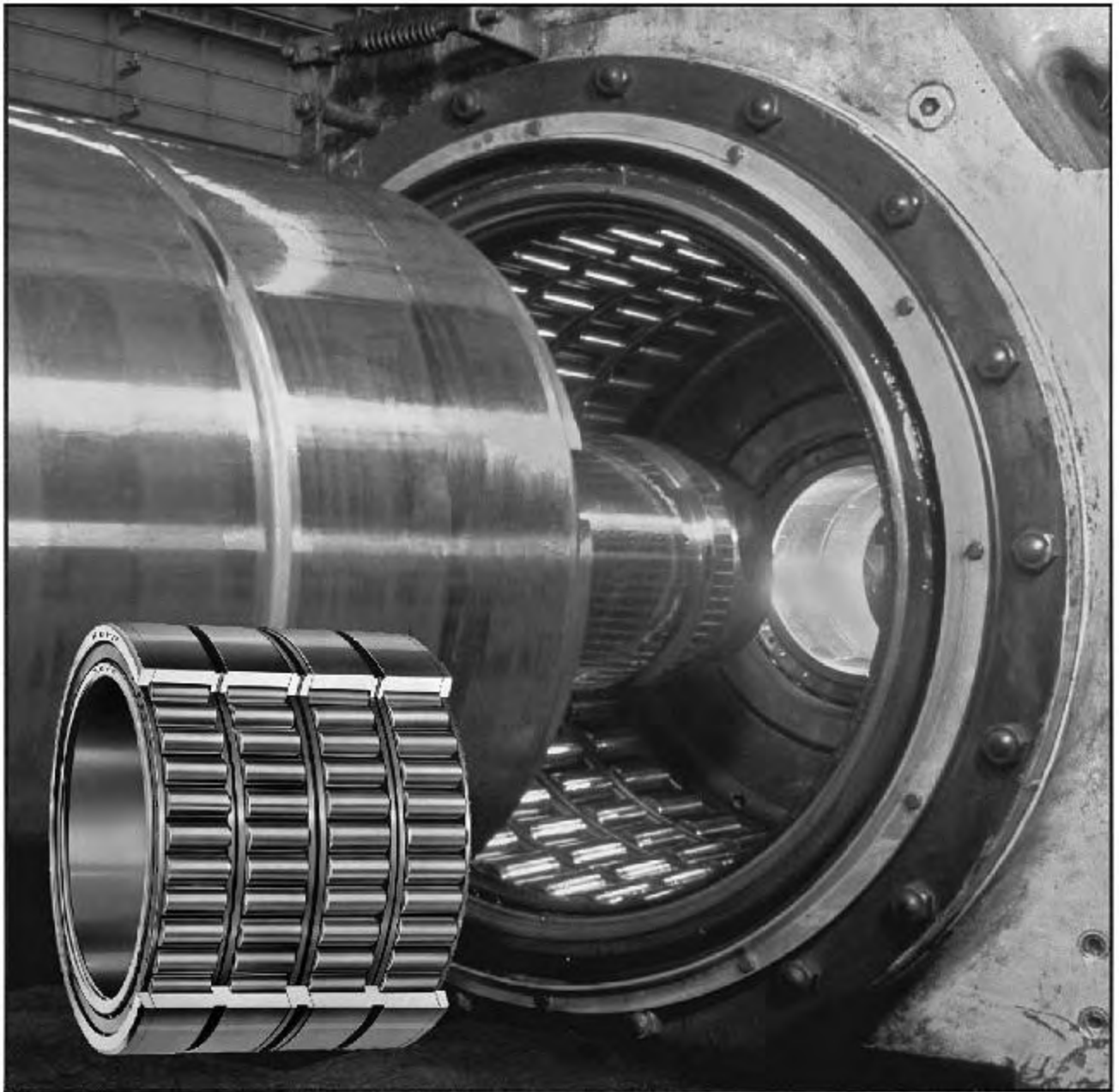


Koyo

INSTALLATION AND MAINTENANCE MANUAL FOR ROLLING MILL BEARINGS

(2)

FOUR-ROW CYLINDRICAL ROLLER BEARINGS (Cylindrical Bore) FOR ROLL NECKS



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INTRODUCTION

Although various types of roll neck bearings are used, four row cylindrical roller bearings with cylindrical bore, mounted with interference fits, are widely used for the rolls of heavy loaded, high precision or high speed rolling mills.

As the roll neck bearing is manufactured to a very high degree of precision, it must be handled with a corresponding degree of carefulness. Otherwise, even an ideally designed and most accurately manufactured bearing can not function as designed and in extreme cases, unexpected operating problems might be resulted. Therefore, the personnel in charge of bearing maintenance are required to have sufficient knowledge about bearing handling and to exercise utmost care in the mounting and dismounting of the bearings.

This manual, which is intended for those who are being trained to handle the roll neck bearings, presents a simplified guide to the handling of four row cylindrical roller bearings with cylindrical bores when used on the rolls of 4 or 6-HI mills, from preparation, mounting, inspection and disassembly, to maintenance.

This manual also contains useful information on the installation and inspection of four row cylindrical roller bearings with cylindrical bores for 2-HI wire rod and bar mills.

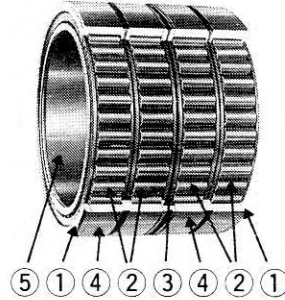
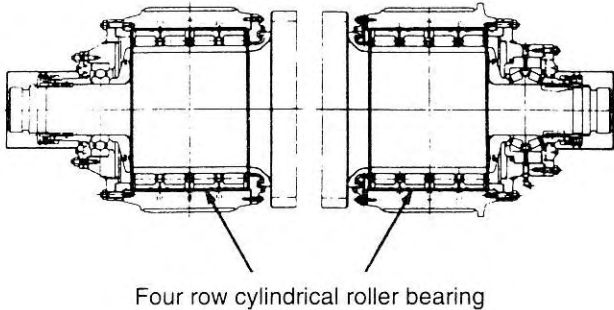
When damage is found in a bearing, a decision must be made whether to rework the bearing for further service or scrap it. This decision depends on the severity of damage as well as on the operating conditions and type of mill. If the damage is borderline, JTEKT should be consulted.

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1. PREPARATION AND INSPECTION

1-1 Preparation and Inspection of Bearings



	Nomenclature
①	Loose rib
②	Roller and cage assembly
③	Outer ring spacer
④	Double row outer ring
⑤	Double row inner ring

Fig. 1-1 Roll neck bearing arrangement

Photo. 1-1 Nomenclature

General Precautions

- 1) Storage Keep bearings and surroundings clean and store in a dry, cool and dark place, Avoid high temperature and direct rays of the sun
- 2) Handling Carefully handle bearings and do not subject to heavy impacts
- 3) Packaging Do not unpack until installation in case of brand new bearing
- 4) Rust Preventive Oil

Remove rust preventive oil thoroughly from bearings when the bearings are oil-mist-lubricated. Pay special attention when washing cages, outer rings, oil holes in outer rings and outer ring spacer.

(Note) When bearings are lubricated with forced circulating oil or grease, the grease sometimes discolors when mixed with rust preventive oil, however, this has no influence on the performance of bearings

Inspection required	Description
<p>1 Check serial numbers and row numbers on each component of the bearing (Fig. 1-2)</p>	<p>Generally, if components of the wrong serial number and row number are mixed and assembled, Premature failures such as seizing or flaking occur because the required internal clearances are not obtainable.</p> <p>However, KOYO four row cylindrical roller bearings are manufactured with strict control of the raceway diameter of the inner ring as well as the roller inscribed circle diameter. This allows the outer ring, rollers and cage assembly and the inner ring to be completely interchangeable.</p> <p>Therefore it does not matter if the serial number and row number of the inner ring do not mate with those numbers of outer ring and rollers & cage assembly (Refer to Fig. 1-4 in Page 2)</p> <p>(Serial and row numbers of outer ring and those roller & cage assembly must be mated and same numbers)</p>
<p>2 Check rolling contact surfaces of inner ring, outer ring and rollers for fatigue and smearing</p>	<p>Any flaking on the rolling contact surfaces of the inner ring, outer ring or roller should be smoothed out on the edge of the flaking with an oil stone of No. 500 roughness or a microgrinder. If the bearings are used without reworking the flaked areas, additional flaking will advance rapidly. Repaired flaking on the outer ring should be located away from the loaded position (Refer to Fig. 1-5)</p> <p>Light smearing on the rolling contact surfaces of the inner ring, outer ring and rollers should also be corrected with an oil stone of No. 500 grit.</p> <p>If smearing hair cracks reach the core structure of case hardened parts, do not use the affected parts, since these cracks may result in an ultimate fracture.</p>

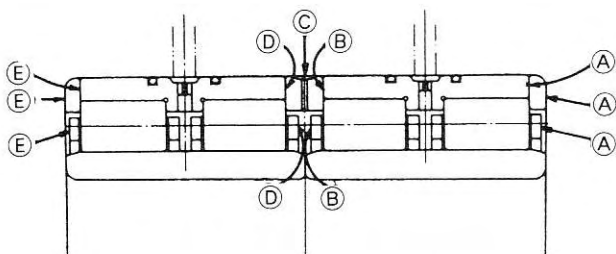


Fig. 1-2 Serial number and row number

VG-10-1

Serial number and Row number (Example)

Marked location	Examples of marking
(A)	VG-10-1
(B)	VG-10-2
(C)	VG-10-2~3
(D)	VG-10-3
(E)	VG-10-4

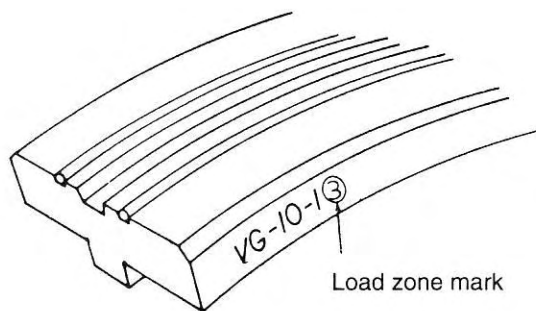
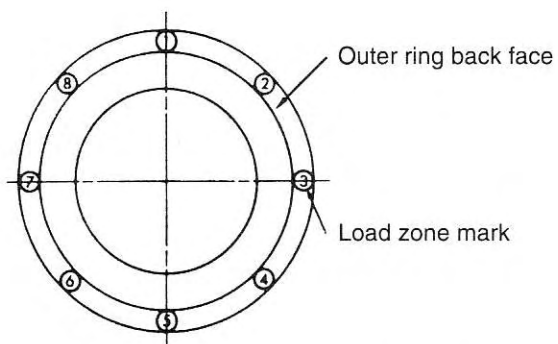

