

NC Tilting Rotary Table INSTRUCTION MANUAL Model : TT200BE-01



DANGER

- This instruction manual is for production engineers and maintenance personnel in charge of operation of this product. When a beginner uses this product, receive instructions from experienced personnel, the distributor or our company.
- Before installing, operating or maintaining this equipment, carefully read this manual and the safety labels attached to the equipment. Failure to follow these instructions and safety precautions could result in serious injury, death, or property damage.
- Store this manual near equipment for future reference.
- If any questions related to safety arise about this manual, please confirm them with the distributor or our company.

KITAGAWA IRON WORKS CO., LTD.

Preface

This manual provides detailed information on the Kitagawa NC rotary table so that you can understand its performance and functions and use it safely and correctly.

Before using this NC rotary table, read this manual carefully to understand how to use it. Always follow the instructions and warnings given in **“Important Safety Precautions”** and **“Precautions for Use”**. Failure to follow these precautions could result in serious injuries.

Terms and Symbols Used for Safety Messages

In this manual, precautions for handling that are considered especially important are classified and displayed as shown below depending on the damage of risk including the seriousness of the harm that could result. Please sufficiently understand the meanings of these terms and follow the instructions for safe operation.

Safety Alert Symbol

This triangle is the safety alert symbol used to alert you to potential safety hazards. To avoid death or injuries that could occur, follow the safety messages given with this safety alert symbol.



Indicates an Imminently hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



Indicates instructions which, if not avoided, could result in damage to the equipment or a shortened work life.

Liability and How to Use this Manual

This unit is installed on the machining centers and suitable for indexing the angle of machining position of the workpieces. Please contact us if it is used for any other applications.

Kitagawa Iron Works Co., Ltd. shall not be held liable for troubles or accidents that arise from a failure to observe these safety precautions mentioned in this manual.

This manual does not predict all potential hazards in operation, inspection, and maintenance under all environmental conditions. There will be an infinite number of matters that cannot or must not be done, and the manual cannot cover all of them.

Therefore, the matters, unless otherwise mentioned clearly as “can be done” or “may be done” in this manual, should be considered as “cannot be done” or “must not be done”.

Please contact us or our agents if you have any uncertainty about safety when you try to perform operation, inspection, or maintenance not mentioned in this manual.

Others

The contents of the instruction manual are subject to change without notice for improvement or specification change.

EC DECLARATION OF CONFORMITY

We hereby declare that the following our product conforms with the essential health and safety requirements of EC Directives.

Product : NC ROTARY TABLE

Type : MR Series, MX Series, MRT Series, CK Series, GT Series,
DM Series, TMX Series, THX Series, TRX Series,
TLX Series, TR Series, TL Series, TBX Series, TUX Series,
TU Series, LR Series, TP Series, TM Series, TH Series,
TT Series, TW Series

Directives : Machinery Directive 2006/42/EC
EMC Directive 2004/108/EC

The above product has been evaluated for conformity with above directives using the following European standards.

Machinery Directive:

EN ISO 12100-1:2003+A1:2009, EN ISO 12100-2:2003+A1:2009,
EN ISO 14121-1:2007, EN 60204-1: 2006+A1:2009, others

EMC Directive:

Emission : EN 55011+A2:2009/A1:2010
Immunity : EN 61000-6-2:2005

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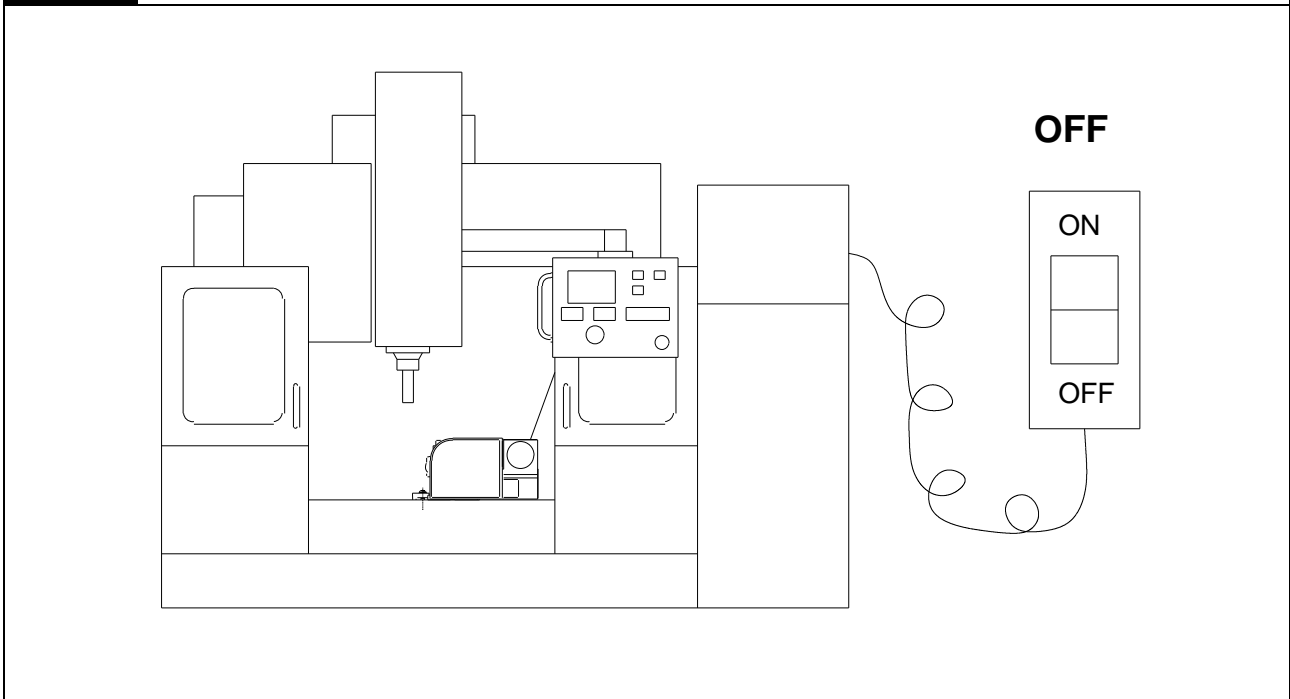
1. For Your Safety

Basic Safety Tips


Please read this manual and follow instructions carefully.

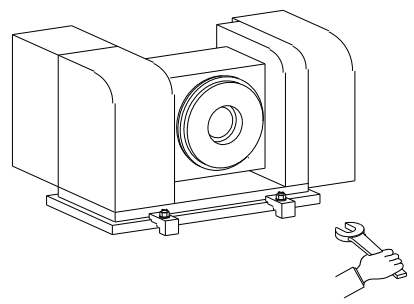


Turn off the main power of the machine prior to maintenance, check, or repair of the unit, Failure to do so may cause severe injury and/or accident.




! WARNING

 Tighten the bolts securely when mounting the unit on the machine table.

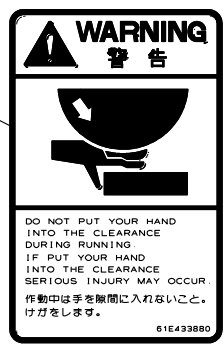
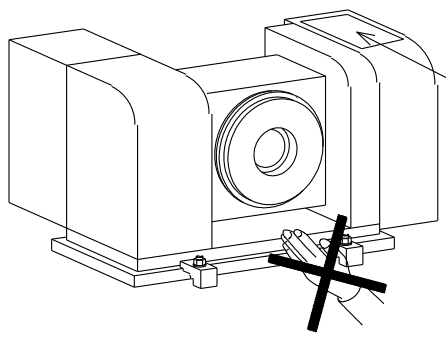



Please refer to the chart below for the recommended tightening torque of the bolts.

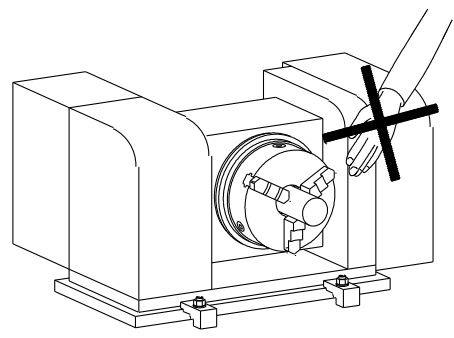
Hex. Bolt Size	Torque N·m
M10	33.8
M12	58.9
M16	146.3
M20	294.3

 Do not touch rotating object during operation.

Fingers or hand may be caught into gap.



 Make sure the working area is clear of any foreign object and/or hand when the unit is in operation to avoid any serious accident and/or injury.



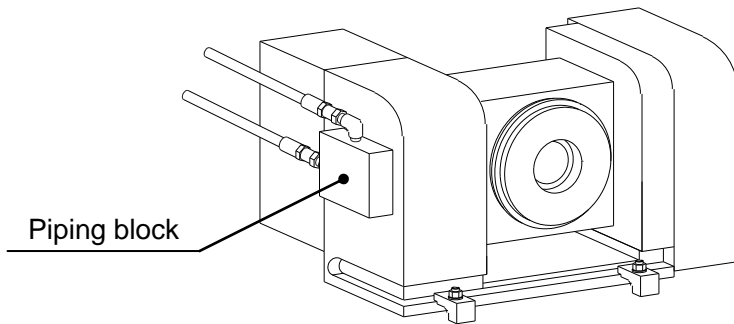


WARNING

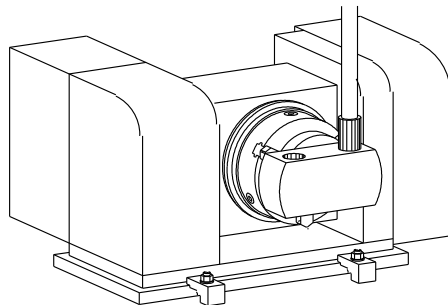


Please consult your local distributor before attempting any modification of the unit.

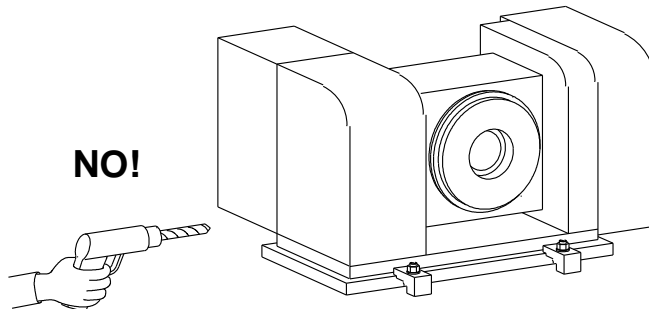
The NC rotary table may malfunction.




Do not apply cutting force which exceeds the specification in this manual. Failure to do so may cause severe injury and/or damage to the unit.

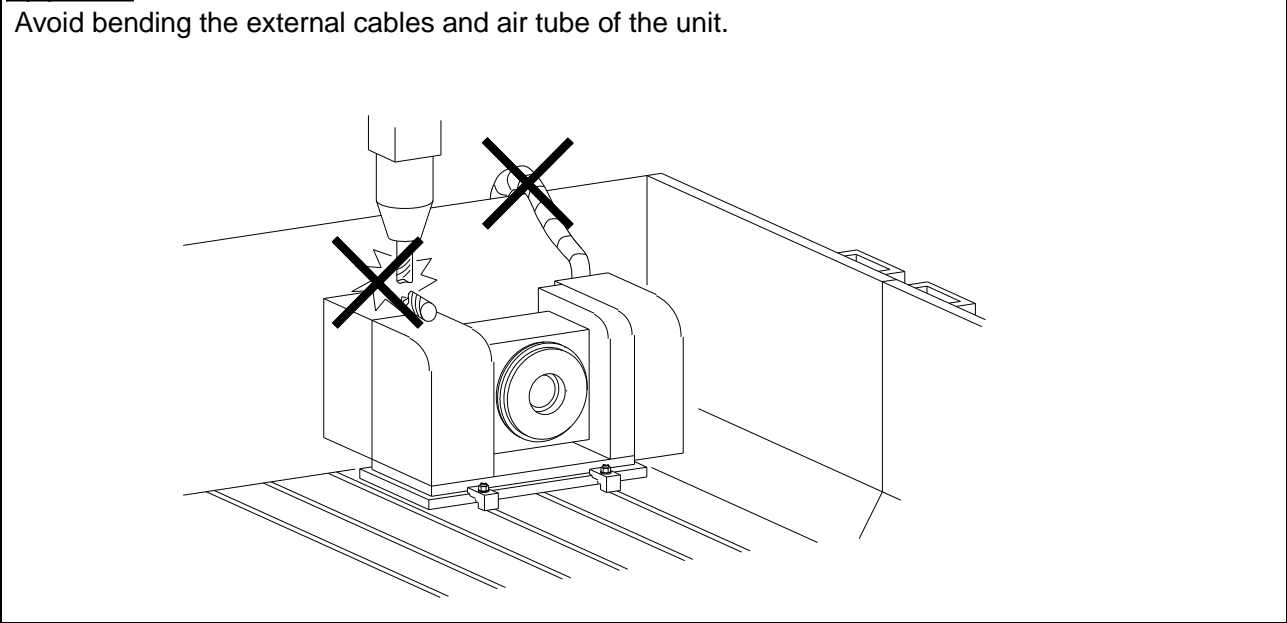



Please consult your local distributor before attempting any modification of the unit.

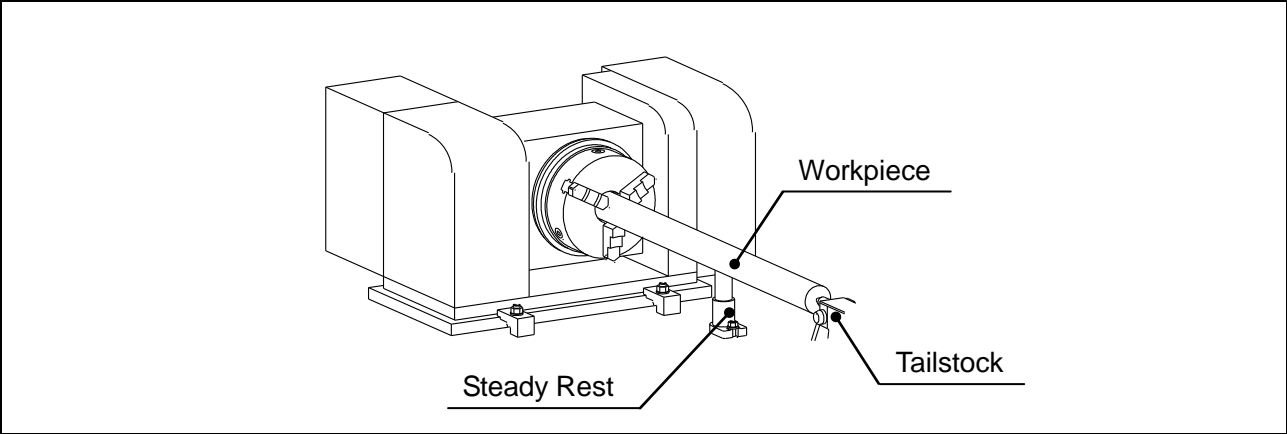


 **WARNING**

 Maintain adequate clearance between the unit and any part of the machine.



 Use a support, steady rest, or tailstock for heavy or long workpieces to prevent any injury and/or accident.



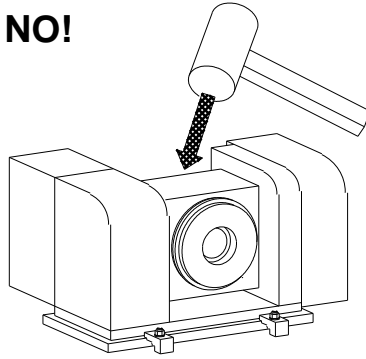


CAUTION



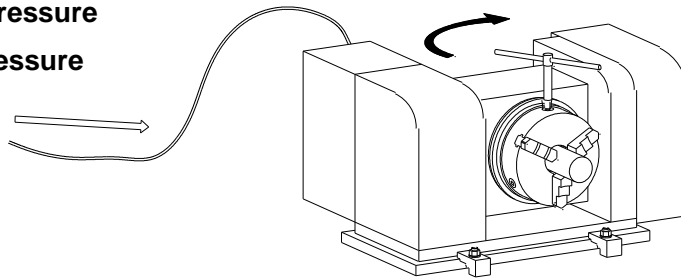
Avoid sudden impact to any part of the unit which may cause damage to the internal mechanism.

NO!

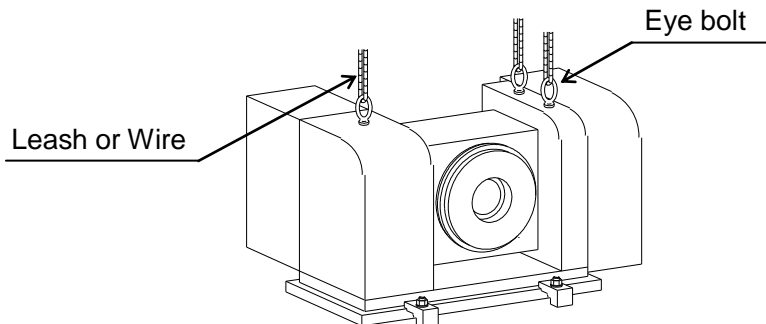


Mount or dismount the workpiece to or from the unit while the unit is clamped to avoid damage to the internal mechanism and diminished indexing accuracy of the unit.

Pneumatic pressure
Hydraulic pressure



When transporting the unit, make sure to use eye bolts and a sufficient leash or wire.

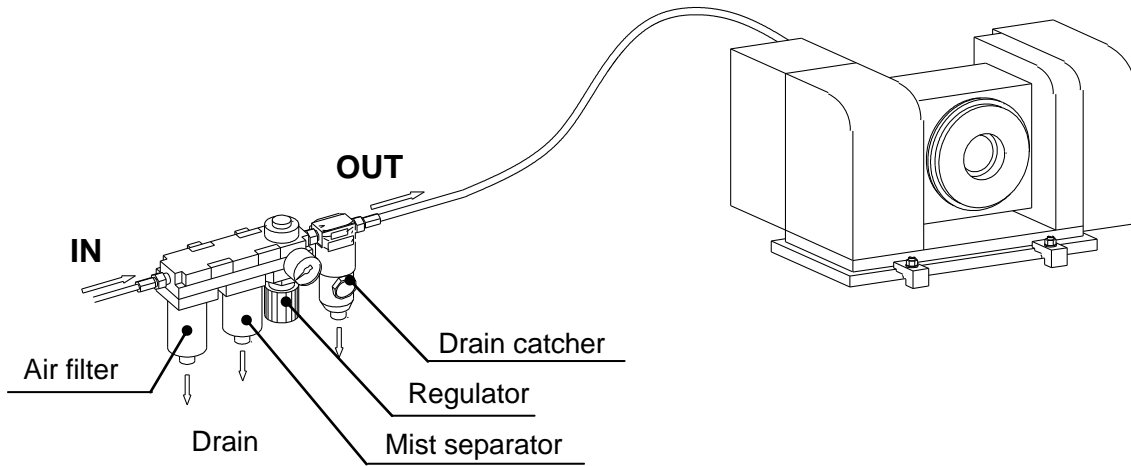


CAUTION



Supply air through Air combination (Air filter, Mist separator, regulator) + Drain catcher.
(The air supply port is on the motor case.)

Apply air purge inside the motor case
and be sure to provide dry air.

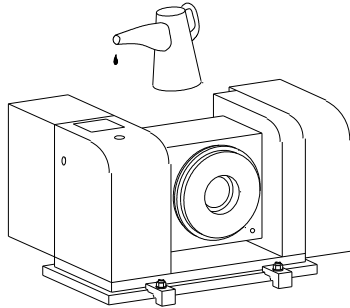


Periodically drain the water in air filter. (It is recommended to use the auto drain type.)

NOTICE



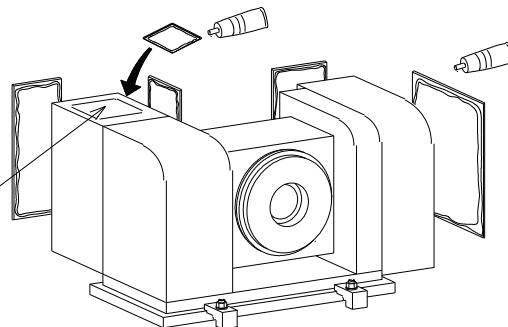
Replace lubricating oil every 6 months.



Coat each cover mounting face for motor case with liquid packing.

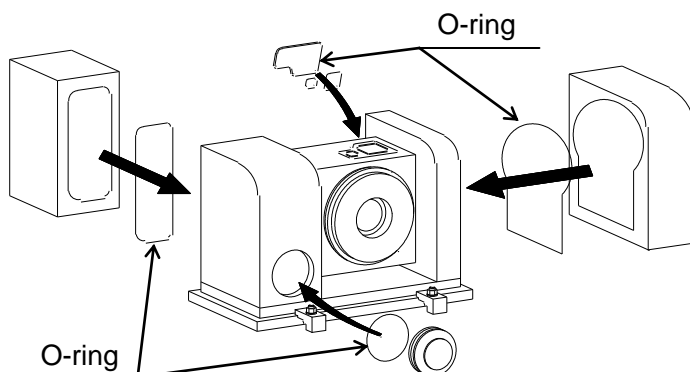
Because coolant is entered,
NC rotary table may be damaged.

注 意
接続工事等の後、カバーを組み付けるときは必ずシリコン系液状ガスケットをむらなく塗布してください。
ATTENTION
After covers are removed to assure water-tightness, a liquid silicon gasket must be applied before replacing covers.



