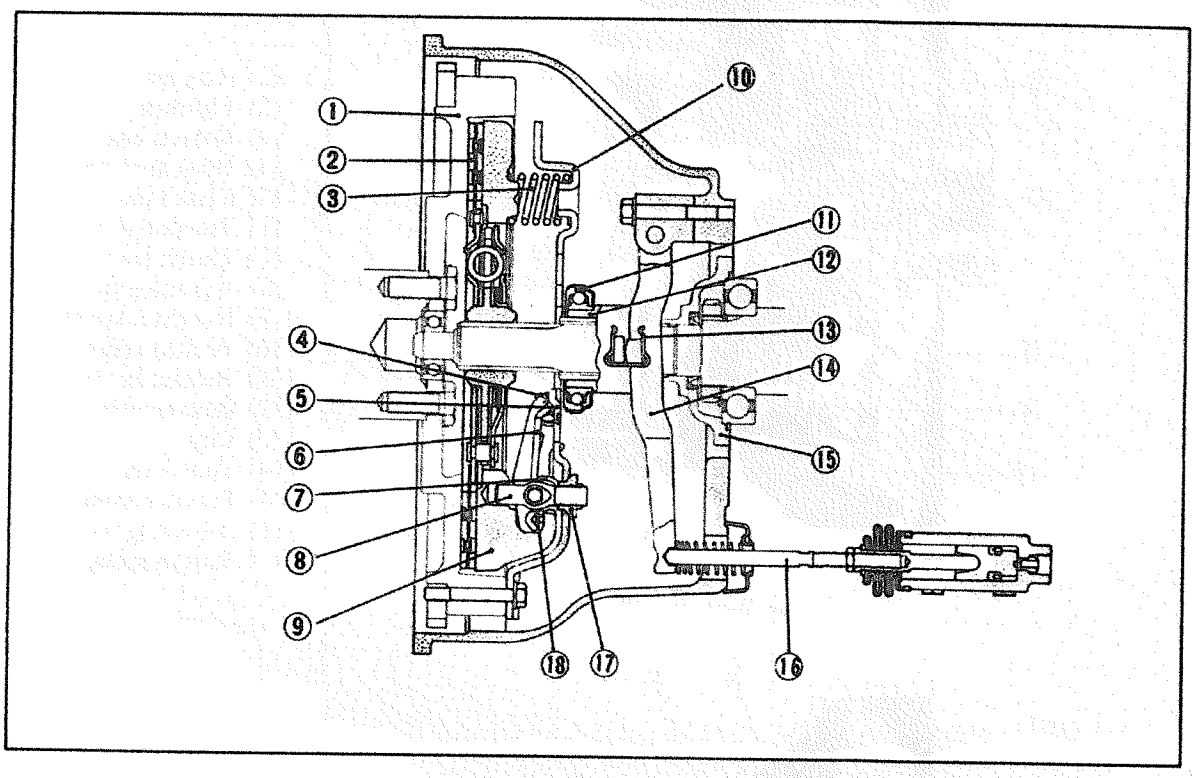
Clutch Specifications

Type		Canter		Rosa	Jeep
		3-ton truck	2-ton truck		
Pressure plate	Set road	528 kg (1,167 lbs.)	500 kg (1,102 lbs.)	←	←
	Transmission torque	30 kg-m (217 ft-lbs.)	29.8 kg-m (215 ft-lbs.)	←	←
Clutch disc		Dry single plate type	←	←	←
Facing	O.D. x I.D. x thickness	260 x 170 x 3.5 mm (10.24 x 6.69 x 0.133 in.)	240 x 150 x 3.5 mm (9.45 x 5.91 x 0.133 in.)	←	←
	Area of facing	300 cm^2 (48 in^2) x 2	276 cm^2 (44 in^2) x 2	←	←
	Material	Semi-mold	←	←	←
Release bearing		Grease-sealed non-lubrication type	←	←	←
Release cylinder, I.D.		19.05 mm (0.7500 in.)	←	←	20.64 mm (0.8126 in.)

SECTION 1. CLUTCH

1. Construction

1-1 Clutch (for Canter 3-ton Truck)

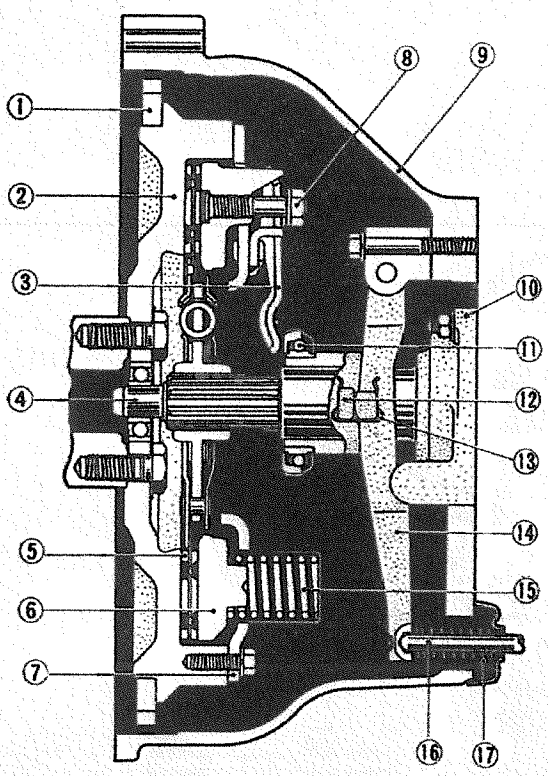


(1) Flywheel
(2) Clutch disc
(3) Pressure spring
(4) Retainer spring
(5) Lever plate
(6) Release lever
(7) Anti-rattle spring
(8) Eyebolt
(9) Pressure plate
(10) Clutch cover
(11) Release bearing
(12) Bearing carrier
(13) Clip
(14) Shift fork
(15) Bearing retainer
(16) Adjuster
(17) Eyebolt nut
(18) Strut

Fig. 1 Sectional View of Clutch (Canter 3-ton Truck)

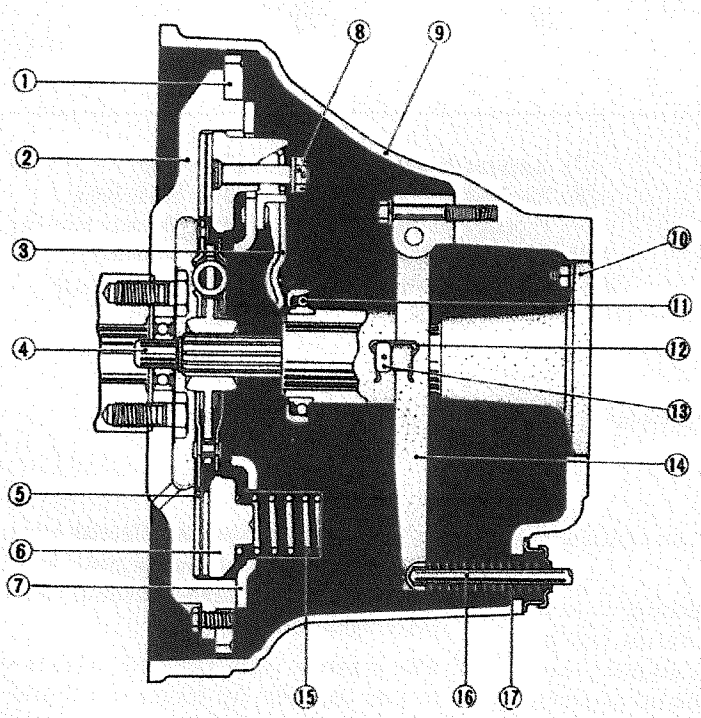
1. The facing is made of semi-mold material excellent in durability.
2. The facing is fitted via the cushioning plate to the clutch plate which is fixed to the hub by way of 6 torsion springs. The cushioning plate and torsion springs absorb rotational vibration and shock of the driving system to ensure a smooth power transmission.
3. As transmission of torque from the clutch cover to the pressure plate is effected under a strap system coupling the clutch cover and the pressure plate with a strap, clutch-in and -out take place smoothly.
4. The pressure plate assembly secures sufficient torque capacity by means of 12 coil springs (pressure springs), minimizing, at the same time, changes in pressing force.

1-2 Clutch (for Canter 2-ton Truck, Rosa and Jeep)



(For Canter 2-ton and Rosa)

(1) Ring gear
(2) Flywheel
(3) Release lever
(4) Main drive gear
(5) Clutch disc
(6) Pressure plate
(7) Clutch bracket
(8) Adjusting nut
(9) Flywheel housing
(10) Bearing retainer
(11) Release bearing
(12) Bearing carrier
(13) Clip
(14) Shift lever
(15) Pressure spring
(16) Adjusting rod
(17) Return spring



(For Jeep)

(1) Ring gear
(2) Flywheel
(3) Release lever
(4) Main drive gear
(5) Clutch disc
(6) Pressure plate
(7) Clutch bracket
(8) Adjusting nut
(9) Flywheel housing
(10) Bearing retainer
(11) Release bearing
(12) Bearing carrier
(13) Clip
(14) Shift lever
(15) Pressure spring
(16) Adjusting rod
(17) Return spring

Fig. 2 Sectional View of Clutch

1. The clutch disc facing is fixed via the cushioning plate to the clutch plate with rivets, while the clutch plate is mounted via torsion springs on the hub.

   The facing is 3.5 mm (0.138 in.) thick and provided on its surface with 27 grooves, 0.8 mm (0.032 in.) (depth) x 1.8 mm (0.071 in.) (width), radially to prevent temperature rise and increase durability. Further, as for the facing material, a highly reliable semi-mold is employed to ensure excellent durability and smooth feeling.

2. The pressure plate assembly is provided with 3 release levers and 9 coil springs secure sufficient torque capacity and minimize changes in pressing force.

3. The release bearing of a grease-sealing type is employed.

2. Removal

1. Remove the transmission.
2. Insert the clutch center guide MD998066 (ST 7099-0) – Canter, Rosa, ST7071-0 – Jeep into the clutch center hole to prevent falling-off of the disc and unfasten clamp bolts coupling the flywheel with the clutch cover, that is, unfasten diagonally opposite bolts in turn, and remove the pressure plate assembly and the clutch disc.
3. Take off the clip linking the release bearing carrier with the shift fork and remove the release bearing and the carrier.
4. Remove the release cylinder assembly.

3. Inspection

1. Wipe off dirt from the release bearing, check it up and replace it if the following failures were observed.

   As the release bearing is of a grease-sealing type, do not wash it with flushing oil, etc.

   a. Irregular revolution.

   b. When making a noise.

2. Inspection of Clutch Release Bearing Carrier

   a. Apply grease to the slide surface of the clutch release bearing carrier and the bearing retainer so as to ensure a smooth slide of the carrier.

   b. If the surface to come into touch with the clutch shift fork were worn out or irregular, repair or replace it.

3. If the clip linking the release bearing carrier with the clutch shift fork or the shift fork return spring were broken or deteriorated, replace it.

4. Inspection of Clutch Disc

   Clean and check up the disc and if any abnormal condition were detected, repair or replace it.

   a. Checking the Deflection

   Test deflection by means of a clutch disc runout tester. If the runout tester were not available, measure deflection of the disc periphery by a simple method and if it exceeds the standard dimensions, repair or replace the disc.

Description	Standard dimension	Service limit	Remarks
Flatness of clutch disc	0.5 mm (0.019 in.)	–	Canter 3 ton
	0.4 mm (0.016 in.) or less	–	The others
Lateral deflection of clutch disc	1.3 mm (0.051 in.)	1.5 mm (0.059 in.)	Canter 3 ton
	0.7 mm (0.028 in.) or less		The others
Longitudinal deflection of clutch disc	1.5 mm (0.059 in.)	2.0 mm (0.079 in.)	Canter 3 ton
	1.0 mm (0.039 in.) or less		The others

   b. Inspection of Clutch Disc Spline

   Fit the spline in the transmission main drive gear spline and if clearance in the revolving direction were beyond the following service limit, replace the clutch disc.

Description	Standard dimension	Service limit
Clearance in the revolving direction of clutch disc spline	0.02 to 0.12 mm (0.0008 to 0.0047 in.)	0.25 mm (0.010 in.)

c. Inspection of the Facing

i. Measure the depth from the facing surface to the rivet head and if worn out beyond the service limit or burning, tear, etc. were observed, replace the clutch disc. (Fig. 3)

Description	Standard dimension	Service limit
Sinking of facing and rivet	1.0 to 1.2 mm (0.039 to 0.047 in.)	0.3 mm (0.012 in.)

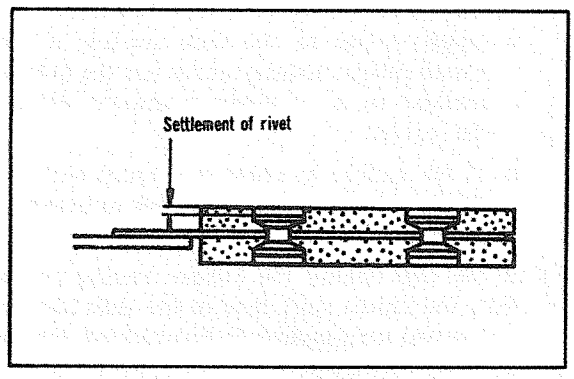


Fig. 3 Wear of Facing

ii. If facing rivets were loosened, replace the clutch disc.

Even if one retightens a loosened rivet, it will again become loose and therefore replace the clutch disc by a new one.

iii. Check the torsion spring and the cushioning plate for breakage and cracking and if defective, replace the clutch disc.

5. Inspection of Pressure Plate Assembly

a. Check the pressure plate friction plane for burning and streaks. If defective, repair or replace it.

b. Inspect the clutch cover as to possible deformation, crack, loose rivets, etc. and if defective, replace it.

c. Using a new clutch disc, mount the pressure plate assembly, measure height and flatness of the lever plate (Canter 3-ton) or the lever by means of the clutch lever gage MD998079 (ST7081-0) – Canter 3 ton; MD998065 (ST7130-0) – Canter 2 ton, Rosa; ST7143-0 – Jeep, and make adjustment by adjusting nuts.

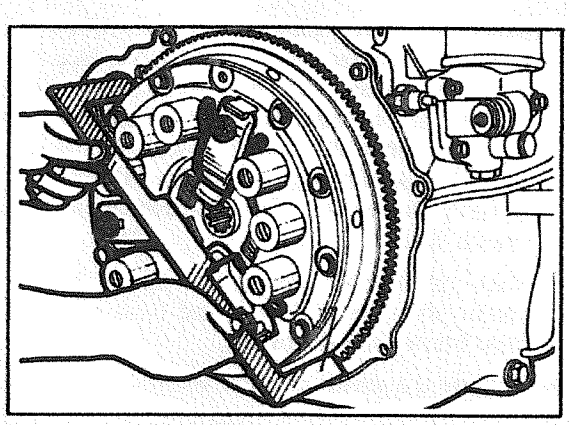


Fig. 4 Measurement of Height and Flatness of Lever

Description	Standard dimension	Service limit	Remarks
Height of lever	49mm (1.93 in.)	±1.5 mm (±0.059 in.)	Canter 2-ton, Rosa, Jeep
Difference in height among 3 lever	–	Within ±0.5 mm (±0.02 in.)	Canter 2-ton, Rosa, Jeep
Height (A) of lever plate	29.45 mm (1.159 in.)	±1.5 mm (±0.059 in.)	Canter 3-ton
Flatness of lever plate	0.4 mm (0.016 in.) or less	0.8 mm (0.031 in.)	Canter 3-ton

– Canter 3-ton –

Note: 1. In case where discrepancies in height and flatness of the lever plate are abnormally large, wear of the eyebolt pin hole may be the cause and therefore check it up and if excessively worn out, replace it and then carry out readjustment as above.

2. When having turned an eyebolt nut, be sure to hold the head and apply turn-locking means thereto after adjustment.

6. Inspection of Release Cylinder

Clean and inspect the cylinder and if defective, repair or replace it.

a. Inspection of Cylinder and Piston

Check the cylinder inside and the piston surface for rust and flaws and if clearance between cylinder and piston were in excess of the service limit, replace them.

Description	Standard dimension	Service limit
Clearance between cylinder and piston	0.02 to 0.105 mm (0.0008 to 0.0041 in.)	0.24 mm (0.0094 in.)

b. Inspection of Piston Cup

Check the cup for flaws and if defective, replace it.

To ensure safety, it is preferable to replace the piston cup at each time of disassembling.

To clean the piston cup, use alcohol or brake fluid. Never wash it with gasoline or the like.

c. If the cylinder cover were deformed, damaged or aged and deteriorated, replace it.

7. Inspection of Flywheel and Pilot Bearing

a. Repair the flywheel if its friction face to come into contact with the clutch disc involves flaws or burning, etc. The max. limit of correction by machining is 0.5 mm (0.020 in.).

b. The pilot bearing should be replaced in the event of difficulty in revolution or play, etc.

8. Inspection of Clutch Shift Fork

If the surface to come into touch with the release bearing carrier were worn out, repair it so as to form a smooth roundness. As this portion is face-hardened, replace it if it has to be shaved more than 1 mm (0.04 in.) in depth. Further, if wear were excessive at the position of fulcrum fitting to the pin, replacement is necessary.

4. Installation

1. In aligning the pressure plate assembly with flywheel knock pins, mount it along with the clutch disc and fix them temporarily.

   Mount the clutch disc, with its longer boss facing the transmission.

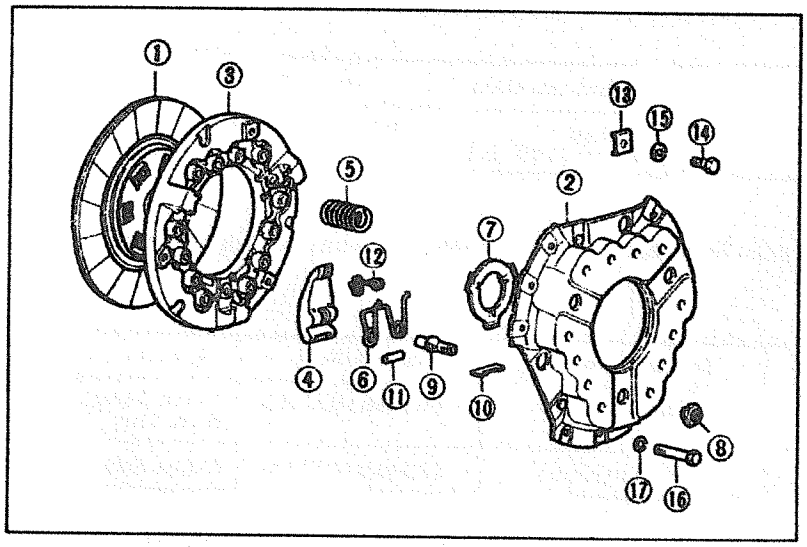
2. Using the clutch center guide, center the clutch disc and clamp the pressure plate assembly fitting bolts.

3. Mount the shift fork, release bearing and carrier, and link the shift fork with the carrier by means of the clip.

4. Install the release cylinder.

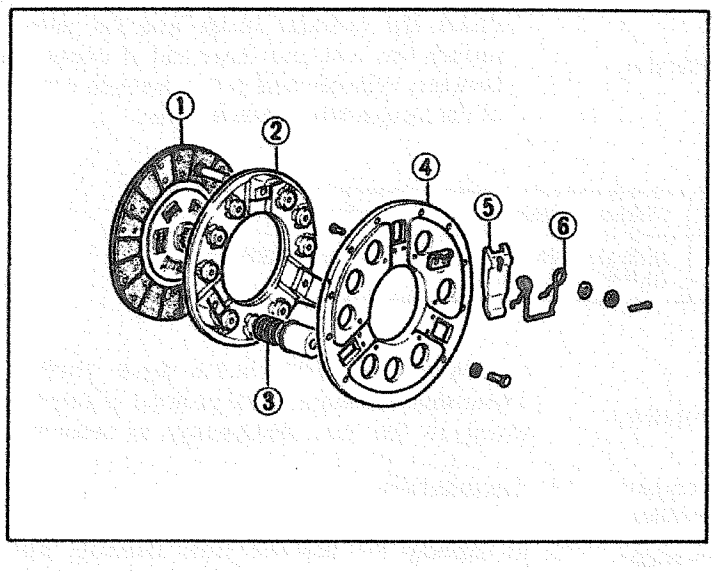
5. Adjustment of Clutch Play

   Adjust play in such manner as to set play of the release cylinder push rod to 4.0 to 4.5 mm (0.157 to 0.177in.). In this case, free travel will be approx. 1.6 mm (0.063in.).



(1) Clutch disc
(2) Clutch cover
(3) Pressure plate
(4) Release lever
(5) Pressure spring
(6) Anti-rattle spring
(7) Lever plate
(8) Eyebolt nut
(9) Eyebolt
(10) Strut
(11) Pin
(12) Release lever plate
(13) Special washer
(14) Bolt
(15) Spring washer
(16) Bolt
(17) Spring washer

Fig. 5 Pressure Plate Assembly (Canter 3-ton Truck)



(1) Clutch disc
(2) Pressure plate
(3) Pressure spring
(4) Cover
(5) Release lever
(6) Return spring

Fig. 6 Pressure Plate Assembly (Canter 2-ton Truck, Rosa, Jeep)

5. Disassembly

Canter 3-ton Truck

1. Stamp register marks at appropriate positions on the clutch cover and the pressure plate as the guides for reassembly.
2. Dismount the release lever plate.
3. Remove strap bolts.
4. Using a press or the installer (special tool 03726-22000), press the clutch cover and the pressure plate, take off eyebolt nuts and then separate the clutch cover and the pressure plate.
5. Disassemble the parts related to the release lever as follows:
   a. Turn the eyebolt 90° to place the pin in the same direction as the release lever and then pull out the pin from beneath the release lever.
   b. Return the eyebolt to its original position and pull it out.
   c. Pull out the release lever horizontally.
   d. Remove the strut.
6. Inspection of Pressure Plate
   a. Measure flatness of the friction face in putting a straight edge thereto and if the service limit were exceeded, repair it to the standard dimension.

Description	Standard dimension	Service limit
Flatness of friction face	Less than 0.05 mm (0.002 in.)	0.13 mm (0.005 in.)

b. If thickness fell below the service limit due to wear or repairs, replace the plate.

Description	Standard dimension	Repair limit	Remarks
Thickness of pressure plate	15 mm (1.02 in.)	14.5 mm (0.57 in.)	Canter 2-ton, Rosa, Jeep
	16 mm (0.63 in.)	15.5 mm (0.610 in.)	Canter 3-ton

c. If the strap bolt fitting hole were deformed elliptically or hole dimensions exceeded the service limit, replacement is required. (Canter 3-ton truck)

Description	Standard dimension	Service limit
Diameter of strap bolt fitting hole	9 mm (0.35 in.)	9.2 mm (0.362 in.)

