

# NC Tilting Rotary Table INSTRUCTION MANUAL Model: TTM101A60

## **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.

Thank you for choosing the Kitagawa NC Rotary Table.

Kitagawa, a world-renowned precision equipment manufacturer, has developed the finest quality NC Rotary Table with emphasis in high precision and rigidity as its basic principals in design.

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.

This NC Rotary Table has been designed to provide years of high precision performance. To ensure optimum and trouble-free performance, please read this operation manual carefully before using the unit and retain this copy for your future reference.

Please pay close attention to the procedures with the following warning marks  to avoid severe injury and/or accident.

## **Safety Alert Symbol**

This is the industry “ Safety Alert Symbol ”. This symbol is used to call your attention to items or operations that could be dangerous to you or other persons using this equipment.

Please read these messages and follow these instructions carefully. It is essential that you read the instructions and safety regulations before you attempt to assemble or use this unit.



**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.**



**Instructions for table performance and avoiding errors or mistakes.**

## 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, GT Series, MX Series, TMX Series  
THX Series, TRX Series, TLX Series, TBX Series  
TUX Series, TR Series, TL Series, LR Series  
TM Series, TH Series, TT Series, TW Series  
DM 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 : BS EN 55011+A2:2007  
Immunity : BS EN 61000-6-2:2005

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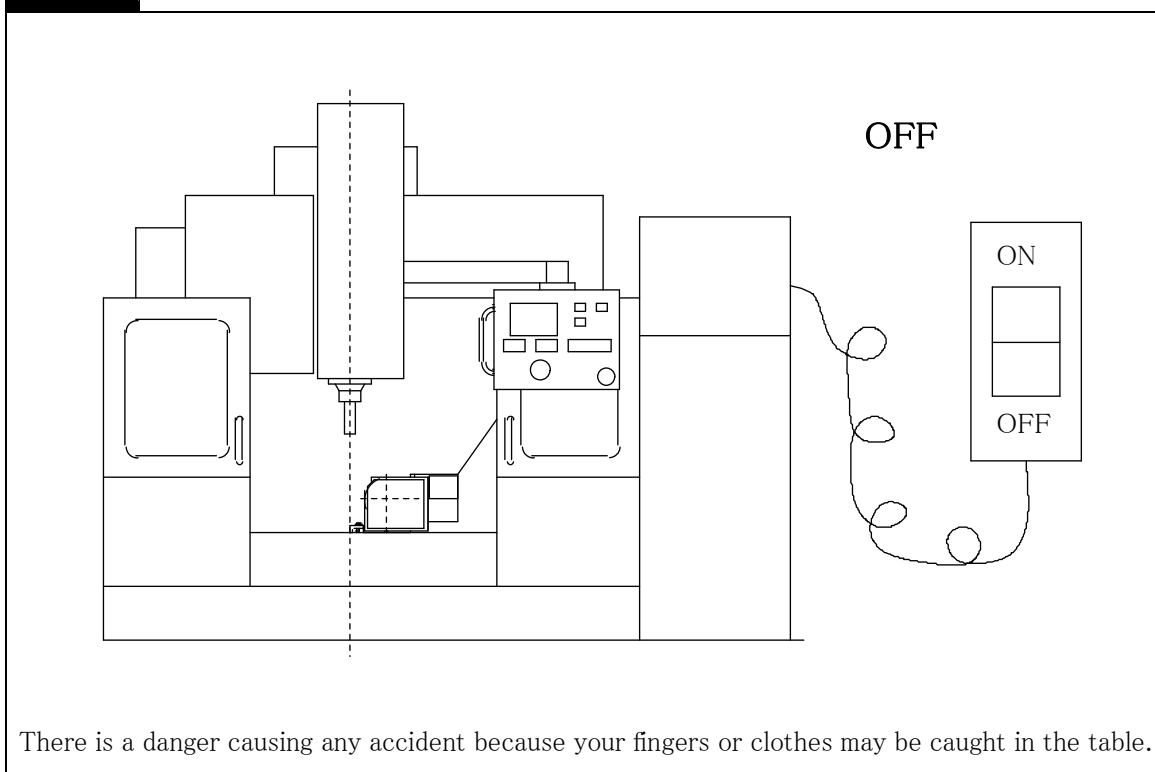
## 1. Operation for Safety

Please read this manual and follow their instructions.

Warranty does not cover damage or accident caused without following the warning items in this manual.

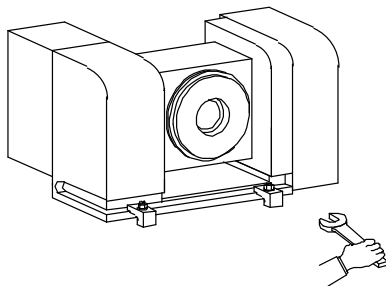


Be sure to turn OFF power source before mounting, maintaining, inspecting and repairing NC rotary table.





Securely tighten bolts.



There is a danger of workpiece scattering because the table overturns.

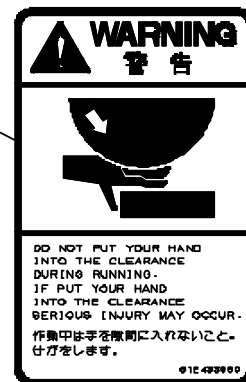
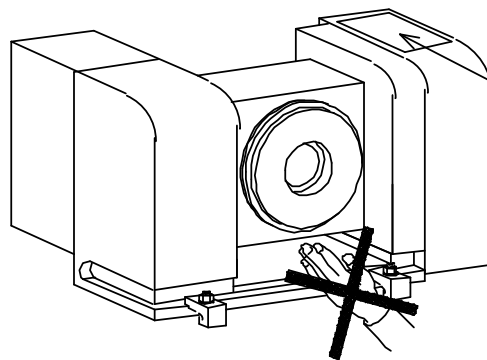
Tighten bolts at specified torque.

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.

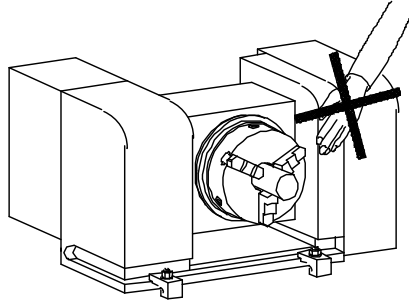
Fingers or hand may be caught into gap.





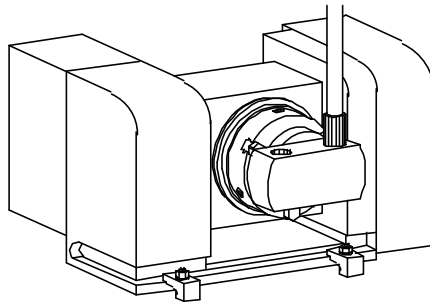
Do not touch rotating object during operation.

Fingers or hand may be caught into the chuck.



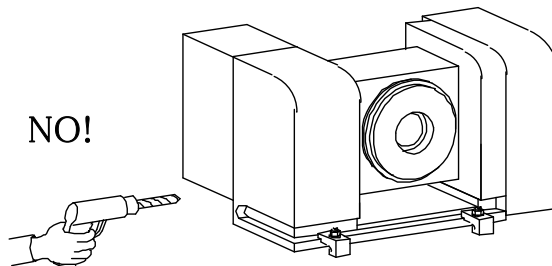
Do not apply an excessive cutting force to NC rotary table.

There is a danger in which NC rotary table damages and workpiece scatters.



Do not modify NC rotary table.

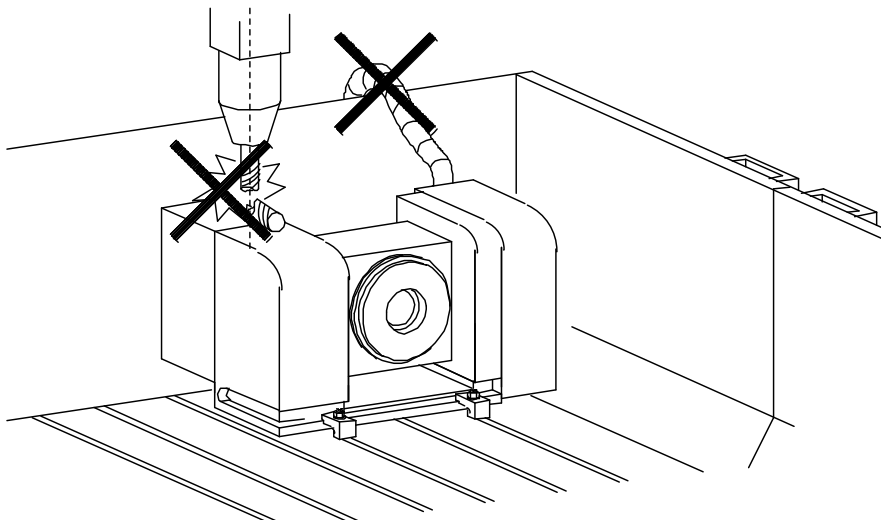
There is a danger in which NC rotary table damages and workpiece scatters.





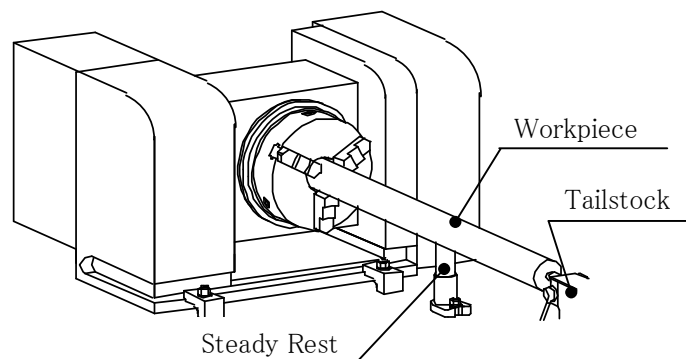
Avoid NC rotary table from interference with mounting equipment.

Tool may be broken or scattered. Avoid cable/hose from interference with mounting equipment and from remarkably bending. There is a possibility that any electric shock occurs if the cable is damaged.



For long or heavy workpiece, use the tailstock and steady rest.

There is a danger of workpiece scattering if workpiece is too long or heavy.



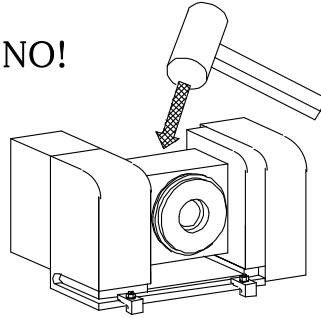




Do not apply any shock to each component of NC rotary table.

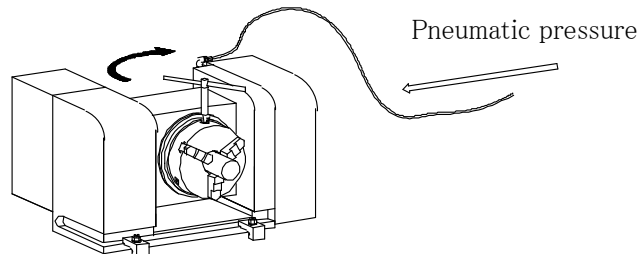
NC rotary table may be damaged  
or workpiece may scatters.

NO!



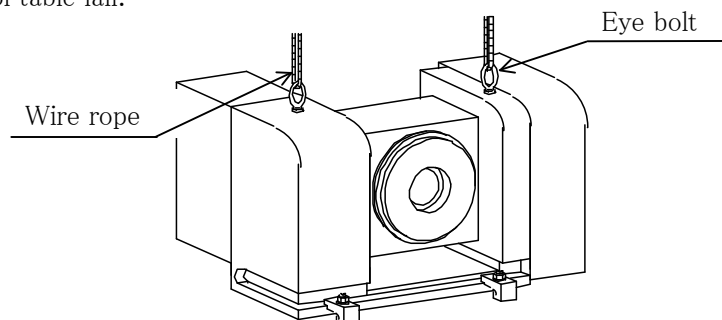
Clamp the table before mounting or removing the workpiece.

Danger because not only machining  
accuracy drops but also NC rotary  
table damages or workpiece scatters.



When transferring NC rotary table, use wire ropes and eye bolts.

Take care of table fall.

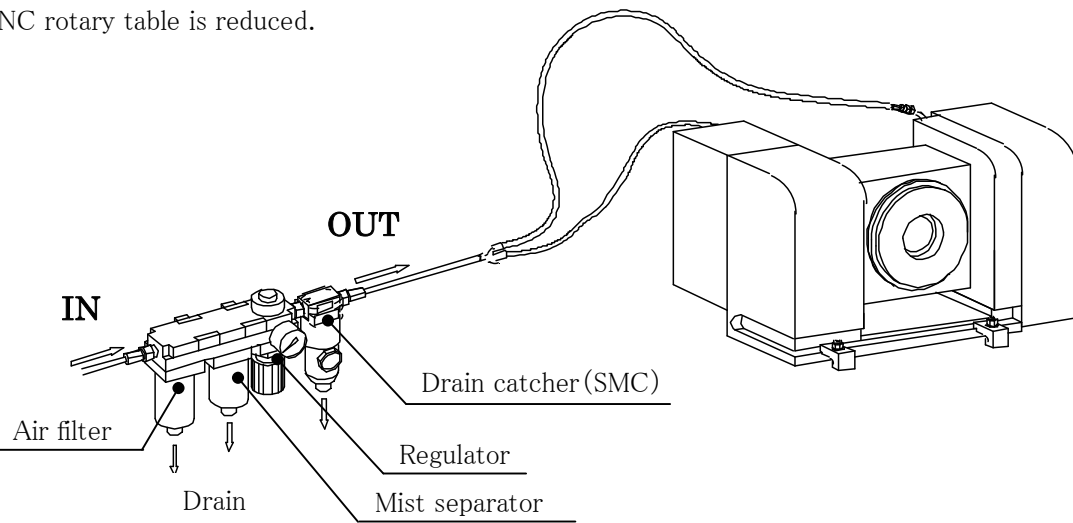


**CAUTION**



Supply clean air passing through the air combination (Air filter, Mist separator, and Regulator) + Drain catcher.

There is a danger of workpiece scattering because not only rust occurs but also the clamp force of NC rotary table is reduced.

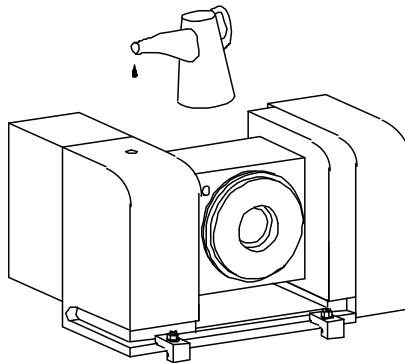


Periodically drain the water in air filter. (It is recommended to use the auto drain type.)

**NOTICE**



Replace lubricating oil every 6 months.



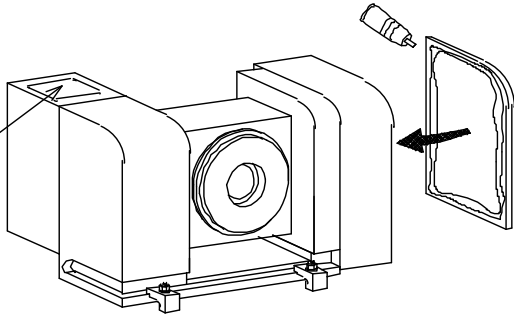
# NOTICE



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

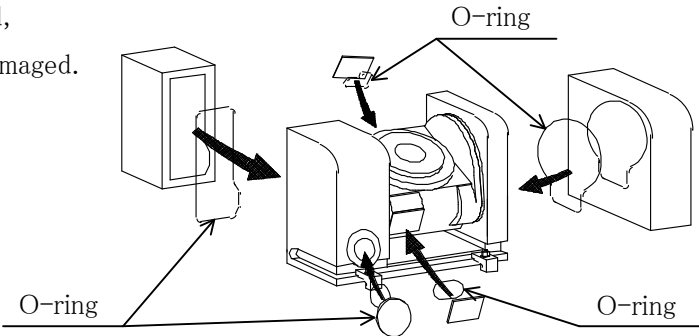
Because coolant is entered,  
NC rotary table may be damaged.

注意  
液漏工事等の後、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わ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.  
(Do not damage each O-ring.)

