C D M

Double Suction Volute Pump

INSTRUCTION MANUAL

CONTENTS

1.Preface

1.1.Precaution for the pump application

We thank you for your choosing our pump very much. In this instruction manual, the precaution to install this pump and to be used safety is mentioned. Execute installation and operation of the pump with being careful of the following items to use the pump for a long time.

- ☐ Be sure to read this instruction manual before installation and operation of the pump.
- ☐ Keep this instruction manual carefully in the place where it can be always seen.
- ☐ Be sure to do disassembly and assembly of the pump in accordance with this instruction manual.
- ☐ Inspect expendable parts such as bearing lubricating grease and gland packing, and replenish or exchange them in accordance with this instruction manual.
- ☐ Be sure to do the periodic inspection of the pump.
- ☐ Store the pump in accordance with this instruction manual when it isn't operated for a long time.

1.2.Precaution in safety

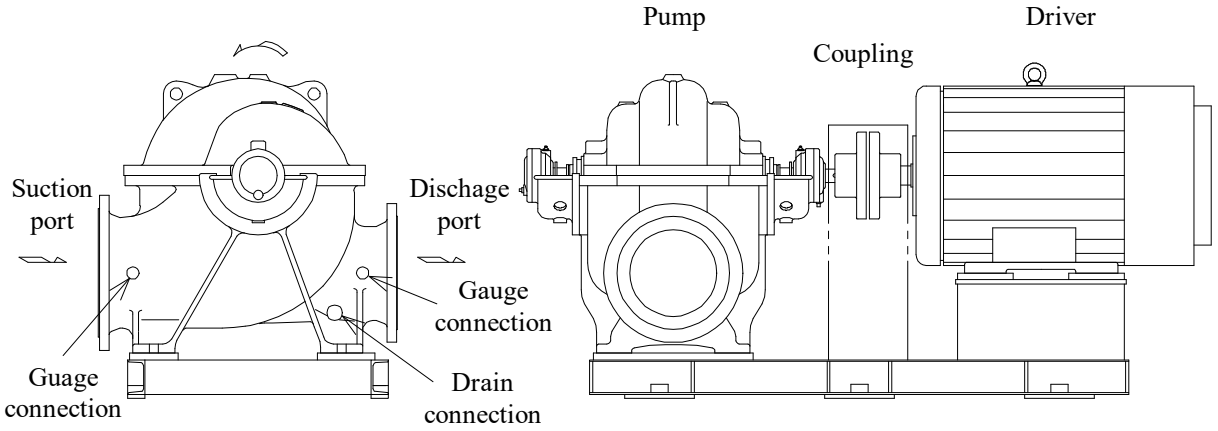
Be sure to follow the items mentioned below because they are generally important in safety.

⚠ CAUTION
1) A person except for the repair technician is never to do decomposition, repair, modification, and so on.
2) Never do work alone, and wear a helmet, safety glasses, earplug, safety shoes, and so on.
3) When oil spills in the floor and the access, wipe it out soon because there is a fear of falling down.
4) Don't lean on the coupling guard, and don't ride on the top of it because it touches the coupling at the time of pumping operation if the coupling guard is transformed.
5) Don't remove the terminal cover of the electric product such as motor during energizing because there is fear of the electric shock.
6) Be sure to turn the switch of the driver off before work. And stick the label such as "Don't turn on the switch!" on the switch not to turn on the switch by accident.

2.Pump outline

2.1.Characteristic of the pump

This pump is the horizontal double suction centrifugal volute pump that has a horizontal suction port and a horizontal discharge port, and is driven by the driver through the coupling. The next figure is the pump outline in the case of the right rotation viewed from coupling side.



Refer to "OUTLINE DRAWING" for the correct outline.

Fig.2-1 Pump outline (CW)

This is an inline type pump, and has the structure that the casing can be divided into upper half and lower half horizontally.

2.2.Structure

The structure of this pump is divided into the following six parts roughly.

1. Casing (1021,1022)
2. Impeller (2340)
3. Shaft (2100)
4. Bearing part
5. Stuffing box
6. Coupling

Here, the number in the parenthesis is part number. See the figure of the next page or the "SECTIONAL DRAWING", about the correspondence with each part and the part number. Part number is written after the part name in the parenthesis to make identification of the part easy. There are some type in the form of shaft sleeve, bearing part, and stuffing box in this pump. Confirm which type is being used for this pump referring to the "SECTIONAL DRAWING".

2.2.1.Pump casing

Pump casing has a suction port and a discharge port in the horizontal directions. The lifting liquid that flowed into a suction port is split equally right and left, and pump casing on the suction side is the form that the lifting liquid is led to impeller double entry. Pump casing on the discharge side is a volute type. And, pump casing is the structure which can be divided into the upper half and lower half horizontally.

The leg of the pump has done the mono-block casting on the casing lower half (1022), and it is fixed on channel bed with 4 bolts. Moreover, it has the gauge connection on each of the suction side and the discharge side, and the drain connection on the discharge side. It has the priming connection on the casing upper half (1021).

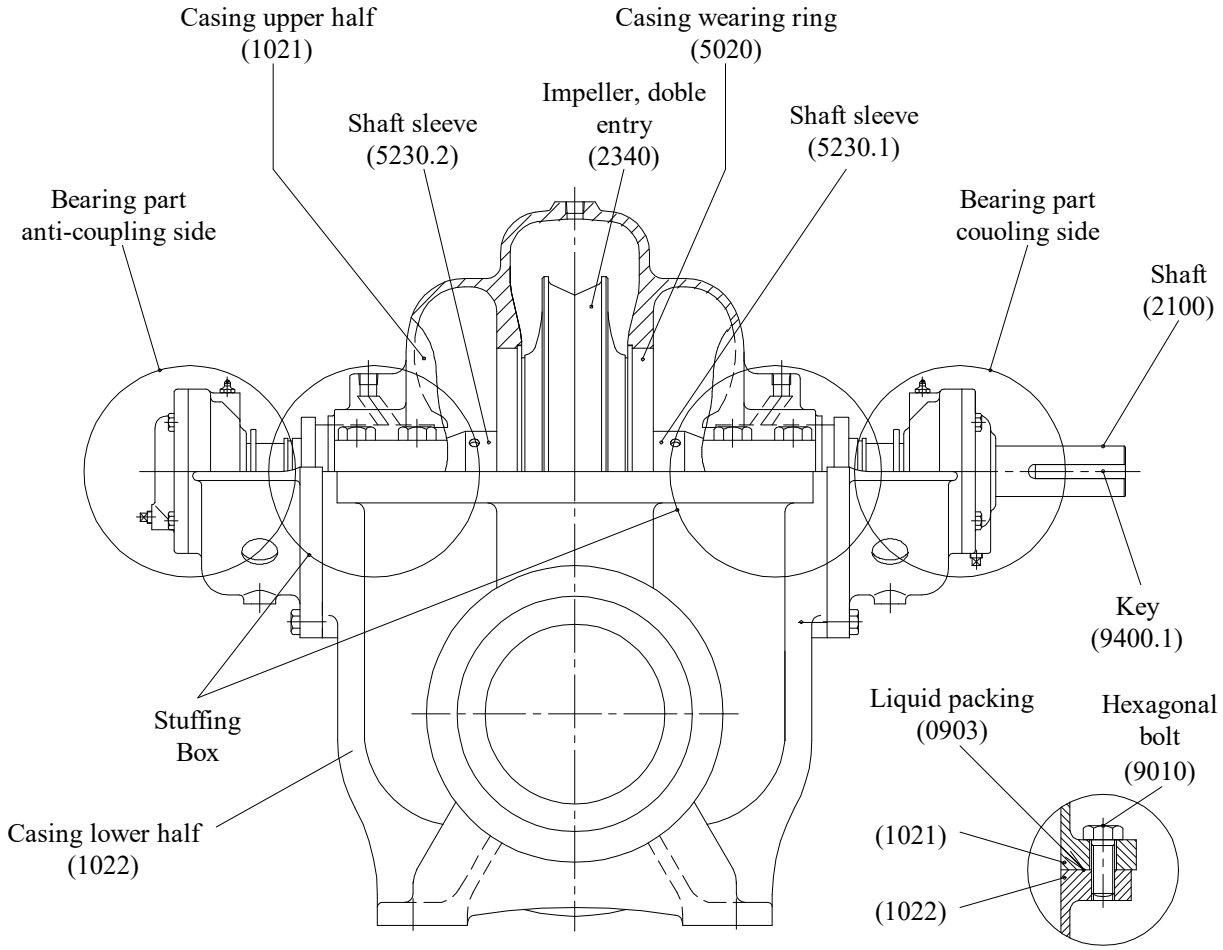


Fig.2-2 Pump structure

2.2.2.Impeller

Impeller (2340) is a double entry type, the axial thrust balances theoretically. There is a plover type impeller which only half pitch moved the blade as a special type.

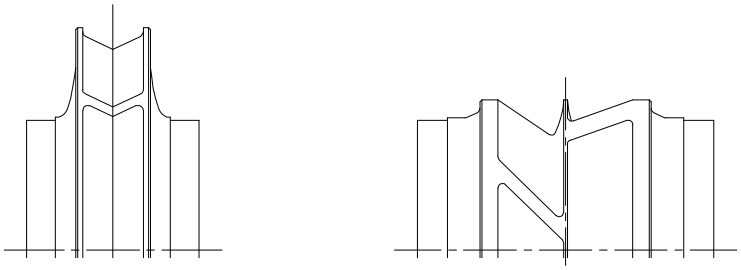


Fig.2-3 Impeller

2.2.3.Shaft

Shaft (2100) transmits the output of the driver through the coupling to the impeller (2340). The structure of the rotor has high rigidity, because both ends of the shaft (2100) are supported by the ball bearings. Moreover, shaft is protected by the shaft sleeves(5230.1, 5230.2), so it doesn't touch the lifting liquid directly. Shaft sleeve in this pump is the following three types.

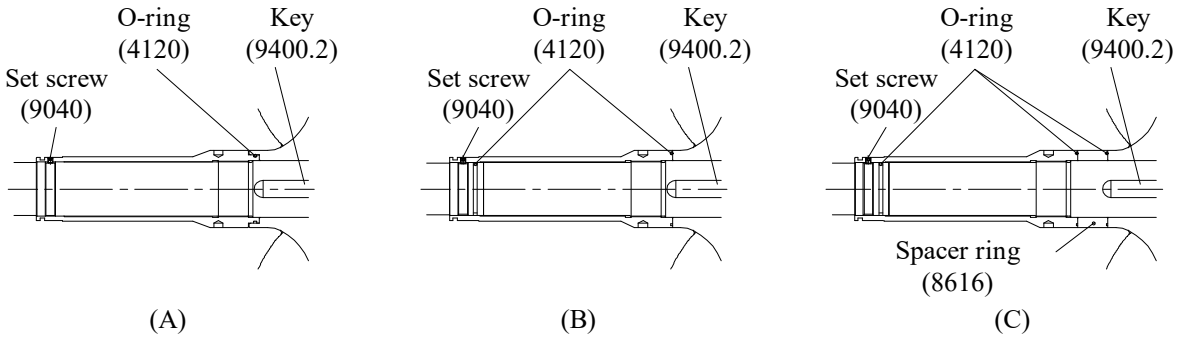
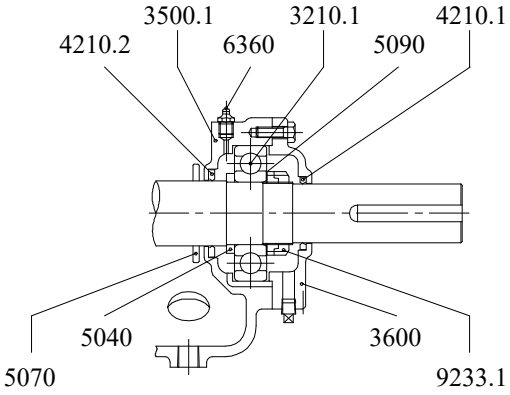


Fig.2-4 Shaft sleeve form

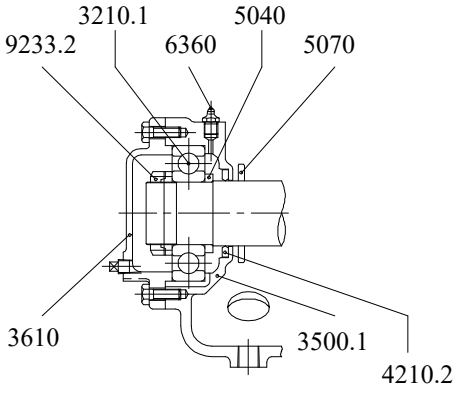
2.2.4.Bearing part

Ball bearings (3210) support the shaft(2100) on both ends. Ball bearing deep groove type is used in the coupling side, the anti-coupling side as well. Ball bearing is lubricated by the grease. There are the following three types on the anti-coupling side.