7. Check the pressure spring for cracks and loss of tension. If the following service limits were exceeded, replace the spring.

Description	Standard dimension	Service limit	Remarks
Free length	73.5 mm (2.894 in.)	70.0 mm (2.756 in.)	
	53.2 mm (2.094 in.)	50.5 mm (1.988 in.)	
Out of square		More than 3°	
Spring tension	63.5kg /47mm (139.9 lbs./1.85 in.)	57 kg (125.6 lbs.)	Canter 2-ton , Rosa, Jeep
	52.9kg/37.5mm (116.9 lbs./1.48 in.)	48 kg (106.1 lbs.)	Canter 3-ton

8. In case strap clearance is more than 0.5 mm (0.020 in.) or clearance between the strap bolt and the strap hole is more than 0.3 mm (0.012 in.), replace the cover or the strap bolt. In the case of a defective strap, replace the clutch cover assembly. (Canter 3-ton truck)
9. Inspect wear of the release lever plate and each pin and replace those being excessively worn out. (Canter 3-ton truck)

6. Reassembly

1. With the friction face of the pressure plate facing down, put it on a press or the installer (special tool 03726-22000) and assemble it following the disassembling procedure in reverse.

GROUP 9A

TRANSMISSION

CONTENTS

SECTION 1. TRANSMISSION (Canter, Rosa)

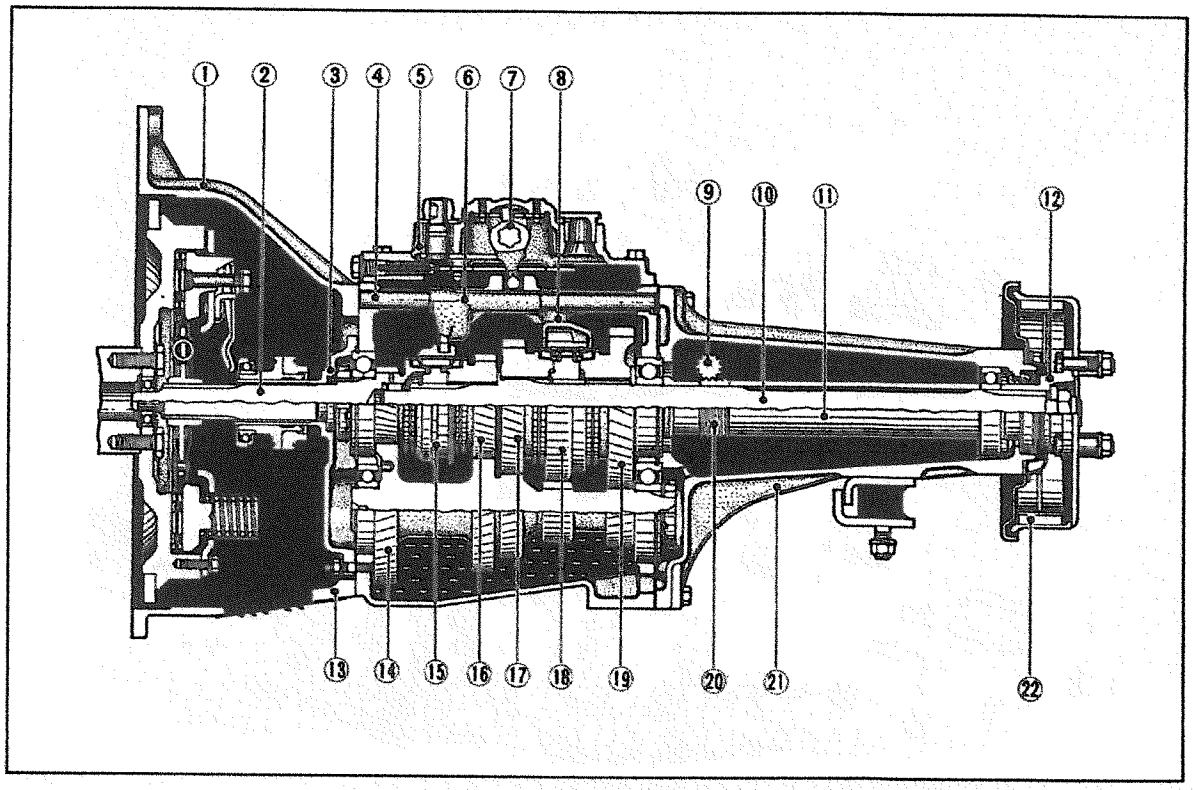
1. Construction

Specifications for Transmission

Model		KM86C (Canter)	KM86D (Canter) KM86B (Rosa)
Type		Full synchro-mesh transmission for forward speed gears	
Control system		Remote control	
Reduction ratio	1st	5.718	
	2nd	3.128	
	3rd	1.722	
	4th	1.000	
	Reverse	5.684	
Speedometer drive gear		4ea.	4ea.
Speedometer driven gear		17ea.	16ea.
Weight of transmission		Approx. 58 kg (128 lbs.)	
Recommended lubricant		Hypoid gear oil EP SAE 80 or 90	
Volume of oil required		3.2 lit. (0.85 U.S.gal.)	

Gears

Description	No. of teeth
Main drive gear	19
Third gear	26
Second gear	32
First gear	39
Sleeve (for 1st and 2nd gears)	36
Reverse idler gear	22
Counter gear (top gear)	39
Counter gear (3rd gear)	31
Counter gear (2nd gear)	21
Counter gear (1st gear)	14
Counter gear (reverse gear)	13



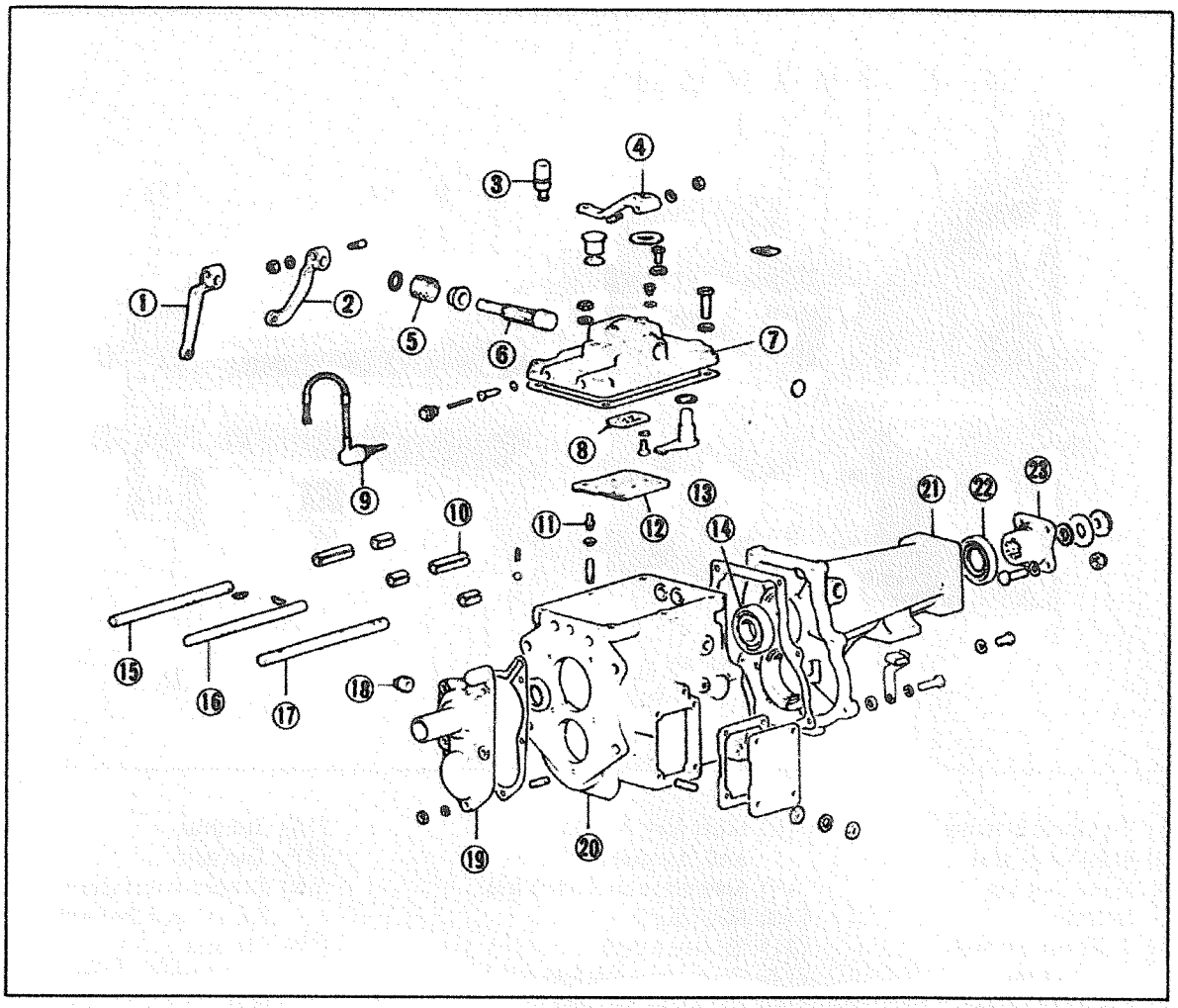
(1) Flywheel housing
(2) Main drive gear
(3) Front bearing retainer
(4) Shift bar for top and 3rd gears
(5) Control housing
(6) Shift fork for top and 3rd gears
(7) Change lever
(8) Shift fork for 1st and 2nd gears
(9) Speedometer driven gear
(10) Main shaft
(11) Distance pipe
(12) Companion flange
(13) Flywheel housing
(14) Countershaft
(15) Synchronizer sleeve for top and 3rd gears
(16) 3rd gear
(17) 2nd gear
(18) Synchronizer sleeve for 1st and 2nd gears
(19) 1st gear
(20) Speedometer drive gear
(21) Extension housing
(22) Center brake assembly

Fig. 1 Sectional View of Model KM86 Transmission

As for differences among the respective transmissions, with Model KM86C transmission as a basic model, Model KM86D transmission differs therefrom in respect of speedometer drive gear and driven gear only and Model KM86B transmission in respect of the selection lever fitted to the control housing rear side.

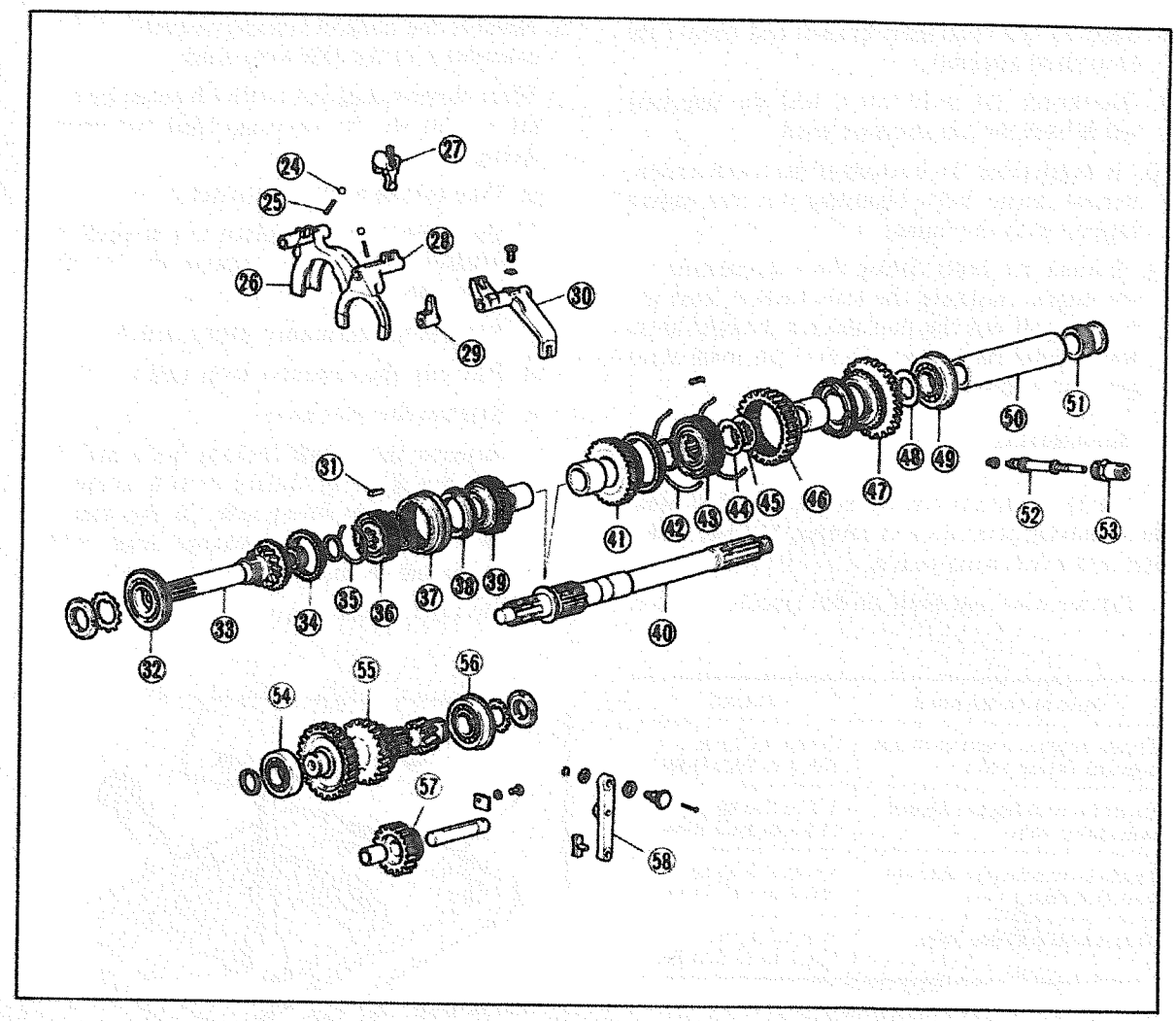
2. Removal

1. Take off the battery terminal wire (-).
2. Disconnect the back lamp switch wire at the position of the connector.
3. Remove the clutch oil pipe from the release cylinder.
4. Remove the speedometer cable.
5. By loosening the flange clamp bolts, separate the propeller shaft from the companion flange on the transmission side and put it down.
6. Remove the center brake return spring and disconnect the center brake wire from the lever.
7. Dismount the starting motor and disconnect the muffler pipe from the brace on the left of the flywheel housing.



(1) Shift lever
(2) Shift lever
(3) Air breather
(4) Selection lever
(5) Return spring
(6) Shift shaft
(7) Control housing
(8) Locking plate
(9) Backup lamp switch
(10) Distance piece
(11) Stud
(12) Interlock plate
(13) Selection shaft
(14) Ball bearing
(15) Shift rall
(16) Shift rall
(17) Shift rall
(18) Plug
(19) Front bearing retainer
(20) Transmission case
(21) Extension housing
(22) Oil seal
(23) Companion flange

Fig. 2 Exploded View of Transmission (1)



(24) Ball
(25) Poppet spring
(26) Shift fork
(27) Change lever
(28) Third and top speed shift fork
(29) Shift arm
(30) Reverse shift arm
(31) Synchronizer shifting plate
(32) Ball bearing
(33) Main drive gear
(34) Synchronizer blocking ring
(35) Synchronizer spring
(36) Clutch hub
(37) Clutch sleeve
(38) Synchronizer blocking ring
(39) Third speed gear
(40) Main shaft
(41) Second speed gear
(42) Synchronizer spring
(43) Clutch hub
(44) Shim
(45) Spacer
(46) Clutch sleeve
(47) Low speed gear with bushing
(48) Spacer
(49) Bearing
(50) Distance pipe
(51) Speedometer drive gear
(52) Speedometer driven gear
(53) Driven gear sleeve
(54) Bearing
(55) Counter gear
(56) Bearing
(57) Reverse idler gear
(58) Shift lever

Fig. 2 Exploded View of Transmission (2)

8. Take off the cross shaft bracket and remove the cross shaft assembly.
9. Disconnect the shift rod C and the selection rod B from the transmission lever.
10. In supporting the bottom of the transmission, remove clamp bolts clamping the rear engine support with the frame.
11. Loosen the bolts fitting the transmission to the engine, separate the transmission from the engine, pull out the transmission straight backward being careful not to pry the main drive gear top and put it down.

3. Installation

The transmission can be installed in following the removing procedure in reverse, but pay attention to the following points.

1. Tighten nuts and bolts to the specified torque.

Parts to be tightened	Torque
Engine support rear-frame side member fitting bolts	3.5 to 4.0 kg-m (25.3 to 28.9 ft-lbs.)
Insulator rear-engine support rear clamp nuts	1.5 to 2.0 kg-m (10.8 to 14.5 ft-lbs.)
Insulator rear-engine side support rear clamp nuts	1.5 to 2.0 kg-m (10.8 to 14.5 ft-lbs.)
Transmission fitting bolts	3 to 3.5 kg-m (21.7 to 25.3 ft-lbs.)

2. When installing the remote control linkage, carry out various adjustments required. (Refer to Chassis Group.)
3. After mounting the clutch oil line, carry out various adjustments required. (Refer to Chassis Group.)
4. When mounting the center brake cable, carry out the required adjustment. (Refer to Chassis Group.)

4. Disassembly

1. Take off the clip linking the shift lever with the bearing carrier and remove the release bearing assembly.
2. Remove the shift lever return spring, loosen the bracket fitting bolts and take off the shift lever.
3. Dismount the release cylinder assembly.
4. Remove the flywheel housing from the transmission case.
5. Remove the control housing assembly and disassemble it in the following order.

   When dismounting the control housing be careful not to let the reversing shift bar poppet spring fall off.

   a. Take off the back light switch.
   b. Using the interlock plate nut wrench MD 998074 (ST7045-0), remove the interlock plate nuts.
   c. Remove the resistance spring and the sleeve.
   d. Pull out the selection lever and the shaft.
   e. Remove the shift lever.
   f. Remove shift shaft locking bolts and pull out the shaft by hitting it with a hammer from the lever fitting side. In this case, remove the plug, shaft, change lever, return spring and retainer at the same time.
   g. Take off the locking plate.

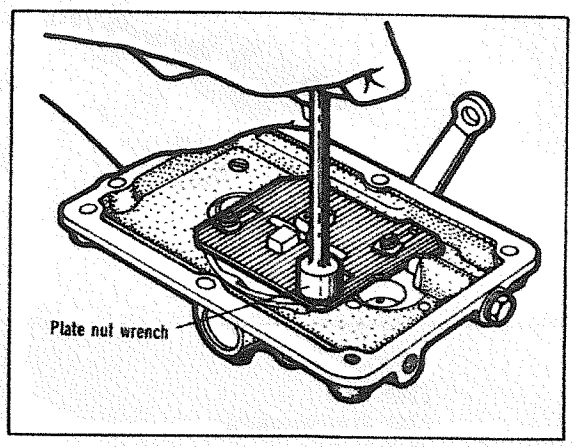


Fig. 3 Disassembling of Control Housing

6. Dismount the center brake drum.
7. Fix the mainshaft by double gear meshing, unfasten companion flange nuts and take out the companion flange.
8. Remove the center brake assembly.

   Remove the extension housing and take off the distance pipe and the speedometer drive gear.
9. Loosen setscrews fixing the reverse shift lever and the shift arm (for plunger switch), pull out the shift bar backward and remove the shift lever and the shift arm distance piece.

   As a poppet ball is provided between the shift bar and the case, pay due attention.

10. Using a punching rod, drive out the top-3rd shift bar and the 1st-2nd shift bar from the front side towards the rear and take off the shift fork and the distance piece.

    Take due caution in this case in that poppet ball and spring will leap out.

11. Remove the main drive gear bearing retainer.

12. Fix the main drive gear by double gear meshing and using the lock nut wrench MD998072 (ST7093-0), loosen main drive gear lock nuts.

    Main drive gear lock nut is provided with "left hand screw".

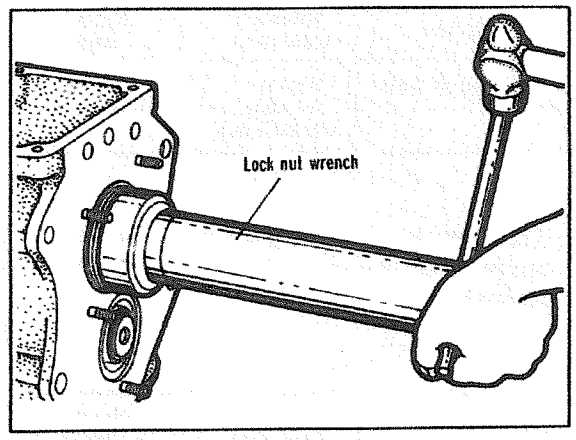


Fig. 4 Removal of Lock Nut

13. Erect the bent washer for the lock nut at the rear end of the countershaft and loosen the lock nut by means of the lock nut wrench MD998071 (ST7094-0).

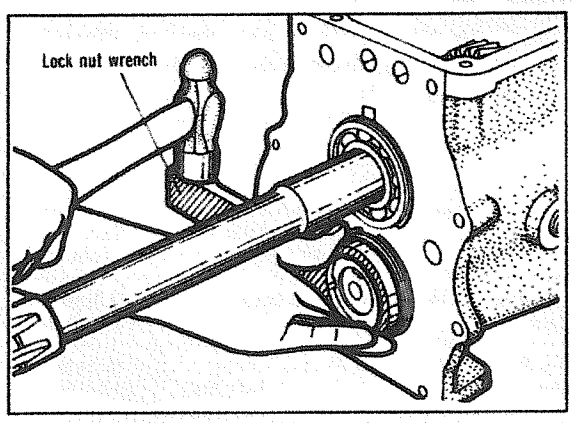


Fig. 5 Removal of Lock Nut

14. Remove snap rings from the main drive gear bearing and the mainshaft bearing.

15. Fit the synchronizer retainer MD998076 (ST 7132-0) into the top and third gears and using the bearing puller MD998056 (ST15032-1), remove the main drive gear bearing.

    The inner race of the main drive gear bearing remains on the main drive gear side.

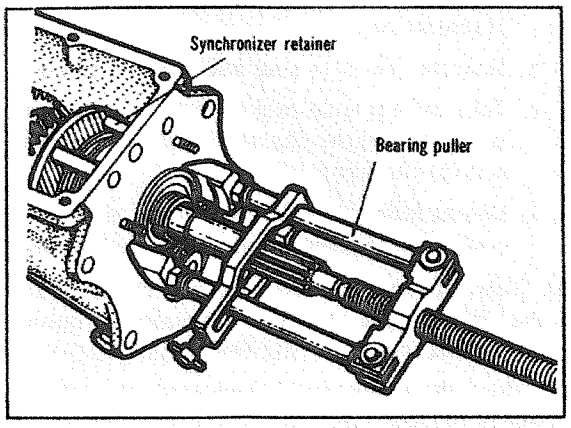


Fig. 6 Removal of Front Bearing

16. Insert the synchronizer retainer MD998076 (ST7132-0) in the same manner as in the case of pulling out the main drive gear bearing and using the bearing puller MD998056 (ST15032-1) with the bearing puller adapter MD998057 (ST15033-1) attached thereto, remove the bearing.

