ISUZU

Bellett

INSPECTING, REPAIRING AND ADJUSTING

ENGINE SERIES

PART 5

INTRODUCTION

ISUZU MOTORS LIMITED

TOKYO, JAPAN

PART 5 INSPECTING, REPAIRING AND ADJUSTING

Preparations:

(1) All pertinent parts should be thoroughly cleaned to remove carbon deposit, grease rust, scale and the like before they are inspected and repaired as necessary.

(2) The oil port should be cleaned and checked with compressed air to see if the port is free from being clogged.

(3) Carbon deposit on the piston head, cylinder head and valve should be carefully removed.

(4) In order to avoid interchanging the parts, the valve, bearing, piston and connecting rod should be provided with suitable marking and stored separately.

5-1 CYLINDER HEAD AND ITS ASSOCIATED PARTS

5-1-1 Cylinder head

(1) Removing the carbon deposit

Carbon deposit should be removed from the cylinder head carefully to prevent the valve seats from being scratched with tools.

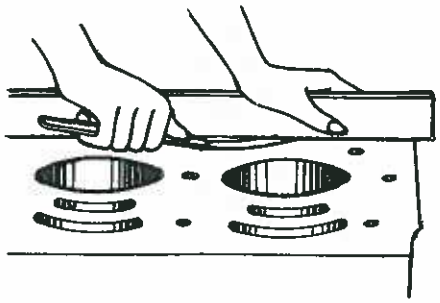


Fig. 5-1

(2) Crack or damage

The cylinder head should be carefully inspected for crack or damage with the aid of damage detector. The cylinder head should be replaced if necessary.

(3) Inspecting the cylinder head for distortion

The cylinder head should be carefully inspected for distortion using a thickness gage with a straight edge held against the lower face of the cylinder head as illustrated in Fig. 5-2.

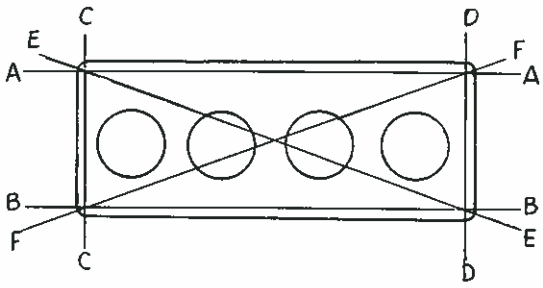


Fig. 5-2

(4) Rectifying the distorted cylinder head

If distortion of the cylinder head should exceeds 0.2mm, the lower face of the cylinder head should be touched upon with a surface grinder to hold the distortion to 0.05mm at the maximum.

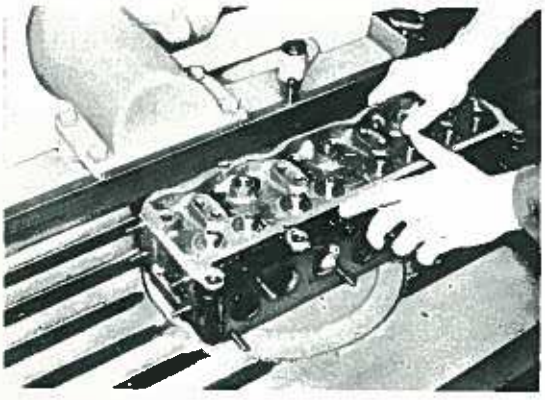


Fig. 5-3

5-1-2 Valve Guide

(1) Inspection

The clearance between the valve stem and the valve guide should be measured, and if the clearance of the intake valve and that of the exhaust valve should exceed 0.20mm and 0.25mm, respectively, these valves together with their valve guides, should be replaced.

Measuring the clearance between the valve stem and valve guide.

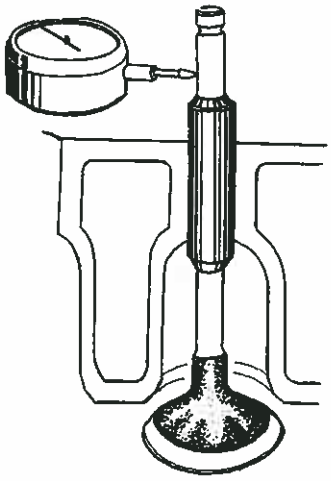


Fig. 5-4

Measurement of the valve guide as mounted in position.

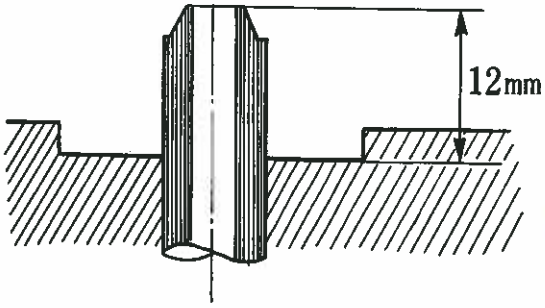


Fig. 5-5

Valve guide replacer

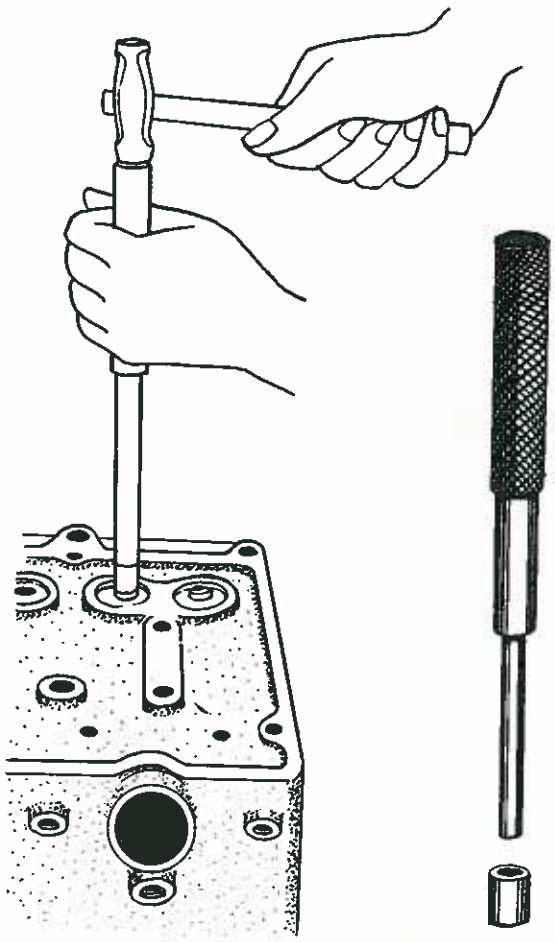


Fig. 5-6

(2) Replacement

The valve guide should be replaced in the following manner with the aid of the valve guide replacer (8523-1212). The valve guide should be removed and refitted into position through the upper part of the cylinder head. (See fig. 5-6)

The valve guide should be refitted into position with its upper tip end protruded from the cylinder head level as illustrated in Fig. 5-5.

5-1-3 Valve Seat

(1) Inspecting

The valve seat in the cylinder head should be carefully checked for wear or damage on the contacting face and rectified as necessary.

(2) Rectifying

The valve seat may be rectified with the aid of valve seat cutter or a valve seat grinder. If the valve guide is worn beyond the serviceability, the contacting face of the valve seat should be rectified after the valve guide is replaced.