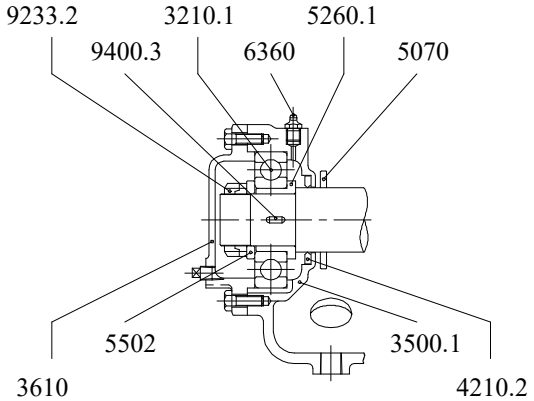
Parts number	Parts name	Parts number	Parts name
3210.1	Ball bearing	5070	Deflector
3210.2	Ball bearing (for double bearing)	5090	Adjust ring
3500.1	Bearing bracket	5260.1	Bearing bushing
3500.2	Bearing bracket (for double bearing)	5260.2	Bearing bushing (for double bearing)
3600	Bearing cover	5502	Bearing washer
3610	Bearing end cover	6360	Grease nipple
4210.1	Oil seal (for bearing cover)	9400.3	Key (for bearing bushing)
4210.2	Oil seal (for bearing bracket)	9233.1	Lock nut (coupling side)
5040	Spacer ring	9233.2	Lock nut (anti-coupling side)



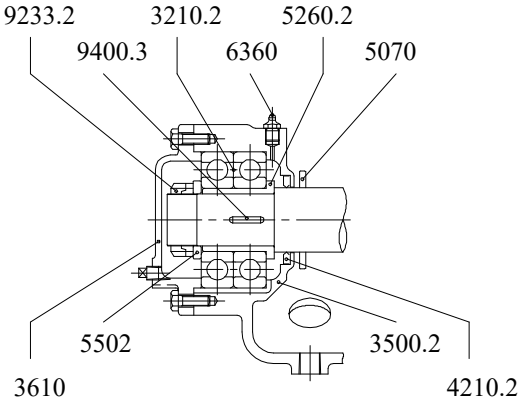
Bearing part coupling side



Bearing part anti-coupling side (A)



Bearing part anti-coupling side (B)



Bearing part anti-coupling side (C)

Fig.2-5 Details of the bearing part

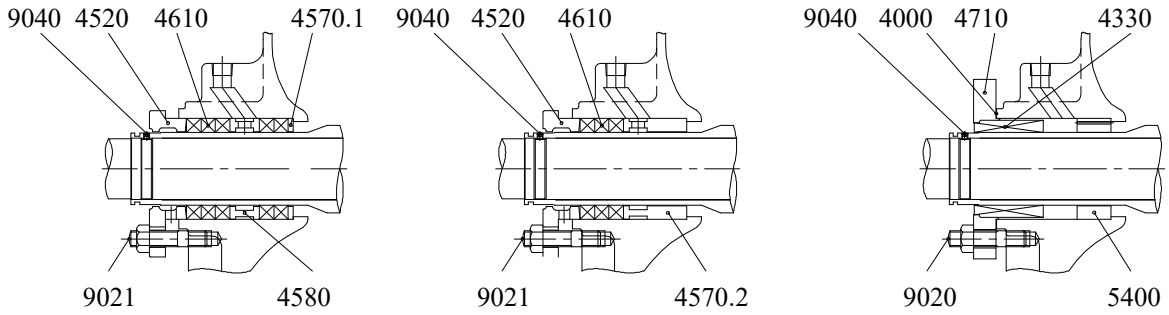
2.2.5.Stuffing box

Stuffing box is set up on the part where the shaft (2100) goes through the pump casing to keep the lifting liquid tight inside the pump. There are two types of stuffing box, gland packing type and mechanical seal type. Refer to “MECHANICAL SEAL INSTRUCTION MANUAL” in the case of the mechanical seal type.

In the case of gland packing type, it gets effects of sealing lifting liquid with flushing and lubricating and cooling effect of the gland packing (4610) by the liquid from the outside or the discharge part to the lantern ring (4580) or the end ring (4570.2).

It is possible to change the gland packing type into the mechanical seal type. Inquire to our company in the case about it.

Part number	Part name	Part number	Part name
4000	Gasket	4610	Gland packing
4330	Mechanical seal	4710	Sealing cover
4520	Gland	5400	Bushing
4570.1	End ring	9020	Stud bolt
4570.2	End ring (for high pressure type)	9021	Gland bolt
4580	Lantern ring	9040	Set screw

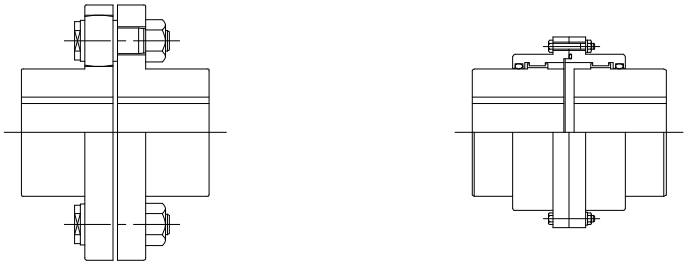


Standard type　　High pressure type　　mechanical seal type

Fig.2-6 Details of stuffing box

2.2.6.Coupling

The flexible coupling or the gear coupling are used mainly for the coupling that transmit the output of the driver to the pump shaft, but sometimes other coupling are used. Refer to “COUPLING INSTRUCTION MANUAL” except for the flexible coupling.



Flexible coupling　　Gear coupling

Fig.2-7 Coupling

3.Installation

3.1.Installation foundation

3.1.1.Foundation to install in the open air

The foundation of the pump must have enough strength to stand long application. Adjust it so that the foundation of the pump and the ground may satisfy the following conditions.

- ☐ It shouldn't cause the differential settlement. It's possible to know the general support force of the ground by the geology, but we recommend measuring the settlement by actually increasing the load in the spot.
- ☐ Foundation settlement should be less than allowable value.
- ☐ The foundation must have the strength that it can stand the various forces and the vibration at the time of the pumping operation. The floor must have enough strength when the pump is installed in the concrete floor directly.

When the foundation doesn't satisfy the above condition, do the proper reinforcement by striking the stake or displacement to the grit and the debris.

3.1.2.Position of the pump

Be careful of the following items to select the installation position of the pump.

- ☐ Install the pump as much as possible near the suction source, and shorten the suction pipe as much as possible.
- ☐ Don't install it in the higher position than the surface of water of the suction source beyond the necessity.
- ☐ Secure the height and the breadth that the disassembly and the assembly of the pump can be done enough.
- ☐ The place where it dried as much as possible is suitable in the installation position of the pump.

3.1.3.Pipe arrangement

Be careful of the following items when putting the pipe arrangement.

- ☐ Install the induction pipe orifice in the depth of more than 1.5 times of the pipe diameter D from the water surface. And keep space beyond the pipe diameter from the bottom of the suction sump to the water induction pipe orifice (Fig.3-1). Then, take more than 1.5 times distance of D from the side wall to the induction pipe.
- ☐ When installing two and more pump in the same suction sump, take the pitch between the suction pipe more than three times of D (Fig.3-1).
- ☐ When the water from the plant is returned to the suction sump, if the water is dropped from the top of the water surface, the air involved in the water sometimes causes instability operation and the vibration of the pump, and break of the shaft. Therefore, be sure to let the head of the pipe for the return water set under the water. And, install the head of the pipe for the return water in as far a position as possible from the pump induction pipe.
- ☐ Set up the strainer for avoiding a dust and so on in the induction pipe side, and don't make the debris flow into the pump. 10-50 mesh is suitable for the roughness of the scale division of the wire net. When the scale division of the wire net is too detailed, loss of head become bigger and suction performance of the pump decline remarkably and cause cavitation.

☐ The induction pipe is to be as short as possible, and reduce the bend section. Enlarge the curvature when unavoidably setting up the bend section.

☐ Connect the induction pipe not to absorb the air, and install it to become an up grade (about 1/50) toward the pump in the case of the vacuum condition. In the case of the pushed condition, install it to become a descent grade (about 1/50) toward the pump.

☐ When the lump of the air is unavoidably made in the induction pipe or other pipe, set up the priming valve or the exhauster for the priming.

☐ When the diameter of the suction pipe is different from the diameter of the suction port of the pump, connect the taper pipe between the suction pipe and the suction port of the pump (Fig.3-2).

☐ Connect the valve as much as possible near the pump discharge port when setting up the valve in the discharge side. And when setting up the check valve, connect it between the pump discharge port and the valve of discharge side.

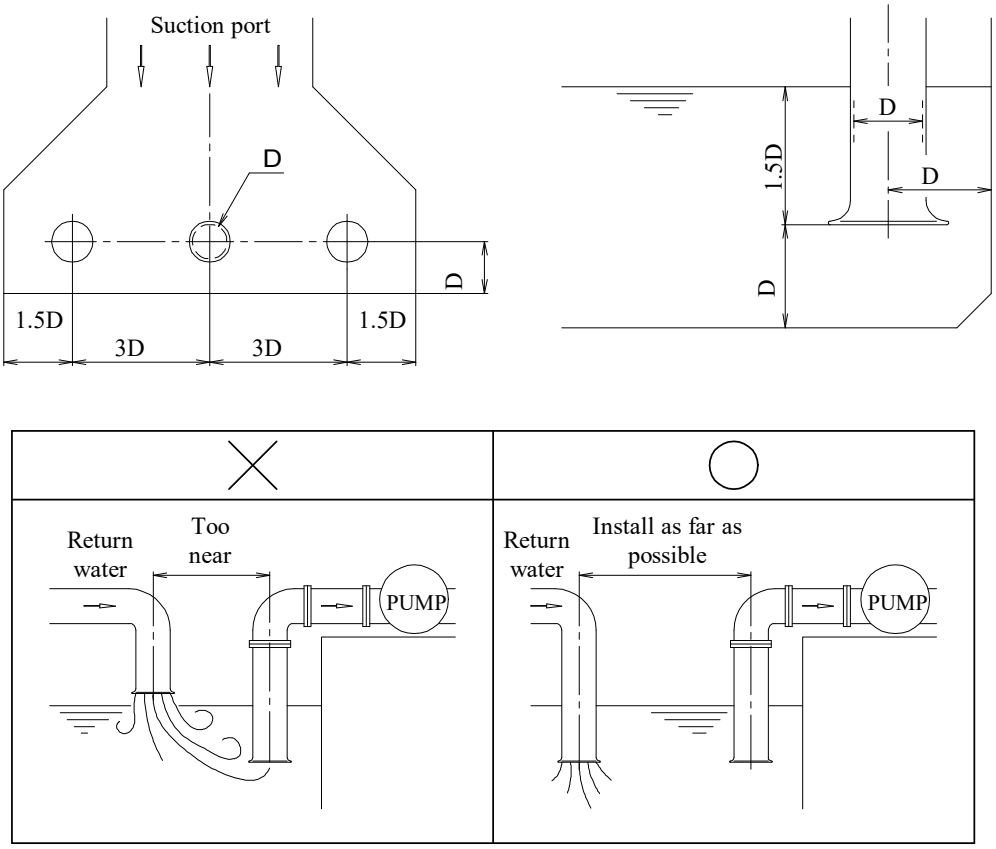


Fig.3-1 Induction pipe arrangement

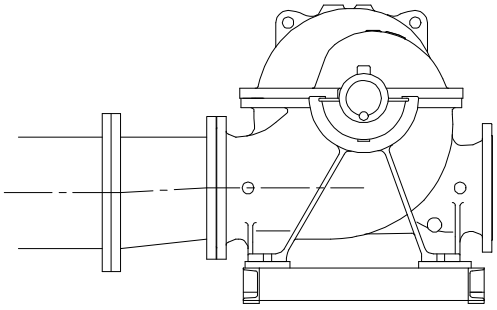


Fig.3-2 Installation of the taper pipe

3.2.Preparation before the installation

3.2.1.Precaution for the installation

⚠ DANGER

1) A person except for the repair technician is never to do decomposition, repair, modification, and so on.
2) Don't enter under the pump or the pump unit, and don't approach that too much.