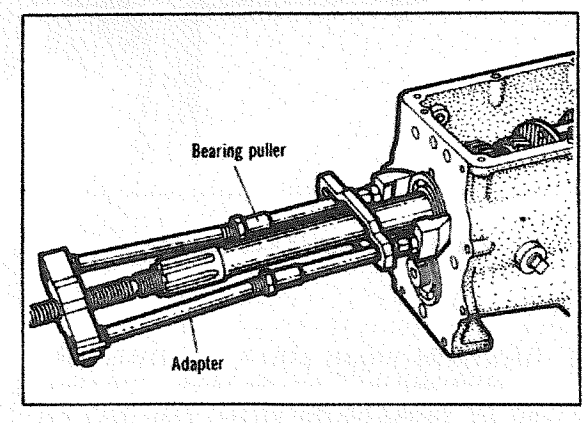


Fig. 7 Removal of Rear Bearing

17. Remove the main drive gear from the case front.
18. After sliding the main shaft assembly towards the rear part of the case, take it out of the case top.
19. Disassemble the mainshaft assembly in the following order.
    a. From behind the mainshaft, take off the spacer washer, first gear, bush, synchronizer ring, spacer synchronizer assembly and synchronizer ring.
    b. Remove the snap ring and the second gear.
    c. Take off the snap ring in front of the mainshaft and remove the synchronizer assembly and the third gear.
    d. Disassemble the removed synchronizer into synchronizer sleeve, hub, piece and spring.
20. Take off the snap ring for the countershaft rear bearing and remove the bearing by means of the bearing puller MD998056 (ST15032-1).
21. Move the countershaft backward and take it out of the case top.

    Leave the countershaft front bearing as it is attached to the case. Normally, do not remove it.

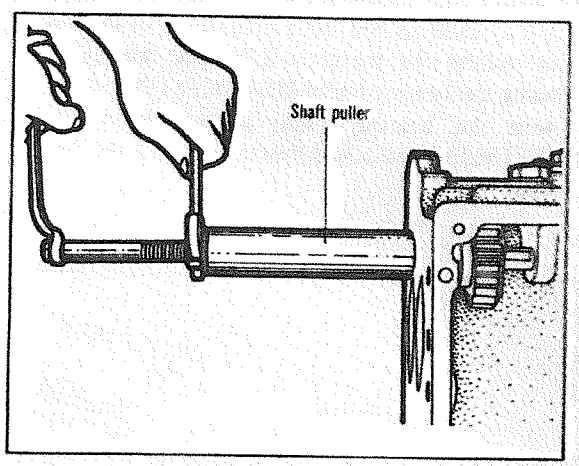


Fig. 8 Removal of Countershaft

22. Remove the stopper plate for the reverse idler gear shaft and pull out the reverse idler gear shaft by means of the reverse gear shaft extractor MD998073 (ST7051-0) and take off the reverse idler gear.

5. Inspection

Clean each of the disassembled parts, check up each part and if defective, repair or replace it.

1. The bearing being damaged or excessively worn out, not moving smoothly or making noise should be replaced.
2. Measure deflection of the mainshaft and correct or replace it when exceeding the repair limit.

Description	Standard dimension	Repair limit
Deflection of mainshaft	Within 0.03mm (0.0012 in.)	0.05mm (0.0020 in.)

3. The shift bar that is bent or in which the poppet ball groove is worn out should be replaced.

Description	Standard dimension	Repair limit
Deflection of shift bar	Within 0.04mm (0.0016 in.)	0.1mm (0.0039 in.)

4. Oil seal having flaw or being worn out or hardened due to seizure should be replaced.
5. Inspection of Gear
    a. If the tooth surface were broken, damaged or worn out excessively, the gear should be replaced.

Description	Standard dimension	Service limit
Backlash of helical gear	0.1 to 0.2mm (0.004 to 0.008in.)	0.3mm (0.012in.)
Backlash of spur gear	0.15 to 0.30mm (0.006 to 0.012in.)	0.5mm (0.020in.)
Backlash of speedometer gear	0.1 to 0.2mm (0.004 to 0.008in.)	0.5mm (0.020in.)

b. If the cone part to come into contact with the synchronizer ring were roughened or damaged, repair or replacement is required.

c. Inspect the synchronizer sleeve and the hub and if worn out excessively or damaged, replace them as an assembly.

6. Inspection of Synchronizer Ring

a. In case where ring tooth surface is damaged or the inside is remarkably worn out or partly worn out, replace the ring.

b. If the ring side of the synchronizer ring comes into contact with the gear when combined with the gear, the ring should be replaced.

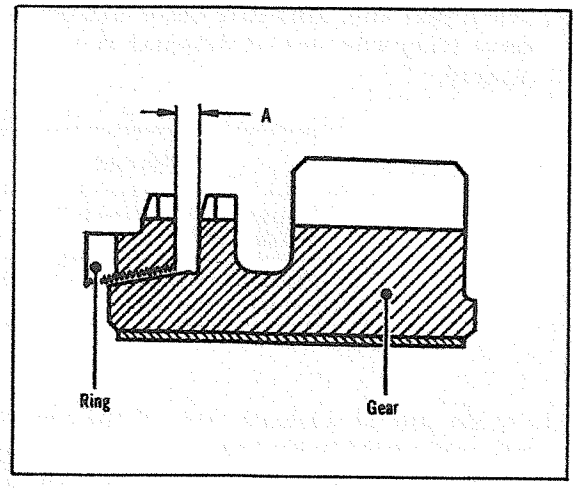


Fig. 9 Inspection of Synchronizer Ring

Description	Standard dimension (A)
Third-top side	1.16 to 1.46mm (0.046 to 0.057 in.)
First-second side	1.69 to 1.90mm (0.067 to 0.075 in.)

7. If the synchronizer piece were deformed, excessively worn out or otherwise defective, replace it.

Description	Standard dimension	Service limit
Clearance between piece and ring in the turning direction	4.0 to 4.23mm (0.157 to 0.167 in.)	5.0mm (0.197 in.)

8. Check up each spring for fatigue and out of square and if defective, replace it.

Description		Standard dimension	Service limit
Return spring (Shift shaft)	Free length	26.5mm (1.043 in.)	25mm (0.984 in.)
	Load	21 kg/16mm (46.4lbs./0.630 in.)	16 kg/16mm (35.4 lbs./0.630 in.)
	Out of square		Less than 3°
Resistance spring	Free length	48.5mm (1.909in.)	47mm (1.850in.)
	Load	3kg/45.5mm (6.6 lbs./1.791 in.)	2.3kg/45.5mm (5.1 lbs./1.791 in.)
	Out of square		Less than 3°
Poppet spring	Free length	24.1mm (0.949in.)	22.5mm (0.886 in.)
	Load	7.7kg/18.3mm (17.0 lbs./0.720 in.)	6.5kg/18.3mm (14.4 lbs./0.720 in.)
	Out of square		Less than 3°

9. The poppet ball, resistance sleeve and return sleeve being worn out or deformed should be replaced.

10. If the change lever top were excessively worn out, replace it.

Description	Standard dimension	Service limit
Clearance between change lever and each shift fork	0.4 to 0.7mm (0.016 to 0.028in.)	1.0mm (0.039in.)
Clearance between change lever and selection shaft	0.08 to 0.28mm (0.003 to 0.011in.)	0.5mm (0.020in.)

11. In the case of excessive wear of the spline part, replacement is required.

12. Check the fork part of each shift fork for wear and if excessively worn out, replace it.

Description	Standard dimension	Service limit
Clearance between 3rd-top shift fork and sleeve	0.42 to 0.66mm (0.017 to 0.026in.)	1.0mm (0.039in.)
Clearance between 1st-2nd shift fork and sleeve	0.32 to 0.58mm (0.013 to 0.023 in.)	1.0mm (0.039in.)

6. Reassembly

1. Drive the key into the reverse gear shaft, insert the shaft through the back of the transmission case, put in the reverse idler gear and drive in the shaft in aligning it with the key way.

   Note: Confirm that the gear slides smoothly.

2. When having removed the countershaft front bearing, using the countershaft front bearing installer MD998068 (ST8005-0) drive the bearing into the countershaft and fit a snap ring thereto. (Fig. 10)

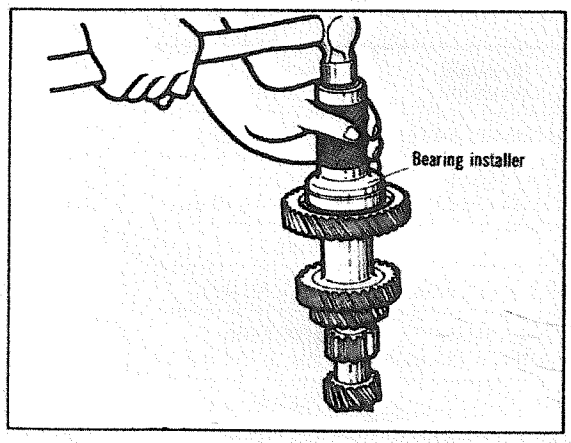


Fig. 10 Driving-in of Front Bearing

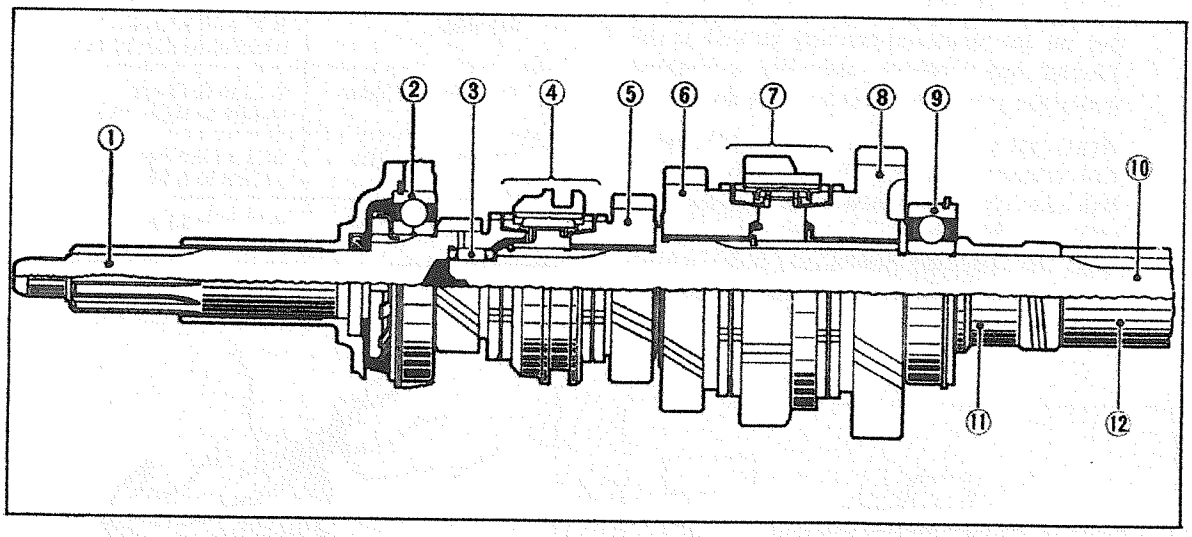
3. Insert the countershaft in the case, put a snap ring on the rear bearing and using the main drive gear bearing installer MD998069 (ST 8004-0) drive the bearing into the shaft.

4. Assemble each synchronizer assembly. Assemble it in paying due attention to proper arrangement of the synchronizer hub and the sleeve; as for the ends of front and rear springs, fit the end of the top-third synchronizer spring to the synchronizer hub hole and that of the 1st-2nd synchronizer spring (using the same piece) to the opposite side.

Difference in Synchronizer Pieces

For 1st-2nd	Total length 23.14mm (0.911 in.)	Made of sheet metal
For 3rd-top	Total length 23.14mm (0.911 in.)	Made of sintered alloy

5. Reassemble the mainshaft according to the following procedure:



(1) Main drive gear
(2) Ball bearing
(3) Needle bearing
(4) 3rd-top-synchronizer assembly
(5) Third gear
(6) Second gear
(7) 1st-2nd synchronizer assembly
(8) First gear
(9) Ball bearing
(10) Mainshaft
(11) Speedometer drive gear
(12) Distance pipe

Fig. 11 Assembling of Mainshaft

a. Insert the third gear and the synchronizer ring in the mainshaft through its front side, mount the top-3rd synchronizer assembly assembled under the preceding item and assemble them with a snap ring so selected as to set end play to the standard dimension.

Note: 1. Be careful not to turn inside out when mounting the synchronizer assembly.

2. Confirm that the synchronizer piece is placed securely in the ring groove.

Types of Snap Ring

	Thickness	Identification color
Snap ring	2.18 to 2.24mm (0.086 to 0.088 in.)	No
	2.2mm (0.083 in.)	Red
	2.4mm (0.094 in.)	White

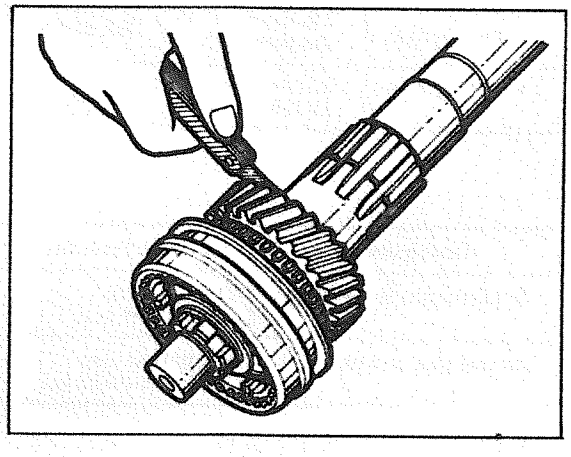


Fig. 12 Assembling of Mainshaft (1)

Description	Standard dimension
Third gear end play	0.1 to 0.2mm (0.004 to 0.008 in.)

b. Insert the second gear (1) in the mainshaft through its rear end, fit the snap ring (2) and put on the synchronizer ring as well as the 1st-2nd synchronizer assembly assembled under the preceding item and the spacer (3).

Next, put in the bush (4), press it forward and confirm end play of the synchronizer hub (5) (clearance between spacer and synchronizer hub) and if it were less or more than the specified dimension, make adjustment by increasing or decreasing the number of shims (6).

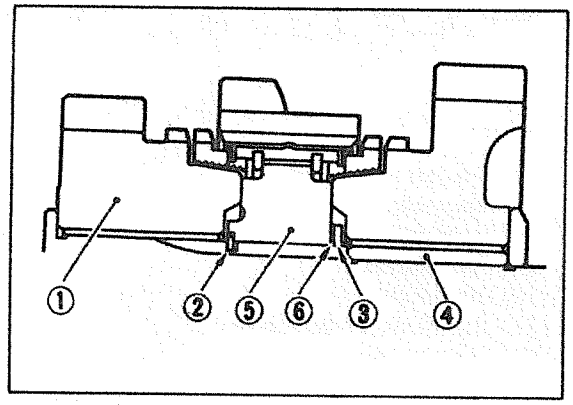


Fig. 13 Assembling of Mainshaft (2)

Description	Thickness per piece	No. of pcs.
Adjusting shim	0.1mm (0.004in.)	max. 3

Description	Specified dimension
Synchronizer hub end play	0 to 0.10 mm (0 to 0.004 in.)
Second gear end play	0.1 to 0.64 mm (0.004 to 0.025 in.)

CAUTION

- **Be careful not to turn inside out when mounting the synchronizer assembly.**
- **Confirm that the synchronizer piece is placed properly in the ring groove.**

c. Insert the synchronizer ring, first gear and spacer and confirm end play.

No. of shims (6)	1st gear end play
No shim	0.01 to 0.31mm (0.0004 to 0.0122 in.)
One piece of shim	0.11 to 0.41mm (0.004 to 0.016 in.)
Two pcs. of shim	0.21 to 0.51mm (0.008 to 0.020 in.)
Three pcs. of shim	0.31 to 0.55 mm (0.012 to 0.022 in.)

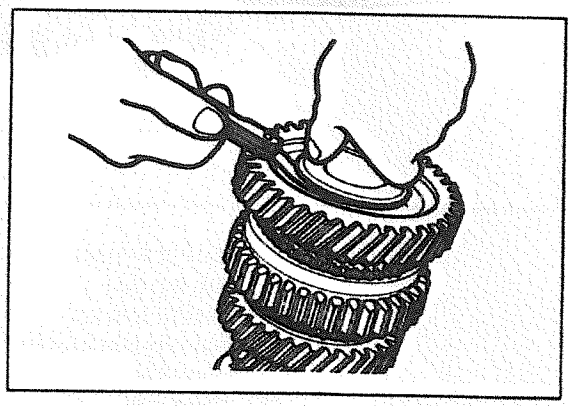


Fig. 14 Assembling of Mainshaft (3)

In the case of no shim, change bush or first gear so as to set first gear end play to a minimum of 0.05 mm (0.0020 in.)

6. Insert the mainshaft assembly assembled under the preceding item from inside the case and put the main drive gear provided with the synchronizer ring in the case from its front side and fit it to the mainshaft.

Note: In this case, put the needle bearing in the main drive gear top and apply grease thereto.

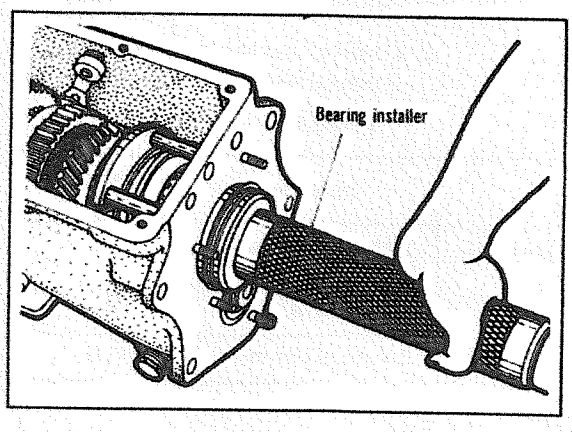


Fig. 15 Assembling of Main Drive Gear and Mainshaft (1)

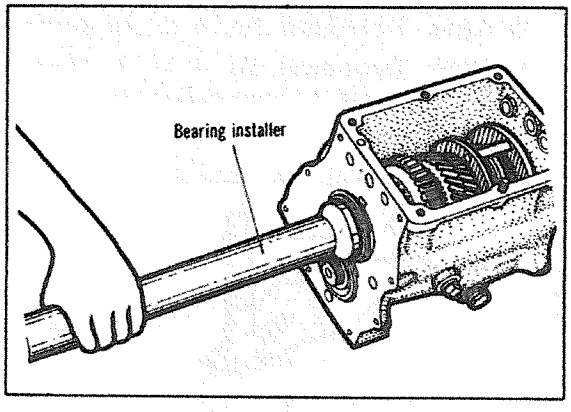


Fig. 16 Assembling of Main Drive Gear and Mainshaft (2)

7. Fit the synchronizer retainer MD998076 (ST 7132-0) in the main drive gear and the third gear and install each bearing equipped with a snap ring using the main drive gear bearing installer MD998069 (ST8004-0) on the front side and the mainshaft center bearing installer MD998067 (ST7131-0) on the rear side.
8. Fix the mainshaft by double gear meshing, tighten the lock nut at the rear end of the countershaft by means of the lock nut wrench MD998071 (ST7094-0) and apply turn-lock thereto.

   Next, tighten the main drive gear lock nut using the lock nut wrench MD998072 (ST7093-0) and apply turn-lock thereto.

   The main drive gear lock nut is provided with "left hand screw".

Parts to be tightened	Torque
Main drive gear lock nut	20 to 25 kg-m (144.6 to 183.1 ft-lbs.)
Countershaft lock nut	15 to 20 kg-m (108.5 to 144.6 ft-lbs.)

9. Mount the front bearing retainer.

   Apply Three-Bond No. 4 to the packing.

   When replacing an oil seal, press in a new oil seal using the oil seal installer MD998070 (ST 7133-0). (Fig. 17)

10. Install each shift bar.

    a. Installation of the 1st-2nd Shift Bar

       Insert the 1st-2nd shift bar from behind the case, mount the distance piece, shift fork and distance piece and in matching the key at the rear end of the shift bar with the case key hole, drive them in.

       Fit the poppet spring and ball to the shift fork with the poppet ball guide MD998075 (ST7038-1) and push out the guide by means of the shift bar, thereby the ball will be fitted in the shift bar.

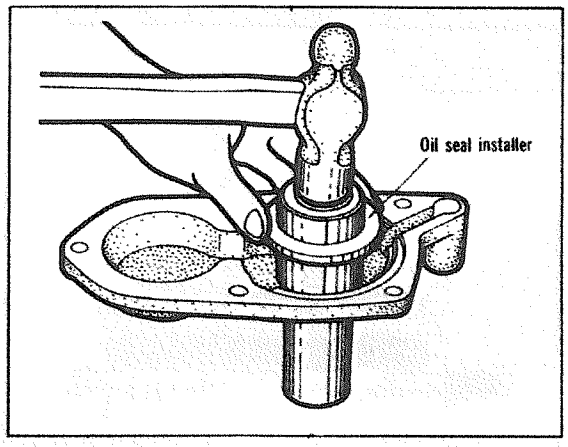


Fig. 17 Pressing-in of Front Oil Seal

    b. Installation of the Top-3rd Shift Bar

       Carry out installation in the same manner as in the case of installation of the 1st-2nd shift bar.

    c. Installation of the Reversing Shift Bar

       Insert the shift bar from behind the case and mount the distance pipe, shift arm and plunger switch shift arm in this order and position each shift arm at the required position by means of a setscrew.

