

KITAGAWA

NC ROTARY TABLES

OPERATION MANUAL

MODEL: TB-180

TB-250

TB-320



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.

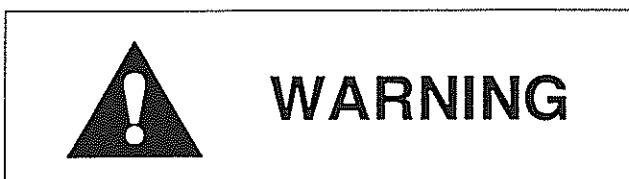
This NC Rotary Table has been designed to provide years of high precision performance. To ensure optimum and trouble-free performance, please read this operation manual carefully before using the unit and retain this copy for your future reference.

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

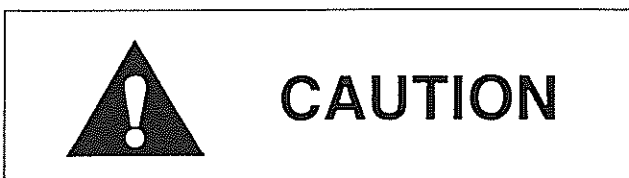
WARNING



This procedure will cause a major accident.

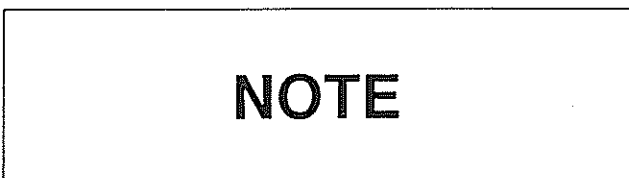


This procedure may cause a major accident.



This procedure may cause a minor accident or damage to the unit.

NOTE



The information may help to improve the productivity of the unit.

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1..For Your Safety

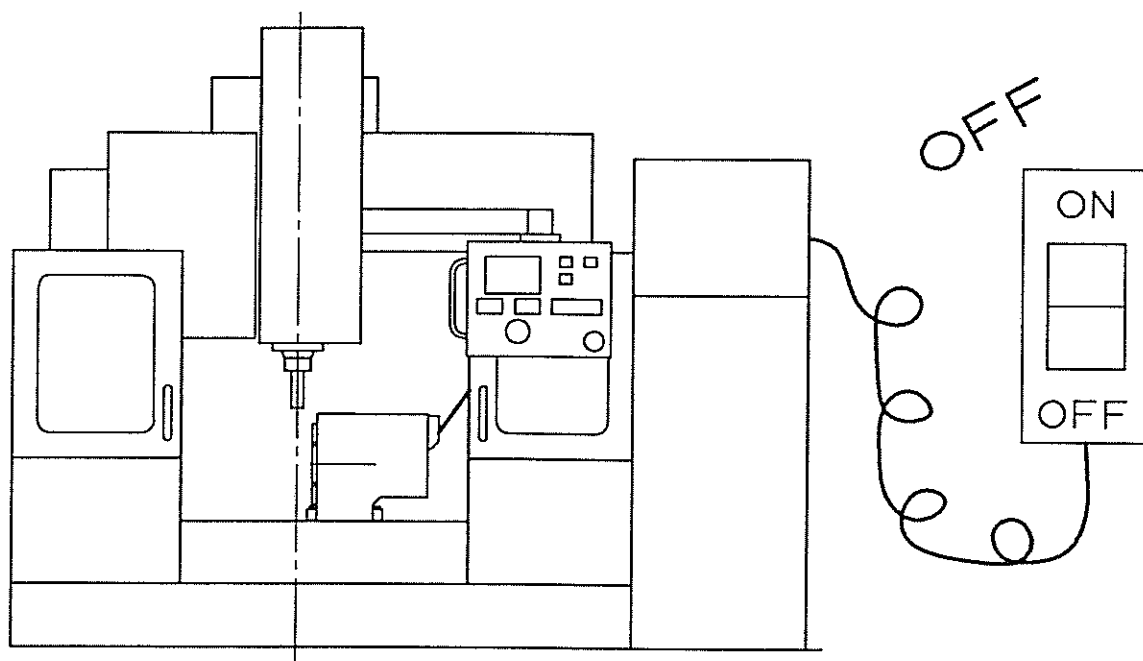
Basic Safety Tips



DANGER



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.



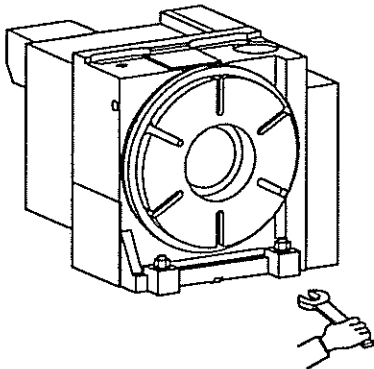


WARNING



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

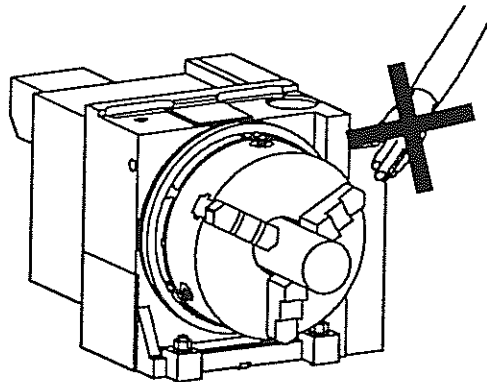
Please refer to the chart below for the recommended tightening torque of the bolts.