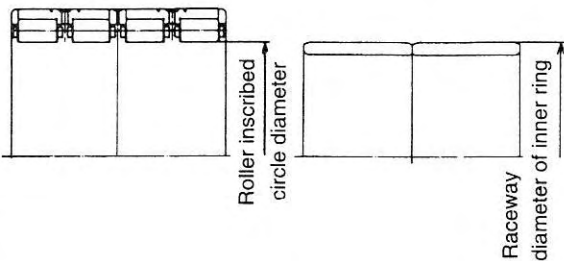

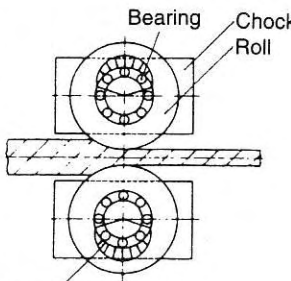





Fig. 1-3 Loaded zone marking on outer ring

Tools for inspection and rework	Remarks
	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Photo. 1-2 Serial No. and row No. of cage</p> </div> <div style="text-align: center;">  <p>Fig. 1-4 Interchangeability</p> </div> </div>
<ul style="list-style-type: none"> • Oil stone (approximately No. 500 grit) • Microgrinder • Emery cloth (approximately No. 200 grit) 	<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;">  <p>Photo. 1-3 Rework of outer ring raceway surface</p> </div> <div style="text-align: center;">  <p>Fig. 1-5 Loaded zone and non-loaded zone</p> </div> <div style="font-size: small;"> <p>(Note) Area indicated by arrows is called the loaded zone and the other area is called the non-loaded zone</p> </div> </div>

Inspection required		Description
3	Check the dimensions of the outer ring outside diameter (Particularly for deformation)	Dimensions of the outer ring (roundness and cylindricity) exceeding tolerances may result in critical damage to the bearing.
4	Check dimensions of inner ring bore (Particularly for deformation). (This check is naturally not required when inner rings are still on the rolls with tight fitting)	Expansion or excessive deformation of the inner ring bore may result in problems such as creeping or fracture.
5	Check roller end face, rib, spacer and loose rib for scuffing	Scuffing is frequently caused by excessively large thrust loads due to irregular rolling. Light scuffing may be reworked but heavy scuffing must be condemned because it may cause failures such as seizure (over heating).
6	Check pins of cage (pin type) for abnormal looseness (Refer to Photo. 1-4)	If cages with loose pins are used without correction, failure may occur. If loose cage pins are found, consult JTEKT.
7	Check inner ring, outer ring, rollers and cage for sludge occurrence (In case of oil mist lubrication)	If sludge is found on the inner ring, outer ring, rollers and cage, wash off thoroughly and blow holes with compressed air to remove, since sludge may clog nozzles resulting in poor lubrication.
8	Check pin hole of roller (pin type cage) for foreign matter	Thoroughly wash pins and pin holes and remove foreign matter, because foreign matter in pin holes may disturb smooth movement of rollers and may cause smearing.
9	Check "O" ring and nozzles of outer ring (In case of oil mist lubrication)	Damaged, loosen or excessively worn "O" rings must be replaced and nozzles must be cleaned thoroughly. In oil mist lubrication, damaged "O" rings and clogged nozzles may cause over-heating because of insufficient lubrication.

Tools for inspection and rework	Remarks
<ul style="list-style-type: none"> Micrometer 	
<ul style="list-style-type: none"> Inside micrometer 	
<ul style="list-style-type: none"> Oil stone (approximately No. 500 grit) Emery cloth (approximately No. 200 grit) 	
	<div style="display: flex; align-items: center; justify-content: center;">  <div style="margin-left: 20px;"> <p>Turn rollers and check if pins have play</p> </div> </div> <p style="text-align: center;">Photo. 1-4 Check abnormal looseness of pin</p>
<ul style="list-style-type: none"> Compressed air Kerosene 	
<ul style="list-style-type: none"> Compressed air Kerosene 	
<ul style="list-style-type: none"> Wire (for cleaning nozzle) Compressed air 	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Photo. 1-5 Check "O" ring</p> </div> <div style="text-align: center;">  <p>Photo. 1-6 Check and clean nozzle holes</p> </div> </div>

1-2 Preparation and Inspection of Roll Necks

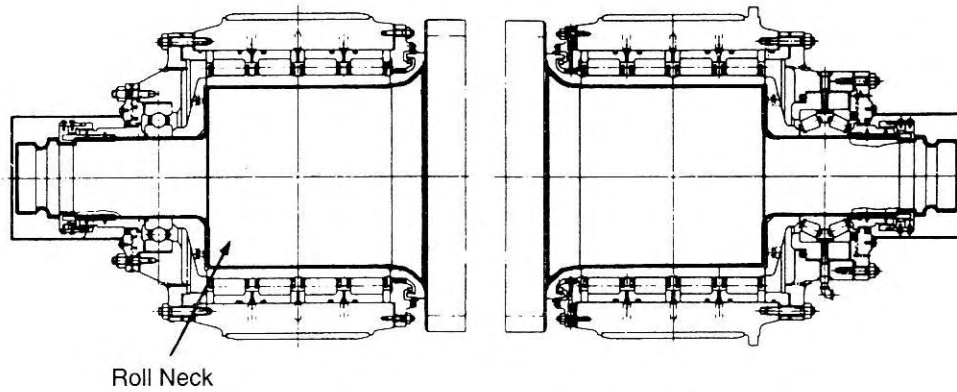


Fig. 1-6 Roll and chock general assembly

Inspection required		Description
1	Check roll neck cylindricity (Photo. 1-7)	Deviation in taper or roundness from specification may cause a partial overload on the bearings resulting in premature failure. (Note) If inner rings are pressed fit on the roll neck and ground together with the roll (refer to (Note) in Page 6), comply with the "Inner ring and roll grinding specifications" Item 3 in Page 16.
2	Check roundness (Photo. 1-7)	
3	Check surface roughness	Dents, nicks, rust and roughness on the roll neck surface can induce creep of the inner ring resulting in seizure, scuffing and cracks. Smooth out dents, nicks and rust (Photo. 1-8). (Note) If inner rings are pressed fit on the roll neck and ground together with the roll (refer to (Note) in Page 6), comply with the "Inner ring and roll grinding specification", Item 3 in Page 16.
4	Check nicks, dents and rust	
5	Check damages and roughness on the fillet ring seal lip contact surface	A rough or damaged seal lip contact surface on the fillet ring may accelerate wear or damage the seal impairing the sealing effectiveness. If grinding marks are spiral or angled, oil may leak from the lip due to a pumping action. When this occurs, correct with an oil stone of approximately No. 500 grit.
6	Check installation of fillet ring	Thoroughly clean off rust preventive oil and dust from the roll neck and shrink fit the fillet ring. If clearance is present between the side face of the barrel and fillet ring, water may enter the bearings. The fillet ring must seat against the roll barrel side face. Check with a feeler gage to insure it is seated. (Note) Before mounting, do not forget to install the "O" ring on the fillet ring, if so designed.

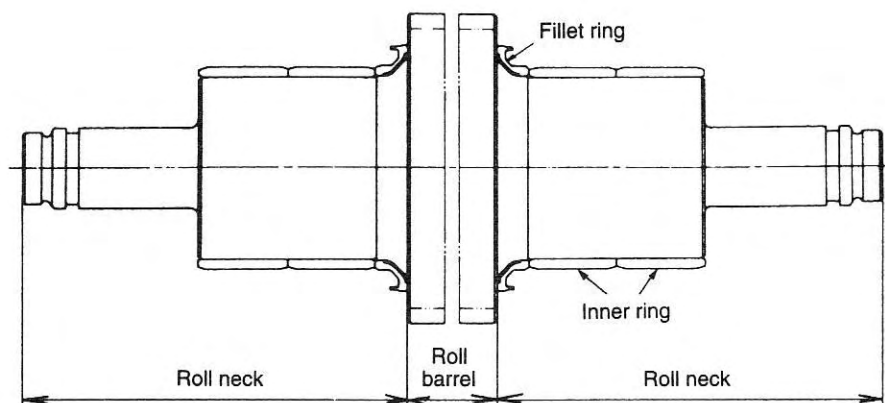


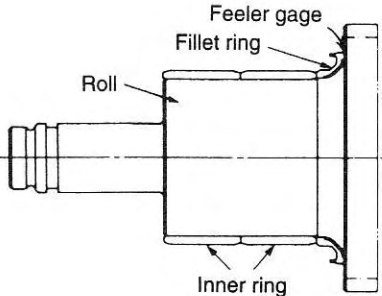


Fig. 1-7 Roll

Tools for inspection and rework	Remarks
<ul style="list-style-type: none"> • Micrometer  <p>Photo. 1-7 Check roll neck taper and roundness</p>	<p>(Note) Grinding of four row cylindrical roller bearings in conjunction with the roll. Inner rings of four row cylindrical roller bearings can be pressed fit by heating inner rings on the roll neck and inner ring raceway surfaces can be ground together with the roll to improve runout. Although four row cylindrical roller bearings can be utilized as received since they fit tightly on the roll neck, the runout of roll can be minimized and rolling preciseness can be improved if inner rings are pressed fit on the roll neck and raceway surfaces ground by a roll grinder. The roll barrel is then finished based on the ground raceway surfaces of the inner ring.</p>
<ul style="list-style-type: none"> • Oil stone (approximately No. 500 grit) • Emery cloth (approximately No. 200 grit) 	<p>A roughness of 1.5 S to 3.0 S (1.5 ~ 3.0μm) is desirable for seal lip rubbing surfaces</p>  <p>Photo. 1-8 Correct of roll neck (Using oil stone of approximately No. 500 grit)</p>
<ul style="list-style-type: none"> • Oil stone (approximately No. 500 oil stone) 	 <p>Fig. 1-8 Check seating of fillet ring</p>
<ul style="list-style-type: none"> • Feeler gage (0.03mm) 	