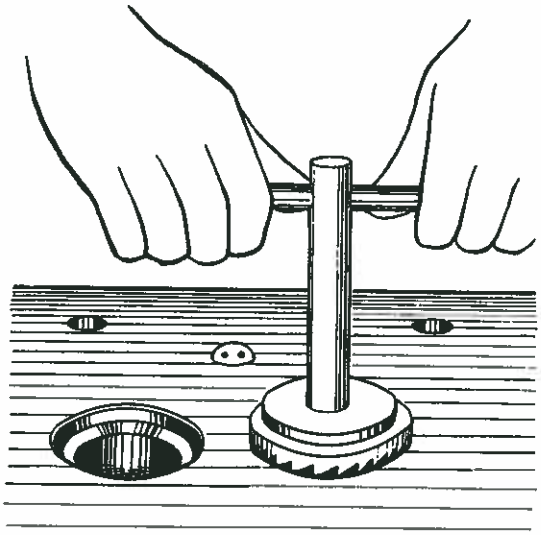


Fig. 5-7

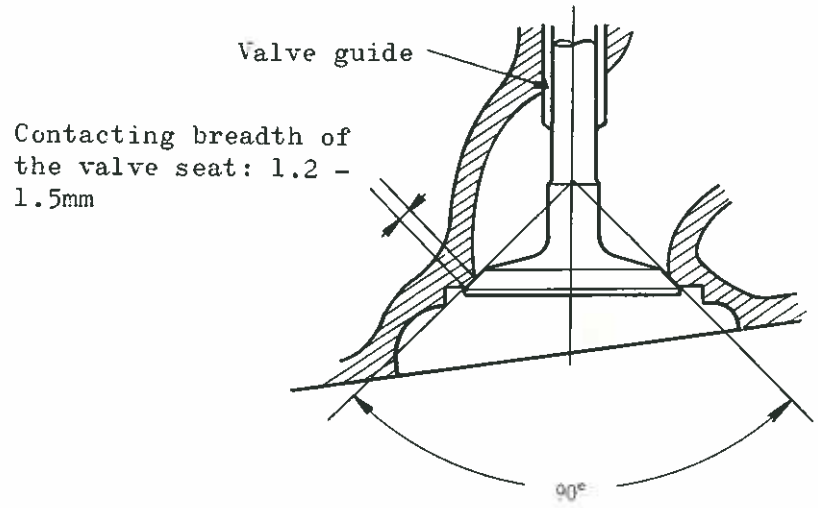


Fig. 5-8

The contacting face of the valve seat should be rectified to hold contacting breadth of 1.2 - 1.5mm with the use of the valve seat cutters having cutting angles of 60°, 90° and 120°.

If the subsidence of the valve seat face exceeds 2.5mm, it should be rectified after the seat ring is fitted in.

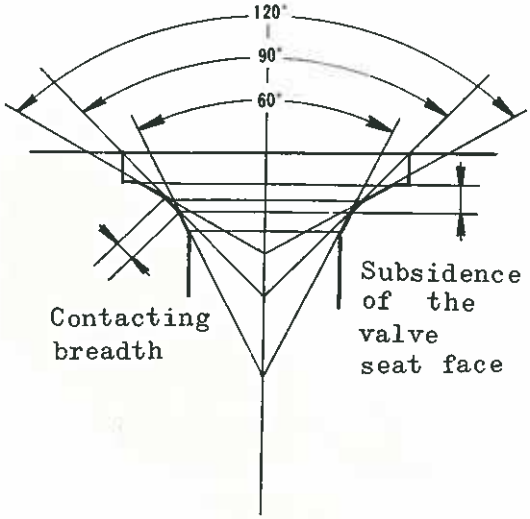


Fig. 5-9

5-1-4 Valve

(1) Inspecting

The valve should be carefully checked for seizure, wear or deformation and replaced as necessary.

(2) The contacting face of the valve and the tip end of the valve stem should be rectified with the valve grinder as necessary.

(3) Service limit of the valve

If the thickness of the valve head is less than 1mm, the valve should be replaced.

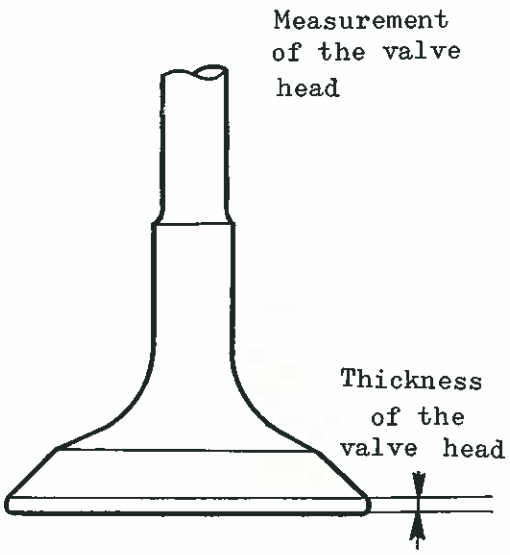


Fig. 5-10

(4) Valve grinding

The valve seat should be coated with grinding paste and then, the valve is ground into its valve seat.

Note: Close attention should be invited so as to keep the valve stem free from grinding paste. As the valve heads for models G130, G150 and G160 engines are finished with alminizing treatment, these valves should be ground with application of light pressure.

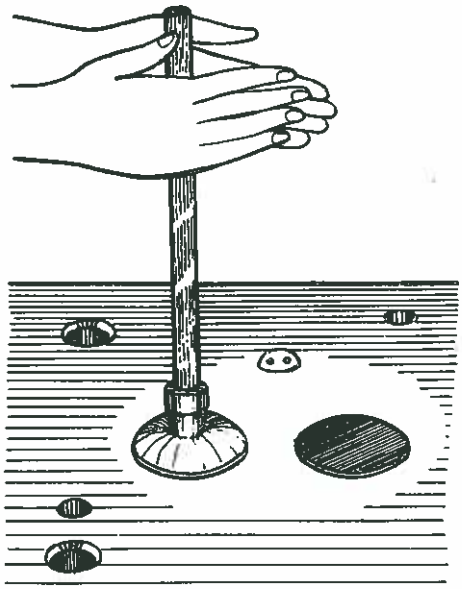


Fig. 5-11

5-1-5 Valve spring

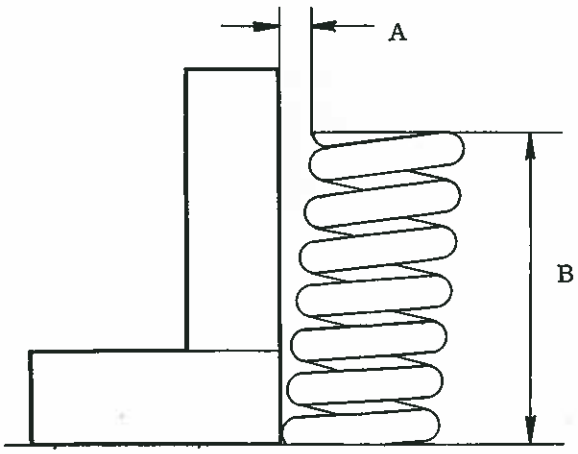
(1) Measurement of the valve spring

( ) denotes "service limit"

	For models G130 & G150		For models G150C & G150D		For model G160		For model C180	
	Inner spring	Outer spring	Inner spring	Outer spring	Inner spring	Outer spring	Inner spring	Outer spring
Free length mm	48.4 (47.0)	53.0 (51.4)	52.5 (50.9)	54.3 (52.7)	50.4 (48.9)	55.0 (53.4)	48.4 (47.0)	53.0 (51.5)
Outside diameter of the steel wire mm	2.9	4.0	2.9	4.0	2.9	4.8	2.9	4.0
Number of coils	6.0	5.0	7.0	5.5	6.0	5.0	6.0	5.0
Length as fitted mm	38.0	40.0	38.0	40.0	38.0	40.0	38.0	40.0
Valve spring load for fitting into position kg	10.8 (9.2)	26.0 (22.1)	12.9 (11.0)	26.0 (22.1)	12.9 (11.0)	30.0 (25.5)	10.8 (9.2)	2.6 (22.1)

(2) Inspecting

The dimensions of the valve spring should be measured after it is carefully inspected for damage.



A: Deviation to right angle
B: Free length

Fig. 5-12

Deviation of the valve spring from the right angle should be measured in the manner illustrated in Fig. 5-12 and if deviation exceeds 1mm, the spring should be replaced.

(3) Measuring

A slide calipers should be used for measuring the valve spring. The valve spring load at fitted length should be measured with the spring tester in the manner as illustrated in Fig. 5-13.