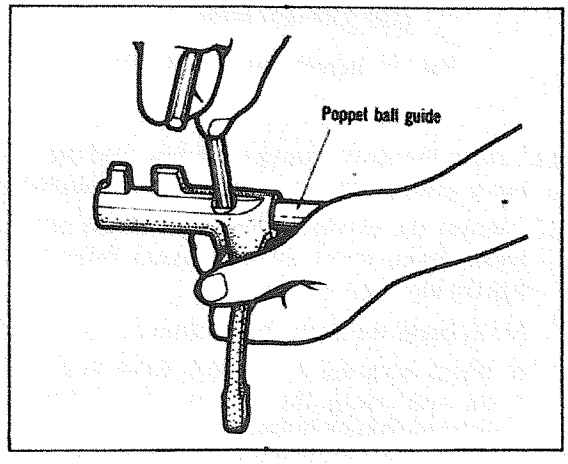
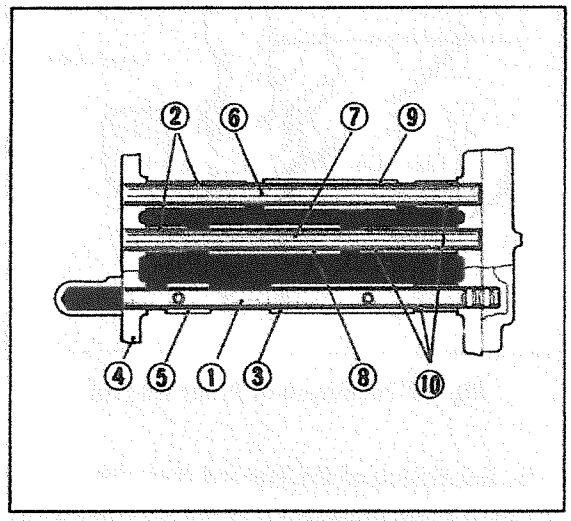


Fig. 18 Installation of Shift Bar

Types of Distance Piece

Distance piece	Length of piece	
	Front side	Rear side
Reverse side	–	28mm (1.10 in.)
3rd-top side	28mm (1.10 in.)	66mm (2.60 in.)
1st-2nd side	66mm (2.60 in.)	28mm (1.10 in.)



(1) Reversing shift bar
(2) Distance piece
(3) Reversing shift arm
(4) Transmission case
(5) Shift arm (for back light switch)
(6) 1st-2nd shift bar
(7) 3rd-top shift bar
(8) 3rd-top shift fork
(9) 1st-2nd shift fork
(10) Distance piece

Fig. 19 Installation of Shift Fork

11. Insert the speedometer drive gear and the distance piece in the rear part of the mainshaft.
12. Mount the extension housing and the center brake drum, insert the companion flange and tighten the nuts.

    Next, install the center brake drum.

    - When replacing an oil seal, drive in a new oil seal using the rear oil seal installer MD998070 (ST7133-0).
    - Apply Three-Bond No. 4 to the packing.
    - Apply Three-Bond No. 4 to the through bolts fitting in the transmission case.

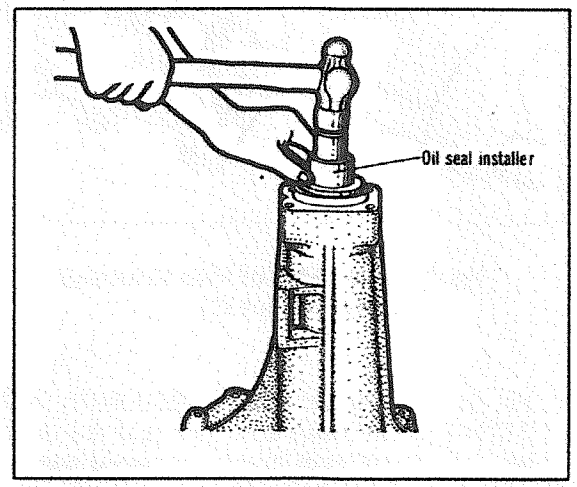
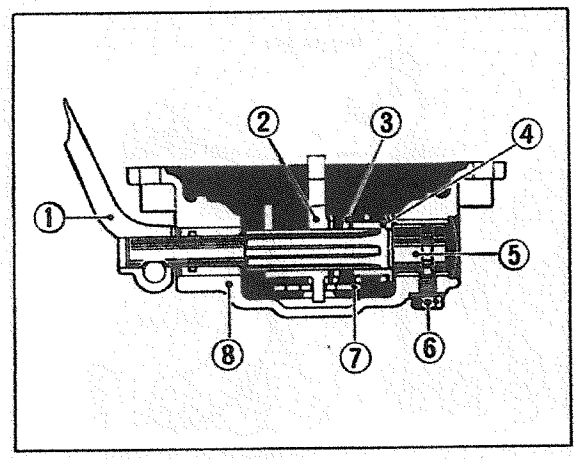


Fig. 20 Press-in of Rear Oil Seal

Part to be tightened	Torque
Companion flange nuts	Over 20kg-m (144.6 ft-lbs.)

13. Mount the speedometer driven gear.
14. Assembling the Control Housing
    a. Clamp the locking plate from inside the control housing.
    b. Apply oil to the change lever spline and insert it into the shift shaft and confirm that the lever slides smoothly.
    c. Reverse the control housing and insert the shift shaft (lever fitting side) in the left side of the housing, put in the spring retainer, return spring and change lever, fit the shift shaft to the control housing and position it with locking bolts.

       In this case, the notch of the shift lever fitting part of the shift shaft should face straight down and the change lever straight up.
    d. After inserting the shift shaft, drive in the plug.
    e. Insert the shift lever in the shift shaft and fit the locking bolt in the notch.



(1) Shift lever
(2) Change lever
(3) Return spring
(4) Spring retainer
(5) Shift shaft
(6) Locking bolt
(7) Locking plate
(8) Control housing

Fig. 21 Assembling of Control Housing (1)

f. Mount the selection shaft and fix the selection lever with locking bolts in aligning it with the notch of the shaft. In this case, tighten the bolts in such manner as to set clearance between housing and washer to the standard dimension.

Description	Standard dimension
Clearance between housing and washer	0.1 to 0.3mm (0.004 to 0.012 in.)

g. Mount the interlock plate in such manner that the notch faces forward and clamp new nuts (not to be reused) using the interlock plate nut wrench MD998074 (ST7045-0) to set clearance between plate and nut to the standard dimension. Confirm that the plate moves lightly

Description	Standard dimension
Clearance between plate and nut	0.05 to 0.2mm (0.002 to 0.008 in.)

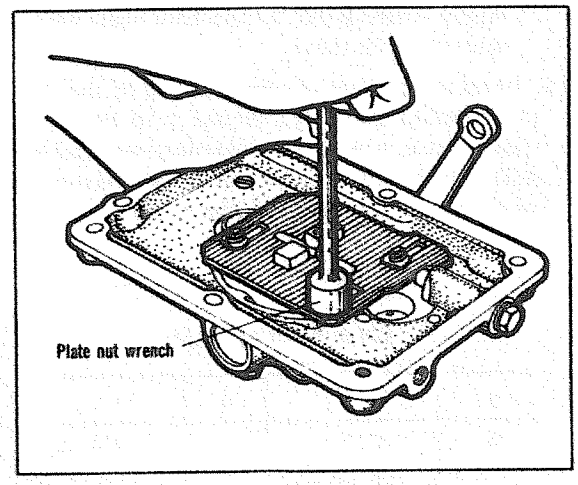


Fig. 22 Assembling of Control Housing (2)

h. Mount the resistance sleeve and the spring.

The resistance sleeve should be so mounted that at the neutral position, the top of the change lever is situated at the center of the locking plate.

In addition, adjust it by inserting shims so that both "shift" and "selection" operations can be selected smoothly.

Apply Three-Bond No. 4 to the plug.

Types of Adjusting Shim

Thickness of shim	0.3mm (0.012 in.)
	0.5mm (0.020 in.)

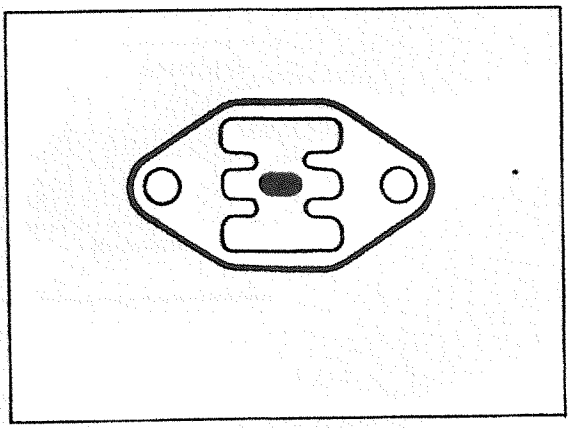


Fig. 23 Assembling of Control Housing (3)

Apply Three-Bond to the back light switch screws and fit them.

15. Upon completion of reassembling of the control housing assembly, mount it in the transmission case, operate the selection lever and the shift lever in turn and confirm movements of each gear and the lever working angles.

Lever Working Angles

a	18° 50′	d	11°
b	8° 10′	e	11°
c	30° (Canter) 21° (Rosa)	f	12°

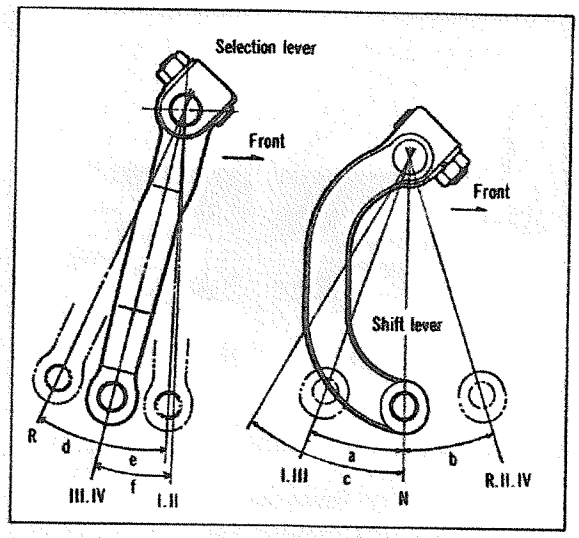


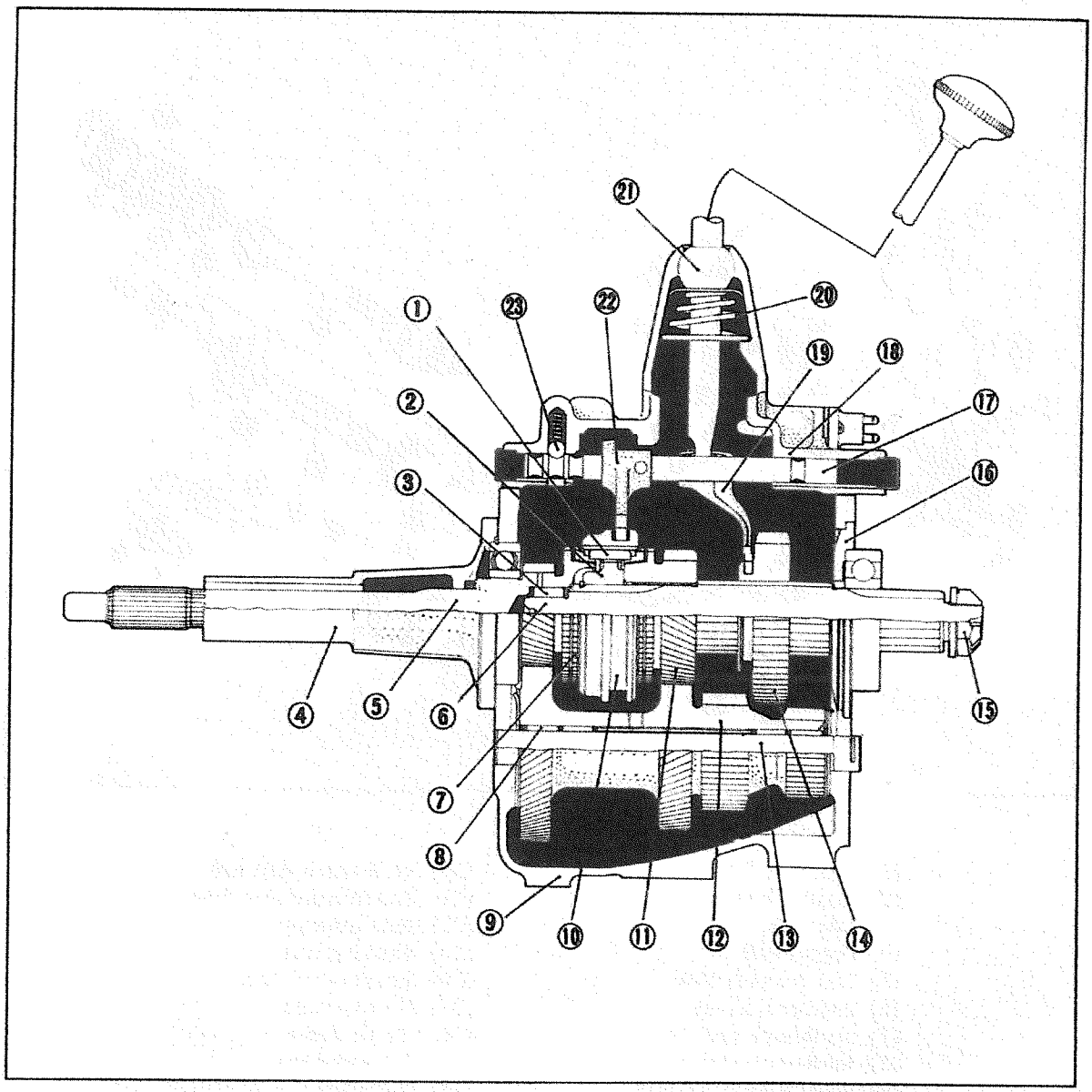
Fig. 24 Working Angle of Each Lever

SECTION 2. TRANSMISSION (Jeep)

1. Construction

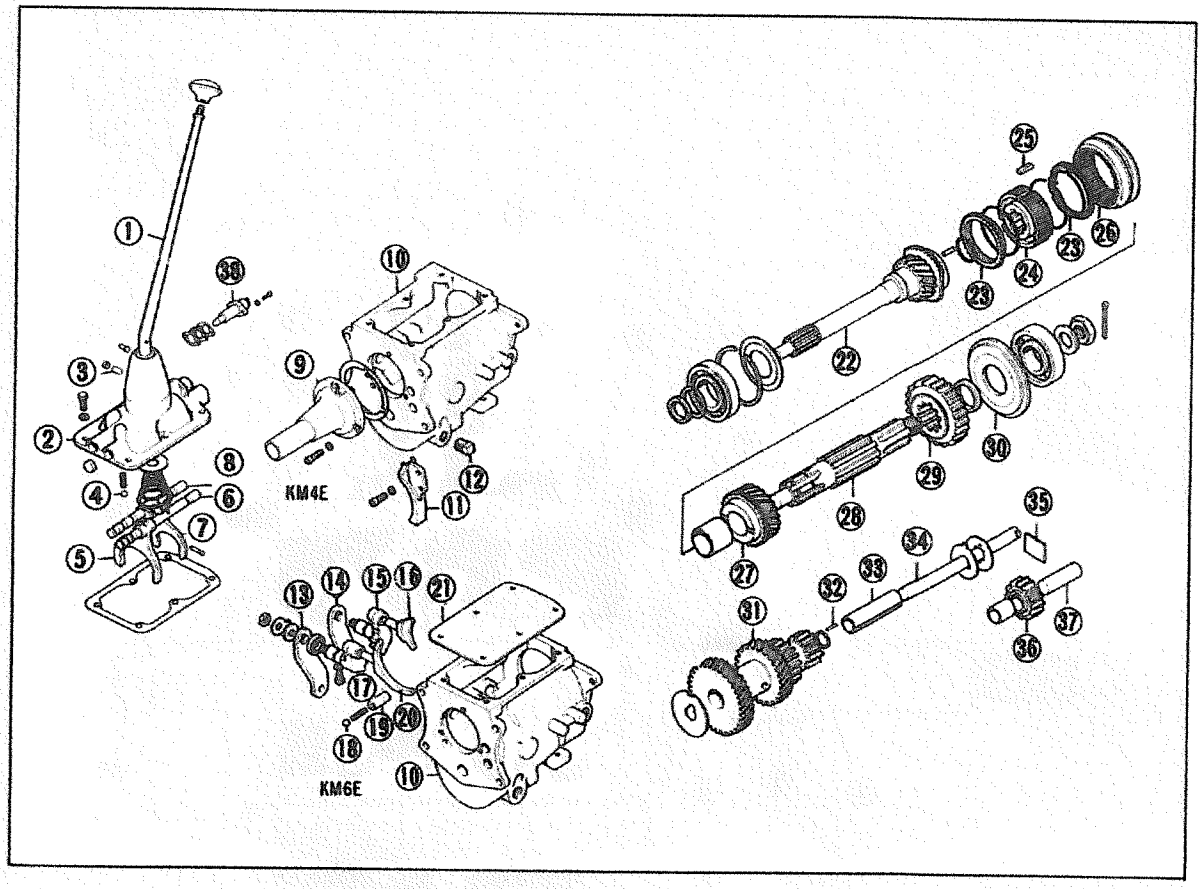
Transmission Specifications

Type		Selective-gear and 2nd-3rd constant-mesh type
Control method		Floor-shift type (KM4E) Column-shift type (KM6E)
Gear ratios	1st	2.798:1
	2nd	1.551:1
	3rd	1.000:1
	Reverse	3.798:1
Transmission oil		SAE80 to 90 1.42 lit. (3.0 U.S.pints)



(1) Shifting plate
(2) Clutch hub
(3) Roller bearing
(4) Front retainer
(5) Main drive gear
(6) Mainshaft
(7) Blocking ring
(8) Needle roller bearing
(9) Transmission case
(10) Clutch sleeve
(11) 2nd gear
(12) Counter gear
(13) Counter gear shaft
(14) 1st-Reverse sliding gear
(15) Companion flange nut
(16) Bearing adapter
(17) Shift rail
(18) Control housing
(19) 1st-Reverse shift fork
(20) Control lever spring
(21) Fulcrum ball
(22) 2nd-3rd shift fork
(23) Poppet ball

Fig. 25 Sectional View of Transmission (KM4E)



(1) Gearshift lever
(2) Control housing
(3) Interlock
(4) Poppet ball
(5) 2nd-3rd shift fork
(6) 2nd-3rd shift rail
(7) 1st-Reverse shift fork
(8) 1st-Reverse shift rail
(9) Front bearing retainer
(10) Transmission case
(11) Oil collector
(12) Drain plug
(13) 2nd-3rd control lever
(14) 1st-Reverse control lever
(15) 2nd-3rd shift lever
(16) 2nd-3rd shift fork
(17) 1st-Reverse shift lever
(18) Poppet ball
(19) Interlock sleeve
(20) 1st-Reverse shift fork
(21) Transmission case cover
(22) Main drive gear
(23) Blocking ring
(24) Synchronizer hub
(25) Shifting plate
(26) Clutch sleeve
(27) 2nd speed gear
(28) Mainshaft
(29) Sliding gear
(30) Bearing adapter
(31) Counter gear
(32) Needle bearing
(33) Distance sleeve
(34) Countershaft
(35) Lock plate shaft
(36) Reverse idler gear
(37) Reverse idler gear shaft
(38) Back light switch

Fig. 26 Exploded View of Transmission

The transmission case is made of cast iron, and attached with the flywheel housing at the front, the control housing (KM4E) or the case cover (KM6E) at the top and the transfer case at the rear end.

2. Removal

This section deals with the removal and installation of the KM4E transmission. Removal and installation of the KM6E transmission are entirely the same except for others than the control levers.

1. Remove transmission and transfer case gearshift lever balls.
2. Remove the transfer case gearshift lever grommet.
3. Remove the transmission floor plate together with the grommet.
4. Remove the control housing from the transmission case.
5. Loosen the engine stay cable and detach its rear end from the engine rear cross member.
6. Remove the brake pedal return spring from the engine rear cross member.
7. Pull off the cotter pin from the rear end of the clutch release rod and remove the rod from the lever and tube.
8. Remove the oil line from the clutch power cylinder.
9. Remove the frame bolt from the clutch control lever and tube.
10. Disconnect the lever and tube from the transmission side and disconnect the clutch cable from the clutch lever.
11. Disconnect the speedometer cable from the transfer case.
12. Detach the parking brake cable from the clip on the flywheel housing. Remove the return spring from the ring.
13. Remove the parking brake cable clevis pin by pulling off the cotter pin.
14. Remove the rear propeller shaft toward the transfer case after removing four nuts and four lock washers.
15. Lower the front propeller shaft by removing two U-bolts from the joint on the transfer case side.
16. Remove the transfer case shift lever upward by pulling off the pivot pin.
17. Support the engine oil pan with a jack through a piece of wood. Also place a jack under the engine rear cross member to receive the transmission.
18. Remove bolts, two on either side, with which the engine rear cross member is attached to the frame.
19. Remove four bolts attaching the transmission to the flywheel housing.
20. Slightly jack down the engine and the transmission and slide the transmission toward the rear of the vehicle until the main drive gear is out of the bell housing.
21. Lower the jack under the transmission and remove the transmission and transfer case as one body from the vehicle.
22. Remove support bolts from the transfer case.
23. Remove two engine rear mounting insulator attaching nuts and lock washers.

3. Installation

Installation can be done by the reverse order of removal.

4. Disassembly

4-1 Transmission and Transfer Case Disassembly

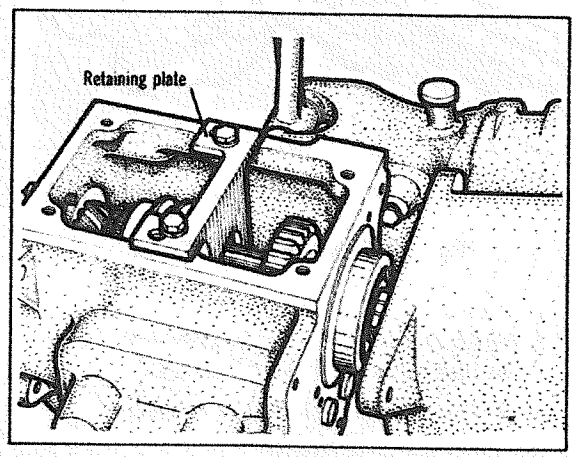


Fig. 27 Transfer Case

1. Remove transmission and transfer case drain plugs by using a special tool Plug Wrench JM 60826 to let the oil drain.
2. Remove transfer case rear cover attaching bolts and lock washers and remove the rear cover together with the gasket.

3. Remove the cotter pin, nut and washer from the transmission mainshaft.
4. Attach a special tool Mainshaft Retaining Plate W194 on the transmission to hold the mainshaft from slipping out.
5. Remove the transfer case mainshaft.
6. Remove transfer case attaching bolts and separate the transfer case from the transmission.

4-2 Transmission Body Disassembly

1. Remove the transmission main drive gear bearing retainer.
2. Remove the main drive gear and the mainshaft.
   a. Loosen the oil collector bolt by means of a screw driver.
   b. Use a special tool Bearing Puller MD998056 and MD998057 (ST15032-1 and ST15033) to remove the front bearing of the main drive gear.