1-3 Preparation and Check of Chock

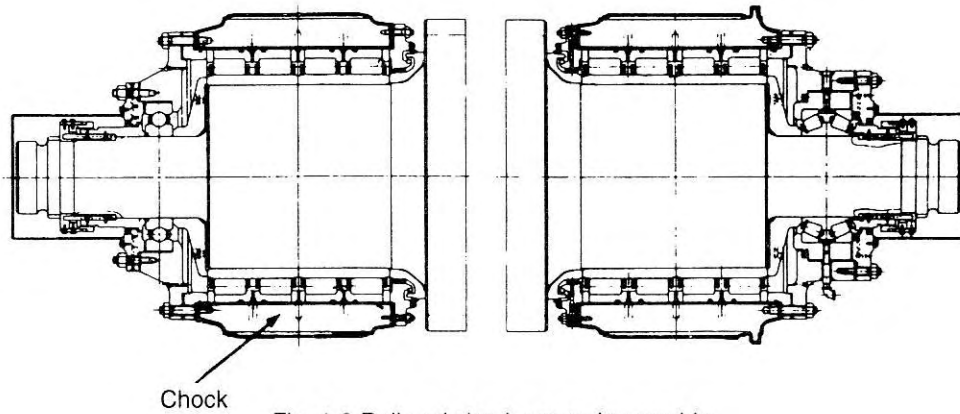


Fig. 1-9 Roll and chock general assembly

Inspection required		Description
1	Check roundness and cylindricity of chock bore (Photo. 1-9)	Deviation in roundness and taper from specification may cause partial overload of the bearings resulting in premature failure. (Refer to "Wear Limit of Chock", Para. 3-4 2) in Page 34)
2	Check bore face for scratches, rust, fretting corrosion (Photo. 1-10)	Scratches and rust on the bore surface may disturb the installation of the outer rings. If rust develops, fretting corrosion on the outer rings may accelerate. Remove by oil stone.
3	Check the locations of oil grooves in the axial direction on the chock bore	If the oil grooves in the chock and oil holes of the bearing do not align (as shown in Fig. 1-11 (A),) poor lubrication may result. Carefully check alignment especially if mist lubrication is being utilized.
4	Check dimension "a" of chock (Fig. 1-12)	If dimension "a" is larger than the width of the assembled bearings. Excessive endplay is produced which can result in premature failure.
	<p>The diagram shows a cross-section of a chock assembly. It consists of a central cylindrical chock between two end plates. The left end plate is labeled 'Inboard end plate' and the right is 'Outboard end plate'. A dimension line labeled 'a' indicates the distance between the inner faces of these two end plates. The central part is labeled 'Chock'.</p>	
5	Check oil holes for clogging and foreign material	Clogged oil holes, nozzles and threads cause poor lubrication. Foreign material may clog oil holes and nozzles during operation resulting in poor lubrication. It is especially important to inspect these items when oil mist lubrication is applied because lubrication is done through small nozzle holes.
6	Check oil mist nozzle (Photo. 1-10) (Unnecessary for grease or forced circulating oil lubrication)	
7	Check threads for burrs and foreign material (Photo. 1-12)	

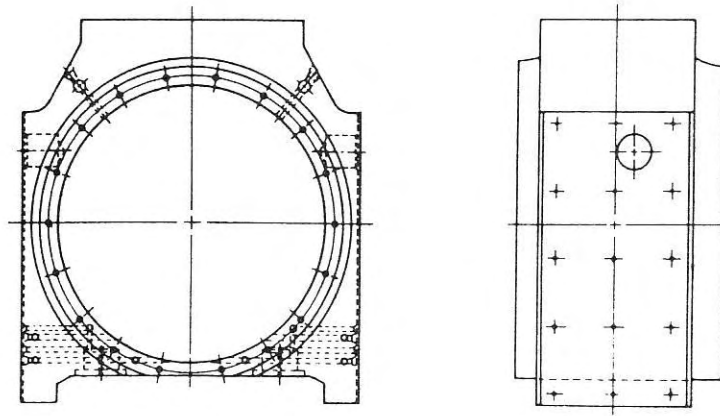


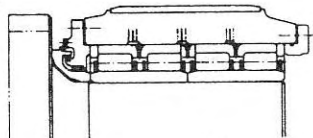
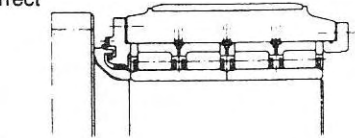
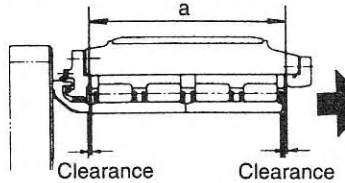
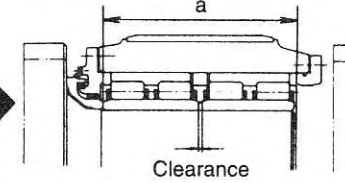
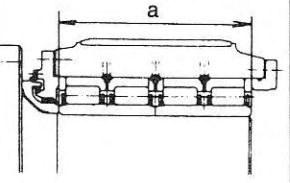




Fig. 1-10 Detail of chock

Tools for inspection and rework	Remarks	
<ul style="list-style-type: none"> • Inside micrometer 	 <p data-bbox="523 1119 968 1178">Photo. 1-9 Check taper and roundness of chock bore</p>	 <p data-bbox="1023 1119 1422 1178">Photo. 1-10 Rework of chock bore surface</p>
<ul style="list-style-type: none"> • Oil stone (approximately No. 500 grit) • Emery cloth (approximately No. 200 grit) 	<div style="display: flex; justify-content: space-around; align-items: center;"> <div data-bbox="523 1205 933 1360"> <p data-bbox="523 1205 614 1234">Ⓐ Wrong</p>  </div> <div data-bbox="943 1205 1390 1360"> <p data-bbox="943 1205 1034 1234">Ⓑ Correct</p>  </div> </div> <p data-bbox="826 1367 1209 1396" style="text-align: center;">Fig. 1-11 Check oil groove location</p>	
<ul style="list-style-type: none"> • Vernier calipers • Feeler gage • Shims 	<div style="display: flex; justify-content: space-around; align-items: center;"> <div data-bbox="523 1409 869 1625"> <p data-bbox="523 1409 678 1438">At assembling Ⓐ Wrong</p>  <p data-bbox="571 1598 678 1625">Clearance</p> </div> <div data-bbox="879 1409 1225 1625"> <p data-bbox="879 1409 1034 1438">During operation Ⓐ Wrong</p>  <p data-bbox="1023 1598 1129 1625">Clearance</p> </div> <div data-bbox="1235 1409 1525 1625"> <p data-bbox="1235 1409 1390 1438">Ⓑ Correct</p>  <p data-bbox="1377 1598 1484 1625">Clearance</p> </div> </div> <p data-bbox="826 1631 1214 1661" style="text-align: center;">Fig. 1-12 Check the "a" of dimension</p>	
<ul style="list-style-type: none"> • Compressed air • Oil stone (approximately No. 500 grit) 	 <p data-bbox="523 1976 1050 2005">Photo. 1-11 Check of oil holes by compressed air</p>	 <p data-bbox="1023 1976 1390 2005">Photo. 1-12 Check burrs</p>

1-4 Preparation and Check of Seals, Outboard, and Inboard End Plates

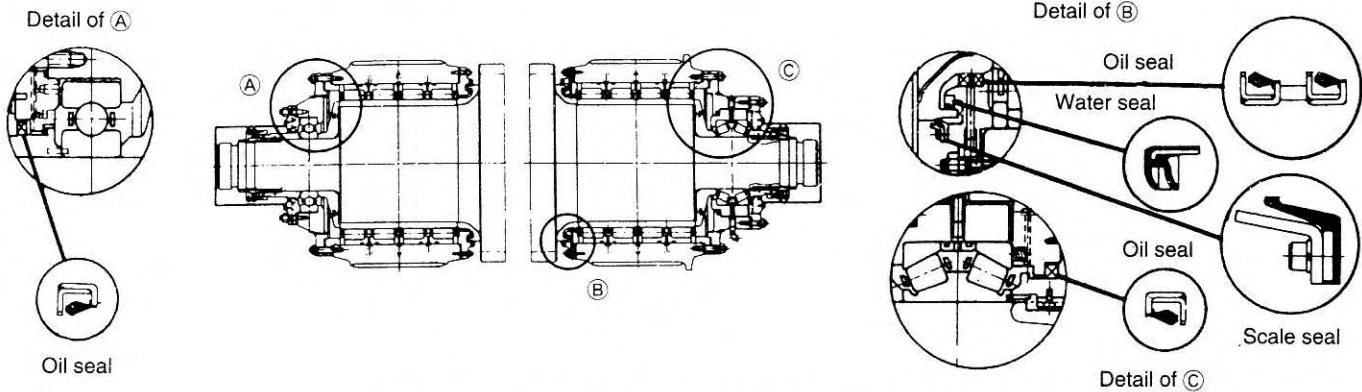


Fig. 1-13 Seals, outboard, and inboard end plates assembly

Inspection required		Description
1	Check seal lips (Photo. 1-13)	During transportation or operation, seals may be deformed or mishandled and seal lips may be injured. Carefully check for defect-free seals.
2	Check seals for deformation and damage	
3	Check the seal counter bores on inboard and outboard end plates for foreign material, scratches and burrs	Remove thoroughly any foreign material, scratches or burrs found in the counter bores of the inboard and outboard end plates since they impair seal performance.
4	Check finished surfaces on which seal lips contact (Seal contacting surface on fillet rings etc.)	Rough seal lip contacting surfaces may accelerate wear or damage of seal lips and promote leakage of lubricant. If grinding marks are spiral or angled, lubricant may be forced out by pumping action. Nicks, dents or foreign matter on the seal lip contacting surface may also cause oil leakage. Thoroughly remove them. 1.5 to 3.0 μm surface finish is desirable for the seal lip contacting surfaces.
5	Check nozzle holes in inboard and outboard end plates (Not applicable for grease or forced circulating oil lubrication)	Remove foreign material thoroughly from nozzle holes in the inboard and outboard end plates, because it may clog the nozzle holes resulting in poor lubrication.
6	Check the direction of the seal lips	Check the direction of the seal lips since they can be installed in the wrong direction. (Fig. 1-13 and 1-14)
7	Check oil holes and nozzle for burrs	Thoroughly remove burrs in the oil holes or nozzles of the inboard and outboard end plates, because burrs damages seals.
8	Insure that seals are provided with garter springs and no foreign material is trapped between the coils (Photo. 1-14)	If seals without garter springs are utilized, poor seal performance may result. Also foreign material trapped between the coils reduce the elasticity of the spring resulting in poor sealing performance. Before re-using seals, remove the garter spring and carefully wash seals and garter springs, since sludge and metallic particles are frequently trapped between the coils.

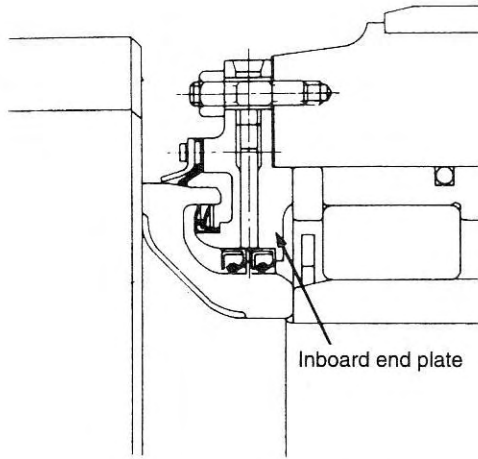


Fig. 1-14 Detail of inboard end plate

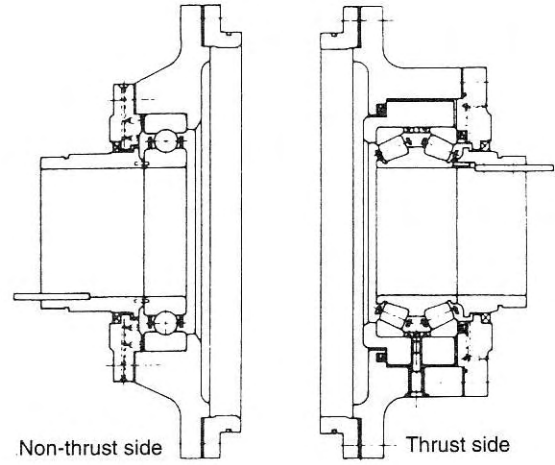




Fig. 1-15 Detail of outboard end plate

Tools for inspection and rework	Remarks
	 <p>Photo. 1-13 Check seal lip condition</p>
<ul style="list-style-type: none"> • Oil stone (approximately No. 500 grit) 	
<ul style="list-style-type: none"> • Oil stone (approximately No. 500 grit) 	
<ul style="list-style-type: none"> • Oil stone (approximately No. 500 grit) • Emery cloth (approximately No. 200 grit) 	
	<p>Photo. 1-14 Check garter spring of seal</p>

