

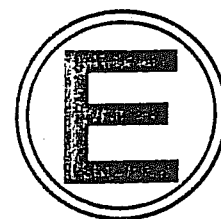
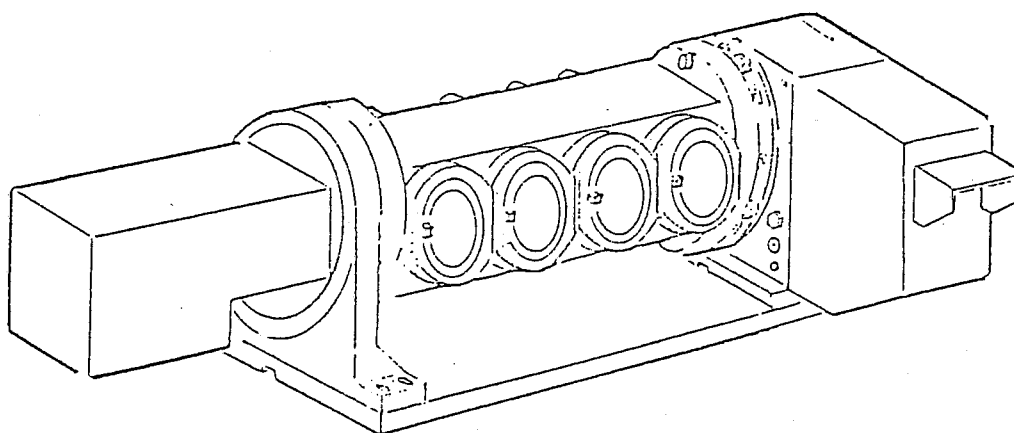
NIKKEN CNC Circular Table

Automatic Tilting Multi-spindle Type

5AX-4MT-120

Individual Instruction Manual

Eighth Edition KB

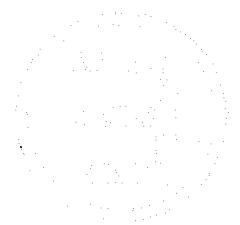


THE UNIVERSITY OF CHICAGO
DEPARTMENT OF CHEMISTRY

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History of Revision

Date	Page	Contents
Mar.3 1986	All	<p>Revision for the entire Sixth Edition</p> <p>Major revised points are as follows:</p> <ol style="list-style-type: none"> ① The tilting shaft over-travel detecting mechanism is transferred from the tailstock side to the tilting axis CNC 250 side. ② The driving system for tilting axis brake is changed from pneumatic system to hydraulic system with solenoid valves equipped normally. ③ The machine zero position for tilting shaft is changed to "OVERHEAD POSITION OF WORK PLECE". Thereby, the displacement range of tilting axis become $-110^{\circ} \sim +110^{\circ}$. ④ The rotating axis zero-point return mechanism is transferred from the tilting axis CNC 250 side table (at right end viewing from the front) to the tailstock side table (left end). ⑤ Rotating axis solenoid valve clamp/unclamp signal wire is led through backside of the quadruple table to the tailstock side. ⑥ Rotating & tilting axes clamp solenoid valves and work change manual valve are summerized into a normally equipped block. <p>Another special accessories are also described.</p> <p>That's all for the Seventh Edition</p>

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History of revision

Date	Page	Contents
Jun. 27 1998		<p>Pressure switch is changed as follows: Form JPB1 & JPB2, SANYO make (Mfg. No. #1000 to #1024) To HW1-3T1-02, TOYOOKI make (Mfg. NO. #1025 and larger)</p>
Oct. 1, 1990	<p>40 to 42 7 to 10 19 to 20 41-2 38 35 to 36</p>	<p>History of revision of rotating axis for clamping mechanism is added because rotating axis brake mechanism is revised.</p> <p>General mechanical diagrams are changed because of above revision</p> <p>Hydraulic clamping pressure and location of air vent hole are changed.</p> <p>Rotating axis clamping mechanism is changed.</p> <p>Tilting axis rotary joint is modified to 5-port type.</p> <p>Arrangement of tilting axis overtravel detection mechanism is changed.</p> <p>Air blowing function is added to mechanism of work changer, so that rotating table center height changes as follows: From 215 mm (Mfg. No. #100 to #1024) To 235 mm (Mfg. No. #1049 and larger) For details, reference should be made to external view attached to each CNC table.</p> <p>Internal taper of work changer is changed from fixed type to selectable type, and 4" scroll chucks (4 pcs.) are excluded from standard accessories. Therefore, attachments are summarized again in Appendix.</p> <p>That's all for Eighth Edition KE.</p>

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SECRET

1. The purpose of this document is to provide information regarding the activities of the [redacted] in the [redacted] area. This information is being provided to you for your information only and should not be disseminated to other personnel.