Attach each O-ring to motor case mounting face, etc. as shown in the following figure. (No damages on O-rings)

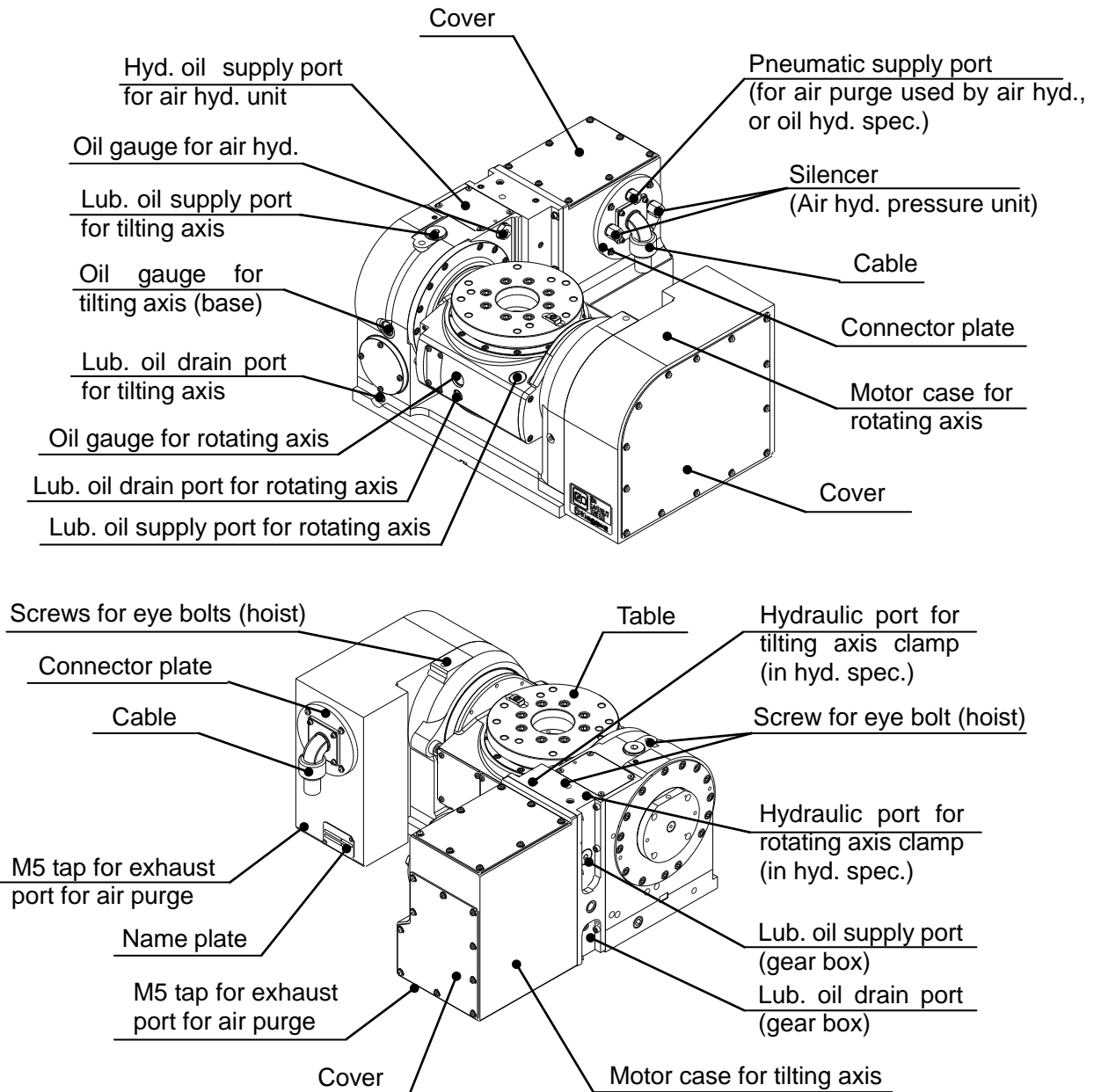
Because coolant is entered,
NC rotary table may be damaged.



2. Outside view

The following figure is the standard outline drawing of model TT200. Since the table clamp device is displayed without classifying the oil hydraulic pressure specification and the pneumatic specification in the following figure, the oil hydraulic pressure supply port becomes valid only when the oil hydraulic pressure system is used.

Thus, the air hydraulic booster is built-in only when the air hydraulic pressure system is used. For detailed models, refer to attached outside view.



3. Specifications

	MODEL		TT200
	ITEM		
1	Table Diameter	mm	ϕ 200
2	Table Height in Horizontal	mm	250
3	Center Height in Vertical	mm	180
4	Total Height in Vertical	mm	289
5	Table reference hole diameter	mm	ϕ 65
6	Table through hole diameter	mm	ϕ 40
7	Clamping Torque [Pneumatic 0.5MPa] [Hydraulic 3.5MPa]	(Rotating axis) N·m	600
		(Tilting axis) N·m	1200
8	Allowable Workpiece Dia.	mm	ϕ 200
9	Allowable Mass of Workpiece	(Horizontal) kg	60
		(Vertical) kg	40
10	Allowable Work Inertia	kg·m ²	0.3
11	Total Reduction Ratio	(Rotating axis)	1/90
		(Tilting axis)	1/180
12	Max. Rotation Speed	(Rotating axis) min ⁻¹	33.3
		(Tilting axis) min ⁻¹	16.6
13	Angle of tilting	degree	-35~110
14	Mass of Rotary Table	kg	About 170
15	Operating temperature range	°C	5~40
16	Operating humidity range	%	30~95
17	Operating altitude range (above sea level)	m	1000 or lower
18	Storage temperature range	°C	-10~60
19	Environmental pollution degree		Degree 3
20	Noise level	dB	79

※The noise level is measured at a distance of 1m from the NC rotary table in front, rear, left, and right four positions of the unit.

※When storing the unit, conduct the antirust treatment and store it in a place free from wetting, condensation, or freeze.

NOTICE

The above specification table shows the values at standard specifications. For details, refer to the Outside View.

NOTICE

Max. table rotation speed is the value when the motor rotates at 3000 min⁻¹.



Be sure to observe the allowance work inertia even if the mass of workpiece is within the allowable value.



There is any case that the tailstock is required by the mass of workpiece, shape, cutting conditions, etc.



For the conditions for using the table, refer to the above specification columns and caution items. Set each cutting condition so as not to exceed the allowance value.

4. Accuracy Standard

(Unit: mm)

	Inspection Item		Allowable Value
1	Run out of table reference hole		0.010
2	Run out of table top face during table rotation		0.015
3	Straightness of table top face (to be concave side.)	Total length	0.010
4	Parallelism of table top face and mounting reference face (tilting axis direction)	Total length	0.020
5	Parallelism of table top face and guide block center line (Tilting angle : 90°)	Total length	0.020
6	Parallelism of tilting axis center line and mounting reference face	Total length	0.020
7	Indexing accuracy	Rotating axis	Cumulative 20 sec
		Tilting axis	Cumulative 60 sec
8	Repeatability	Cumulative	4 sec

1	2	3
4	5	6
7,8 Index accuracy is measured with the optical device.		

5. Operation Ready

After unpacking, the tilting rotary table is mounted to the machine tool. Observe the following procedure before performing the operation (trial run).

5-1. Table transfer and mounting to machine tool

- 1) When transporting the unit, hook ropes to the eyebolts attached and transport the unit carefully, not giving a shock. The ropes used should be wire ropes having enough strength to lift up the unit.
- 2) Clean the table face on the machine tool and the mounting base surface of NC table after checking that burr or flaw is not found. If the burr or flaw is found, repair them with the oil grinding stone.
- 3) The motor case may be removed depending on the maintenance work. Accordingly, whenever possible, install the NC rotary table in a position where the motor case can be removed. In case of vertical installation, the guide blocks will fit into the slotted groove on the machine. If there is any play between the guide block and the T-slot, place the unit against one side of the T-slot to eliminate the gap.
- 4) Securely fix the NC rotary table to the machine tool with the attached clamper.



Do not enter a part of your body under the NC rotary table during transportation.

Unexpected accidents such as a disengagement of lifting devices may cause the NC rotary table to drop on your body.



When mounting the NC rotary table to the machine tool, check the mounting space carefully. Especially, take care so that the NC rotary table, cables and air/hydraulic hoses will not interfere with the splash guard or ATC device and spindle head of machine tool because the table or spindle head moves.



Do not damage the cables by placing a heavy thing or pinching them. If the cables are damaged, there is a danger of electric shock.



Tighten the bolts of clamper at the specified torque by using the mounting seat effectively.



The transport and lifting devices must be operated only by the qualified persons for respective devices.

Operating the transport devices by an unqualified person causes the NC rotary table or machine to be damaged due to an operation error, resulting in accidents.



When transporting a pallet on which NC rotary table is mounted, take measures against over-turning or drop.

Transporting the pallet with NC rotary table mounted unstably may cause the NC rotary table to overturn and then to drop from the pallet.



Disconnect electric cables and working fluid piping when relocating the NC rotary table.

Relocating the NC rotary table with electric cables and working fluid piping connected and hung down causes the NC rotary table to be unstable or the worker to be tripped, resulting in unexpected accidents. Electric cables or working fluid piping may be damaged during relocation, and if the NC rotary table is installed on the machine again, unexpected accidents may occur.

If electric cables and working fluid piping cannot be disconnected, secure them to the NC rotary table.

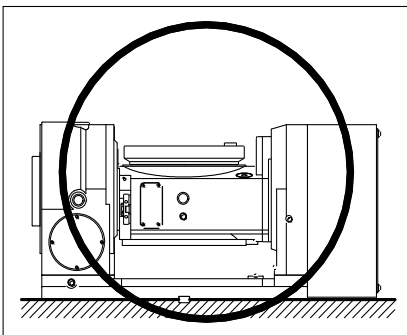


Flush the working fluid piping sufficiently before connecting it to the NC rotary table. If foreign matter enters the piping route, the product capability may not be exhibited.

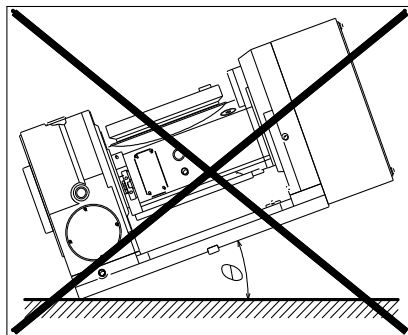


Be sure to use the NC rotary table body in a horizontal state. If you use the NC rotary table body in an inclined state, hydraulic oil and lubrication oil are not supplied to the proper levels respectively, resulting in operation failure or reduction in the product life.

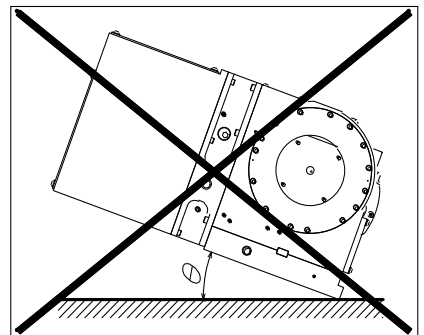
The following figures indicate the examples. If you intend to use the unit in an inclined state, please contact your sales agent (M/C maker) or your local distributor.



Horizontal state



Bad example



Bad example

5-2. Oiling

Lubrication oil has been already filled in NC rotary table before shipping. Check that the lubrication oil is filled to the center position of the oil gauge before operating the machine.



Replace lubrication oil every 6-month. At this time, completely drain the oil. When filling the oil tank with lubrication/hydraulic oil, remove the chip and foreign matter on the oil filler neck. If the chip and foreign matter are entered, the important parts such as the worm gear, bearings, etc., are seized and accuracy is reduced. In the air/hydraulic specification, a clamp alarm occurs.



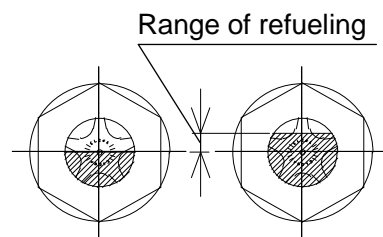
Fill the tank with lubricating oil to center position of oil gauge.
The shortage of oil leads to the insufficient performance of table.
Use the lubricating oil recommended in the table on the item 5-5.
Use the hydraulic oil recommended in the table on the item 5-6.

5-3. Required lubrication oil volume

(Unit: liter)

Type	TT200
Tilting axis	0.45
Gear box	0.15
Rotating axis	0.55

Filled with Daphne Multiway 32MT (IDEMITSU) before shipping.



Details of oil gauge

5-4. Required operation oil volume

(For air hydro booster at pneumatic/hydraulic spec.)

(Unit: liter)

Model	TT200
Operation oil	0.35

Filled with Daphne Neo fluid 32 (IDEMITSU) before shipping.

5-5. Recommended lubrication oil

(Viscosity grade ISO VG32)

Maker	Name
IDEMITSU	Daphne Multiway 32MT
MOBIL	Vactra oil No. 1
JX NIPPON OIL & ENERGY	Uniway EV32
SHELL	Shell Tonna oil S32
COSMO	Dynaway 32

5-6. Recommended operation oil

(For air hydro booster at pneumatic/hydraulic spec.)

(Viscosity grade ISO VG32)

Maker	Name
IDEMITSU	Daphne Neo Fluid 32
	Daphne Super Hydro 32A
MOBIL	Mobil DTE XL32
JX NIPPON OIL & ENERGY	Super Hyrando SE32
SHELL	Shell Tellus Oil 32
COSMO	Cosmo Super Epoch ES32

5-7. Safety of Oil and Antirust Oil Used for the Unit

5-7-1. Scope of application

- Specified lubricating oil
- Specified hydraulic oil (MR, MX, MRT, CK, GT, RK, TM2100·3100, TH2100·3100, TT(TW)101·120, TT140, TT150, DM do not use)
- Antirust oil applied to the unit at delivery (Houghton Japan, Rust Veto 377)

5-7-2. First-aid treatment

Aspiration : In case of much aspiration, go to a place where there is fresh air, and cover your body with a blanket to keep your body warm. Consult a doctor if necessary.

Sticking to your skin: Wipe off the oil, and wash your skin with water and soap. If you feel itchy or you get inflamed, consult a doctor immediately.

Entering your eye: Wash your eye with fresh water for at least 15 minutes, and then consult a doctor.

Accidental drinking: Consult a doctor immediately without vomiting forcibly. If you are polluted in your mouth, wash with water thoroughly.

- For lubrication oils and hydraulic oils other than specified ones, and antirust oils prepared by the customer, refer to the safety information prepared for respective oils.

5-7-3. Flammable characteristics

- Watch out for fire since lubricating oil and hydraulic oil are flammable. Hazardous substances will be generated if they combusted.
- The flash point of lubricating oil and hydraulic oil put in the unit at the delivery exceeds 200°C. It may be different from that of the lubricating oil and hydraulic oil prepared by the customer.
- Antirust oil is highly volatile and thus likely to catch fire, and also it mixes with air to form explosive mixture gas.
- The flash point of antirust oil applied to the unit at the delivery is 38°C. It may be different from that of the antirust oil prepared by the customer.

5-7-4. Disposal of lubricating oil and hydraulic oil

Dispose of used lubricating oil and hydraulic oil exhausted from this unit in accordance with the laws and regulations of your country. You may suffer punishment if you disposed of waste oil without following the laws and regulations.

6. Inspection

Daily inspection

- 1) Check the fixing condition of NC rotary table (including jig if mounted).
- 2) Confirm that the chips accumulating in a rotary part of NC rotary table are removed.
- 3) Check the electric connection cables and the air hoses are not damaged, and also, check the pneumatic and hydraulic pressure.
- 4) Check the oil volume of air hydraulic system. (Check that the oil level of hydraulic oil is in the upper part of oil gauge.)
- 5) Check the zero return motion (machine), indexing motion and position.
- 6) Check unusual vibration and noise do not occur. (Body, motor)
- 7) Check unusual heating. (Body, gear box, motor)

Periodical inspection (Inspect the following items every 6-month.)

- 1) Check the dirt degree of lubrication oil.
- 2) Check the dirt degree of hydraulic oil.
- 3) Check connectors are well mounted and cables are not damaged.
- 4) Check wiring cables in the motor case do not corrode or are disconnected.

7. Use of NC Rotary Table

This unit is installed on the machining centers, and on its table surface the chuck or fixture is attached to clamp the workpiece. It indexes the angle of machining position by the control of machining center or Kitagawa's own controller. During the machining, the working fluid is supplied to retain the workpiece.

8. Table Clamp

8-1. Precautions for table clamp



Be sure to rotate the table with the table unclamped and use the table with it clamped when machining after positioning. If the table is operated by mistake, take care since the worm wheel may be damaged. Check the signals of pressure switch to check Clamp/Unclamp operations.



Never operate the table at clamping torque or more in specification column because the clamping part will be worn and the worm wheel also will be damaged.



Clamped status is not canceled completely when residual pressure remains while unclamping. Thus, the table operation may continue under half clamped condition. Since the above mentioned case leads to the seizing of worm gear and clamped part, take extreme care of back pressure.

In case of especially hydraulic clamp, design the circuit so that back pressure is less than 0.2 MPa while unclamping.



If a silencer is clogged with cutting fluid etc., there are possibilities that compressed air may not be exhaust and it leads unclamp failure alarms. To avoid clogging, maintain silencer periodically.

8-2. Supply of pneumatic and hydraulic pressure for clamp

The clamber to clamp the table is incorporated in the NC rotary table and two air and hydraulic clamp specifications are provided for operation. However, in the air pressure clamp specifications, the air hydraulic booster is incorporated in the table. Since the NC rotary table is delivered in accordance with the customer's specifications, supply a pressure source according the specifications.

8-2-1. Pneumatic clamp specifications

- 1) Supply clean air (moisture, oil content, powder dust eliminated) passing through the air combination (Air filter, mist separator, regulator) + drain catcher.
- 2) Connect the pipe exclusive for air pressure durable to max. operating pressure over 0.6 MPa to the air pressure supply port. The air pressure supply port is provided on the motor case. See the external view attached for details. (Connection port is Rc1/4).
- 3) Use this unit in the air pressure range of 0.45 to 0.6 MPa.
- 4) If the air remains in the table clamp device, the specified clamp torque cannot be attained. Thus, perform the air bleeding work .[Refer to section 8-3]

8-2-2. Hydraulic clamp specifications

- 1) Connect the pipe exclusive for hydraulic pressure durable to max. Operating pressure over 3.7 MPa to the hydraulic pressure supply port. (Connection port is Rc3/8)
- 2) Use this unit in the hydraulic pressure range of 3.5 to 3.7 MPa.
- 3) If the air remains in the table clamp device, the specified clamp torque cannot be attained. Thus, perform the air bleeding work .[Refer to section 8-3]



Port Rc 1/4 is provided. In the hydraulic clamp spec., use connection port of Rc 3/8 for different diameter.

Using the hose equivalent to 3/8 is recommended.

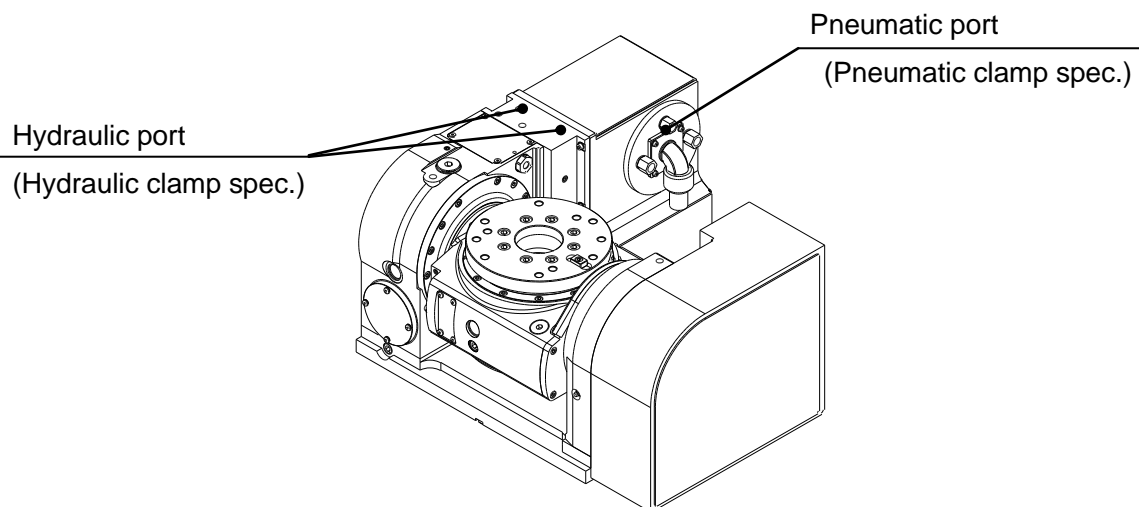
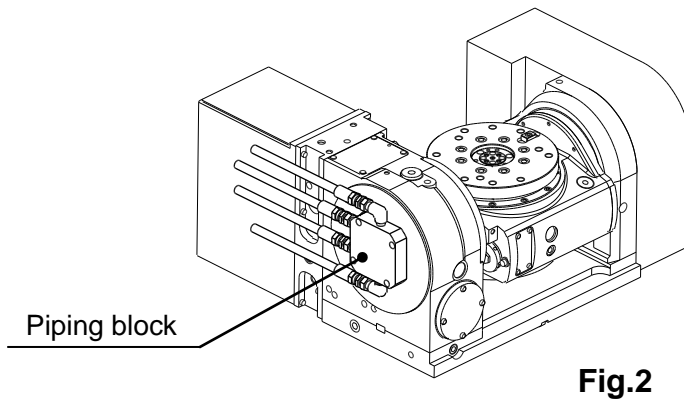


Fig.1 (TT200)

8-2-3. Rotary joint specifications

Do not change the mounting direction of the piping block. When the piping block is removed, hydraulic oil mixes with lubrication oil. Moreover, when the hydraulic oil is reduced, a brake alarm occurs.



8-3. Air Relief

Always perform the air relief work when supplying oil after disassembling the parts relating to the clamping circuit and after a brake alarm occurs. If air relief is not sufficient, the specified clamp torque cannot be attained and an alarm occurs.