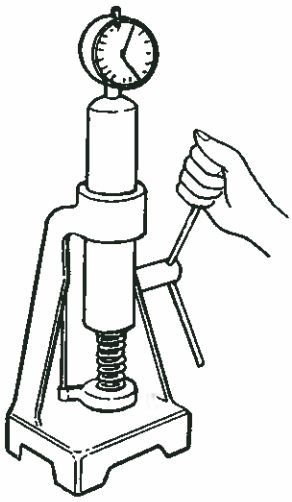


Fig. 5-13

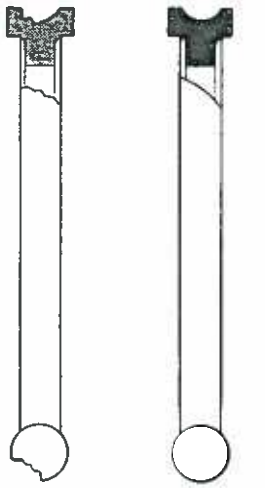


Fig. 5-14

5-1-6 Push rod

(1) Inspecting

The push rod should be inspected for bend or wear in the upper and lower ends and replaced as necessary.

5-1-7 Tappet

(1) Inspecting

The tappet has a large spherical contact with the cam and the contact face of the cam has a tapered portion. The tappet freely rotates and slides with rotation of the camshaft. The tappet should be visually inspected for wear on the sphere (Fig. 5-17) and the condition of contacting face (Fig. 5-16).

Cam Shaft and Tappet

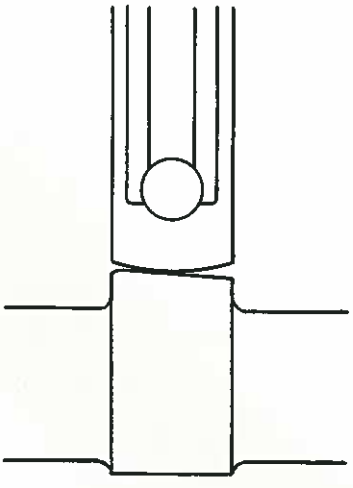
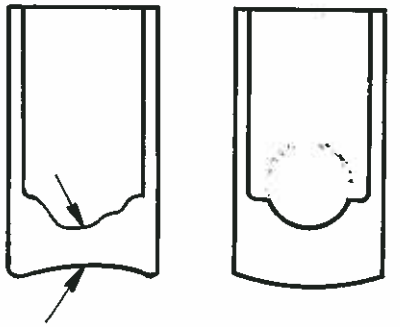


Fig. 5-15

(2) Wear in the circumference of the tappet

The outside diameter of the tappet should be measured with a micrometer and if the wear is in excess of 21.95ø, the tappet should be replaced.



Condition of the spherical portion

Fig. 5-17

Measuring the rocker shaft bending

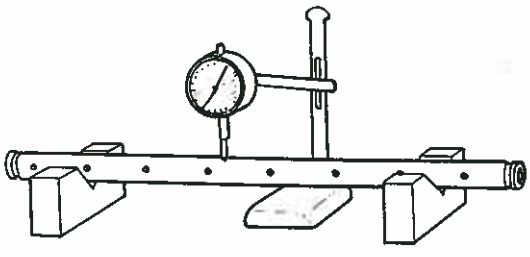


Fig. 5-18

Condition of the contacting face of the tappet

Normal

Abnormal wear in the sphere causes displacement of stripes on the tappet

In the instance where the tappet fails to rotate freely:
The parts should be checked for failure and replaced as necessary.

Crack

Abnormal wear
Dappled wear

Fig. 5-16

5-1-8 Rocker shaft

(1) Inspecting

1) External portion
If there is considerable wear or damage in the sliding portion of the rocker arm, this should be replaced.

2) Measurement

The outside diameter of the rocker shaft is standard at 19ϕ but if it does not retain 18.85ϕ for wear, the rocker shaft should be replaced. The rocker shaft should be further inspected for bend with the aid of a dial gage and a V-block. Appreciable bending of the rocker shaft may be rectified with a press machine but if the bending is beyond correction, the shaft should be replaced.

3) Adjusting

If the clearance between the inner circumference of the rocker arm and the outer circumference of the rocker shaft is in excess of 0.2mm, it should be adjusted by replacing the pertinent parts to adjust this clearance to less than 0.04mm.

5-1-9 Rocker arm

(1) Inspecting and adjusting

The inner circumference of the rocker arm is standard at 19ϕ, and if the clearance between the outer circumference of the rocker shaft and the rocker arm is in excess of 0.2mm, the clearance should be adjusted to 0.04mm by replacing the pertinent parts as necessary. If there is considerable wear in the portion that comes in contact with the valve stem end, the rocker arm should be replaced. Appreciable wear in the rocker arm may be rectified with the aid of an abrasive stone.

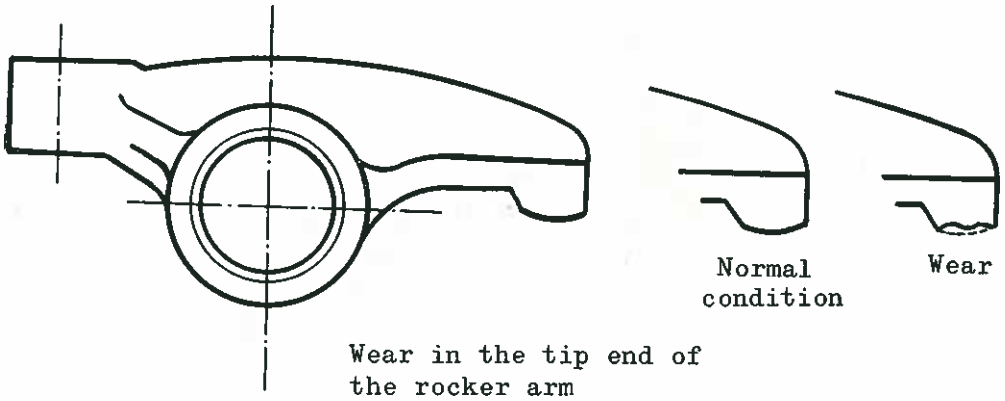


Fig. 5-19

5-2 MANIFOLDS

(1) Inspecting

1) The intake and exhaust manifolds should be inspected for distortion with all the associated parts fastened in the face directly fastened to the cylinder head. If the distortion in the mounting face is in excess of 0.4mm, it should be rectified with a surface grinder.

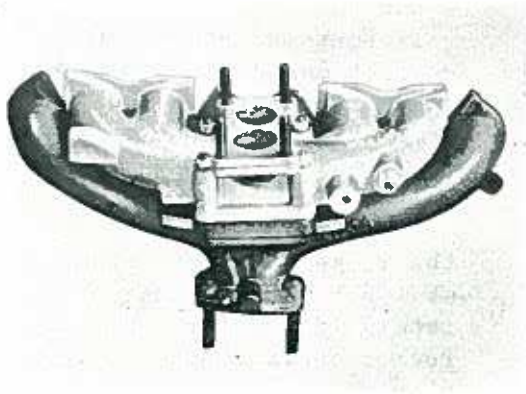


Fig. 5-20

2) The intake and exhaust manifolds should also be inspected for corrosion, damage or crack and the faulty parts replaced as necessary.

5-3 EXHAUST PIPE AND MUFFLER

(1) Inspecting

1) The entire exhaust system should be checked for crack, wear or damage and rectified or the faulty parts replaced as necessary.