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



## 2. Specifications

ITEM	MODEL		TT(M)101	TT(M)120 TTS(M)120
	1	Table Diameter	mm	φ 110
2	Table Height in Horizontal	mm	185	220
3	Center Height in Vertical	mm	140	150
4	Total Height in Vertical (M signal specification)	mm	227	265 (272)
5	Table reference hole diameter	mm	φ 50	φ 60
6	Table through hole diameter	mm	φ 32	
7	Clamping Torque[Pneumatics 0.5MPa (5.1kgf/cm <sup>2</sup> )]	[Rotating axis] N·m (kgf·m)	180(18.4)	120(12.2)
		[Tilting axis] N·m (kgf·m)	300(30.6)	200(20.4)
8	Allowable Workpiece Dia.	mm	φ 110	φ 125
9	Allowable Mass of Workpiece	(Horizontal) kg	35	
		(Vertical) kg	20	
10	Allowable Work Inertia	kg·m <sup>2</sup> (kgf·cm·sec <sup>2</sup> )	0.05(0.5)	0.06(0.6)
11	Total Reduction Ratio	(Rotating axis)	1/72	1/90
		(Tilting axis)	1/120	1/180
12	Max. Rotation Speed	(Rotating axis) min <sup>-1</sup>	41.6	33.3
		(Tilting axis) min <sup>-1</sup>	25.0	16.6
13	Angle of tilting	degree	-20~120	-20~110
14	Mass of Rotary Table	kg	About 65	[TT(M)120] About 100 [TTS(M)120] About 110
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  $3000 \text{ min}^{-1}$ .

## CAUTION

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

## CAUTION

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

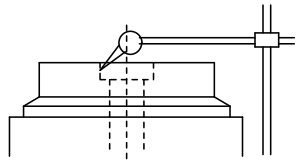
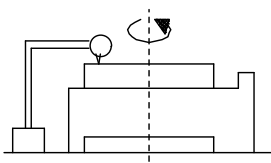
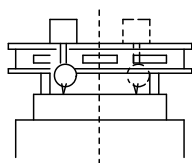
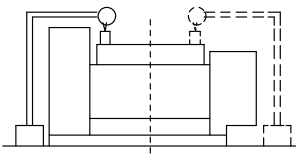
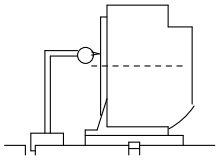
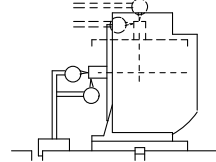
## CAUTION

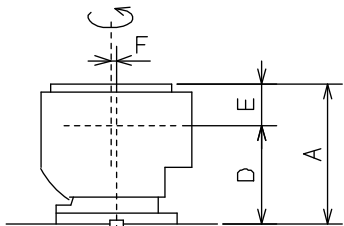
For the conditions for using the table, refer to the above specification columns and caution items. Set each cutting condition so as not to exceed the allowance value.

### 3. Accuracy Standard

(Unit : mm)

Description of Inspection		Guaranteed Accuracy	
1	Run-out of center 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 table top face and mounting reference face	Total length 0.020	
7	Indexing accuracy	Rotating axis	Cumulative 30 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.		

Tilting axis coordination related value	
	A _____ D _____ E _____ F _____

## 4. Operation Ready

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

### 4-1. 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 clamber.



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 clamber 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.

#### 4-2. Oiling

Lubricant has been already filled in the NC rotary table body before shipping. Check the lubricant is filled to the center line of the 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.



Recommended Lubricant (Viscosity grade ISO VG32)

Maker	Name
IDEMITSU	Daphne Multiway 32MT
MOBIL	Vactra oil No. 1
JOMO	Slidus HS32
SHELL	Shell Tonna oil S32
NIPPON OIL CORPORATION	Uniway EV32
COSMO	Dynaway 32

Required Oil    Tilting axis body : 0.4 liter  
                   Rotating axis body : 0.4 liter

☆ Daphne Multiway 32MT has already been filled before shipping.

#### 4-3. Trial run, accuracy check

- 1) Perform the trial run under no load in which no workpiece is mounted on the table.
- 2) Check there is no noise and vibration during the operation of axis LOW, HIGH, FORWARD and REVERSE. Perform the running-in of rotary axis by two slowly increase the forward and reverse directions at 1 rpm at first. After that, slowly increase the speed in high speed. Perform the running-in of the tilting axis by two strokes at the feed of 1 rpm, paying attention so as not to enter in the over travel area and slowly increase the speed.
- 3) During the above operation, check there are the working sound and exhaust sound form the solenoid valves and silencer incorporated in NC rotary table.
- 4) Check accuracy, referring to the inspection result table and the accuracy standard in the manual.

#### 4-4. Setting of ZRN and shift value to machine datum

\*\*\*\*\*  
 The contents of this item are unnecessary for the NC rotary table of Kitagawa's controller spec. and 4th and 5th axes spec. which don't have a Proximity switch for ZRN deceleration.  
 \*\*\*\*\*

- 1) After checking the above operation, when there is no alarm, return each axis to machine datum. For the ZRN of each axis, the axis rotates at high speed in the fixed direction and decelerates with the sensor (proximity switch) of the incorporated ZRN decelerating dog before stopping by receiving the standard signal of motor detector.
- 2) The tilting axis datum (0° ) is where the table face is horizontal and +90° is where the table face is vertical. The standard ZRN direction of tilting axis is set from - (minus) direction to 0° .

- 3) The ZRN direction of rotary table is clockwise.
- 4) Individually perform ZRN for the tilting axis and the rotary table to find the angle difference between the actual stopping position and the machine datum. To compensate this angle difference, set the parameter value of datum shift volume of control unit. If the compensating value exceeds the setting range, it is necessary to adjust the ZRN deceleration dog position.

## **4-5. Safety of Oil and Antirust Oil Used for the Unit**

### **4-5-1. Scope of application**

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

### **4-5-2. 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.

### **4-5-3. 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.

#### 4-5-4. 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.

### 5. Workpiece mounting

Securely mount the workpiece for a high accuracy machining.



If the workpiece is not securely mounted, not only accuracy is wrong but also the machine and tool are damaged. In the worst case, it will result in serious injury.



Avoid mounting a workpiece which has poor flatness or perpendicularity directly to a table face. This may strain the table and prevent smooth rotation, which may result in very poor indexing accuracy. Shimming may be required to prevent this problem.



Clamp the workpiece in equipartition on the rotary table as much as possible.

### 6. 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.

## 7. Table Clamp

### 7-1. Pneumatic supply for clamp

- 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 0.5 to 0.6 MPa (5.1 to 6.1 kgf/cm<sup>2</sup>).

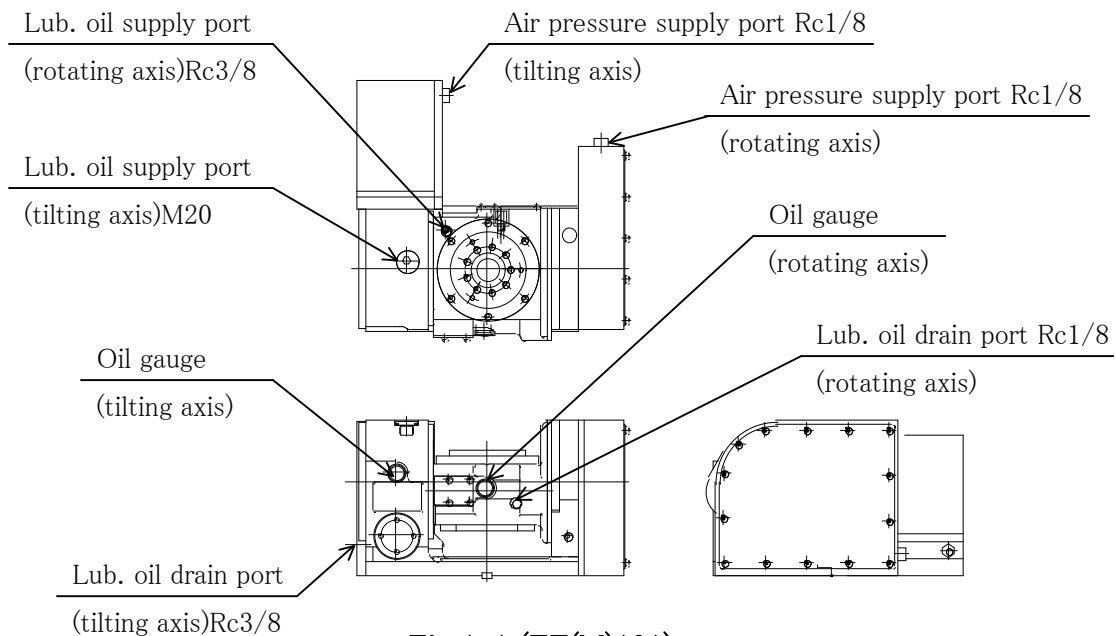


Fig.1-1 (TT(M)101)

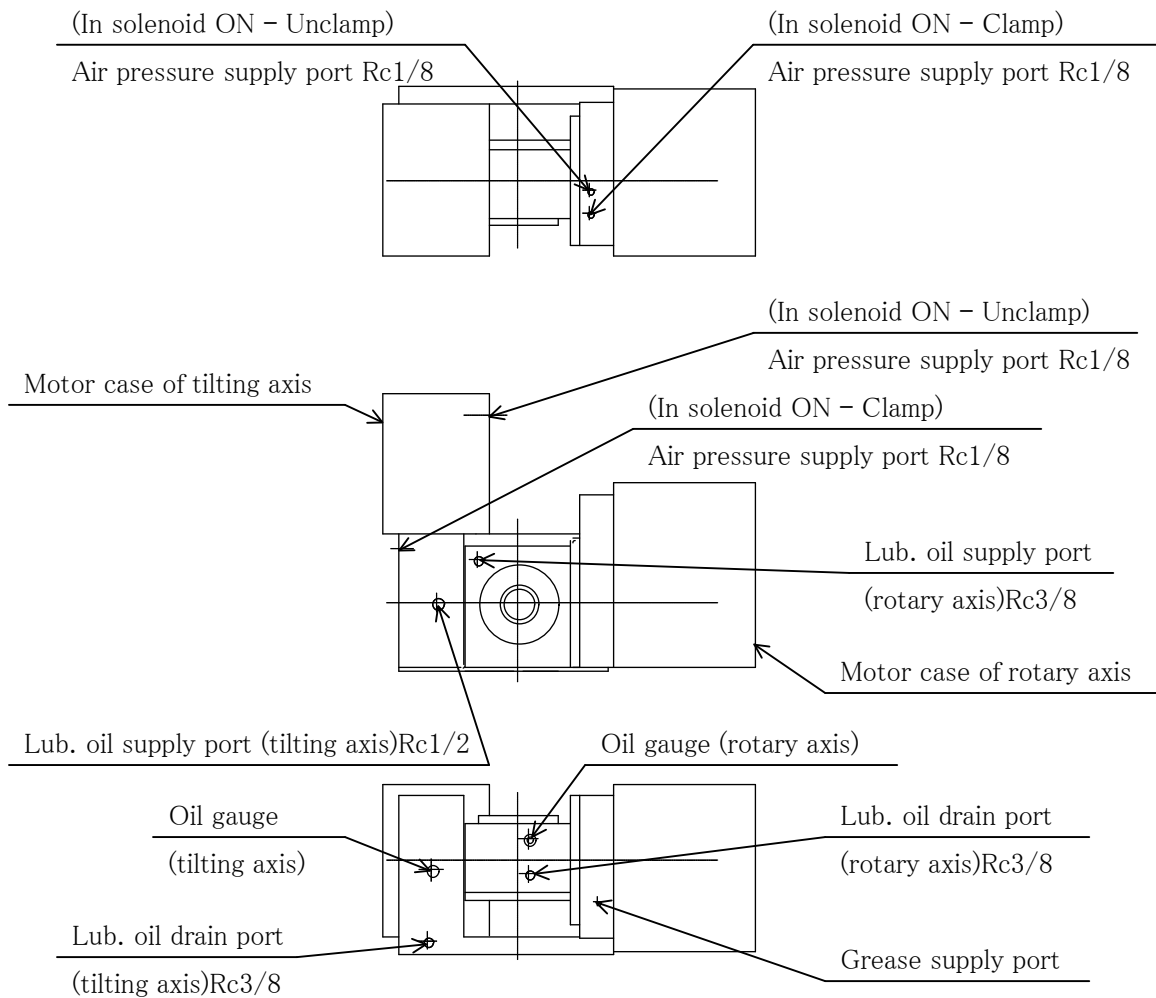


Fig.1-2 (TT(M)120,TTS(M)120)

4) Clamp - Unclamp caution



Rotate the table and move the tilting axis with the chuck unclamped. After positioning, machine the workpiece with the chuck clamped. Take care because the worm wheel will be damaged by misuse.



Avoid the machining more than the clamping force shown in the specification table. The clamped part is worn and the worm wheel is damaged.



Completely escape pressure when the unit is unclamped. If remained, the worm gear and clammer will be seized and damaged.

Therefore, take care of back pressure.

5) Clamp - Unclamp check

The set up pressure of the switches for pneumatic systems are as follows:

	Clamp Signal (SP1,3)	Unclamp Signal (SP2,4)
Pneumatic	0.25MPa (2.55kgf/cm <sup>2</sup> )	0.055MPa (0.56kgf/cm <sup>2</sup> )

6) In the case of pneumatic specification, the solenoid valves are incorporated. The piping is as follows with the standard specification. Take care when the electric wires are routed.

(Excitation Unclamp Spec.)

Solenoid: ON ... Table Unclamp

Solenoid: OFF ... Table Clamp

(Excitation Clamp Spec.)

Solenoid: ON ... Table Clamp

Solenoid: OFF ... Table Unclamp



Since there is polarity in the pressure switch by SMC CORP., a proximity switch, and a solenoid valve, please refer to the wiring diagram.

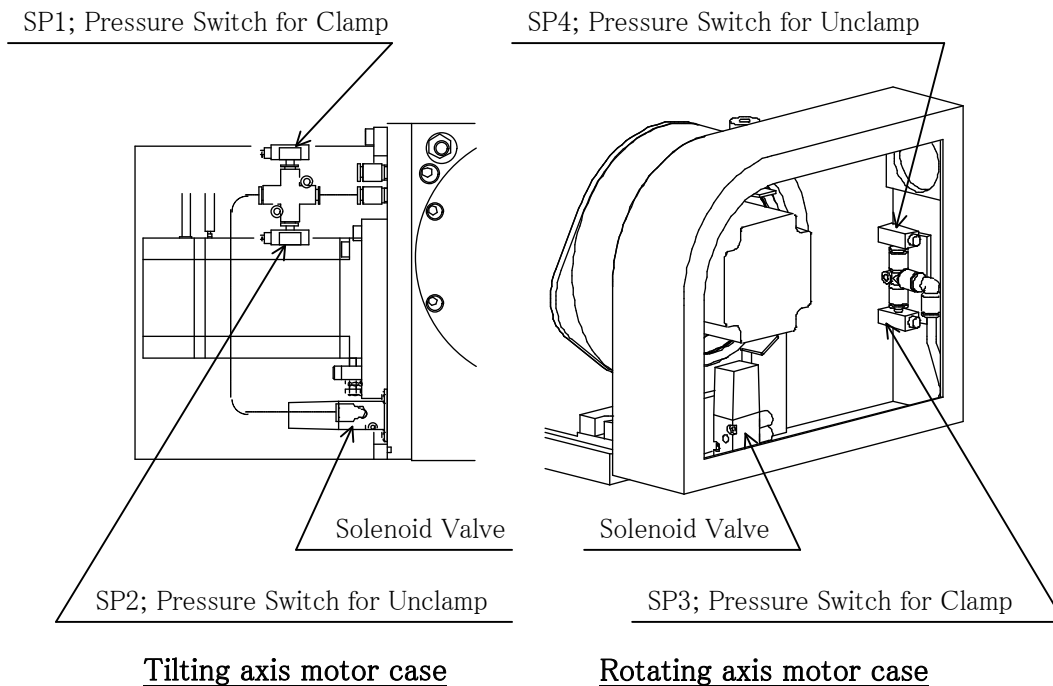


Fig.2 (TT(M)101)