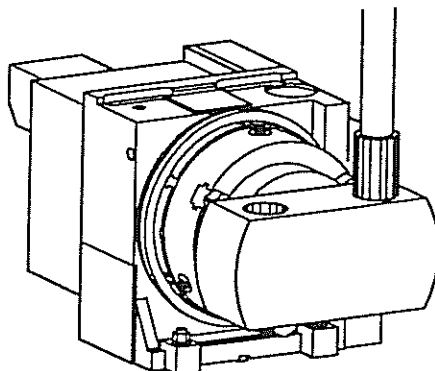
Hex Bolt Size	Torque (kgf.m)
M10	7.4
M12	11.0
M16	25.5
M20	41.0



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



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

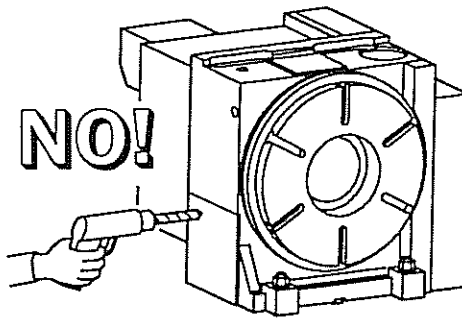




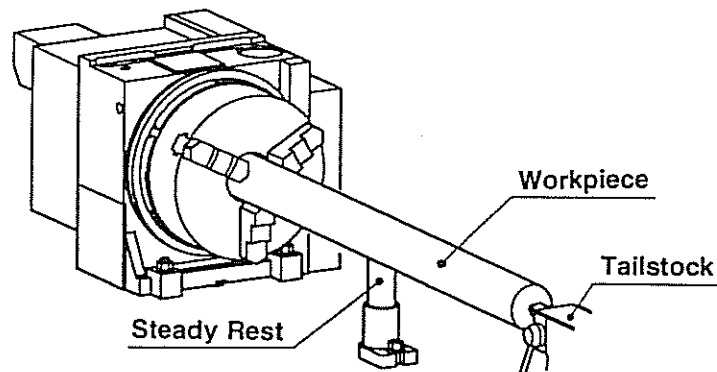
WARNING



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



Use a support, steady rest, or tailstock for heavy or long workpieces to prevent any injury and/or accident. (See P.7)

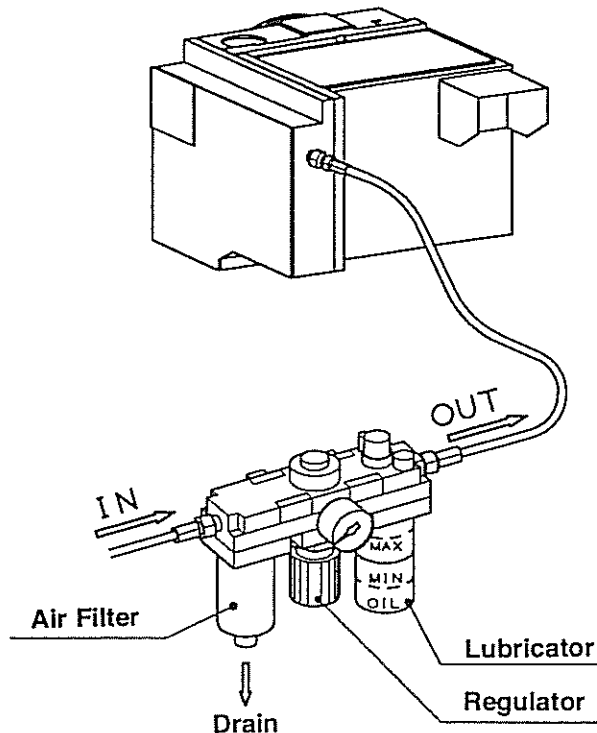




CAUTION



Use an appropriate air filtration system (filter, regulator, lubricator set) and maintain this filtration system in optimum working condition at all times.



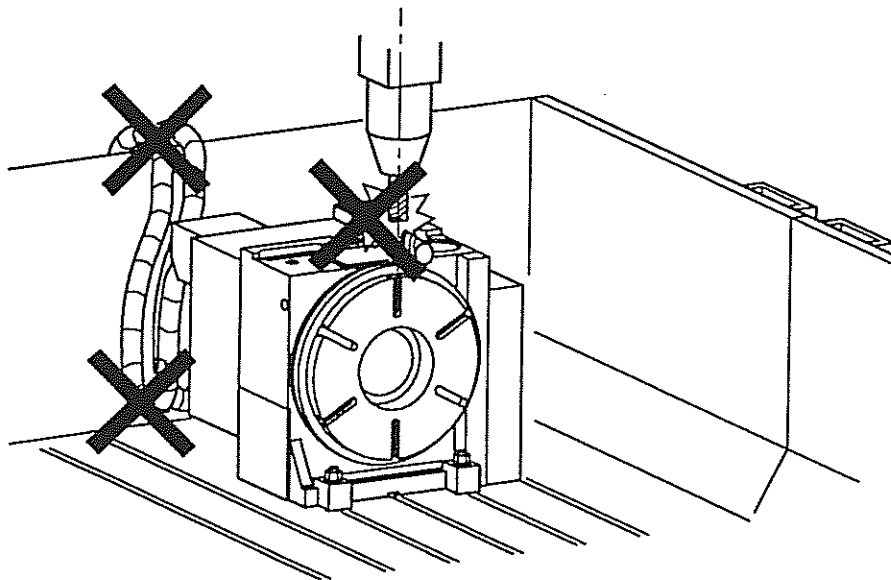
Maintain adequate oil levels to avoid losing of the clamping force as well as corrosion of the unit.

Use recommended oil for lubricator. (ISO VG32)



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

Avoid bending the external cables and air tube of the unit.