⚠ CAUTION

3) Never do work alone, and wear a helmet, safety glasses, earplug, safety shoes, and so on.
4) Confirm safety before the work so that workers may not cause oxygen deficiency or gas poisoning when workers work in the pit, the manhole, and so on.
5) Set up a safety fence around the workspace, and secure evacuation access.
6) Confirm that there is no danger of the fire and the detonation before the work when the work that a spark evolutes such as welding.
7) Be sure to turn the switch of the driver off before the work before the aligning work. And stick the label such as "Don't turn on the switch!" on the switch not to turn on the switch by accident.
8) Install the coupling guard in the fixed position, and fix it securely with bolts.

Be careful that anything isn't paid into the pump and it isn't left in the pump at the time of the installation.

Store the pump referring to the "***7. Storage procedure***" when you can't install the pump soon.

3.2.2.The tool and jig for the installation

It is convenient that the following tools are prepared for at the time of the installation. But, our company doesn't supply those tools and the jigs fundamentally.

- ○ Tools
  - ☐ Hammer
  - ☐ Lead hammer
  - ☐ Bar
  - ☐ Straight edge
  - ☐ Precision level
  - ☐ Wrench
  - ☐ Dial gauge
  - ☐ Clearance gauge
  - ☐ Screw driver
  - ☐ Tape measure
  - ☐ Chisel
- ○ Jigs
  - ☐ Taper liners (for the temporary liner and the regular liner)
  - ☐ Straight liners (for the temporary liner and the regular liner)

3.3.Transportation of the pump

When transport the pump, be careful of the following items.

⚠ CAUTION
1) Never do the work alone, and wear a helmet, safe glasses, earplug, safety shoes, and so on. 2) Check slinging tools such as wire rope and crane securely before the work. 3) Never wear the steel wire rope on the lifting eye of the pump casing upper half at the time of carrying the pump unit or the pump. 4) Never wear the steel wire rope on the eyebolt of the driver at the time of carrying the pump unit. 5) Don't enter under the pump or the pump unit, and don't approach that too much.

When transport the pump unit that put the pump and the driver on the common channel bed, wear the steel wire rope on the pump and the driver as the Fig.3-3.

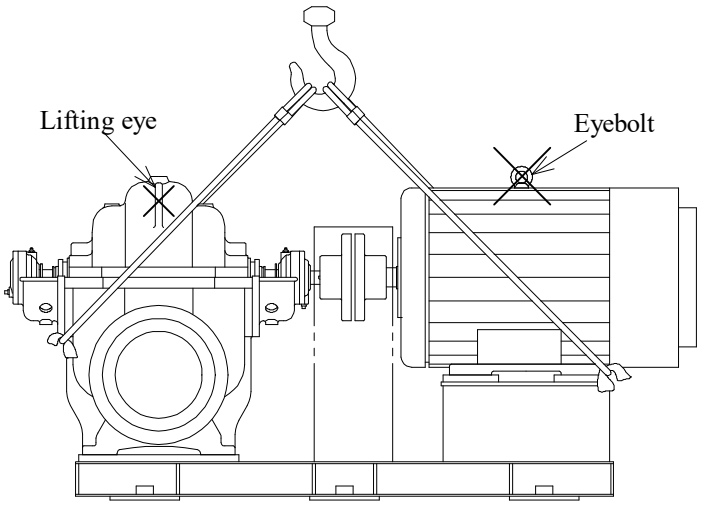


Fig.3-3 Transportation of the pump unit

3.4.Installation of the pump unit

3.4.1.Aligning and fixation of the pump unit

Aligning the pump unit in the following order.

1. Inking for the aligning

Do the inking in the foundation based on the wall or the column, and make the inking center line the standard for the installation before putting the pump unit on the foundation concrete. At this time, confirm whether the foundation dimension and the holes for the foundation bolts are constructed as mentioned in the "FOUNDATION DRAWING" or the out side view (Fig.3-4). Modify it properly in advance if there is a part where is different from the drawing. Clean holes for foundation bolts elaborately.

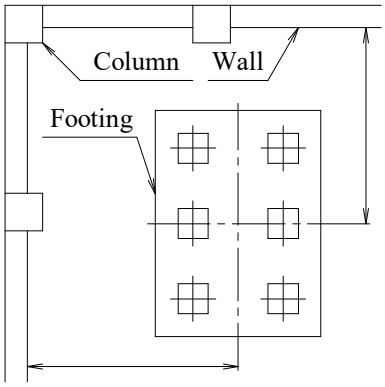
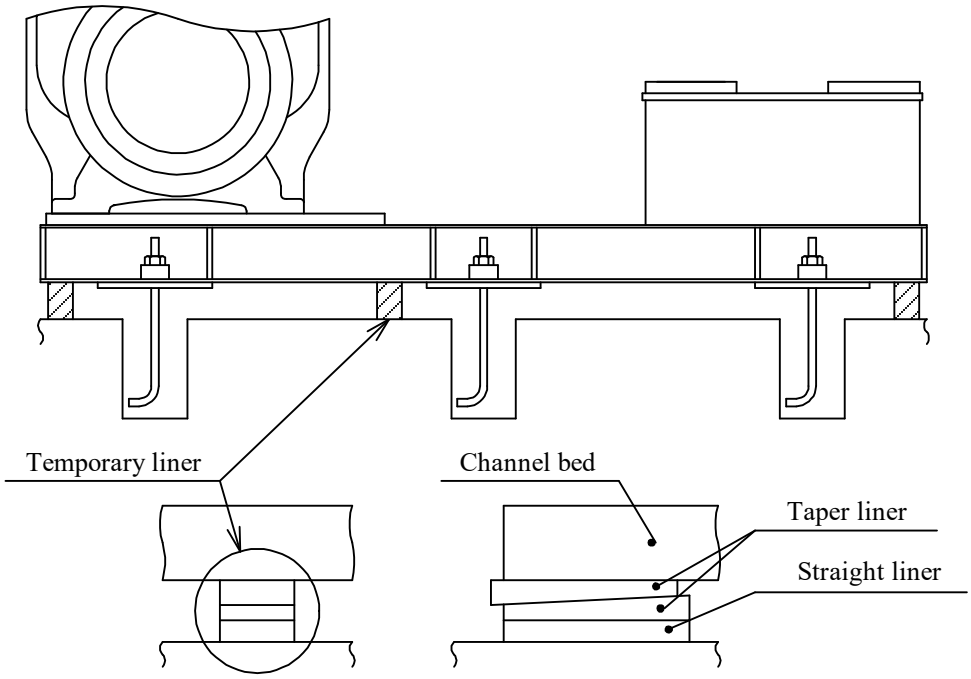


Fig.3-4 Foundation of the pump

2. Temporary installation of the pump unit and temporary aligning

Install the temporary liners (straight liners, taper liners) for the temporary installation between the channel bed and foundation (Fig.3-5). Install it in the position to hit both sides of the leg of the pump and the driver, and to reduce the distortion of the channel bed as much as possible. But, be careful on both sides of the foundation bolts to keep it away too much to the foundation bolts because the regular liners (straight liners, taper liners) later. Put the pump unit on the temporary liners, and adjust the center height of the pump by the temporary liners. Take down the plumb in the center of the flange, and align the pump with the centerline. Align the center in the shaft direction by looking for the center of the pump from the center of the foundation bolts. Measure the horizontal of the channel bed at the end of the installation side of the pump and the driver (Fig.3-6).



Packers can be used instead of the temporary liners.

Fig.3-5 Temporary liner

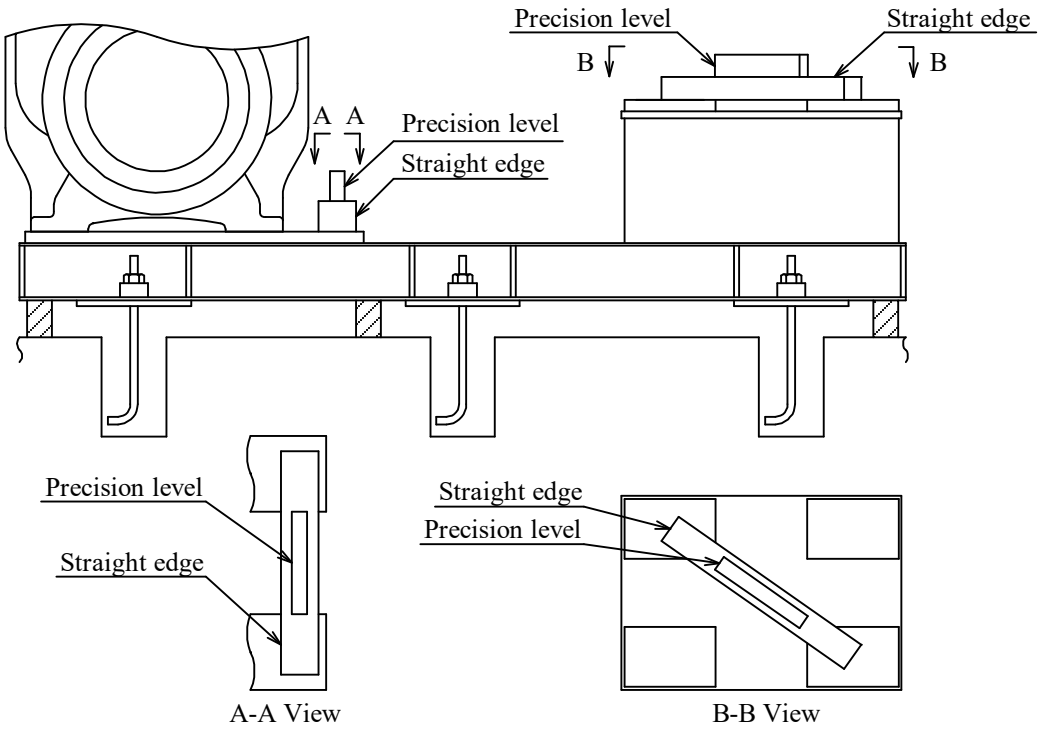


Fig.3-6 The horizontal of the channel bed

3. Temporary aligning of the coupling

Measure the distortion of the parallelism and the run out of the coupling, and adjust the temporary aligning of the pump and the driver by the temporary liners (Fig.3-8).

4. The fixation of the foundation bolts

Install the foundation bolts, and pour the concrete into the holes for the foundation bolts after the location of the pump and the horizontal are decided.

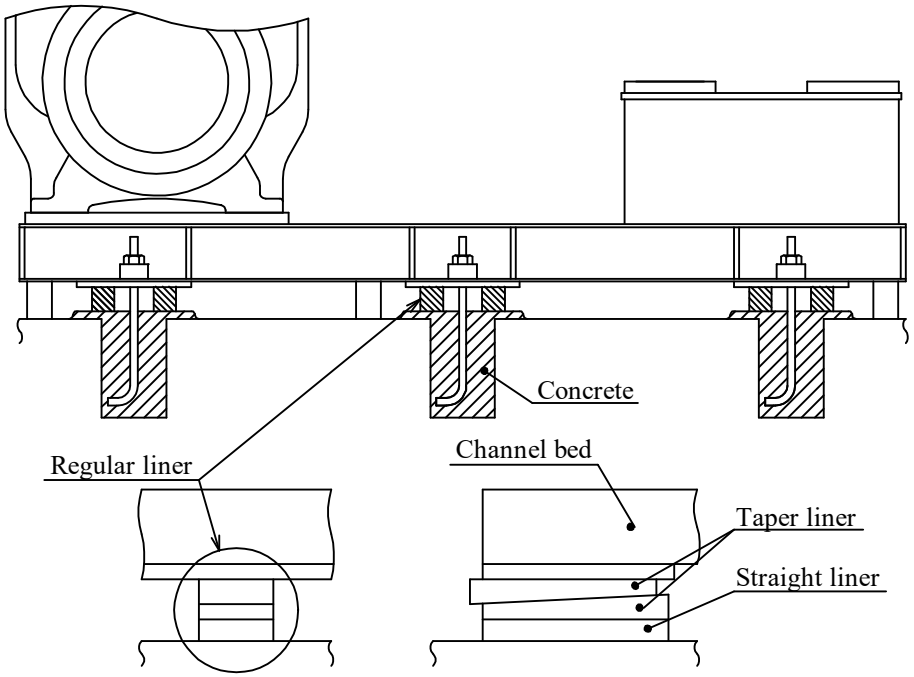


Fig.3-7 Regular liner

5. Regular installation of the pump and regular aligning

Install the regular liners on both sides of the foundation bolts after the concrete is stiffened to a certain extent (Fig.3-7). Execute regular installation and regular aligning of the pump unit after the concrete does the cure enough (without using the rapid combination material, more than one week). Fasten the foundation bolts, and fix it on the foundation base with confirming the horizontal adjustment that it went by the temporary installation, and the aligning of the pump. Execute the spot welding so that the regular liner may not deviate after tightening the foundation bolts.