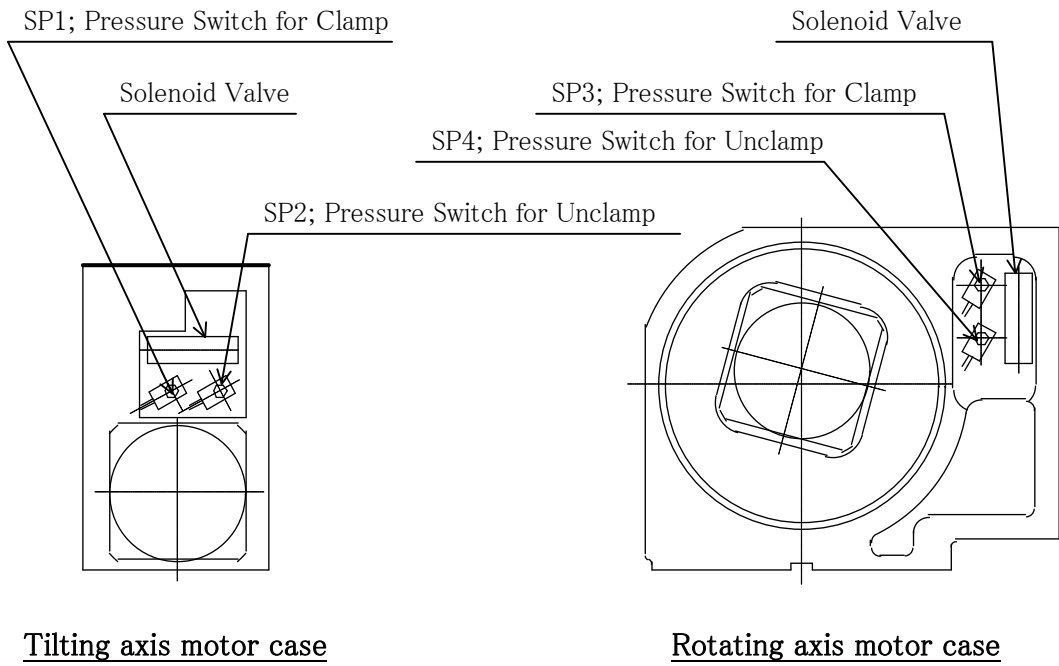


Fig.2-2 (TT(M)120)

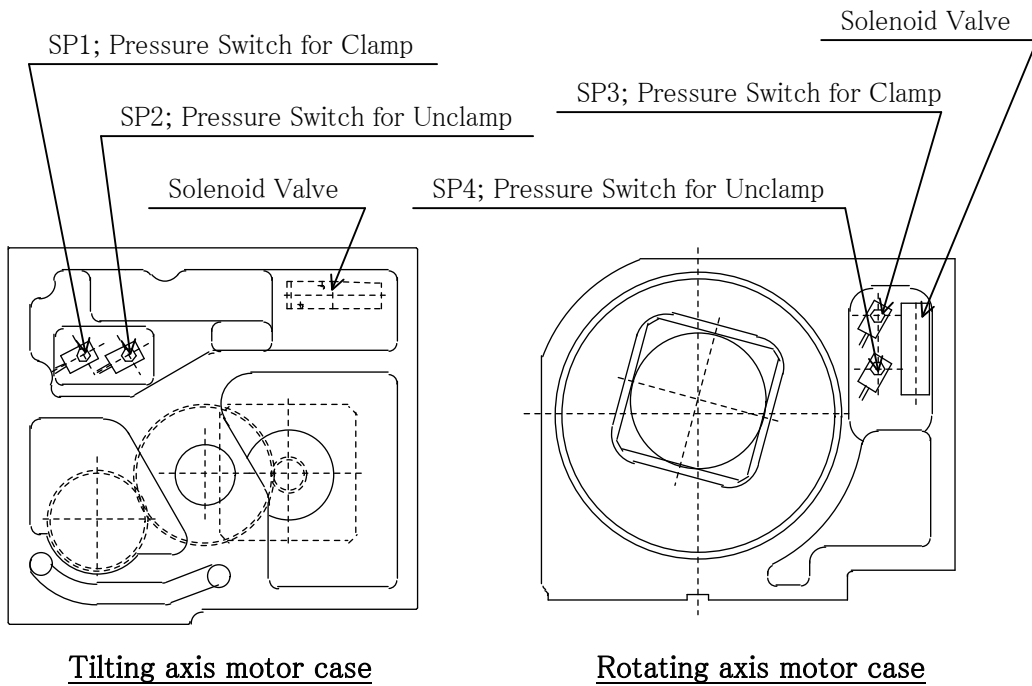


Fig.2-3 (TTS(M)120)

## 7-2. Air purge



According to the circumstance of use, the dew may be occurred in the motor case.

Air is exhausted from the portion of the air exhaust so that it causes the obstacle of electric parts or each part.

The air purge is performed by air branched inside of NC table that uses air for clamp.

Be sure to use the clean air (passing through air filter, mist separator, regulator and drain catcher) passing through the filter. If the air contains water content (moisture), oil content, etc., it is entered in the motor case, thus causing in equipment damage.

The air inside of motor case is exhausted from the exhaust port for air purge.

In case that the portion of the air closed, motor case or motor etc. may be damaged so that the dew cannot be exhausted and that pneumatics is kept in the motor case.

Therefore, the portion of exhaust should not be closed.

When exhausting, though exhaust sound occurs, there is no trouble.

## 8. Inspection

Daily inspection (Inspect the following items before starting the machine.)

- 1) Confirm that the NC rotary tables (including jigs, if attached) are securely fixed.
- 2) Confirm that the chips accumulating in a rotary part of NC rotary table are removed.
- 3) Confirm that the electric connection cables and hoses are not damaged and the pneumatic pressure is appropriate.
- 4) Confirm that the machine-zero return and indexing operation and position.
- 5) Confirm that there is no abnormal vibration or noise. (eq. Body and motor)
- 6) Confirm that there is no abnormal heating. (eq. Body and motor)

Periodic inspection (Inspect the following items every six months.)

- 1) Confirm that muddiness of the lubricant.
- 2) Confirm that the connectors are securely attached and there is no damage on the cables.
- 3) Confirm that corrosion and breaking of the wiring in the motor case.



## 9. Maintenance Work

### 9-1. 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.

### 9-2. 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.

## 10. Each Component and Maintenance, Adjustment

This chapter explains the structure and maintenance, adjustment about worm gear, spur gear drive mechanism, ZRN device, tilting axis emergency stop device and motor case.

### 10-1. Backlash adjustment of worm gear

The worm and worm wheel are made of the special material and accurately machined. Though the backlash of the worm gear has already been adequately adjusted before shipping, it may be necessary to adjust it after using for a long period of time.

The adequate values of backlash are as follows. These values were measured when the machine is cooled. Thus, values are measured after interrupting for a long period of time. Consequently, when operating the machine for a long period of time, the backlash values become smaller than the following table due to thermal expansion.



If backlash is too small, the worm gear will be seized.

#### ■ Adequate backlash

		Circular arc length at peripheral table position ( $\mu$ m)	Angle(sec.)
TT(M)101	Rotating axis	12~36	38~129
	Tilting axis	4~9	16~33
TT(M)120	Rotating axis	12~39	38~96
TTS(M)120	Tilting axis	4~7	10~20

When adjusting the backlash, measure the current backlash with the following method before adjusting it.

#### 10-1-1. Backlash measuring method of rotating axis worm gear (See Fig.3)

- 1) Tighten a block at the tap on outer side of the table surface and set dial gauge on the side face of the block.
- 2) Insert a flat or round steel bar into the table through a tapped hole on the table surface. Turn the table slowly, release your hands when the tooth of the worm wheel makes contact with the worm shaft, and read the value on the dial gauge. Then, rotate the table in the opposite direction, in the same way as stated above, until the tooth of the worm wheel makes contact with the worm shaft and read the dial gauge. The difference of these measurements is the amount of backlash.

3) (In case of TT(M)101)

The above measurements should be conducted at six different points by rotating the table 60 degrees at a time. Compare the readings with the correct amount of backlash shown above. If the reading is out of the range specified, take the following procedures to adjust the backlash so that the minimum reading is within the correct range specified above.

(In case of TT(M)120, TTS(M)120)

The above measurements should be conducted at eight different points by rotating the table 45 degrees at a time. Compare the readings with the correct amount of backlash shown above. If the reading is out of the range specified, take the following procedures to adjust the backlash so that the minimum reading is within the correct range specified above.

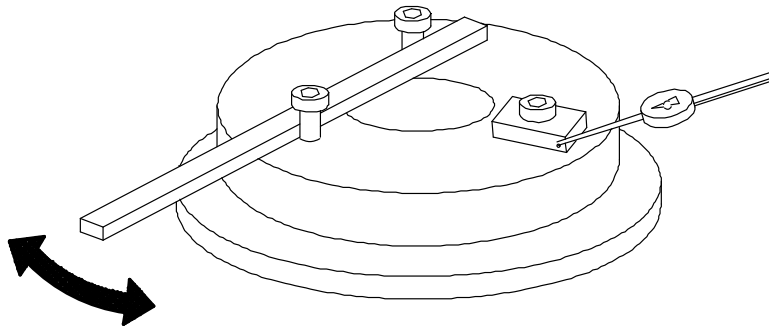


Fig.3

**10-1-2. Backlash measuring method of tilting axis worm gear (See Fig.4)**

- 1) Set the dial gauge around the outer periphery on the table surface.
- 2) After turning the tilting body at about 10kg in the minus direction, loosen force and read the value of dial gauge with the body maintained at the force of 2~3kg in the same direction. Similarly turn the body in the reverse direction and read the value of dial gauge. This difference of measuring values is the backlash.

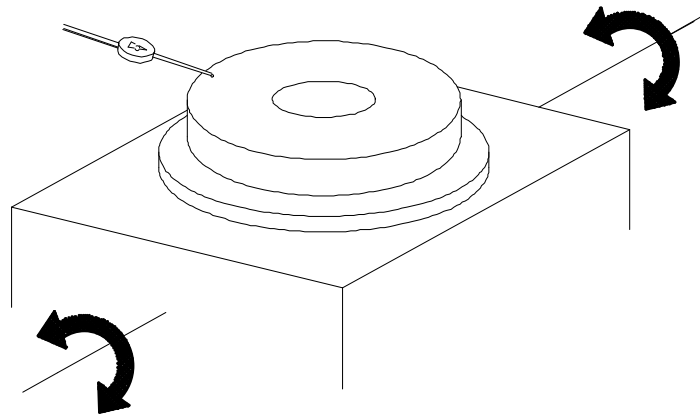


Fig.4

### 10-1-3. Backlash adjusting method of rotating axis worm gear (See Fig.5: TT(M)101)

- 1) Remove the workpiece, jig, etc., on the table before adjusting and level the table.
- 2) Drain the lubricant from the drain port.
- 3) Remove the cover ① and loosen the hexagon socket set screw ②.
- 4) The Lock nut ③ and the bearing case ④ is set up with M48×P1.5 thread. When you loosen these parts, you lock the bearing case ④ by using the bar. (You can lock it by plugging in the hole of  $\phi$  4-12)
- 5) The degree of backlash becomes to be small by the direction of clockwise.
- 6) Confirm the degree of backlash after setting up the bearing case ④ and tightening the lock nut ③ tightly.

#### NOTICE

The pitch of bearing case's outside hole  $\phi$  4-12 is 30 degrees.  
The bearing case is turned for 30 degrees moving, backlash becomes to be 0.003mm smaller.

#### CAUTION

Don't adjust the backlash once. Slowly and carefully adjust it.

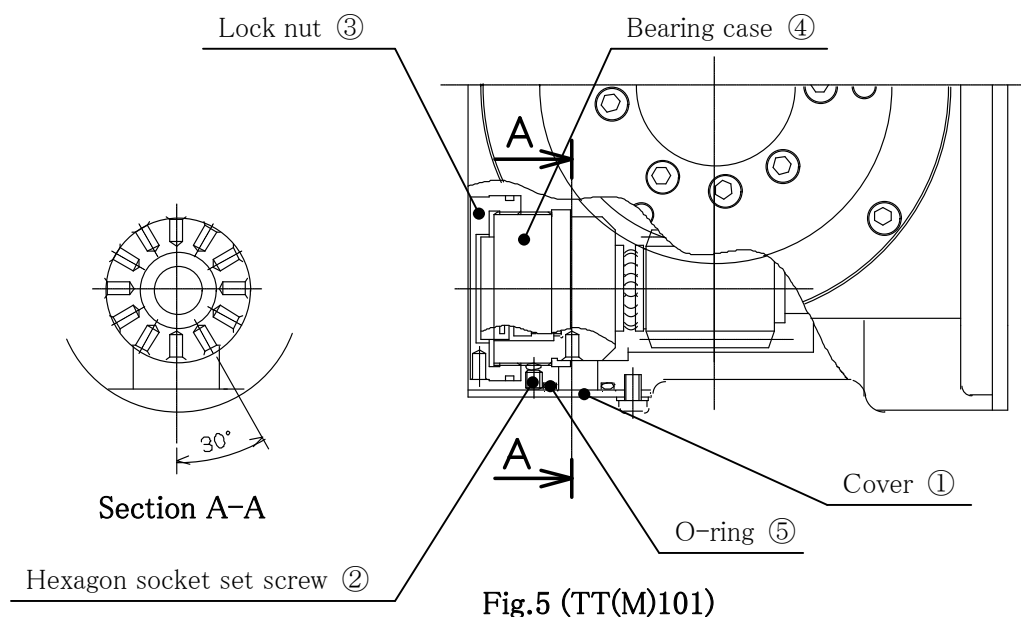
After adjusting, reassemble the worm gear by the reverse procedure of the above and securely tighten the bolts. After reassembling, measure the backlash again at the same position in reference to 10-1-1. Check that the backlash is proper.

#### CAUTION

When the cover ① is re-installed, be careful not to damage the O-ring ⑤. The damaged O-ring ⑤ may allow the cutting water to enter the motor case.

#### CAUTION

When mounting the hexagon socket head set screws ②, make sure to put the coat seal agent on the thread part of set screws and tighten them firmly.



#### 10-1-4. Backlash adjusting method of rotary axis worm gear (See Fig.6: TT(M)120,TTS(M)120)

- 1) Remove the workpiece, jig, etc., on the table before adjusting and level the table.
- 2) Drain the lubrication oil from the drain port.
- 3) Remove the cover ①.
- 4) The Lock nut ② and the bearing case ③ is set up with M42×P1.5 thread.  
When you loosen these parts, you lock the bearing case ③ by using the bar.  
(You can lock it by plugging in the hole of  $\phi$  5-8.)
- 5) The degree of backlash becomes to be small by the direction of clockwise.
- 6) Confirm the degree of backlash after setting up the bearing case ③ and tightening the lock nut ② tightly.

### NOTICE

The pitch of bearing case's outside hole  $\phi$  5-8 is 45 degrees.  
The bearing case is turned for 45 degrees moving, backlash becomes to be 0.006mm smaller.

### CAUTION

Don't adjust the backlash once. Slowly and carefully adjust it.

After adjusting, reassemble the worm gear by the reverse procedure of the above and securely tighten the bolts. After reassembling, measure the backlash again at the same position in reference to 10-1-1. Check that the backlash is proper.

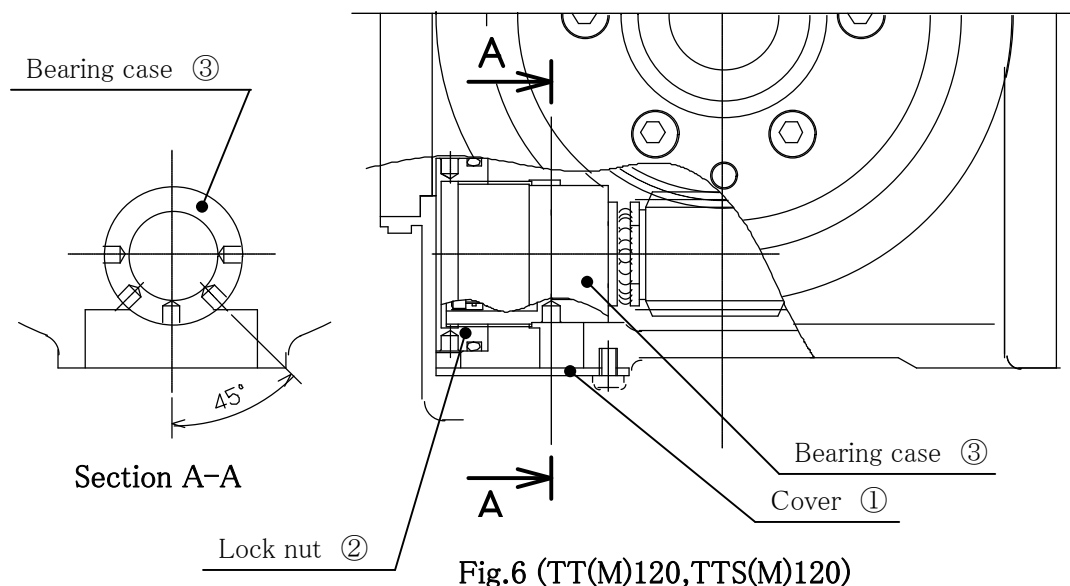


Fig.6 (TT(M)120,TTS(M)120)

**10-1-5. Backlash adjusting method of tilting axis worm gear (See Fig.7-1, Fig.7-2)**

- 1) Remove the workpiece, jig, etc., on the table before adjusting and level the table.
- 2) Don't have to drain lubricant from the drain port.
- 3) Remove the cover ①.
- 4) The bearing case ④ is fixed on the hexagon socket head cap screws ③ and the Hexagon socket headless set screw ②.
- 5) Slightly loosen four pieces of hexagon socket head cap screws ③.
- 6) (In case of TT(M)101)

Backlash becomes smaller by forwarding Bearing case ④, when 4 pieces of the Hexagon socket headless set screw ② are loosen equally and 4 pieces of the Hexagon socket head cap screw ③ are tighten.