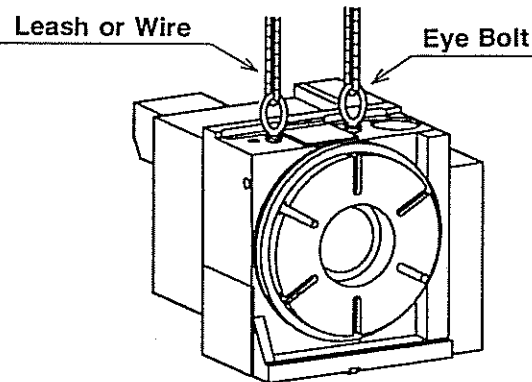




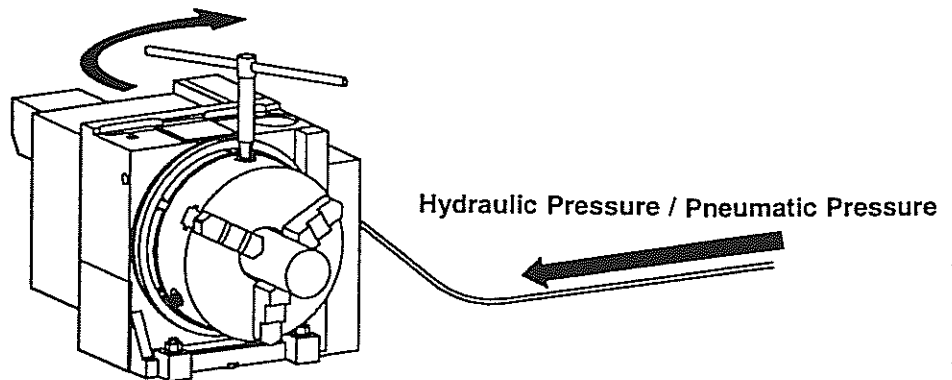
CAUTION



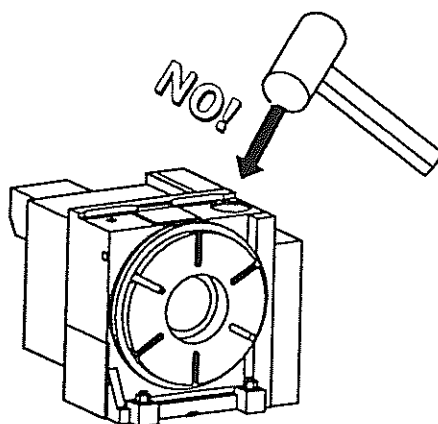
When transporting the unit, make sure to use eye bolts and a sufficient leash or wire.



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.



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

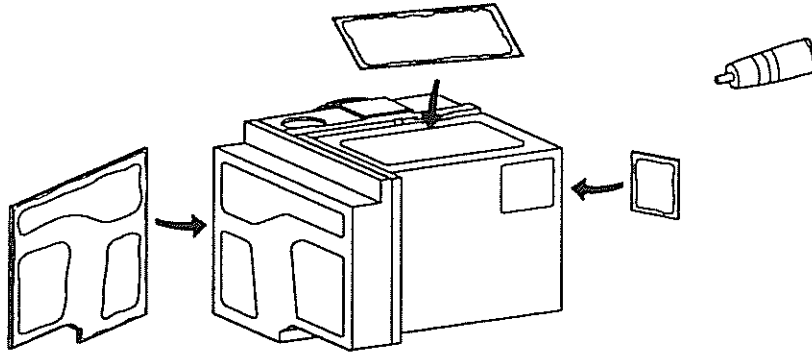




CAUTION



When removing the covers under any circumstances, make sure to strip existing sealing compound and uniformly apply new sealing compound before re-assembling for the prevention of coolant leakage into the unit caused the malfunction of the unit.



2. SPECIFICATIONS

MODEL		TB-180	TB-250	TB-320
Table Diameter (mm)		φ180	φ250	φ320
Center Height in Vertical (mm)		140	180	225
Overall Height in Vertical (mm)		260	332	405
Thru Hole Diameter (mm)		φ40	φ70	φ100
Width of T Slot (mm)		12	12	14
AC Servo Motor	— Fanuc	1-0S	5S	5S
	— Meltas	—	HA80C-S	HA80C-S
	— Yasnuc	—	USAFED-09FA1S	USAFED-09FA1S
Gear Ratio		1/90	1/90	1/180
Maximum R.P.M		22.2	22.2	11.1
Minimum Resolution (Degree)		0.001	0.001	0.001
Indexing Accuracy (Second)		20	15	15
Repeatability (Second)		±2	±2	±2
Clamping Force (kgf·m)				
— Air Pressure at 5 kgf/cm ²		10	25	50
— Hydraulic Pressure at 35 kgf/cm ²		35	90	160
Permissible Load (kgf)	— Vertical	80	125	180
Maximum Work Inertia (kgf·cm·Sec ²)		7.4	19.9	45.7
Weight (kg)		76	155	220

NOTE

Table clamping forces are measured under 5 kgf/cm² pneumatic pressure and 35 kgf/cm² hydraulic pressure. Maximum R.P.M. is at 2000 R.P.M. of motor rotation.



CAUTION

Although the weight of the workpiece is within permissible Load, Maximum Work Inertia must stay within the specification.



CAUTION

A tailstock may be required depending upon the weight and shape of the workpiece or the cutting conditions.



CAUTION

The cutting conditions are to be within the specifications above.