2. MOUNTING AND DISMOUNTING

2-1 Mounting Seals

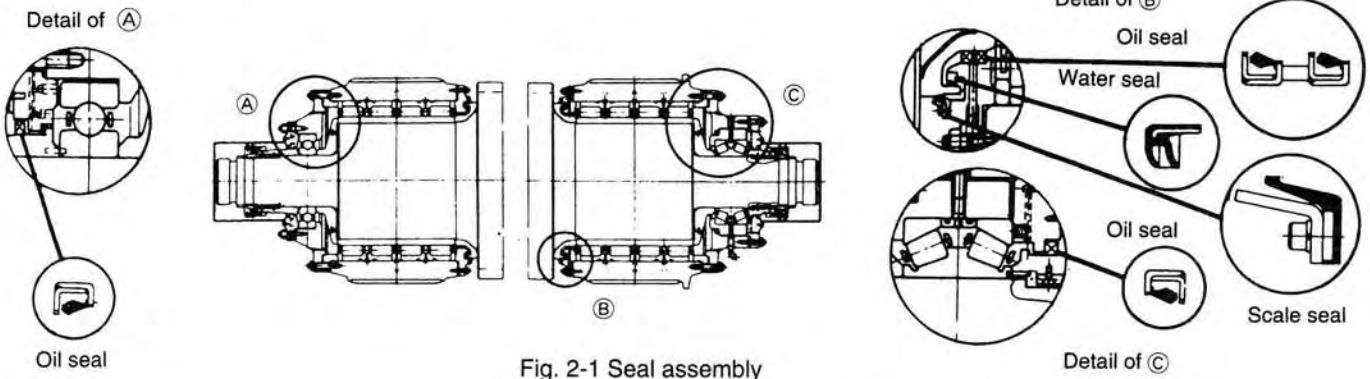


Fig. 2-1 Seal assembly

	Mounting procedure	Procedure diagram	Mounted parts
1	Mount No. 1 seal (oil seal) on the inboard end plate (Fig. 2-4)	<p>Fig. 2-4 Mount No. 1 and No. 2 seals</p>	<p>Fig. 2-5 No. 1 and No. 2 seals lip direction</p>
2	Mount No. 2 seal (oil seal) on the inboard end plate (Fig. 2-4)	<p>Fig. 2-7 Mount the No. 3 seal</p>	<p>Fig. 2-8 No. 3 seal lip direction</p>
3	Mount the No. 3 seal (water seal) on the inboard end plate (Fig. 2-7)	<p>Fig. 2-9 Mount the No. 4 and No. 5 seals</p>	<p>Mount on the inboard end plate with hexagon socket head bolts</p> <p>Fig. 2-10 Lip direction of No. 4 and No. 5 seals</p>
4	Mount the No. 4 and No. 5 seals (scale seals) on the inboard end plate (Fig. 2-9)	<p>Fig. 2-11 Mount the No. 1 seal</p>	<p>Fig. 2-12 Lip direction No. 1 seal</p>
5	Mount the No. 1 seal in the outboard end plate (thrust side) (Fig. 2-11)		

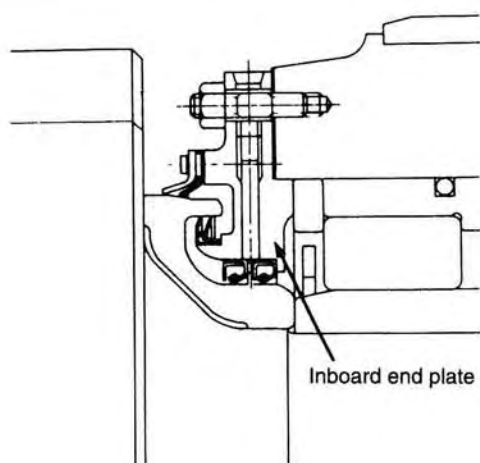


Fig. 2-2 Detail of inboard end plate assembly

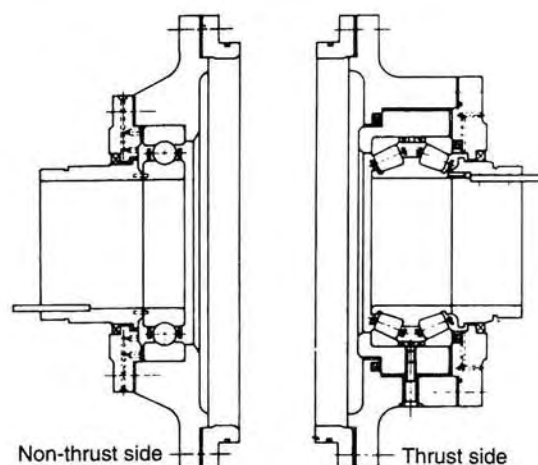
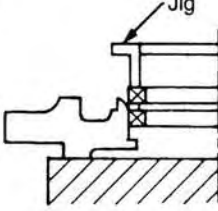


Fig. 2-3 Detail of outboard end plate assembly

Procedure details and caution	Tools for mounting and dismounting
<ol style="list-style-type: none"> 1) Apply grease or oil to lips and external faces of seals. 2) Do not hit the seal directly with a hammer. Utilize a proper jig (Fig. 2-6) or wooden plate and tap in the circumferential direction, and mount the seal in gradually. 3) After mounting the No. 1 seal, insure that the seal is seated to end plate flange by using a feeler gage. 4) Then mount the No. 2 seal, exercising care to note the direction of the seal lip. 5) Pack grease in the space between the No. 1 and No. 2 seals. (Grease packing is required even when using oil mist lubrication) 	<ul style="list-style-type: none"> • Wooden or plastic hammer • Assembly jig or fixture • Feeler gage  <p style="text-align: center;">Fig. 2-6 Mount the seals</p>
<ol style="list-style-type: none"> 1) Apply oil or grease to the lip and inner face of seal. 2) Turn the inboard end plate upside down if necessary and mount the No. 3 seal. 3) Pack grease (extreme pressure) in the space between lips. (Grease packing is required even when using oil mist lubrication) 	<ul style="list-style-type: none"> • Wooden hammer • Assembly jig or fixture
<ol style="list-style-type: none"> 1) Apply a thin coat of lubricating grease between the inboard end plate and the seal. (Required even when using oil mist lubrication) 2) Mount No. 4 and No. 5 seals. At this stage tighten bolts lightly because the center of seals must be aligned. 3) Mounting of the No. 4 and No. 5 scale seals may be done after the bearings are mounted in the chock to prevent seal damage prevention and increase operational effectiveness. <p>(Note) No. 4 and No. 5 scale seal mounting may be made after step 3 on Page 29.</p>	<ul style="list-style-type: none"> • Allen wrench
<ol style="list-style-type: none"> 1) Same as mounting of the No. 1 seal in step 1 above. <p>(Note) Also the same for mounting seals on the non-thrust side outboard end plate.</p>	<ul style="list-style-type: none"> • Wooden hammer • Assembly jig or fixture • Feeler gage

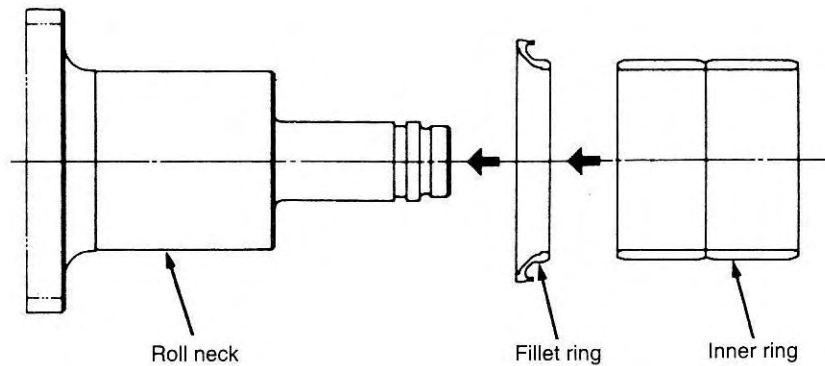
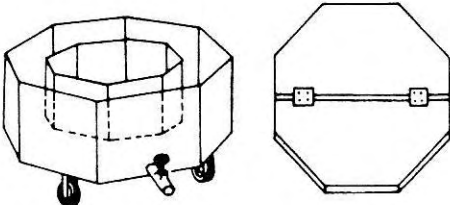


Fig. 2-14 Mounting inner rings and fillet ring on the roll neck

Procedure details and cautions	Remarks
<p>1) Thermally expand the inner rings in an oil bath of 100 to 120°C (be careful not to exceed 120°C) or by induction heating.</p> <p>2) Heat the fillet ring in the same manner.</p> <p>3) Machine oil No. 150 is suitable for oil bath.</p> <p>(Note) Before mounting, don't forget to install the "O" ring on the fillet ring, if so designed.</p>	
<p>1) After mounting the fillet ring on the roll neck and insuring it is seated against to roll barrel side face, mount the inner rings. The mounting procedure for the fillet ring and inner rings are the same. The mounting procedure for the inner rings is as follows.</p> <p>2) It is desirable to mount the inner rings with the roll vertical. When it is mount necessary to the inner rings with the roll horizontal because of working space etc. , align the center of the roll and center of the inner rings with care and assemble rapidly. Prior to mounting, thoroughly remove oil from the inner ring bore and raceway surface.</p> <p>① To mount the inner rings with the roll vertical, hoist the inner rings with the lifting jig as shown in Fig. 2-16 and mount on the roll.</p> <p>② To mount the inner rings with the roll horizontal, the inner rings may be wound with wire rope around the raceway surface (it is better not to directly wind the wire rope but apply cloth or felt between the raceway and wire rope) and hoisted by a crane. Then mount the inner rings on the roll neck by aligning the rings with the roll. It is better to place the rings in a V block and mount on the roll neck utilizing rails as shown in Fig. 2-17.</p>	 <p style="text-align: center;">Oil bath tank</p>