(In case of TT(M)120,TTS(M)120)

Backlash becomes smaller by forwarding Bearing case ④, when 4 pieces of the Hexagon socket headless set screw ② are loosen equally and 8 pieces of the Hexagon socket head cap screw ③ are tighten.

**NOTICE**

(In case of TT(M)101)

Backlash becomes to be 0.01mm smaller by turning the Hexagon socket headless set screw ② through 100° in CCW.

(In case of TT(M)120,TTS(M)120)

Backlash becomes to be 0.01mm smaller by turning the Hexagon socket headless set screw ② through 90° in CCW.

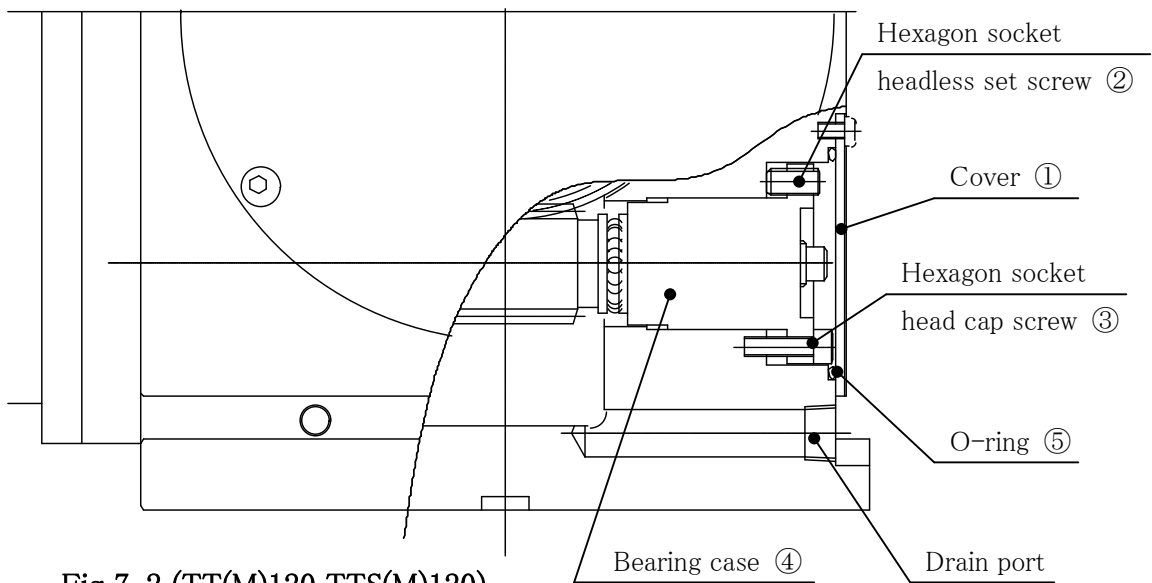
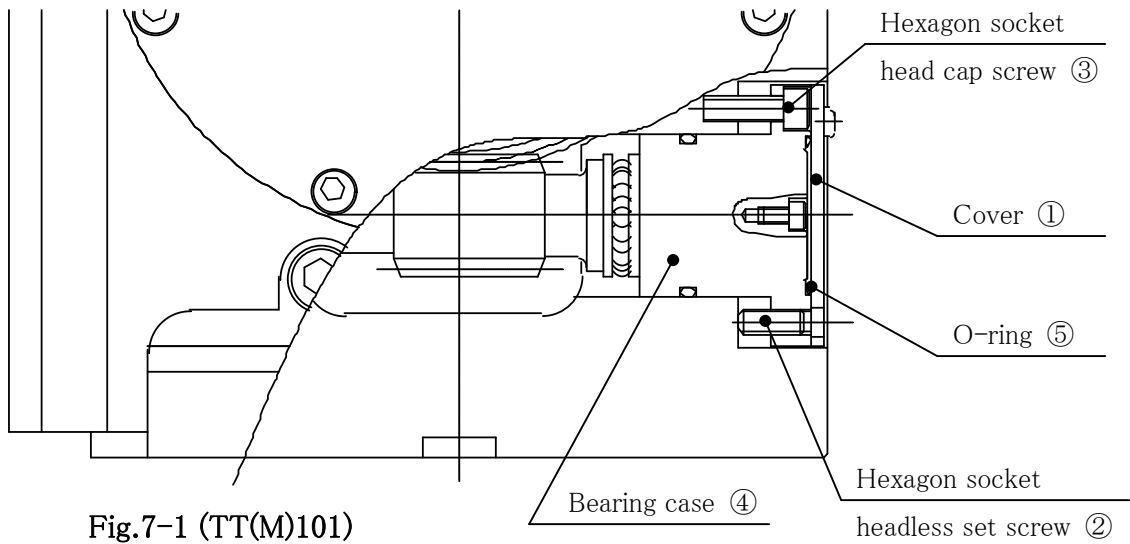


Don't adjust the backlash once. Slowly and carefully adjust it.

After adjusting, reassemble the worm gear by the reverse procedure of the above and securely tighten the bolts. After reassembling, measure the backlash again at the outer periphery of the table and at the same position. Check that the backlash is proper.



When the cover ① is re-installed, be careful not to damage the O-ring ⑤. The damaged O-ring ⑤ may allow the cutting water to enter the motor case.



## 10-2. Backlash adjustment of spur gear

### 10-2-1. Backlash adjusting method of rotary axis drive spur gear (See Fig.8-1, Fig.8-2)

The backlash between spur gears of Z1 and Z2 is adjusted by touching the hex. head bolt ① for stopper to the side face of the servo motor and by varying the distance between axes after adjusting the motor position.

- 1) When you adjust the backlash, it is necessary to keep tilting axis in the horizontal position (0 degree) and remove the workpiece, jig, etc., on the table.
- 2) Drain the lubricant from the drain port.
- 3) Remove the motor case ④. (Refer to 11-1)
- 4) Slightly loosen four set screws ② which fix the servo motor. (When there is flange on the servo-motor's back, loosen 4 set screws ⑫ for setting up the flange Notice; don't loosen the set screws ② for being set up the motor.
- 5) Tune the hex. socket head cap screw ① for stopper to left, return it and lower the servo motor until the backlash becomes nearly zero(0) .

- 6) (In case of TT(M)101)

The proper backlash is 0.02~0.04mm. When turning the hex. head bolt ① 10° (1/36-turn) to right, the backlash of 0.016mm can be obtained. At this time, check the motor travel with the dial gauge touched to the servo motor side.

(In case of TT(M)120, TTS(M)120)

The proper backlash is 0.01~0.03mm. When turning the hex. head bolt ① 10° (1/36-turn) to right, the backlash of 0.02mm can be obtained. At this time, check the motor travel with the dial gauge touched to the servo motor side.

- 7) Fasten the 4 set screws ② with putting the motor on the hexagon bolt for motor's stopper. Notice; In case (Fig.8-2), loosen the set screws ⑫ in the stead of the 4 set screws ②.
- 8) After adjusting, rotate the motor from slow speed to high speed to check no noise occurs.



When remounting the motor, be sure to carefully set O-ring ③.  
Fig.8-2: When you set up the flange, don't forget to set the  
O-ring ③ ⑬.

(In case of TT(M)120, TTS(M)120)

Make sure to put the liquid gasket on the thread part of set screws ② and tighten them firmly.



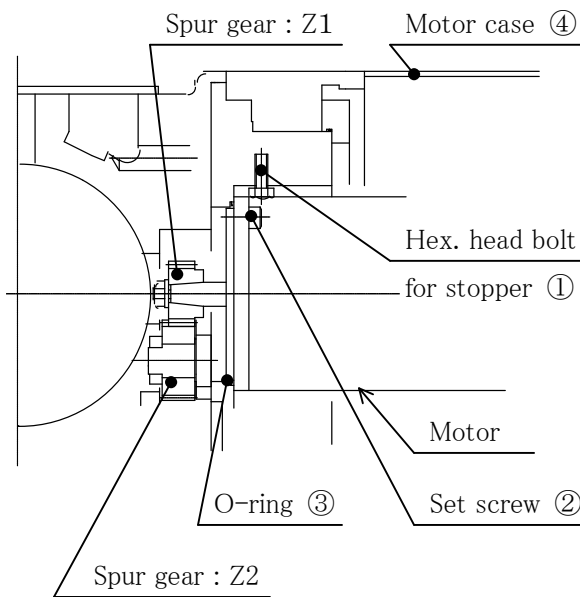


Fig.8-1

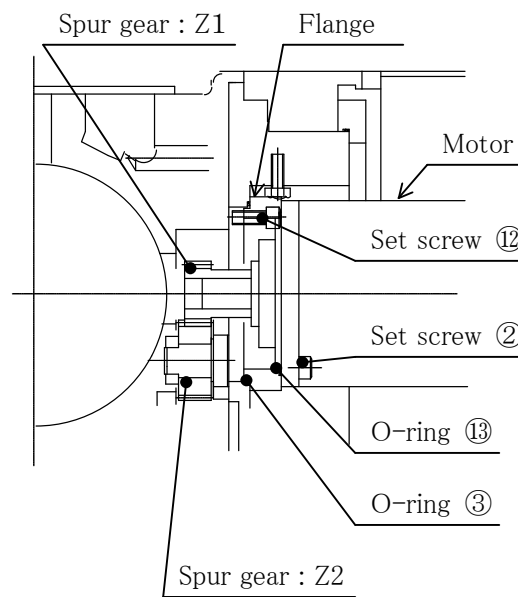


Fig.8-2

**10-2-2. Backlash adjusting method of tilting axis drive spur gear (See Fig.9-1, Fig.9-2, Fig.9-3)**

- 1) Remove the workpiece, jig, etc., on the table before adjusting and level the table.
- 2) Drain the lubricant from the drain port.
- 3) Remove the motor case ①. (Refer to 11-2)
- 4) Touch the hex. socket head cap screw ② for stopper to side face of servo motor. In case of Fig.9-2 (with flange), touch the hex. socket to the face of flange.
- 5) Slightly loosen four screws ③ which fix the servo motor. When there is another flange on the motor loosen the 4 bolts ③ lightly.
- 6) Tune the hex. head bolt ② for stopper to left, return it and lower the servo motor until the backlash becomes nearly zero(0).
- 7) (In case of TT(M)101)  
The proper backlash is 0.02~0.04mm. When turning the bolt 10° (1/36-turn) to right, the backlash of 0.016mm can be obtained. At this time, check the motor travel with the dial gauge touched to the servo motor side.  
(In case of TT(M)120)  
The proper backlash is 0.01~0.03mm. When turning the bolt 10° (1/36-turn) to right, the backlash of 0.02mm can be obtained. At this time, check the motor travel with the dial gauge touched to the servo motor side.
- 8) Securely tighten screws ③, dabbing the hex. head bolt ② to the motor.
- 9) After adjusting, rotate the motor from slow speed to high speed to check no noise occurs.



When moving the motor, be careful not to damage the O-ring ④.

The damaged O-ring ④ may allow the cutting water to enter the motor case.

Fig.9-2; When you set up the flange, be sure to carefully set the O-ring ④ ⑭.

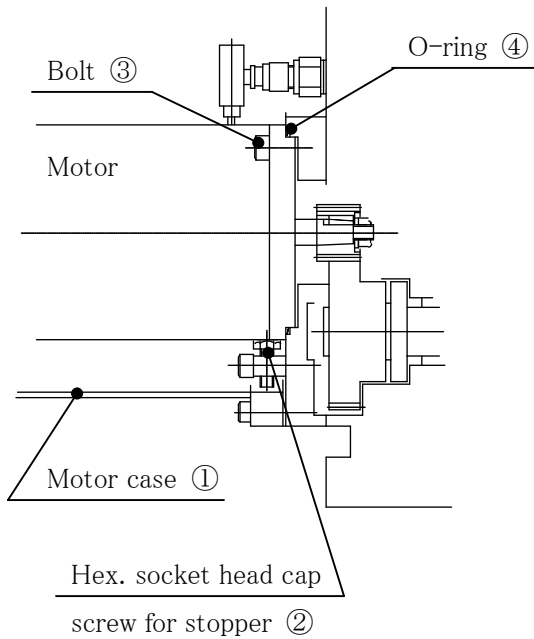


Fig.9-1 (TT(M)101,TT(M)120)

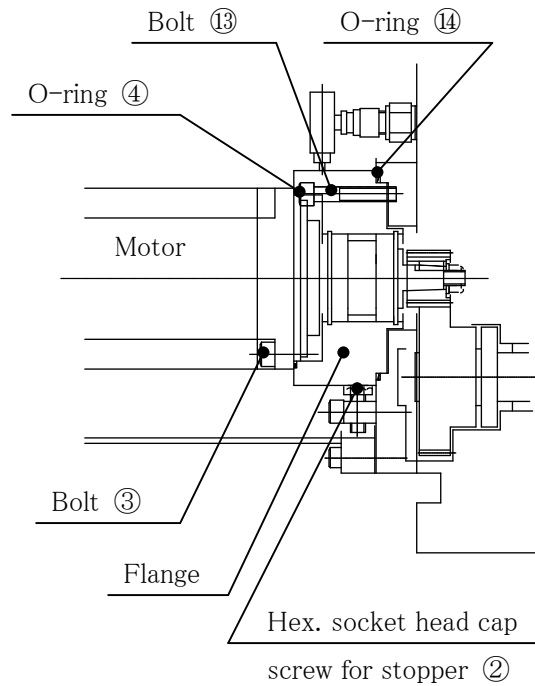


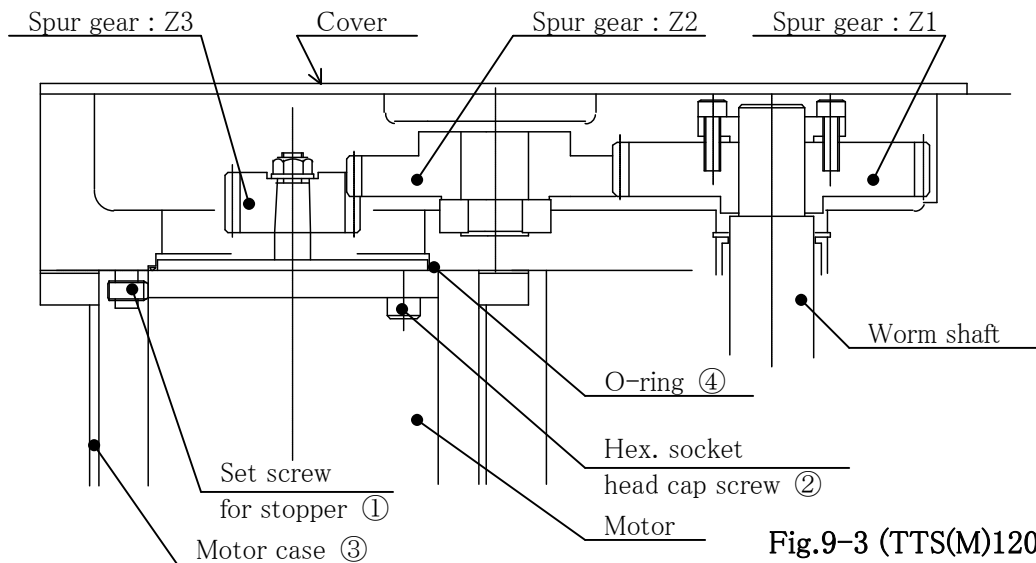
Fig.9-2 (TT(M)120)

(In case of TTS(M)120)

Refer to clause 10-2-1 because it is a structure similar to the table rotation axis side.



When remounting the motor, be sure to carefully set O-ring ④.



### 10-3. ZRN device

\*\*\*\*\*

The contents of this item are unnecessary for the NC rotary table of Kitagawa's controller spec. and 4th and 5th axes spec. which don't have a Proximity switch for ZRN deceleration.

(In case of Kitagawa's controller spec)

Machine zero position of this unit which set at shipment from factory is memorized due to the specification of servo motor with absolute encoder. Accordingly this unit does not have machine zero position device like as proximity SW and Dog.