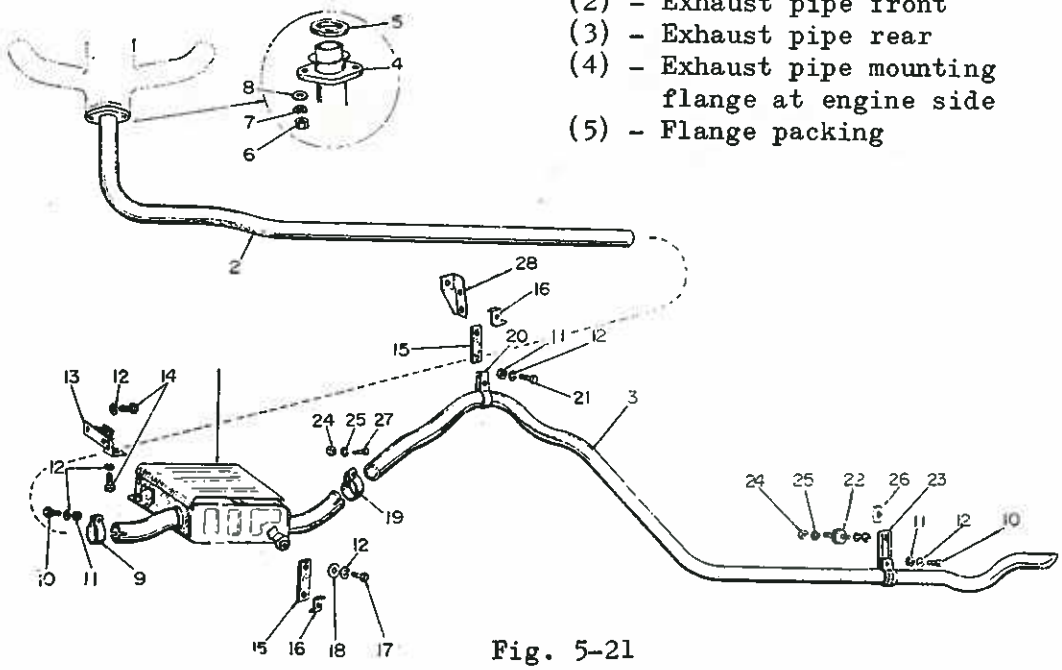


Fig. 5-21

(1) - Exhaust muffler assembly
(2) - Exhaust pipe front
(3) - Exhaust pipe rear
(4) - Exhaust pipe mounting flange at engine side
(5) - Flange packing
(6) - Nut
(7) - Spring washer
(8) - Plain washer
(9) - Exhaust pipe clamp
(10) - Bolt
(11) - Nut
(12) - Spring washer
(13) - Muffler body mounting rubber
(14) - Bolt
(15) - Exhaust muffler hanger belt
(16) - Plate
(17) - Bolt
(18) - Plain washer
(19) - Tail pipe clamp
(20) - Tail pipe hanger
(21) - Bolt for fastening the tail pipe to the differential carrier

5-4 CYLINDER BODY

5-4-1 Inspecting the cylinder block

(1) Inspecting the cylinder block for crack or damage:

The cylinder block should be checked visually and with the aid of a detector and rectified or replaced as the situation calls for.

(2) Measuring the distortion of the upper face of the cylinder block.

With a straight edge attached in six different ways A, B, C, D, E and F as illustrated in Fig. 5-22, the upper face of the cylinder block should be inspected for distortion. If the distortion is in excess of 0.2mm, it should be rectified to 0.05mm or below with a surface grinder. The maximum rectifying margin is 0.4mm.

Portions of the cylinder block to which the straight edge is attached for measuring distortion

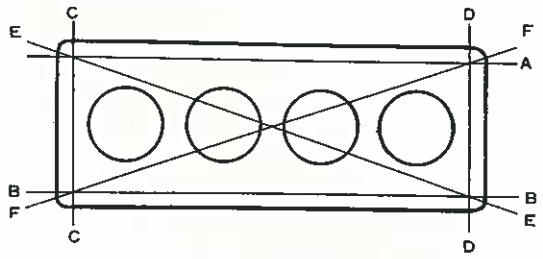


Fig. 5-22

Illustration showing the method of measuring the distortion of the cylinder block.

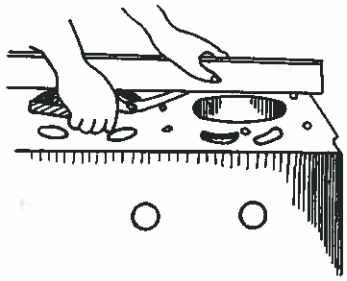


Fig. 5-23

(3) Hydraulic test

With the hydraulic pressure of 5 kg/cm^2 applied, the cylinder block should be carefully checked for water leakage. If the leak is beyond the repair, the cylinder block should be replaced.

(4) Measuring the cylinder bore wear

Wear of the cylinder walls should be measured in each cylinder in the axial direction of the crankshaft and in a direction across the axis of the crankshaft. The measurement should be taken at three portions, upper, center and lower part of each cylinder wall. The portion of the cylinder wall where the first piston ring comes in contact when the piston is held at its T.D.C. should be regarded as "upper portion

of the cylinder bore". This is equal to a portion 7.5mm (12mm for the model C180) below the top level of the cylinder block. The portion where the piston skirt comes in contact when the piston is held at its B.D.C. should be regarded as "lower portion of the cylinder bore". The upper portion of the cylinder wall is mainly subjected for wear whilst the wear in the lower portion is considerably small, the actual wear on the cylinder wall may be obtained by deducting the measured value of the lower portion from the measured value of the upper portion. If the wear is in excess of 0.2mm (0.4mm for model C180), the cylinder wall should be rectified by boring. Wear in the cylinder wall should be measured with a cylinder gage (inside dial gage) by attaching the gage to the cylinder wall in the right angle. If only one of the cylinder fails to meet with the specified value, the entire cylinder walls should be regarded as due for correction.

Measuring the Cylinder bore

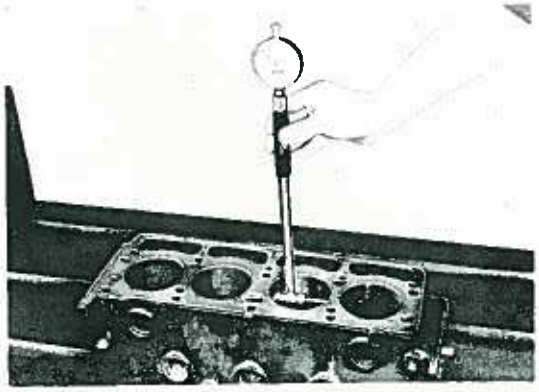


Fig. 5-24

(5) Rectifying the cylinder wall

1) At the time when the engine is dismantled, the stepped wear in the upper portion of the cylinder wall should be rectified with a ridge reaming machine even if the wear or tapered wear is less than 0.2mm (0.4mm for model C180).

Measuring the outside diameter of piston

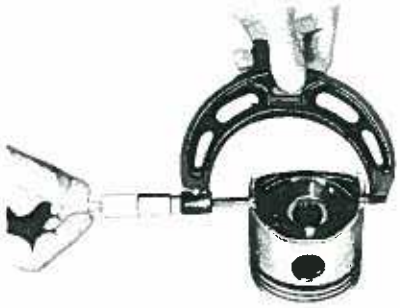


Fig. 5-25

2) Boring the cylinder wall

If the cylinder wall is considered as due for rectification, the size of the over-sized piston for replacement should be predetermined by selecting the cylinder whose wear is

largest. The outside diameter of the piston should be measured at the piston skirt using an outside micrometer. Then, the desired inside diameter of the cylinder wall should be obtained by the following formula:

Desired inside diameter as finished by boring and honing:

(mm) = P + C - H ± E

P = Outside diameter of piston (mm)

C = Clearance between piston and cylinder wall 0.045 ± 0.01 (± 0.07mm for model C180)

H = Excessive margin for honing: Less than 0.02mm

E = Allowable error of boring finish (mm)

* The measurement should be taken while the parts are held at normal temperature.

3) Honing finish and measuring

The cylinder wall should be further treated with honing every after it is rectified by boring. Honing serves to smoothen out the cylinder wall thereby removing the trace of the cutting tool. Therefore, an excessive margin given to the cylinder wall for honing often leads to improper finish. Upon completion of the honing, the inside diameter of the cylinder should be measured in the manner introduced in Paragraph (4) above, and the tolerance of inside diameter when measured at the upper, center and lower portion of the cylinder wall should be held to 0.02mm or less.