2. The [redacted] has been identified as a [redacted] and is currently active in the [redacted] area. It is believed that the [redacted] is involved in [redacted] activities and is a potential threat to the [redacted] program.

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Appendix

Attachment (special accessories)

- ① 4" scroll chucks (4 pcs.)
- ② Collet chuck for flange-shaped workpiece
- ③ Jig for ring-shaped workpiece
- ④ Collet chuck for bar-shaped workpiece
- ⑤ Jig plate

1. Preface

Thank you much for purchase of NIKKEN CNC Circular Table.

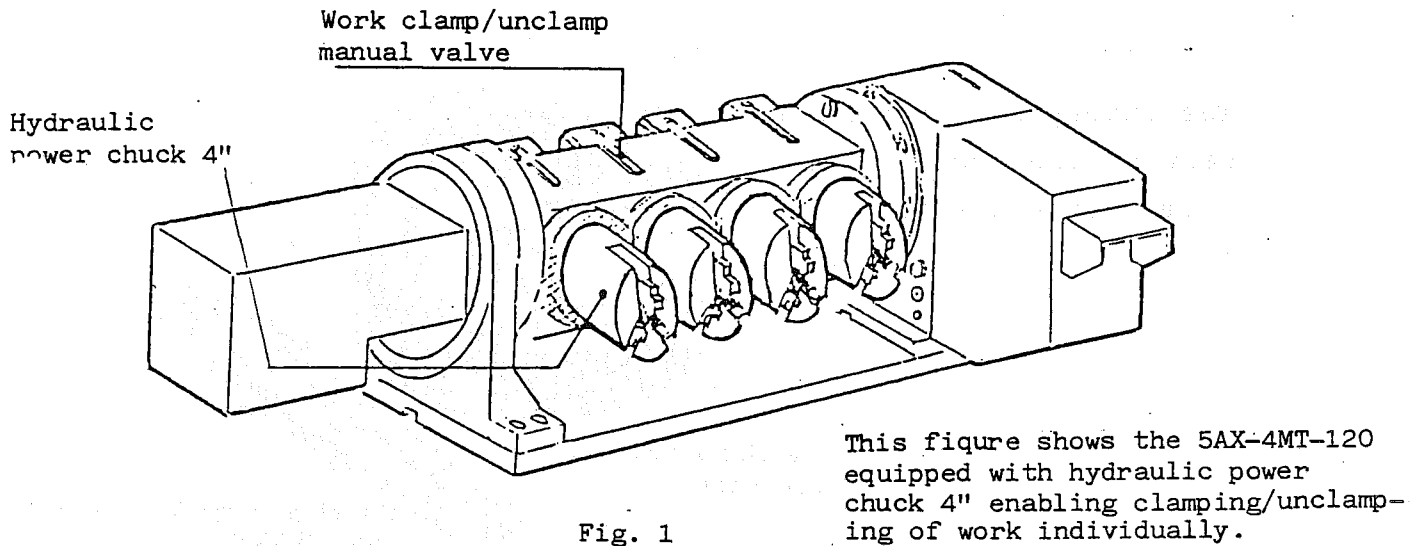
NIKKEN CNC Circular Table is designed and manufactured on the basis of our spirit of "every-day research", which words are the origin of our company name, and customers' intention is incorporated in the design to a maximum practical extent. We are sure that this Table will satisfy you for its high performance, high quality and easy operation.

NIKKEN CNC Circular Table withstands long-term and full operation. In order to ensure its proper handling and full utility for the intended purpose, please read the instruction manuals attached hereto.

We appreciate our connection with you through NIKKEN CNC Circular Table and wish to enroll you in our customer list for future service activities. Please fill and mail the attached post card to us.