3.4.2.Connection of the pipe

After the pump unit fixed the position, connect the suction pipe and the discharge pipe (and valve) with being careful of the following items.

1. Be careful of the way of the support of the pipe and the valve so that the load of them may not act on the pump at the time of the connection.
2. Confirm that the pump isn't causing the distortion by the load of the pipe.
3. Confirm that the shaft of the pump turns around smoothly by hand.
4. Be careful not to tighten unequally when tightening the flange.

3.4.3.Final aligning of the coupling

The aligning of the coupling must be modified because of the channel bed's own distortion, though it is being aligned once in the factory in the case of the pump unit. Therefore, the bolts of the coupling are being removed at the time of shipping. After the pump is aligned completely and the suction and the discharge pipe were connected, align the coupling as a final aligning. When the error of the aligning of the coupling is big, it causes the early abrasion of the parts of the coupling or the overheating of the bearing. Do the regular aligning of the coupling following the following items referring to the Fig.3-8.

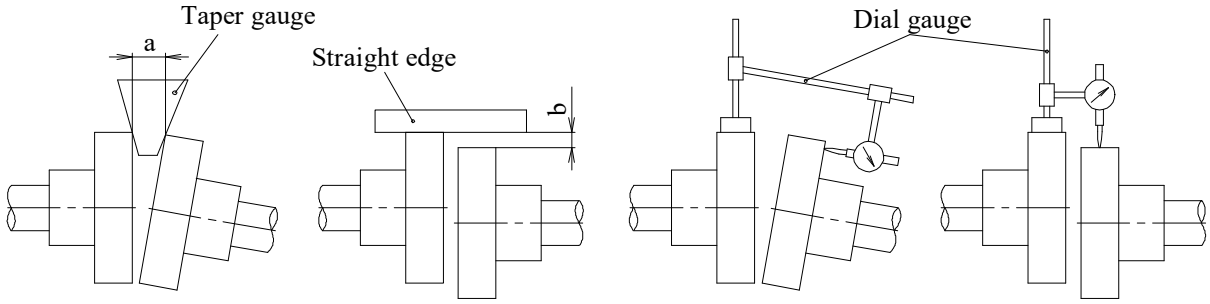


Fig.3-8 Aligning of the coupling

☐ Parallelism of the coupling

Put the taper gauge or the clearance gauge on four points of the circumference of the coupling, and measure the end-to-end of the coupling surface dimension "a" at each point. The parallelism is found with a_{max}-a_{min}. The allowable value of the parallelism is 0.05mm in the case that the flexible coupling are used. Refer to "COUPLING INSTRUCTION MANUAL" for the allowable value in the case that the other coupling are used.

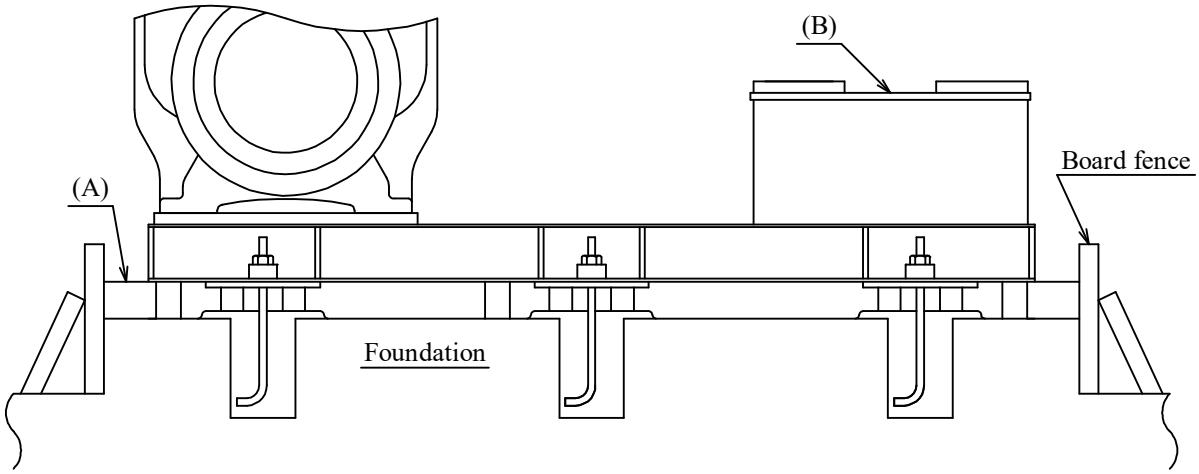
☐ Run out of the coupling circumference side

Check the run out of the coupling circumference side by using the straight edge. The allowable value of the run out is 0.05mm in the case that the flexible coupling are used. Refer to "COUPLING INSTRUCTION MANUAL" for the allowable value in the case that other coupling are used.

Parallelism and run out of the coupling can be measured more precisely by using the dial gauge. In that case, set the dial gauge on the coupling as the Fig.3-8, and turn it 1lap measuring the distortion.

3.5.Grouting mortar

After the connection of the pipe and all the aligning are completed, make the board fence around the foundation. First, pour the mortar into the inside of the bed (Fig.3-9 (A)). Then after about 1 hour, pour the mortar the bottom part of the driver (Fig.3-9 (B)). Confirm the existence of the blowhole of the bed before pouring mortar and if it is not here, make the several bores with the drill. Pour mortar with attacking the board fence for the grouting lightly so that the lump of the air can't be formed in the grouting work. Get rid of the casing for grouting, and finish the



edge of the foundation after mortar is completely stiffened.

Fig.3-9 Grouting mortar

4. Operation of the pump

⚠ CAUTION

1) Don't touch the casing of the pump that handles high temperature liquid. When a human body touches it, there is fear of the burn.
2) Stuffing box doesn't stop the pumping liquid completely. Therefore, don't touch a splash liquid from stuffing box when the pump lift the liquid which course serious injury on the human body.
3) Don't run the pump with removing coupling guard.
4) Don't approach the rotation part unreasonably because there is fear of the splash due to the failure of the rotation part.
5) Don't run the pump for a long time with closing the discharge valve completely.
6) Stop the pump immediately when the pump oscillated abnormally or took out the abnormal sound or something was wrong with the pump.
7) Discharge the liquid inside the pump after the pump stops if the liquid have the possibility that it is frozen.
8) When the pump is run after you keep it for a long time, run it after overhaul.

4.1. Precaution before operating the pump

When you start the pump for the first time after the pump installation completion, confirm the following items before the start surely, and confirm that there is right.

- ☐ Confirm the direction of the rotation by starting the driver after removing the coupling bolts. The pump is right rotation from the driver (CW : Clockwise） if there is a suction port in the right from the driver, but if there is opposite side, the pump is left rotation from the driver (CCW : Counter-Clockwise) (Fig.4-1). The direction arrow is cast on the pump casing upper half (1021).
- ☐ Confirm whether the coupling bolts are installed securely, and it doesn't become loose.
- ☐ Confirm whether the coupling can turn smoothly by hand.
- ☐ Confirm whether the coupling guard is installed securely.
- ☐ Confirm whether the pipes for priming or flushing or drain are connected securely, the pipes aren't clogged and the pipes are in the proper condition.
- ☐ Confirm whether the strainer isn't stuffed, when the strainer is set up in the induction pipes.
- ☐ Confirm whether the pump doesn't leak even if making it fill with the lifting liquid with the valve in the induction pipe and the discharge pipe closed fully. But, there is leakage from the stuffing box in the case of gland packing type.

Start up the pump following the "***4.2. Start up***", after confirming all above items and that no abnormality exists.

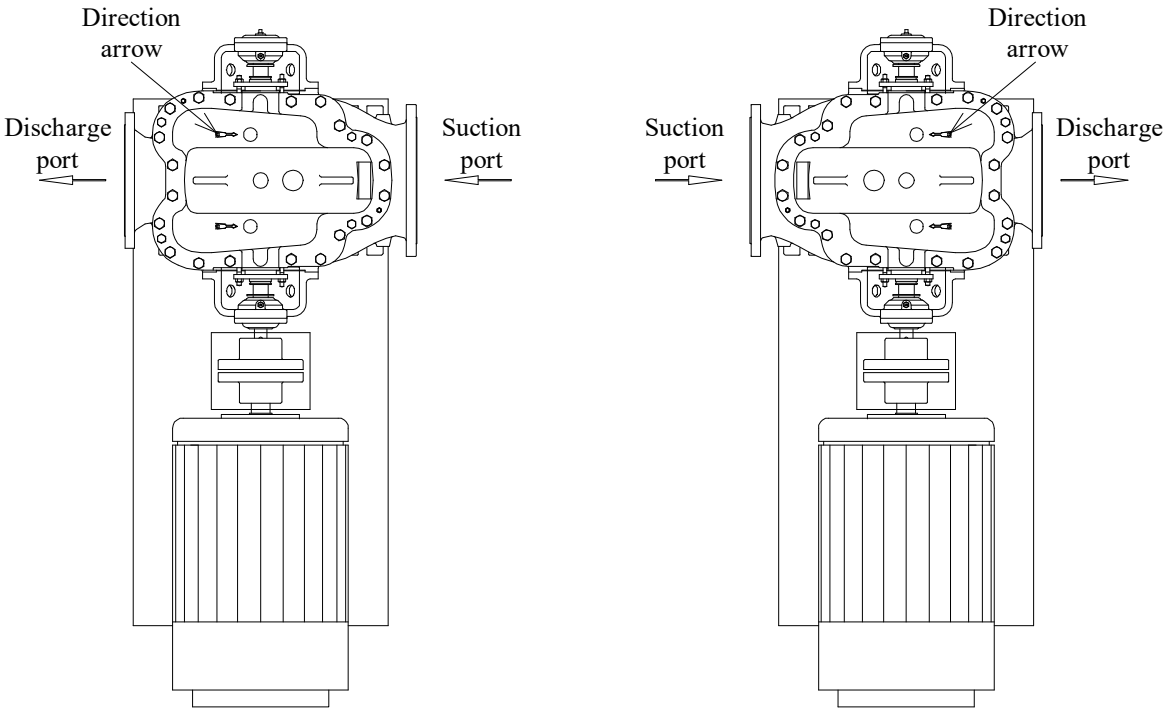


Fig.4-1 Direction of rotation

4.2.Start up

Start up the pump in accordance with the following order.

1. Open the valve of suction side fully, and close the valve of discharge side fully.
2. Prime the lifting liquid in the suction pipe and the inside of the pump fully.
3. Confirm that no person is near the pump.
4. Confirm that the rotor of the pump turns smoothly by making it to start and stop momentarily.
5. Confirm there is no abnormality, starts up the pump again and opens the valve of discharge side gradually until the discharge of the pump become the rated discharge.

Open the valve with confirming the pressure gauge of discharge side so that the total head of the pump may not become less than a specified at the time of the first pump operation and so on.

Don't run the pump for a long time with closing the valve of discharge side completely because liquid temperature inside the pump rises and causes the accident when the running is continued with closing the valve of discharge side.

Check in accordance with the "*5.2.Check during the pump operation*" during the pumping operation.