Homing the cylinder wall

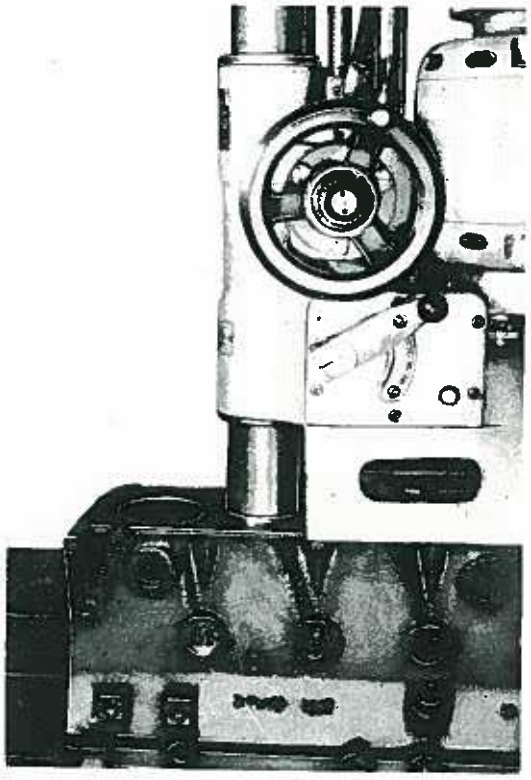


Fig. 5-26

4) The clearance between the piston and the cylinder wall

With a thickness gage inserted in the cylinder wall, the piston should be turned upside down and inserted into the cylinder wall until the

Honing the cylinder wall

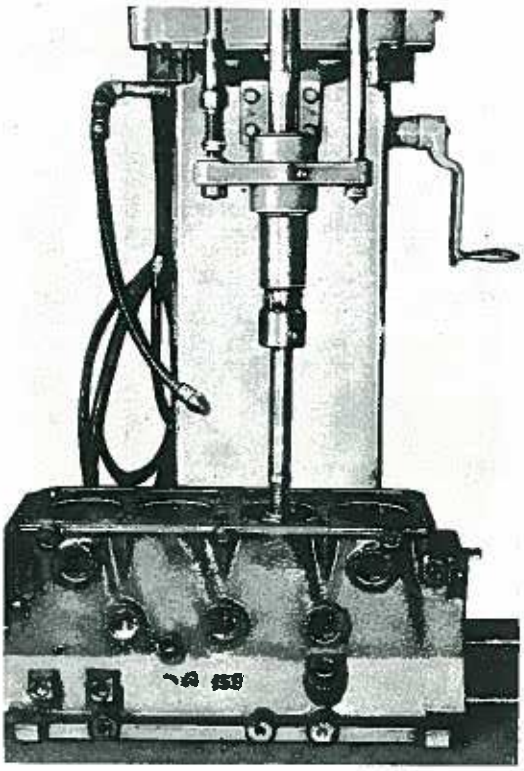


Fig. 5-27

Measuring the clearance between the piston and cylinder

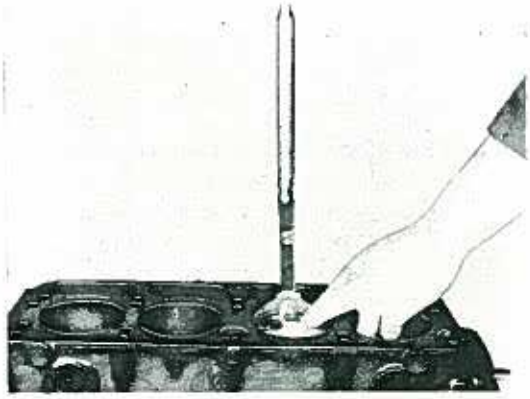


Fig. 5-28

piston skirt comes in level with the top face of the cylinder block. Then, the piston should be slid up and down in the cylinder bore while pressed onto the cylinder wall in a direction opposite to the thickness gage. Judgement should be exercised to determine the clearance therebetween by feeling the friction imposed on the sliding piston. The clearance may be correctly measured with the aid of a spring balancer by pulling the piston out of the cylinder bore upward. If the tensile strength required for pulling the piston is 0.5 - 1.0 kg common to the cylinder bores, the cylinder should be considered as in normal condition.

A list of the dimensions of the pistons by grade

Piston size (dimensions of over-size pistons)	Piston grade	Length of piston skirt (mm)		
		G-130 D=75ø	G-150 D=79ø	C-180 D=79ø
S. T. D	A	-0.035 -0.025	-0.035 -0.025	-0.060 -0.070
	B	-0.024 -0.015	-0.024 -0.015	-0.050 -0.060
	C	-0.014 -0.005	-0.014 -0.005	-0.040 -0.050
	D	-0.004 +0.005	-0.004 -0.005	-0.030 -0.040
O. S 0.25 " 0.50 " 0.75 " 1.00 " 1.25 " 1.50	The tolerance in dimensions is held same as above			

A list of the dimensions of the cylinder bores by grade

Size of the cylinder bore	Cylinder bore grade	Inside diameter of the cylinder bore (mm)		
		G-130 D=75ø	G-150 D=79ø	G-180 D=79ø
S. T. D	A	+0.01 0	+0.01 0	+0.01 0
	B	+0.02 +0.01	+0.02 +0.01	+0.02 +0.01
	C	+0.03 +0.02	+0.03 +0.02	+0.03 +0.02
	D	+0.04 +0.03	+0.04 +0.03	+0.04 +0.03
O. S 0.25 " 0.50 " 0.75 " 1.00 " 1.25 " 1.50	The tolerance in measurement of the cylinder bore is held same as above			

5-5 PISTON AND ITS ASSOCIATED PARTS

5-5-1 Piston

(1) Inspecting the piston

The piston should be visually inspected for crack, scratch or seizure and carbon deposits should be removed from the ring grooves. If the chafing or scuffing is significant, the piston should be replaced.

(2) Measuring the piston

The largest diameter of the piston skirt should be taken for measurement by bringing a slide caliper to the piston in the direction across the axial line of the piston pin.

(3) Over-sized piston

When the cylinder bore is rectified by boring, the over-sized piston should be fitted into the cylinder as necessary. The over-sized pistons are available in six sizes giving every 0.25mm of difference between adjacent pistons in the diameter. The over-size synbol is stamped on the piston crown.

(4) Clearance between the circumference of the piston and the cylinder bore

Excessive clearance will result in the compression leak and further lead to power loss. If the clearance is too small, it would often invite piston seizure and other troubles; therefore, it is necessary to keep the correct clearance as specified.

5-5-2 Piston ring

Every engine overhauling should be followed by the replacement of the piston rings. When the over-sized piston is used, the over-sized piston rings relative to the over-size piston should be utilized.

5-5-3 Inspecting the piston rings

The piston rings should be carefully checked for rupture, damage or wear and replaced as necessary.

5-5-4 Measuring the clearance between piston ring and its groove

The clearance between the piston ring and the groove should be measured with the aid of the thickness gage at several optional portions on the circumference of the piston ring.

Measuring the clearance between piston ring and ring groove

Fig. 5-29

Measuring the piston ring gap

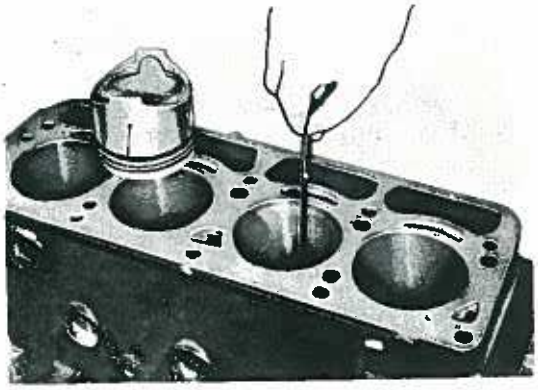


Fig. 5-30

Clearance between the piston ring and upper and lower face of the ring groove (mm)

	Standard value	Service limit
Compression ring	0.036 - 0.074	0.3
Oil control ring	0.040 - 0.082	0.15

(1) Measuring the piston ring gap

With the piston ring inserted in the cylinder bore (the piston ring should be pushed into the cylinder with the piston head to align the ring at right angle to the cylinder wall), a thickness gage should be inserted into the ring gap for measuring the ring gap. When replacing the piston rings without rectifying the cylinder bore, the piston ring gap should be measured by inserting the piston ring into the portion (normally the lower part of the cylinder wall) of the cylinder in which the wear is smallest.