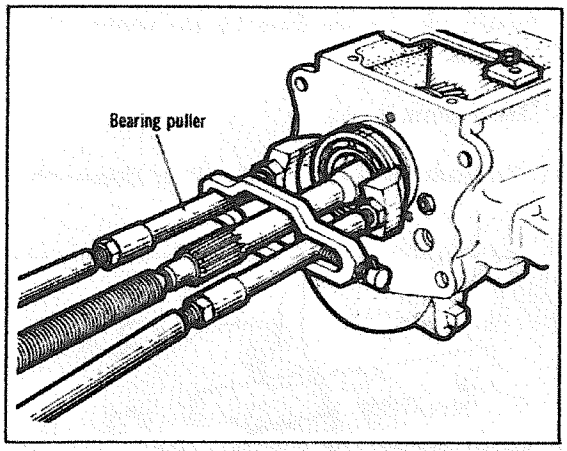


Fig. 28 Removing the Bearing

   c. When removing the main drive gear, be careful not to drop 14 roller bearings.
   d. Remove the mainshaft gear assembly.
3. Removal of Countershaft
   a. Using a brass bar, drive the countershaft about 10 mm (0.394 in.) out rearward.
   b. Using a special tool Countershaft Installer W166, drive out the transmission countershaft toward the rear.

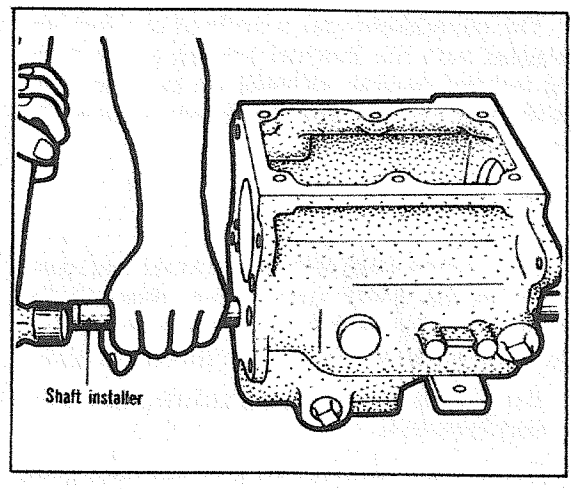


Fig. 29 Driving out the Countershaft

4. Removing the Countershaft Gear and Roller Bearing Spacer.
5. Removing the Reverse Idler Gear

   Drive the reverse idler gear shaft toward the rear of the case, using a driver.

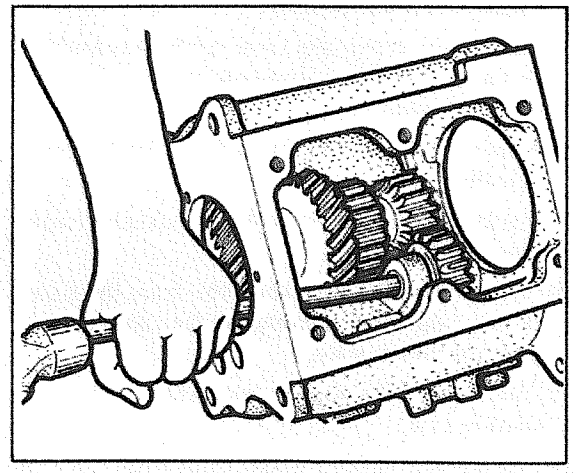


Fig. 30 Removing the Reverse Idler Gear

4-3 Control Mechanism Disassembly

Remove shift forks and rails.

When the shift rails are removed, the poppet ball may jump out. To prevent this, slowly draw the rail out with your hand placed on the ball hole in the control housing. Use care not to lose the ball and poppet spring.

5. Reassembly

1. Reassembly can be done by reversing the order of disassembly. When assembling, observe the following cautions.

   Move the control levers to their operating position and see if the shift rails properly move.

2. Apply grease to 22 countershaft needle roller bearings.

   Install them in one row inside of the countershaft bore and see if they are fitted properly.

   a. Using a special tool Bearing Sleeve W166, push the bearing into the gear.

   b. Adjust the countershaft gear-to-transmission case end play to the specified size by installing a selective-fit countershaft rear thrust washer (steel).

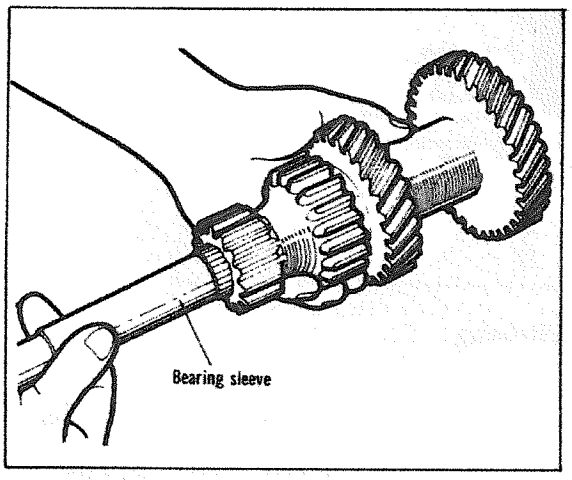


Fig. 31 Installing the Bearing

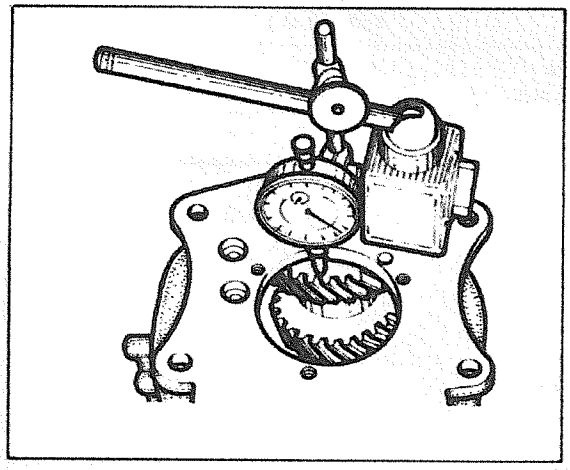


Fig. 32 Countershaft End Play

3. Use a special tool Bearing Installer ST7134-0 to install the main drive gear. Install a snap ring of proper size so that it will be tight in the groove of the main drive gear.

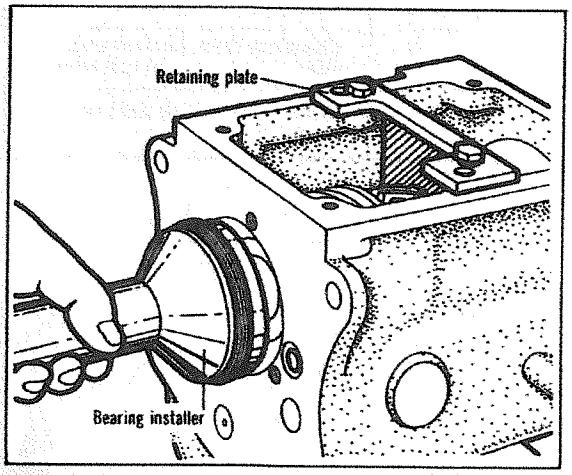


Fig. 33 Installing the Main Drive Gear Bearing

4. Use a special tool Bearing Installer 610213-0 to install the mainshaft bearing.

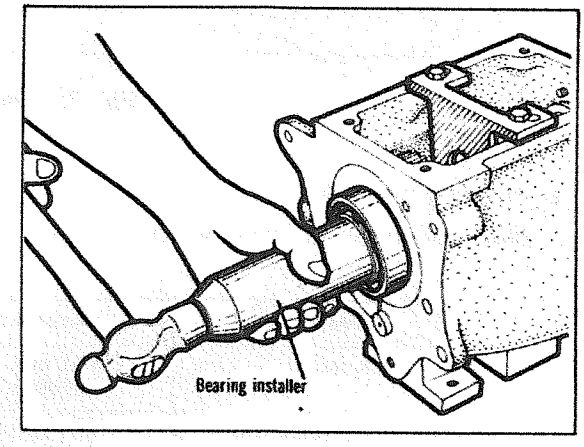


Fig. 34 Installing the Mainshaft Bearing

5. When assembling the synchronizer, clean and check the clutch sleeve and hub. Assemble them and see if they slide smoothly. Attach the synchronizer spring end to one of the three synchronizer shifting plates. The front and rear springs must be installed to the same plate, in the opposite directions.

6. Inspection

1. Checking the Control Housing (KM4E)

a. Control Levers and Shift Rails

Make the following checks and replace the part that is defective.

Sign	Description	Standard dimension	Service limit
A	Clearance from forward end of control lever to shift rail groove	0.08 to 0.28 mm (0.003 to 0.011 in.)	1.0 mm (0.039 in.)
B	Control housing-to-shift rail clearance	0.05 to 0.12 mm (0.002 to 0.005 in.)	0.2 mm (0.008 in.)

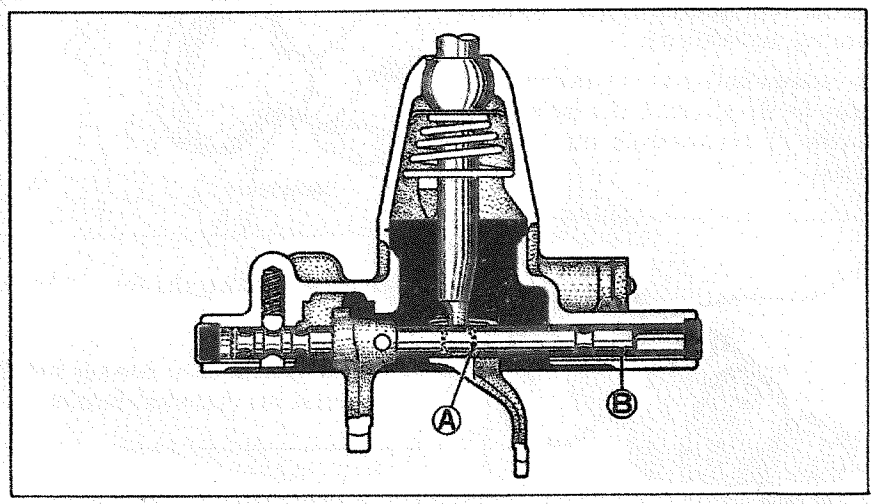


Fig. 35 Control Housing

b. Control Lever Springs

Make checks on the following descriptions and replace the spring that is defective.

Description	Standard dimension	Repair limit
Free length	50.8 mm (2.000 in.)	±4 mm (±0.157 in.)
Compression load	18.1 kg/33.3 mm (30.0 lbs./1.311 in.)	13.5 kg/33.3 mm (29.8 lbs./1.311 in.)
Squareness		3°

c. Poppet Springs

Check the following descriptions and replace the spring that is defective.

Description	Standard dimension	Repair limit
Free length	23.8 mm (0.937 in.)	±2 mm (±0.079 in.)
Compression load	10.0 to 11.8 kg/18.3 mm (22.1 to 26.1 lbs./0.720 in.)	8.5 kg/18.3 mm (18.8 lbs./0.720 in.)
Squareness		3°

2. Checking the Control Housing (KM6E)

a. Select a proper shift lever interlock sleeve so that the sleeve-to-lever clearance is 0.03 to 0.08 mm (0.001 to 0.003 in.) when either shifting lever is engaged.

Length of sleeve: 32.69, 32.79, 32.89, 32.99 and 33.10mm (1.288, 1.291, 1.295, 1.300 and 1.303 in.)

b. Make the following checks on the poppet springs. Replace the spring that is defective.

Description	Standard dimension	Repair limit
Free length	29.8 mm (1.173 in.)	±2 mm (±0.079 in.)
Compression load	4.08 kg/23.8 mm (9.0 lbs./0.937 in.)	3 kg/23.8 mm (6.6 lbs./0.937 in.)
Squareness		3°

3. Checking the Main Drive Gear and Mainshaft

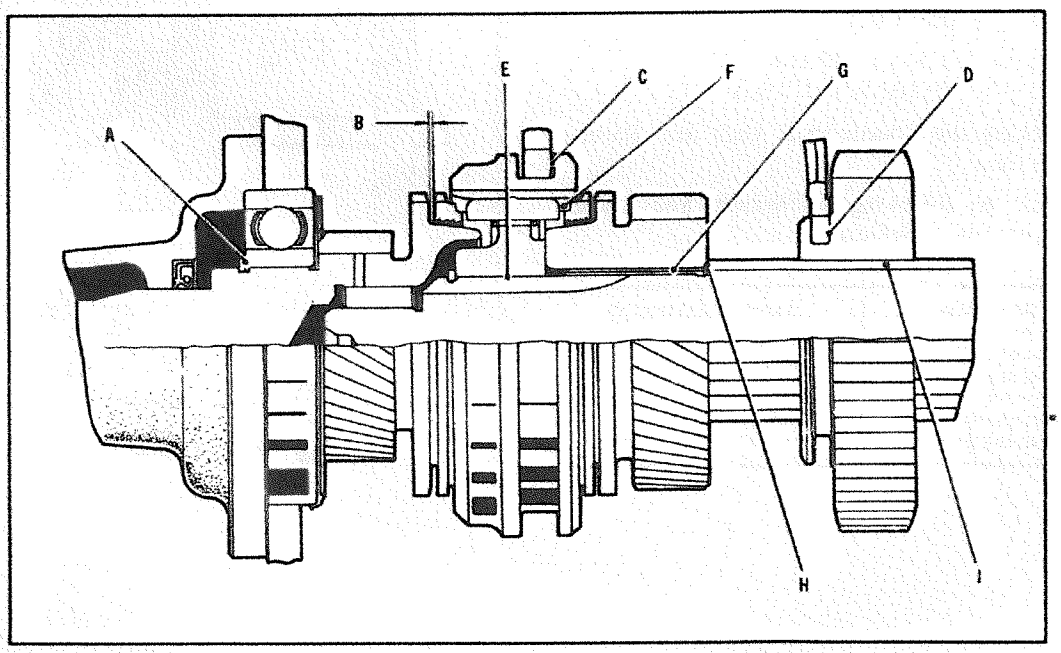


Fig. 36 Main Drive Gear and Mainshaft

Check the following descriptions and replace the part that is defective.

Sign	Description	Standard dimension	Service limit
A	Front bearing end play	0	Adjust by means of selective snap ring
B	Blocking ring-to-gear clearance	1.40 to 1.19 mm (0.055 to 0.047 in.)	
C	Clutch sleeve-to-gear clearance	0.66 to 0.41 mm (0.026 to 0.016 in.)	1.0 mm (0.039 in.)
D	1st-Reverse sliding gear-to-shift fork clearance	0.13 to 0.37 mm (0.005 to 0.015 in.)	1.0 mm (0.039 in.)
E	Clutch hub-to-mainshaft spline clearance in direction of rotation	0.051 to 0.127 mm (0.002 to 0.005 in.)	0.2 mm (0.008 in.)
F	Clutch hub-to-clutch sleeve clearance in direction of rotation	0 to 0.03 mm (0 to 0.001 in.)	0.1 mm (0.004 in.)
G	Mainshaft-to-2nd speed gear clearance	0.04 to 0.07 mm (0.002 to 0.003 in.)	0.15 mm (0.006 in.)
H	2nd speed gear end play	0.13 to 0.41 mm (0.005 to 0.016 in.)	1.0 mm (0.039 in.)
I	Mainshaft-to-1st-Reverse sliding gear clearance	0.08 to 0.15 mm (0.003 to 0.006 in.)	0.3 mm (0.012 in.)

Kinds of front bearing and play adjusting snap rings:

Thickness: 2.18 to 2.24 mm, 2.26 to 2.31 mm, (0.086 to 0.088 in.), (0.089 to 0.091 in.),

2.34 to 2.39 mm, 2.44 to 2.49 mm, (0.092 to 0.094 in.), (0.096 to 0.098 in.),

2.54 to 2.59 mm (0.100 to 0.012 in.)

4. Checking the Countershaft Gear and Reverse Idler Gear

Check the following descriptions and replace the part that is defective.

Description	Standard dimension
Countershaft gear end play	0.13 to 0.37 mm (0.005 to 0.015 in.)
Reverse idler gear end play	0.13 to 0.35 mm (0.005 to 0.013 in.)

5. Number of Gear Teeth, and Gear Backlash

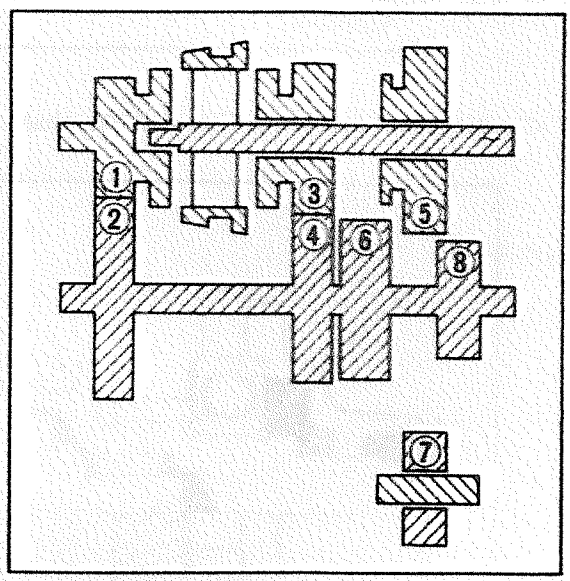


Fig. 37 Gear Backlash

Gear	No. of teeth
1	18
2	33
3	22
4	26
5	29
6	19
7	16
8	14

Gear combination	Backlash
1 and 2	0.08 to 0.15 mm (0.003 to 0.006 in.)
3 and 4	0.08 to 0.15 mm (0.003 to 0.006 in.)
5 and 6	0.10 to 0.20 mm (0.004 to 0.008 in.)
5 and 7	0.10 to 0.20 mm (0.004 to 0.008 in.)
7 and 8	0.10 to 0.20 mm (0.004 to 0.008 in.)

GROUP 9B

TRANSFER

(Jeep)

CONTENTS

SECTION 1. TRANSFER

1. Construction

The transfer case is a two-speed auxiliary gear box installed at the rear of the transmission, and is provided with a low-speed gear and a directly-coupled gear. Its purpose is to transfer power from the transmission to the front driving axle. It has also a mechanism to disconnect the flow of power.

At the front of the transfer case is installed the front bearing cap, to which two long and short shift levers (KM4E) or one shift lever (KM6E) are connected to change gear engagement.

The left-hand long lever used in the KM4E model is used to change the flow of power to the front driving axle, while the right-hand short lever is for changing to a low-speed gear. The short lever is operable only when the front axle driving lever is provided.

In the case of the KM6E transmission, the single lever has the same functions as the two levers used in the KM4E. Namely it is used in two ways.

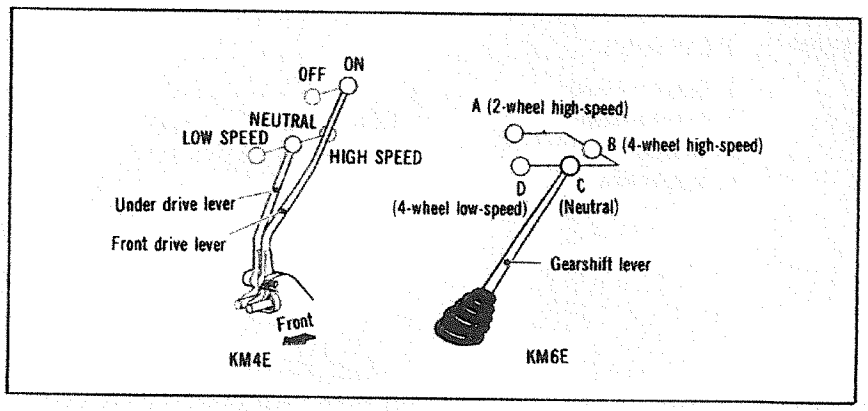
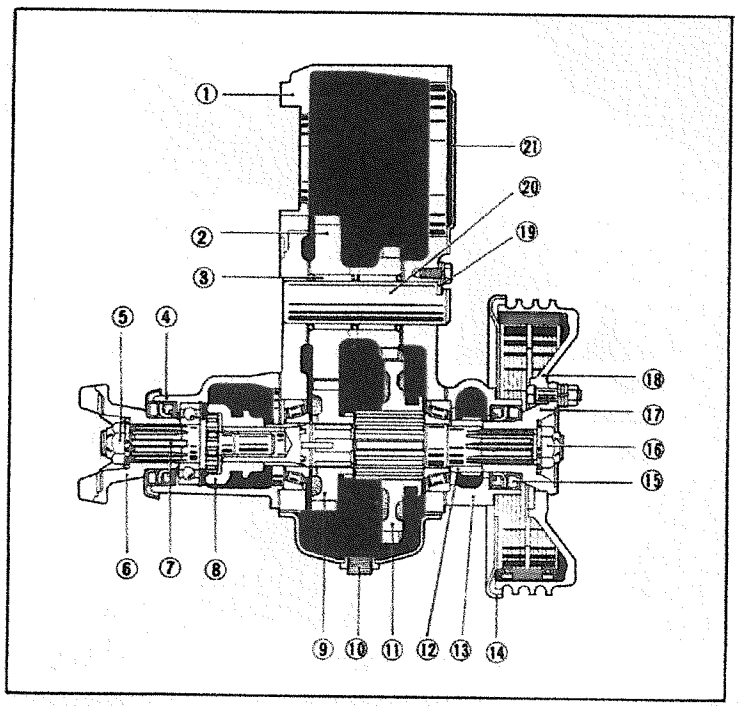