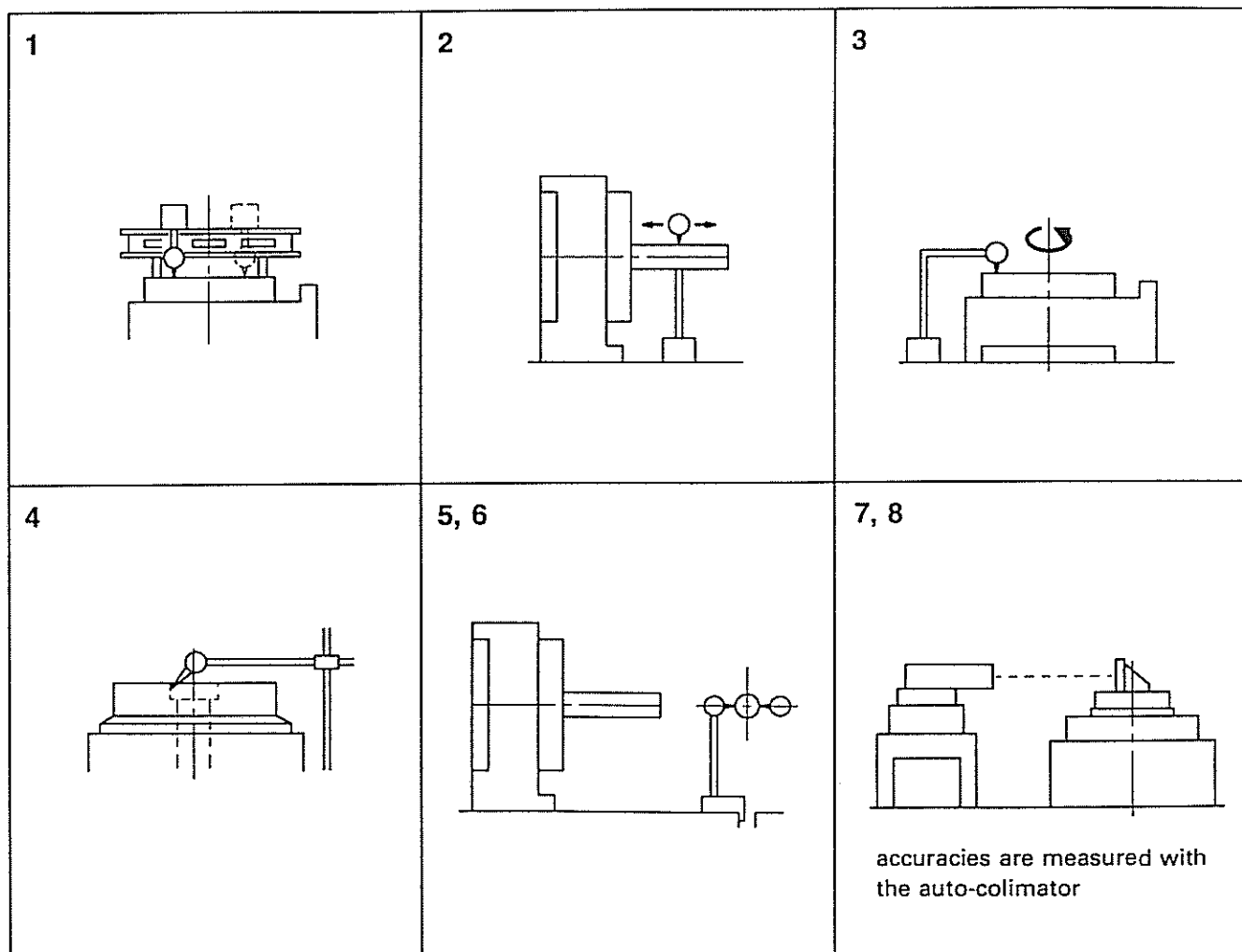
3. ACCURACIES

GUARANTEED ACCURACIES

ITEM	DESCRIPTION OF INSPECTION	GUARANTEED ACCURACY (mm)
1	Flatness of Table Face	0.01
2	Parallelism Between Table Face and Base	0.02
3	Parallelism Between Center of Table and Base	0.02
4	Run-out of Table Face in Rotation	0.01
5	Concentricity of Center Hole	0.01
6	Parallelism Between Center of Table and Center of Guide Blocks	0.02
7	Deviation Between Center of Table and Center of Guide Blocks	0.02
8	Indexing Accuracy	*15
9	Repeatability	±2

Note: * means 20 seconds for Model: TB-180.

Note: Measurement is taken at 12" length from either face or center of the table.



4. PREPARATION

Uncrate the unit and mount it on the machine.

4-1 Installation

- 1) When lifting the unit, securely screw in the eye bolts provided. Use wire loop which provides sufficient strength to lift the unit.
- 2) Clean the unit thoroughly with an adequate cleaning agent. When installing the unit on the machine table, make sure there is no foreign material nor damage such as nicks and burrs on the mating faces. Use an oil stone for correction if necessary.
- 3) Locate and set the unit at the most suitable location for the operation. In case of a vertical unit, 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) Firmly clamp down the unit to the machine with the furnished clamping fixtures.



When the unit is installed on the machine, ensure to avoid any interference with any part of the machine. Especially when the machine has a capability of X-Y-Z axis movement of the spindle head or the machine bed, the interference must be checked carefully before starting the operation.



Apply the clamping fixtures to the step of the unit provided, and clamp the bolts with the specified torque.

4-2 Lubrication



Change the lubrication oil every 6 months. Be sure to drain all oil from the unit first. When pouring oil into the unit, make sure to clean the area around the lubrication port so that no foreign material will enter the system which will cause severe damage to the internal mechanism. Use recommended oil shown 4-4.

4-3 Required Oil Quantity

Model	TB-180	TB-250	TB-320
QTY (ℓ)	1.2	2.3	3.5

4-4 Recommended Lubricating Oil

For 180

MANUFACTURER	PRODUCT NAME
Mobile	Vactra Oil No. 1
Shell	Shelltona Oil K32

* Grade of Viscosity: ISOVG 32

For 250 and 320

MANUFACTURER	PRODUCT NAME
Mobile	Vactra Oil No. 2
Shell	Shelltona Oil K68

* Grade of Viscosity: ISOVG 68

5. Table Clamp and Unclamp

5-1 General Instruction



ATTENTION

When the table is positioned, activate the table clamp, When the table is in motion, inactivate the table clamp.

Improper procedures in table clamp and/or unclamp may cause severe damage to the internal mechanism. This unit is supplied with two pressure switches for table clamp and unclamp for added safety.



ATTENTION

Make sure that your cutting operation on the unit does not exceed the table clamping force specified on the specification sheet. This may cause damage to the internal mechanism.



ATTENTION

If some excessive pressure remains when it is unclamped, the unit is operating under a half-clamp situation. This may cause severe damage to the internal mechanism.

Especially when unclamped using the hydraulic system, make sure the back pressure is less than 2 kgf/cm^2

Do not operate the pneumatic clamp system under hydraulic pressure, and the hydraulic clamp system under pneumatic pressure.

5-2 Confirmation of Clamp and Unclamp

The unit is equipped with two built-in pressure switches for clamp/unclamp detection as shown in fig.1.

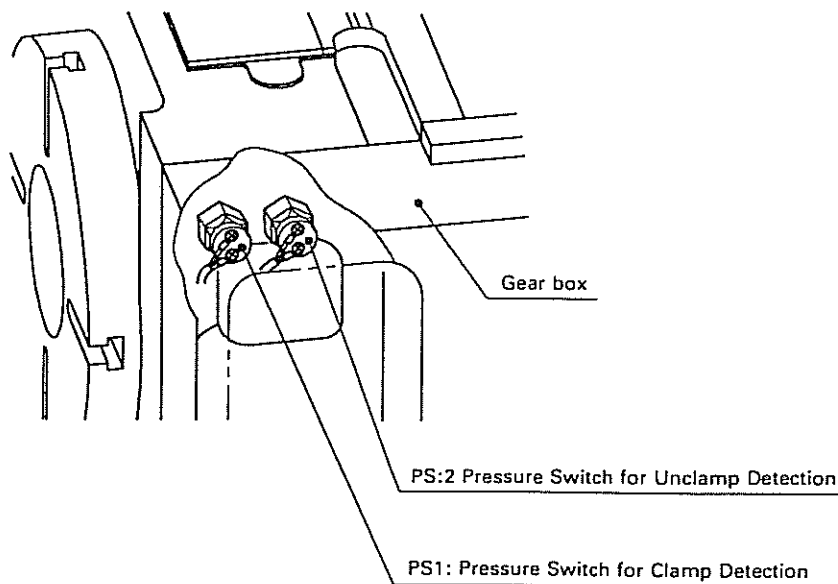


Fig. 1

The set up pressure of the switch for both pneumatic and hydraulic systems are as follows:

Signal	Clamp Signal (PS1)	Unclamp Signal (PS2)
Hydraulic	28 kgf/cm^2	2 kgf/cm^2
Pneumatic	3 kgf/cm^2	0.5 kgf/cm^2

5-3 Solenoid Valve for Clamp and Unclamp

For Pneumatic Clamping, a solenoid valve is equipped inside.