(2) Rectifying the piston ring gap

If the piston ring gap is excessively small, it should be rectified to provide specified clearance and the opposed tip ends properly aligned with the aid of file or the piston ring filing tool.

Piston ring gap (mm)

			Standard value	Service limit
Compression ring	No.1	for models G130, G150	0.23 - 0.36	1.5
		C180	0.20 - 0.40	
	No.2	G130, G150 C180	0.23 - 0.36	
	No.3	C180		
Oil control ring	No.1	C180	0.10 - 0.30	1.0
	No.2	G130, G150 C180	0.20 - 0.40	

Rectifying the piston ring gap

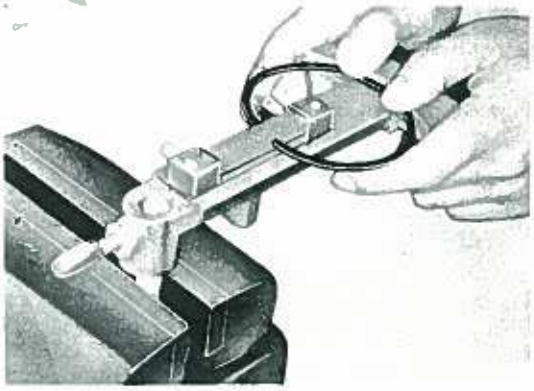


Fig. 5-31

5-5-4 Inspecting and rectifying the connecting rod small-end bush

(1) The connecting rod bushing should be visually inspected and replaced if wear or damage is serious.

(2) The bush should be removed and replaced with new one with the aid of the connecting-rod small-end bushing replacer (8523-1369).

(3) When replacing the bushing, the inner circumference of the bushing should be touched upon with a pin hole grinder or a reaming machine to provide the correct clearance between the piston pin and the bushing.

5-5-5 Inserting the piston pin into the piston

The piston should be replaced together with the piston pin. The clearance between the piston and the piston pin is standard at 0.004mm (0-0.013mm for the model C180) and if this clearance is too large, it

Measuring the piston pin (mm)			
		Nominal dimension	Service limit
Piston pin	G130 G150	22ϕ	21.97ϕ
Piston pin	C180	24ϕ	23.965ϕ

would often cause tapping noise while the engine is running. If a correct clearance is provided between the piston and its pin, the piston pin can be smoothly pushed into the piston when the piston is heated to about 70-100°C.

5-5-6 Inspecting and rectifying the connecting rod

The connecting rod should be carefully inspected for bending or distortion with the aid of connecting rod aligner.

Measuring the connecting rod bending

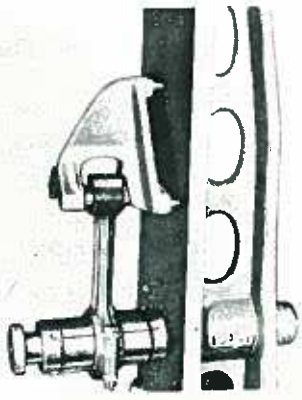


Fig. 5-32

This inspection is directed to the big-end and small-end bearings readily mounted on the connecting rod and hence, the bearings should be absolutely free from excessive wear.

With the piston pin put through the bushing on the small-end of the connecting rod, a measuring tripod should be placed over the piston pin to see if the legs of the tripod come in even contact with the connecting rod aligner. If any of the three legs fails to come in contact with the aligner, a thickness gage should be inserted under the leg to measure the bending or distortion thereof. If the distortion at the big-end or the small-end of the connecting rod is in excess of 0.2mm at the measuring length of 100mm, or the bending at the big-end or small-end of the connecting rod is in excess of 0.15mm at the measuring length of 100mm, the distortion or bending should be reduced to less than 0.08mm or 0.05mm, respectively, and if the distortion or bending is beyond correction, the connecting rod should be replaced.

Rectifying the connecting rod bush

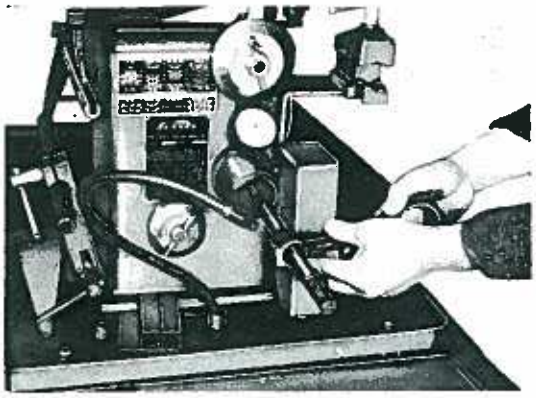


Fig. 5-33

5-5-7 Inserting the piston pin into the bushing

When the correct clearance is provided between the piston pin and bushing, the piston pin can be pushed into the bushing with thumb after the piston pin is well lubricated with engine oil.

Clearance between the bush and piston pin (mm)		
Standard value	G130 G150	less than 0.011
	C180	less than 0.02
Service limit	above 0.05	

5-5-8 Inspecting the connecting rod bearing

(1) The connecting rod bearing should be visually inspected and replaced if the bearing is applicable to any of the following:

1) Excessively worn
2) Separation
3) Crack or dent
4) Corrosion or damage

(2) Measuring the oil clearance

Oil clearance (mm)	
Optimum clearance (standard value)	0.03 - 0.06
Service limit	0.1

If the oil clearance on the connecting rod bearing is in excess of the service limit, it tends to give excess oil flow which results in a decrease of oil pressure and further in abnormal engine operating noise. If the oil clearance is too small, it will often lead to over-heating of the bearings and further to bearing seizure.

(3) The oil clearance may be checked in the following manner with use of a press gage.

1) Oil and dust should be throughly removed from the bearing and crankshaft pin.

2) The press gage (with the measuring range of 0.025 - 0.075mm) should be cut in the same size as the bearing width and placed over the crank pin located in the axial direction of the crankshaft (the oil port should be avoided from being covered with the press gage) and then, the connecting rod bearing cap should be clamped back in by applying a clamping torque of 2.4 - 2.9 m-kg. (6.5 - 7.0 for model C180). During this measurement, the crankshaft should be held from being turned. The bearing cap should then be removed a few minutes later.

Measuring the oil clearance. Before pressure is applied.

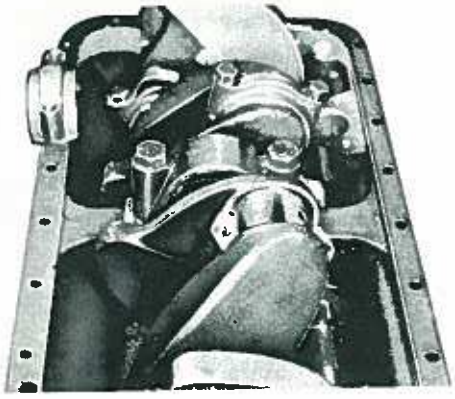


Fig. 5-34

3) After the bearing cap is released, the press gage should be taken out and its width is measured with a

Measuring the oil clearance. After pressure is applied.