Fig. 1 Transfer Control Lever

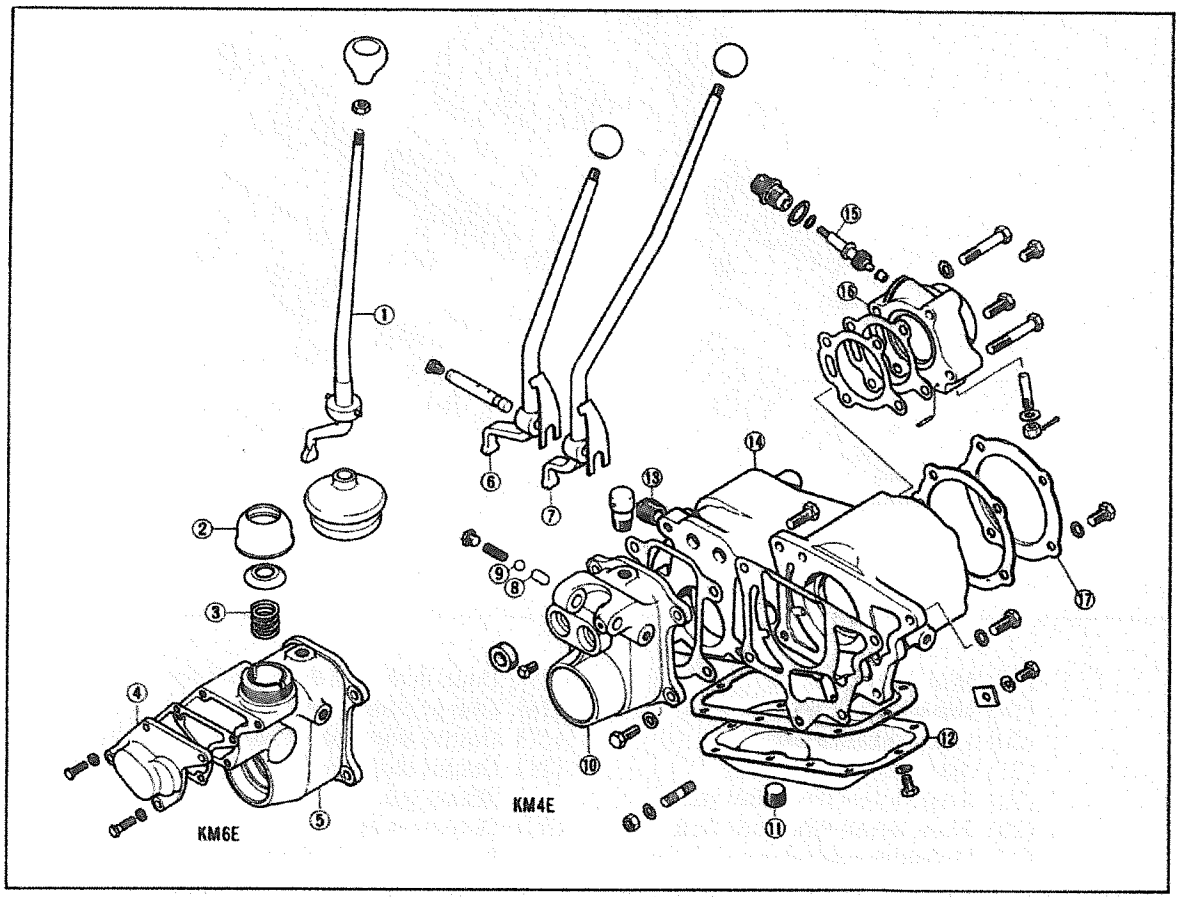


(1) Transfer case
(2) Intermediate gear
(3) Bearing roller
(4) Front cap
(5) Companion flange nut
(6) Companion flange
(7) Output clutch shaft
(8) Output clutch shaft gear
(9) Output gear
(10) Drain plug
(11) Sliding gear
(12) Speedometer drive gear
(13) Rear cap
(14) Brake assembly
(15) Felt seal
(16) Companion flange nut
(17) Companion flange
(18) Brake drum
(19) Lock plate
(20) Intermediate shaft
(21) Rear cover

Fig. 2 Details of Transfer Case

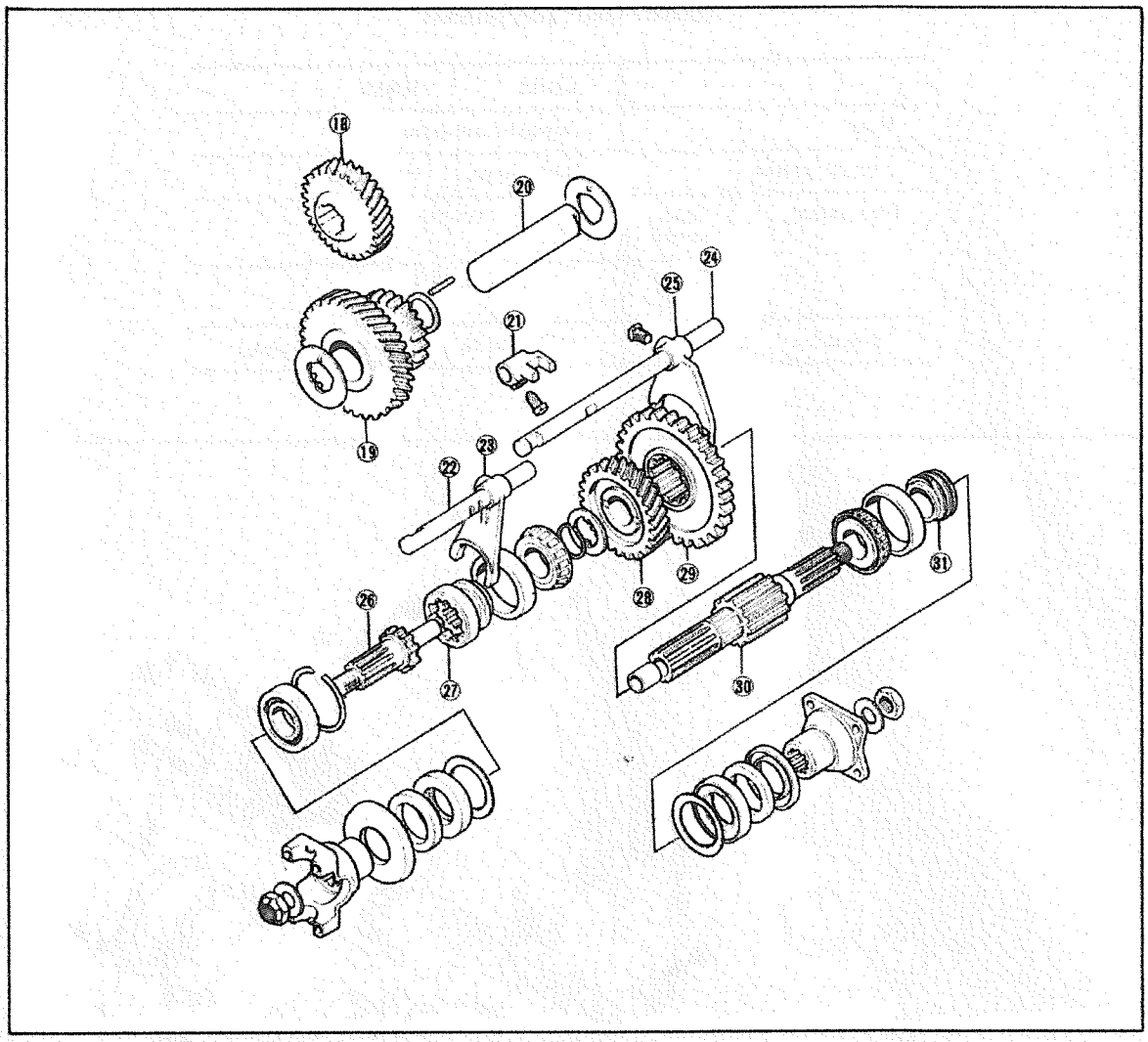
Transfer Case Specifications

		KM4E	KM6E
Type		2-speed front-drive	
Control system		2-lever type	1-lever type
Gear ratios	High speed	0.933:1	
	Low speed	2.384:1	
Oil used		SAE80 to 90, 1.66 lit. (3.5U.S.pints)	



(1) Control lever
(2) Control housing cap
(3) Control lever support spring
(4) Bearing cap cover
(5) Control housing
(6) Underdrive shift lever
(7) Front wheel drive shift lever
(8) Shift rod interlock
(9) Poppet ball
(10) Output shaft front cap
(11) Drain plug
(12) Bottom cover
(13) Pipe plug
(14) Transfer case
(15) Speedometer driven gear
(16) Output shaft gear bearing cap
(17) Rear cover

Fig. 3 Exploded View of Transfer Case (1)



(18) Mainshaft gear
(19) Intermediate gear
(20) Intermediate shaft
(21) Shift arm
(22) Front wheel drive shift rod
(23) Front wheel drive shift fork
(24) Underdrive and direct shift rod
(25) Underdrive and direct shift fork
(26) Output clutch shaft
(27) Output clutch shaft gear
(28) Output shaft gear
(29) Sliding gear
(30) Output shaft
(31) Speedometer drive gear

Fig. 4 Exploded View of Transfer Case (2)

2. Disassembly

1. Remove the parking brake drum and the companion flange.
2. Remove the output shaft rear bearing cap.
3. Remove the output shaft front bearing cap.
4. Drive the intermediate shaft out toward the opposite side of the transfer case lock plate by using a brass adapter and remove the intermediate gear.

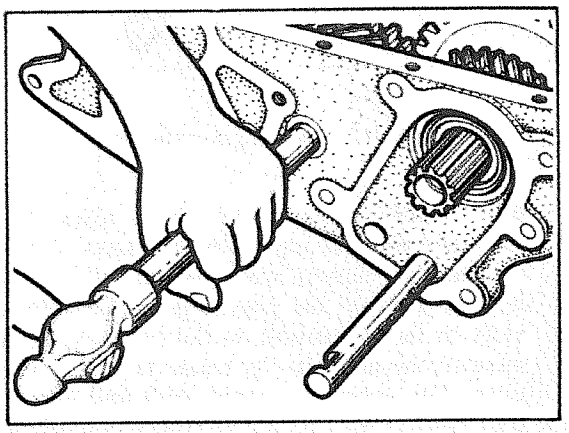


Fig. 5 Removing the Intermediate Gear

5. Drive the output shaft out toward the opposite side of the threads. Separate the shaft from the output shaft bearing cap.
6. To disassemble the output shaft gear and bearing, use a special tool Removing Wedge W139. Drive the tool in between the gear and the bearing until the bearing comes off from the shaft.

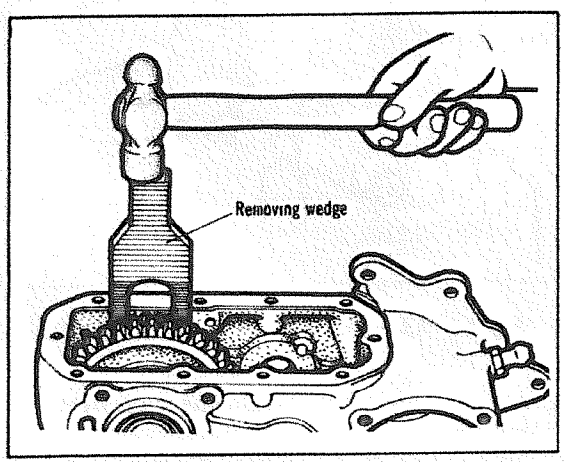


Fig. 6 Removing the Output Shaft Gear

7. To remove the bearing cap, drive in the special tool Removing Tool W141 between the output shaft gear and the bearing and drive the shaft out from rear by using a soft hammer.

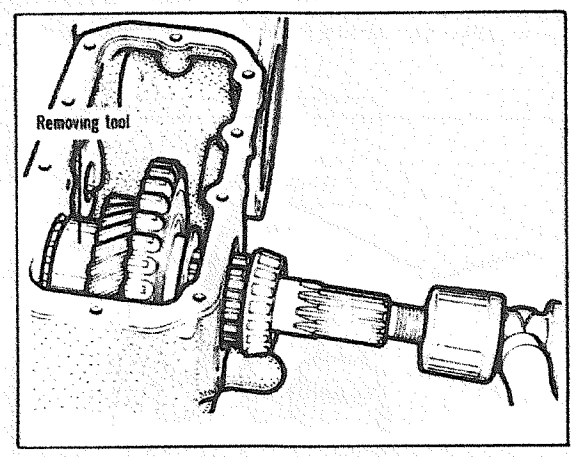


Fig. 7 Removing the Bearing

8. Do not remove the output shaft clutch shaft pilot bushing except when it has a damage or any other flaw.
9. Disassembling the underdrive shift fork and shaft.
10. Remove the front wheel drive shift fork and rod.
11. Remove the output clutch shaft bearing.
12. Remove the output shaft front oil seal.
13. Remove the shift rod oil seal by using a special tool Oil Seal Puller W176.

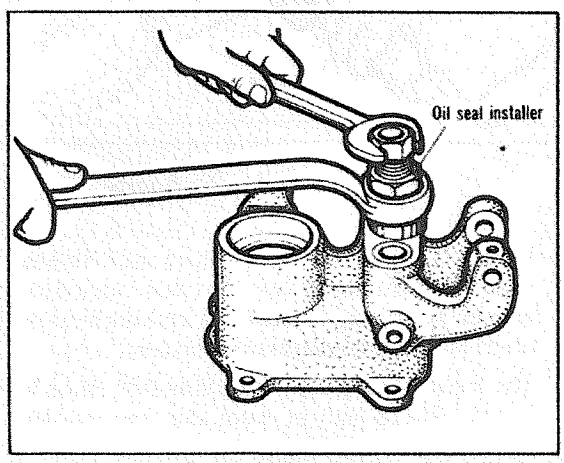


Fig. 8 Removing the Oil Seal

3. Reassembly

Reassembly can be done by the reverse order of disassembly. When assembling, observe the following items.

1. Use a special tool Oil Seal Installer ST7135-0 to drive the oil seal into the front bearing cap.

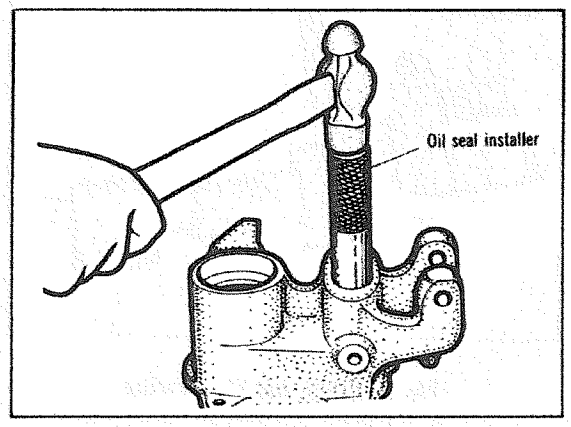


Fig. 9 Installing the Oil Seal

2. Use a special tool Bearing Installer ST7136-0 to install the bearing onto the output clutch shaft and the output shaft.

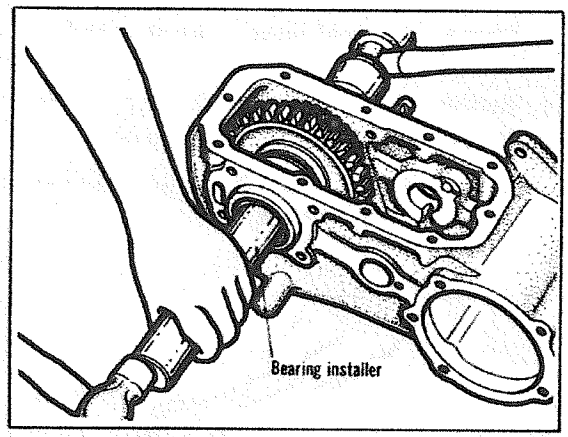


Fig. 10 Installing the Bearing

3. Install the front and rear output shaft bearing caps into the transfer case. The rear bearing cap should be driven in until its end slightly extends out of the transfer case surface.

   The front bearing cap, when installed, must be 3 mm (0.118 in.) in from the case surface.

4. Install the output shaft oil seal by using a special tool Oil Seal Installer W143.

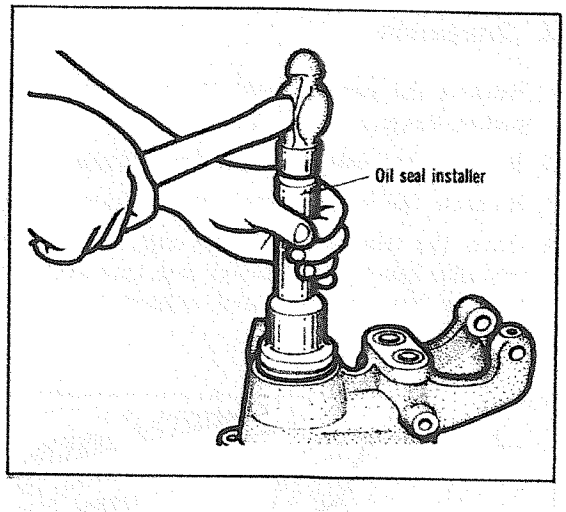


Fig. 11 Installing the Oil Seal

5. After installing the output shaft, adjust the shaft end play. To adjust, insert a screw driver between the output shaft gear and the transfer case and pry the gear to press the output shaft as far as possible to the other end and measure the end play by means of a dial indicator. The specified output shaft end play is 0.05 to 0.15 mm (0.002 to 0.006 in.). Adjust the end play if necessary, by increasing or decreasing the bearing cap shim. Where there is the specified end play, remove the output shaft rear bearing cap, apply THREE-BOND to the shim, and tighten the bearing cap together with the center brake assembly.

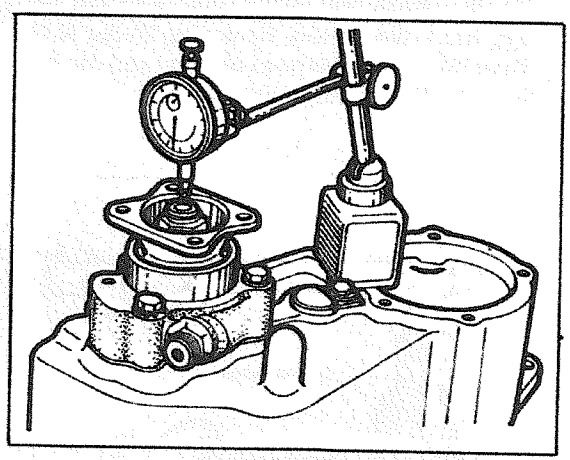


Fig. 12 Adjusting the Output Shaft End Play

6. Attach a felt seal to the companion flange oil seal guard.
   Apply grease to the surface which contacts the seal.

7. Apply heat-resisting grease to the flange surface which the oil seal contacts. Insert the flange assembly onto the output shaft splines. Then tighten the companion flange nut to a more than 20 kg-m (145 ft-lbs.) torque.

8. Attach a felt seal in the inner surface of the front yoke dust seal and apply a heat-resisting grease to the oil seal contacting surface.

   Also apply the grease to the oil seal contacting surface of the yoke, insert the yoke assembly onto the output clutch shaft splines, and tighten the companion flange nut to a more than 20 kg-m (145 ft-lbs.) torque.

4. Inspection

1. Check the following points and replace any defective part.

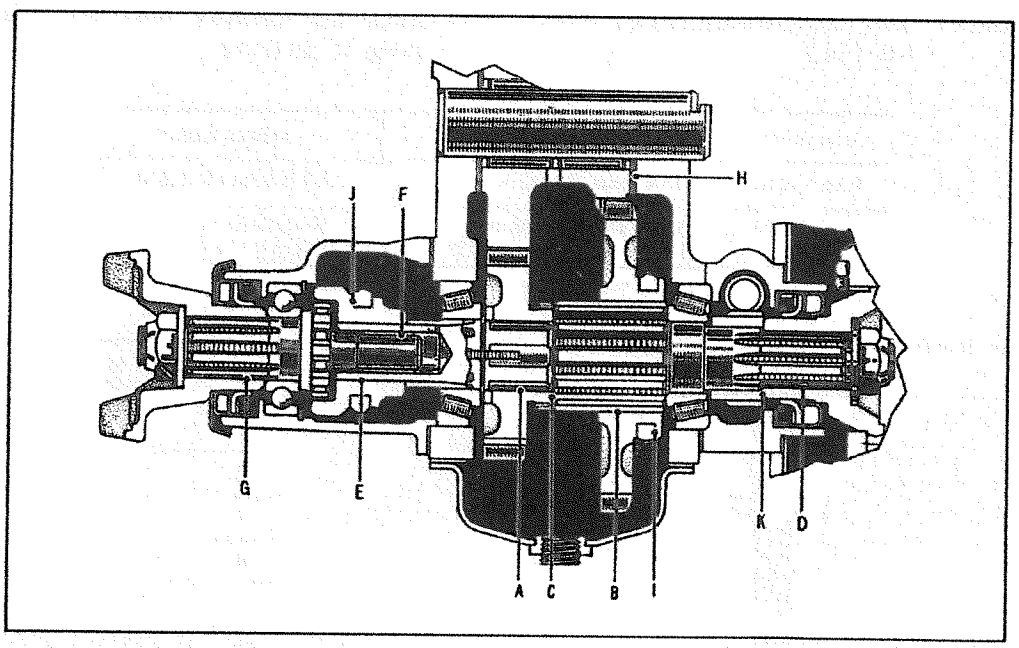


Fig. 13 Transfer Check Points

Sign	Description	Standard dimension	Service limit
A	Output shaft-to-output shaft gear clearance	0.038 to 0.064 mm (0.0015 to 0.0025 in.)	0.15 mm (0.0059 in.)
B	Output shaft-to-sliding gear clearance in direction of rotation	0.1 to 0.18 mm (0.0039 to 0.0071 in.)	0.5 mm (0.0197 in.)
C	Output shaft-gear end play	0.58 to 0.20 mm (0.0228 to 0.0079 in.)	1.0 mm (0.0394 in.)
D	Output shaft-to-companion flange clearance (rear) in direction of rotation	0.025 to 0.013 mm (0.0010 to 0.0005 in.)	0.05 mm (0.0020 in.)
E	Output shaft-to-output clutch shaft and gear clearance in direction of rotation	0.14 to 0.038 mm (0.0055 to 0.0015 in.)	0.3 mm (0.0118 in.)
F	Output clutch shaft gear-to-bushing clearance	0.08 to 0.038 mm (0.0031 to 0.0015 in.)	0.1 mm (0.0039 in.)
G	Output clutch shaft-to-companion flange clearance (front) in direction of rotation	0.064 to 0.013 mm (0.0025 to 0.0005 in.)	0.15 mm (0.0059 in.)
H	Intermediate gear end play	0.43 to 0.15 mm (0.0169 to 0.0059 in.)	1.0 mm (0.0394 in.)

Sign	Description	Standard dimension	Service limit
I	Sliding gear groove-to-fork clearance	0.12 to 0.40 mm (0.0047 to 0.0157 in.)	1.0 mm (0.0394 in.)
J	Output clutch shaft gear groove-to-fork clearance	0.12 to 0.40 mm (0.0047 to 0.0157 in.)	1.0 mm (0.0394 in.)
K	Output shaft end play	0.05 to 0.15 mm (0.0020 to 0.0059 in.)	Adjust by means of shim

Kinds of output shaft bearing cap rear shims:

Thickness: 0.08, 0.25, 0.8mm (0.003, 0.010, 0.031 in.)

2. Poppet Spring

Check the following items and replace the spring if defective.

Description	Standard dimension	Service limit
Free length	23.67 mm (0.932 in.)	±0.2 mm (±0.008 in.)
Load/length	11 to 15 kg/17.86 mm (24.3 to 33.2 lbs./0.703 in.)	9 kg/17.86 mm (19.9 lbs./0.703 in.)