8-3-1. Pneumatic clamp system (See Fig.3-1, Fig.3-2, Fig.3-3)

- 1) Tilt the rotating axis 90° from the horizontal state of table (0°) to make the table vertically.
- 2) Move the piston of the cylinder for the tilting axis or rotating axis (hereinafter referred to as piston) to the returned edge. When the air is supplied with the solenoid valve ON at excitation unclamp specification and with the solenoid valve OFF at excitation clamp specification, the piston moves the returned edge.
- 3) Remove tank cover on air hydraulic part (hereinafter referred to as cover) ① and fill the oil tank fully with the specified hydraulic oil. The hydraulic oil is reduced by the air relief work, so supply oil as necessary when performing the work.

Air relief on rotating axis side

Bleed air on the rotating axis side at three points (②, ③, ④).

- 1) Slightly loosen the screw of air relief plug ② with the table clamped to leak the hydraulic oil a little, so as to bleed the bubbles (air) contained in the oil. After leaking the oil for a while, once tighten the screw of ② with the table clamped.
- 2) Repeat the clamp/unclamp operations in this state. At this time, bubbles come out on the oil tank side. The hydraulic oil is filled in the primary side piping line and air is discharged by repeating the clamp/unclamp operations. Check that bubbles on the tank side are eliminated by the air relief work for the tilting axis and rotating axis.
- 3) Again, loosen the screw of ② to leak hydraulic oil a little, so as to bleed the bubbles contained in the oil. Repeat this operation until the bubbles disappear, and tighten the screw of ② again.
- 4) Bleed the air by means of air relief plug ③ by the same procedure.
- 5) Then, bleed the air by means of air relief plug ④ by the same procedure.
- 6) Repeat the procedure until no bubbles are found in the leaking oil even if any screw of air relief plug ②, ③ or ④ is loosened.

Air relief on tilting axis side

Bleed air on the tilting axis side at two points (⑤, ⑥).

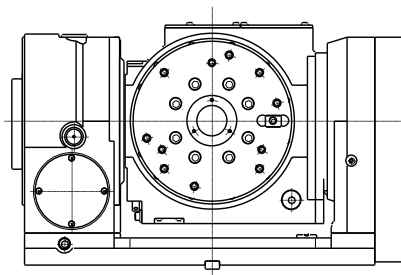
- 1) Bleed air using air relief plug ⑤ by the same procedure as step 1) of "Air relief on rotating axis side".
- 2) Bleed the air by means of air relief plug ⑥ by the same procedure.
- 3) Repeat the procedure until no bubbles are found in the leaking oil even if any screw of air relief plug ⑤ or ⑥ is loosened.
- 4) After completion of the air relief work, supply hydraulic oil or adjust the oil level so that the oil level

comes near the center of the oil gauge on the side of the tilting axis base.

- 5) Upon completion of all the works, check that the O-ring on the cover ① mounting part does not protrude from the groove and then mount cover ①.
- 6) Operate the NC rotary table to check that the table clamp alarm does not light up on both the tilting axis side and the rotating axis side. If the alarm lights up, it indicates that the pressure does not reach the specified value because of incomplete air relief. In such a case, perform the air relief work again on the lighting side.

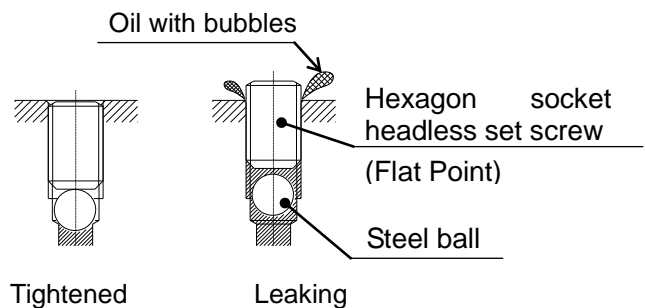


- 1) When the air relief plug is abruptly loosened, the hydraulic oil may spill out from the air relief plug. Slightly push the air relief plug with the hexagon bar spanner and cover it with rags to prevent the plug from flying out and the hydraulic oil from spilling out. Be careful that a steel ball jumps out when the plug is removed.
- 2) Once some air has been removed, leave it in clamp/unclamp for five seconds or longer and then remove the air again until there is none left.
- 3) When you loosen the air relief plug, leave it in clamp mode until the plug is tightened again. If you switch it to unclamp mode while the plug is still loose, there is danger of air being sucked in.
- 4) The hydraulic oil is reduced during air bleeding. Perform the work while checking the oil level in the oil tank.
- 5) Be sure to perform the air relief work on both the rotating axis and tilting axis.
- 6) Fill the oil tank with the hydraulic oil to a high level of oil gauge.



Front View of Vertical Table Face

Fig. 3-1



Detail of Air Relief Plug

Fig. 3-2

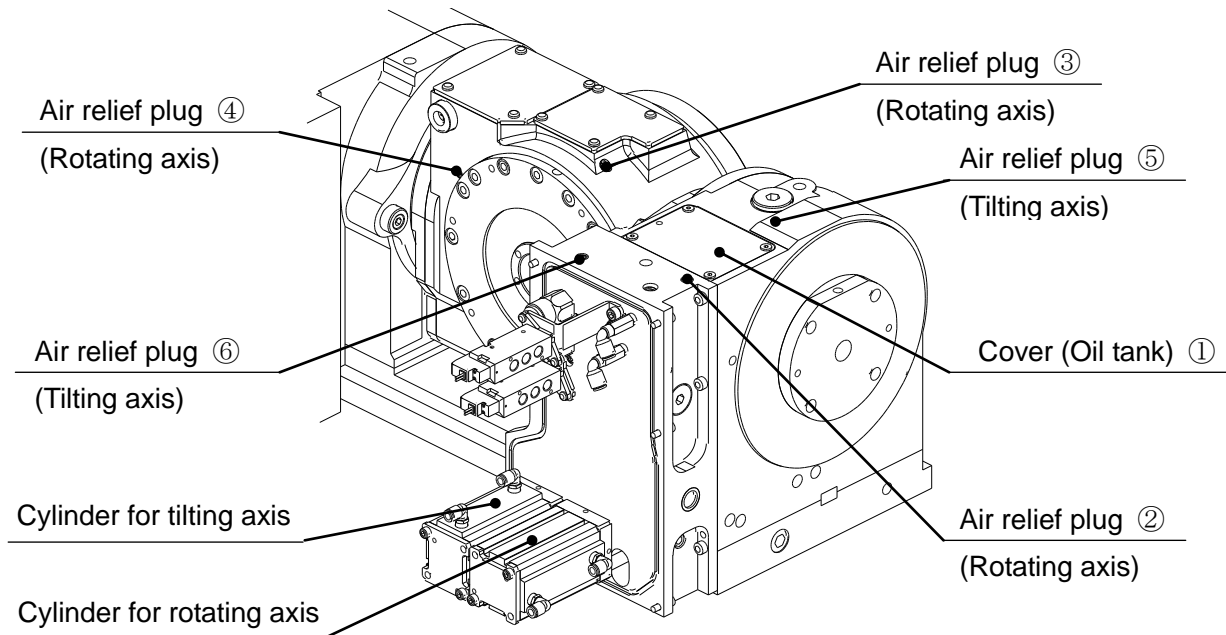


Fig. 3-3

8-3-3. Hydraulic clamp system (See Fig.4)

Tilt the rotating axis 90° from the horizontal state of table (0°) to make the table vertically. (See Fig.3-1)

Air relief on rotating axis side

Bleed air on the rotating axis side at two points (①, ②).

- 1) Clamp the NC rotary table (apply hydraulic pressure).
- 2) Slightly loosen the screw of air relief plug ① with the table clamped to allow hydraulic oil to leak a little, so as to bleed the bubbles (air) contained in the leaking oil. After a while, with the table clamped, tighten the screw of ① once, and repeat the clamp and unclamp operation. Again, loosen the screw of ① to leak the hydraulic oil a little to bleed the bubbles contained in the oil. Repeat this operation until the bubbles disappear, and tighten the screw of ① again. Retain lightly the air relief plug ① with a hexagonal wrench key, and with the plug covered with rags, loosen the plug a little to bleed the air.
- 3) When bubbles (air) mixed with oil does not run over the air relief plug ①, tighten the air relief plug ① under a clamp state.
- 4) Then, bleed the air by means of air relief plug ② by the same procedure.
- 5) Repeat the procedure until no bubbles are found in the leaking oil even if any screw of air relief plug ① or ② is loosened.

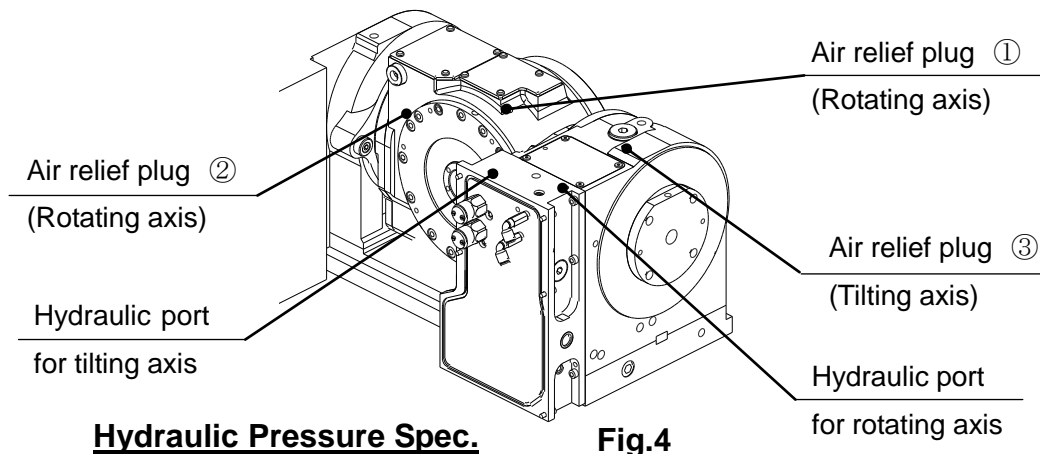
Air relief on tilting axis side

Bleed air on the tilting axis side at one point (③).

- 1) Perform the air relief with the air relief plug ③ by the above steps 1) and 2).
- 2) When bubbles (air) mixed with oil does not run over the air relief plug ③, tighten the air relief plug ③ under a clamp state.



- 1) When the air relief plug is too loosened, there is a possibility that the air relief plug flies out and hydraulic oil spills out. Slightly push the air relief plug with the hexagon bar spanner and cover it with rags so as not to fly out the plug and spill out the hydraulic oil.
- 2) When you loosen the air relief plug, leave it in clamp mode until the plug is tightened again. If you switch it to unclamp mode while the plug is still loose, there is danger of air being sucked in.
- 3) During air bleeding, since oil for the pump unit becomes short, it is necessary to fill the oil tank with the hydraulic oil.
- 4) Be sure to perform the air relief work on both the rotating axis and tilting axis.
- 5) After finishing the air relief, cleanly wipe oil spilled around the unit with a waste cloth.
- 6) Take care so as not reduce pressure during clamp.



8-3-4. Maintenance inspection

- 1) Air may mix in oil during operation because the piping joint, each plug, etc., are loosened. At this time, bleed the air according to the procedures of the above.
- 2) The hydraulic oil is deteriorated when it is used for a long period of time. Replace the oil every year.
- 3) With the NC rotary table operated after ready for start-up, if a brake alarm occurs, check the air bleeding for confirmation.

8-4. Air purge



Dew drops may occur in the motor case by ambient environment. In this case, each component in addition to electric apparatus will fail or rust will occur. Therefore, the air is purged and exhausted from the air purge exhaust port.

(Air Hydraulic pressure system)

The air purge is performed by air branched in the NC rotary table from air used for clamp. Thus, air is used in the motor case from joint with hole of 0.4mm.

Be sure to supply clean air passing through the filter (air filter, mist separator, regulator and drain catcher). If moisture, oil content, etc., are mixed in the air, its air is entered in the motor case, thus damaging the equipment. The air in the motor case is exhausted from the air purge exhaust port.

If the air purge exhaust port is closed, condensed drops are not exhausted and pressure is kept in the motor cover as is, thus causing in motor case damaging and motor malfunction.

Therefore, never close the air purge exhaust port. When exhausting air, although any exhaust sound occurs, there is no problem.

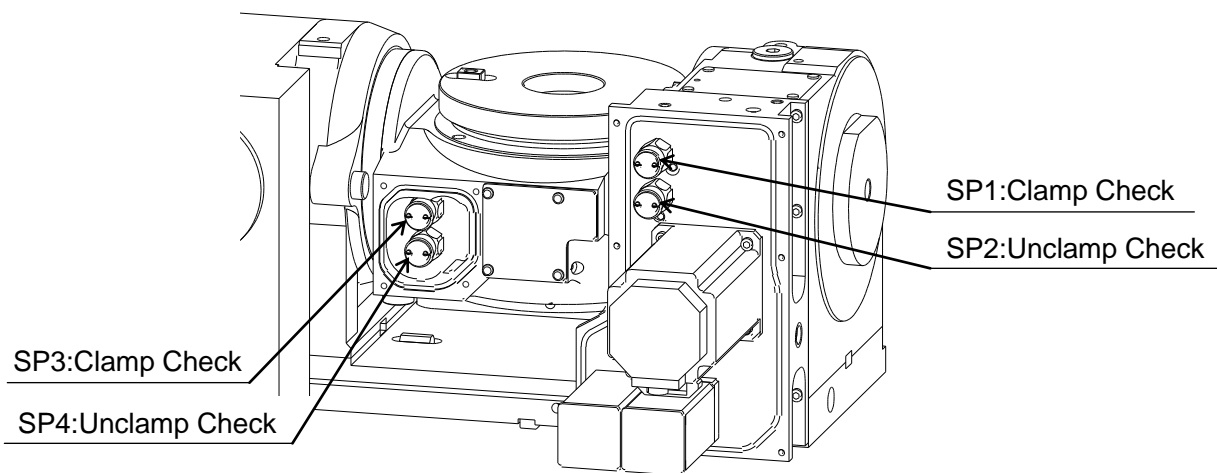
(Hydraulic pressure system)

Since an exclusive supply port for air purge is provided, be sure to supply clean air as well as the type of air pressure specifications (Pneumatic: 0.5MPa).

When performing the air purge, block M5 screw hole of air purge exhaust port as shown in the outside view with the cross recessed round head screw M5 and the seal washer 5. (If not blocked, coolant may enter in the motor case.)

8-5. Checking device for Clamp/Unclamp

To proceed a secure work, be sure to use Clamp/Unclamp confirmation signals. (See Fig.5)



Inside view of rotating axis table rear base

Inside view of tilting axis motor case

Fig.5

The set pressure values of pressure switches for air/hydraulic pressure clamp specifications are as follows:

Clamp check (SP1, SP3)	2.20 MPa (176 112 200)
Unclamp check (SP2, SP4)	0.40 MPa (176 120 400)

8-6. Solenoid valve for Clamp/Unclamp

In case of NC rotary table made by air hydraulic clamp specifications, the solenoid valve is incorporated. Since the following piping is used as standard, take care when electric cables are connected.

Refer to outside view and item 23-2.

(Excitation Unclamp Spec.)

Solenoid: ON ... Table Unclamp

Solenoid: OFF ... Table Clamp

(Excitation Clamp Spec.)

Solenoid: ON ... Table Clamp

Solenoid: OFF ... Table Unclamp



In hydraulic clamp specifications, the solenoid valve is not incorporated. When the solenoid valve is mounted outside of NC rotary table, route cable at the above specification.

9. Mounting of Workpiece

Mount the workpiece securely to increase accuracy.



If the workpiece is not mounted securely, accuracy becomes not only worse but also the machine and tools are damaged.

Therefore, take extreme care because it also causes an accident resulting in injury or death in the worst case.



When the workpiece that flatness and straightness are not obtained is tightened as is, the workpiece or the rotary table may be distorted, thus resulting in low accuracy or unevenness rotation. In such case, insert the shim(s) between the workpiece and the rotary table.



When the workpiece is tightened, fix the workpiece equally and securely on the rotary table as much as possible.

10. Maintenance Work

10-1. Corrective Action in Case of Failure, and Disassembly

See the “Troubleshooting” if a failure occurred in the unit due to any reason. Also, for the disassembly procedure when performing the maintenance work, refer to the parts list and the procedure given in the corresponding maintenance item.

10-2. Before Performing Maintenance Work

When performing the maintenance work, shut off the power (primary power supply) of the machining center or Kitagawa’s own controller to set the pressure adjusting valve of air combination that supplies the air to the NC rotary table to 0 MPa or shut off the power of the air compressor to exhaust the compressed air, so as to stop the supply of the working fluid.



Perform the maintenance work with the workpiece removed. Performing the work with the workpiece left on the table may cause the workpiece to be dropped out, resulting in injuries.



Appropriate value in each maintenance item has been set for smooth function of each device, and thus you should observe it. Performing the maintenance work without observing the appropriate value may cause NC rotary table to fail or each device to be damaged.



Clamp the table clamp device of NC rotary table when removing the workpiece.

11. Backlash Adjustment of Worm Gears

The worm shaft and worm wheel are made of the special materials and they are accurately machined. The dual lead worm system is adopted for eliminating the backlash of worm gear. It changes the lead of right and left teeth of worm shaft a little and adjusts the backlash for the worm wheels by shifting this worm shaft in the axis direction.

This dual lead worm system can adjust the backlash finely without changing an ideal engagement state and it is theoretical and most secure backlash adjustment method.

Although the backlash of worm gear has already been adjusted before shipping, it is necessary to adjust the backlash when the machine is operated for a long period of time. The proper values for backlash are shown in the following list. These are values when the machine is cooled. Thus, they are values after interrupting for a long period of time. Consequently, when the machine is operated for a long period of time, the backlash becomes small in comparison with the following values.

NOTICE

If backlash is too small, the worm gear will cause seizing.

○ Adequate Backlash

TT200	Circular arc length at peripheral table position (μm)	Converted angle (sec.)
Rotating axis	14 ~ 42	29 ~ 86
Tilting axis	8 ~ 17	14 ~ 29

When adjusting the backlash, measure the current backlash by the following method. After that, adjust it.

This adjustment affect the indexing accuracy and worm wheel durability, thus it is strongly recommended that a skilled technician should do the adjustment. Please consult Kitagawa distributor before the adjustment.

11-1. Backlash measuring method of worm gear of rotating axis

- 1) Set the dial gauge the periphery of the guide block on the table top face.
- 2) Read the value of dial gauge at the position where the table stops after rotating the table slowly in one way with the flat steel or round bar inserted in the guide block on the surface of table (with worm wheel gear tooth attached). At this time, for the torque added to the table, refer to the list created later. Next, rotate the table under the same condition in the reverse direction to read the value of dial gauge. This difference of measured values is the backlash.
- 3) Perform the above measurement at 8 positions by rotating the table and compare them with the above adequate values. (See Fig.6)

$$T = F \times L$$

T: Torque (N·m)

F: Effort force (N)

L: Distance from table center to point to add force F (m)

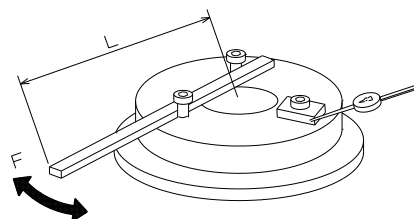


Fig.6

11-2. Backlash measuring method of worm gear of tilting axis

- 1) Set the dial gauge the periphery of the table top face.
- 2) Read the value of dial gauge at the position where the table stops after rotating the tilting body slowly in one way with the flat steel or round bar inserted in eye bolts screwed in tap holes on the table back face (with worm wheel gear tooth attached). At this time, for the torque added to the tilting body, refer to the list created later. Next, rotate the tilting body under the same condition in the reverse direction to read the value of dial gauge. This difference of measured values is the backlash. (See Fig.7)

$$T = F \times L$$

T: Torque (N·m)

F: Effort force (N)

L: Distance from table center to point to add force F (m)

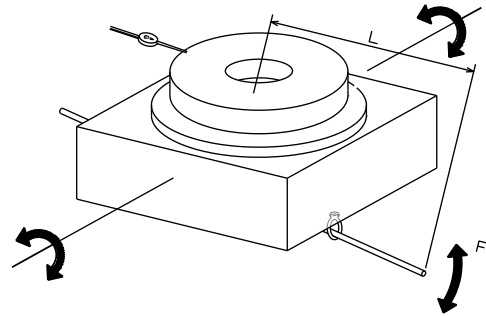


Fig.7

Table type: TT200	Torque T (N·m)
Rotating axis	30
Tilting axis	9

11-3. Backlash adjusting method of rotating axis worm gear (See Fig.8)

- 1) Drain lubrication oil from the rotating axis lubrication oil drain port. (See the outside view.)
- 2) Remove the cover ①.
- 3) Remove hexagon socket head cap screw ③ and washer ④ which fix lock nut ②.
- 4) The lock nut ② is engaged with the bearing case ⑤ by M42, P1.5 screw. Since eight 5mm drill holes are provided on the periphery of the lock nut ② and the bearing case ⑤, fix the bearing case ⑤ with a proper round bar before loosening the lock nut ②.
- 5) When rotating and advancing the bearing case ⑤ clockwise by using the above 5mm drill hole, the backlash becomes small.
- 6) After adjusting the backlash, fix the bearing case ⑤ and tighten the lock nut ② securely. Then, measure the backlash again and check that it is proper.
- 7) After checking that the backlash is proper, mount the cover ① again to the original position with hexagon socket head cap screws ③ and washer ④.

NOTICE

Each interval between the hole and the hole of periphery of bearing case is 45° . When rotating the bearing case 45° , the backlash of about $8\mu\text{m}$ is reduced at arc length on the peripheral position of table.

NOTICE

Adjust the backlash slowly and carefully without adjusting the backlash at a time.



CAUTION

When mounting the cover ①, do not damage O-ring ⑥.