Please keep "Inspection Table", "Common Instruction Manual" and "Individual Instruction Manual" in your file.

Various types (including attachments) other than the standard 5AX-4MT-120 and 5AX-2MT-200 are also available on your request. As for the single-purposed controller enabling all the circular table works with only one M-signal, please consult us freely since we have many experiences and gave actual results.



If there should happen any trouble on the circular table, please advise us of all letters engraved on its name plate.

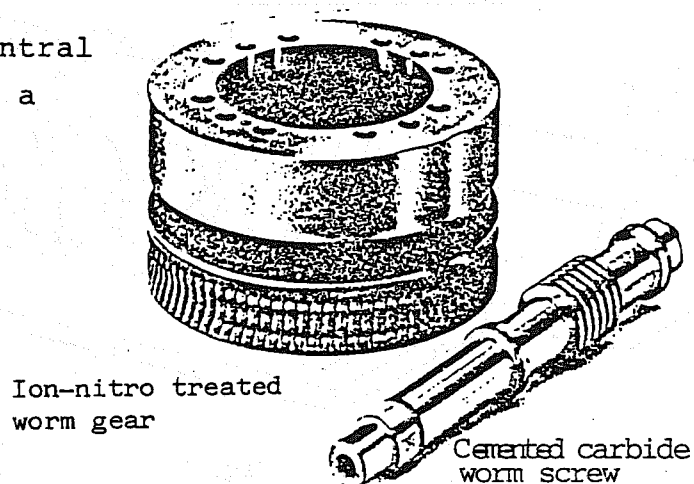


2. Characteristics of NIKKEN CNC Circular Table

NIKKEN CNC Circular Table has the following substantial characteristics:

1. Prevention of gear wear and maintenance of precision of indexing

The important and central part of the table is a worm gear and a worm screw.



As shown in the above, the worm gear of specially hardened special alloy steel with its teeth of ion-nitro treatment is used for the central part of NIKKEN CNC Circular Table, together with the worm of patented super-hard alloy. The problem of slip friction, therefore, is solved and their anti-wear quality is by far better than phosphor bronze and aluminum bronze.

2. Rapid feed speed

In the case of Model CNC-400V(F), the maximum number of revolutions is 166 R.P.M. The table for positioning, therefore, turns at a high speed of 20m/min. or above, when converted to its circumferential speed.

The above high speed results from the application of the special worm gear and worm screw as mentioned above, and the hollow roller bearing of high precision to the rotating friction part. Light torque and wear-free system is adopted and the mechanism of the table is free from a trouble.

3. Strong power of cutting

The worm gear and the worm screw are made of a combination of super-hard alloy and hardened steel, and have enough rigidity. In addition, the slip friction of tooth surface is made smooth by the special treatment of worm teeth. Consequently, strong and continuous cutting is ensured.

Also, the powerful hydraulic brake mechanism is employed so that strong and effective positioning is ensured to enable heavy duty cutting.

4. Easiness to use

Many attaching jigs conforming to all types of work pieces are available to enable easy work change with simple handling. (Refer to "Special accessories".)

Thanks to brake solenoid valves for both the tilting axis and rotating axis incorporated in the table, connection

works of hydraulic piping etc. become easy.

Optimum combination of machining devices including the attachments may be examined and discussed according to work pieces to be machined, convenient machining system become available.

5. Improvement in productivity

Ordinary ATC time is around 20 seconds for tip-to-tip, however, in case of the 5AX-4Mt type the ATC time per one work piece can be shortened to about 5 seconds (a fourth) because four work pieces can be mounted. Therefore, in case where many cutting tools are required, the productivity is improved by a large margin. Since different work pieces can be machined at the same time even for the multiproduct with small-quantity production, the preparation time and ATC time are reduced to cause an improvement in productivity. Further, if mounted on the double-spindle machine, the multi-surface simultaneous machining becomes possible to provide further effective manpower saving (AS regards the pitch between tables for double spindle machine, please consult us.)

Moreover, the unmanned operation becomes possible when the automatic work changing system is employed (by numerically controlling the work clamp/unclamp operation)

in combination with a robot, an auto-loader etc.

6. Safety

Clamp/unclamp state of table is ensured by the incorporated pressure switch and sensor, so that errors due to coolant or chip can be eliminated to secure a highly safe machining work.