The piping is arranged as follows as a standard set up.

Be sure to arrange electrical wiring accordingly.

Solenoid ON — Unclamp

Solenoid OFF — Clamp



For Hydraulic Clamping, the solenoid valve of the hydraulic unit shall have the same piping and electrical wiring as in the pneumatic clamping above.

6. Mounting the Workpiece



Securely mount the workpiece to the unit. If this is not done properly, it may cause poor indexing accuracy as well as severe injury and/or accident.



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.



If the workpiece is off-centered, it may cause inaccurate indexing.

7. Adjustment of Backlash between Worm Wheel and Worm Gear

The amount of backlash has been adjusted to the appropriate range at time of the shipment from the factory. However, if it becomes necessary, excessive backlash between the precisely machined double-lead worm and worm wheel can be eliminated easily with two slightly different inclined leads provided on the worm gear. Appropriate amount of backlash between the worm and worm wheel is shown below. The figures apply only when the unit is cold. The amount of backlash will be reduced 3 - 5 seconds due to thermal expansion when the unit warms up during operation.



ATTENTION

If the amount of backlash is too small, it may cause a heat seizure of the worm and worm wheel.

Table Diameter	Backlash in Circular Length (μm)	Backlash in Seconds
TM-180	12 ~ 31	28 ~ 71
TM-250	14 ~ 42	23 ~ 69
TR-320	15 ~ 45	19 ~ 63

If it is necessary to adjust the amount of backlash, measure the backlash using the following procedure:

7-1 Measuring Backlash (See Fig.2)

- 1) Place a dial indicator close to the table circumference on one of the T-Slots.
- 2) Insert a steel rod into another table T-Slot and move it in a clockwise direction with approximately 110 ft-lbs of force. Release and read the dial indicator.
Next, apply force in a counter-clockwise direction on the steel rod. Release and read the dial indicator.
The amount of backlash is the difference between the two dial indicator readings.
- 3) Check the amount of backlash at eight equally divided positions by repeating the procedures above. If the amount of backlash is not within the appropriate range, adjust the amount using following procedures.

7-2 Procedure for Backlash Adjustment (See fig.3)



WARNING

Be sure to shut off the main power of the machine when the cover of the gear case is removed.

Failure to do so may cause severe injury and/or accident.

- 1) Completely drain the lubrication oil from the drain port.
- 2) Remove the motor cover (7) from the gear case.
- 3) Remove the pressure flange (8) and the clamp ring (9) by loosening the socket head cap screws. Then remove the gear (10).
- 4) Loosen the socket head cap screw mounting bearing case (4). Slowly rotate the worm shaft with the lock nut hole to remove the entire bearing case (4).
- 5) Remove the worm shaft (5) from the casting body, then remove the spacer (3).
- 6) The backlash can be adjusted by altering the spacer (3) thickness.

NOTE

The amount of grinding to reduce the backlash by 0.01 is as follows:

Model	TB-180	TB-250	TB-320
Amount of Grinding (mm)	0.314	0.466	0.466



ATTENTION

Both faces of the spacer should be precisely ground to keep accurate parallelism. The adjustment of the backlash should be achieved gradually and cautiously. Repeat the procedure if necessary.

Re-assemble the worm gear by reversing the procedure above after adjusting the spacer thickness.

After reassembling the unit, recheck the backlash at the same positions that you measured before adjustment, and confirm the backlash is adequate.



ATTENTION

For gear assembly, tighten the hex bolts with very uniform pressure to eliminate any gear wobbling motion.