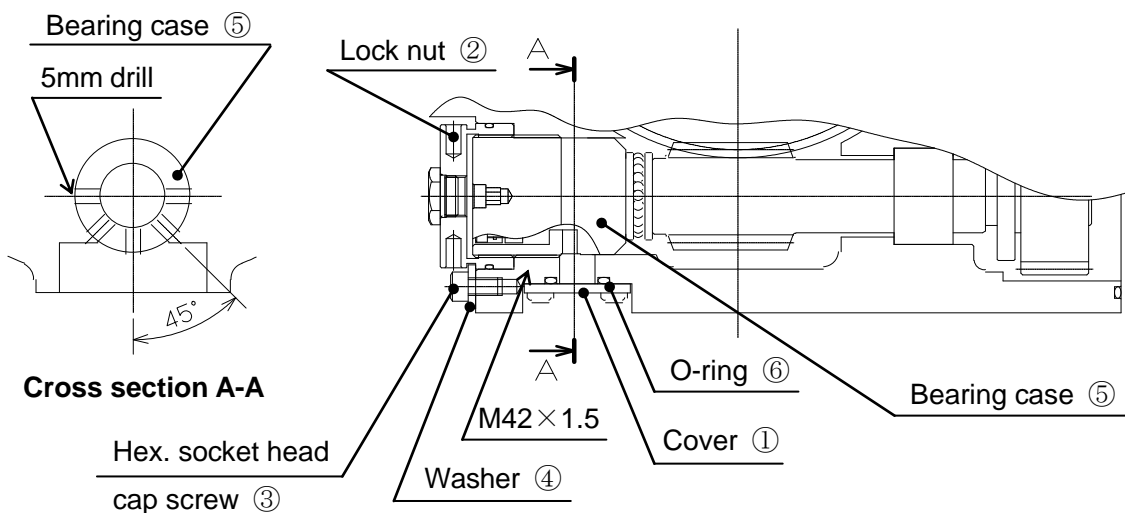


Fig.8

11-4. Backlash adjusting method of tilting axis worm gear (See Fig.9)

- 1) Remove the workpiece, jig, etc. on the table before adjusting and horizontalize the table.
- 2) Drain lubrication oil from the tilting axis lubrication oil drain port. (See outside view.)
- 3) Remove cross recessed round head screws ⑥ and ⑦ which fix cover ① to remove the cover① by using two punched taps ⑦ on a diagonal line.
- 4) The bearing case ④ is positioned by adjusting screws ② and hexagon socket head cap screws ③.
- 5) When loosening four adjusting screws ② to the same amount and tightening four hexagon socket head cap screws ③ to the same amount, the bearing case ④ advances and the backlash becomes small.

NOTICE

The rotating angle of adjusting screw to reduce the backlash to 0.01mm is as follows:

Type	TT200
Return angle	About 90°

When adjustment is finished, mount the workpiece, jig, etc. by the reverse procedures as the above and tighten bolts securely. After mounting, measure the backlash again on the periphery of table at the same position as the position before adjusting, and check that the measured value is proper.

NOTICE

Adjust the backlash slowly and carefully without adjusting the backlash at a time.



CAUTION

When mounting the cover ①, do not damage O-ring ⑤.

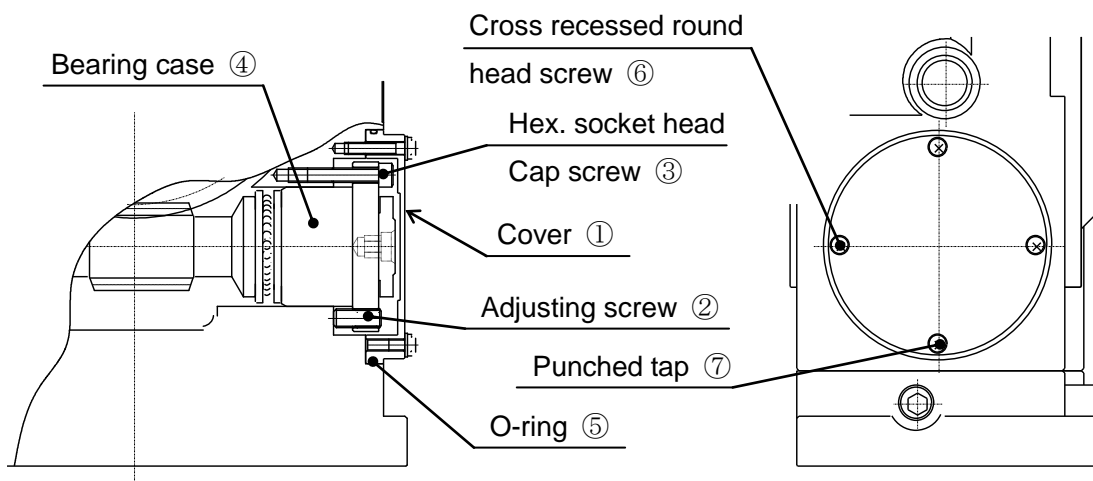


Fig.9

12. Backlash Adjustment of Spur Gears

The adequate backlash of spur gear is 0.02mm~0.04mm. If the measured backlash is deviated, it is necessary to adjust the backlash.

12-1. Backlash adjusting method of rotating axis drive spur gears (See Fig.10)

The backlash between Z1 – Z2 spur gears is adjusted by changing a center distance after adjusting the motor position.

- 1) Adjust the backlash where the table surface is horizontal.
- 2) Drain lubrication oil from the rotating axis lubrication oil drain port (See outside view).
- 3) Slightly loosen four mounting bolts ③ which fix the motor.
- 4) Move the motor in the arrow direction so that the backlash becomes zero (0) approximately.
- 5) Move the motor by pushing it up in the opposite direction of step 4) so that the backlash of the gear falls within the adequate range (0.02 mm - 0.04 mm).

At this time, check the motor movement with the dial gauge attached to the motor side.

- 6) Tighten four mounting bolts ③ that loosened slightly.
- 7) After adjusting, run the motor from slow speed to high speed to check that abnormal noise does not occur.

If the value does not fall within the adequate range (0.02 - 0.04 mm), repeat step 3) to 6) again.



When mounting the motor, take care so that O-ring ② will not be damaged.

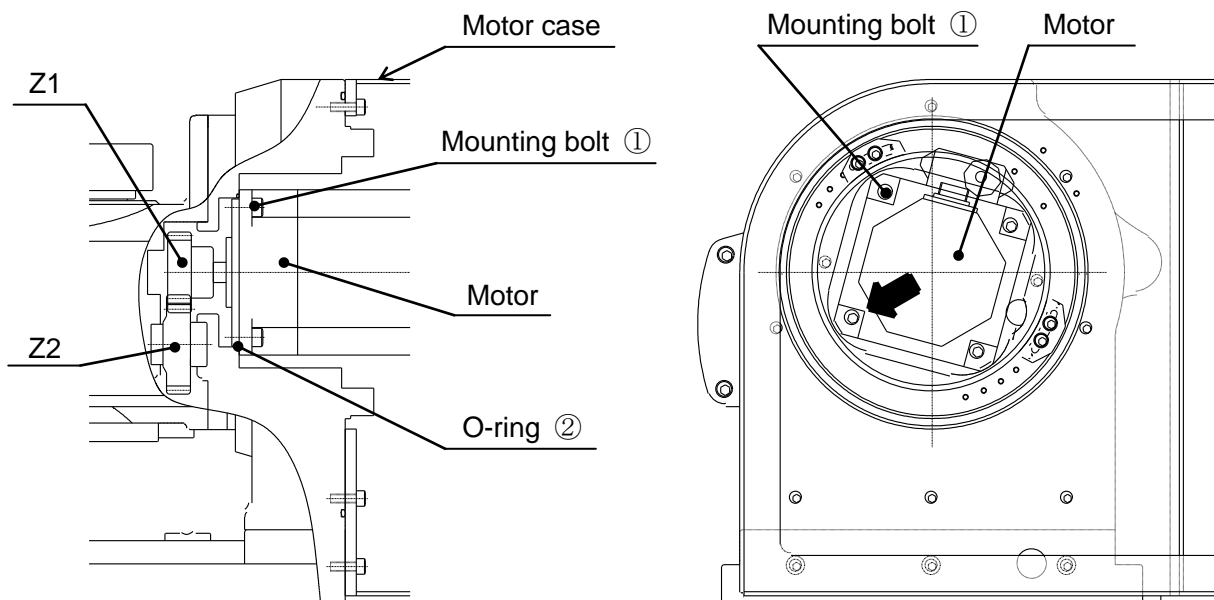


Fig.10

12-2. Backlash adjusting method of tilting axis drive spur gears (See Fig.11)

The adequate backlash of spur gear is 0.02mm~0.04mm. If the measured backlash is deviated, it is necessary to adjust the backlash.

- 1) Drain lubrication oil from the tilting axis lubrication oil drain port (See outline drawing).
- 2) Slightly loosen four mounting bolts ③ which fix the motor.
- 3) Insert a rod ① (approximately $\phi 5$, a bar wrench may also be used) in the hole located above the motor and operate it to lower the motor position until the backlash becomes zero (0) approximately.
- 4) Insert a rod ② (approximately $\phi 5$, a bar wrench may also be used) in the hole located below the motor and operate it to move the motor until the backlash falls within the adequate range (0.02 mm - 0.04 mm). At this time, check the motor movement with the dial gauge attached to the motor side.
- 5) Tighten four mounting bolts ③ that loosened slightly.
- 6) After adjusting, run the motor from slow speed to high speed to check that abnormal noise does not occur.



When mounting the motor, take care so that O-ring ④ will not be damaged.

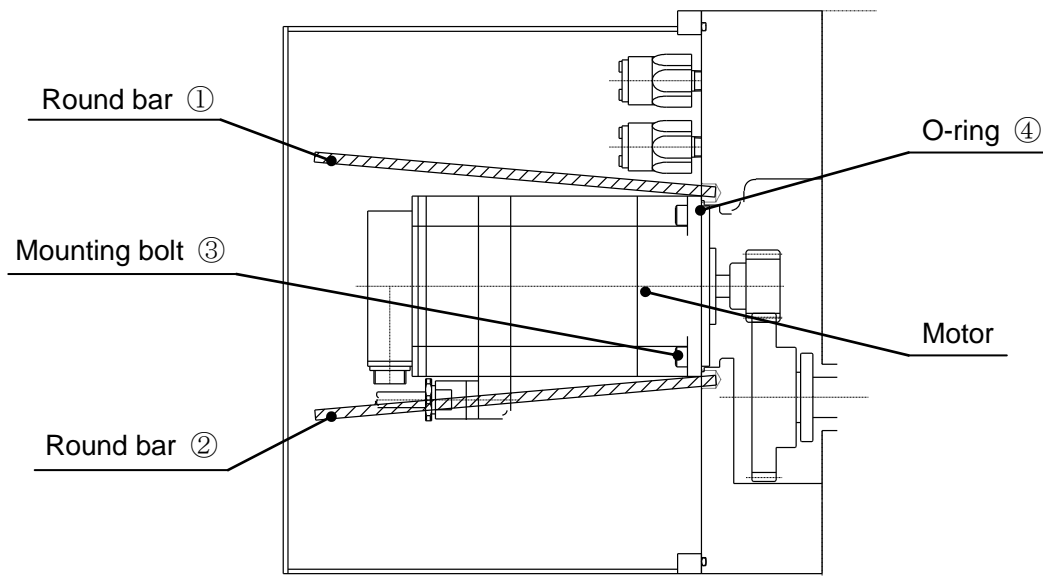


Fig.11

13. Machine zero point setting

For the NC rotary table with the additional axis but without our controller and the dog type zero point return specification, it is necessary to set the machine zero point to the machine as the machining reference point of the rotary table.

When setting the machine zero point, move the NC rotary table to the position where the machine zero point will be set. Then set the position as the machine zero point using the CNC parameters.

For the machine zero point setting procedure using the parameters, refer to our Controller Instruction Manual (in the section of zero point setting procedure) or the instruction manual for the machine on which the rotary table is installed.

NOTICE

Basically, machine zero point should be set at the installation of the NC rotary table. So it does not need to be set under normal conditions of use. However, it must be reset in the following cases.

- ◇When the encoder cable of the rotary table is removed from the machine or controller.
- ◇When the encoder backup battery on the machine side or controller runs down.
- ◇When the servo motor, encoder, or encoder cable is replaced or repaired.

13-1. Dog type zero point return device (OPTION)

NOTICE

(OPTION)

The contents of this section is applicable to the NC rotary table with the dog type zero point return specification.

13-1-1. Rotating axis ZRN (Zero Return) device (See Fig.12-1)

The dog for ZRN deceleration is mounted inside of table and it can be mounted on the circumferential position (angle).

When a zero position is changed or return rotation direction is changed to the other direction, since it is necessary to change the dog position, the following procedure is recommended for adjustment.

- 1) Drain lubrication oil from the tilting axis lubrication oil drain port (See outside view).
- 2) Remove covers ① and ④.
- 3) When the cover ① is removed, since a dog adjusting hole is found, rotate the table with the manual pulse generator or Manual axis feed key to the place where the dog can be found.
- 4) Loosen set screws ③ which fix the dog ②.
- 5) Move the dog ② to the proper position.
- 6) After adjusting the dog position, tighten set screws ③ securely.



CAUTION

When mounting the cover again after adjusting the dog position, take care so that O-ring is not damaged.

The proximity switch is used as the dog detecting sensor. The gap between the dog and the proximity switch is set to about 0.75mm. (Thread pitch for mounting the proximity switch is 1mm.) The proximity switch with a lamp is used. When the dog is detected, since the lamp goes off, use the proximity switch as a target when the dog position is adjusted.

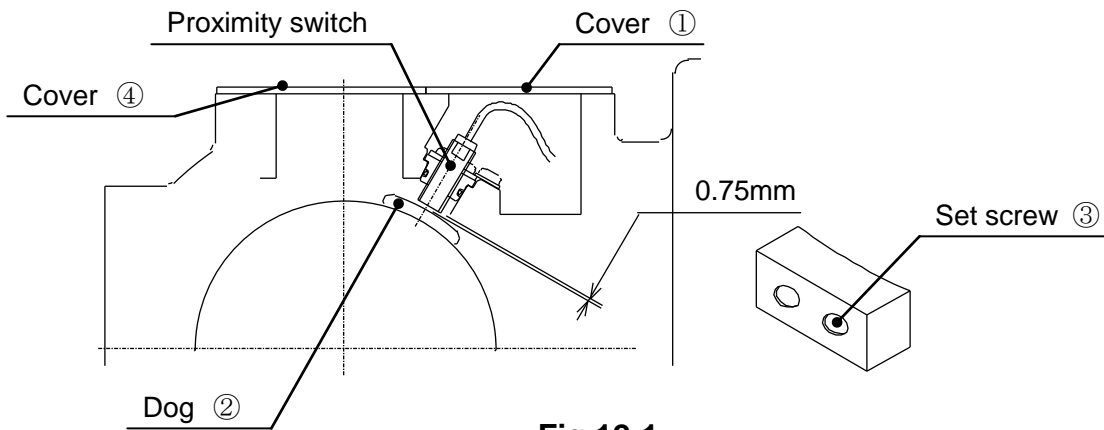


Fig.12-1

13-1-2. Tilting axis ZRN device (See Fig.12-2)

- 1) The ZRN deceleration dog and the proximity switch are contained into the rotating axis motor case.
- 2) In the standard specification, the horizontal table face position is regarded as an origin. The proximity switch ② detects dog ①.

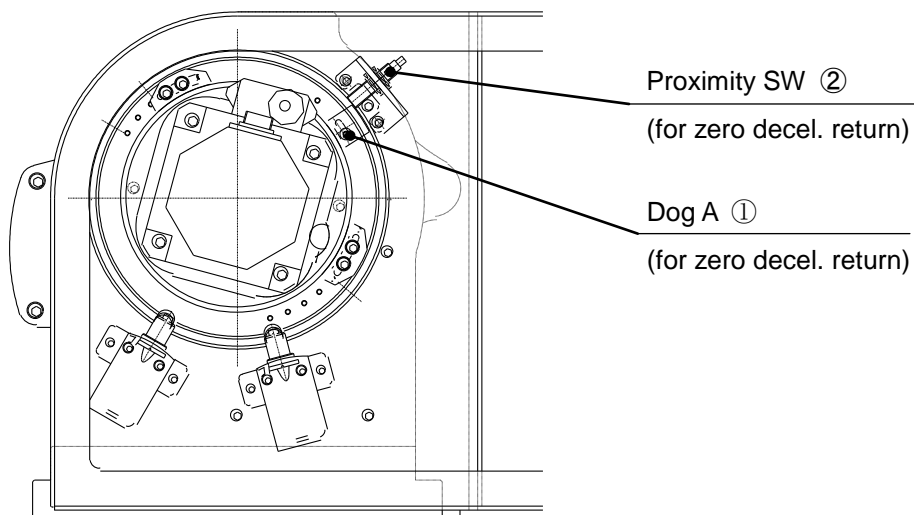


Fig.12-2

14. Tilting Axis Over Travel Stop Device (See Fig.13)

14-1. Tilting axis over travel stop device

- 1) Remove the cover on the motor case side.
- 2) The dog and the limit switch of emergency stop for the tilting axis stroke limit are contained into the rotating axis motor case.
- 3) The limit switch A ③ detects dog A ① of stroke limit on the horizontal table face position side.
- 4) The limit switch B ④ detects dog B ② of stroke limit on the vertical table face position side.
- 5) The angle until the emergency stop mode is applied to the machine from the horizontal table face is about 35°. The angle until the emergency stop mode is applied to the machine from the vertical table face is about 20° .



The angle values of 35° or more from the horizontal table face and 20° or more from the vertical table face cannot be set.



The angle may be limited within a standard value in advance by customer conditions or to prevent the interference with the jig, workpiece, etc. In this case, it cannot be set more than the limited angle.

14-2. Adjusting methods of dog for vertical over-travel

- 1) When the customer will change position of dog A ① according to the shape of workpiece and jig, loosen hexagon socket head cap screw which fix the dog A ①. Once remove the dog A ①.
- 2) Rotate the tilting axis to the tilting angle to be set in the minus direction with the manual pulse generator or the Manual axis feed key, checking that it does not interfere with the jig or workpiece.
- 3) After rotating the rotary table to the desired tilting angle, slightly tighten hexagon socket head cap screws which fix the dog A ①.
- 4) Slide the dog A ① in the reverse direction clockwise (CW) before fixing until the over-travel alarm lamp lights. Tighten hexagon socket head cap screw that loosened slightly.
- 5) After fixing the dog A ①, rotate the tilting axis again with the manual pulse generator or the Manual axis feed key and check that the tilting axis stops at the desired tilting angle position and alarm lamp lights.
- 6) After adjusting, mount the side cover of motor case on the rotating axis side.



When mounting the cover, coat the cover with liquid packing (liquid gasket 1216 made by THREE BOND) evenly.

14-3. Adjusting methods of dog for horizontal over-travel

- 1) When the customer will change position of dog B ② according to the shape of workpiece and jig, loosen hexagon socket head cap screw which fix the dog B ②. Once remove the dog B ②.
- 2) Rotate the tilting axis to the tilting angle to be set in the plus direction with the manual pulse generator or the Manual axis feed key, checking that it does not interfere with the jig or workpiece.
- 3) After rotating the rotary table to the desired tilting angle, slightly tighten hexagon socket head cap screws which fix the dog B ②.
- 4) Slide the dog B ② in the reverse direction counterclockwise (CCW) before fixing until the over-travel alarm lamp lights. Tighten hexagon socket head cap screw that loosened slightly.
- 5) After fixing the dog B ②, rotate the tilting axis again with the manual pulse generator or the Manual axis feed key and check that the tilting axis stops at the desired tilting angle position and alarm lamp lights.
- 6) After adjusting, mount the side cover of motor case on the rotating axis side.



When mounting the cover, coat the cover with liquid packing (liquid gasket 1216 made by THREE BOND) evenly.

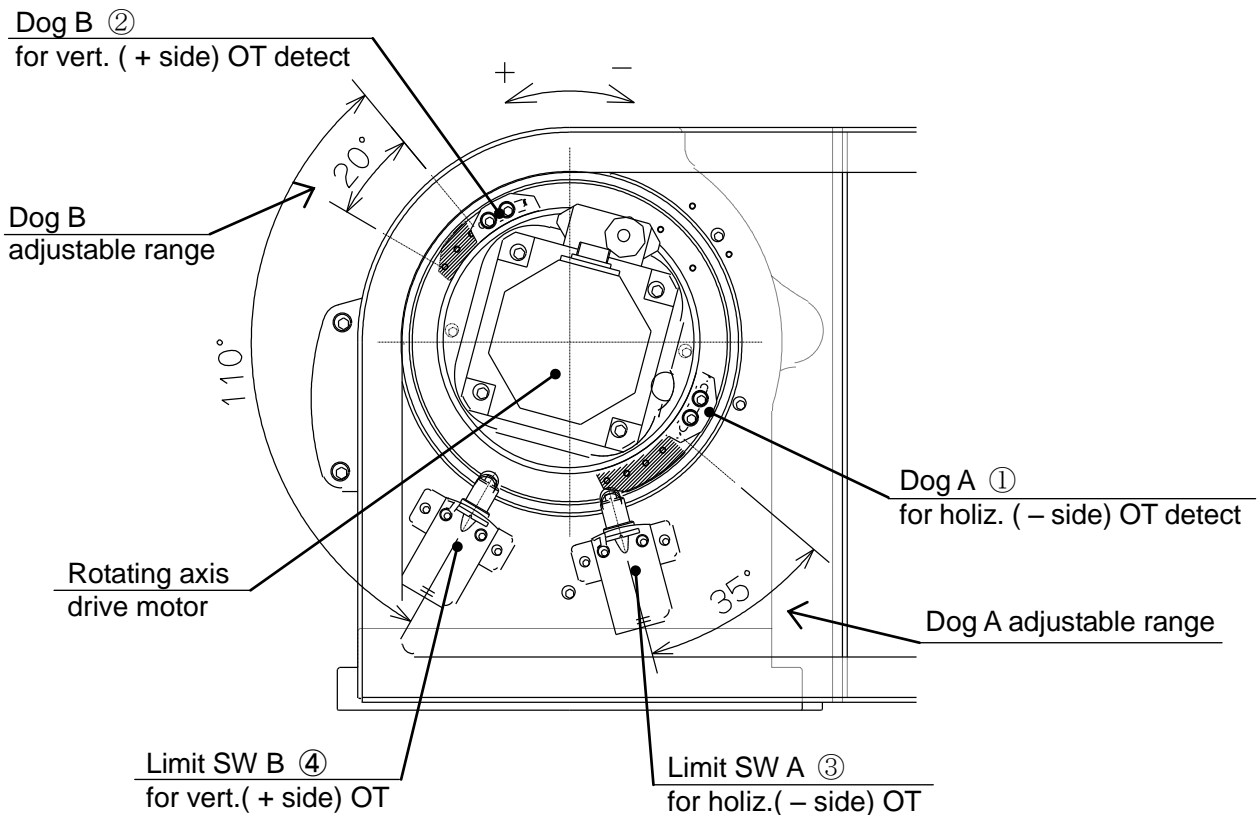


Fig.13

15. Motor Case

15-1. To remove motor case (See Fig.14)

When removing the motor case of tilting axis for maintenance, etc., the following procedure is recommended.