3. Gear Backlash

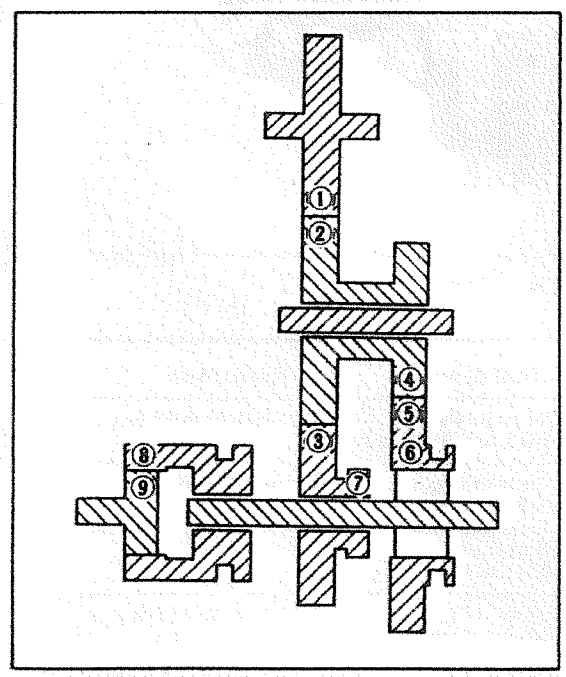


Fig. 14 Gear Backlash

Gear	No. of teeth
1	30
2	39
3	28
4	18
5	33
6	12
7	12
8	10
9	10

Gear combination	Backlash
1 and 2	0.08 to 0.15 mm (0.003 to 0.006 in.)
3 and 4	0.08 to 0.15 mm (0.003 to 0.006 in.)
5 and 6	0.10 to 0.20 mm (0.004 to 0.008 in.)
5 and 7	0.10 to 0.20 mm (0.004 to 0.008 in.)*
7 and 8	0.10 to 0.20 mm (0.004 to 0.008 in.)

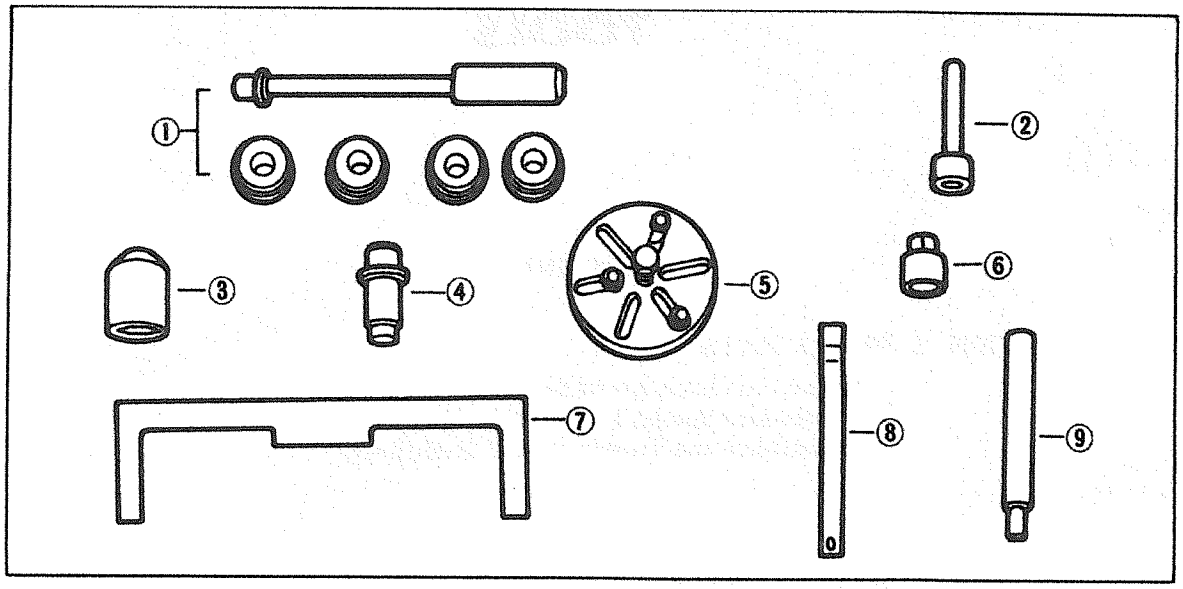
GROUP 21

TOOLS

CONTENTS

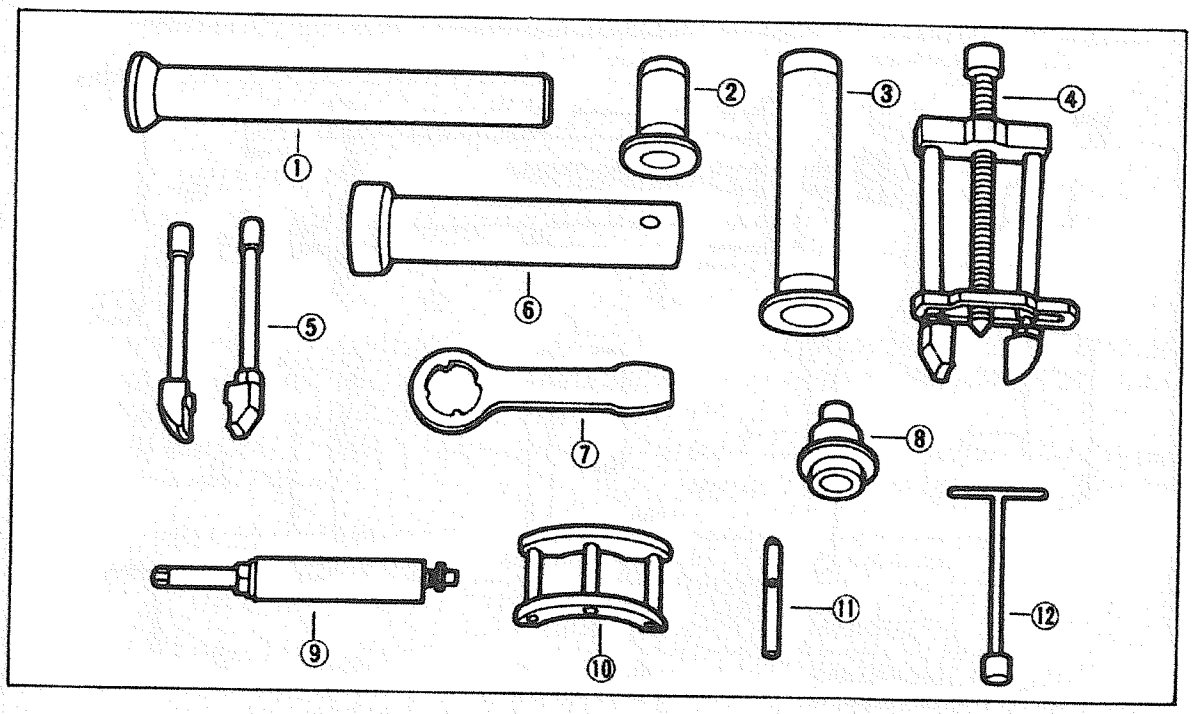
SECTION 1. SPECIAL TOOLS

1. Engine and Clutch Special Tools



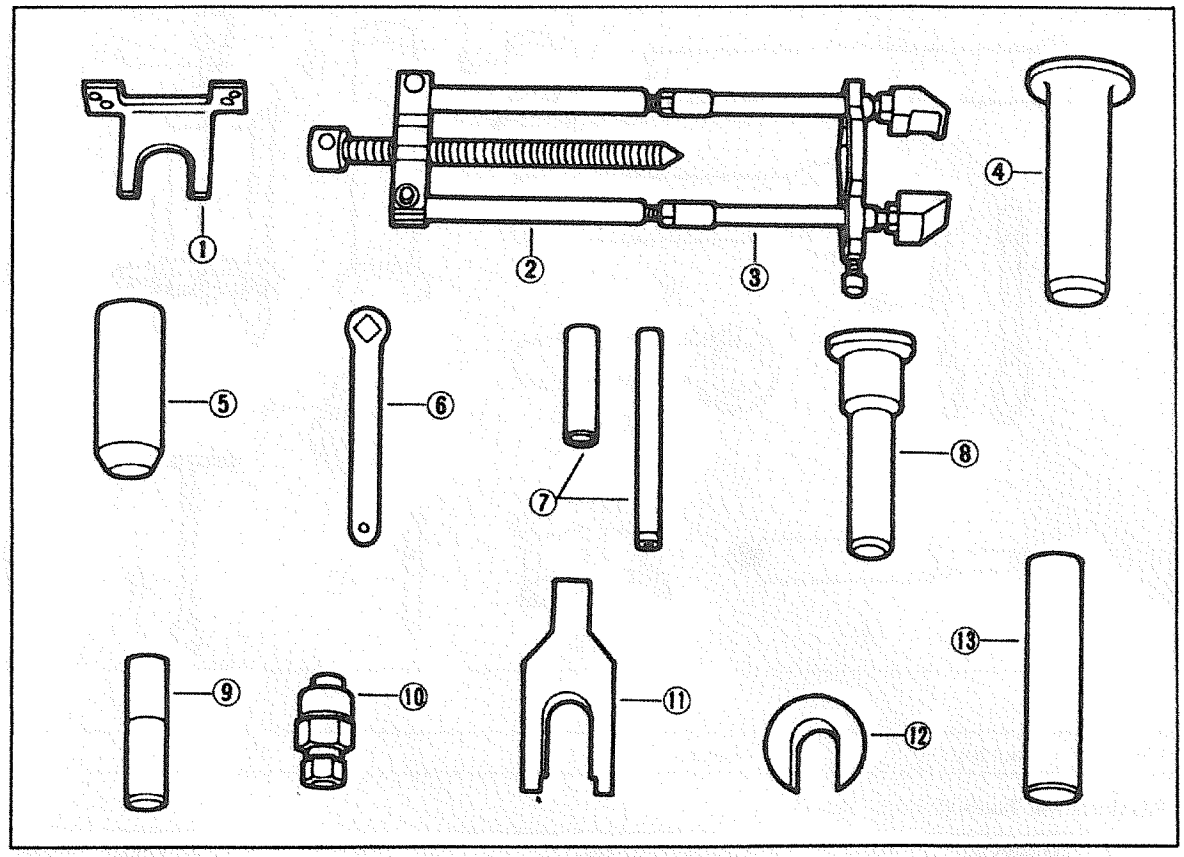
No.	Tool No.	Name of Tool	Use
Engine Tools			
1	MD998080 (ST8033-0)	Camshaft bearing installer	For removal and installation of camshaft bearings
2	MD998062 (ST8065-0)	Valve guide installer	For removal and installation of valve guide
3	MD998063 (ST8041-1)	Crankshaft bolt wrench	For removal and tightening cranking bolts
4	MD998077 (ST8014-0)	Rod bushing installer	For removal and installation of connecting rod bushings
5	MD998013 (ST8101-2)	Water pump impeller puller	For removal of water pump impeller
6	MD998012 (ST15044-1)	Oil pressure switch wrench	For removal and tightening oil pressure switch
Clutch Tools			
7	MD998065 (ST7130-0)	Clutch lever gage (Canter, Rosa)	For clutch lever height adjustment
	MD998079 (ST7081-0)	Clutch lever gage (Canter 3 ton)	For clutch lever height adjustment
	ST7143-0	Clutch lever gage (Jeep)	For clutch lever height adjustment
8	MD998064 (ST7021-1)	Free travel gage	For clutch free travel adjustment
9	MD998066 (ST7099-0)	Clutch disc center guide (Canter, Rosa)	For centering flywheel and clutch disc
	ST7010-0	Clutch disc center guide (Jeep)	For centering flywheel and clutch disc

2. Transmission Special Tools (Canter, Rosa)



No.	Tool No.	Name of Tool	Use
Transmission Tools (Canter, Rosa)			
1	MD998067 (ST7131-0)	Mainshaft center bearing installer	For installation of mainshaft center bearing
2	MD998068 (ST8005-0)	Countershaft front bearing installer	For installation of countershaft front bearing
3	MD998069 (ST8004-0)	Main drive gear bearing installer	For installation of main drive gear bearing and countershaft rear bearing
4	MD998056 (ST15032-1)	Bearing puller	For removal of main drive gear bearing and countershaft rear bearing
5	MD998057 (ST15033-1)	Bearing puller adapter	For removal of mainshaft center bearing
6	MD998072 (ST7093-0)	Bearing lock nut wrench	For tightening and removal of main drive gear bearing lock nut
7	MD998071 (ST7094-0)	Bearing lock nut wrench	For tightening and removal of countershaft rear lock nut
8	MD998070 (ST7133-0)	Oil seal installer	For installation of extension housing and front bearing retainer oil seals
9	MD998073 (ST7051-0)	Reverse idler shaft puller	For removal of reverse idler gear shaft
10	MD998076 (ST7132-0)	Synchronizer retainer	Guide for removal and installation of main drive gear bearing and mainshaft bearing
11	MD998075 (ST7038-1)	Poppet ball guide	For installation of top-3rd and 1st-2nd speeds shift fork poppet spring balls
12	MD998074 (ST7045-0)	Interlock plate nut wrench	For tightening and removal of interlock plate nut

3. Transmission and Transfer Special Tools (Jeep)



No.	Tool No.	Name of Tool	Use
1	W194	Mainshaft retainer plate	For holding mainshaft in assembling transmission
2	MD998056 (ST15032-1)	Main drive gear bearing puller	For installation of main drive gear bearing
3	MD998057 (ST15033-1)	Bearing puller adapter	For remover of main shaft center bearing
4	ST7134-0	Main drive gear bearing installer	For installation of main drive gear bearing
5	610213-0	Mainshaft bearing installer	For installation of mainshaft rear bearing
6	JM60826	Square head pipe plug and spanner	
7	W166	Countershaft installer	For installation of countershaft needle bearing and installation of shaft
8	W143	Output shaft front and oil seal installer	Installation of output shaft oil seal
9	ST7135-0	Oil seal installer	For installation of transfer case shift rod and oil seal
10	W176	Shift rod oil seal puller	
11	W139	Bearing cone removing wedge	For removal of output shaft bearing cone
12	W141	Bearing cap removing tool	For removal of output shaft bearing cap
13	ST7136-0	Bearing installer	For installation of output clutch shaft bearing

GROUP 22

MAINTENANCE

CONTENTS

SECTION 1. PERIODIC INSPECTION

1. Lubrication and Inspeciton Chart

1-1 Lubrication Chart

No.	Lubrication point	Lubrication period					Lubricants	
		New car		Every 3,000 km (2,000 miles)	Every 12,000km (8,000 miles)	Every 18,000km (12,000 miles)	Name of lubricant	Quantity
		First 1,500km (1,000 miles)	First 3,000km (2,000 miles)					
1.	Change engine oil	○	○	○			Engine oil	5.3lit. (1.4U.S.gal)
2.	Lubricate distributor				○		Engine oil	As required
3.	Change transmission (transfer) oil		○			○	Hypoid gear oil EP grade	Transmission 3.2 lit. (0.8U.S.gal.) Transfer 1.66 lit. (3.5U.S.gal.).
4.	Add starting motor pinion bearing oil					○	Engine oil	

SECTION 2. SERVICING STANDARD

1. Engine

All values in mm (in.) unless otherwise indicated.

Group	Item		Standard dimension	Repair limit	Service limit	Remarks
Combustion chamber	Compression pressure		9.5kg/cm² (135.1 psi)	7.5kg/cm² (106.7 psi)		Pressure difference: 0.7kg/cm² (1.0 psi) at 250 rpm
	Cylinder block and head distortion		0.05 (0.0020)	0.1 (0.004)		
	Distortion of manifold fitting surface		0.05 (0.0020)	0.2 (0.008)		
	Cylinder bore size		85 (3.35)	+0.2 (+0.008)	+1.2 (+0.047)	O.S.0.25 (0.010), 0.50 (0.020), 0.75 (0.030), 1.00 (0.039)
	Variation in cylinder bore size after reboring		Less than 0.02 (0.0008)			
	Difference in cylinder bore size between cylinders		Less than 0.02 (0.0008)			
	Piston O.D.		84.99 (3.346)	-0.1 (-0.004)		O.S.0.25 (0.010), 0.50 (0.020), 0.75 (0.030), 1.00 (0.039)
	Piston-to-cylinder clearance		0.03 to 0.05 (0.0012 to 0.0020)		0.2 (0.008)	
	Piston ring side clearance	No. 1	0.051 to 0.089 (0.00201 to 0.00350)		0.2 (0.008)	
		No. 2	0.035 to 0.078 (0.00138 to 0.00307)		0.2 (0.008)	
		No. 3	0.026 to 0.064 (0.00102 to 0.00252)		0.2 (0.008)	
	Piston ring end gap	Compression ring	0.3 to 0.5 (0.012 to 0.020)		1.5 (0.059)	
		Oil ring	0.18 to 0.38 (0.0071 to 0.0150)		1.5 (0.059)	
	Piston ring tension	No. 1	1.86 to 2.48 kg (4.10 to 5.47 lbs.)		1.6 kg (3.5 lbs.)	
		No. 2	1.4 to 1.9 kg (3.1 to 4.2 lbs.)		1.2 kg (2.6 lbs.)	
		No. 3	0.7 to 1.0 kg (1.5 to 2.2 lbs.)		0.6 kg (1.3 lbs.)	
		Expander	4.5 to 5.5 kg (9.9 to 12.13 lbs.)			
	Spark plug gap		0.7 to 0.8 (0.028 to 0.031)			

Group	Item		Standard dimension	Repair limit	Service limit	Remarks
Principal moving parts	Piston pin O.D.		24.0 to 24.006 (0.9397 to 0.940)			
	Piston pin-to-piston interference		0 to 0.004T (0 to 0.00016T)			
	Connecting rod small end bushing I.D.		24.005 to 24.015 (0.945 to 0.946)			
	Piston pin-to-rod bushing clearance		0.005 to 0.021 (0.0002 to 0.0008)		0.1 (0.004)	
	Connecting rod bend and twist		Within 0.05 (0.0020)	0.15 (0.0059)		
	Difference in connecting rod weight		±5gr (±0.18 oz)			With metal and bolt
	Difference in connecting rod and piston assembly weight		±10gr (±0.35 oz)			
	Crankshaft pin O.D.		55.0 to 55.015 (2.1604 to 2.170)	−0.15 (−0.0059)	−0.90 (−0.0354)	U.S.0.25 (0.010), 0.50 (0.020), 0.75 (0.030)
	Connecting rod bearing-to-crankpin clearance		0.038 to 0.073 (0.00150 to 0.00287)	0.15 (0.0059)		
	Connecting rod-to-crankpin axial clearance		0.1 to 0.25 (0.004 to 0.0098)		0.4 (0.016)	
	Connecting rod bearing crush height		0.1 to 0.15 (0.004 to 0.0059)			
	Roundness and taper of crankshaft journals		Within 0.01 (0.0004)	0.05 (0.0020)		
	Bend of crankshaft		Within 0.01 (0.0004)			
	Thickness of thrust bearing		3.550 to 3.575 (0.140 to 0.141)		−0.2 (−0.008)	
	Parallelism of thrust bearing		Less than 0.025 (0.00098)			
	Crankshaft journal O.D.		67.985 to 68.00 (2.6794 to 2.6800)	−0.15 (−0.0059)	−0.90 (−0.0354)	U.S.0.25 (0.010), 0.50 (0.020), 0.75 (0.030)
	Crankshaft-to-main bearing clearance		0.038 to 0.073 (0.00150 to 0.00287)	0.15 (0.0059)		
	Crankshaft end play		0.1 to 0.15 (0.004 to 0.0059)			
	Ring gear-to-pinion backlash		0.23 to 0.58 (0.0091 to 0.0228)			
Valve mechanism	Wear of cam lobe Intake and exhaust		38.81 (1.5279)		−0.5 (−0.020)	
	Camshaft journal O.D.	No. 1	46.650 to 46.675 (1.8370 to 1.8380)		−0.4 (−0.016)	U.S.0.25 (0.010)
		No. 2	46.250 to 46.275 (1.8210 to 1.8220)		−0.4 (−0.016)	U.S.0.25 (0.010)

Group	Item		Standard dimension	Repair limit	Service limit	Remarks
Valve mechanism	Camshaft journal O.D.	No. 3	45.150 to 45.175 (1.7780 to 1,7790)		–0.4 (–0.016)	U.S.0.25 (0.010)
		No. 4	44.650 to 44.675 (1.7580 to 1.7590)		–0.4 (–0.016)	U.S.0.25 (0.010)
	Taper and roundness of journal		Within 0.01 (0.0004)	0.05 (0.0020)		
	Camshaft bearing I.D.	No. 1	46.70 to 46.725 (1.839 to 1.840)			
		No. 2	46.325 to 46.350 (1.824 to 1.825)			
		No. 3	45.225 to 45.250 (1.781 to 1.782)			
		No. 4	44.70 to 44.725 (1.760 to 1.761)			
	Camshaft bearing-to-shaft clearance	No. 1, 4	0.025 to 0.075 (0.00098 to 0.00295)		0.15 (0.0059)	
		No. 2, 3	0.050 to 0.100 (0.00197 to 0.00394)		0.20 (0.0079)	
	Camshaft end play		0.1 to 0.18 (0.004 to 0.0071)	0.3 (0.012)		
	Camshaft bend		Within 0.02 (0.008)	0.05 (0.0020)		
	Valve spring tension	When installed	26kg/40 (57.3 lbs/1.57)		21kg/40 (46.3 lbs/ 1.57)	
		When compressed	58kg/31 (127.9 lbs/1.22)		47kg/31 (103.6 lbs/ 1.22)	
	Free length of valve spring		47.7 (1.880)		±1.5 (±0.059)	
	Squareness of valve spring		Less than 1.5°		3°	
	Valve seat ring O.D.	Intake	46.17 to 46.19 (1.8167 to 1.8175)			
		Exhaust	36.11 to 36.13 (1.4143 to 1.4151)			
	Cylinder head seat ring bore I.D.	Intake	46.0 to 46.025 (1.81 to 1.811)			
		Exhaust	36.0 to 36.025 (1.41 to 1.411)			
	Valve sinkage Intake & exhaust				1.5 (0.059)	
	Width of valve seat contact	Intake	0.9 to 1.3 (0.035 to 0.051)			
		Exhaust	1.2 to 1.6 (0.047 to 0.063)			
	Valve seat ring angle Intake and exhaust		45°			
	Thickness of valve head	Intake	1.5 (0.059)		1.0 (0.039)	
		Exhaust	1.5 (0.059)		1.0 (0.039)	
	Valve seat angle Intake and exhaust		$45^{\circ}{}^{+30}_{0}$			