4.3.Shut down

Shut down the pump in accordance with the following order.

1. Close the valve of discharge side fully.
2. Turn off the switch of the driver. At this time, confirm that the rotation speed is to go down smoothly and the pump stops quietly.
3. Discharge all the lifting liquid inside the pump when there is a fear of freezing.

Store the pump in accordance with the "*7. Storage procedure*" when the pump is not run for a long time.

5.Maintenance

⚠ CAUTION
Be sure to turn the switch of the driver off before work. And stick the label such as “Don’t turn on the switch!” on the switch not to turn on the switch by accident.

5.1.Maintenance standard

The operation condition of the pump varies in each pump equipment, and what is stated about the continuous running, so do the maintenance and inspect by based on the actual operating time (Table5-3).

5.2.Check during the pump operation

During the pump operation, check the following items and stop the pump immediately if the abnormality is seen.

- ☐ Check whether the pump vibrates abnormality or the pump takes out the abnormal sound or something is wrong with the pump.
- ☐ Check whether the suction pressure satisfy the required NPSH(Net Positive Suction Head) of the pump (See the value of the suction pressure gauge).
- ☐ Check whether the pump satisfy the rated discharge pressure.
- ☐ Check whether the driver is operated in the overloaded condition.
- ☐ Check whether the pump is operated in the condition that priming is not complete.
- ☐ Check whether the pump is run with the valve of discharge side closing fully.
- ☐ Check whether the bearing temperature (or the temperature of the bearing bracket) doesn’t rise abnormally.
- ☐ Check whether the leakage from stuffing box is a proper quantity in the case of the gland packing type. In the case of the mechanical seal type, check whether there isn’t leakage.

We recommend taking the record about the following items during the pump operation to make measure in the failure easy.

- ☐ Discharge pressure
- ☐ Suction pressure
- ☐ The leakage from the stuffing box.
- ☐ The temperature around the stuffing box of the casing (whether there is no abnormal heating).
- ☐ Motor current
- ☐ Sound level
- ☐ The vibration of the pump
- ☐ The leakage from the pipe
- ☐ The temperature of the bearing or the bearing bracket (whether there is no abnormal heating).

5.3.Maintenance of the bearing part

The ball bearing deep groove type is used in this pump. The ball bearing is lubricated by the grease. Use the grease which equal to the thing of the following standard.

JIS K2220 GRADE 1 No.1 No.2

The time of the supplement and the exchange of the grease are the following table.

Table5-1 The rule of the operating time

	The rule of the operating time
Grease supplement	1,000 hours
Grease exchange	3,000 hours

The supplement of the grease is to do the proper quantity from the grease nipple (6360) installed in the bearing bracket (3500) by the grease gun.

5.4.Maintenance of the stuffing box

There are two stuffing box types in this pump, gland packing type and mechanical seal type. Refer to the “MECHANICAL SEAL INSTRUCTION MANUAL” in the case of the mechanical seal type.

5.4.1.Flushing to the stuffing box

The pressure of the flushing to the stuffing box must be neither too high nor too low. When pressure is too high or too low, it makes the stuffing box overheat, and fasten the abrasion of the shaft sleeve (5230), and sometimes causes the seizure shaft sleeve (5230) and the grand packing (4610). Furthermore, when the suction pressure is poor, it has the possibility that the air enter the pump from the stuffing box.

When the solid (as the slurry) is contained in the lifting liquid, the abrasion of the shaft sleeve (5230) and the exhaustion of the gland packing (4610) become drastic.

Lubricate and cool the gland packing (4610) by proper liquid quality and the pressure.

Table5-2 Flushing condition

Liquid quality	The fresh water is better.
Flushing pressure	suction pressure＋0.1MPa（but ≧1.MPaG）

5.4.2.Check the gland packing

The gland packing (4610) is exhausted during the pump operation. So tighten the gland bolts (9021) again so that the leakage from the stuffing box may become a proper quantity. If the clearance between the pump casing and the gland (4520) becomes under the allowable value, replace all gland packing (4610) (Table5-4).

5.5.Periodic inspection

The periodic inspection can’t be missed for the satisfying operation of the pump for a long time. In the periodic inspection, disassemble all parts of the pump and check of each part.

5.5.1.The time of the periodic inspection

The time of the periodic inspection varies in the operating condition of the pump. Decide the time of the periodic inspection as the lifting liquid and the operating condition referring to the following table.

Table5-3 The time of the periodic inspection

Lifting water	Operating condition	Standard time span
Fresh water	Continuous operation	Once a year
	Short operation	Once a few years
The liquid that contains the solid (such as the slurry).	Continuous operation	Once six months
	Short operation	Once a year

5.5.2.Check of the pump parts in the periodical inspection

Check the wear of the following exhaustion parts at the time of the periodic inspection, and replace the unconformable parts. Refer to the "***6. Disassembly and assembly***" for the disassembly and assembly of the pump.

Table5-4 Exhaustion parts list at periodic inspection

Parts name	Inspection item	Allowable value
Gland packing (4610)	The space between the pump casing and the gland (4520)	≧2mm
Shaft sleeve (5230)	The abrasion loss of the diameter of the shaft sleeve on the gland packing part.	≦1mm (Diameter)
Casing wearing ring (5020)	The clearance between the casing wearing ring (5020) and impeller (2340).	Material ○Cast iron/Bronze casting ≦1.2mm (Diameter) ○Stainless steel ≦2.4mm (Diameter)
Bearing (3210)	—	Replace every time
Oil seal (4210)	—	Replace every time
O-ring (4120)	—	Replace every time
Bolts set of coupling (coupling rubber)	—	Replace every time

Moreover, measure the run out of the shaft end at coupling side, after supporting of both bearing part of the shaft, and confirm that the run out is within 15/100mm.

6.Disassembly and assembly

⚠ CAUTION

1) Be sure to turn the switch of the driver off before work. And stick the label such as "Don't turn on the switch!" on the switch not to turn on the switch by accident.
2) Shut the valve of the suction side and the discharge completely when you discharge a liquid inside the pump from the drain valve. In the case of that pumping liquid is very high temperature, discharge a liquid inside the pump after the liquid fell down even the about room temperature.
3) Confirm that a liquid inside the pump is discharged securely because disorder such as inflammation is likely to be caused when it stain to the human body when a liquid is a chemical liquid.
4) Wear a rope on the position where it was shown in this instruction manual, and lift it by using the chain block and so on when you lift part and partly remove assembling goods.
5) Be sure to wear safeguard glove, when handle the part such as the ball bearing and the coupling over heated.

Don't disassemble the pump as much as possible except for the time of the periodic inspection and the following case.

- ☐ When the dust went into the pump.
- ☐ When it is judged that something is wrong with the pump.

6.1.Disassembly of the pump

6.1.1.Precaution before the disassembly

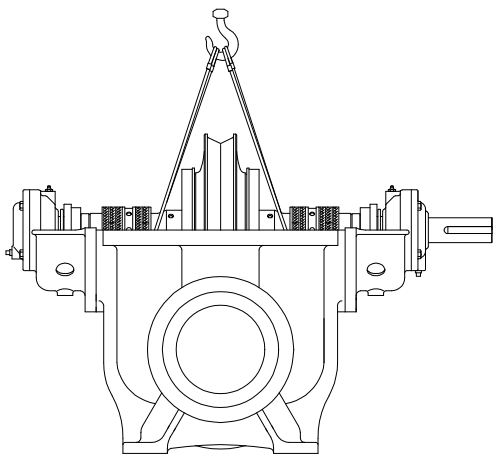
Be careful of the following items when disassembling the pump.

- ☐ Disassemble after surely confirming the dimension between the parts in the shaft direction, the clearance of the sliding part and so on.
- ☐ Be careful not to lost or injure the parts.

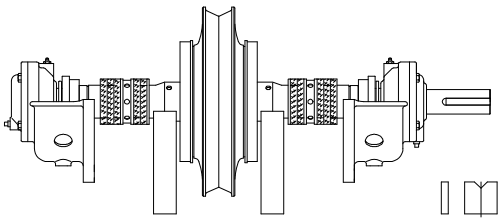
6.1.2.Disassembly

Disassemble the pump in accordance with the next order. Refer to the "***2. Pump outline***" or "SECTIONAL DRAWING" for the parts name and the parts number.

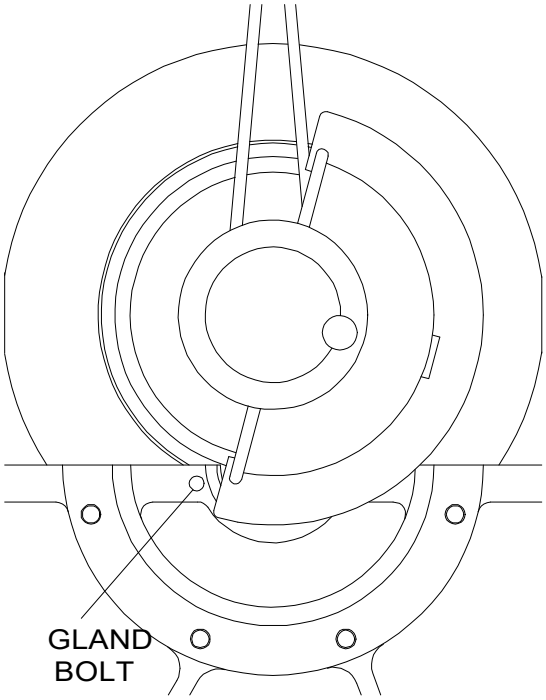
1. Remove the coupling guard, and remove the bolts of the coupling. Then disconnect the pump side coupling from the driver side coupling.
2. Remove the nuts fixed the glands (4520), and pull out the glands (4520) from the gland bolts (9012).
3. Remove the bolts fixing the casing upper half (1021) to casing lower half (1022) and the pins.
4. Jack up the casing upper half (1021) by turning the jack bolts on the casing upper half (1021).
5. Hang up the casing upper half (1021), and move to the place where it don't become the obstacle with the hoist and so on. At this time, be careful not to injure the mating surface of the casing upper half (1021).
6. Sketch the design of the cotton yearn that used as a string packing (0903), if it was put on the mating surface.
7. Remove the bolts fixing the bearing brackets (3500).
8. Hang up the whole of the rotor including the bearing brackets (3500) as the right figure. And move them to the large place enough to

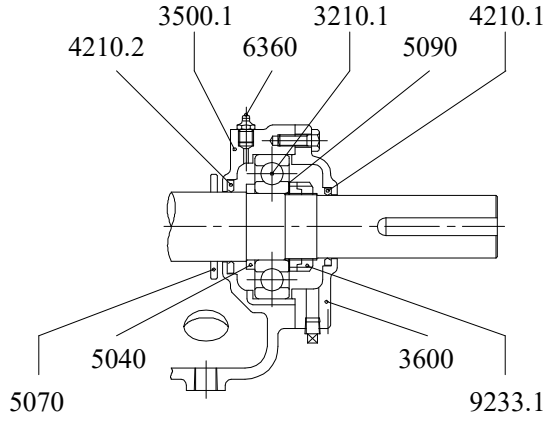


work, then put them on the floor as the right figure. At this time, pull it up so that it may not be caught in the gland bolts (9021) with turning the bearing brackets (3500) because the bearing brackets are caught in the gland bolts (9021) when leaving the whole of the rotor with no turning.