- 1) Remove the covers ② and ③ of motor case ① and disconnect wiring cables from electric apparatuses of motor and solenoid valves, etc. and also, remove three piping of red, blue and black connected to the connector plate ④. (For piping, refer to the piping diagram of item 23.)
- 2) Loosen hexagon socket head cap screws ⑤ which fix the motor case ① and remove the motor case slowly with the motor case ① raised.



CAUTION

Connect the air hose correctly and take care so as not to bend it.

15-2. Countermeasures for waterproof

To prevent the motor from coolant penetration, O-rings are used to the mounting faces on the motor case ① and the connector plate ④, and also, liquid packing (1216 made by THREE BOND) are used on connection parts among the motor case ① and covers ②, ③.



CAUTION

When reassembling the motor case ① and connector plate ④, take extreme care so that the O-rings will not be damaged. If the O-rings are damaged, coolant may enter into the motor case.

When reassembling the covers, coat connection parts with liquid packing.

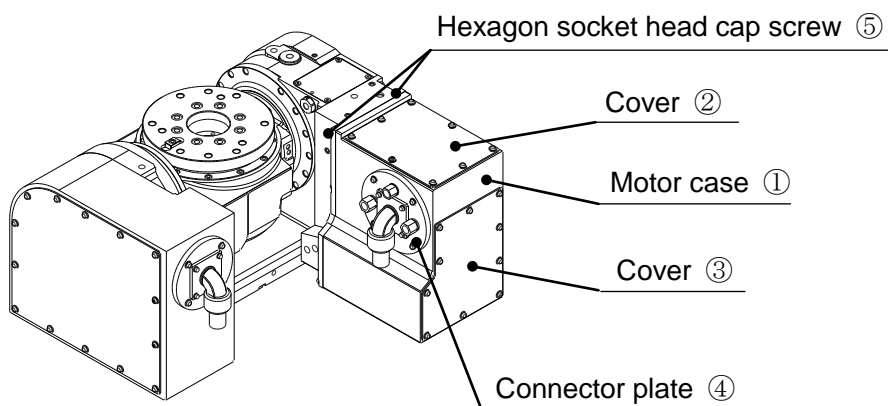


Fig.14

16. Motor

16-1. Tilting axis drive motor

16-1-1. To remove motor

When replacing the motor, remove the motor according to the following procedure. (See Fig.15)

- 1) Drain lubrication oil from the lub. oil drain port of gear box. (See the outside view.)
- 2) Remove the motor case according to item 15-1.
- 3) Remove hexagon socket head cap screws ⑤ which fix the motor ④.
- 4) Remove the motor ④ slowly, raising it.

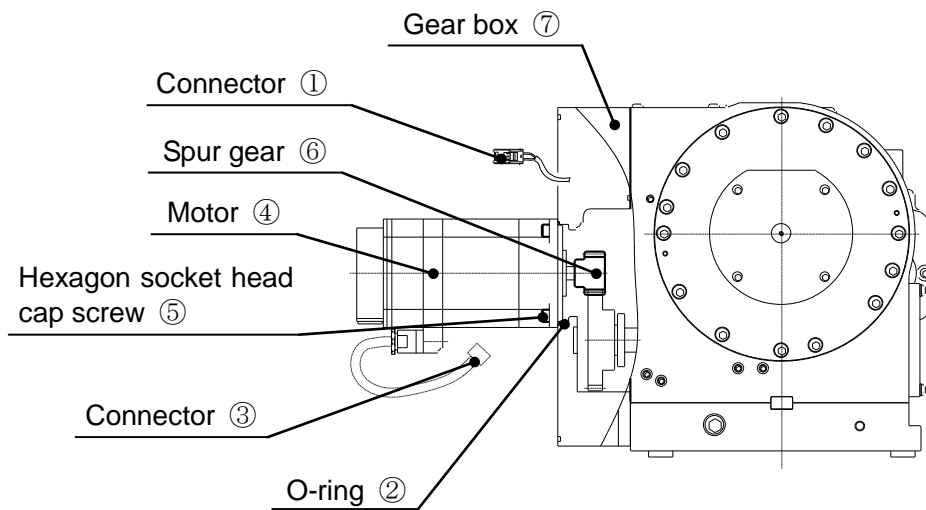


Fig.15

16-1-2. To disassemble motor

- 1) Clean mounting faces (gear box ⑦ and motor ④) and O-ring grooves.
- 2) Mount the O-ring ② and mount the motor ④ by the reverse procedure as the above removing.
- 3) After mounting the motor, adjust the backlash of spur gears ⑥ according to item 12.



Mount the motor to the spur gear ⑥ carefully after cleaning so that the spur gears are not damaged.



When mounting the motor ④, take extreme care so that O-ring ② is not damaged because lubrication oil may enter into the motor case.



Connect the connector ① according to item 17-2. Connect the connector ③ securely so that the pin does not cause contact failure, and also cables are not bent or crushed.

16-2. Rotating axis drive motor

16-2-1. To remove drive motor

When replacing the motor, remove the motor according to the following procedure. (See Fig.16)

- 1) Drain lubrication oil from the rotating axis lub. oil drain port. (See the outline drawing.)
- 2) Remove the cover ⑦.
- 3) Remove hexagon socket head cap screws ⑤ which fix the motor ④.
- 4) Remove the motor ④ slowly, raising it.

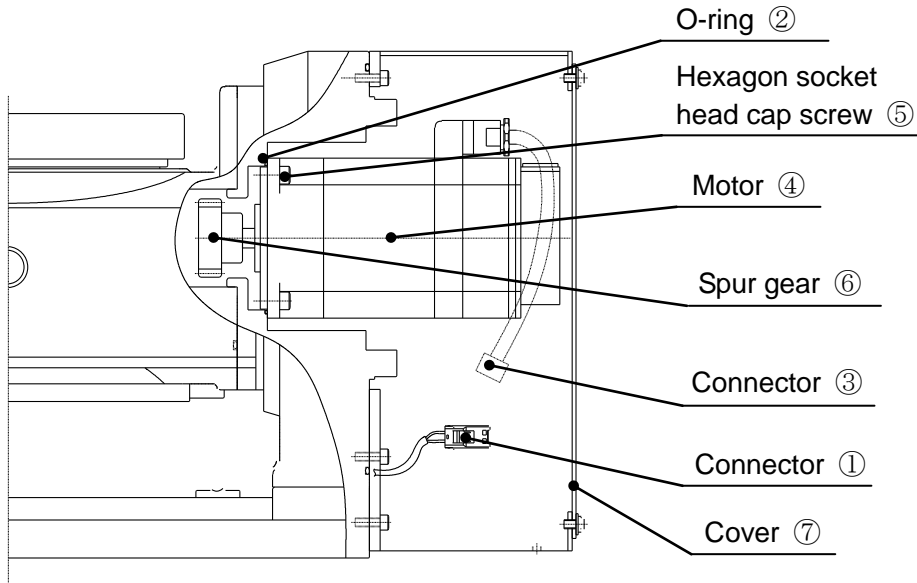


Fig.16

16-2-2. To mount drive motor

- 1) Clean mounting face (motor ④) and O-ring groove.
- 2) Mount the O-ring ② and mount the motor ④ by the reverse procedure as the above removing.
- 3) After mounting the motor, adjust the backlash of spur gears ⑥ according to item 12.



Mount the motor to the spur gear ⑥ carefully after cleaning so that the spur gears are not damaged.



When mounting the motor ④, take extreme care so that O-ring ② is not damaged because lubrication oil may enter into the motor case.



Connect the connector ① according to item 17-2. Connect the connector ③ securely so that the pin does not cause contact failure, and also cables are not bent or crushed.

16-3. To mount spur gears

The mounting method of spur gears varies by the motor shaft and flange diameter. The following procedure is recommended to mount the spur gears by three-method mainly used.

○Taper shaft

- 1) Wipe up dust adhered on the taper shaft surface and inside of spur gears.
- 2) Attach the key to the shaft before mounting the spur gear.
- 3) Attach the washer and tighten the nut securely.

○Straight shaft (with key)

- 1) Wipe up dust adhered on the straight shaft surface and inside of spur gears.
- 2) Attach the key to the shaft.
- 3) Fix the spur gear and washer securely.
- 4) Mount the spur gear with the washer to the shaft securely by using the bolt.

○Straight shaft (locking element spec.)

- 1) Wipe up dust adhered on the straight shaft surface and inside of spur gears and coat them with oil or grease. However, do not use lubricate of silicon system or molybdenum system, or oil and grease including an extreme-pressure additive agent.
- 2) Insert the washer, locking element, spacer and spur gear in order.
- 3) At this time, attach the locking element (Generic name for inner ring and outer ring) so as to pressurize the inner ring.
- 4) Tighten bolts on each diagonal line equally in order so that the end face of spur gear and the flange end face of motor become parallel.
- 5) Tighten the bolts until washers do not move in an axial direction. After that, adjust the mounting position of spur gear.
- 6) Attach the dial gauge to the end face of spur gear and tighten bolts equally. Rotate the spur gears and also, tighten each bolt until the run out of dial gauge becomes 0.01mm or less.
- 7) Check that the spur gears are fixed to the shaft securely.

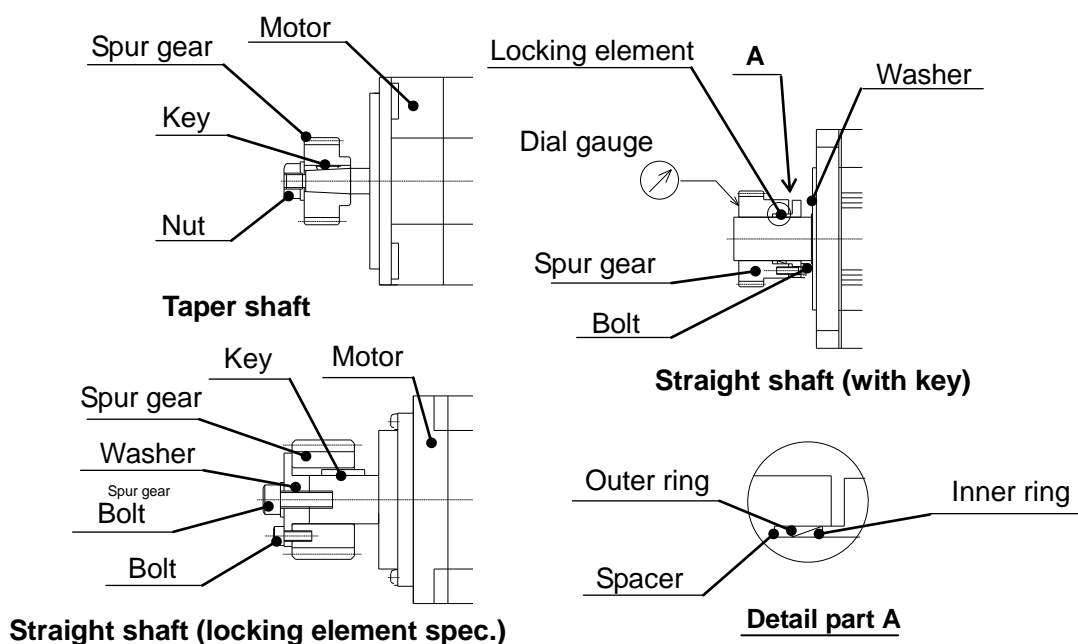


Fig.17

17. Connector

When removing connectors (made by MOLEX) such as proximity switches, etc., unavoidably in motor case removing, the following procedure is recommended.

17-1. To remove connector

- 1) Pushing the claw ③ of receptacle housing, remove the plug housing ① and receptacle housing ②.



Do not apply any load to cables.

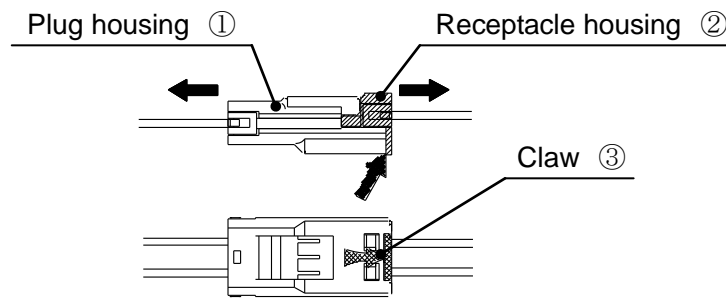


Fig.18

17-2. To mount connector

- 1) Mate the plug housing ① to the receptacle housing ② as shown in the following figure.
- 2) Insert the receptacle housing ② into the plug housing ① securely until a clicking noise occurs.
- 3) After mounting, pull the receptacle housing ② slightly and check that it does not draw out.



Check that connectors and cables are not damaged before connecting.



Connect cables so as not to be bent or crushed.



Do not apply any load to cables.

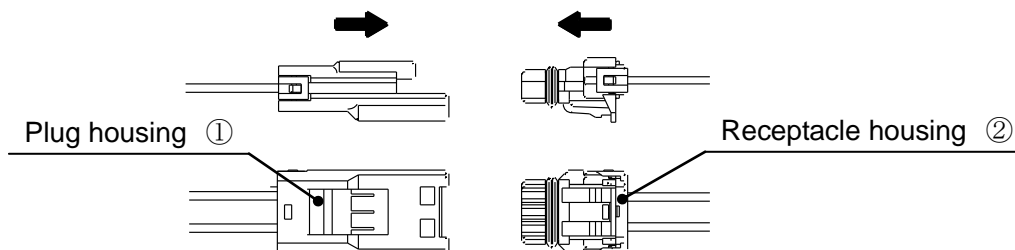
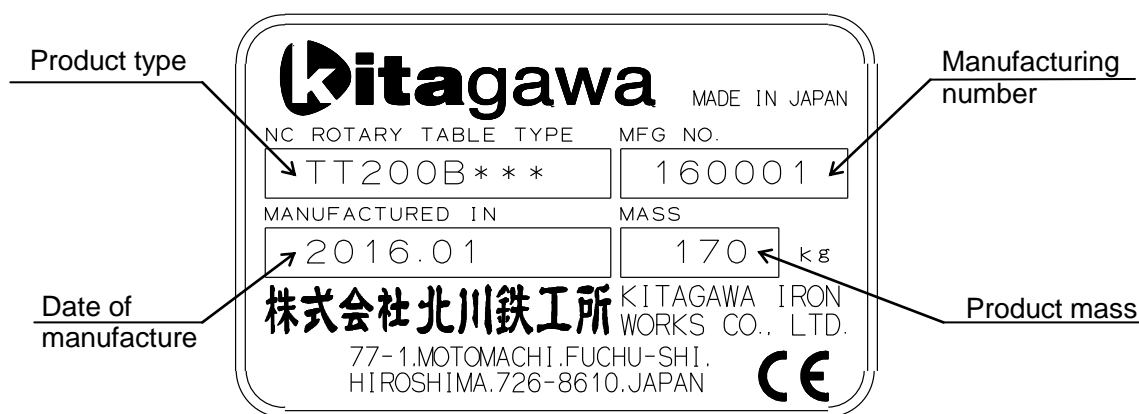


Fig.19

18. Troubleshooting

Check corresponding item given in this chapter to take corrective actions when the unit seems to be faulty. If the fault persists, please contact your sales agent (M/C maker) or us. When making an inquiry, let us know the product type and manufacturing number marked on the nameplate of the NC rotary table body.



Nameplate

Symptom ①: Table does not rotate

Possible causes	Corrective actions
No cable connection between NC rotary table and control unit	Check the cable for connection, and connect it
Broken cable between NC rotary table and control unit	Check the cable for continuity, and replace it
Faulty clamp device	See "Symptom ⑤"
Decentered workpiece, overloaded fixture, and friction torque of steady rest and rotary joint make the load torque larger than the motor torque	Compare the specification of NC rotary table with the work condition to make improvement
Use of unit out of specified temperature range	Adjust ambient temperature within specified temperature range

Symptom ②: Table does not rotate but generates a noise

Possible causes	Corrective actions
Motor makes a howling sound to try to rotate →Seizure of gears due to lack or deterioration of lubricating oil	Stop the use of NC rotary table immediately. Please contact the sales agent.
Gears generate a noise →Faulty rotation due to damaged gears	Stop the use of NC rotary table immediately. Please contact the sales agent.
Unit generates a noise at startup and stops soon →Faulty rotation because foreign substances mix in the oil bath	Supply lubricating oil until foreign substances come out of the drain port.

Symptom ③: Table does not rotate smoothly but generates a noise

Possible causes	Corrective actions
Noise is generated repeatedly during rotation →Gears are damaged	Stop the use of NC rotary table immediately. Please contact the sales agent.
→Faulty rotation of gears because foreign substances mix in the oil bath	Open the lubricating oil drain port, and supply lubricating oil until foreign substances come out of the drain port.
Load due to overloading exceeds motor output	Compare the specification of NC rotary table with the work condition to make improvement
Lack or deterioration of lubricating oil blocks smooth rotation	Check oil level, viscosity and change interval of lubricating oil
Faulty clamp device	See "Symptom ⑤"
Inappropriate backlash amount	Adjust backlash amount to appropriate value

Symptom ④: Chattering occurs during cutting

Possible causes	Corrective actions
Inappropriate clamp condition of NC rotary table or fixture	Check the clamp condition, and correct it
Excess cutting force is applied during cutting	Adjust cutting condition to the specified condition to change the cutting force to appropriate value
Faulty clamp device	See "Symptom ⑤"
Faulty locking of worm spindle in the backlash adjustment	Readjust
Fault due to damaged NC rotary table or expired life of components	Stop the use of NC rotary table immediately. Please contact the sales agent.
Fault occurs only during continuous cutting →Lack or deterioration of lubricating oil blocks smooth rotation →Inappropriate backlash amount	Check oil level, viscosity and date of last change of lubricating oil Adjust backlash amount to appropriate value
Chips accumulate in rotary part of NC rotary table	Remove accumulated chips in daily inspection

Symptom ⑤: Table is not clamped or unclamped

Possible causes	Corrective actions
Faulty solenoid valve	Replace the solenoid valve
Faulty clamp/unclamp confirming device (pressure switch)	Check and replace the clamp/unclamp confirming device (pressure switch)
Damage or connection failure of working fluid pipe for clamp	Check the piping for connection, and replace
Supply pressure of working fluid for clamp is lower than specified value	Change to appropriate value according to the specification
Back pressure acts to the air pressure exhaust port of solenoid valve, as the air purge port in the motor case is blocked.	Remove the cause that blocks the air purge port.
Faulty clamp device	Stop the use of NC rotary table immediately. Please contact the sales agent.
Fault due to damaged NC rotary table or expired life of components	Stop the use of NC rotary table immediately. Please contact the sales agent.

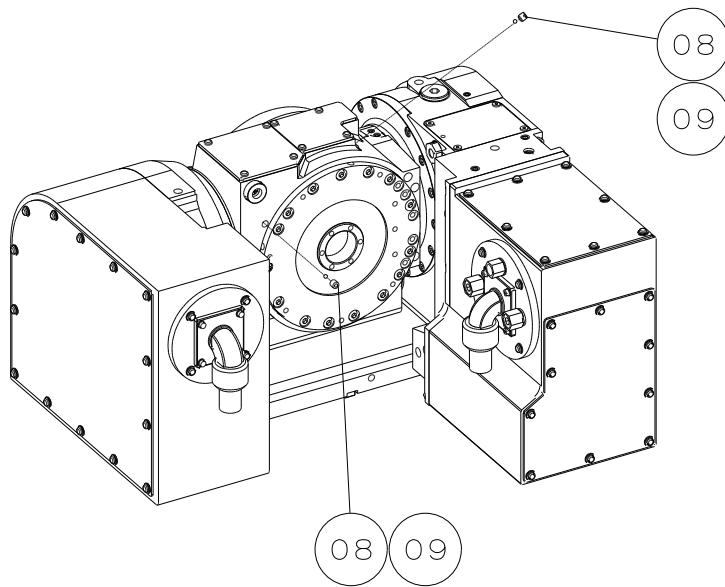
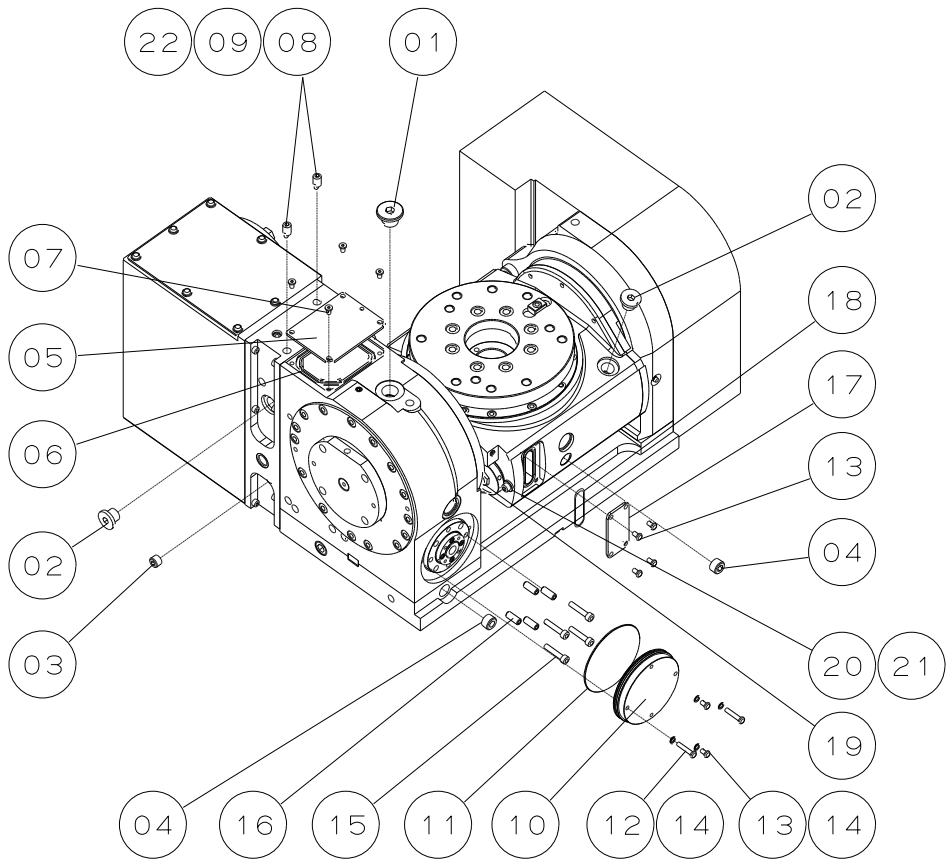
Symptom ⑥: Index accuracy error

Possible causes	Corrective actions
The unit is overloaded during rotation	Compare NC rotary table specification with work condition to make improvement
Workpiece is dislocated due to low clamp torque	Compare NC rotary table specification with cutting condition to make improvement
Zero return position is dislocated due to faulty zero point shift adjustment	Check the zero point and zero point shift amount
Faulty zero point dog position adjustment	Adjust the zero point dog
Faulty zero return deceleration signal device	Check the zero return deceleration signal device and replace the proximity switch
Faulty clamp operation	See “Symptom ⑤”
Inappropriate backlash amount	Adjust the backlash
Inappropriate backlash compensation amount	Change the backlash compensation amount
Worm shaft locking failure in backlash adjustment	Readjust
Fault due to damaged NC rotary table or expired life of components	Stop the use of NC rotary table immediately. Please contact the sales agent.