2-2 Mounting Inner Rings on Roll Necks

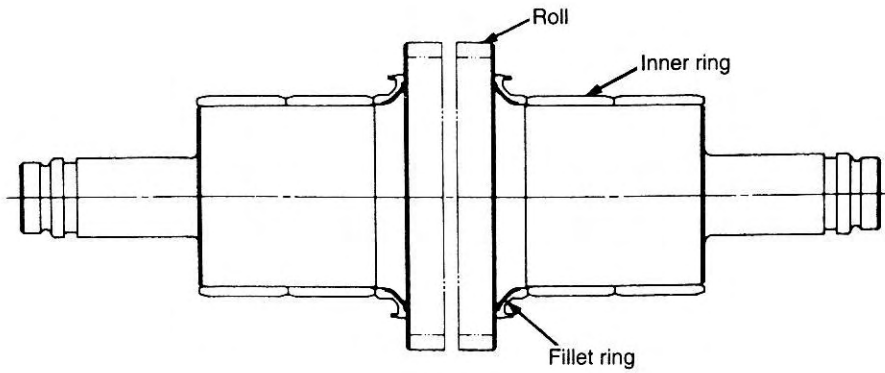
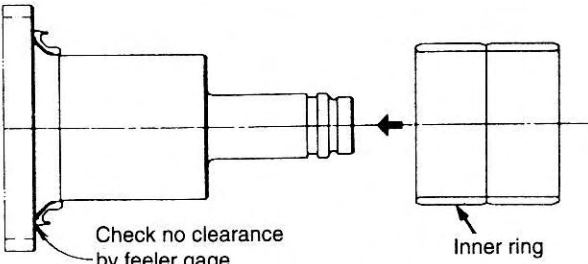
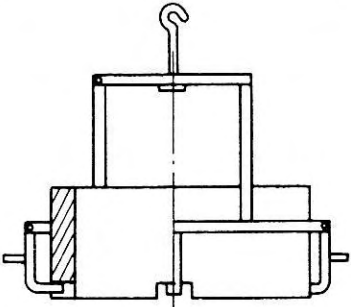
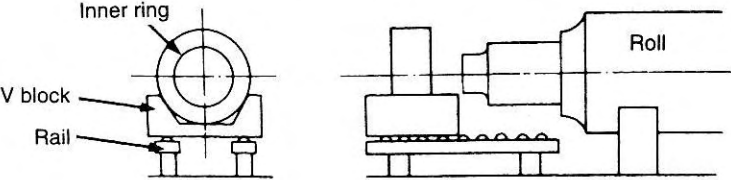


Fig. 2-13 Inner ring and fillet ring assembly

Mounting procedure	Procedure diagram and photo
<p>1 Heat fillet ring and inner rings</p>	
<p>2 Mount fillet ring first then inner rings on the roll neck (1)</p>	 <p>Fig. 2-15 Mount fillet ring first then inner rings on the roll neck</p>  <p>Fig. 2-16 Inner ring lifting jig</p>  <p>Fig. 2-17 Inner ring mounting rail</p>

Mounting procedure	Procedure diagram and photo
<p>2 Mount inner rings on roll neck (2)</p>	<div data-bbox="462 325 1393 630"> <p>Fig. 2-18 Driving inner rings on</p> </div> <div data-bbox="462 808 839 1123"> <p>Fig. 2-19 Clearance check</p> </div> <div data-bbox="931 850 1393 1144"> <p>Photo. 2-1 Mount inner rings on roll neck</p> </div>
<p>3 Grinding of roll barrel and inner rings (Fig. 2-20)</p>	

Procedure details and cautions	Remarks
<p>3) Since inner rings shrink as the temperature is lowered after mounting, push inner rings until cooling down. This can be done by using the (A) jig as shown in Fig. 2-18.</p> <p>4) After mounting the inner rings, insure there is no clearance between the fillet ring and inner ring and between inner rings. If clearance is existed, push the ring or reassemble from the beginning.</p> <p>(Note) If the positions of assembled fillet ring and inner rings are noted, creep of the inner rings can be identified at next inspection.</p>	
<p>1) When inner rings warp after press fitting by uneven heating and cooling during mounting and it is important to minimize the run-out of the roll, the inner rings may be ground together with the roll. The method and specifications for grinding of the inner rings grinding together with the roll are the following.</p> <p>2) Surface roughness and dimensions of the inner rings shall comply with drawings.</p> <p>3) Eccentricity shall be measured at the same phase.</p> <p>When grinding the inner rings and roll.</p> <p>It is best to support the roll necks, Fig. 2-20, on rests and grinding the roll barrel (b) and inner ring raceways (a) and (c) at the same time.</p> <p>Specifications for inner ring and roll grinding.</p> <ul style="list-style-type: none"> • The roughness of the finished surface of the bearing inner rings shall be 1.5µm or less. (Measure with a NF profilometer etc.) • Grinding should be done targeting less than 5µm radial runout of the roll barrel and a maximum of 10µm. • Roughly grind to the finish diameter plus 20µm to 30µm and then finish grind. • Exercise care to prevent burn marks or grinding cracks. 	

2-3 Mounting Bearing into the Inboard End Plate and Chock

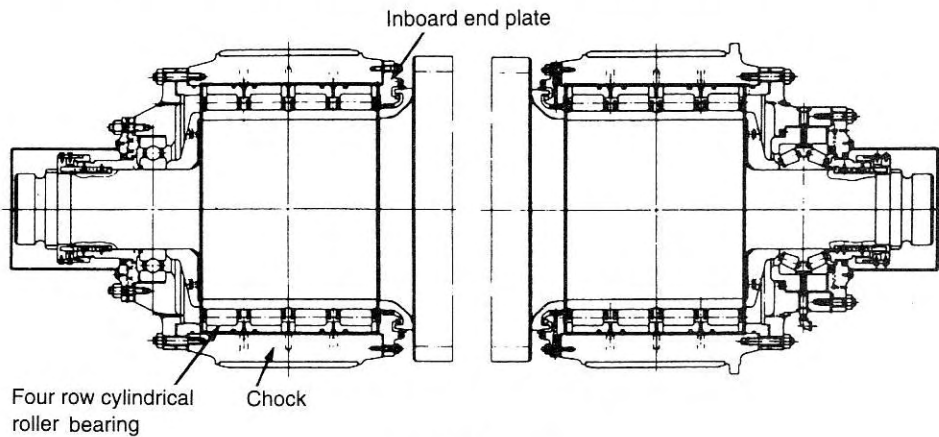


Fig. 2-21 Assembly

Mounting procedure	Procedure diagram and photo	
<p>1 Attach inboard end plate to chock (Fig. 2-24)</p>	<p>Fig. 2-24 Attach inboard end plate</p>	<p>Photo. 2-2 Coat oil or grease</p>
<p>2 Install loose rib (side ring) into chock (Fig. 2-25)</p>	<p>Fig. 2-25 Install loose rib</p>	<p>Photo. 2-3 Lifting jig</p>

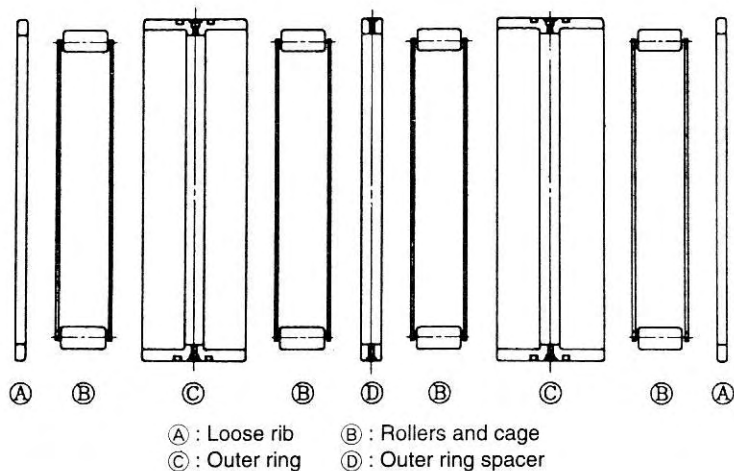


Fig. 2-22 Components of four row cylindrical roller bearing

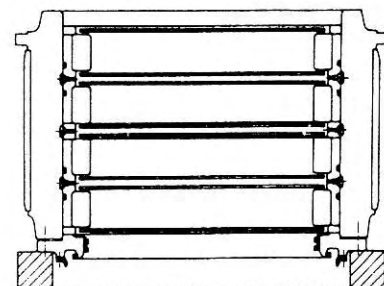


Fig. 2-23 Detail of chock and bearing assembly

Procedure details and cautions	Remarks
<ol style="list-style-type: none"> 1) Attach the inboard end plate to the chock. (Insert approx. 1mm thick (as desired) shim or gasket between the inboard end plate and the chock) (Fig. 2-24 (A)) 2) Place on a bench or wooden bars, with the inboard end plate side (roll barrel side) downwards, if so designed. (Fig. 2-24(B)) Care should be exercised so as not to damage the seal. 3) Coat grease or mist oil on the bore surface of the chock in order to prevent fretting corrosion. (Photo. 2-2) 	
<ol style="list-style-type: none"> 1) Lift the loose rib (side ring), row No. 1 (serial and row No. VG-10-1 in Fig. 1-2 in Page 2 as example) with a lifting jig or by hand, and after insuring the direction, install the loose rib into the chock horizontally. 2) If it is difficult to install, utilize a brass bar on the ring for tapping. Do not hit the ring directly by hammer. 3) After installation, confirm if the rib is seated on the shoulder of the chock inboard end plate by using a feeler gage. 	<p style="text-align: right;">Loose rib</p>