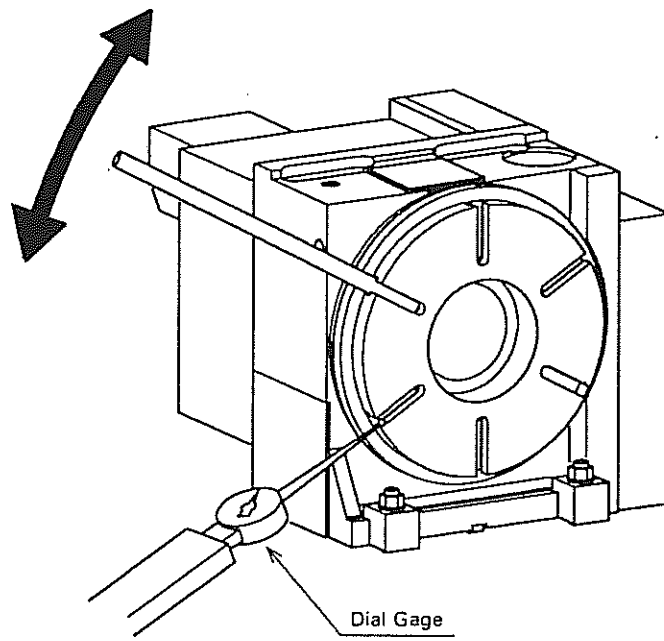


Fig. 2

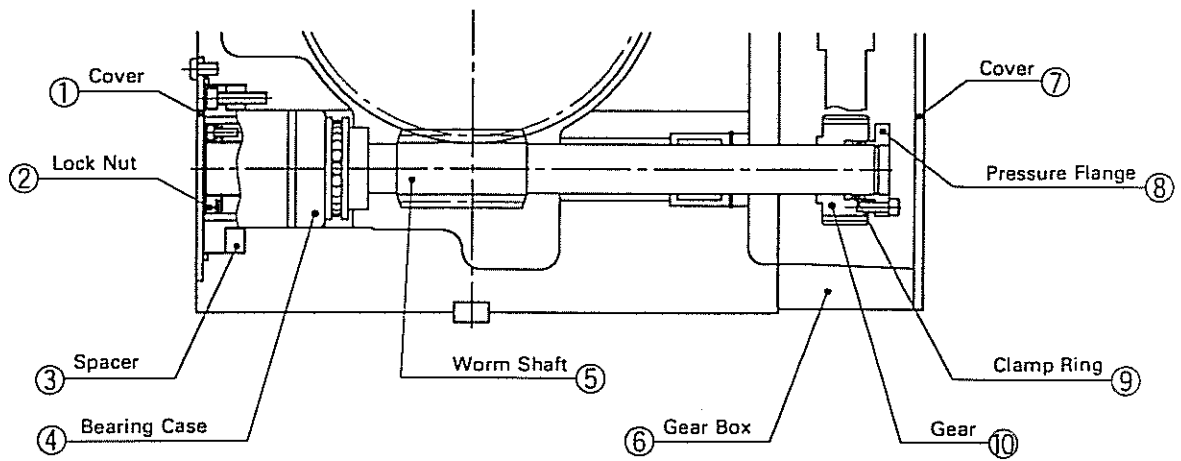


Fig. 3

8. Zero-Return and Dog

8-1 Dog Position

The dog position is adjusted for zero-return in a clockwise rotation at the factory. The table datum groove comes to position at a right angle to the motor when connected to the NC unit. The dog, which activates the table speed reduction, is located inside the unit. However, the dog can be exposed if the adjustment of the dog position is required. Fine adjustment of the dog position may be required at the customer at the time of interface with the NC controller of the machine.

NOTE

The zero return dog is not provided on the unit for both the SUPER MAC and the OSP controller, in which the zero return position is programmed in their own software.

8-2 Dog Position Adjustment (See Fig. 4 & 5)

- 1) Drain the lubrication oil.
- 2) Remove the cover (1)
- 3) Loosen set screw (3) on the dog (2).
- 4) Relocate dog to the appropriate position.
- 5) Make sure to tighten set screw after the position is adjusted.



CAUTION

When putting the cover back, remove the existing sealing compound and uniformly apply with new sealing compound (Three Bond Company Seal Compound 1215 was used at the factory)

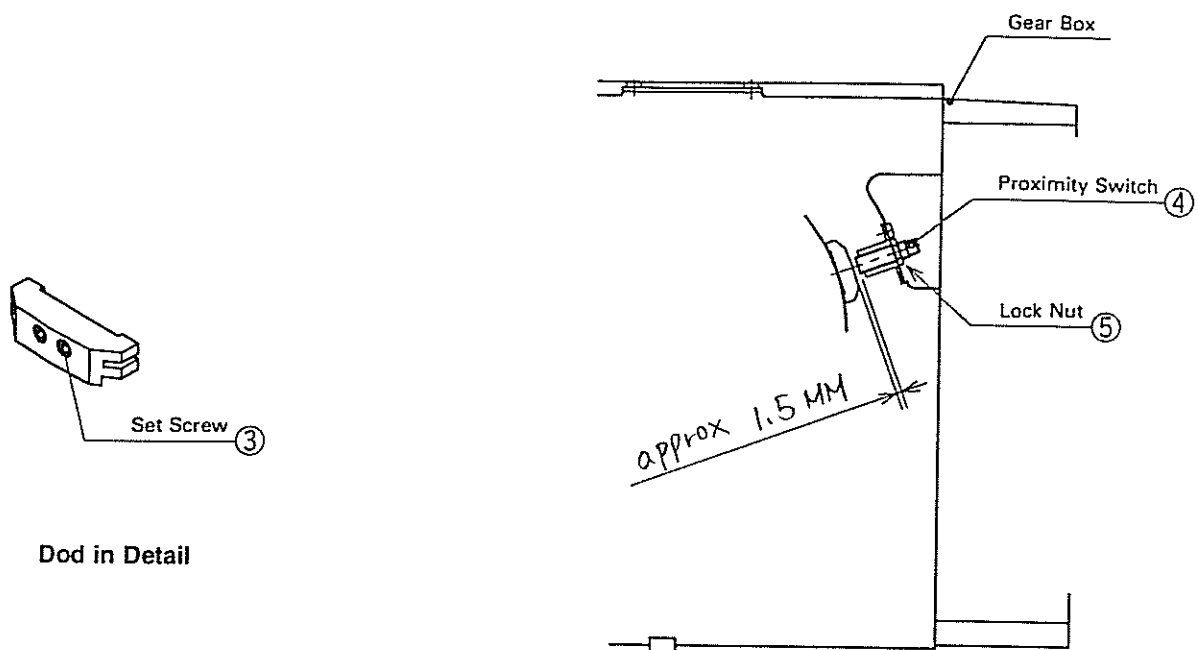
8-3 Sensor Mechanism

- 1) Proximity Switch (See Fig. 4 & 5)

The gap between the dog (2) and the proximity switch (4) should be adjusted to approximately 1.5_{mm} by the 1.00mm pitch thread provided on the proximity switch.

- 2) Limit Switch (See Fig. 4 & 5)

A roller plunger actuator (7) is provided between the dog (2) and the limit switch (6). Loosen the socket head cap screw (8) for fine adjustment of the limit switch position.



Dod in Detail

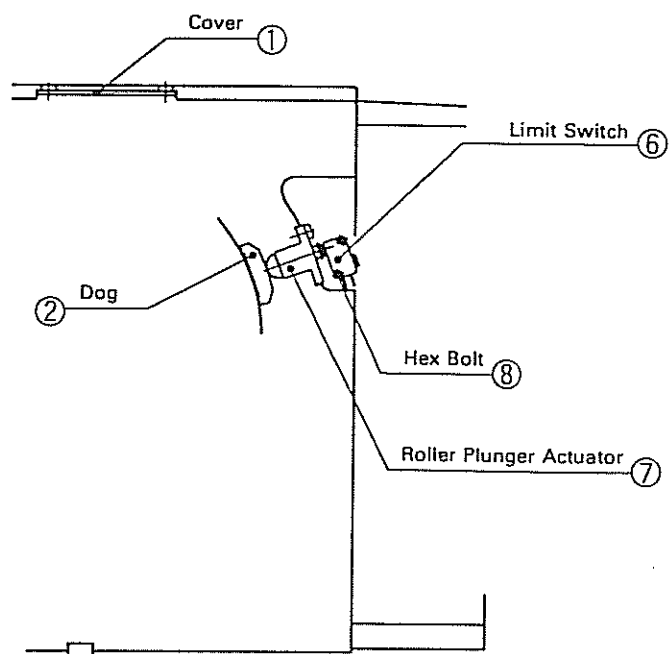


Fig. 4

9. Adjustment of Backlash of the Spur Gears

9-1 Measuring Backlash (refer to Fig.5)

9-1-1 Measuring the Backlash of the Spur Gears Z2 (13) and Z3 (12)

- 1) Completely drain the lubrication oil through the drain port.
- 2) Remove the cover (6).
- 3) Lock the movement of the spur gear Z3 (12) with an appropriate tool such as a screw driver.
- 4) Set a dial indicator at the pitch circle on the tooth face of the spur gear Z2 (13).
- 5) Read the total movement of the dial indicator by manually rotating the spur gear Z2 (13) in both clockwise and counterclockwise directions. This total movement of the dial indicator will be the backlash.