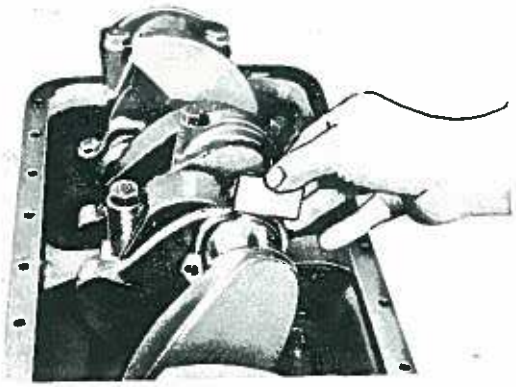


Fig. 5-35

scale printed on the container of the gage. The narrowest and widest portion of the press gage should be carefully measured for determining the serviceability of the crank pin and the bearing.

4) If the clearance is too large due to worn crank pin and bearing, the crank pin should be rectified by grinding and the connecting rod bearing of small-size should be fitted in. If the crankshaft has been replaced, a standard-size bearing should be fitted in.

5) Where the smaller-size bearing is used for the rectified crankshaft pin, or the crankshaft is replaced, or a standard-size bearing is mounted, the oil clearance should be

checked before the bearing is mounted on the crankshaft pin.

(4) Inspecting the clamping margin of the bearing

The clamping margin (clash) of the bearing should be measured with the aid of a height measuring gage or by mounting the bearing on the bearing cap and with 800 kg of pressure applied to the bearing, the clearance between the lower face of the big-end bearing cap and the opposed ends of the bearing half should be measured. The clearance (may be termed as bearing clash or clamping marging) is standard at 0. - 0.02mm.

Note: If excessive clearance is found between the bearing cap and the opposed ends of the bearing half (clamping margin is too small), the bearing tends to shrink innerward during service and often leads to exfoliation.
If the clamping margin is too large, the reverse side of the bearing does not come in direct contact with the bearing cap and the connecting rod and hence, the heat conductivity is limited and lead to bearing seizure.
If the clamping margin is excessively large, the inner face of the bearing tends to distort causing poor contact with the connecting rod and also leads to bearing seizure.

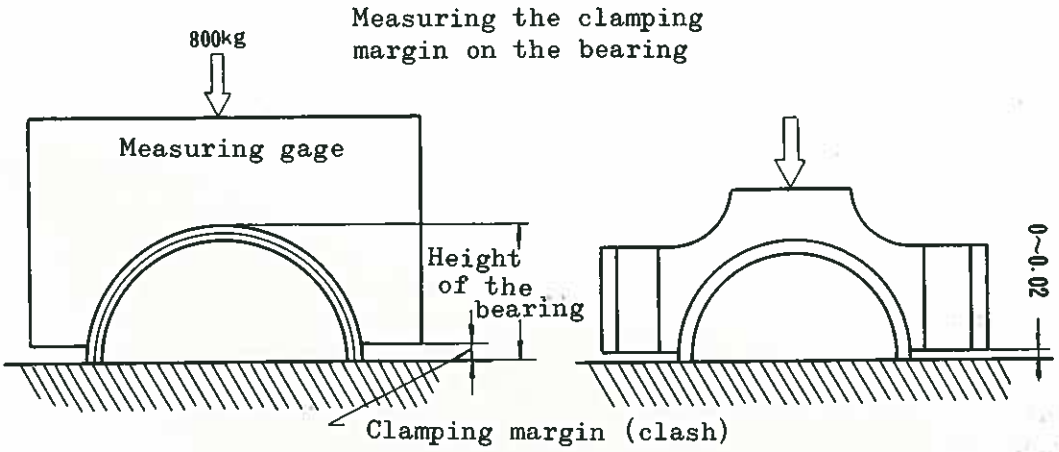


Fig. 5-36

5-6 CRANKSHAFT

5-6-1 Inspecting the crankshaft

The crankshaft journal and the crankpin should be inspected for wear using a micrometer.
Measurement should be taken at least three different portions of the joint in the axial direction, and at least two portions on the circumference of the shaft should be checked for wear in a direc tion across the shaft. The difference in the measured valve between the two portions or the difference between the measured and the specified value may be regarded as wear.

Note: The taper on the fillet portions on the crank pin and on the crank journal should be held at an angle of 3.5 and if the tapered wear of the crank journal or the crank pin is in excess of 0.05mm, it should be regarded as due for rectification.

Measuring the jaurnal and crankpin

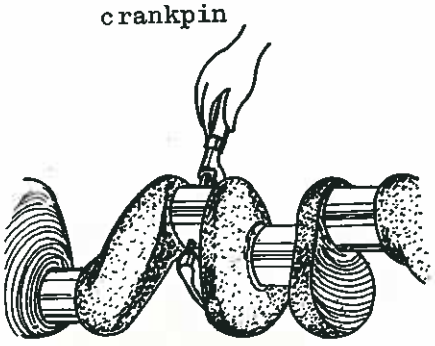


Fig. 5-37

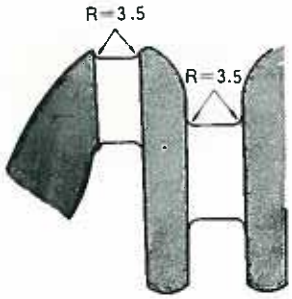


Fig. 5-38

Wear of the crankshaft (mm)

	Nominal dimensions	Service limit
Wear of the crank journal	G130 G150 56 ø	55 ø
	C180 60 ø	58.93ø
Wear of the crank pin	G130 G150 49 ø	48 ø
	C180 51 ø	49.93ø

5-6-2 Measuring the distortion of the crankshaft

With the outer journals of the crankshaft mounted on the V-block, the dial gage should be attached to the center journal and the crankshaft is carefully turned to measure the distortion.
(See Fig. 5-39)
Distortion or slight bending may be corrected using a crankshaft grinder but, if the distortion or

bending is in excess of 0.1mm, the crankshaft should be rectified to give a maxium distortion or bending of 0.05mm with use of a press machine. The crankshaft should be replaced if the distortion or bending is serious. An undersized bearing should be used where the crankshaft has been rectified by grinding. The undersized main bearings are available in the following four (4) different sizes.

Size mm	0.25	0.50	0.75	1.00

Measuring the distortion of the crankshaft

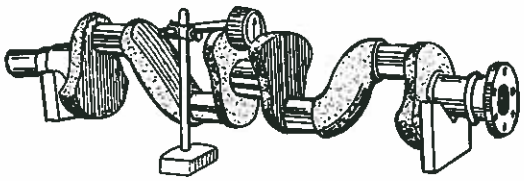


Fig. 5-39

5-6-3 Measuring the play of the crankshaft in the axial direction

The clearance between the thrust bearing and the crankshaft should be measured using a thickness gage, (See Fig. 5-40) and if it is in excess of 0.3mm, the thrust bearing should be replaced. If the clearance is within 0.05 - 0.10mm, the crankshaft play should be regarded as normal. The thrust bearing should be mounted in place with its oil slotted face toward the thrust face of the crankshaft.

Measuring the journal and crankpin

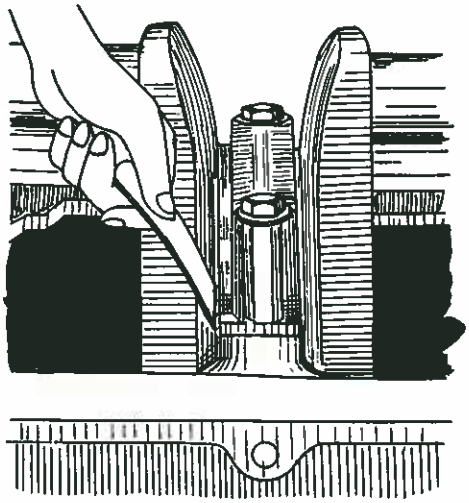


Fig. 5-40

5-6-4 Inspecting the crankshaft bearing

The crankshaft bearing should be inspected in the same manner as inspecting the connecting rod bearing.

If the crank journal is excessively worn, it should be rectified by grinding and an undersized bearing is fitted into position. The big-end bearing cap should be clamped by applying a torque of 9-10 m-kg to the clamping bolts. The bearing caps should be clamped in the order of center, front and rear by applying even torque repeatedly up to 9-10 m-kg.