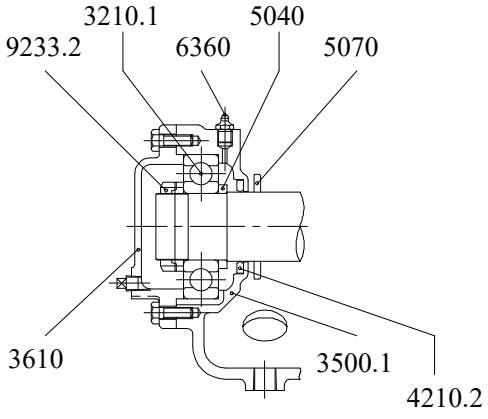


9. Pull out the coupling from the shaft (2100), and take out the key (9400.1).
10. Detach the bearing cover (3600) and the bearing end cover (3610) from the bearing brackets (3500).
11. Remove the oil seal (4210.1) from the bearing cover (3600).
12. Remove both sides of the lock nuts (9233.1, 9233.2). Remove the adjust rings (5090) at the coupling side. Then remove the bearing washer (5502) from the shaft (2100) in the case of bearing part type is (B) or (C).
13. Pull out both the bearing brackets (3500) together with the ball bearings (3210.1, 3210.2), the spacer ring (5040), the oil seals (4210.2). In the case of bearing part type is

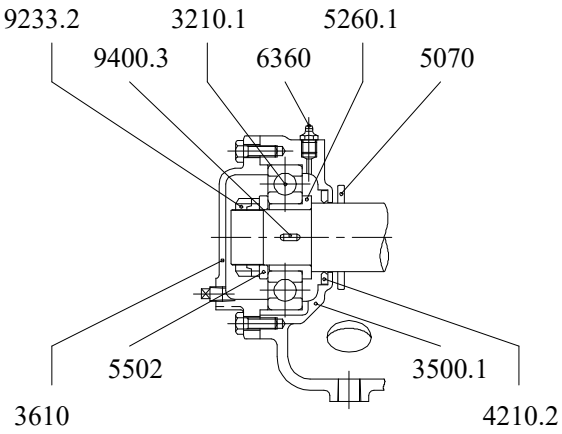




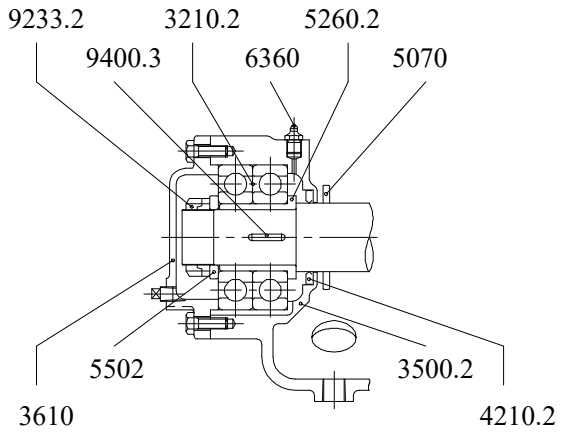
Bearing part coupling side



Bearing part anti-coupling side (A)



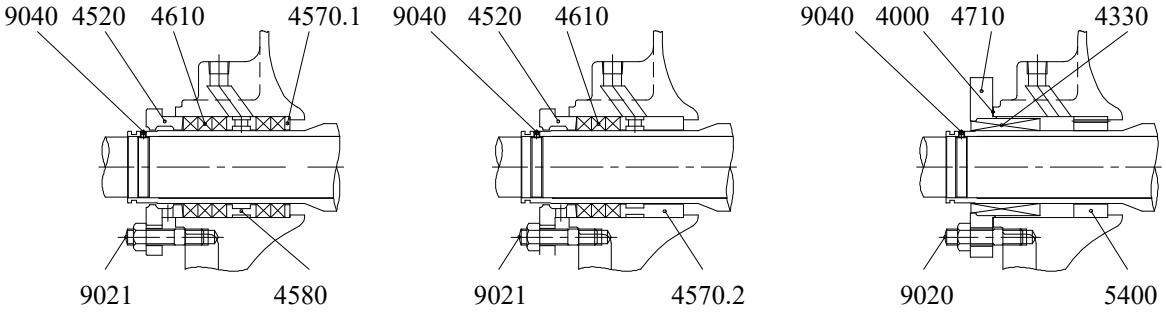
Bearing part anti-coupling side (B)



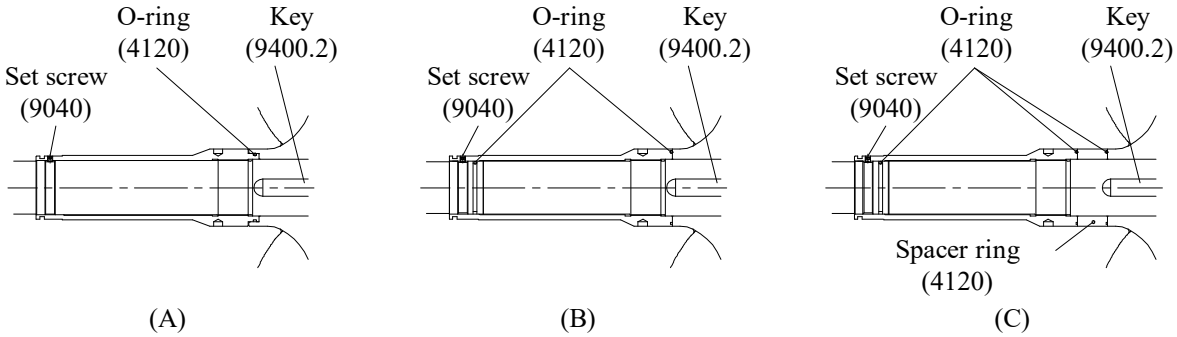
Bearing part anti-coupling side (C)

(B) or (C), pull out the bearing bushing (5260) with them too. If it's difficult to pull out them, it may be necessary to heat the inner ring of the ball bearing (3210) to facilitate pulling out. Never use a hammer for this purpose. After then, remove the key (9400.3) in the case of bearing part type (B) and (C).

14. Remove the ball bearings (3210.1, 3210.2) of the bearing brackets (3500) and the spacer ring (5040), the oil seals (4210.2). Remove the ball bearing (3210.1 or 3210.2) from the bearing bushing (5260.1 or 5260.2) in the case of bearing part type (B) and (C).
15. Take out the casing wearing rings (5020), the deflectors (5070), the glands (4520), the gland packings (4610) from the shaft (2100).
16. In the case of standard type of stuffing box, remove the lantern rings (4580) and the end rings (4570.1) from the shaft (2100). In the case of high pressure type, remove the end rings (4570.2) from the shaft (2100). Refer to the "MECHANICAL SEAL INSTRUCTION MANUAL" in the case of mechanical seal type.



17. Remove the shaft sleeves (5230) after loosening the set screws (9040) fixing the shaft sleeves (5230). Pull out the spacer rings (8616) in the case of shaft sleeve type (C).



18. Remove the o-rings (4120) on the shaft sleeves (5230). Remove the o-rings (4120) on the shaft (2100) and the spacer rings (8616) in the case of shaft sleeve type (B) or (C).
19. Remove the impeller (2340) and the key (9400.2).

This is the end of disassembly procedure. After disassembly, clean up all parts and remove the rust.

6.2.Assembly of the pump

6.2.1.Precaution before the assembly

Check the wear of the expendable parts referring to the "*5.5.2. Check of parts in the periodical inspection*" before assembly. Never use the parts, the wear of which exceeds the allowable value.

Check whether the finished surface, like mating surface of the casing and the end face of the shaft sleeve, isn't injured. If the finished surface is injured, finish the surface again until it becomes flat with the fine oil stone. Never use the file and so on for this purpose. It has the possibility that the confusion of the perpendicularity or the parallelism by using file causes a pump trouble.

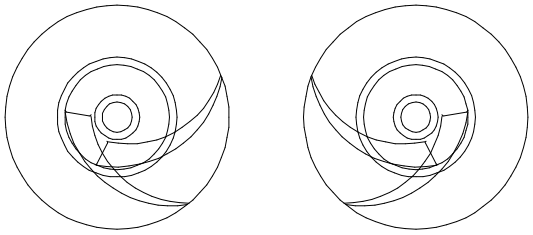
Be sure to remove the rust on the fitting portion and the surface of the shaft (2100) completely, and apply the oil there lightly. Apply a seizure preventive to the thread part before tightening.

In the case of lifting the liquid which corrode the pump easily, like seawater and brine, apply the crevice corrosion preventive in the proper time of assembly referring to the "*6.3 Crevice corrosion prevention*".

6.2.2.Assembly

Reassemble the pump in accordance with the following order. Refer to the "***2. Pump outline***" or "SECTIONAL DRAWING" for the parts name and the parts number.

1. Set the key (9400.2) on the shaft (2100) and set the impeller (2340) on the shaft (2100). At this time, be careful not to mistake the direction of the impeller (2340)(Refer to the right figure).



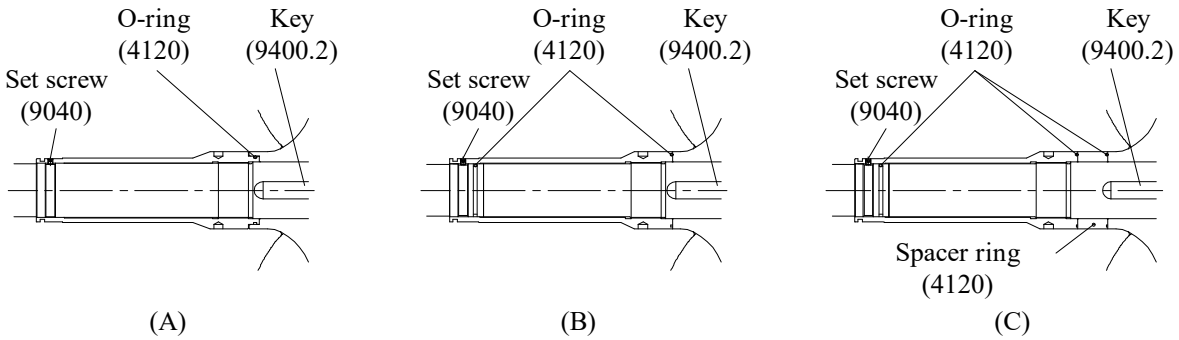
View from the couplings

2. Fit the shaft sleeves (5230) in accordance with shaft sleeve type.

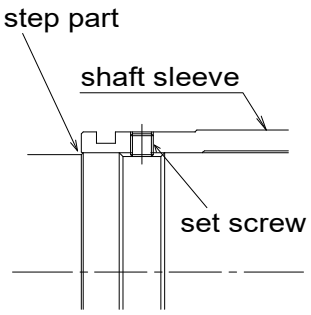
(A) Fit the o-rings (4120) on grooves of the shaft sleeves (5230), and fit the shaft sleeves (5230) on the shaft (2100).

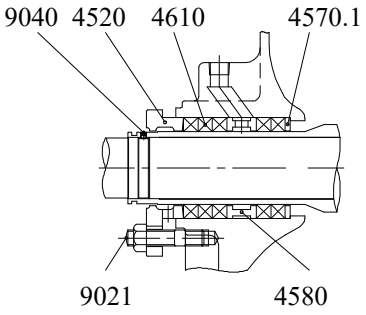
(B) Fit the o-rings (4120) on grooves of the shaft (2100) and the shaft sleeves (5230), and fit the shaft sleeves (5230) on the shaft (2100).

(C) Fit the o-rings (4120) on grooves of the spacer rings (8616), and fit the spacer rings (8616) on the shaft (2100). Then fit the o-rings (4120) on grooves of the shaft (2100) and the shaft sleeves (5230) on the shaft (2100).

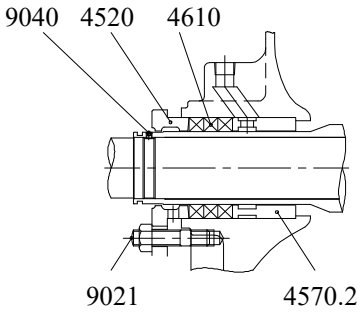


3. Put the center of the impeller (2340) by mating the end surface of the shaft sleeves (5230) to the step part of the shaft (2100)(Refer to the right figure).
4. Fit the casing wearing rings (5020) on the impeller (2340).
5. In the case of standard type of stuffing box, fit the lantern rings (4580) and the end rings (4570.1) on the shaft (2100). In the case of high pressure type, fit the end rings (4570.2) on the shaft (2100). Refer to the "MECHANICAL SEAL INSTRUCTION MANUAL" in the case of mechanical seal type.