9-1-2 Measuring the Backlash of the Spur Gears Z1 (11) and Z3 (12)

- 1) Completely drain the lubrication oil through the drain port.
- 2) Remove the cover (6).
- 3) Lock the movement of the spur gear Z3 (12) with an appropriate tool such as a screw driver.
- 4) Set a dial indicator at the pitch circle on the tooth face of the spur gear Z1 (11).
- 5) Read the total movement of the dial indicator by manually rotating the spur gear Z1 (11) in both clockwise and counterclockwise directions. This total movement of the dial indicator indicates the backlash.

Backlash between each gear engagement should be between 0.02 and 0.04. Backlash adjustment is required if the measurement is much smaller or larger than these figures.

9-2 Adjustment of Backlash of the Spur Gears (Refer to Fig.5)

9-2-1 Adjustment of the Backlash of the Spur Gears Z2 (13) and Z3 (12)

Backlash can be adjusted by rotating the eccentric ring which has a maximum of 0.3 of eccentricity.

- 1) Measure the backlash by following the procedure 1) through 5) in section 9-1-1 above.
- 2) Set the leave a dial indicator at the pitch circle on the tooth face of the spur gear Z2 (13) for further backlash measurement needed.

- 3) The eccentric shaft (8) is positioned securely by the hex bolt (9) and the steel ball(7).

Remove the hex bolt (10). Then, adjust the amount of eccentricity as measuring the backlash with a dial indicator by slowly turning the hex screw (9) in either clockwise or counterclockwise directions.

Backlash can be increased by rotating the eccentric shaft (8) in clockwise direction, and decreased in counterclockwise direction.

Alignment marks indicating the proper backlash position are engraved at the factory on both the eccentric shaft and the gear box for your convenience.

9-2-2 Adjustment of Backlash of the Spur Gears Z1 (11) and Z3 (12)

- 1) Measure the backlash by following the procedure in section 9-1-2.
- 2) Loosen the hex bolt (5).
- 3) Loosen the four hex bolts (2) mounting the servo motor (4), then eliminate the backlash nearly zero by slowly tightening the hex bolt (5).
- 4) Loosen and adjust the position of the hex bolt (5) and move the servo motor (4) toward the hex bolt (5).

NOTE

The hex bolt (5) has 1.0mm pitch thread.

Therefore, backlash can be adjusted approximately 0.033 by turning the hex bolt (1) by 10 degrees.

- 5) Securely tighten the four hex bolts (2), and measure the backlash by following the procedure in section 9-2-2.

Repeat the procedure 2) through 5) if the backlash measurement above is not between 0.02 and 0.04.



CAUTION

Avoid any damage such as nicks and dents to the tooth face of the spur gear when backlash measurement or adjustment are performed.

Damage on the tooth face may prevent smooth rotation resulting in poor indexing accuracy and abnormal gear noise.

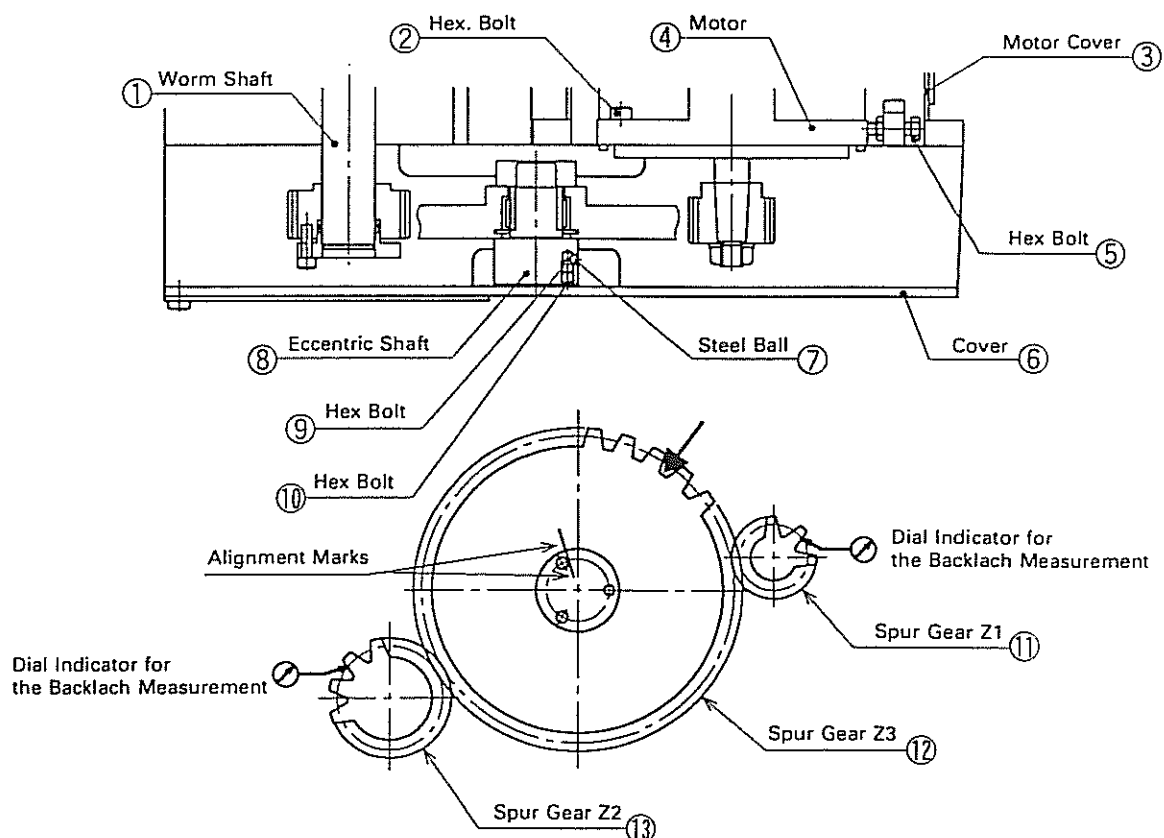


Fig. 5

10. Motor Cover

10-1 Dismount

Please follow the procedure below for removing the motor cover. (See fig.6)

- 1) Disconnect wires from the terminal box (3).
- 2) Disconnect the cannon connectors (2) from the servo motor.
- 3) Remove the motor cover.