Fig. 2-26 Lifting jig

Mounting procedure

Procedure diagram

3 Install rollers and cage assy together with outer ring (Fig. 2-27)

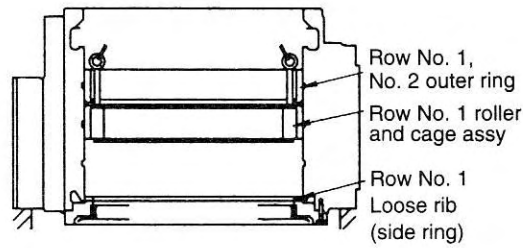


Fig. 2-27 Install rollers and cage assy and outer ring together

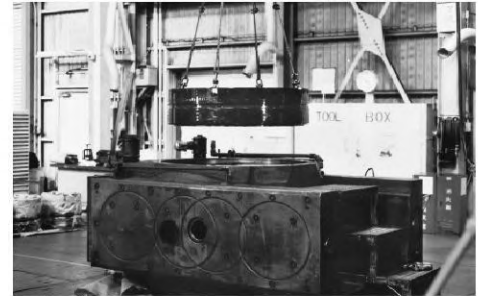


Photo. 2-4 Install rollers and cage assy together with outer ring

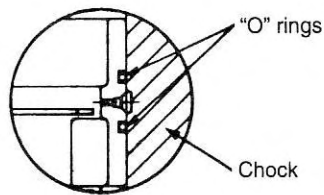


Fig. 2-28 "O" rings on outer ring outside diameter



Photo. 2-5 Oil tank

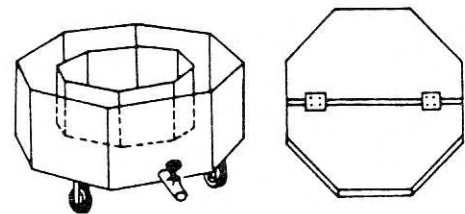
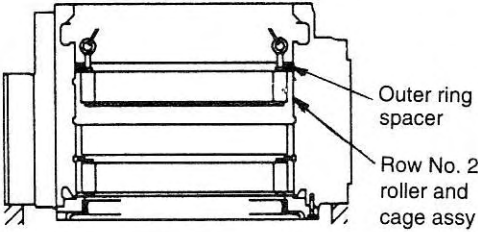
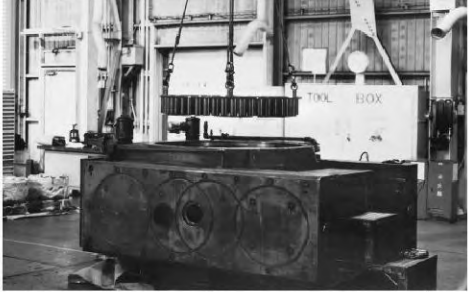
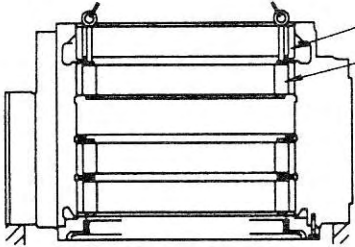
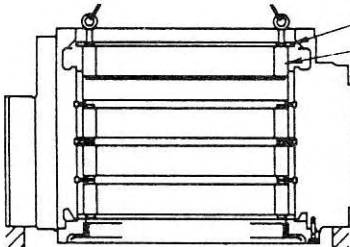
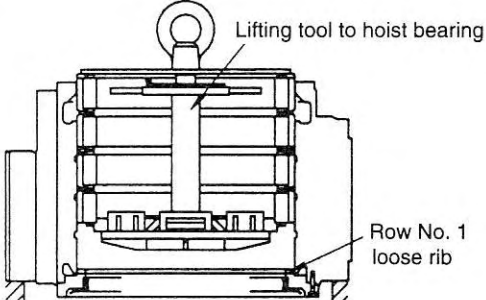
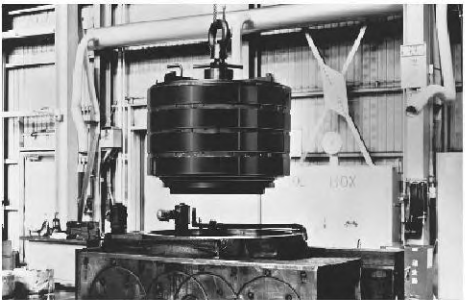


Fig. 2-29 Oil tank

Procedure details and cautions	Remarks
<p>1) Coat adequate grease or oil on rollers and cage pin holes.</p> <p>2) In case of oil mist lubrication, it is better to dip the roller and cage assembly into mist oil tank.</p> <p>3) Assemble row No. 1 roller and cage assembly and row No. 1, No. 2 outer ring. (See Page 2 Fig. 1-2)</p> <p>4) Screw the lifting eye bolts in the threaded holes provided on the cage, and hoist the set of roller/cage assy and outer ring together.</p> <p>5) Confirm the load zone mark on outer ring and the position on chock.</p> <p>6) Install the set of roller/cage assy and outer ring into chock slowly and carefully. (Note) In case of "O" ring is provided on outer ring O. D. (Fig. 2-28), take care not to damage the "O" ring.</p>	

Mounting procedure	Procedure diagram and photo	
<p>4 Install No. 2 row rollers and cage assy and together with outer ring spacer into chock (Fig. 2-30)</p>	 <p>Outer ring spacer Row No. 2 roller and cage assy</p> <p>Fig. 2-30 Install No. 2 row rollers and cage assy and together with outer ring spacer into chock</p>	 <p>Photo. 2-6 Install No. 2 row rollers and cage assy and together with outer ring spacer into chock</p>
<p>5 Install No. 3 row roller and cage assy together with No. 3, No. 4 row outer ring into chock (Fig. 2-31)</p>	 <p>Row No. 3, No. 4 outer ring Row No. 3 roller and cage assy</p> <p>Fig. 2-31 Install No. 3 row roller and cage assy together with No. 3, No. 4 row outer ring into chock</p>	
<p>6 Install No. 4 row roller and cage assy together with loose rib (side ring) (Fig. 2-32)</p>	 <p>Row No. 4 loose rib (side ring) Row No. 4 roller and cage assy</p> <p>Fig. 2-32 Install No. 4 row roller and cage assy together with loose rib</p>	
<p>★ Lifting tool to hoist bearing assembly to install at once (Fig. 2-33)</p>	 <p>Lifting tool to hoist bearing Row No. 1 loose rib</p> <p>Fig. 2-33 Lifting tool to hoist bearing assembly to install at once</p>	 <p>Photo. 2-7 Lifting tool to hoist bearing assembly to install at once</p>

Procedure details and cautions	Remarks
<ol style="list-style-type: none"> 1) Assemble row No. 2 rollers and cage assy and outer ring spacer. (See serial and row No. in Fig. 1-2 in Page 2) 2) Screw the lifting eye bolts in the threaded holes provided on the cage, and hoist the set of rollers/cage assy and outer ring spacer together. (Same procedure as 3-4) in Page 19) 3) Install the above set into No. 2 row outer ring inside which already installed in the chock. At this time, to avoid scratch damage between rollers and outer ring raceway, rollers should be pushed toward inside. 4) Lightly rotate the bearing to check if the outer ring, rollers and cage are properly assembled. 5) Insure that the oil holes of the chock align with the oil holes of the spacer. 	
<ol style="list-style-type: none"> 1) As same procedure as 3 in Page 19, install row No. 3 rollers and cage assy and row No. 3, No. 4 outer ring into chock. (Serial and row No. are shown in Fig. 1-2 in Page 2) 2) Confirm load zone mark mates with that of row No. 1 and No. 2 outer ring. 3) Make sure that the oil holes of the chock align with the oil holes of the outer ring. 4) Lightly rotate the bearing to insure that the outer ring, rollers and cage are properly assembled. 5) After assembling, apply grease in case of grease lubrication and mist oil in case of oil mist lubrication. (Note) In care of "O" ring is provided on outer ring O.D., take care not to damage the "O" ring. 	
<ol style="list-style-type: none"> 1) Install row No. 4 loose rib (side ring) into chock same as mounting procedure 2. 	
<p>Procedure 3~6 can be easily proceeded if lifting tool to hoist bearing assembly is used.</p> <ol style="list-style-type: none"> 1) Install row No. 1 loose rib into chock. 2) Install bearing assy, which assembled on bench according to procedure 3-6, by aligning load zone mark. 	

2-4 Mounting Bearings into the Outboard End Plate

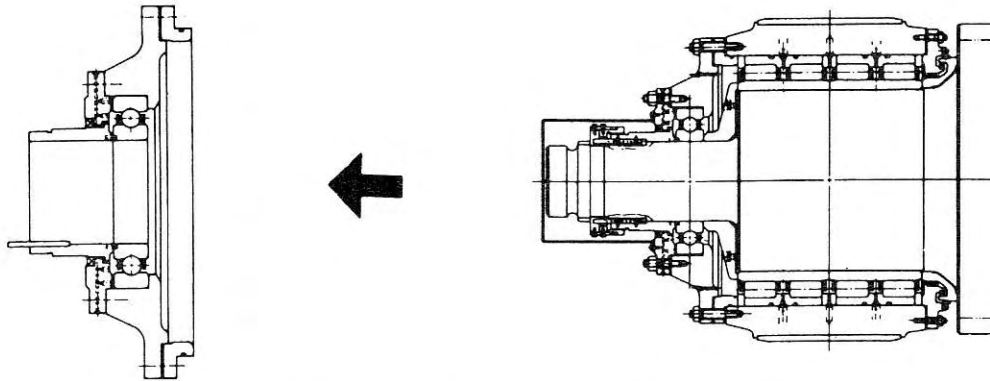
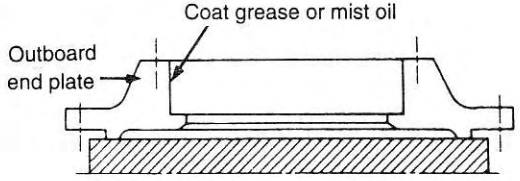

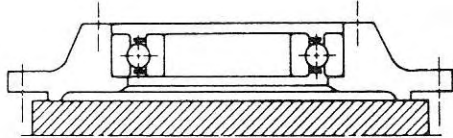
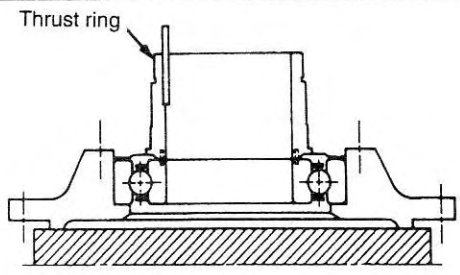
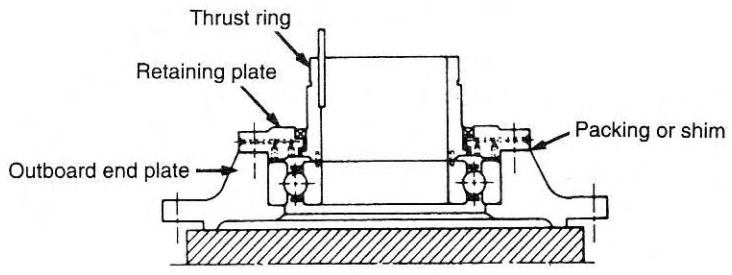


Fig. 2-34 Non-thrust side outboard end plate assembly

Mounting procedure	Procedure diagram and photo	
<p>1 Install bearings into the non-thrust side outboard end plate (Fig. 2-36)</p>	 <p>Fig. 2-36 Non-thrust side outboard end plate</p>	 <p>Photo. 2-8 Install deep groove ball bearing</p>
<p>2 Install deep groove ball bearing (Fig. 2-37)</p>	 <p>Fig. 2-37 Install deep groove ball bearing</p>	
<p>3 Install thrust ring and attach retaining plate on end plate (Fig. 2-38 and 2-39)</p>	 <p>Fig. 2-38 Install thrust ring</p>  <p>Fig. 2-39 Attach retaining plate</p>	

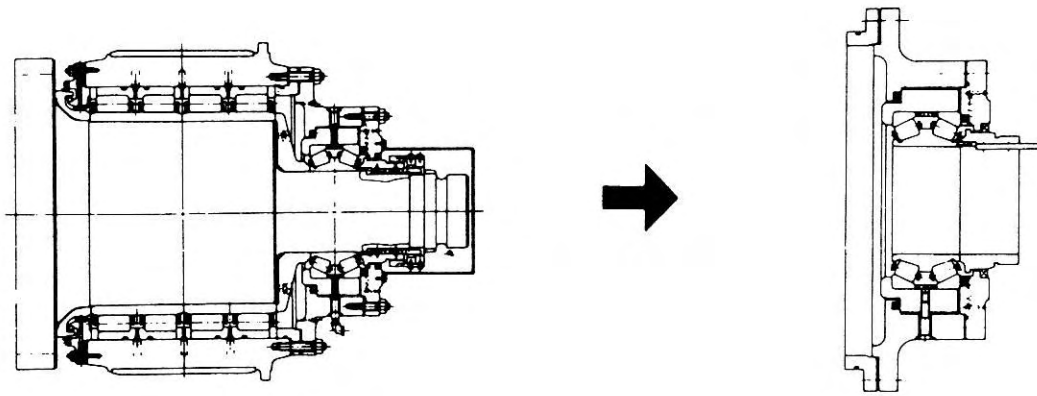
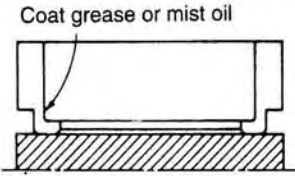
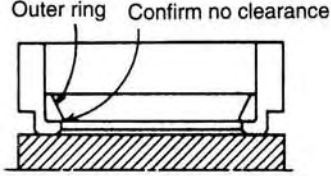
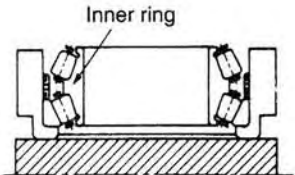
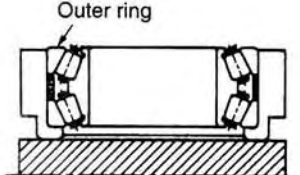