When changing machine zero position, instruction manual of controller (article for setting of machine zero position) would be referred.

\*\*\*\*\*

#### 10-3-1. ZRN device on table (See Fig.10-1, Fig.10-2)

The ZRN device rotates clockwise (CW) on the standard specification. The ZRN deceleration dog is mounted in the table and it can be mounted on the optional position of outer periphery. When changing the ZRN position or ZRN rotary direction counterclockwise, the dog position can be changed by the following procedure.

- 1) Drain the lubricant from the drain port.
- 2) Remove the cover ①.
- 3) Loosen the set screws ③ which fix the dog ②.
- 4) Shift the dog to the proper position.
- 5) After adjusting the position, securely tighten the set screws ③.

## NOTICE

(TT(M)101)

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

(TT(M)120,TTS(M)120)

When setting the cover ① again after adjusting the dog position, be sure to evenly coat seal agent on the cover ①. (The seal agent 1216 made by Three Bond Co., has already been coated on the cover ① before shipping.)

The proximity switch is provided as the sensor for detecting the dog. The gap between the dog and the switch is set to about 0.75mm. (The thread pitch for mounting the proximity switch is 1mm.) The proximity switch is equipped with the lamp. Since the lamp goes out when the dog is detected, use it when the dog is adjusted.

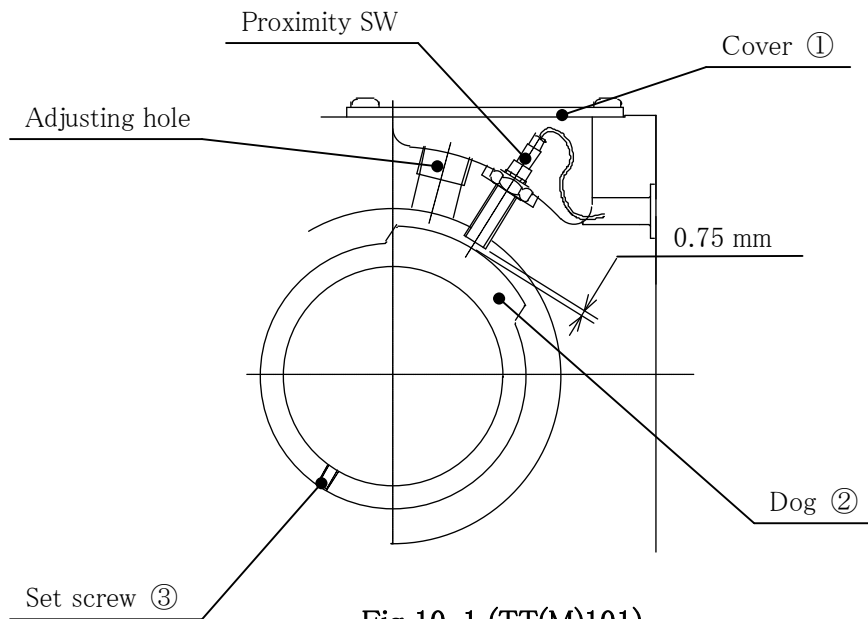
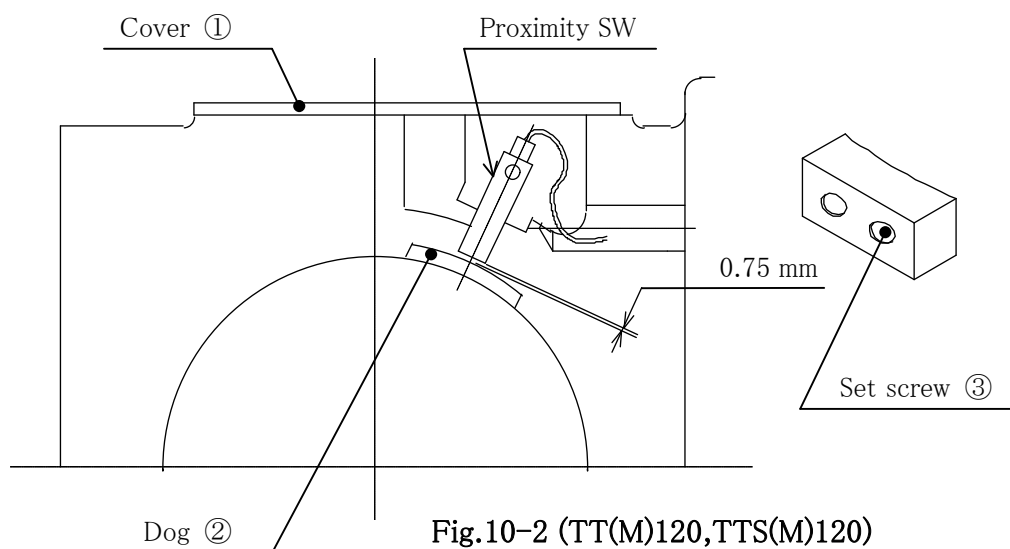


Fig.10-1 (TT(M)101)



### 10-3-2. Tilting axis ZRN device (See Fig.11: TT(M)101)

There is the proximity switch in the motor case for rotating axis motor drive.

The horizontal table face is the datum as the standard specification. The dog ① of Fig.11 is detected with the proximity switch ②.

Rotating axis body rotate with the dog.

When you change the vertical mechanical-zero position from horizontal one (standard spec), It is necessary to replace the dog ① on the position of angle ( $\theta_h$ ) formed between rotating axis and proximity switch at the vertical table position.

The ZRN position can be changed by the following procedure.

- 1) Remove the hexagon socket flange head screw plug in the lubrication port.
- 2) Loosen the set screws ③ which fix the dog ② from the lubrication port.
- 3) Turn the rotating axis body staying the dog.
- 4) After adjusting the position, securely tighten the set screws ③.

$\theta_h^\circ$  : At the horizontal mechanical-zero position, angle formed between rotating axis and proximity switch

$\theta_v^\circ$  : At the vertical mechanical-zero position, angle formed between rotating axis and proximity switch

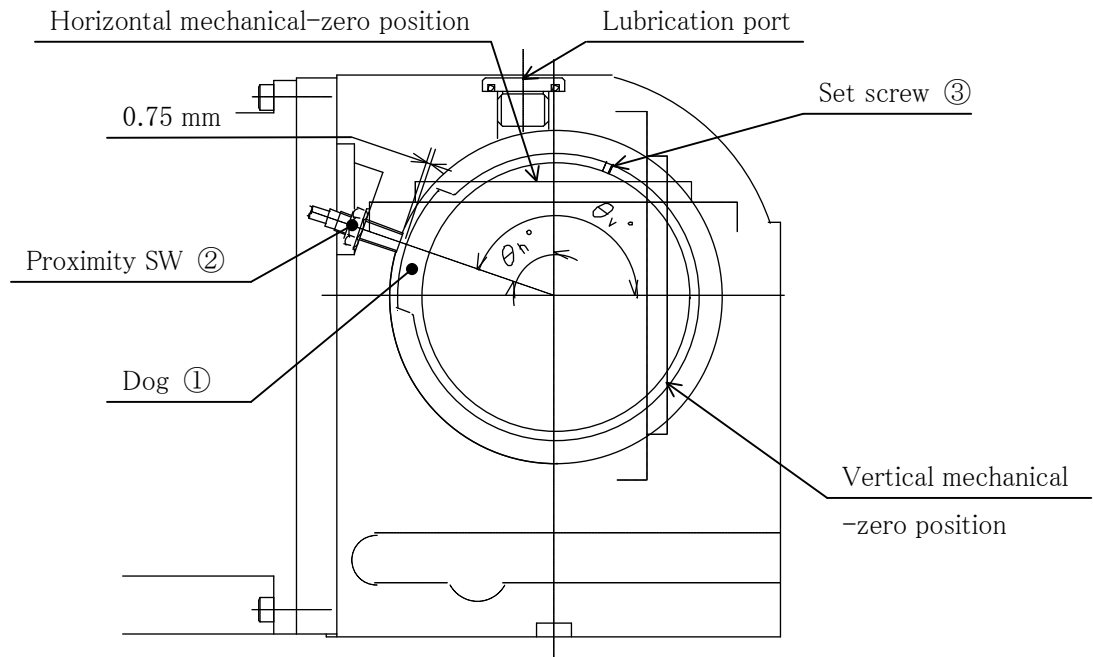


Fig.11 (TT(M)101)

**10-3-3. Tilting axis ZRN device (See Fig.12: TT(M)120,TTS(M)120)**

- 1) This is the proximity switch and the dog in the motor case.
- 2) The horizontal table face is the datum as the standard specification. The dog ① of Fig.12 is detected with the proximity switch ②.
- 3) When you change the vertical mechanical-zero position from horizontal one (standard spec), Please contact of our company.

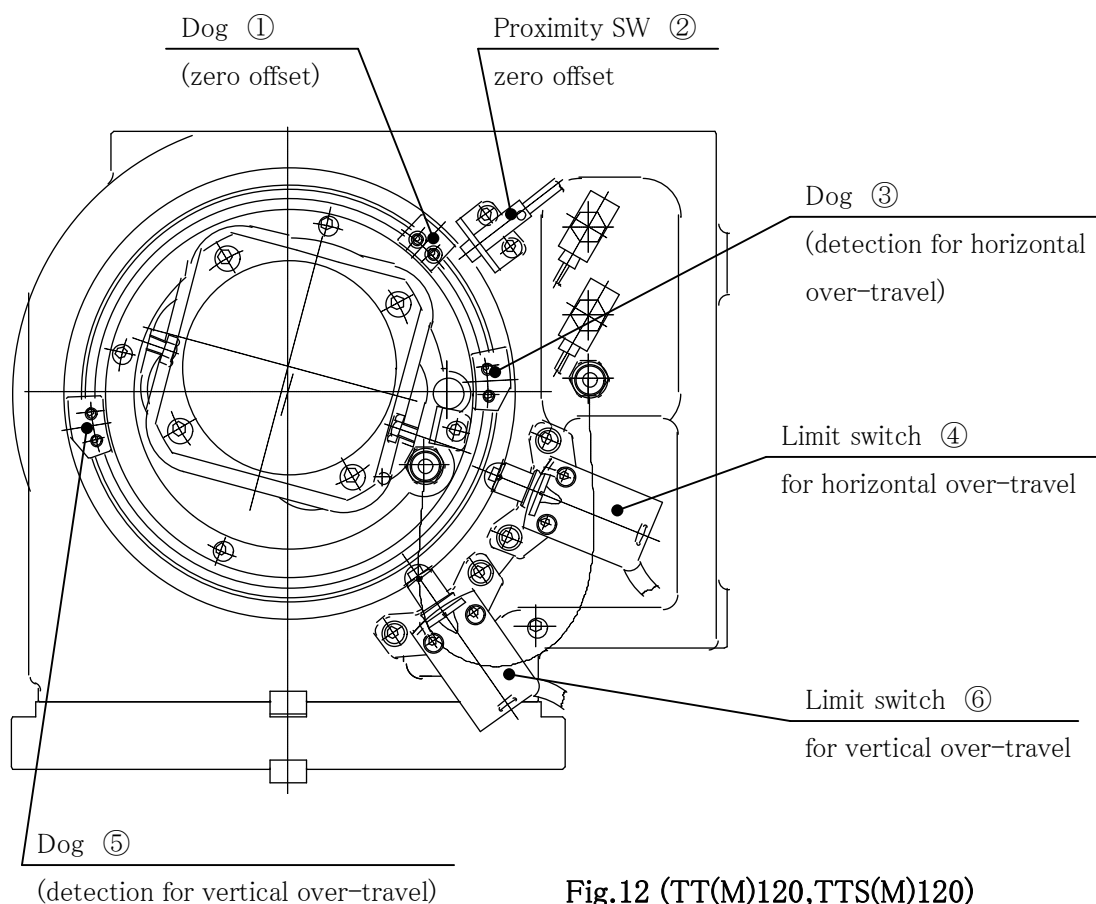


Fig.12 (TT(M)120,TTS(M)120)

#### 10-4. The equipment for stopping the over-travel

(TT(M)101: See Fig.13)

The dog for emergency stop of stroke limit of tilting axis and limit switch are inside the motor case. The dog B ③ located on the stroke limit to the (-) direction is detected with the limit switch B ②. The dog A ④ located on the stroke limit to the (+) direction is detected with the limit switch A ①. The angle of 20° to the (-) direction and the angle of 120° to the (+) direction is provided until the emergency stop is applied.

The stroke limit can be changed by the following procedure by the shape of work and jig.

- 1) Remove the motor case for rotating axis motor drive.
- 2) Loosen 4 set screws ⑤ which fix the dogs.
- 3) Tighten the set screws after move the dogs to the proper position.

(Adjusting area of (-) direction is from 0° to 20° .)

(Adjusting area of (+) direction is from 90° to 120° .)



Since it becomes the cause of a trouble when moving the dogs, be careful of the dog position.



After adjusting, rotate the motor for tilting axis from slow speed to high speed to check.

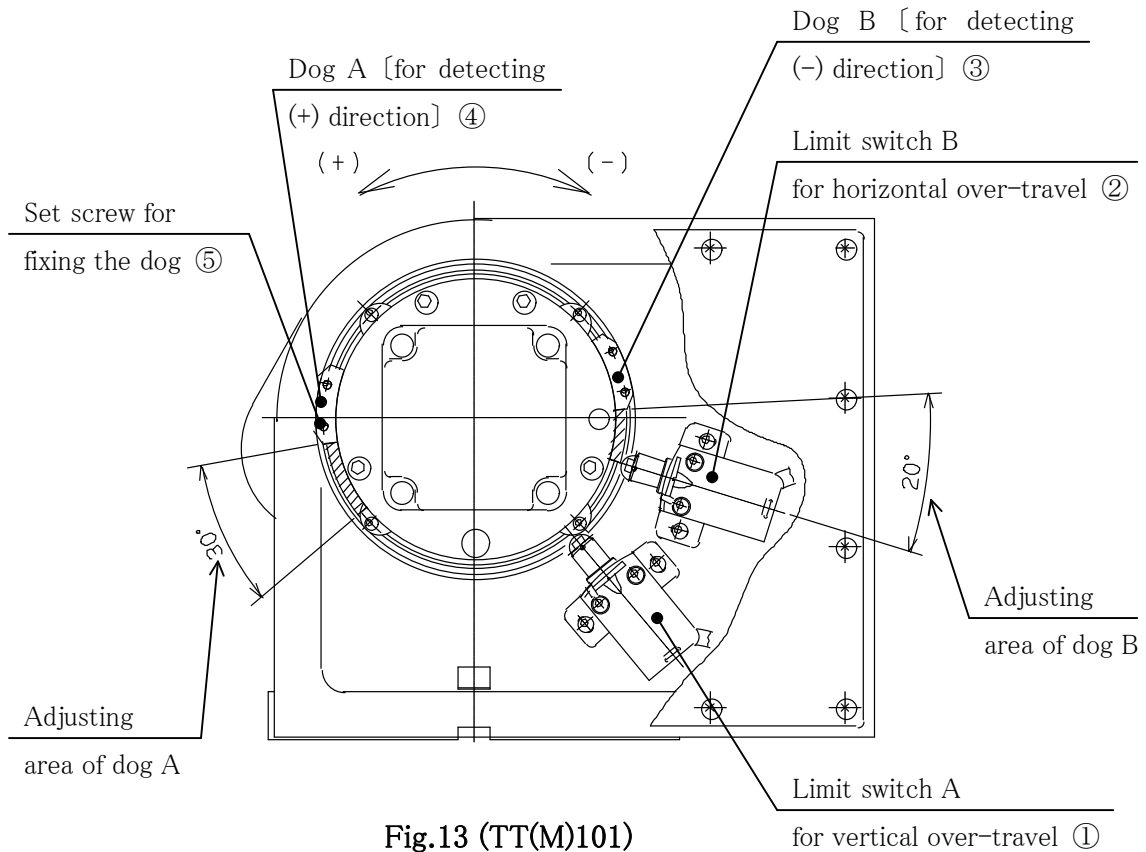


Fig.13 (TT(M)101)

This figure shows the dog positions when the table is level.

(TT(M)120, TTS(M)120: See Fig.12)

- 1) The dog for emergency stop of stroke limit of tilting axis and limit switch are inside the motor case.
- 2) The dog ③ of Fig.12 located on the stroke limit on the horizontal table face position is detected with the limit switch ④.
- 3) The dog ⑤ located on the stroke limit on the vertical table face position is detected with the limit switch ⑥.
- 4) The angle of 20° is provided until the emergency stop is applied from the horizontal and vertical positions of table face. Provide the soft limit by the work shape, etc.