Note: The engine dismantling should always be followed by the replacement of felt rings and gaskets.

Removing the crankshaft bushing

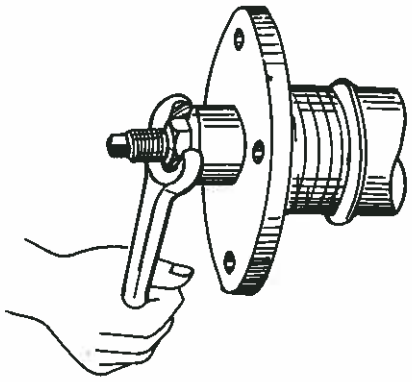


Fig. 5-41

5-6-5 Inspecting the crankshaft bushing

If there is wear or damage on the crankshaft bushing, it should be replaced. The crankshaft bushing should be removed and refitted into place in the following manner with the aid of the crankshaft bushing replacer (8523-1366).

With a tap cutter screwed into the bushing, an adapter should be put through the tap cutter and turned clockwise to pull out the bushing. (See Fig. 5-41). The bushing should be put into the crankshaft with a setting tool (8522-0020) by lightly hitting the tool head.

5-6-6 Inspecting the flywheel and gear ring.

1) The clutch driven plate of the flywheel should be carefully inspected for proper contact and flatness. If the wear, distortion or damage is significant, the parts should be replaced.

2) Distortion of the contacting face of the clutch driven plate should be measured with the aid of dial indicator and if this distortion is in excess of 0.1 mm, it should be rectified.

3) The flywheel to gear ring engagement should be carefully checked and if the gear ring is loosened or slanted, the trouble should be rectified.

4) The gear ring should be visually inspected for wear or damage. If the wear or damage is serious the gear ring should be replaced but if the wear or damage is slight, the gear ring may be put back into service by remounting on the flywheel with 90° turned either way. The gear ring should be removed and refitted in place after it is adequately heated for expansion.

5-7 CAMSHAFT

The camshaft should be dismantled and visually inspected for wear or abnormal condition. If the wear is considerable the camshaft should be regarded as due for replacement.

1) Measuring the effective height of the cam

The effective height of the cam on the camshaft should be measured with a micrometer, (See Fig. 5-42) and if it is in excess of service limit, the cam together with the camshaft should be replaced.

Measuring the effective height of the cam

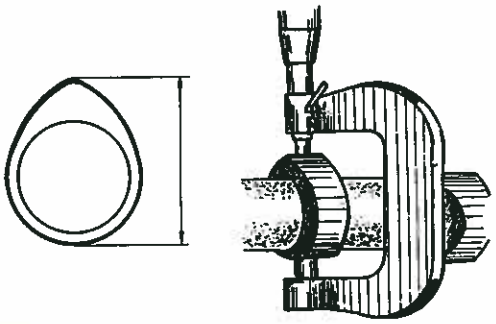
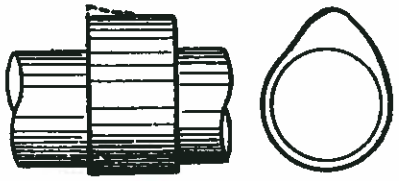


Fig. 5-42

	Height of the cam (mm)	Service limit (mm)
G130 . G150 C180	35.50	35.00
G150C·G150D	36.07	35.60

2) Measuring the camshaft journal

If the wear is significantly great, the camshaft should be replaced. If the wear is slight, it may be rectified with a crankshaft grinder. When the distorted wear on the camshaft journal is in excess of 0.05mm, it should be rectified or the parts replaced.



Tapered wear Stepped wear

Fig. 5-43

Diameter of the camshaft journal (mm)	
Nominal dimensions	Service limit
45 ϕ	44.6 ϕ

3) Distortion of the camshaft

Distortion of the camshaft should be measured by the journal gage with the outer journals mounted on a V-block. (See Fig. 5-44). If the deflection or distortion of the camshaft is in excess of 0.1 mm, it should be rectified with a crankshaft grinder and the shaft with serious bending should be replaced.

Measuring the camshaft bending

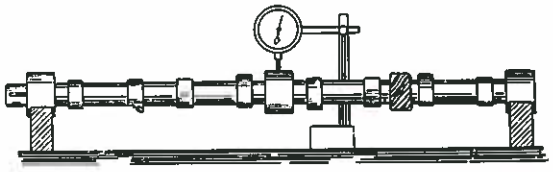


Fig. 5-44

4) Inspecting the oil pump and drive gear

The oil pump drive gear should be visually inspected for wear or damage and further carefully checked for trouble by engaging it with the counter gear.

5) Inspecting the camshaft bearing

The inner circumference of the camshaft bearing and outer diameter of the camshaft journal should be measured for checking the clearance therebetween. The clearance is normally 0.05mm and if there is provided a clearance in excess of 0.12mm, it should be rectified by replacing the bearing with trouble. If the clearance is too large, the camshaft journal should be rectified with a grinder and an undersized bearing of 0.25mm is fitted thereto.

6) The camshaft bearing should be removed and refitted into position with the aid of a camshaft bearing replacer. (8523-1360) (See Fig. 5-45)

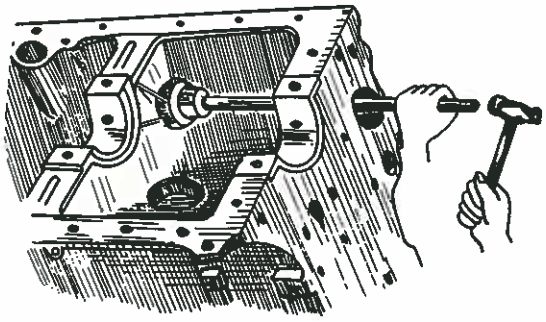


Fig. 5-45

7) Inspecting the play of the camshaft in the axial direction

The play of the camshaft in the axial direction should be measured by inserting a feeler gage (thickness gage) into the clearance between the sprocket on the camshaft and thrust plate.

Play of the camshaft in the axial direction

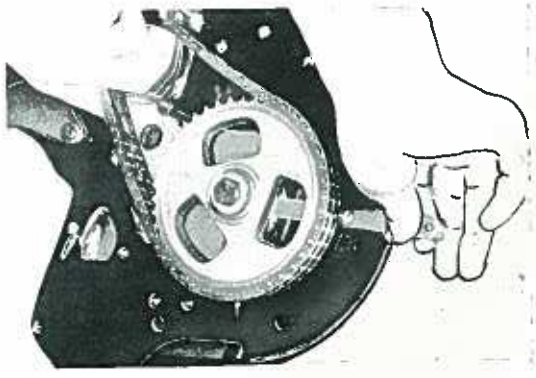


Fig. 5-46

The play is standard at 0.05 - 0.1mm but if it exceeds 0.2mm, the play should be adjusted by replacing the trust plate. (See Fig. 5-46) The method for inspecting the camshaft play in the axial direction on the model C180 is as follows: The play of the camshaft in the axial direction may be measured with a feeler gage by mounting the camshaft timing wheel on the camshaft and with the thrust plate slid all the way to the cam gear side. Then the feeler gage is inserted into the clearance between the thrust plate and journal. The play is standard at 0.05 - 0.1mm, but if it exeeds the standard value, it should be adjusted by replacing the thrust plate.

5-8 TIMING WHEEL

5-8-1 Dismantling

The timing wheel (cam and crankshaft) should be dismounted with the use of the timing wheel puller.

Fig. 5-47

5-8-2 Inspecting the timing chain and tensioner blade

The timing chain and the tensioner should be checked for wear or damage, and both parts should be replaced if the wear or damage is significant. The camshaft sprocket and the crankshaft sprocket should also be checked for wear or damage at the portion normally held in contact with the timing chain.

5-8-3 Inspecting the timing gear

The arrangement of the timing gears:

The crank gear, idling gear, camgear and pump gear are provided with setting marks X, Y and Z respectively so that they can be properly refitted into their positions.