The +/- over-travel detection limit switch is normally provided in the tilting axis to cause the emergency stop of table in the event of emergency and prevent the table from accident and breakage due to run away.

7. Reliability

This circular table is most reliable not only in maintaining a high-precision but in heavy duty machining work. Further, as a countermeasure against water and moisture, careful consideration such as development of special seal is given thereto.

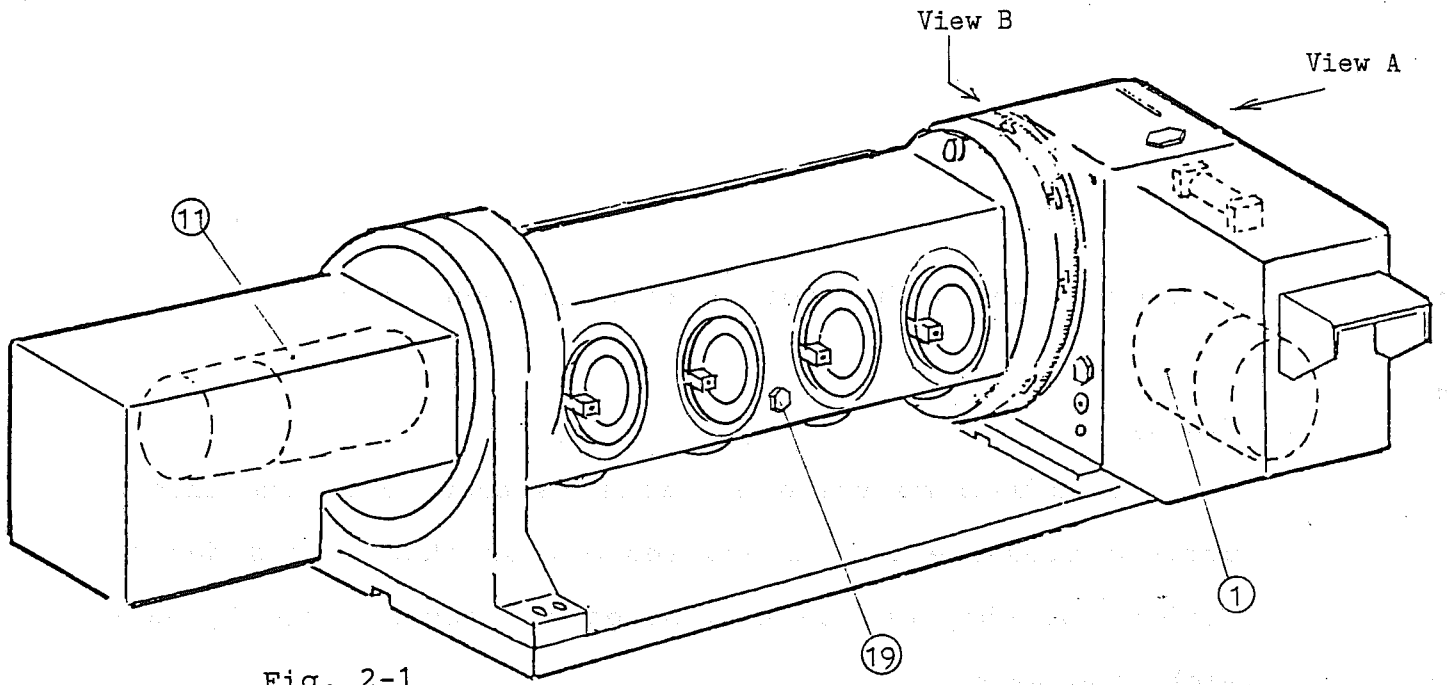


Fig. 2-1

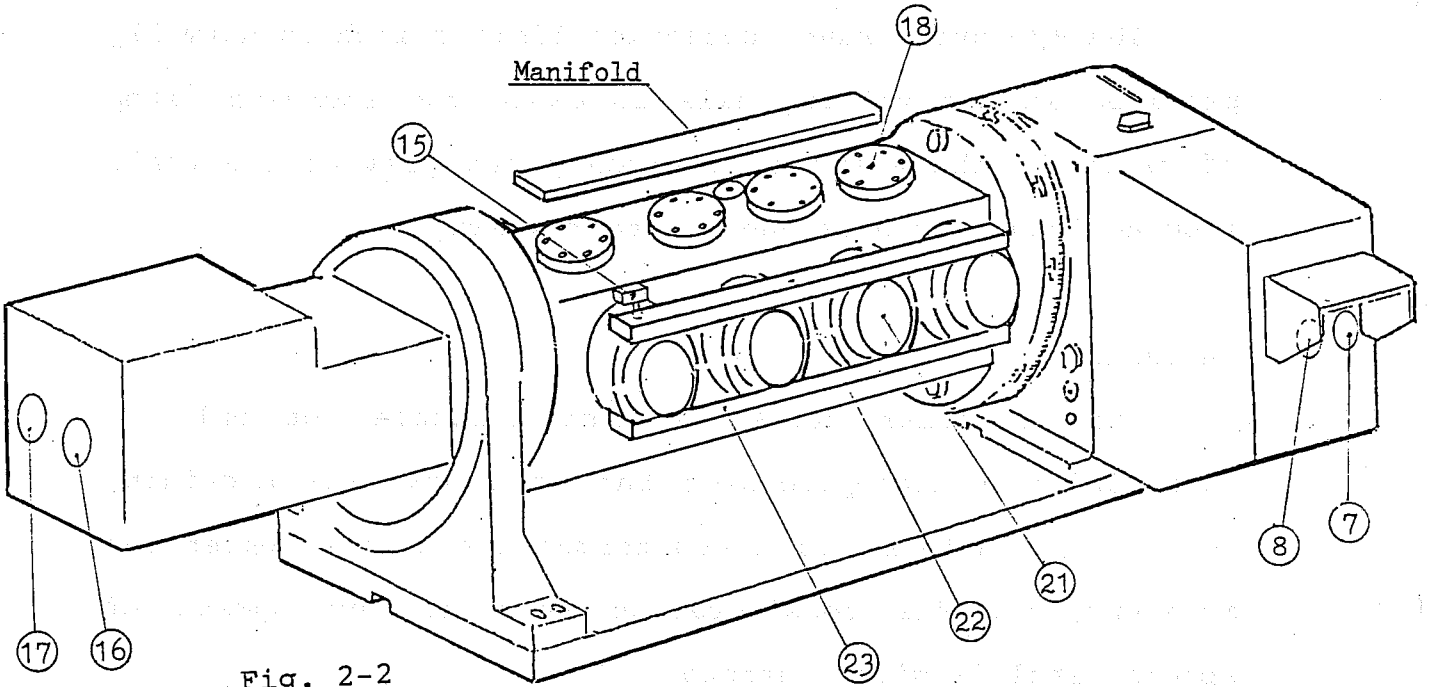
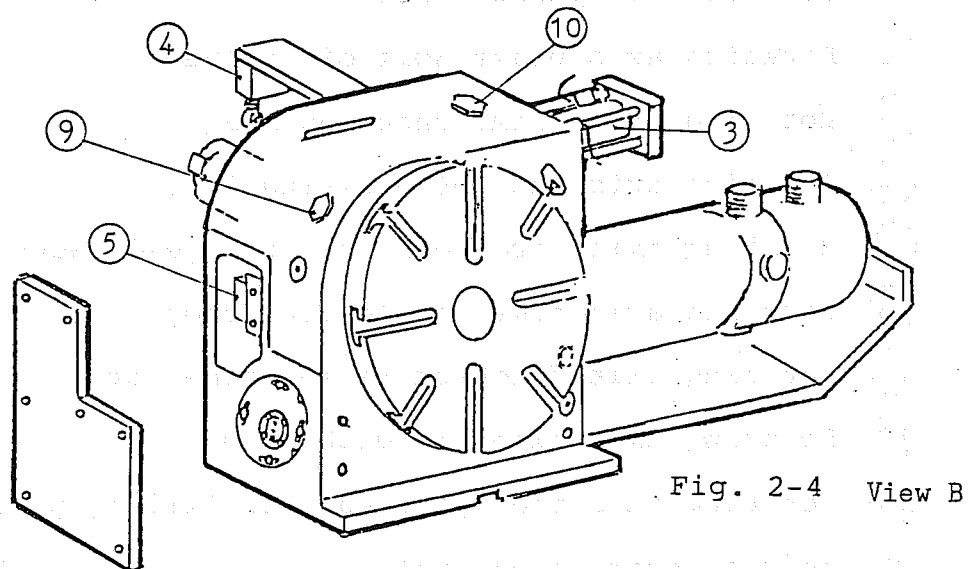
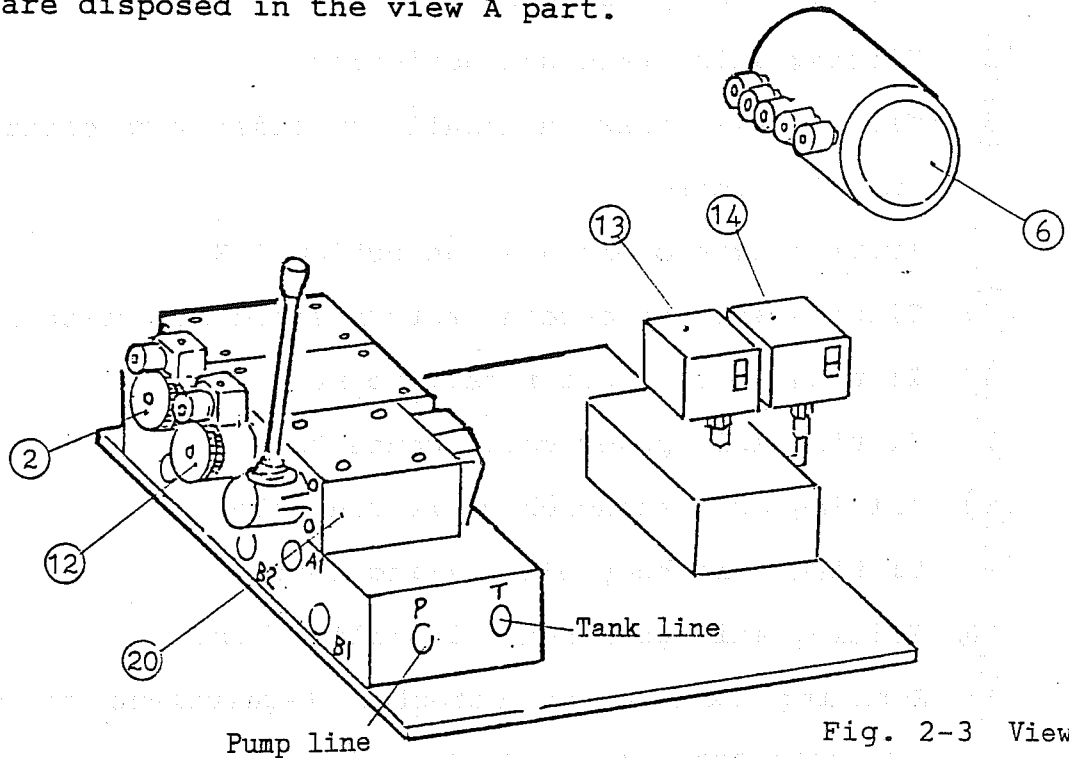