## 11. Motor case

### 11-1. Motor case for rotating axis motor drive

#### 11-1-1. Dismount (See Fig.14)

Please follow the procedure below for removing the motor case ①.

- 1) Remove the cover ② of the motor case ① and remove wiring and air hose and the canon connector of the motor ⑤.
- 2) Loosen the hexagon socket head cap screws ④ , which sets the motor case ① on the gear box ⑦ and carefully detach the motor case ① by lifting the case upward.

#### 11-1-2. Waterproofing

In order to prevent the entering of coolant from the outside, O-ring ④ is used at the portion of connection between motor case ① and the body, and sealing compound (Three Bond Company Seal Compound 1216 or similar) is used at the portion of connection between motor case ① and cover ②.



When the motor case ① is re-installed, be careful not to damage the O-ring ⑥. The damaged O-ring ⑥ may allow the cutting water to enter the motor case. When the cover ② is re-installed, make sure to strip the existing sealing compound and uniformly apply with new sealing compound to the mounting face.



When the cover ② is re-installed, be careful not to break a hose.

A hose that is connected from a notch of motor flange must be turned around a motor to the counterclockwise (CCW). (Refer to View B)

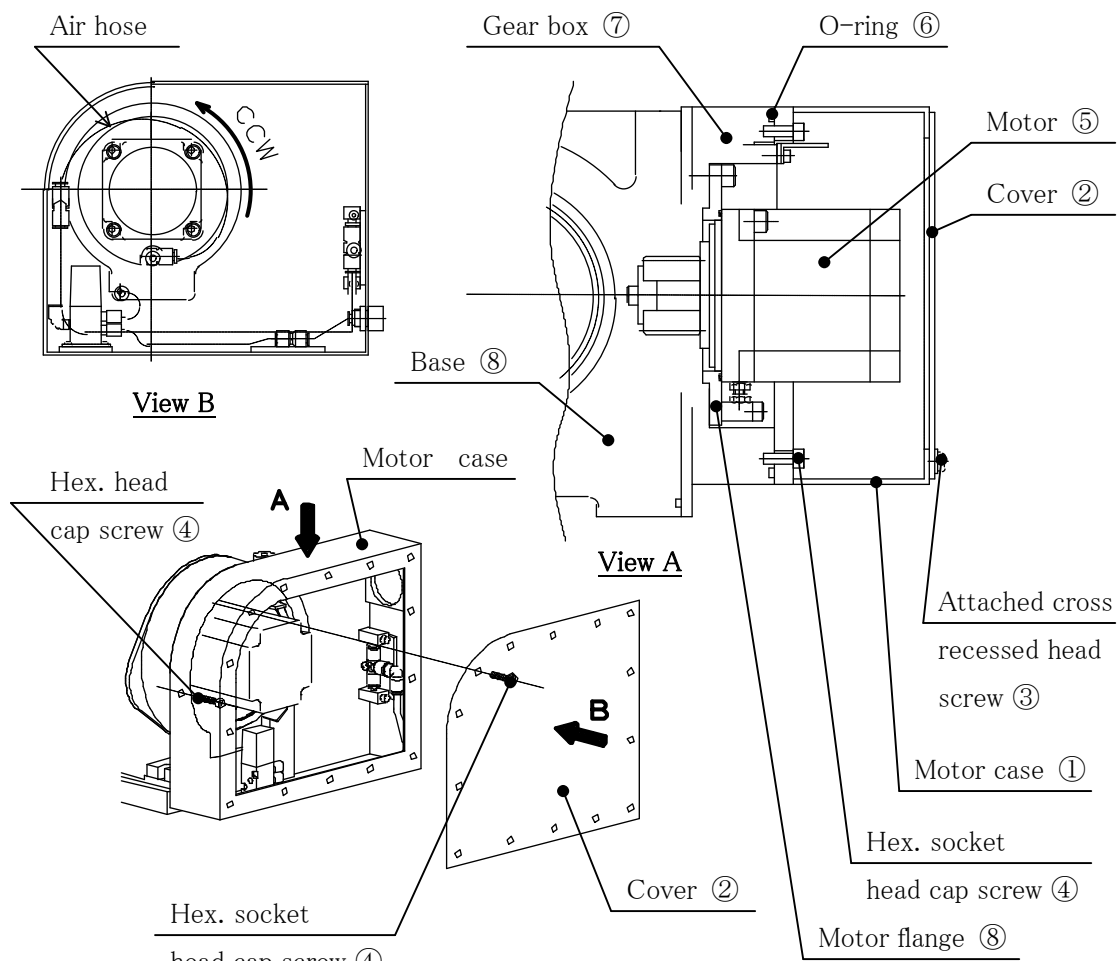


Fig.14

## 11-2. Motor case for tilting axis motor drive

### 11-2-1. Dismount (See Fig.15)

Please follow the procedure below for removing the motor case ①.

- 1) Remove the cover of the motor case ① and remove wiring and air hose and the canon connector of the motor ⑥.
- 2) Loosen the hexagon socket head cap screws ③, which set the motor case ① on the gear box ② and carefully detach the motor case ① by lifting the case upward.

### 11-2-2. Waterproofing

In order to prevent the entering of coolant from the outside, O-ring ⑥ is used at the portion of connection between motor case ① and the body, and sealing compound (Three Bond Company Seal Compound 1216 or similar) is used at the portion of connection between motor case ① and cover.



When the cover is re-installed, make sure to strip the existing sealing compound and uniformly apply with new sealing compound to the mounting face.



When the motor case ① is re-installed, be careful not to damage the O-ring ④. The damaged O-ring ④ may allow the cutting water to enter the motor case. When the motor case ① is re-installed, be careful not to break a hose.

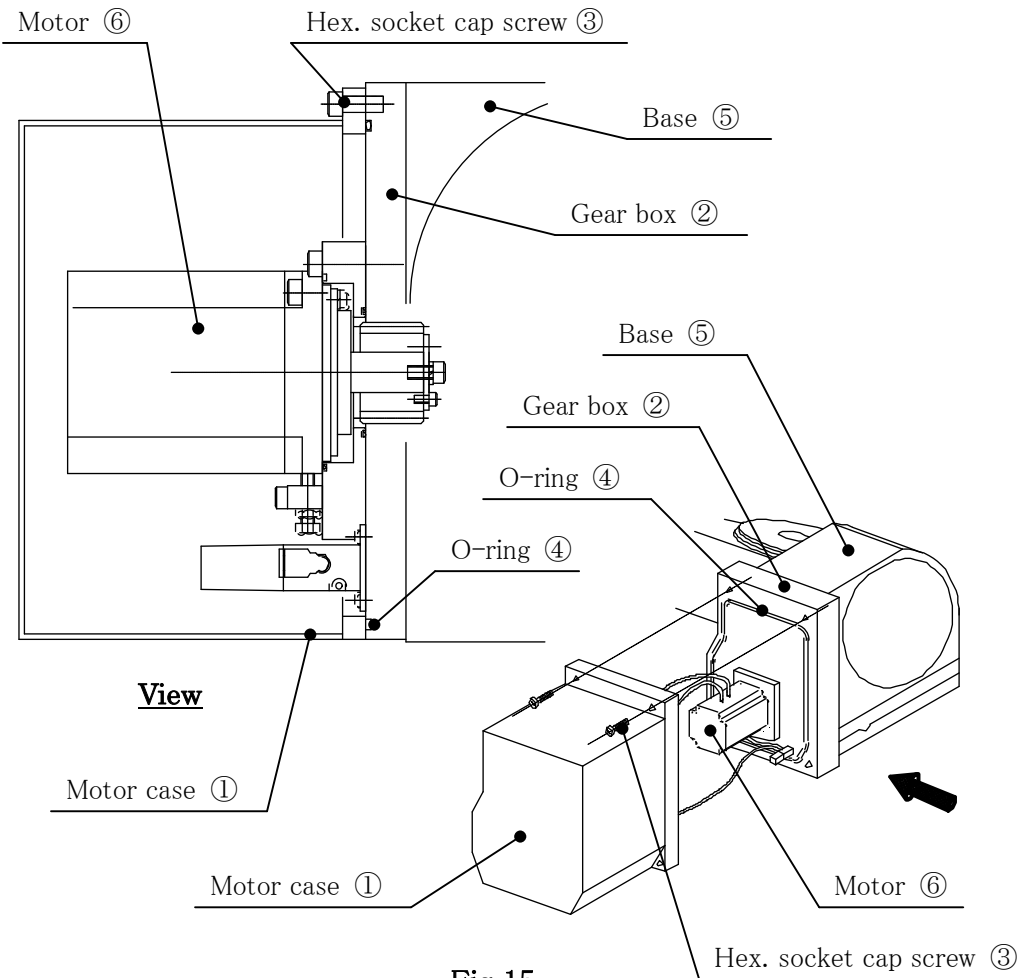
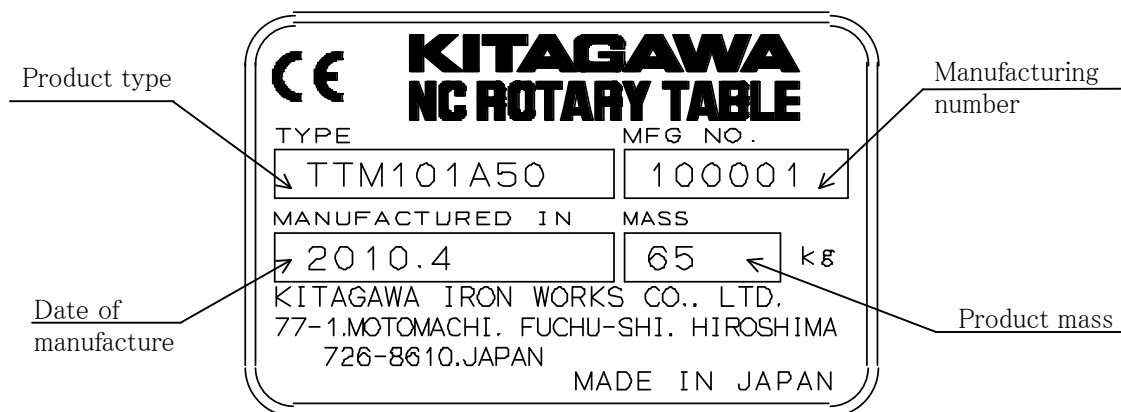


Fig.15

## 12. 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.
Air is sealed in by the check valve (GT only)	See “Manual clamp release method” (GT only)

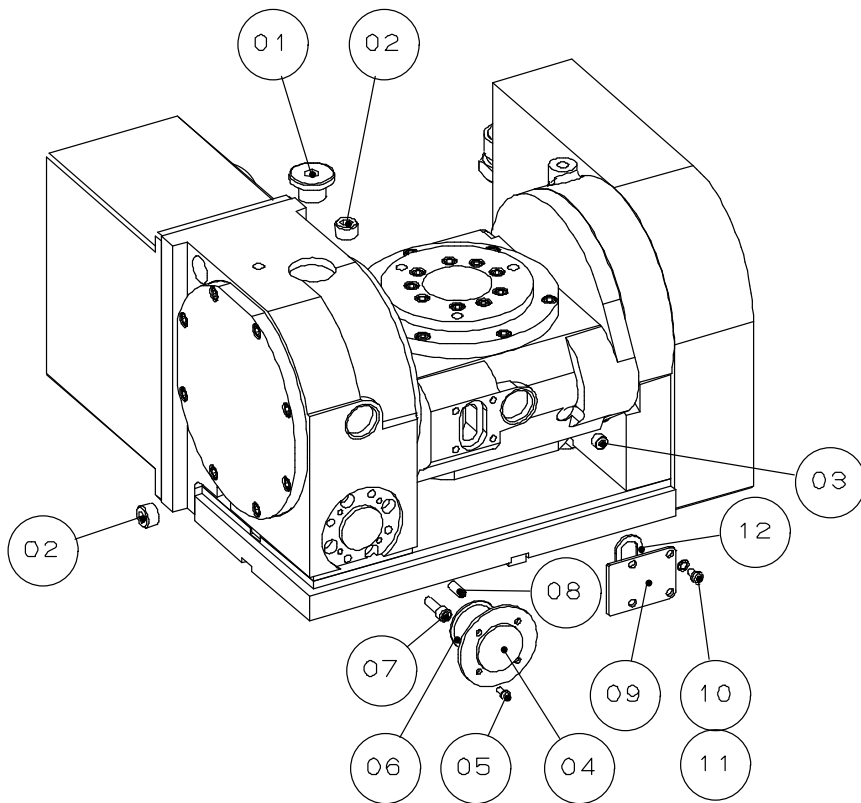
Symptom ⑥: Index accuracy error

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.

### 13. Parts List

○ Main Body

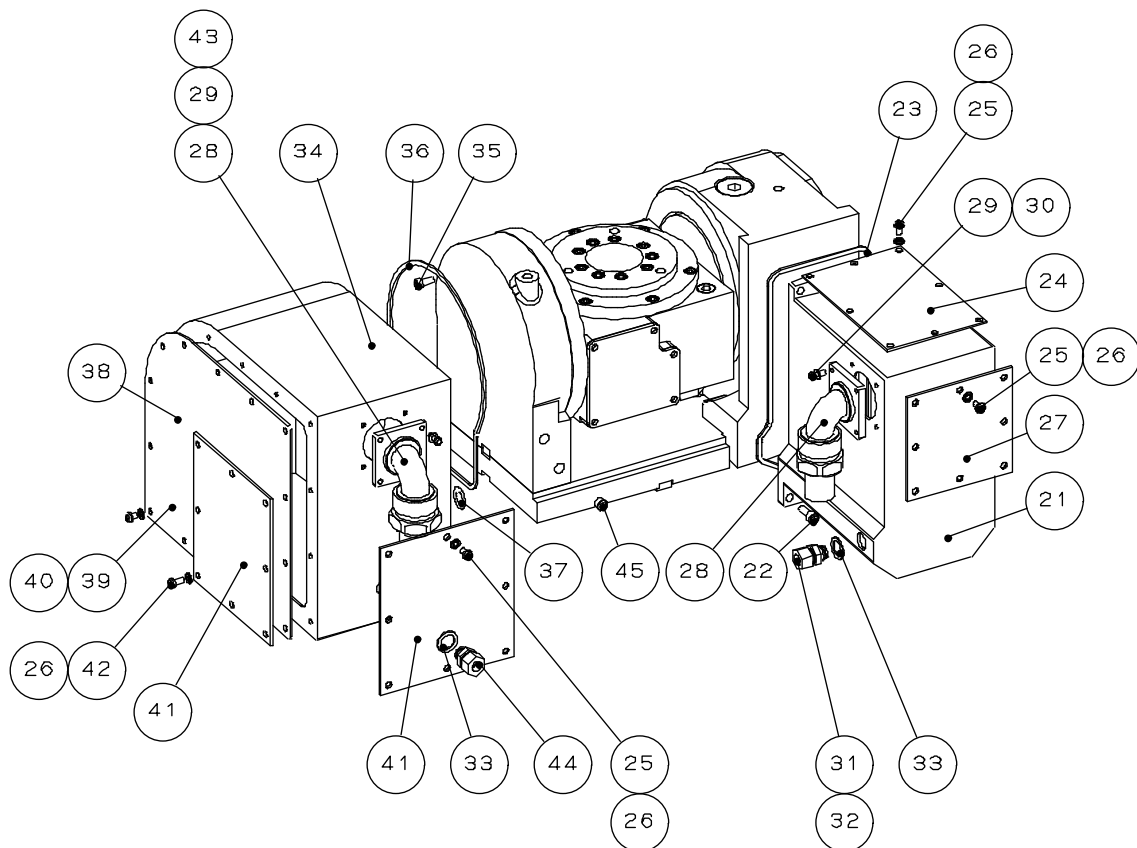
MARK	NAME	TT(M)101	TT(M)120 TTS(M)120	Q'ty	Recital
01	Hexagon socket flange head screw plug with O-Ring	M20x1.5	—	1	Gosho
	Hexagon socket headless tapered pipe plug	—	Rc1/2		
02	Hexagon socket headless tapered pipe plug	Rc3/8		2	
03	Hexagon socket headless tapered pipe plug	Rc1/8	Rc3/8	1	
04	Cover (1)			1	
05	Machine screw	M4x8 (4)	M5x8 (3)	(*)	
06	O-Ring	S35.5	G65	1	
07	Socket Head Cap Screw	M6x20		4	
08	Hexagon socket headless set screw (Flat Point)	M6x16 (4)	M8x16 (8)	(*)	
09	Cover (2)			1	
10	Machine screw	M5x8		4	
11	Seal washer	5S1	—	4	
12	O-Ring	G25	—	1	