19. Parts List

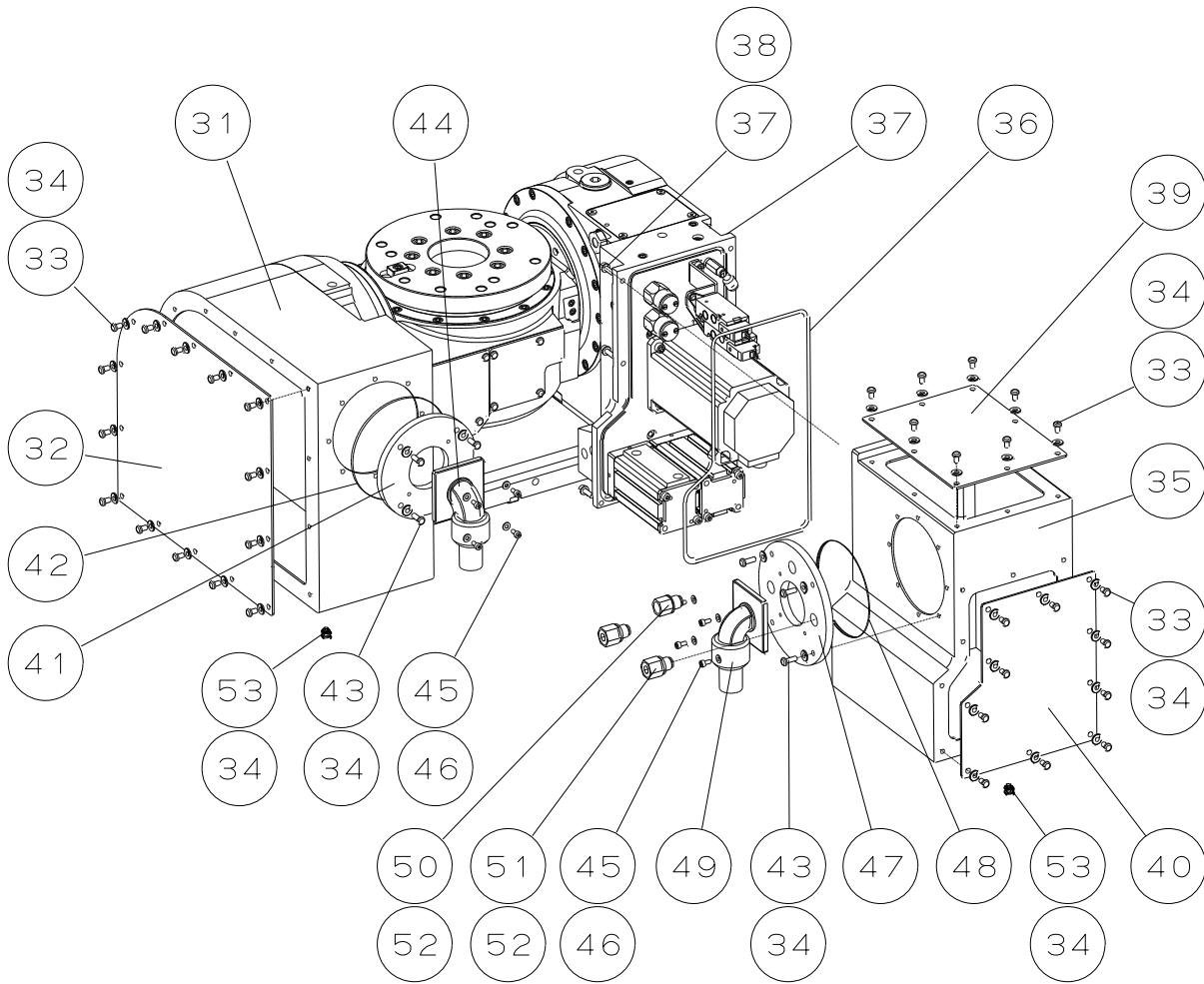
○ Main Body

MARK	NAME	TT200	Q'ty	Recital
01	Hexagon socket flange head screw plug with O-Ring	M20x1.5	1	Gosho
02	Hexagon socket flange head screw plug with O-Ring	M16x1.5	2	
03	Hexagon socket headless tapered pipe plug	Rc1/4	2	
04	Hexagon socket headless tapered pipe plug	Rc3/8	1	
05	Cover (1)		1	
06	O-Ring	G80	1	
07	Hexagon socket head cap screw (Special low head)	SSH-M5x10	4	
08	Hexagon socket headless set screw (Flat Point)	M8x8	4	
09	Steel ball	6.3	4	
10	Cover (2)		1	
11	O-Ring	S90	1	
12	Machine screw	M5x25	2	
13	Machine screw	M5x8	6	
14	Seal washer	5S1	5	
15	Hexagon socket head cap screw	M6x30	4	
16	Hexagon socket headless set screw (Flat Point)	M8x20	4	
17	Cover (3)		1	
18	O-Ring	G40	1	
19	Plug	MPG14	1	Pisco
20	Hexagon socket head cap screw	M6x10	1	
21	Washer	WSSB15-6-2.5	1	
22	Different diameter elbow	NR-202	2	Musashi (Hydraulic)



○ Motor Case(For M Signal)

MARK	NAME	TT200	Q'ty	Recital
31	Motor case (1)		1	
32	Cover (1)		1	
33	Machine screw	M5x8	32	
34	Seal washer	5	40	(Booster)
			42	(Hydraulic)
35	Motor case (2)		1	
36	O-Ring	GS255	1	
37	Hexagon socket head cap screw	M5x16	6	
38	Washer	5	3	
39	Cover (2)		1	
40	Cover (3)		1	
41	Connector plate (1)		1	
42	O-Ring	S112	1	
43	Machine screw	M5x14	8	
44	Cable connector (1)		1	
45	Hexagon socket head cap screw	M4x8	8	
46	Washer	4	8	
47	Connector plate (2)		1	
48	O-Ring	S130	1	
49	Cable connector (2)		1	
50	Bulkhead connector	KQ2E06-02	1	SMC (Booster)
51	Bulkhead connector	KQ2E06-03	2	SMC (Booster)
		KQ2E06-01	1	SMC (Hydraulic)
52	Seal washer	14S1	3	(Booster)
			1	(Hydraulic)
53	Hexagon socket head cap screw (Special low head)	SSH-M5x8	2	(Hydraulic)

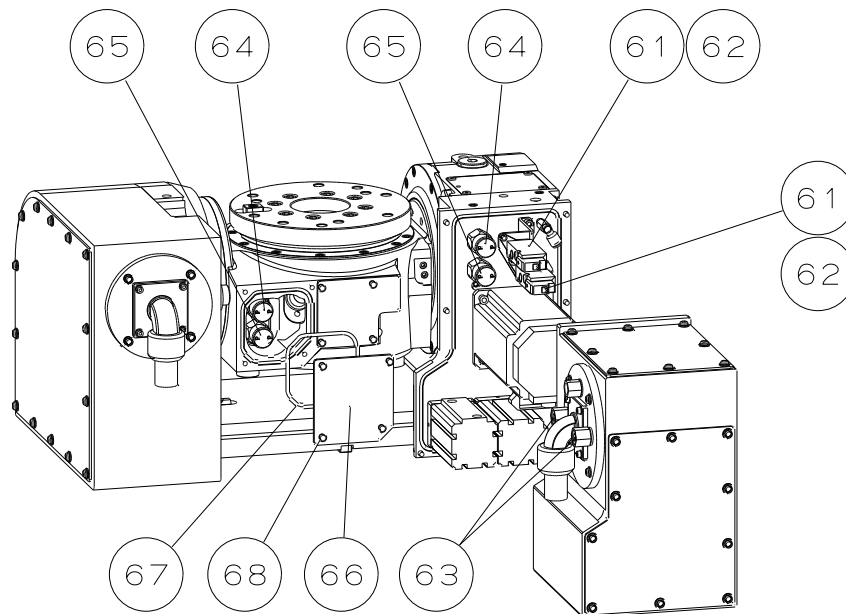


When the specification is 4th and 5th axes, the motor case and the cable are different from the above figure.

For detailed models, refer to attached outside view.

○ Clamp Detection Device

MARK	NAME	TT200	Q'ty	Recital
61	Solenoid valve	SYJ7120-5GS-01-F-Q	2	SMC (Booster)
62	Machine screw	M4x6	4	(Booster)
63	Plug silencer	PSA103	2	TAIYO (Booster)
64	Pressure switch for clamp detection	176 112 200	2	SKF
65	Pressure switch for unclamp detection	176 120 400	2	SKF
66	Cover		1	
67	Machine screw	M5x8	8	
68	O-Ring	G85	1	

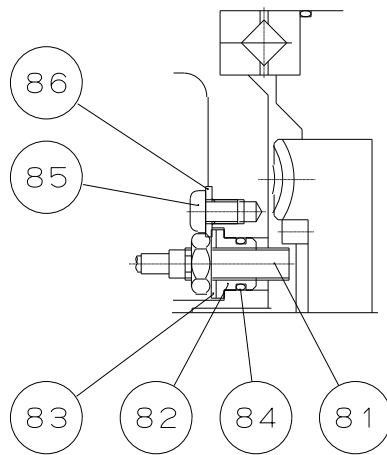
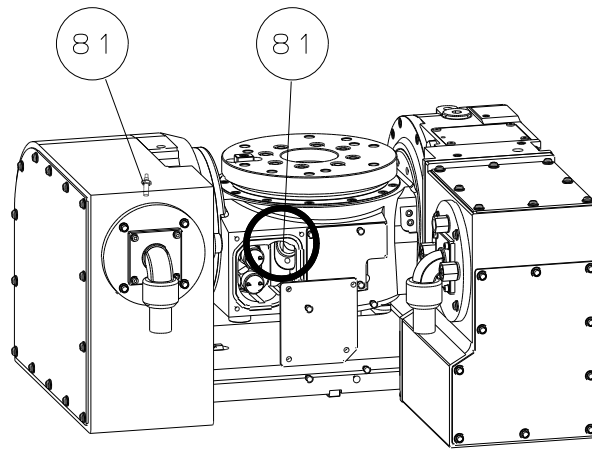


When the specification is different, the model and the installation position of the solenoid valve and the pressure switch are different from the above figure.

For detailed models, refer to attached wiring diagram.

○ Built-in ZRN (Zero Return) Device (OPTION)

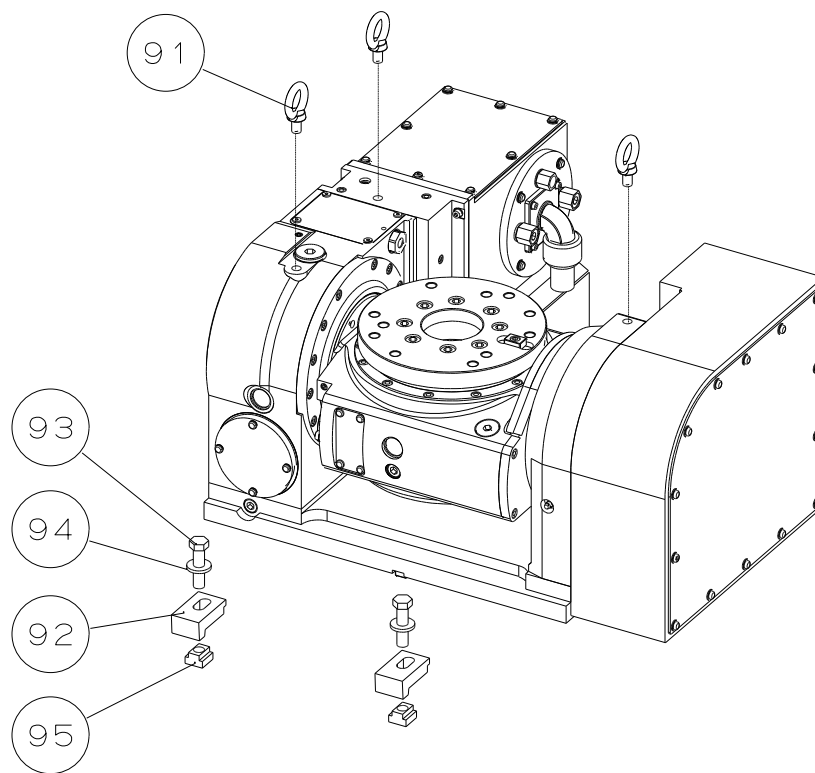
MARK	NAME	TT200	Q'ty	Recital
81	Proximity switch	FL7M-3K6H	2	Azbil
82	Holder for Proximity switch		1	
83	Seal washer	DT-1-12	1	Mitsubishi Cable
84	O-Ring	P16	1	
85	Machine screw	M6x8	1	
86	Washer	6	1	



No proximity switch is provided for the M signal type.

○ Accessory

MARK	NAME	TT200	Q'ty	Recital
91	Eye bolt	M10	3	
92	Clamp		4	
93	Hexagon head bolt	M16x65	4	Strength Dimension : 8.8
94	Washer	16	4	
95	T-slot nut	1816	4	



When the specification is different, the clamping parts and guide block are different from the above figure.
For detailed models, refer to attached outside view.

20. Storage

NOTICE

When storing NC rotary table after removing it from the machine tool, place it on the stable wooden base for maintaining accuracy after removing chips or coolant, etc. Coat the table with rust prevention oil and case or lap it with the wooden cover or vinyl cover, etc. When using the wooden base and box, avoid the wooden base and the green wood. Since the green wood is not chemically neutral, use the wood moistened with paraffin.

21. Disposal of NC Rotary Table

Dispose of this unit in accordance with the laws and regulations of your country.

You may suffer punishment if you disposed of this unit without following the laws and regulations.

22. Reference Data

22-1. Conversion of arc length and angle

NOTICE

“What is the linear length at the table circumference with 20 seconds cumulative indexing accuracy ?”

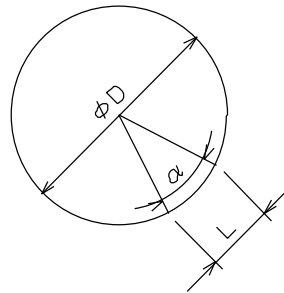
“What is the angle with a cumulative pitch error of 0.01mm ?”

To answer these questions, use the following formula representing the relationship between the angle and linear length at the table circumference.

D: Diameter of Workpiece (mm)

α : Angle (seconds)

L: Linear length at the table circumference (mm)



$$\frac{L}{\pi \times D} = \frac{\alpha}{360^\circ \times 60' \times 60''} \dots\dots\dots (1)$$

$$\alpha = \frac{360 \times 60 \times 60 \times L}{\pi \times D} = \frac{4.125 \times L \times 10^5}{D} \dots\dots\dots (2)$$

$$L = \frac{\alpha \times \pi \times D}{360 \times 60 \times 60} = 2.424 \times 10^{-6} \times \alpha \times D \dots\dots\dots (3)$$

(Examples)

Assuming the diameter of the workpiece is 100mm, and by using formula (3), the cumulative indexing accuracy of 20 seconds as linear length at table circumference will be :

$$L = 2.424 \times 20 \times 100 \times 10^{-6} = 0.004848mm$$

Therefore, the length is approximately 0.0048mm.

And converting the cumulative pitch error of 0.01mm to an angle, use formula (2):

$$\alpha = \frac{4.125 \times 0.01 \times 10^5}{100} = 41.25''$$

Therefore, the angle is approximately 41 seconds.

Thus, by using the formula (2) and (3), the indexing precision and pitch error can be converted in terms of linear length and angle.

22-2. Coordinate calculation of table center for tilting angle

When the coordinate of table center as the tilting axis is 0° (horizontal) is regarded as $X = 0, Z = 0$, the calculation formula finding the coordinate of table center when tilting axis is tilted θ° is shown as follows:

$$X = F \cos \theta - E \sin \theta - F$$

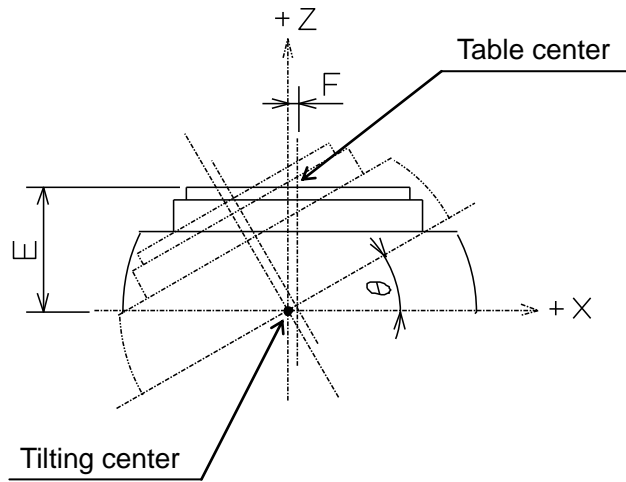
$$Z = E \cos \theta + F \sin \theta - E$$

<Example>

In case of $E=70, F=0$.

$$X = -70 \sin \theta$$

$$Z = 70 \cos \theta - 70$$



22-3. Workpiece interference area

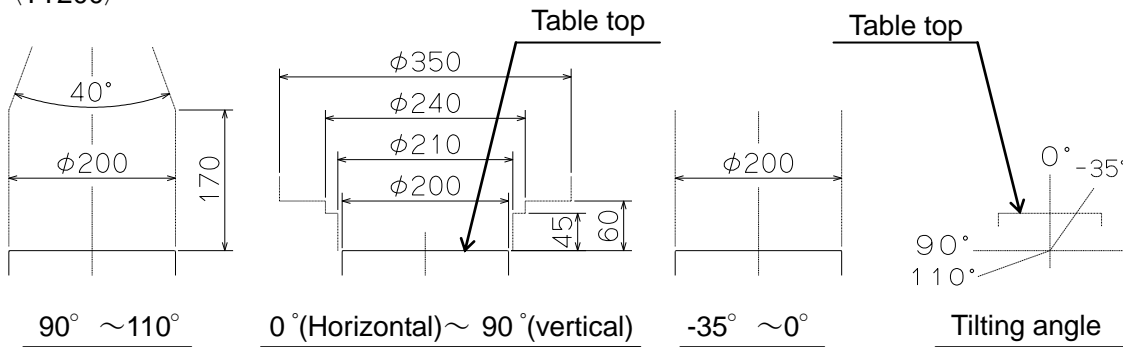
Since the following shows standard specifications, take care in case of special specifications. Interference with the clamp device is not considered.

Tilting range may be reduced due to fit the Jig or Chuck onto Face plate.

(Refer to the back of the Instruction Manual drawing and the outside view.)

Set a soft limit by the parameter to prevent interference at the customer.