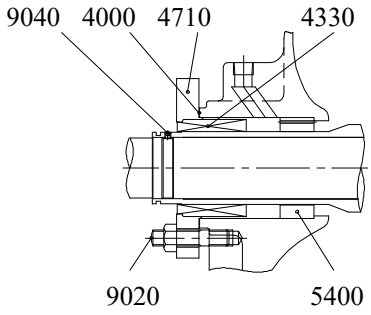




Standard type

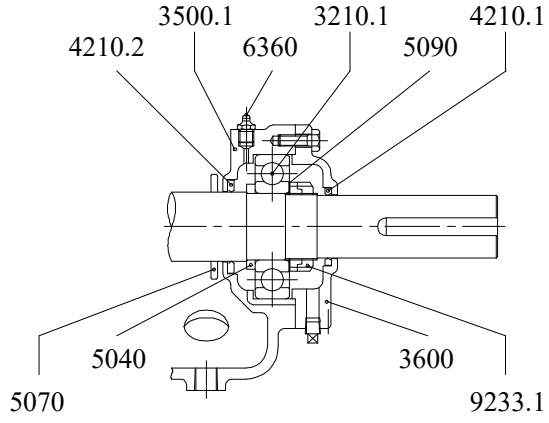


High pressure type

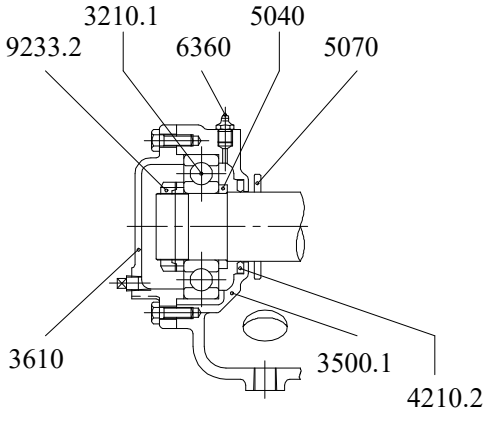


Mechanical seal type

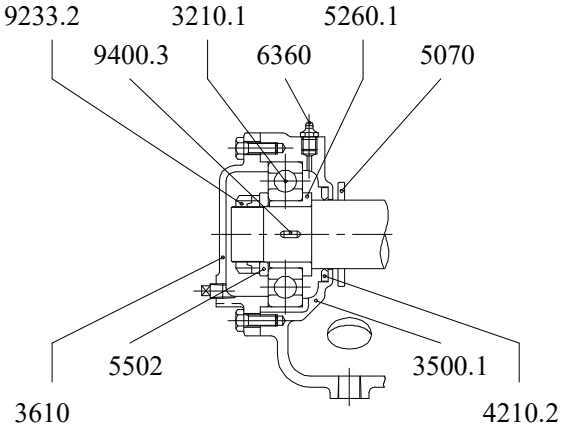
6. Fit the glands (4520) and the deflectors (5070).
7. Put the oil seals (4210.2), the spacer ring (5040), the ball bearings (3210.1, 3210.2) into the brackets (3500) of the coupling side and the anti-coupling side. In the case of the



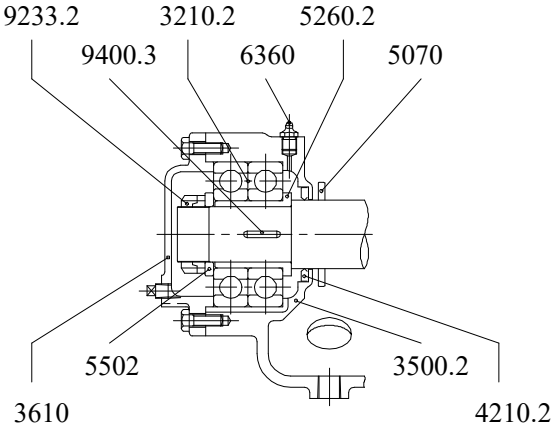
Bearing part coupling side



Bearing part anti-coupling side (A)



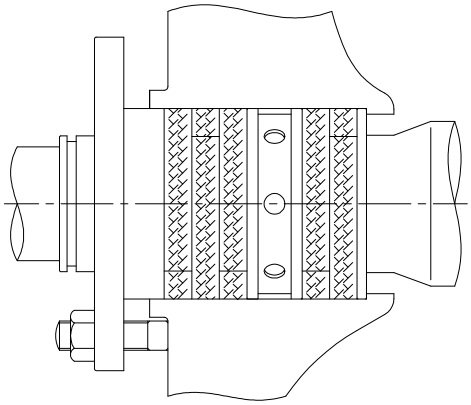
Bearing part anti-coupling side (B)



Bearing part anti-coupling side (C)

bearing part type (B) and (C), put on after putting the ball bearing (3210.1 or 3210.2) on the bearing bushing (5260.1 or 5260.2).

8. In the case of the bearing part type (B) and (C), Set key (9400.3) on shaft (2100). Fit the bearing bracket (3500) on the shaft (2100) together with the ball bearings (3210.1, 3210.2) and so on. If it's difficult, it may be necessary to heat the inner ring of bearing to facilitate its installation. Never use a hammer for this purpose.
9. Fit the adjust rings(5090) at the coupling side. Then fit the bearing washer (5502) on the shaft (2100) in the case of the bearing part type (B) and (C). After then fix the ball bearings (3210.1, 3210.2) by tightening the lock nuts (9233.1, 9233.2).
10. Apply grease to the ball bearings (3210). Set the oil seal (4210.1) on the bearing cover (3600), then fix the bearing cover(3600) and the bearing end cover (3610) on the bearing brackets (3500).
11. Set the key (9400.1) on the shaft (2100), then fit the pump side coupling on the shaft (2100).
12. Mount the whole rotor with the bearing brackets (3500) on the casing lower half (1022) in accordance with the same way at the time of disassembly. In this time, be sure to match the set screws which attached on the casing wearing rings (5020) to the notch portion on the casing lower half (1022). And be sure to care the gland bolts (9021) in the same way at the disassembly.
13. Fix the bearing brackets (3500) on the casing lower half (1022) by bolts. Fit both end face of the casing wearing rings (5020) and the casing lower half (1022), then check the clearance equality between both side of the impeller (2340) and the casing wearing rings (5020)(Refer to the "*5.5.2. Check of the parts in the periodical inspection*")
14. After confirming or adjusting that the impeller (2340) is the center between the casing wearing rings (5020), tighten the set screws (9040) of the shaft sleeves (5230).
15. Insert the gland packings (4610) in the stuffing box with shifting the cut end of it by 60 to 90 degrees (Refer to the right figure).



16. Apply liquid packing on the mating surface of the casing lower half uniformly. The cotton yearn may be used by the case that the discharge pressure is high. So, if the cotton yearn was used at the time of disassembly, put on the cotton yearn as the string packing on the mating surface of the casing lower half referring to the sketch at the disassembly or the Fig.6-1. Be especially careful to putting the cotton yearn at the part of the stuffing box (Fig.6-1 Detail of the part A) and the notch for the set screws of the casing wearing rings (5020)(Fig.6-1 Detail of the part B).

    At the stuffing box, contact the cotton yearn to the the gland packing (4610), but don't contact it to the lantern rings (4580).

    In the case of mechanical seal type, keep a small space between the cotton yearn and mechanical seal not to enter the cotton yearn into the stuffing box. But, contact the cotton yearn to the seat packing (4000) between the seal cover and the casing.

    At the part of notch for the set screws, keep a small space between the cotton yearn and notch. But contact the cotton yearn to the casing wearing rings (5020).

    In the case that the discharge pressure is very high, we may put the cotton yearn as

lower half of the upper figure in the Fig.6-1. So, be sure to sketch the design of the cotton yearn at the time of the disassembly, and put it on the mating surface as same as shipping condition possible. At this time, be careful not to put it on the place where the jack bolts hit the mating surface of the casing lower half.

17. Confirm that the jack bolts don't come out the mating surface of the casing upper half. Then mount the casing upper half on the casing lower half using the pins as a guide. At this time, be careful not to injure the casing wearing rings (5020).
18. Tighten all bolts equally for fixing the casing upper half to the casing lower half.
19. Put the glands (4520) on the gland bolts (9021), then tighten nuts for the gland bolts (9021) properly.
20. Confirm the alignment of the coupling (Refer to the "*3.4.3 Regular aligning of the coupling*". And match the mark on the coupling, then tighten bolts of the coupling.
21. Place the coupling guard.

This is the end of assembly procedure. Close the drain valve, if it still open.

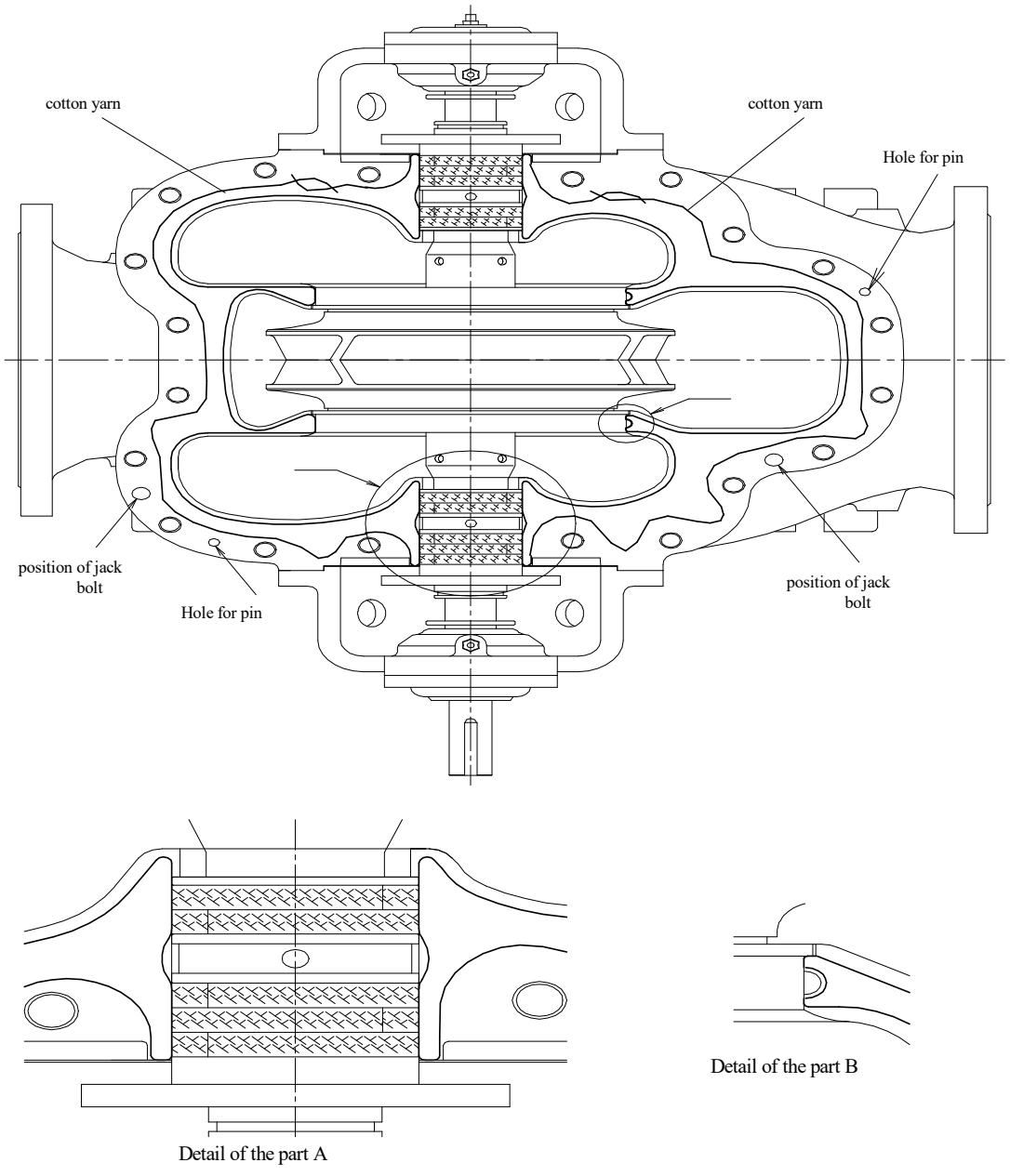


Fig.6-1 The way of putting the cotton

6.3.Crevice corrosion prevention

In the case of lifting the liquid which corrode the pump easily, like seawater and brine, apply the crevice corrosion preventive to the part below (the bold line in the Fig.6-2).