○ Motor Case(For M Signal)

MARK	NAME	TT(M)101	TT(M)120 TTS(M)120	Q'ty	Recital
21	Motor case (1)			1	
22	Socket head cap screw	M6x16 (4)	M5x20 (7)	(*)	
23	O-ring	GS180	—	1	
24	Cover (1)	—		1	
25	Machine screw	—	M5x8	24	
26	Seal washer	—	5	32	
27	Cover (2)	—		1	
28	Connector plate			2	
29	Machine screw	M4x12	M5x12	8	
30	Washer	4	—	4	
	Seal washer	—	5		
31	Bulkhead connector	KQE06-01	—	1	SMC
	Male nylon cap	—	Rc1/8		
32	Male connector	—	KJS06-01S	1	SMC
33	Seal washer	14S1	—	2	
34	Motor case (2)			1	
35	Socket head cap screw	M5x12 (7)	M5x16 (14)	(*)	
36	O-ring	GS185	—	1	
37	O-ring	P16	—	1	
38	Cover (3)			1	
39	Machine screw	M5x6 (14)	M5x8 (7)	(*)	
40	Seal washer	5 (14)	5 (7)	(*)	
41	Cover (4)	—		2	
42	Machine screw	—	M5x10	8	
43	Washer	4	5	4	
44	Bulkhead connector	KQE06-01	—	1	SMC
45	Male nylon cap	—	Rc1/8	1	



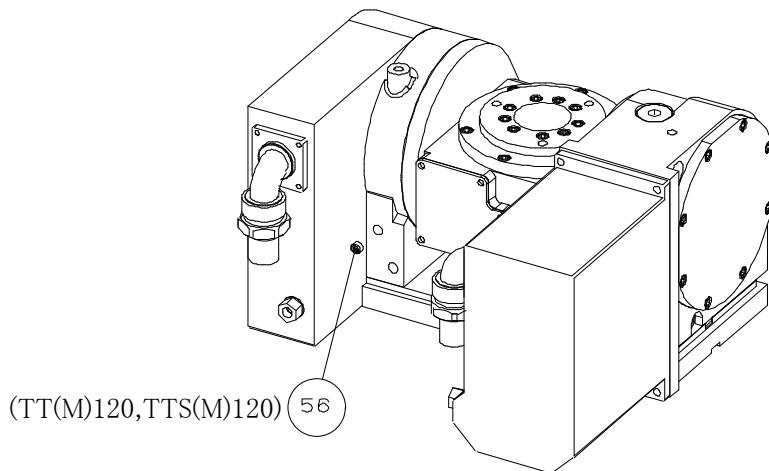
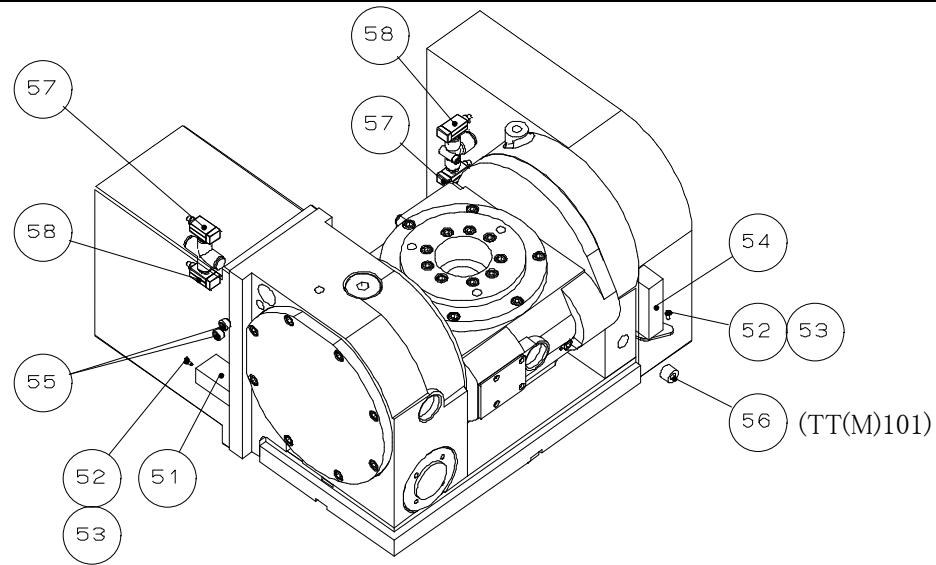


When the specification is 4th and 5th axes, the motor case and the cable are different from the above figure.

For detailed models, refer to attached outside view.

○ Clamp Detection Device

MARK	NAME	TT(M)101	TT(M)120 TTS(M)120	Q'ty	Recital
51	Solenoid valve	VK332-5DS-M5-F-Q	VK334-5DS-Q	1	SMC
52	Machine screw	M3x6	M3x25	4	
53	Spring washer	—	3	4	
54	Solenoid valve	VK332-5DS-M5-F-Q	VK334-5DS-Q	1	SMC
55	Plug silencer	PSA101 (2)	PSA101 (1)	(*)	TAIYO
56	Plug silencer	PSA102	PSA101	1	TAIYO
57	Pressure switch for clamp detection	PS1000-R06L-Q-X140		2	SMC
58	Pressure switch for unclamp detection	PS1100-R06L-Q-X141		2	SMC

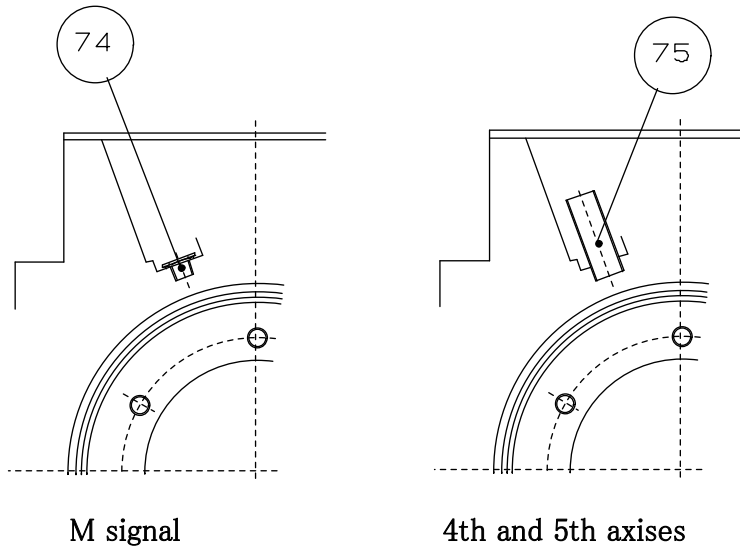
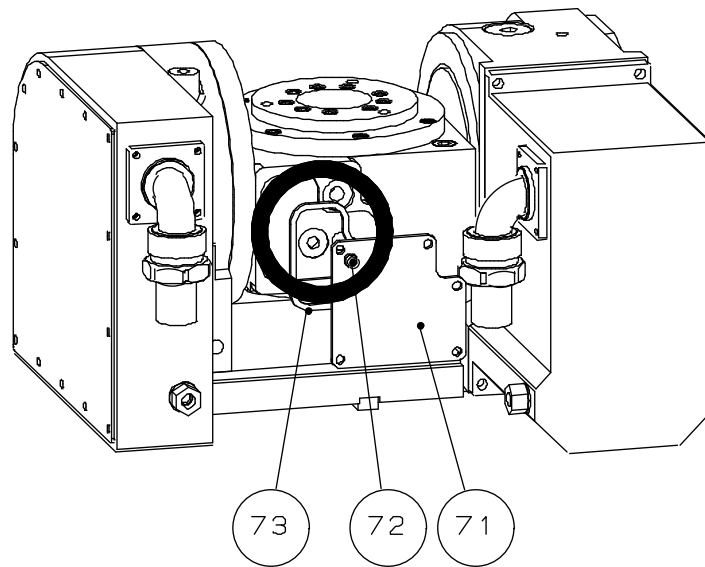


When the specification is different, the model and the installation position of the solenoid valve and the pressure switch are different from the above figure.

For detailed models, refer to attached wiring diagram.

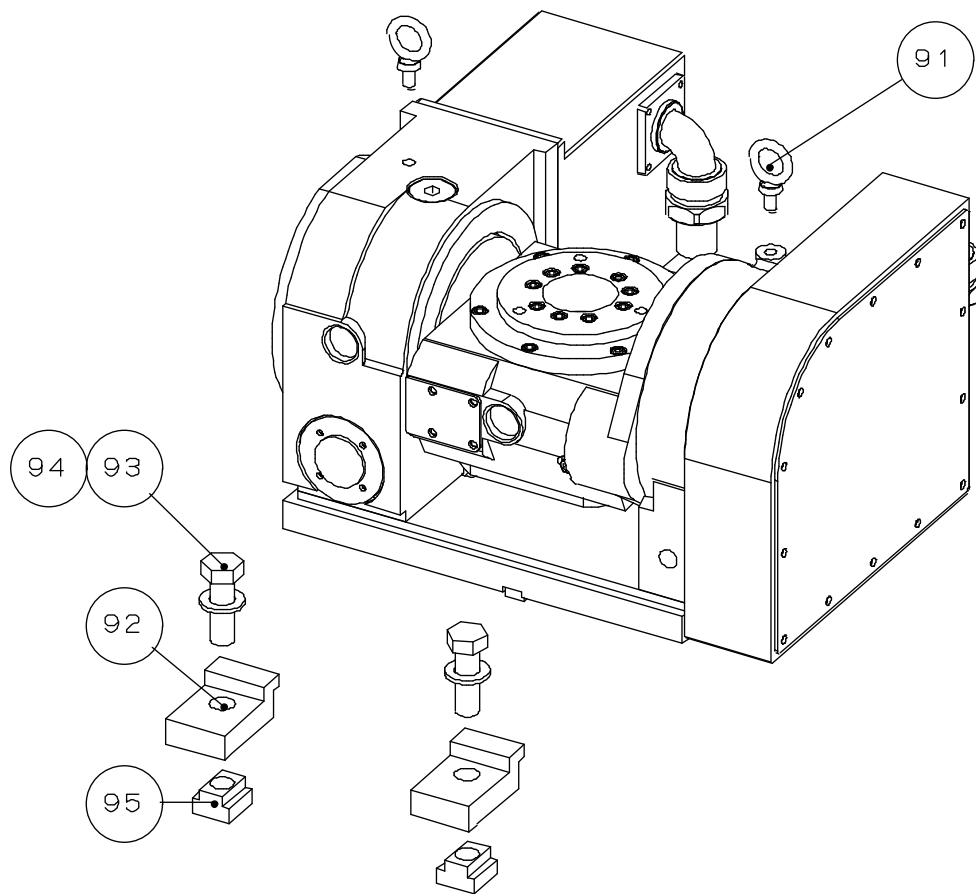
○ Built-in ZRN (Zero Return) Device

MARK	NAME	TT(M)101	TT(M)120 TTS(M)120	Q'ty	Recital
71	Cover			1	
72	Machine screw	M5x8 (5)	M5x10 (6)	(*)	
73	O-ring	G80	—	1	
74	Seal plug	PG8C		1	Showa Yuki
75	Proximity switch	FL7M-2K6H		1	Yamatake



○ Accessory

MARK	NAME	TT(M)101	TT(M)120 TTS(M)120	Q'ty	Recital
91	Eye bolt	M8 (2)	M8 (4)	(*)	
92	Clamp	(2)	(4)	(*)	
93	Hexagon head bolt	M12x40 (2)	M12x50 (4)	(*)	Strength Dimension: 8.8
94	Seal washer	12	—	2	
	Washer	—	12	4	
95	T-slot nut	1412 (2)	1412 (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

## 14. 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.

## 15. 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.

## 16. Reference Data

### 16-1. Conversion of arc length and angle

**NOTICE**

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

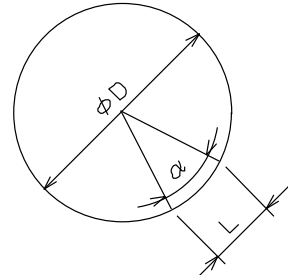
“What is the angle with a cumulative pitch error of 0.01mm ?”

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)

$\alpha$  : 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 (2), 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 (3):

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

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.

### 16-2. Coordinate calculation of table center for tilting angle

The calculation which finds the table center coordinate when tilted  $\theta^\circ$  is shown as follows.  
 For values of E and F, use values entered in the inspection table.

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

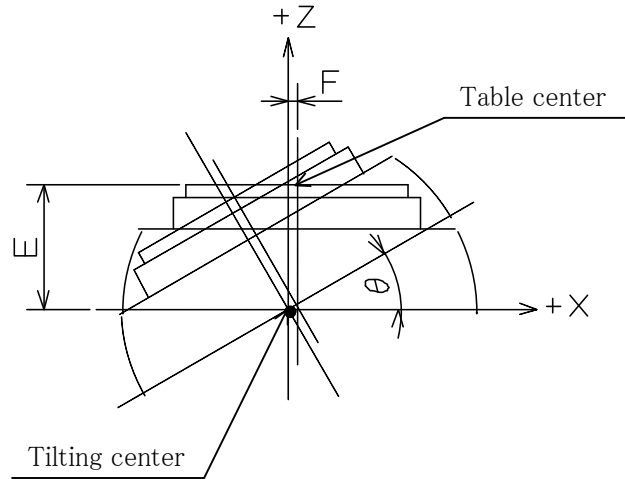
$$Z = E \cos \theta + F \sin \theta - E$$

<Example>

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

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

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

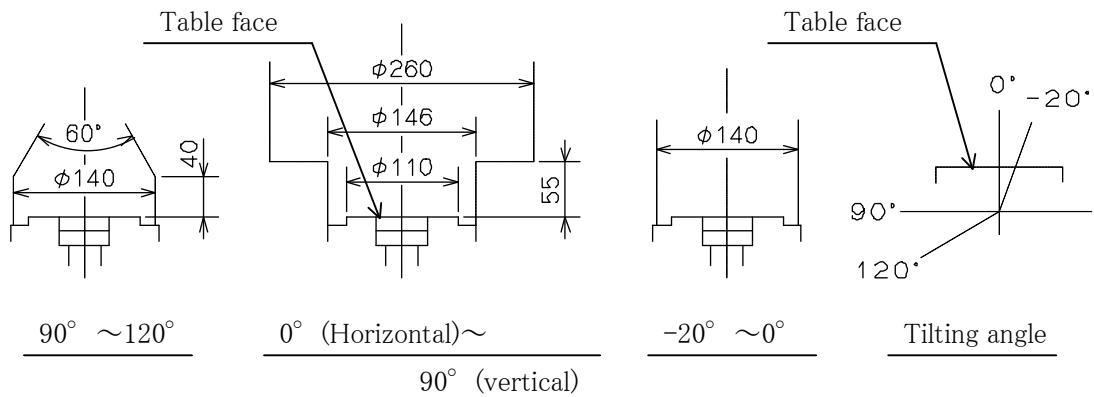


### 16-3. Workpiece interference area

Since the following shows the standard specifications, take care in the case of special specifications.  
 The interference with the clammer 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.

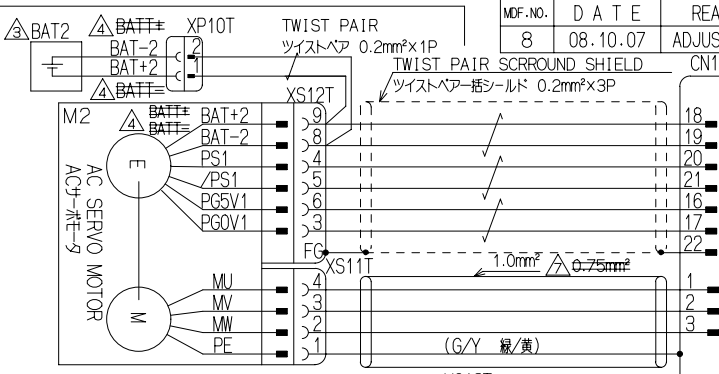




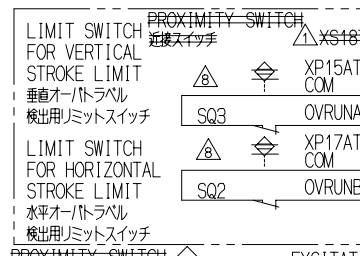


**NOTE 注意**

- SHIELDING WIRES MUST BE USED FOR SIGNAL OF ENCODER.  
エンコーダの信号線はシールド線を使用。
- "FG" IS SHIELD EARTH.  
"FG" はシールドアース。
- "PE" IS EARTH.  
"PE" はアース。
- MOTOR MODEL SHOULD BE REFERRED WITH O.V. DRAWING.  
モーター型番を参照して下さい。
- フレッシュスイッチの共通ラインは-コモンです。  
THE COMMON LINE OF A PRESSURE SWITCH IS (-) COMMON.