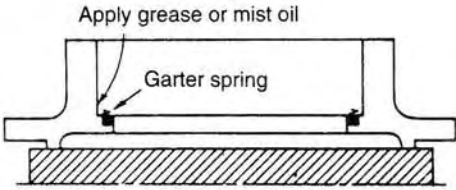
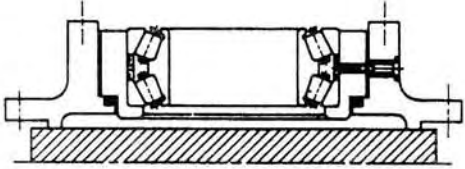
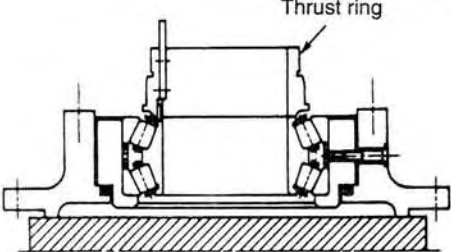
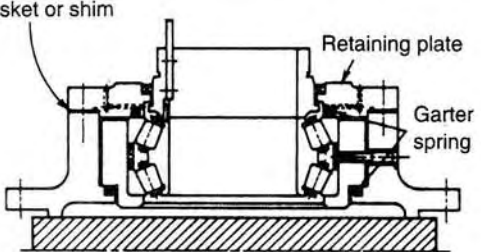


Fig. 2-35 Thrust side outboard end plate assembly

Procedure details and cautions	Remarks
<p>Coat grease or mist oil on the bore face of the outboard end plate.</p>	
<ol style="list-style-type: none"> 1) Coat grease or mist oil on O. D. surface of the deep groove ball bearing and install the bearing into end plate. 2) Pack the grease into the 1/3 ball bearing inside space in case of grease lubrication. 	
<ol style="list-style-type: none"> 1) Install the thrust ring. 2) Attach the retaining plate to the outboard end plate, and fasten lightly with bolts. 3) Check the gap between retaining plate and end plate by the feeler gage and select a gasket or shim thickness suitable for that gap, then assemble see Table 2-1 (page 28) for shim selection. 4) Tighten the bolts uniformly. 	

Mounting procedure	Procedure diagram and photo	
<p>4 Install double row tapered roller bearing into the thrust side sleeve</p>	 <p>Coat grease or mist oil</p> <p>Fig. 2-40 Sleeve</p>	 <p>Outer ring Confirm no clearance</p> <p>Fig. 2-41 Install outer ring</p>
<p>5 Install the sleeve and thrust bearing assembly into the thrust side outboard end plate</p>	 <p>Inner ring</p> <p>Fig. 2-42 Install inner ring</p>	 <p>Outer ring</p> <p>Fig. 2-43 Install outer ring</p>
	 <p>Sleeve and thrust bearing assembly</p>  <p>Apply grease or mist oil</p> <p>Garter spring</p> <p>Fig. 2-44 Thrust side outboard end plate</p>	
	 <p>Fig. 2-45 Install sleeve and bearings assembly into outboard end plate</p>	 <p>Thrust ring</p> <p>Fig. 2-46 Install thrust ring</p>
		 <p>Gasket or shim</p> <p>Retaining plate</p> <p>Garter spring</p> <p>Fig. 2-47 Install retaining plate</p>

Procedure details and cautions	Remarks
<ol style="list-style-type: none"> 1) Coat grease or mist oil on the bore face of the sleeve. 2) Install one outer ring into sleeve. 3) Make sure that the outer ring side face is in close contact with sleeve shoulder using a feeler gage. 4) Coat grease or mist oil on the inner ring assembly (inner ring, rollers and cages) and install into sleeve. 5) Install the outer ring spacer. In case of oil mist lubrication, insure that the oil holes of the chock and the oil holes of the spacer are aligned. 6) Install another outer ring. (Note) Installation procedures should be done by confirming bearing row No. 7) After installation, rotate the bearing lightly to insure that the outer rings and inner ring are properly assembled. 	
<ol style="list-style-type: none"> 1) Install garter springs in the outboard end plate. 2) Coat grease or mist oil on the bore surface of the outboard end plate. 3) Install the sleeve, in which the thrust bearings have been already installed. 4) Install the thrust ring. 5) Attach the retaining plate on the end plate. At this time, set the garter springs correctly and install gaskets or shims of designed thickness between end plate and retaining plate. (for shim selection. see Table 2-1 on page 28)··· selection procedure to be refered to page 27 procedure 2 (Note 1) Be careful since the installation of the garter springs is not simple. (Note 2) In case of a non pre-road type garter spring, adjust the gap with shims. 6) Firmly tighten the clamping bolts to fix the retaining plate on the outboard end plate. 	

2-5 Assembling Chock Body and Outboard End Plate, and Mounting Roll

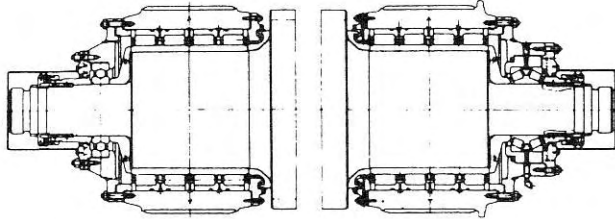


Fig. 2-48 Assembly

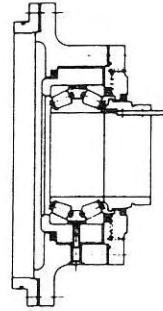
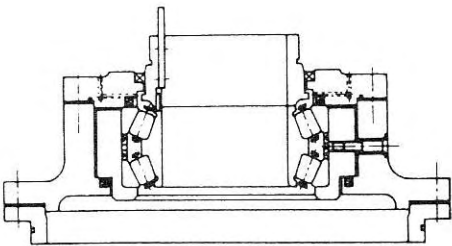

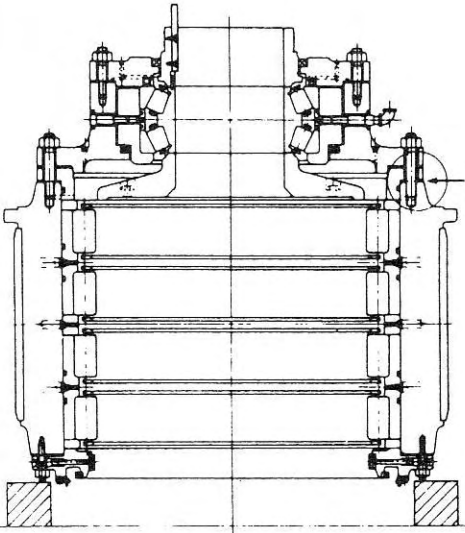



Fig. 2-49 Outboard end plate assembly (Thrust side)

Mounting procedure	Procedure diagram and photo	
<p>1 Provisional fastening of the outboard end plate</p>	 <p>Fig. 2-52 Thrust side outboard end plate</p>	 <p>Photo. 2-9 Install thrust side outboard end plate</p>
<p>2 Measure the gap for shim selection</p>	 <p>Measure the gap and select the shims</p> <p>Fig. 2-53 Decide the shim thickness</p>	 <p>Photo. 2-10 Gap check</p>

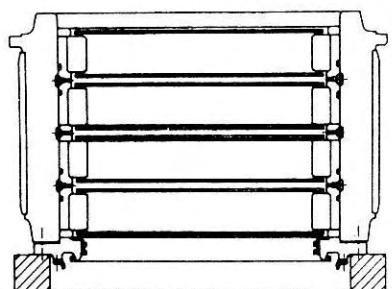


Fig. 2-50 Chock body

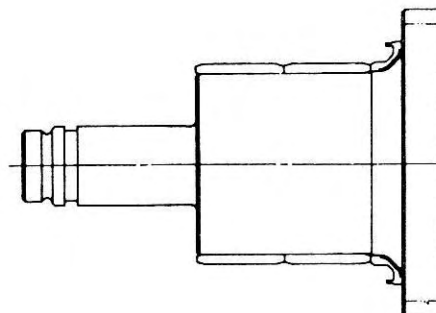









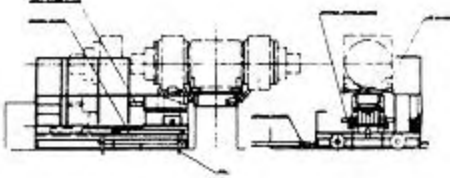
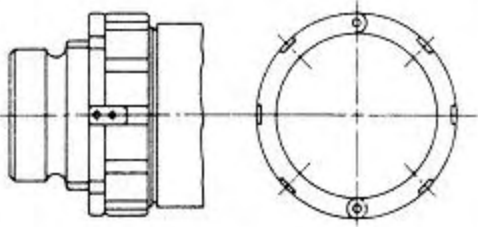
Fig. 2-51 Roll