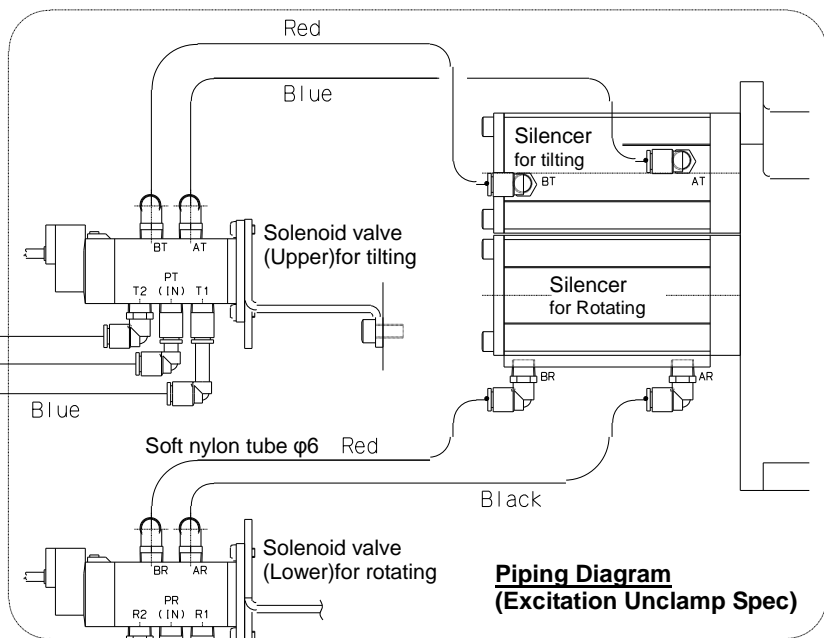
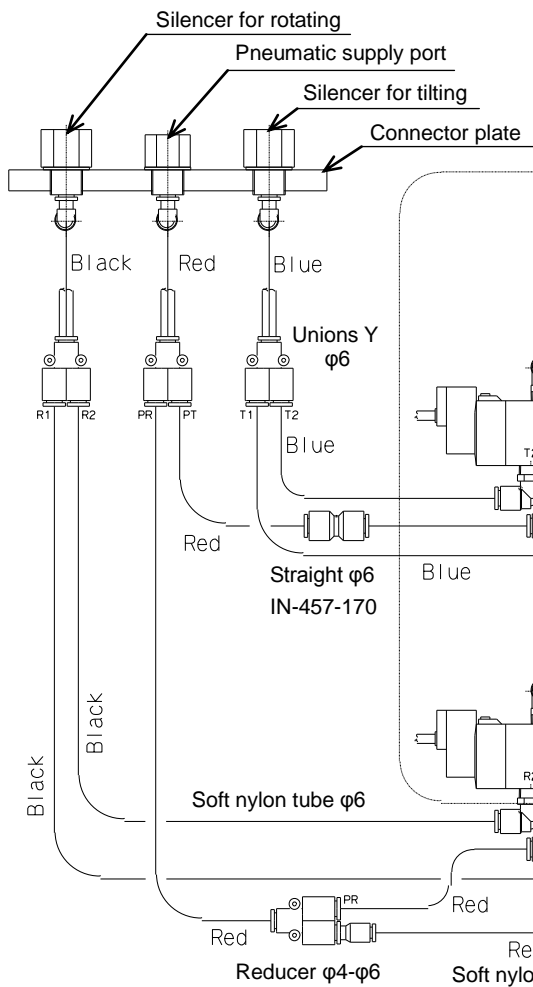
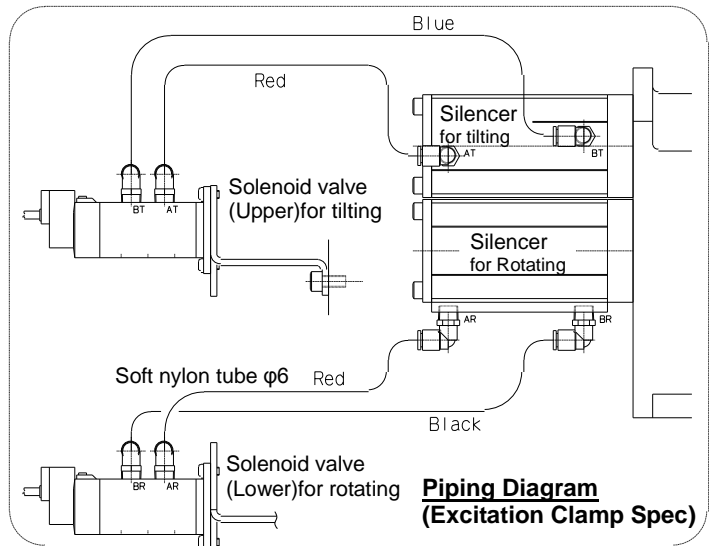
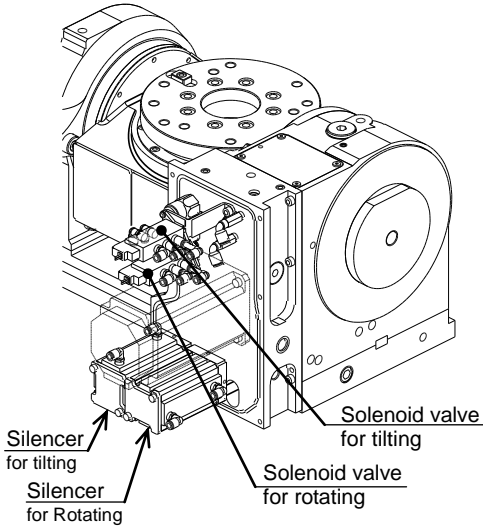
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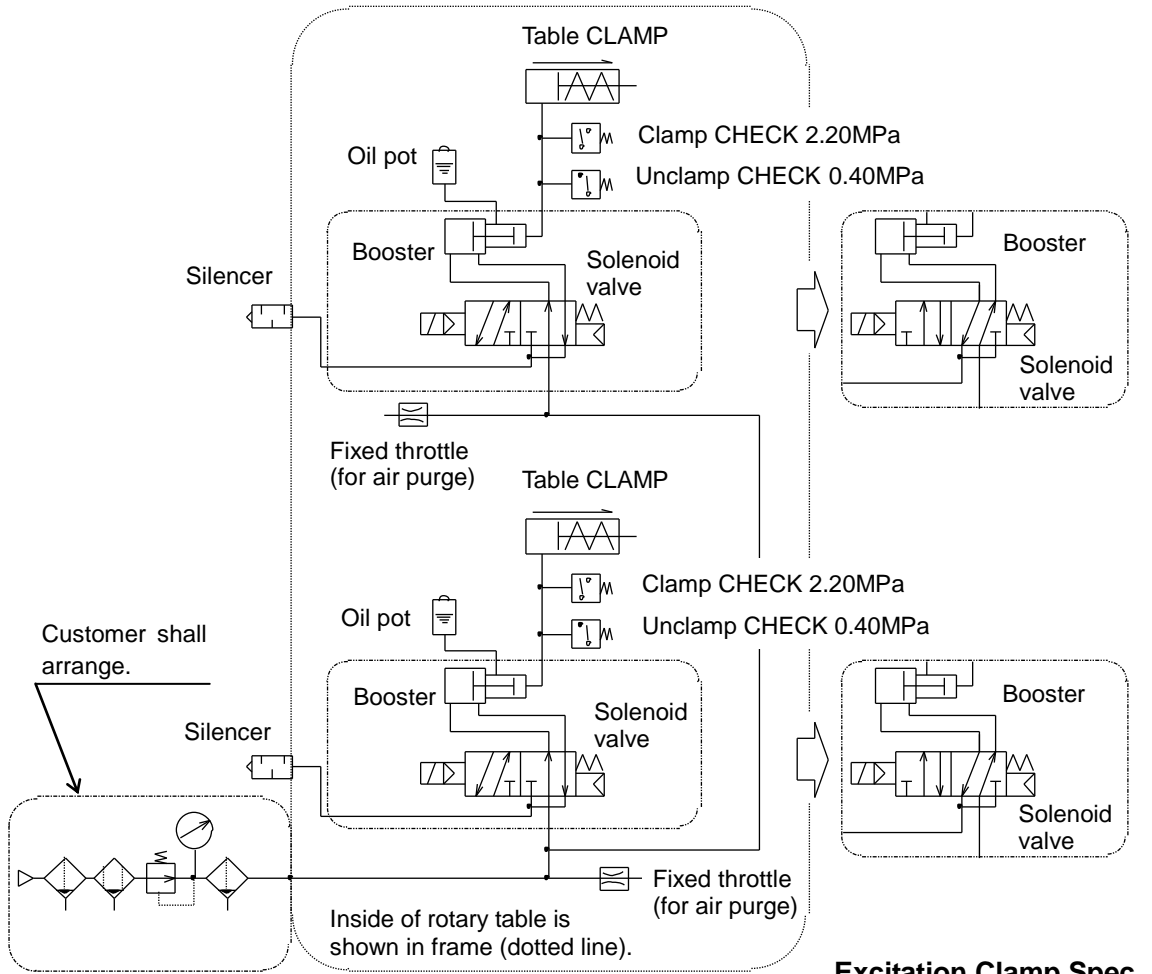
23. Piping Diagram on Air Hydraulic System

When removing the piping unavoidably to remove the motor case, refer to the following outside view and circuit diagram. For detailed models, refer to attached outside view.

23-1. Outside view of connection piping system



23-2. Pneumatic/hydraulic circuit diagram

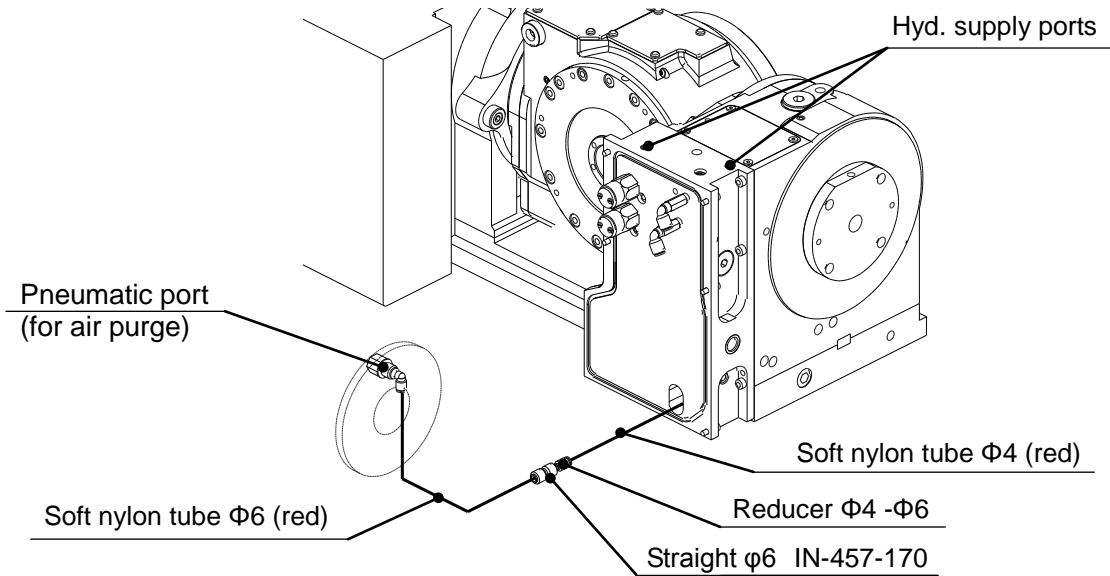


Air combination
(Air filter + Mist separator +
Regulator) + Drain catcher

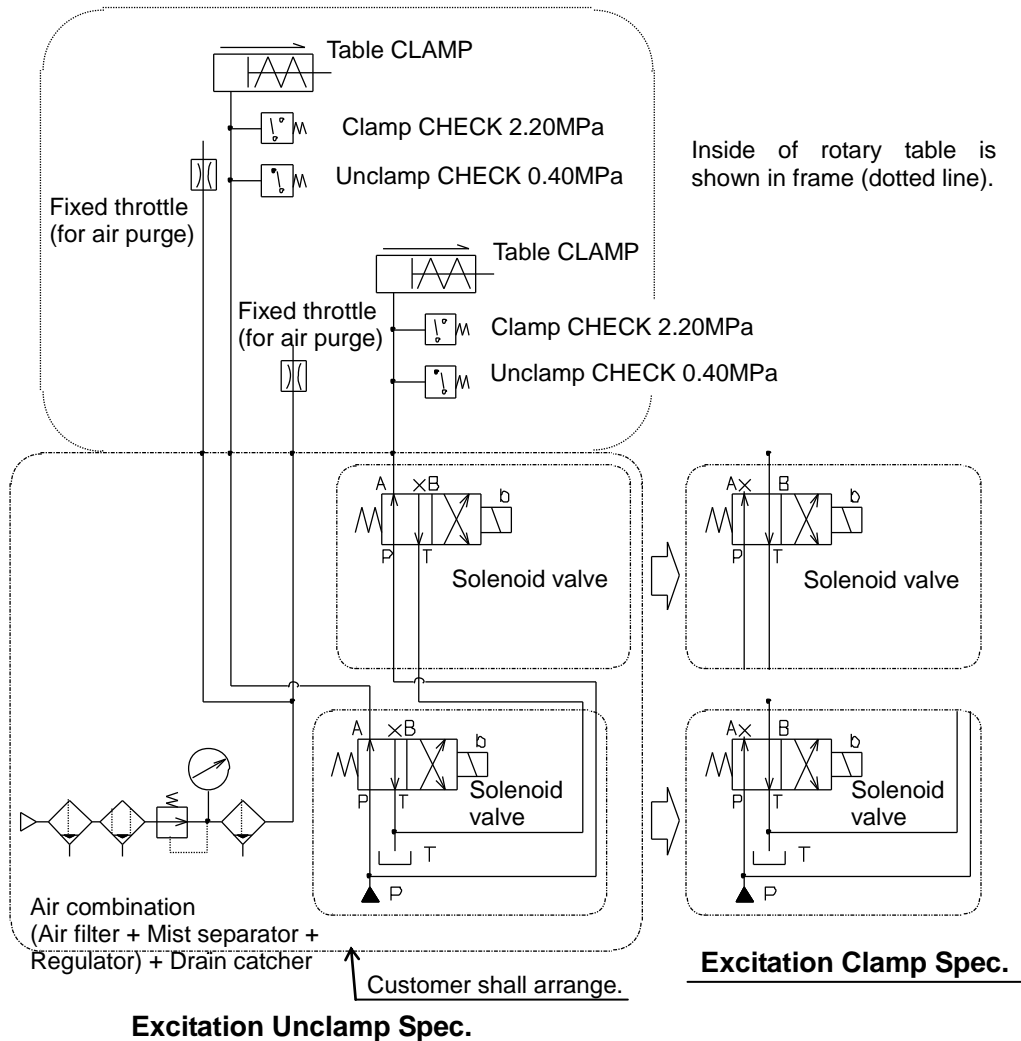
Excitation Unclamp Spec.

24. Piping Diagram on Hydraulic System

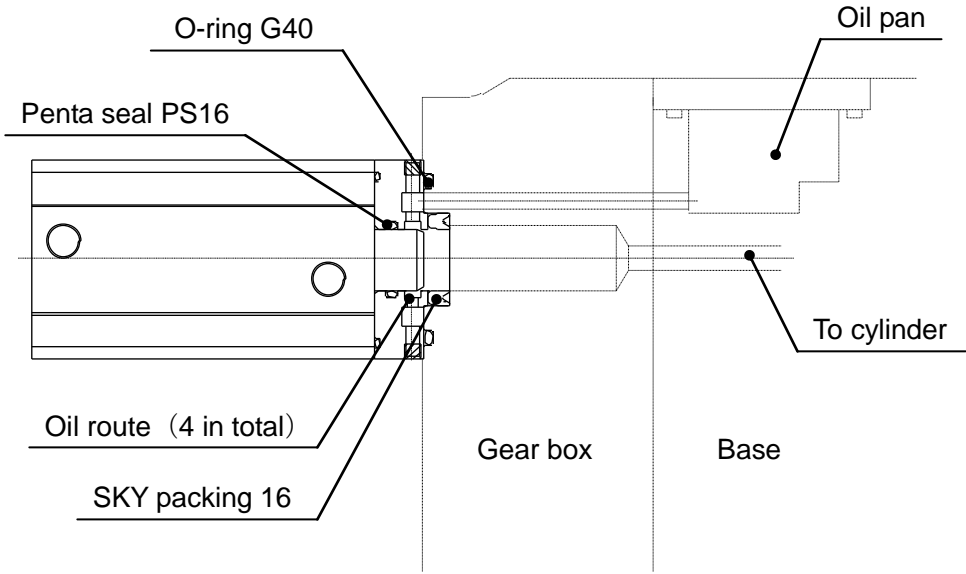
24-1. Outside view of connecting piping system



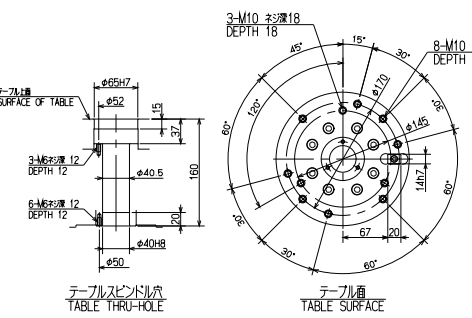
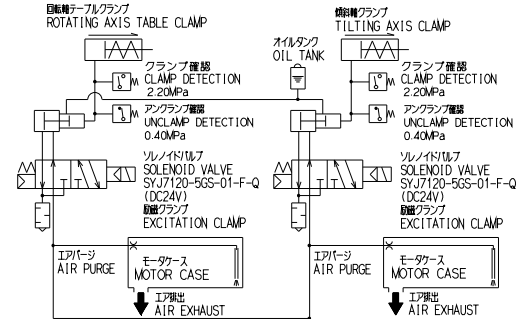
24-2. Hydraulic circuit diagram



25. Outside view of Air Hydraulic Part

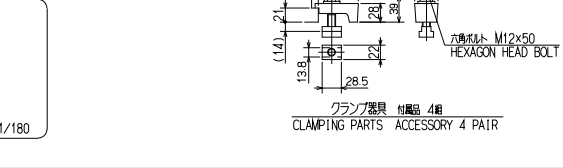
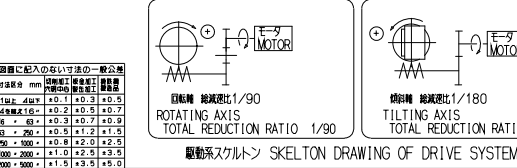
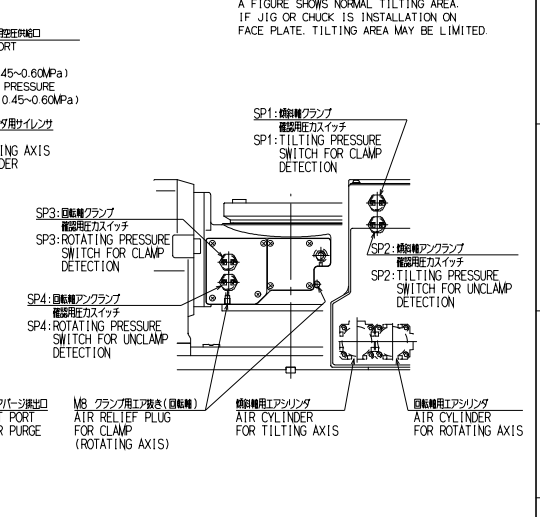
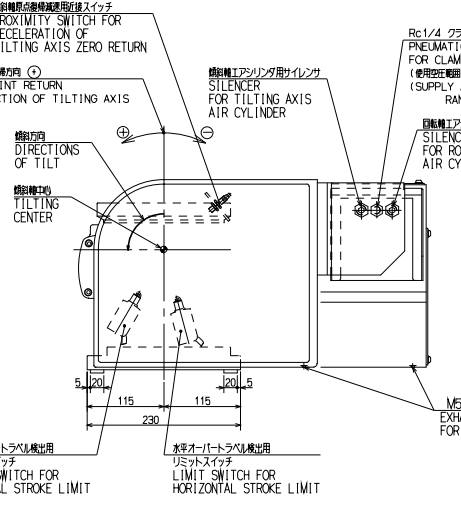
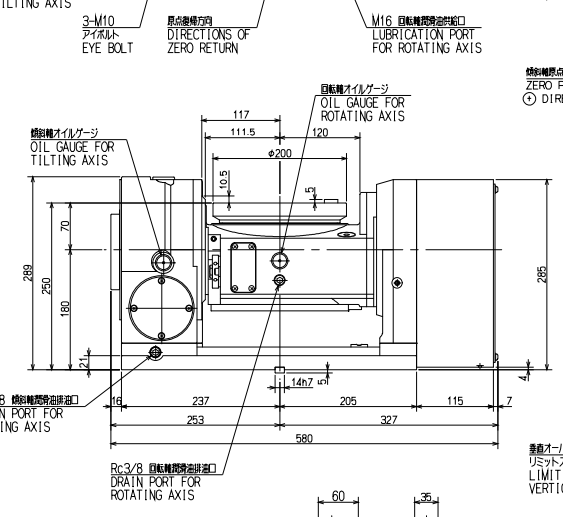
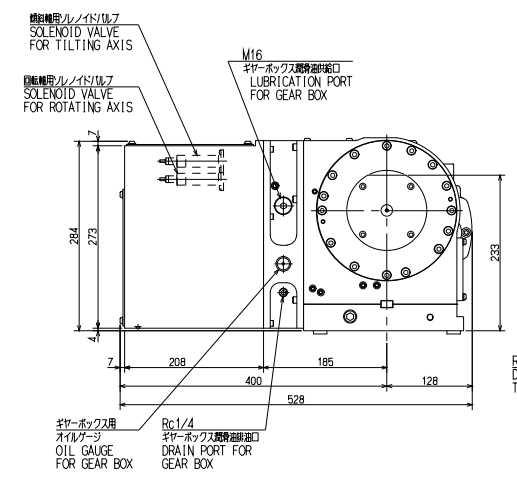
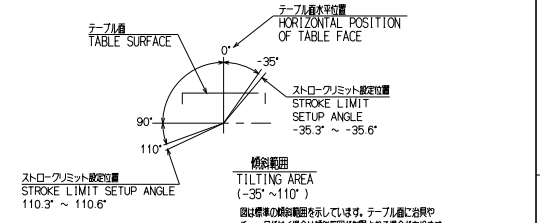
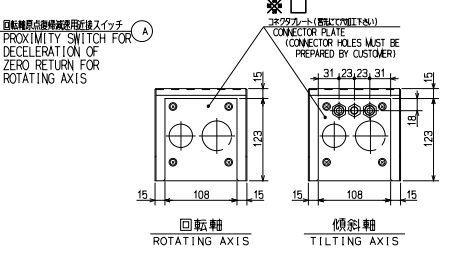
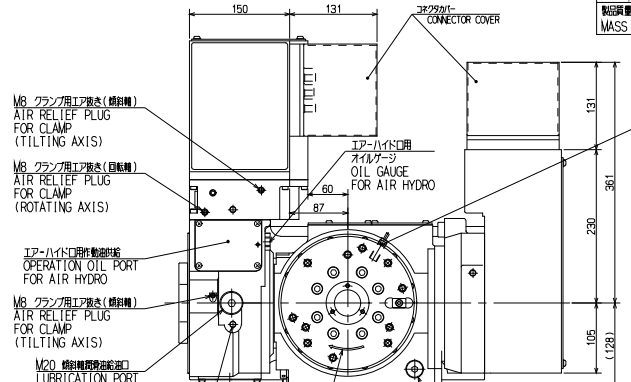
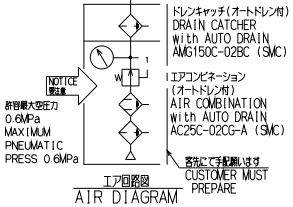