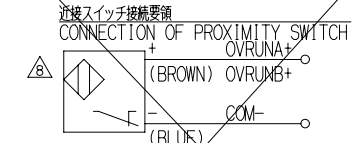
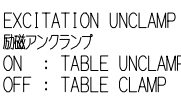
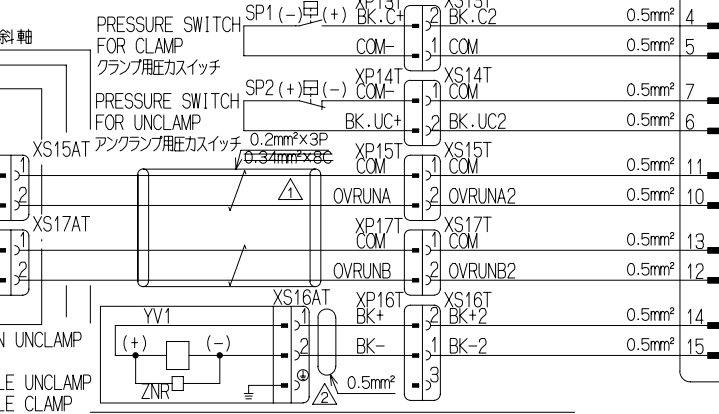


**TILTING AXIS / 傾斜軸**



**SOLENOID VALVE SPECIFICATIONS**

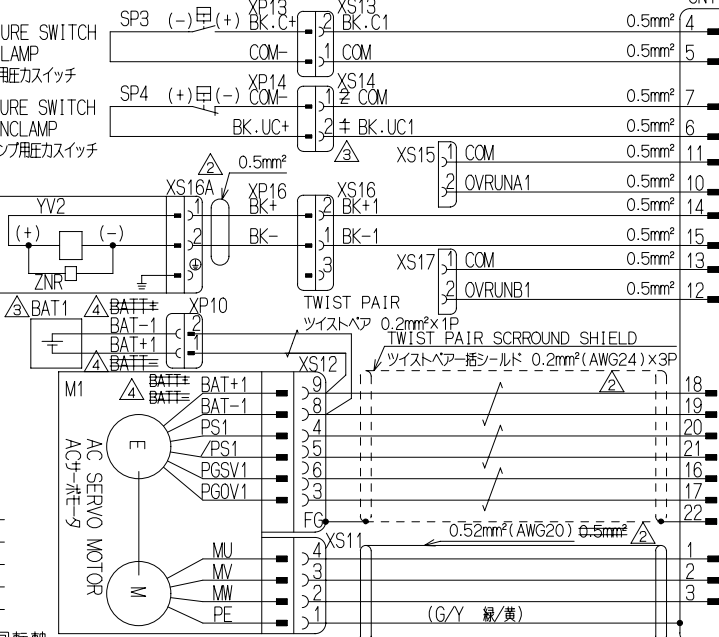
定格電源電圧 RATED SUPPLY VOLTAGE	DC24V
消費電力 POWER CONSUMPTION	4W



**近接スイッチ仕様 SPECIFICATIONS**

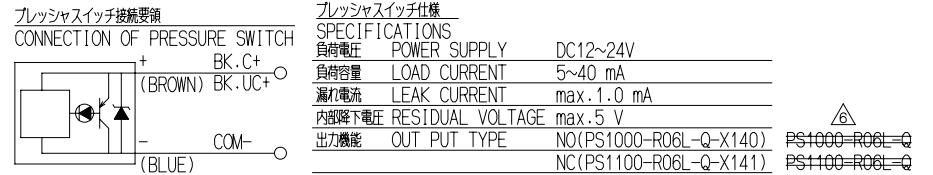
電源電圧 POWER SUPPLY	DC10~30V
負荷容量 LOAD CURRENT	9~100 mA
漏れ電流 LEAK CURRENT	max. 0.55 mA
残留電圧 RESIDUAL VOLTAGE	max. 3.0 V
出力機能 OUT PUT TYPE	NC

**ROTATING AXIS / 回転軸**



MDF. NO.	DATE	REASON OF REVISION	MDF. NO.	DATE	REASON OF REVISION	CUSTOMER
8	08.10.07	ADJUSTMENT (Δ5 PLACES)	4	07.04.23	ADJUSTMENT (Δ7 PLACES)	
			5	07.06.01	ADJUSTMENT (Δ1 PLACE)	1
			6	07.09.20	ADJUSTMENT (Δ3 PLACES)	2
			7	07.11.07	ADJUSTMENT (Δ1 PLACE)	3

MARK 記号	NAME 品名	MAKER メーカー	TYPE 型式	Qty 個数	REMARKS 備考
M1	AC SERVO MOTOR ACサーボモータ	YASKAWA	SGMP5-04A2A6S	1	
M2	AC SERVO MOTOR ACサーボモータ	YASKAWA	SGMAS-08A2A6S	1	
BAT1.BAT2	BATTERY バッテリー	YASKAWA	JZSP-BA01	2	
SP1.SP3	PRESSURE SWITCH フレッシュスイッチ	SMC	PS1000-R06L-Q PS1000-R06L-Q-X140	2	0.25 MPa 1a 0-29 MPa
SP2.SP4	PRESSURE SWITCH フレッシュスイッチ	SMC	PS1100-R06L-Q PS1100-R06L-Q-X141	2	0.055 MPa 1b 0-05 MPa
SQ2.SQ3	LIMIT SWITCH リミットスイッチ	YAMATAKE	LJM-D2502L1	2	DC10~30V
YV1.YV2	SOLENOID VALVE ソレノイドバルブ	SMC	VK332-5GS-M5-F VK332-5DS-M5-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	
XP15T.XP17T XP15AT.XP17AT	PLUG HOUSING プラグハウジング	MOLEX	52116-0242	4	
XP16.XP16T	PLUG HOUSING プラグハウジング	MOLEX	52116-0341	2	
XS13.XS13T XS14.XS14T XS15.XS15T XS17.XS17T	RECE HOUSING リセプタクル	MOLEX	52117-0241	8	
XS15AT.XS17AT	RECE HOUSING リセプタクル	MOLEX	52117-0242	2	
XS16.XS16T	RECE HOUSING リセプタクル	MOLEX	52117-0341	2	
XS16A.XS16AT	CONNECTOR コネクタ	SMC	VK300-82-1	2	SOLENOID VALVE ACCESSORIES ソレノイドバルブ付属品
XP10.XP10T	CONNECTOR コネクタ	HRS	DF3-2EP-2C	2	PIN:DF3-EP2428PCA ピン:DF3-EP2428PCA
XS11T	RECEPTACLE リセプタクル	JST	J37-06FMH-8KL	1	CONTACT : SJ3F-41GF-P1.8 コンタクト : SJ3F-41GF-P1.8 YASKAWA : JZSP-CSM9-3 安川電機 : JZSP-CSM9-3
XS11	RECEPTACLE リセプタクル	JST	J27-06FMH-7KL	1	CONTACT : SJ2F-01GF-P1.0 コンタクト : SJ2F-01GF-P1.0 YASKAWA : JZSP-CSM9-2 安川電機 : JZSP-CSM9-2
XS12.XS12T	CONNECTOR コネクタ	MOLEX	54346-0070	2	54346-0020
CN1	CONNECTOR コネクタ	ILME	CDDM24	2	PIN:CDMA0.3 CDMA0.5 CDMA1.0 ピン:CDMA0.3 CDMA0.5 CDMA1.0
	HOODS フード	ILME	CAV06L21	2	



**フレッシュスイッチ仕様 SPECIFICATIONS**

定格電圧 POWER SUPPLY	DC12~24V
負荷電圧 LOAD CURRENT	5~40 mA
漏れ電流 LEAK CURRENT	max. 1.0 mA
内部降下電圧 RESIDUAL VOLTAGE	max. 5 V
出力機能 OUT PUT TYPE	NO (PS1000-R06L-Q-X140) NC (PS1100-R06L-Q-X141)

CAREER	SCALE	TYPE	TTM101A60	WEIGHT	kg
MANAGER	CHIEF	DRAWN BY	NCテーブル NC ROTARY TABLE		
		DATE	NAME		
		03.11.06	テンキシヨウ		
			WIRING DIAGRAM		
KITAGAWA IRON WORKS CO.,LTD.			DRW NO.	61E-37-1350	

**要注意**

1. 図はTTM101A610を例に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。

CUSTOMER		
MOD. NO.	DATE	REASON OF REVISION

A

B

C

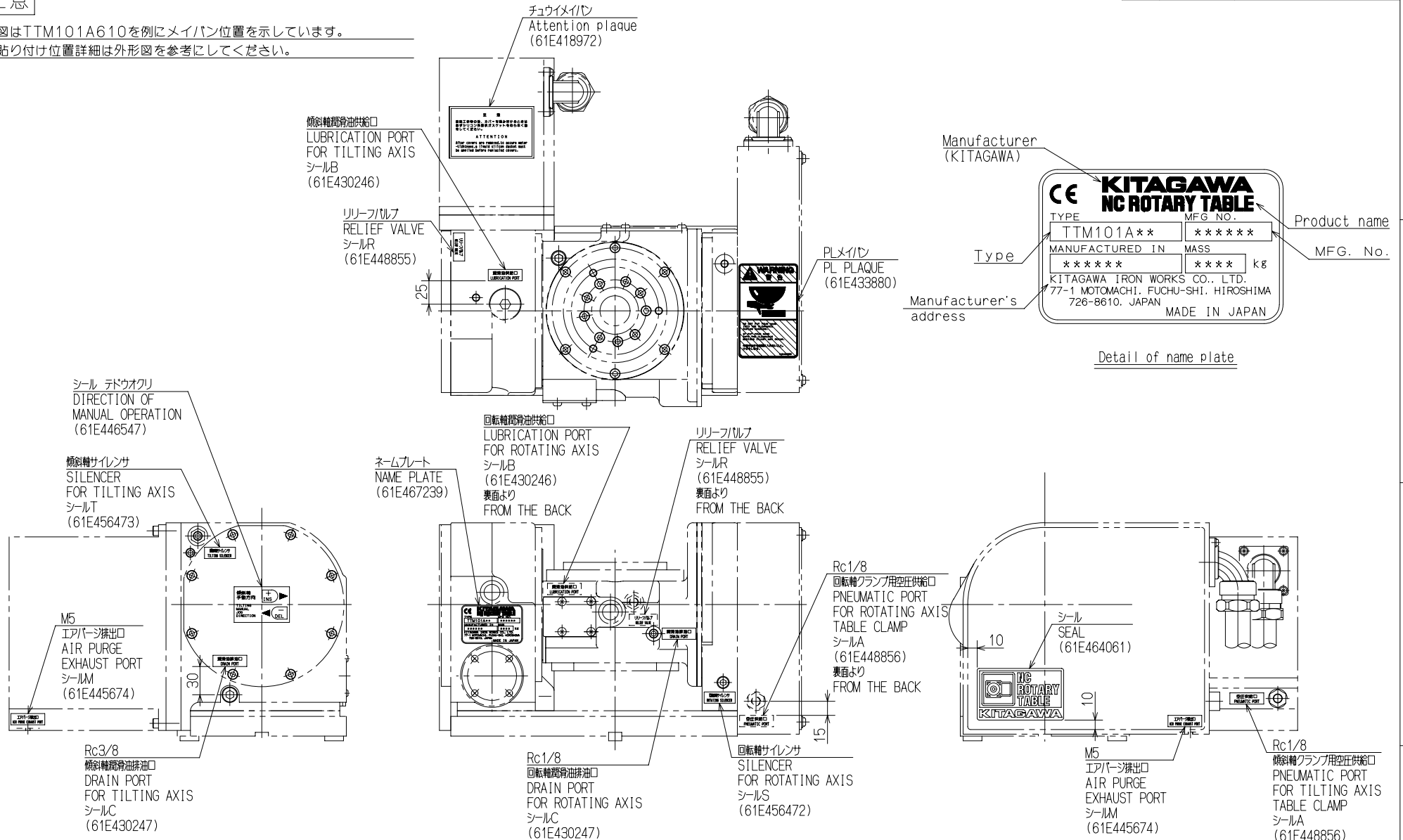
D

A

B

C

D



CAREER		SCALE	TYPE	TTM101A610	WEIGHT	kg
MANAGER	CHIEF	1:4	NAME	NCテーブル NC ROTARY TABLE		
DRAWN BY H. ENDO		3RD ANGLE		メイバン詳細図 DETAILS OF PLAQUE		
KITAGAWA IRON WORKS CO., LTD.		DATE 10.05.17	DRW NO.	61E80	7757	$\begin{matrix} \phi \\ \downarrow \end{matrix}$

1

2

5

6

KITAGAWA IRON WORKS CO., LTD. Machine Tools and Accessories Division URL <http://www.mta.kiw.co.jp/>  
77-1 Motomachi Fuchu city, Hiroshima pref., 726-8610, Japan TEL +81-847-40-0526 FAX +81-847-45-8911

■ Global Network

America Contact	<b>KITAGAWA-NORTHTECH INC.</b> <a href="http://www.kitagawa.com/">http://www.kitagawa.com/</a> 301 E. Commerce Dr, Schaumburg, IL. 60173 USA <b>TEL +1 847-310-8787 FAX +1 847-310-9484</b>
	<b>TECNARA TOOLING SYSTEMS, INC.</b> <a href="http://www.tecnaratools.com/">http://www.tecnaratools.com/</a> 12535 McCann Drive, Santa Fe Springs, California 90670 USA <b>TEL +1 562-941-2000 FAX +1 562-946-0506</b>
Europe Contact	<b>KITAGAWA EUROPE LTD.</b> <a href="http://www.kitagawaeurope.com/">http://www.kitagawaeurope.com/</a> Units 1 The Headlands, Downton, Salisbury, Wiltshire SP5 3JJ, United Kingdom <b>TEL +44 1725-514000 FAX +44 1725-514001</b>
	<b>KITAGAWA EUROPE GmbH</b> <a href="http://www.kitagawaeurope.de/">http://www.kitagawaeurope.de/</a> Reeserstrasse 13, 40474, Dusseldorf Germany <b>TEL +49 211-550294-0 FAX +49 211-55029479</b>
	<b>KITAGAWA EUROPE LTD. Poland Office</b> <b>TEL +48 607-39-8855 FAX +48 32 -49- 5918</b>
Asia Contact	<b>KITAGAWA INDIA PVT LTD.</b> Lotus House East, Lane 'E' North Main Road, Koregaon Park, Pune, 411001, Maharashtra, India <b>Tel: +91 20 6500 5981 Fax: +91 20 6500 5983</b>
	<b>KITAGAWA (THAILAND) CO., LTD. Bangkok Office</b> 9th FL, Home Place Office Building, 283/43 Sukhumvit 55Rd. (Thonglor 13),Klongton-Nua, Wattana, Bangkok 10110, Thailand <b>TEL +66 2-712-7479 FAX +66 2-712-7481</b>
	<b>KITAGAWA IRON WORKS CO., LTD. Singapore Branch</b> #02-01 One Fullerton, 1 Fullerton Road, Singapore 049213 <b>TEL +65 6838-4318 FAX +65-6408-3935</b>
	<b>KITAGAWA IRON WORKS CO., LTD. Shanghai Representative Office</b> Room1315 13F Building B. Far East International Plaza,No.317 Xian Xia Road, Chang Ning, Shanghai, 200051China <b>TEL +86 21-6295-5772 FAX +86 21-6295-5792</b>
	<b>DEAMARK LIMITED</b> <a href="http://www.deamark.com.tw/">http://www.deamark.com.tw/</a> No. 6, Lane 5, Lin Sen North Road, Taipei, Taiwan <b>TEL +886 2-2393-1221 FAX +886 2-2395-1231</b>
	<b>KITAGAWA KOREA AGENT CO., LTD.</b> <a href="http://www.kitagawa.co.kr/">http://www.kitagawa.co.kr/</a> 803 Ho, B-Dong, Woolim Lion's Valley, 371-28 Kansan-Dong,Kumcheon-Gu, Seoul, Korea <b>TEL +82 2-2026-2222 FAX +82 2-2026-2113</b>
Australia & New Zealand Contact	<b>DIMAC TOOLING PTY LTD.</b> <a href="http://www.dimac.com.au/">http://www.dimac.com.au/</a> 61-65 Geddes Street, Mulgrave, Victoria, 3170 Australia <b>TEL +61 3-9561-6155 FAX +61 3-9561-6705</b>

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