10-2 Waterproofing

For the prevention of coolant leakage into the unit, all attached elements such as lids and covers are coated with sealing compound, and an oil seal is used on the rotating element. When removing the covers under any circumstances, make sure to strip the existing sealing compound and uniformly apply with new sealing compound before re-assembling. A drain port is provided to drain the coolant out, in the event of coolant leakage into the unit. However, avoid shooting coolant around the motor cover area and the drain port area as much as possible. In addition, do not place the unit near the drain port on the machine table.



When putting the motor cover back on the unit, remove the existing sealing compound and uniformly apply with new sealing compound (Three Bond Company Seal Compound 1215 was used at the factory).



Drain the lubrication oil before starting the procedure to remove the motor.

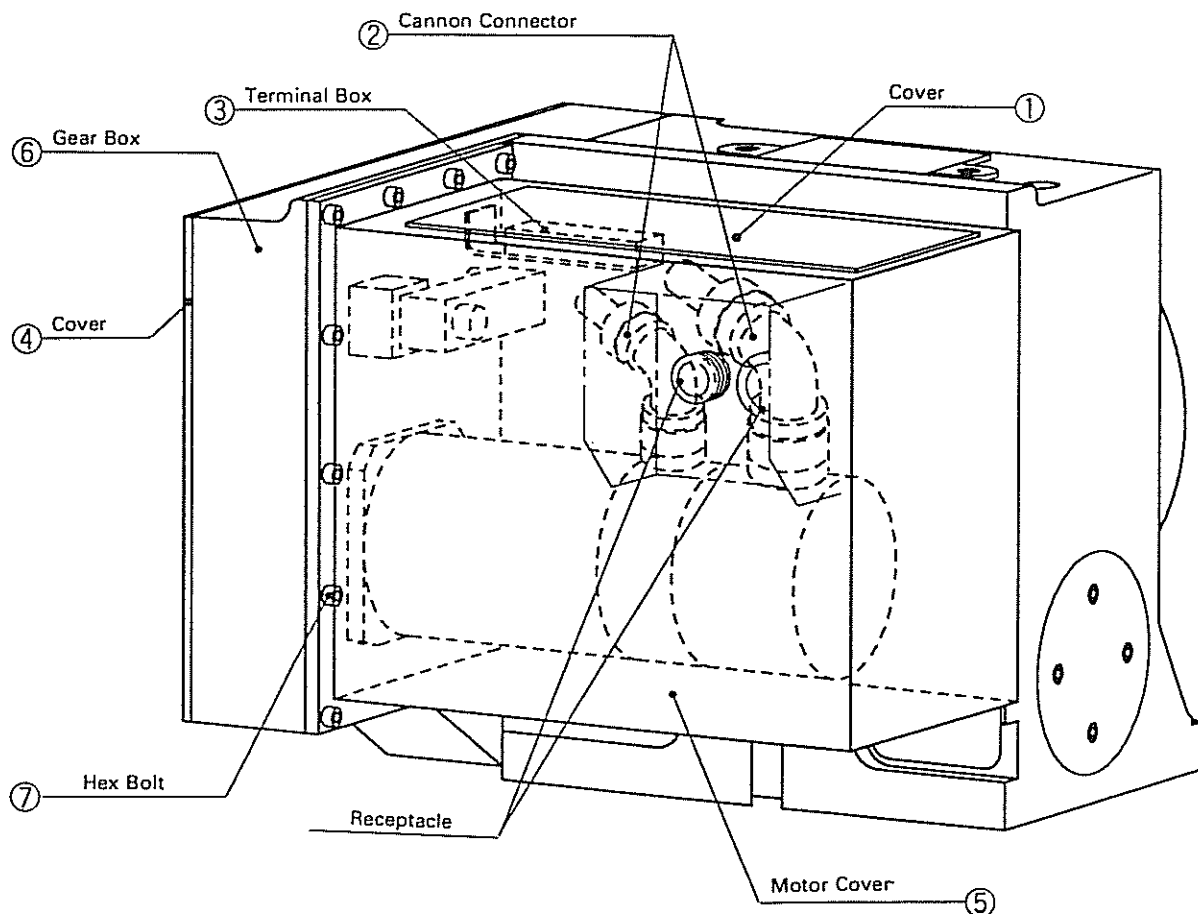


Fig. 6

11. Storage



ATTENTION

When removing the unit from the machine table, apply oil to prevent rust and store it on a stable wooden stand or in the original crate with the appropriate cover to protect it from dust and maintain its accuracy.

Note: Some raw wood is chemically unstable and may cause rust on the unit.

12. Indexing Accuracy and Pitch Error

NOTE

"What is the liner length at the table circumference with 30 seconds cumulative indexing accuracy?"

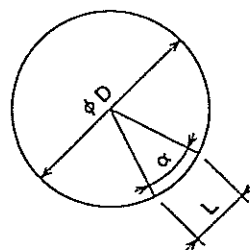
"What is the angle with a cumulative pitch error of .002 inches?"

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 (inch)

α : Angle (Seconds)

L: Linear length at the table circumference



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

(1)

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

or

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

(Examples)

Assuming the diameter of the workpiece is 100 mm, and by using formula (3), the cumulative indexing accuracy of 30 seconds as linear length at table circumference will be:

$$L = 2.424 \times 30 \times 100 \times 10^{-6} = 0.007272 \text{ mm} = 7.3 \mu\text{m}$$

Therefore, the length is approximately 7.3 μm .

And converting the cumulative pitch error of 0.05 to an angle, use formula (2):

$$\alpha = \frac{4.124 \times 0.05 \times 10^5}{100} = 206.25''$$

Therefore, the angle is approximately 206.25 seconds equal to 3 minutes 26 seconds.

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

KITAGAWA

PRODUCTION PLANT

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