Pneumatic Specifications



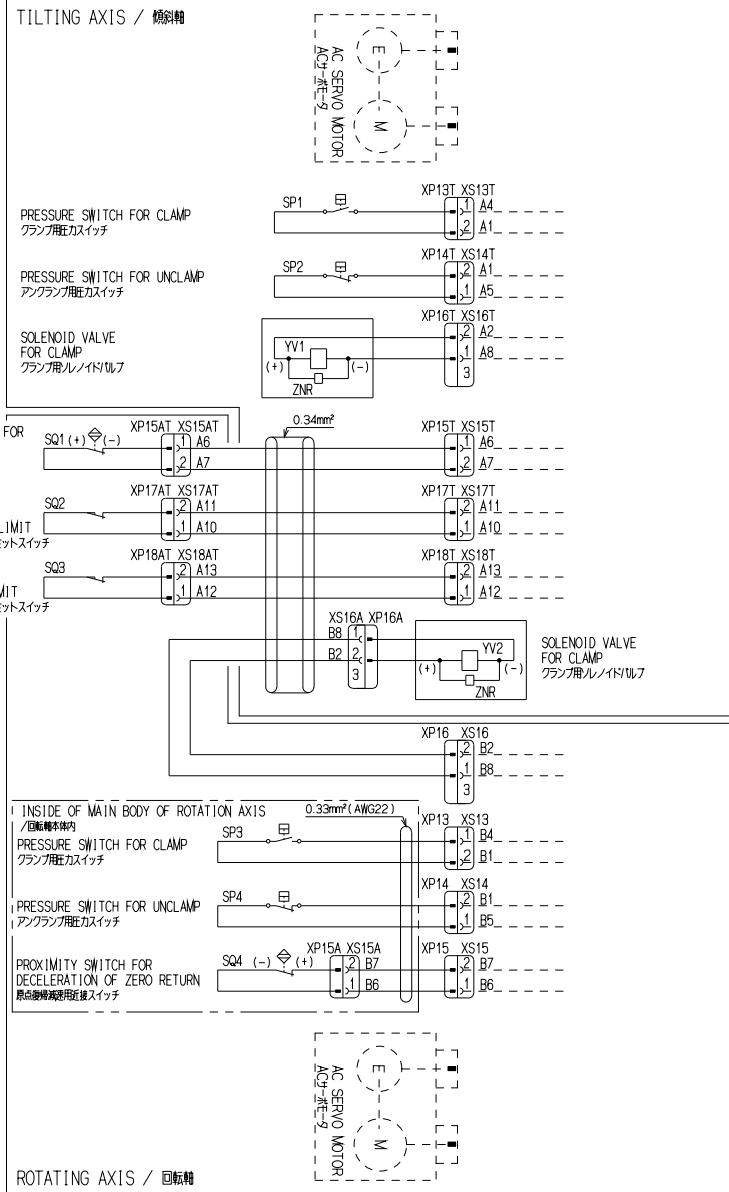
仕様 SPECIFICATIONS	
回転軸 ROTATING AXIS	傾斜軸 TILTING AXIS
索引精度 INDEXING ACCURACY	20 sec以内
再現精度 REPEATABILITY	4 sec以内
テーブル最高回転速度 MAXIMUM ROTATION SPEED [モータ用 MOTOR]	33.3 min ⁻¹ (3000 min ⁻¹)
クランプトルク [空気圧シリンダ用 PNEUMATIC PRESS]	600 N·m (0.5 MPa)
許容最大圧力 MAXIMUM PNEUMATIC PRESS	0.6 MPa
総減速比 TOTAL REDUCTION RATIO	1/90
慣性モーメント (減速機・クランプ用) MACHINE INERTIA (REDUCED TO MOTOR SHAFT)	0.000204kg·cm ²
許容質量 ALLOWABLE MASS OF WORK	水平面 HORZ 60 kg 傾斜時 TILT 40 kg
許容ワーク径 ALLOWABLE WORK DIA.	φ200 mm
質量 MASS OF ROTARY TABLE	170 kg

- 【注記】 NOTE**
- ACサーボモータを使用する場合は、お客様にて手配及び調整をお願いします。
 WITHOUT MOTOR (SETTING WORKS OF MOTOR AT CUSTOMER.)
 傾斜軸の可能なモータ MOUNTING POSSIBLE MOTOR FOR TILTING AXIS
 FANUC αIF 2/5000 (αIA1000) (A06B-0205-B000)
 回転軸の可能なモータ MOUNTING POSSIBLE MOTOR FOR ROTATING AXIS
 FANUC αIF 2/5000 (αIA1000) (A06B-0205-B000)
 - 図中に記載のない仕様変更は、カタログ記載の仕様とします。
 ACCURACY STANDARDS EXCEPT STATED IN THIS DRAWING SHOULD BE APPEALED TO THAT IN CATALOGUE.
 - 配管の配管カバーを再取り付けする時は、必ずシリコン液状グasketをおおきく塗布して下さい。
 AFTER COVERS ARE REMOVED, TO ASSURE WATER/TIGHTNESS, A LIQUID SILICON GASKET MUST BE APPLIED BEFORE REPLACING COVERS.
 - 本機はエアポート仕様での空気供給口のクランプ用エアを供給して下さい。
 THIS ROTARY TABLE IS DESIGNED UNDER THE CONDITION OF AIR PURGE. ACCORDINGLY CLEAN AIR FROM PNEUMATIC PORT HAVE TO BE SUPPLIED.
 - 本テーブルは、指定されたモータを回転させる必要があり、弊社より提供した動作確認が必須です。
 THERE IS NO TEST EQUIPMENT TO ROTATE THE SERVO MOTOR THAT DECIDED BY THE CUSTOMER SO THE ROTATION OF THIS ROTARY TABLE IS CHECKED BY KITAGAWA TEST EQUIPMENT.
 - ワークの質量や径はカタログを参照してください。質量を超える場合は弊社に問合せ下さい。
 PLEASE REFER TO THE CATALOGUE FOR ALLOWABLE LOADING AREA. IF THE WORK PIECE SIZE IS LARGER THAN THE ALLOWABLE LOADING AREA PLEASE CONTACT US.
 - 本機を傾斜に設置する場合は、図面に示すように、外形寸法φ10mm以上の余裕を確保下さい。
 WHEN YOU INSTALL A ROTARY TABLE ON A MACHINE PLEASE KEEP A CLEARANCE OF MORE THAN 10 mm BETWEEN THE ROTARY TABLE AND THE MACHINE SPLASHGUARD IN ORDER TO PREVENT THE INTERFERENCE.



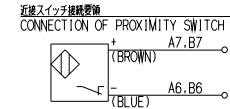
CAREER	61E252259.61E114639	SCALE	TYPE	TT200BE-01	WEIGHT	kg
W.D.	61E253270	1:4	NCテーブル NC ROTARY TABLE			
MANAGER	CHIEF	DRAWN BY	NAME			
		MED A	TT200BE-01 ガイキ			
		DATE	OUTSIDE VIEW			
KITAGAWA IRON WORKS CO.,LTD		16.03.03	DRAW NO. 61E114722 20			

CUSTOMER		
MF. NO.	D A T E	REASON OF REVISION
1	07.01.09	ADJUSTMENT(Δ1 PLACE)



(OTスイッチ / OT SWITCH) ※ □
(ソレノイド電圧 / SOL. VOLTAGE) ※ □

MARK 記号	NAME 品名	MAKER メーカー	TYPE 型式	Q'ty 数量	REMARKS 備考
SP1, SP3	PRESSURE SWITCH プレッシャスイッチ	SKF	176 112 200	2	2.2MPa 1a
SP2, SP4	PRESSURE SWITCH プレッシャスイッチ	SKF	176 120 400	2	0.4MPa 1b
SQ1	PROXIMITY SWITCH 近接スイッチ	Azbil	FL7M-2K6H	1	DC10~30V
SQ2, SQ3	LIMIT SWITCH リミットスイッチ	Azbil	LJM-D2502L1	2	△
SQ4	PROXIMITY SWITCH 近接スイッチ	Azbil	FL7M-3K6H	1	DC10~30V
YV1, YV2	SOLENOID VALVE ソレノイドバルブ	SMC	SVJ7120-5GS-01-F-Q	2	DC24V
XP13, XP13T	PLUG HOUSING プラグハウジング	MOLEX	52116-0240	2	
XP14, XP14T	PLUG HOUSING プラグハウジング	MOLEX	52116-0241	2	
XP15, XP15A XP15T, XP15AT	PLUG HOUSING プラグハウジング	MOLEX	52116-0242	8	
XP17T, XP17AT XP18T, XP18AT	PLUG HOUSING プラグハウジング	MOLEX	52116-0341	3	
XS13, XS13T	RECE. HOUSING 受信ハウジング	MOLEX	52117-0240	2	
XS14, XS14T	RECE. HOUSING 受信ハウジング	MOLEX	52117-0241	2	
XS15, XS15A XS15T, XS15AT	RECE. HOUSING 受信ハウジング	MOLEX	52117-0242	8	
XS17T, XS17AT XS18T, XS18AT	RECE. HOUSING 受信ハウジング	MOLEX	52117-0341	3	



近接スイッチ仕様 SPECIFICATIONS

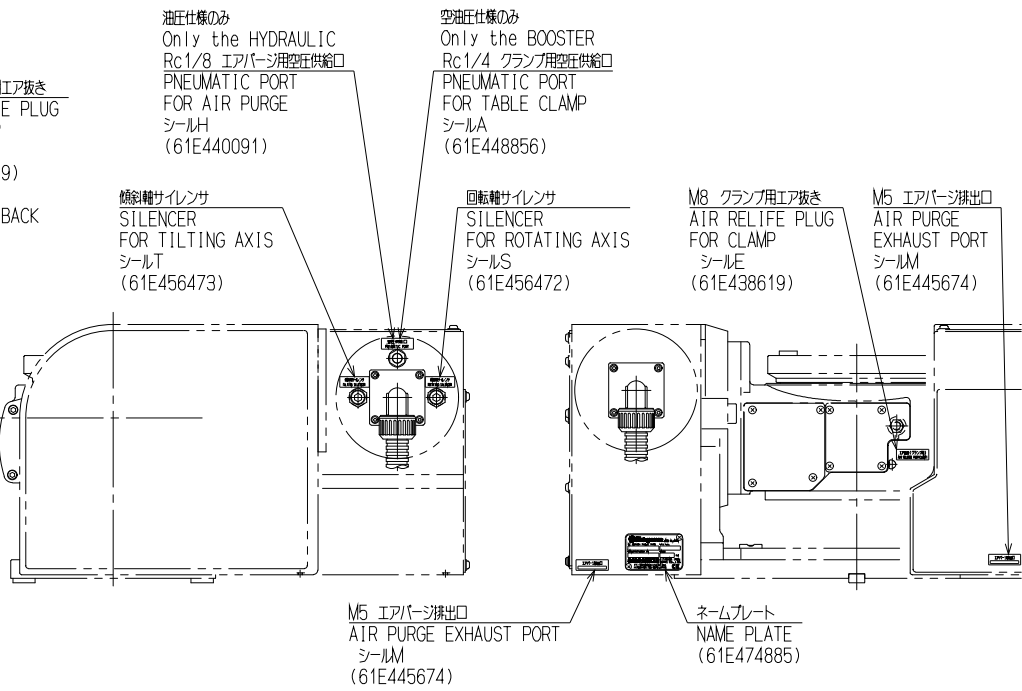
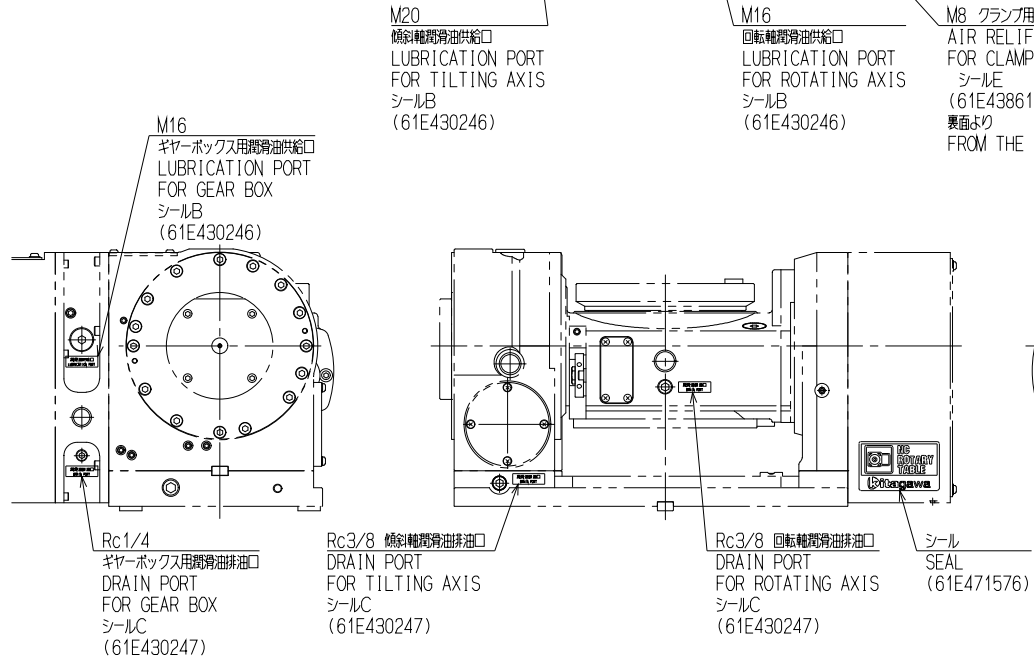
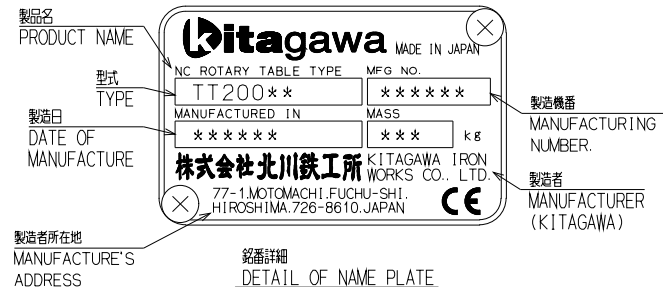
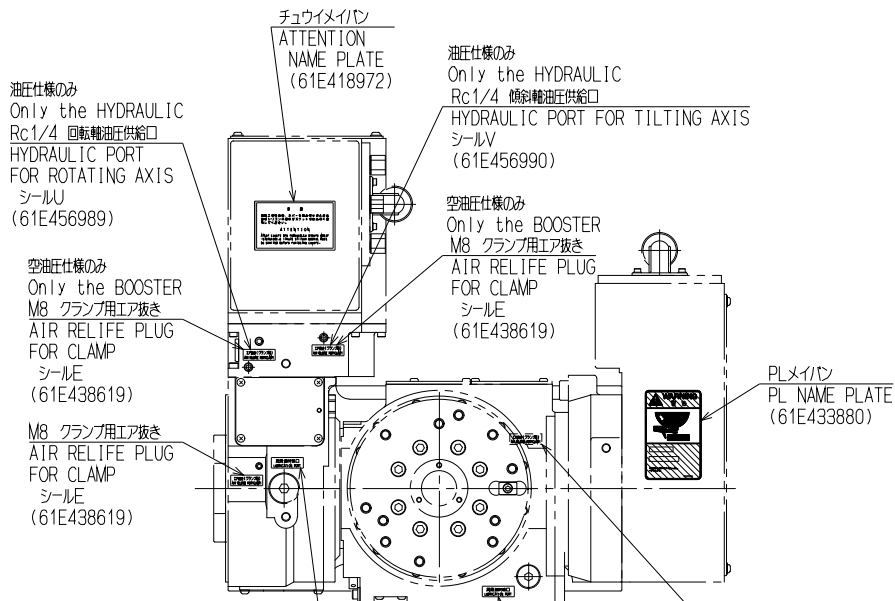
使用電圧範囲	OPERATING VOLTAGE RANGE	DC10~30V
動作電流	SWITCHING CURRENT	3~100 mA
漏れ電流	LEAKAGE CURRENT	max. 0.55 mA
動作電圧残留電圧	RESIDUAL VOLTAGE	max. 3.0 V
出力接点	OUTPUT CONTACT	NC

ソレノイドバルブ仕様 SOLENOID VALVE SPECIFICATIONS

	YV1, YV2	
定格電源電圧	RATED SUPPLY VOLTAGE	DC24V
消費電力	POWER CONSUMPTION	0.35W

CAREER	SCALE	TYPE	TT182BE-01	WEIGHT	k.8
MANAGER	CHIEF	DRAWN BY	NCテーブル NC ROTARY TABLE		
		T. OGASAWARA	アソキショウ		
		AWARA	WIRING DIAGRAM		
KITAGAWA IRON WORKS CO., LTD.	DATE	06.04.24	DRW NO.	61E253270	1/1

CUSTOMER		
MOD. NO.	DATE	REASON OF REVISION



要注意 NOTE

1) 図はTT200BV-00のメイバン位置を示しています。
 貼り付け位置詳細は外形図を参考にしてください。
 THE POSITION OF TT200BV-00 NAMEPLATE IS SHOWED IN THIS DRAWING.
 THE POSITION OF NAMEPLATE SHOULD BE REFERRED TO OUTSIDE VIEW.

CAREER		SCALE	TYPE	TT200BV-00	WEIGHT	kg
MANAGER	CHIEF	DRAWN BY	3RD ANGLE	NCテーブル NC ROTARY TABLE		
		S. SA TOH		NAME	メイバン詳細図 DETAILS OF NAME PLATE	
KITAGAWA IRON WORKS CO., LTD.		DATE		DRW NO.	61E834391	
		16.02.11				



<http://www.kiw.co.jp>

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	<p>TECNARA TOOLING SYSTEMS, INC. http://www.tecnaratools.com 12535 McCann Dr, Santa Fe Springs, California 90670 USA TEL +1 562-941-2000 FAX +1 562-946-0506</p>
Europe Contact	<p>KITAGAWA EUROPE LTD. http://www.kitagawaeurope.com Unit 1 The Headlands, Downton, Salisbury, Wiltshire SP5 3JJ, United Kingdom TEL +44 1725-514000 FAX +44 1725-514001</p>
	<p>KITAGAWA EUROPE GmbH http://www.kitagawa.global/de Borsigstrasse 3, 40880, Ratingen Germany TEL +49 2102-123-78-00 FAX +49 2102-123-78-69</p>
	<p>KITAGAWA EUROPE GmbH Poland Office http://www.kitagawaeurope.com 44-240 Zory, ul. Niepodleglosci 3 Poland TEL +48 607-39-8855 FAX +48 32-749-5918</p>
	<p>KITAGAWA EUROPE GmbH Czech Office http://www.kitagawa.global/cz Purkynova 125 621 00 Brno, Czech Republic TEL +420 549-273-246 FAX +420 549-273-246</p>
	<p>KITAGAWA EUROPE GmbH Romania Office http://www.kitagawa.global/ro Strada Heliului 15, Bucharest 1, 013991, Romania TEL +40 727-770-329</p>
	<p>KITAGAWA EUROPE GmbH Hungary Office http://www.kitagawaeurope.com Dery T.u.5 , H-9024 Győr, Hungary TEL +36 30-510-3550</p>
Asia Contact	<p>KITAGAWA INDIA PVT LTD. http://www.kitagawa.global/in Plot No.215, 4th Phase, Bommasandra Industrial Area, Bommasandra Jigani Link Road, Bangalore 560 099, Karnataka, India TEL +91-80-2976-5200 FAX +91-80-2976-5205</p>
	<p>KITAGAWA (THAILAND) CO., LTD. Bangkok Branch 9th FL, Home Place Office Building, 283/43 Sukhumvit 55Rd. (Thonglor 13), Klongton-Nua, Wattana, Bangkok 10110, Thailand TEL +66 2-712-7479 FAX +66 2-712-7481</p>
	<p>KITAGAWA IRON WORKS (SHANGHAI) CO., LTD. Room308 3F Building B. Far East International Plaza, No.317 Xian Xia Road, Chang Ning, Shanghai, 200051 China TEL +86 21-6295-5772 FAX +86 21-6295-5792</p>
	<p>KITAGAWA IRON WORKS (SHANGHAI) CO., LTD. Guangzhou Office B0725/F, West Tower, Yangcheng International Trading Centre, No.122 East Tiyu Road, Tianhe District, Guangzhou, China TEL +86 20-2885-5276</p>
	<p>DEAMARK LIMITED http://www.deamark.com.tw No. 6, Lane 5, Lin Sen North Road, Taipei, Taiwan TEL +886 2-2393-1221 FAX +886 2-2395-1231</p>
	<p>KITAGAWA KOREA AGENT CO., LTD. http://www.kitagawa.co.kr 803 Ho, B-Dong, Woolim Lion's Valley, 371-28 Gasan-Dong, Gumcheon-Gu, Seoul, Korea TEL +82 2-2026-2222 FAX +82 2-2026-2113</p>
Oceania Contact	<p>DIMAC TOOLING PTY. LTD. http://www.dimac.com.au 69-71 Williams Rd, Dandenong South, Victoria, 3175 Australia TEL +61 3-9561-6155 FAX +61 3-9561-6705</p>

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2017.02.