- ☐ Crevice part
- ☐ Thread part (except for the flushing, the vent, the drain pipe arrangement)
- ☐ Key and key way
- ☐ Mating surface of the flange and bearing brackets
- ☐ Inside of the stuffing box
- ☐ Set screws for whirl stop
- ☐ Hole for pins
- ☐ Gland bolts and nuts
- ☐ Grooves for o-rings

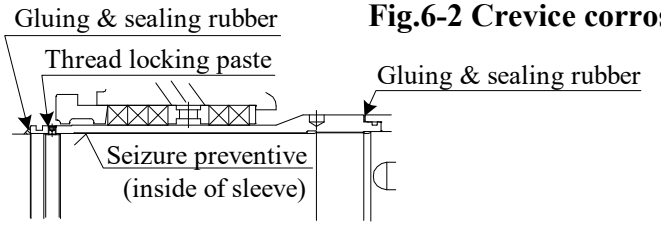
Applying the crevice corrosion preventive is necessary even in the case of cathodic protection except for the shaft sleeve part.

Do the crevice corrosion prevention and protection of the shaft in accordance with detail of the shaft sleeve part in the Fig.6-2. We recommend to use the material that shown in the Table6-1.

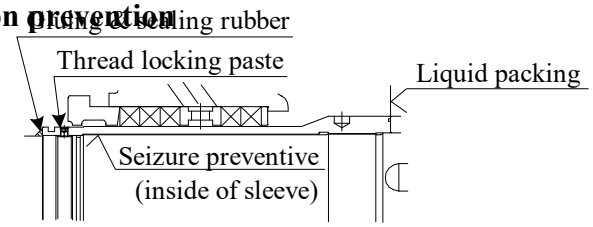
Table6-1 Crevice corrosion prevention and shaft protection

Crevice corrosion preventive	KINORUSTER No.750 (KINSEI KOGYO CO., LTD.)
Liquid packing	Threebond #1102 (Three Bond Co., Ltd.)
Thread locking paste	Loctite No.242 (Loctite (Japan) Corporation)
Gluing & sealing rubber	Silicon rubber KE-45

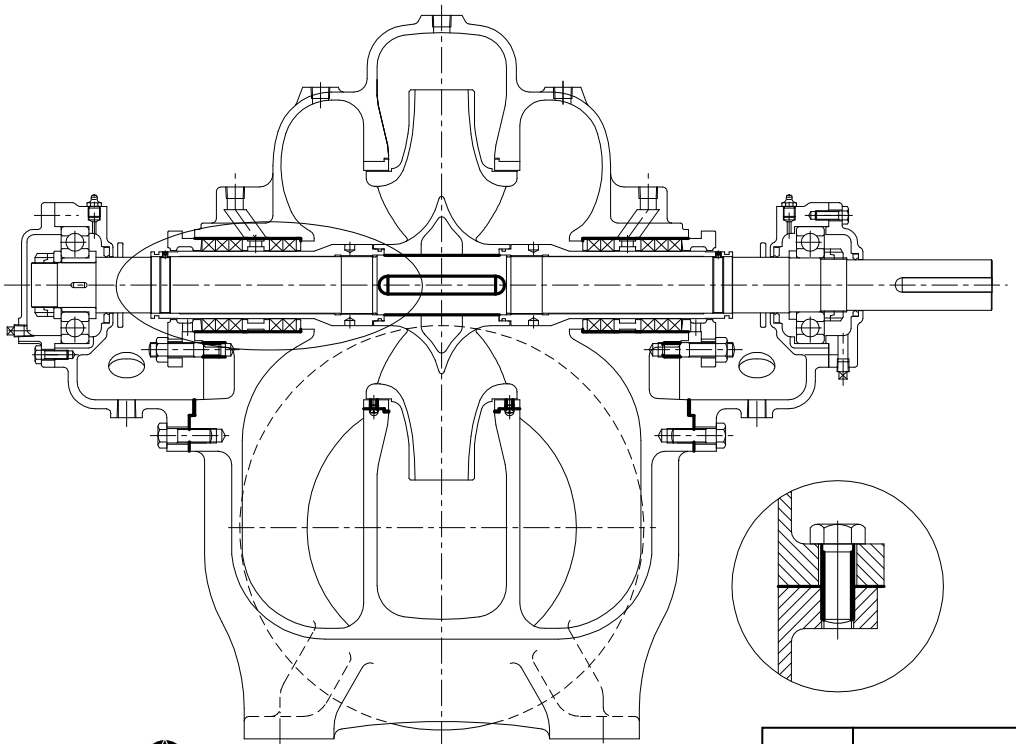
Fig.6-2 Crevice corrosion prevention



Detail of sleeve part
(Shaft sleeve type( ))



Detail of sleeve part
(Shaft sleeve type( ))



7. Storage procedure

7.1. Store the pump with connecting the pipe arrangement

Do the following process when store the pump with connecting the pipe arrangement for a long time (over than six months).

- ☐ Discharge the lifting liquid inside the pump to prevent the pump fracture due to freezing in winter and the corrosion of the pump casing by the lifting liquid.
- ☐ Apply the rust inhibitor on the finishing surface of the shaft and coupling and so on not to rust them (the Table7-1).

Overhaul is not necessary during the storage of the pump. But inspect the following items by the test pump operation for about thirty minutes once a month.

- ☐ Pump outline.
- ☐ The Lubrication condition of the bearing (Whether there is abnormal heating up of the bearing bracket or abnormal sound)
- ☐ The condition of the gland packing (Whether it is dry. If it is dry, apply oil or grease)

If the pump can not be done the test pump operation, turn the rotor by hand twice a month. We recommend overhauling the pump before operating the pump after the storage for a long time. In the case not doing the test running, check above items and check items before starting (Refer to the "***4.1. Precaution before the pump operation***") and then start the pump.

- ☐ Whether all bolts are tightened firmly.
- ☐ Whether the pump parts don't rust.

7.2. Store the pump without connecting the pipe arrangement

Be careful of the following items when store the pump without connecting the pipe arrangement.

- ☐ Store in the building that has concrete floor.
- ☐ Cover the flange and put a plug into screw opening not to enter the trash.
- ☐ The part, peeled off paint or not applied rust inhibitor, store after applying paint or rust inhibitor referring to the "*7.3 Precaution in the rust prevention*".
- ☐ Put the parts on the wooden block and keep more than 100mm from the floor. And hang the cover on them.

7.3. Precaution in the rust prevention

Do the rust prevention to the pump, the related parts, the spare parts and the accessory parts in the proper way, and follow the following items.

- ☐ Before the rust prevention process, put the mask tape on the part where is not need rust prevention.
- ☐ Remove the rust and clean up it by using thinner and so on at the part where needs rust prevention.
- ☐ Be careful not to leave the mark of the brush as much as possible when using the brush for the application of the rust inhibitor.
- ☐ Avoid a windy day and a rainy day when applying the rust inhibitor in the outdoor.

We recommend to use the rust inhibitor in the Table7-1.

Table7-1 Proper rust inhibitor

part	proper rust inhibitor
Inside of the pump casing	RUSMIN MK-1000C (KYOEISHA YUSHI KAGAKU KOGYO CO., LTD.)
The ball bearing	NOX-RUST 307-59B (PARKER INDUSTRIES INC.)
The surface of the flange	NOX-RUST 366B (PARKER INDUSTRIES INC.)
The others	NOX-RUST 307-59B (PARKER INDUSTRIES INC.)

8. Trouble shooting

8.1. Pump trouble and breakage of the pump

8.1.1. Compensation

All the pump parts are made under the strict quality control. We do the variety inspection and the test such as quality of the material and dimension precision in the production process along the quality control plan document. And we ship the pump which satisfies the prescribed quality.

We can't compensate for the pump trouble and the breakage of the pump by the following case.

- ☐ When the pump didn't operate in the condition which is described in the "PUMP DATA SHEET" (Total head, Capacity, Liquid quality, Liquid temperature).
- ☐ When the pump trouble or breakage of the pump was caused by wrong installation, wrong pipe arrangement and wrong operation of the pump or the pump parts against this instruction manual.
- ☐ When the pump trouble or breakage of the pump was caused by natural disaster.

8.1.2. Repair and after service

We recommend to make repair the pump to our technician or make it sent back the pump to our factory in the case of the pump repair.

Let us know the item of the following mentioned in the nameplate in the inquiry for the pump repair and the order of the parts. The nameplate is put on the pump.

- ☐ Pump type and size
- ☐ Product number of our company (AP-_ _ _ _ _ _)← Six-digit number
- ☐ Delivery time

Let us know the part name, the quality of the material and the number mentioned in the

TORISHIMA PUMP			
TYPE&SIZE			
PRODUCT No. AP-		No.	
TOTAL HEAD	m	SPEED	min^{-1}
CAPACITY		DRIVER	kW
BRG. No.		—	PIECES
		—	PIECES
DELIVERY TIME			
TORISHIMA PUMP MFG.CO.,LTD. OSAKA JAPAN			

"SECTIONAL DRAWING" or the "SPARE PARTS LIST" when ordering the parts.

Fig.8-1 Nameplate (standard)

8.2.Pump troubles and measure of that

The main troubles of the pump are following items. If the trouble in the pump happened, stop the pump immediately, and take necessary steps. When the trouble isn't still repaired or you can't know the cause, make contact to out company after being examining the trouble in detail.

The contents of the trouble	*Cause*		*Measure*
1. Insufficient decrease or incapable of pumping	(1)	The direction of rotation is contrary.	Correct the terminal connection of the driver properly.
	(2)	The rotation speed lowers.	Check the driver for overload, power supply frequency and voltage. Restore them normal.
	(3)	The clogging of the suction pipe or the impeller.	Clean the strainer on the suction side and induction pipe, impeller if necessary.
	(4)	The pump priming is insufficient.	Prime the pump again. Reexamine the adjustment of the pipe when it isn't still repaired.
	(5)	The air enters from the stuffing box.	Increase the flushing pressure, and confirm whether the liquid flow securely. Clean up the flushing pipe when it isn't still repaired.
	(6)	The cavitation evolutes.	Open the valve of suction side when the valve of suction side is close. Check whether the suction side strainer and pipe don't clog, and clean up it. Check whether the discharge is not excessive, and adjust it to the proper quantity.
	(7)	The clearance between the impeller and the casing wearing ring is too large.	Check the clearance between the impeller and the casing wearing ring, then exchange the casing wearing ring if it isn't allowable value. (Refer to the "*5.5.2 Check the parts in the periodical inspection*")
	(8)	The total head is too high.	The actual total head is too higher than the planning total head. Consult our company.
2. The overload of the driver	(1)	The pump didn't operate in the rated point.	Adjust to the rated discharge by the valve of discharge side.
	(2)	The pump left the liquid which is bigger specific weight liquid or bigger viscosity than fixed liquid.	Adjust to the discharge which is allowable for the driver by the valve of discharge side (Refer to the "PUMP PERFORMANCE CURVE".
	(3)	The rotation speed is excessive.	Return the rotation speed of the driver to the rated value.
	(4)	The dust entered the pump.	Disassemble the pump and remove the dust.
	(5)	The lifting liquid inside the pump frozen.	Melt the liquid by throwing the hot water and so on. Discharge the liquid inside the pump if the pump stopped.

3. The leakage from the pump or flange part	(1)	The installation bolts were not tightened perfectly.	Stop the pump and tighten bolts uniformly again after the pump and pipe cool down enough.
	(2)	The installation of the seat packing or mating surface is not good.	Exchange the seat packing or refinish the mating surface.
4. The overheat of the stuffing box	(1)	The flushing liquid was not enough.	Adjust the quantity of the flushing liquid properly. Check whether the flushing pipe was close, and clean up the pipe.
	(2)	The run out of the shaft is too big.	Disassemble the pump and adjust the balance of the rotor again.
	(3)	The exhaustion of the gland packing exceeds the allowable value.	Replace the gland packing.
	(4)	The nuts for the gland bolts tighten too much or the gland contacted to the shaft sleeve by unequally tightening.	Tighten nuts equally after putting the gland packing again. If the shaft sleeve is injured, finish the surface again or exchange it.
5. The overheat of the bearing	(1)	Aligning of the coupling is not good.	Align the coupling again.
	(2)	The pump takes too big force from the pipe.	Modify the pump not to take the force from the pipe arrangement. And check the aligning of the coupling again.
	(3)	Too much lubricating grease.	Adjust the quantity of the grease properly.
	(4)	Too little lubricating grease or the grease is not good.	Apply proper quantity of the grease. Or exchange the grease.