Procedure details and cautions	Remarks																																	
<p>1) Attach the outboard end plate assembled previously to the chock body. 2) Fasten provisionally with four bolts equally spaced.</p>																																		
<p>1) Measure the gap between the chock and outboard end plate at four points. 2) Decide the thickness of shim depending on the average gap at four points. 3) Remove the four bolts fastened provisionally. (Note) Selection and combination of cork or rubber shims with regard to the measured gap is shown in table 2-1.</p>	<p>Table 2-1 Selection table for cork or rubber shims (Unit in mm)</p> <table border="1" data-bbox="1034 1434 1505 1843"> <thead> <tr> <th>Measured gap</th> <th>Thickness of shims</th> <th>Combination of shims</th> </tr> </thead> <tbody> <tr> <td><0.95</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>1.0 ~ 1.25</td> <td>1.5</td> <td>1.5</td> </tr> <tr> <td>1.35 ~ 1.65</td> <td>2.0</td> <td>2.0</td> </tr> <tr> <td>1.75 ~ 2.0</td> <td>2.5</td> <td>1.0+1.5</td> </tr> <tr> <td>2.1 ~ 2.4</td> <td>3.0</td> <td>1.0+2.0</td> </tr> <tr> <td>2.5 ~ 2.8</td> <td>3.5</td> <td>1.5+2.0</td> </tr> <tr> <td>2.9 ~ 3.2</td> <td>4.0</td> <td>2.0+2.0</td> </tr> <tr> <td>3.3 ~ 3.6</td> <td>4.5</td> <td>1.0+1.5+2.0</td> </tr> <tr> <td>3.7 ~ 4.0</td> <td>5.0</td> <td>1.0+2.0+2.0</td> </tr> <tr> <td>4.3 ~ 4.5</td> <td>5.5</td> <td>1.5+2.0+2.0</td> </tr> </tbody> </table> <p>(Note) JTEKT recommends cork or rubber shims rather than steel shims.</p>	Measured gap	Thickness of shims	Combination of shims	<0.95	1.0	1.0	1.0 ~ 1.25	1.5	1.5	1.35 ~ 1.65	2.0	2.0	1.75 ~ 2.0	2.5	1.0+1.5	2.1 ~ 2.4	3.0	1.0+2.0	2.5 ~ 2.8	3.5	1.5+2.0	2.9 ~ 3.2	4.0	2.0+2.0	3.3 ~ 3.6	4.5	1.0+1.5+2.0	3.7 ~ 4.0	5.0	1.0+2.0+2.0	4.3 ~ 4.5	5.5	1.5+2.0+2.0
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Mounting procedure	Procedure diagram and photo	
<p>3 Attach the outboard end plate to chock</p>	 <p>Photo. 2-11 Set the shim</p>	 <p>Photo. 2-12 Attach the outboard end plate</p>
<p>4 Coat lubricant on the inner ring raceway surfaces and fillet ring</p>		
<p>5 Mount the chocks on the roll</p>	 <p>Photo. 2-14</p>	 <p>Photo. 2-15</p>
<p>6 Install the half rings and covers</p>	 <p>Photo. 2-16 Install the half ring</p>	 <p>Photo. 2-17 Attach the cover</p>

2-6 Dismounting Bearings

- To remove the bearings from the chock, reverse the mounting procedures of Para. 2-2 to 2-5. It is important to keep the surroundings clean and to remove foreign material such as scale sticking to the chock prior to removal of the bearings
- To remove the inner rings, thermal expansion by electromagnetic induction heater or expansion by hydraulics are generally used. However normally removal is not necessary because inner rings and roll are considered as one part.

Procedure details and cautions	Remarks
<ol style="list-style-type: none"> 1) Set the selected shims first on the chock. 2) Again attach the outboard end plate on the chock and tighten bolts to specification. On this occasion, tighten bolts in diagonal sequence to insure even tightening. 	 <p>Photo.2-13 Assembly of chock and bearing outer ring and roller</p>
<ol style="list-style-type: none"> 1) Coat grease or mist oil on the raceway surfaces of the inner ring and the face of the fillet ring. 	
<ol style="list-style-type: none"> 1) Again coat grease in case of grease lubrication and mist oil in case of oil mist lubrication on the inner ring raceway and roll neck just before mounting on the roll. 2) Place the roll on a horizontal position and hoist the chock. Mount the chock on the roll neck. 3) Since the inner ring raceway surfaces and roller rolling surfaces can be scratched, take care when mounting the chock. 4) Scratches may be prevented by the use of a cart or automatic mounting device. 	 <p>Fig. 2-54 Automatic mounting device</p>
<ol style="list-style-type: none"> 1) Install the half rings on the roll neck. 2) Attach the cover. 3) Firmly tighten the bolts holding the scale seals. (No. 4 and No. 5 seals shown in Page11 Fig. 2-10) 	 <p>Fig. 2-55 Half ring</p>

3. MAINTENANCE AND INSPECTION

It is inevitable that the raceway and rolling contact surfaces of bearing are getting fatigue with use. Proper maintenance and inspection are required to postpone this fatigue and prevent premature failure during operation.

3-1 Inspection During Operation

Irregularities in bearing performance during operation are indicated by noise, heat and vibration. Initial familiarity with the noise, heat and vibration under normal operating conditions and monitoring them during operation will establish guide lines for determining when a deterioration in bearing performance is occurring. A soniferous bar (Photo. 3-1) are useful in measuring bearing performance.



Photo. 3-1 Checking sound with soniferous bar

3-2 Routine Inspection

Pull the roll from the stand and check the chock and roll separated.

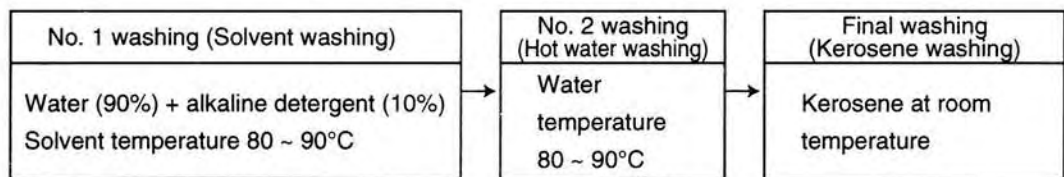
- 1) Just after the roll is pulled out, check the water content emulsification in the grease (oil).
If a considerable amount of water is observed, disassemble and check the seals.
- 2) Check the seal lip for irregularities such as foreign material or damages and replace defective seals.
- 3) Check the seal lip contact surface on the fillet ring or thrust ring for irregularities such as abnormal wear. Repair or replace if necessary.
- 4) Check roller rolling surface, roller end face and raceway surfaces.
- 5) Check looseness of pin welds.
- 6) Though direct check on outer ring raceway is difficult, irregularity such as flaking can be observed by flaked particles in the bearing.
- 7) In case of forced circulating oil lubrication, periodical check on oil filter is required to find whether flaked particles are remained.

3-3 Regular Overhaul

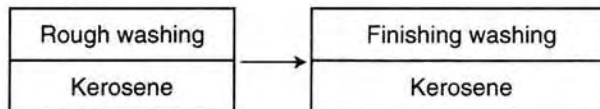
In addition to routine inspection, whether or not the bearings show signs of abnormality, they should be dismantled from the chock for inspection at regular intervals. The frequency depends upon the operation of the rolling mill, however it is desirable to conduct the inspection at least every three months after within one years operation. The frequency may decrease depending upon the condition of the bearings, i.e., if the bearing condition is good, inspection at every 6 months may be acceptable.

- 1) Remove foreign material adhering to the chock such as scale prior to removing the chock from the roll.
- 2) Remove the bearings in accordance with dismantling procedures. At this time confirm the bearing was correctly mounted such as load zone position, row No. inspection No. etc.
- 3) Wash the bearings by either of the following two methods.

(A) Method



(B) Method



Washing can be improved if the liquid is blown away by compressed air and bearings components should be rotated by hand while washing.

- 4) Check the cage, outer ring and inner ring for irregularities. Rework irregularities if found.
- 5) After washing, the components with the same serial No. should be kept together for strage or reassembling to avoid mixture of components with different serial Nos.
- 6) Loaded zone of the outer ring should be altered as shown in Fig. 3-1 at regular intervals. Also alter the assembling row number as shown in Fig. 3-2.

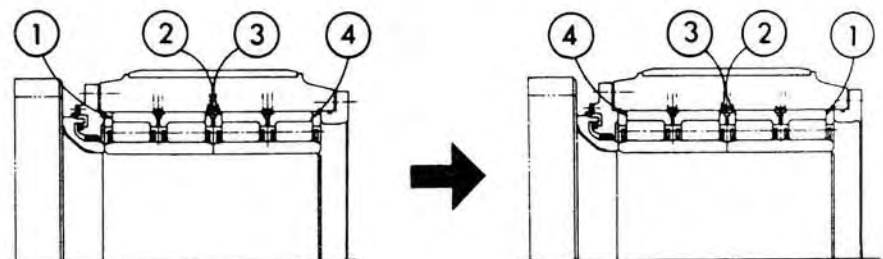
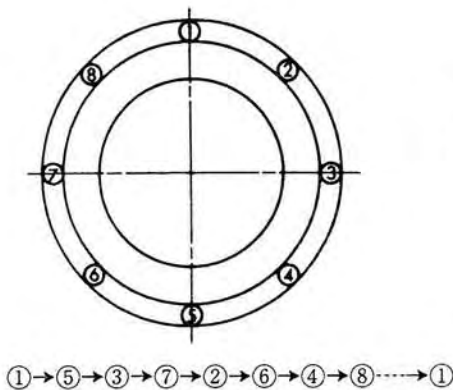


Fig. 3-1 Change position of loaded zone on outer ring

Fig. 3-2 Change direction of assembling row number of bearings in chock

7) Inspection and correction of bearing components

① O.D. surface of outer ring

Excessive fretting corrosion should be corrected by emery cloth of approximately No. 200 grit or oil stone of approximately No. 500 grit.

② Raceway surface of outer ring

Smearing should be corrected with an oil stone of approximately No. 500 grit or emery cloth of approximately No. 200 grit.

For small flaking, the sharp edges should be blended with a microgrinder and then ground smooth with an oil stone and install and position at no load zone area in the chock. Outer rings having large or deep flaking should not be re-used.



Photo. 3-2 Correction of outer ring raceway surface (Oil stone)



Photo. 3-3 Correction of outer ring raceway surface (Emery cloth)

③ Roller rolling surface

Smearing shall be corrected by oil stone of approximately No. 500 grit or emery cloth of approximately No. 200 grit. Flaking normally are basis for rejection. However, when flaking are minor and rotational accuracy is not largely affected, the edges of the flaking may be repaired by a microgrinder and smoothed out by an oil stone of approximately No. 500 grit.



Photo. 3-4 Correction of roller rolling surface (Microgrinder)



Photo. 3-5 Correction of roller rolling surface (Oil stone)

④ Raceway surface of inner ring

Smearing or scratches should be corrected by an oil stone of approximately No. 500 grit. Same as ③ above roller repairing for flaking.

For small flaking, the sharp edges should be blended with a micro-grinder and then ground smooth with oil stone or emery paper. Inner ring having large or deep flaking should not be re-used.

3-4 Other Cautions

- 1) Vibration occurring during operation at no loading has a large effect on the bearing service life. Thus the clearance between the chock and mill stand shall not exceed the following values. (Table 3-1)

Table 3-1 Clearance between the chock and mill stand window with regard to roll diameter

Unit in mm

Roll barrel diameter	Clearance between chock and mill window	
	Minimum	Minimum
250 ~ 340	0.30	0.40
360 ~ 380	0.35	0.45
400 ~ 450	0.40	0.60
550 ~ 650	0.55	0.75
700 ~ 800	0.70	0.90

- 2) Excessive variation in chock inside diameter cause abnormal load on bearings which can result in premature life or failure of the bearings. The chock bore shall not exceed the specified limits.

Table 3-2 Recommended chock bore dimensions for metric series bearings

Unit in 0.001mm

Bearing O.D. (mm)		Max. chock bore out-of-roundness	Allowable Max. chock bore
Over	Incl.		
120	150	75	+150
150	180	100	+250
180	250	150	+300
250	315	150	+300
315	400	150	+300
400	500	150	+300
500	630	150	+300
630	800	200	+450
800	1 000	250	+500
1 000	1 250	300	+600
1 250	1 600	350	+750
1 600	2 000	400	+900

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