Group	Item		Standard dimension	Repair limit	Service limit	Remarks
Valve mechanism	Valve stem O.D.	Intake	8.682 to 8.695 (0.3422 to 0.3428)		–0.1 (–0.004)	
		Exhaust	8.638 to 8.660 (0.3406 to 0.3414)			
	Valve stem-to-guide clearance	Intake	0.017 to 0.056 (0.00067 to 0.00220)		0.1(0.004)	
		Exhaust	0.052 to 0.100 (0.00205 to 0.00394)		0.15 (0.0059)	
	Valve guide mounting dimensions Intake and exhaust		19.5 (0.768)			
	Cylinder head tappet hole dia.		22 (0.87)			
	Tappet O.D.		22 (0.87)		–0.1 (–0.004)	
	Tappet-to-tappet sleeve clearance		0.007 to 0.041 (0.00028 to 0.00161)		0.2 (0.008)	
	Bend of push rod		Less than 0.1 (0.004)	0.3 (0.012)		
	Valve clearance Intake and exhaust		0.2 (0.008)			When engine is warm
	Tensioner sleeve-to-body clearance		0.006 to 0.055 (0.00024 to 0.00217)			
Lubricating system	Engine oil pressure		0.3kg/cm² (4.27 psi)			
	Oil pump delivery		22lit./min (5.8 gpm) Pump 1,500rpm Delivery pressure 6kg/cm² (85.3 psi)			
	Relief valve opening pressure		8 to 10kg/cm² (113.8 to 142.2 psi)			
	Outer rotor-to-body clearance		0.1 to 0.17 (0.004 to 0.0067)		0.3 (0.012)	
	Outer rotor-to-cover clearance		0.05 to 0.10 (0.0020 to 0.0039)		0.15 (0.0059)	
	Outer rotor-to-inner rotor clearance		0.09 to 0.2 (0.0035 to 0.008)		0.25 (0.0098)	
	Drive shaft diameter		12.446 (0.490)		–0.2 (–0.008)	
	Drive shaft-to-body clearance		0.036 to 0.065 (0.00142 to 0.00256)		0.12 (0.0047)	
Cooling system	Fan belt deflection		7 to 9 (0.28 to 0.35)			When depressed at a point midway between pump and generator pulleys.
	Thermostat operating temperature		82°C (179.6°F)			
	Thermostat wide-open temperature		95°C (203.0°F)			
	Water pump capacity		Over 140lit./min (37.0 gpm) Pump speed, 4,500rpm Delivery pressure, 9 mAq (29.5ftAq)			

Group	Item			Standard dimension		Repair limit	Service limit	Remarks
Fuel system	Fuel pump performance			Intake pressure Over 400mmHg (15.75in.Hg)				At pump speed of 2,500rpm
				Delivery pressure 0.2 to 0.3kg/cm² (2.84 to 4.27 psi)				
				Amount of delivery Over 1.8lit./min (0.48gpm)				
Electrical system	Generator	No-load characteristic	Voltage	14V				
			Current	16.5A				
			Speed	Less than 1,300rpm				
		Load characteristic (Battery + resistance load)	Voltage	14V				
			Current	32A				
			Speed	Less than 2,500rpm				
		Rotor-to-stator core clearance		0.45 (0.0177)				
		Slip ring diameter		33 (1.30)				32.2 (1.268)
		Size of brush		19 (0.75)				6 (0.24)
		Brush spring pressure		350gr (12.4 oz)				240gr (8.5oz)
		Insulation resistance		500V megger				In dry state at normal temperature
	Voltage regulator	Constant-voltage relay	No-load regulated voltage	14.0 to 15.0V		14.0 to 15.5V		At generator speed of 4,000 rpm
			Point gap	0.3 to 0.4 (0.012 to 0.016)				
			Air gap	0.7 to 1.1 (0.031 to 0.047)				
			Back gap	0.75 to 1.1 (0.030 to 0.043)				
		Pilot lamp relay	Extinguishing voltage	4.2 to 5.2V		3.7 to 5.7V		
			Lighting voltage	0.5 to 3.0V		Less than 3.5V		
			Point gap	0.75 to 1.1 (0.025 to 0.043)				
			Air gap	0.9 to 1.2 (0.035 to 0.047)				
			Back gap	0.75 to 1.1 (0.025 to 0.043)				
	Starting motor	No-load characteristic		MS-A_2 R	MV-A_4L			
			Voltage	11.5V	12V			
			Current	Less than 55A	50A			
			Speed	Over 4,500rpm	3,700 rpm			

Group	Item			Standard dimension		Repair limit	Service limit	Remarks
Electrical system	Starting motor	Load characteristic	Voltage	6V	5V			
			Current	Less than 670A	500A			
			Turning force	More than 2.4kg-m (17.4ft-lbs.)	1.3kg-m (9.4 ft-lbs.)			
		Switch operating voltage	IN-voltage	Less than 9V	11V			
			OFF-voltage	Simultaneous with opening of circuit				
		Shaft O.D.	Rear	14.2 (0.559)			–0.10 (–0.0039)	
			Front	12.2 (0.480)			–0.10 (–0.0039)	
			Middle	19.2 (0.756)			–0.10 (–0.0039)	
		Shaft-to-metal clearance	Rear	0.05 to 0.104 (0.0020 to 0.00409)			0.20 (0.0079)	
			Front	0.03 to 0.082 (0.0012 to 0.00323)			0.20 (0.0079)	
			Middle	0.22 to 0.353 (0.0087 to 0.01390)			0.40 (0.0157)	
		Shaft deflection		Less than 0.05 (0.0020)		0.1 (0.004)	0.2 (0.008)	
		Commutator	Outside dia.	39 (1.54)			37 (1.46)	
			Uneven wear	Less than 0.05 (0.0020)		0.2 (0.008)	0.4 (0.016)	
			Undercut	0.5 (0.020)		0.2 (0.008)		
		Brush	Length	17 (0.67)			9 (0.35)	
			Spring pressure	1.13kg (2.49 lbs.)				
		Pinion travel		13 (0.51)				
		Pinion-to-ring gear gap		4 (0.16)				
		Insulation resistance		500V megger				In dry state at normal temperature
	Distributor	Point gap		0.45 to 0.55 (0.0177 to 0.0217)				
		Contact pressure		0.5 to 0.65kg (1.1 to 1.43 lbs.)				
		Condenser capacity		0.15 ± 10% μF				
		Centrifugal spark advance mechanism	Start of spark advance	500rpm 0° ± 1°				
			Full advance	2,000rpm 12° ± 1°				

Group	Item			Standard dimension	Repair limit	Service limit	Remarks
Electrical system	Distributor	Vacuum spark advance mechanism	Start of spark advance	90mmHg 0° (3.54in.Hg)			
			Full advance	500mmHg 13.5° (19.69 in.Hg)			

2. Clutch

1. Canter 2-ton Truck, Rosa, Jeep

Item			Standard dimension	Repair limit	Service limit	Remarks
Clutch disc	Clutch disc run-out	Axial	Less than 0.7 (0.028)		1.5 (0.059)	
		Radial	Less than 1.0 (0.039)		2.0 (0.079)	
	Main drive gear spline clearance in direction of rotation		0.02 to 0.12 (0.0008 to 0.0047)		0.25 (0.0098)	
	Rivet sinkage from head to clutch friction facing		1.5 to 2.2 (0.059 to 0.087)		0.3 (0.012)	
Pressure plate	Flatness of plate		Within 0.05 (0.002)	0.1 (0.004)		
	Clutch pressure spring	Free length	73.5 (2.894)		70.0 (2.756)	
		Load	63.5kg/47 (139.9 lbs./1.85)		57kg/47 (125.7 lbs./ 1.85)	
		Squareness			Less than 3°	
	Clutch lever height		49 (1.93)	±0.25 (±0.0098)		From disc jointing surface of flywheel
Clutch	Free travel		1.6 (0.063)	±0.1 (±0.004)		

2. Canter 3-ton Truck

Item		Standard mounting dimension	Repair limit	Service limit	Remarks
Clutch disc	Thickness of clutch facing	3.5 (0.138)			
	Flatness of clutch disc	Less than 0.4 (0.016)			
	Lateral run-out of clutch disc	Less than 0.7 (0.028)		1.5 (0.059)	
	Vertical run-out of clutch disc	Less than 1.0 (0.039)		2.0 (0.079)	
	Main drive gear spline clearance in direction of rotation	0.02 to 0.12 (0.0008 to 0.0047)		0.25 (0.0098)	
	Rivet sinkage from rivet head to clutch friction facing	1.2 to 1.8 (0.047 to 0.071)		0.3 (0.012)	
Pressure plate	Flatness of pressure plate	Less than 0.05 (0.0020)	0.13 (0.0051)		
	Height of lever plate	29.45 (1.159)		±1.5 (±0.059)	

Item		Standard mounting dimensions	Repair limit	Service limit	Remarks
Pressure plate	Thickness of pressure plate	16 (0.63)	15.5 (0.610)		
	Strap bolt hole dia.	9 (0.35)	9.2 (0.362)		
	Free length of pressure spring	53.2 (2.094)		50.5 (1.988)	
	Installed load of pressure spring	52.9 kg (116.6 lbs.)		48kg (105lbs.)	At installed length of 37.5 (1.476)
	Squareness of pressure spring	Within 2°		More than 2°	
	Clutch free travel	1.6 (0.063)	±0.2 (±0.008)		

3. Transmission

1. Canter, Rosa

Item	Standard dimension	Repair limit	Service limit	Remarks
Hub sleeve-to hub clearance in direction of rotation	0.01 to 0.09 (0.0004 to 0.0035)		0.15 (0.0059)	
Mainshaft-to-hub clearance in direction of rotation	0.05 to 0.14 (0.0020 to 0.0055)		0.2 (0.008)	
Mainshaft-to-3rd gear clearance	0.037 to 0.083 (0.00146 to 0.00327)			
3rd speed gear end play	0.1 to 0.2 (0.004 to 0.008)			
Mainshaft-to-2nd gear clearance	0.039 to 0.065 (0.00154 to 0.00256)			
Mainshaft-to-spacer bushing clearance	0 to 0.038 (0 to 0.00150)			
1st gear-to-spacer bushing clearance	0.039 to 0.065 (0.00154 to 0.00256)			
Reverse idler gear-to-shaft clearance	0.033 to 0.064 (0.00130 to 0.00252)		0.15 (0.0059)	
Main drive gear bearing end play				
Synchronizer piece-to-synchronizer hub clearance in direction of rotation	0.12 to 0.38 (0.0047 to 0.0150)		0.3 (0.012)	
3rd-top speed shift fork-to-hub sleeve groove clearance	0.42 to 0.66 (0.0165 to 0.0260)		1.0 (0.039)	
1st-2nd speed hub sleeve-to-shift fork clearance	0.32 to 0.58 (0.0126 to 0.0228)		1.0 (0.039)	
Reverse idler gear-to-shift shoe clearance	0.04 to 0.102 (0.0016 to 0.00402)		5.0 (0.197)	
Bend of mainshaft	Within 0.03 (0.0012)	0.05 (0.0020)		
Interlock plate-to-nut clearance	0.02 to 0.05 (0.0008 to 0.0020)			

Item		Standard dimension	Repair limit	Service limit	Remarks
Poppet ball spring	Free length	24.1 (0.949)		±1.5 (±0.059)	
	Compression load	7.7kg/18.3 (16.98 lbs./0.720)		6.5kg/18.3 (14.33lbs./ 0.720)	
	Squareness			3°	
Each shift rail-to-fork clearance		0.031 to 0.092 (0.00122 to 0.00362)		0.2 (0.008)	
Selection shaft-to-control housing clearance		0.02 to 0.073 (0.0008 to 0.00287)			
Selection shaft-to-gearshift lever clearance		0.08 to 0.28 (0.0031 to 0.0110)		0.5 (0.020)	
Gearshift lever forward end-to-each shift fork groove clearance		0.4 to 0.7 (0.016 to 0.028)		1.0 (0.039)	
Shift shaft-to-gearshift lever clearance in direction of rotation		0.057 to 0.15 (0.0021 to 0.0059)			
Driven gear-to-sleeve clearance		0.05 to 0.15 (0.0020 to 0.0059)			
Driven gear-to-bushing clearance		0.126 to 0.227 (0.00496 to 0.00894)			
Resistance spring	Free length	48.5 (1.909)		±1.5 (±0.059)	
	Compression load	3kg/45.5 (6.6 lbs./1.791)		2.3kg/45.5 (5.07lbs./1.791)	
	Squareness			3°	
Gear backlash of each gear		0.1 to 0.3 (0.004 to 0.012)			
Mainshaft spline-to-companion flange clearance in direction of rotation		0.005 to 0.103 (0.00020 to 0.00406)			

2. Jeep

Item	Standard dimension	Repair limit	Service limit	Remarks
Second-speed gear-to-main shaft clearance	0.04 to 0.07 (0.0016 to 0.0028)		0.15 (0.006)	
Second speed gear end play	0.13 to 0.41 (0.005 to 0.016)			
Internal high speed gear clutch hub-to-sleeve clearance	0 to 0.03 (0 to 0.001)		0.1 (0.004)	
Internal high speed gear clutch hub-to-main shaft spline clearance	0.051 to 0.127 (0.002 to 0.005)		0.20 (0.008)	
Synchronizer shifting plate clearance in direction of rotation	3.45 to 3.68 (0.136 to 0.145)	3.8 (0.150)		
Internal high clutch sleeve-to-shift fork clearance	0.41 to 0.66 (0.016 to 0.026)		1.0 (0.039)	
Clutch sleeve groove width	9.53 (0.376)			
Sliding gear-to-main shaft clearance	0.08 to 0.15 (0.003 to 0.006)		0.3 (0.012)	
Sliding gear-to-low reverse shift fork clearance	0.13 to 0.38 (0.005 to 0.001)		1.0 (0.039)	

Item	Standard dimension	Repair limit	Service limit	Remarks
Sliding gear groove width	5.44 (0.214)			
Control lever tip-to-shift rail groove clearance	0.08 to 0.28 (0.003 to 0.012)			
Poppet spring tension	10.0 to 11.8kg/18.3 (22.1 to 26.1 lbs./0.721)		15% decrease	
Countershaft gear end play	0.30 to 0.46 (0.012 to 0.018)			Adjust by thrust washer
Reverse gear-to-shaft clearance	0.03 to 0.06 (0.001 to 0.002)	0.12 (0.005)		
Reverse idler gear-to-case end play	0.13 to 0.33 (0.005 to 0.013)			
Speedometer driven gear-to-sleeve clearance	0.05 to 0.15 (0.002 to 0.006)	0.30 (0.012)		
Driven gear-to-sleeve axial clearance	0.10 to 1.30 (0.004 to 0.051)	1.50 (0.059)		
Driven gear-to-bushing clearance	0.13 to 0.23 (0.005 to 0.009)	0.35 (0.014)		
Main shaft and clutch hub backlash	0.15 to 0.24 (0.006 to 0.010)			Replace the parts if they generate noise.
Second gear and clutch hub backlash	0.23 to 0.32 (0.009 to 0.012)			Replace the parts if they generate noise.
Blocking ring and clutch hub backlash	0.22 to 0.41 (0.009 to 0.016)			Selective mesh
Main shaft axial play	0			Adjusted by selected snap ring
Main drive gear and counter gear	0.08 to 0.15 (0.003 to 0.006)			Replace the parts if they generate noise.
Second speed gear and counter gear	0.08 to 0.15 (0.003 to 0.006)			"
Low reverse sliding gear and counter gear	0.10 to 0.20 (0.004 to 0.008)			"
Reverse gear and counter gear	0.10 to 0.20 (0.004 to 0.008)			"
Speedometer driven gear and drive gear	0.10 to 0.20 (0.004 to 0.008)			"

4. Transfer Case (Jeep)

Item	Standard dimension	Repair limit	Service limit	Remarks
Output shaft axial play	0.20 to 0.58 (0.008 to 0.023)			
Output shaft sliding gear-to-under drive shaft fork groove clearance	0.12 to 0.40 (0.005 to 0.016)		1.0 (0.039)	
Output shaft gear-to-output shaft clearance	0.038 to 0.064 (0.002 to 0.003)		0.15 (0.006)	
Output sliding gear-to-output shaft spline clearance	0.10 to 0.18 (0.004 to 0.007)		0.50 (0.020)	
Clutch gear groove-to-shift fork clearance	0.12 to 0.40 (0.005 to 0.016)		1.0 (0.039)	
Output clutch shaft pilot section outside diameter	15.856 (0.625)			
Output clutch shaft pilot section clearance	0.038 to 0.08 (0.0015 to 0.0032)		0.10 (0.004)	
Output clutch gear-to-output shaft spline clearance	0.14 to 0.038 (0.0055 to 0.0015)		0.3 (0.012)	
Output shaft gear-to-output shaft clearance	0.14 to 0.38 (0.0055 to 0.015)		0.3 (0.012)	
Bushing-to-output clutch shaft clearance	0.038 to 0.08 (0.0015 to 0.0032)		0.15 (0.006)	
Transfer shift rod-to-front bearing clearance	0.03 to 0.15 (0.001 to 0.006)			
Shift fork-to-gear groove clearance	0.12 to 0.40 (0.005 to 0.016)		1.0 (0.039)	
Shift lever-to-rod clearance	0.53 to 1.04 (0.020 to 0.041)			
Poppet spring (Load/length)	11 to 15kg/17.8 (24.3 to 33.2 lbs./0.701)		15% decrease	
Companion flange-to-output shaft spline clearance	0.025 to 0.013T (0.001 to 0.0005T)		0.05 (0.002)	
Front yoke-to-output clutch shaft spline clearance	0.013 to 0.064 (0.0005 to 0.0025)		0.15 (0.006)	
Mainshaft gear and intermediate gear backlash	0.10 to 0.15 (0.004 to 0.006)		Replace the parts if they generate noise due to excess backlash	
Intermediate gear and output shaft gear backlash	0.10 to 0.15 (0.004 to 0.006)		"	
Intermediate gear and sliding gear backlash	0.20 to 0.28 (0.008 to 0.011)		"	
Output shaft gear and sliding gear backlash	0.10 to 0.18 (0.004 to 0.007)		"	

SECTION 3. TORQUE SPECIFICATION

Note: All values in kg-m (ft-lbs.) unless otherwise indicated.

Parts to be tightened	Torque		Remarks
○ Cylinder block			
Bearing cap bolts	11.5 to 12	(83.1 to 86.8)	
Rear plate	4 to 5	(28.9 to 36.2)	
Oil pump	1.5 to 2	(10.8 to 14.5)	
Engine support brackets	4 to 5	(28.9 to 36.2)	
Starting motor	6 to 7	(43.4 to 50.6)	
Oil pan drain plug	5 to 6	(36.2 to 43.4)	
○ Cylinder head			
Cylinder head bolts	10 to 11	(72.3 to 79.5)	After lapping, additionally tighten in warm state [at water temperature of 80°C (167°F)]
Cylinder head nut	2 to 3	(14.5 to 21.7)	Ditto
Rocker arm studs	6 to 7	(43.4 to 50.6)	
Manifolds	1.5 to 2	(10.8 to 14.5)	
Rocker arm cover	0.2 to 0.4	(1.4 to 2.9)	
Spark plugs	2 to 3	(14.5 to 21.7)	
○ Crankshaft			
Rod caps	5 to 5.5	(36.2 to 39.8)	
Flywheel	12 to 12.5	(86.8 to 90.4)	
Crankshaft pulley	6 to 7	(43.4 to 50.6)	
○ Timing system			
Camshaft sprocket	2 to 3	(14.5 to 21.7)	
○ Electrical			
Generator fitting bolt	1.7 to 2.2	(12.29 to 15.91)	
○ General torque specifications			
6mm (0.23in.) dia. screws	0.3 to 0.4	(2.17 to 2.89)	Head mark 4 SS41B
8mm (0.31 in.) dia. screws	0.8 to 1.0	(5.78 to 7.23)	Head mark 4 SS41B
10mm (0.39 in.) dia. screws	1.5 to 2.0	(10.84 to 14.46)	Head mark 4 SS41B
12mm (0.47 in.) dia. screws	3.0 to 3.6	(21.69 to 26.03)	Head mark 4 SS41B
6mm (0.23 in.) dia. screws	0.6 to 0.8	(4.34 to 5.78)	Head mark 7 S45C
8mm (0.31 in.) dia. screws	1.5 to 2.0	(10.85 to 14.46)	Head mark 7 S45C
10mm (0.39 in.) dia. screws	2.5 to 3.0	(18.08 to 21.69)	Head mrak 7 S45C
12mm (0.47 in.) dia. screws	6.7 to 7.0	(43.38 to 50.61)	Head mark 7 S45C

SECTION 4. SEALERS AND SEALING POINTS

1. Sealers and Sealing Points in Engine Assembly

Parts to be sealed	Mating parts	Sealers	Sealing surface	Time of application
Timing chain cover gasket	Timing chain cover	Herdine F2	One side	Before assembly
	Cylinder block	THREE-BOND 4A	One side	At the time of assembling
Front plate gasket	Front plate	THREE-BOND 4A	Both sides	Ditto
	Cylinder block			
Fuel pump gasket	Insulator	THREE-BOND 4A	One side	Ditto
	Cylinder block, fuel pump			
Hole cover gasket	Hole cover	THREE-BOND 4A	One side	Ditto
	Cylinder block			
Oil pan gasket	Cylinder block sub-ass'y	THREE-BOND 4A	Circumference and one side	Before assembly
Cylinder head gasket	Cylinder head Cylinder block	THREE-BOND 4A	Both sides	At the time of assembling
Exhaust and intake manifolds gaskets	Intake and exhaust manifold	THREE-BOND 4A	Both sides	At the time of assembling
Water pump packing	Water pump	THREE-BOND 4A	One side	Before assembly
Cylinder head rear plate gasket	Cylinder head	THREE-BOND 4A	One side	Before assembly
Oil filter gasket	Cylinder block Oil filter	THREE-BOND 4A	Both sides	At the time of assembling
Crankshaft front oil seal	Timing chain cover	THREE-BOND 4A	Circumference	At the time of assembling
Crankshaft rear end oil seal	Cylinder block bearing cap	THREE-BOND 4A	Circumference	At the time of assembling
Outlet fitting gasket	Outlet fitting spacer	Herdine F2	One side	Before assembly
Oil tensioner packing	Loose side tensioner	THREE-BOND 4A	One side	Before assembly

2. Sealing Points and Sealers for Taper Screws and Plugs

Parts to be sealed	Sealing points	Sealers
Oil pressure switch	Effective threads	Hermeseal H1
Cylinder block screw plug	Effective threads	Hermeseal H1
Cylinder block flush head plug	Outer surface	Hermeseal H1
Cylinder head screw plug	Effective threads	Hermeseal H1
Cylinder head rear plate stud bolt	Effective threads	THREE-BOND 4A
Cylinder head by-pass nipple	Effective threads	Hermeseal H1
Cylinder head bolt	Effective threads	Hermeseal H1
Water pump bolt	Effective threads	Hermeseal H1
Emission hose nipple	Effective threads	Hermeseal H1
Intake manifold taper screw plug	Effective threads	Hermeseal H1
Temperature gage unit	Effective threads	Hermeseal H1
Temperature gage joint	Effective threads	Hermeseal H1

When applying a sealer to the effective threads, use care so that the sealer will not flow out into oil holes and main gallery.