Fig. 2-2

In this manual, the front side means a side from which the tilting axis table can be seen at the right side and the motor cover can be seen at this side.

The tilting axis clamping solenoid valve, rotating axis clamping solenoid valve and work changing solenoid valve are disposed in the view A part.



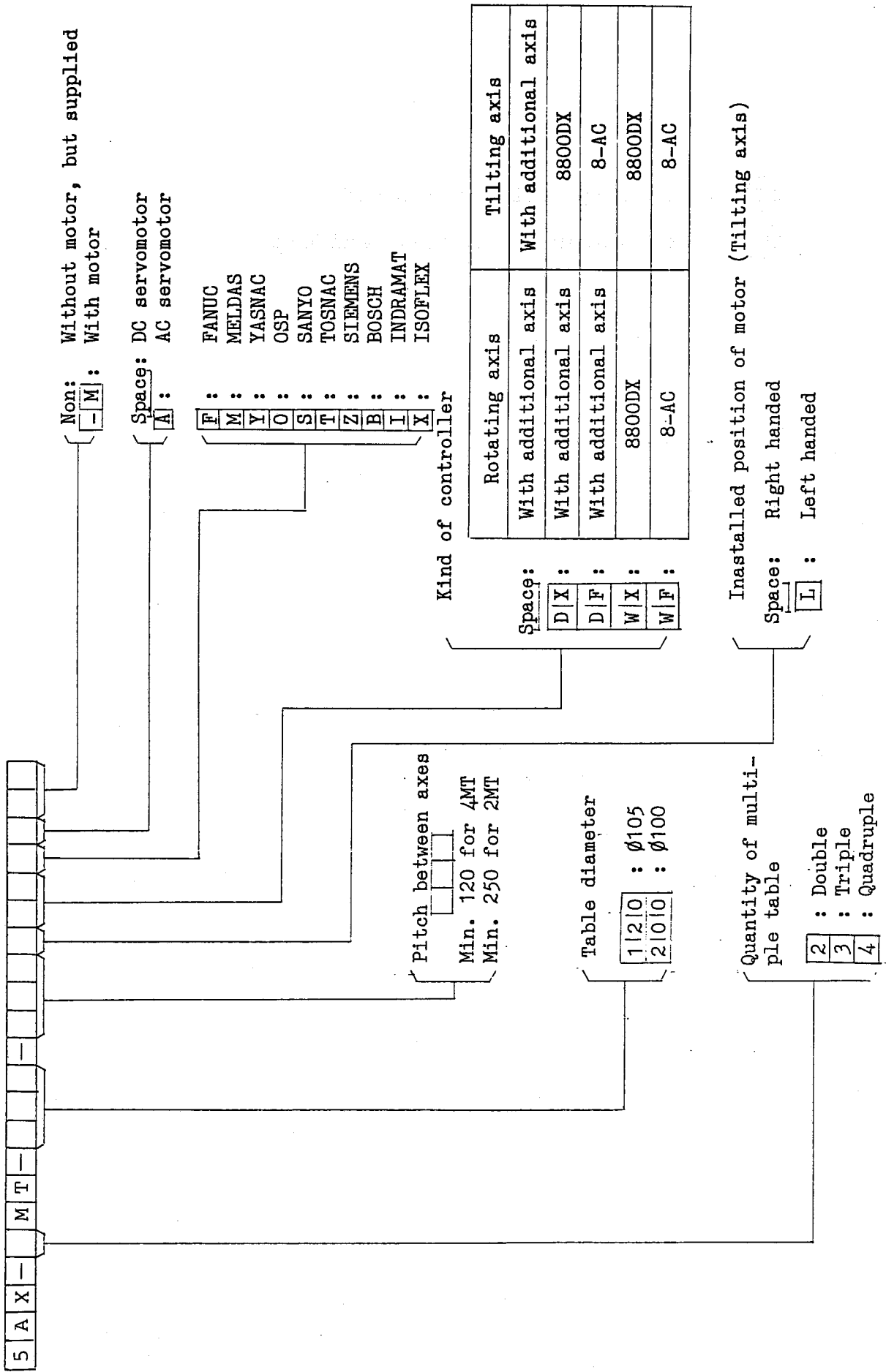
In NIKKEN tables, the standard tilting axis for 5AX-4MT-120 is CNC250 for hydraulic clamping and equipped with 5-port rotary joint.

- ① Tilting axis motor detector (equivalent to FANUC AC 0S, 3000 PPR pulse coder)
- ② Tilting axis brake solenoid valve
- ③ Tilting axis brake hydraulic cylinder with clamp/unclamp ensuring sensor
- ④ Tilting axis overtravel detection L.S.
- ⑤ Tilting axis zero-point return speed reduction L.S.
- ⑥ Tilting axis 5-port rotary joint
- ⑦ Tilting axis power cable connector
- ⑧ Tilting axis feedback cable connector
- ⑨ Tilting axis body oil filling port
- ⑩ Tilting axis gear box oil filling port
- ⑪ Rotating axis motor detector (equivalent to FANUC AC 5S, 2000 PPR pulse coder)
- ⑫ Rotating axis brake solenoid valve
- ⑬ Rotating axis clamp ensuring P.S.
- ⑭ Rotating axis unclamp ensuring P.S.
- ⑮ Rotating axis zero-point return speed reduction L.S.
- ⑯ Rotating axis power cable connector
- ⑰ Rotating axis feedback cable connector
- ⑱ Rotating axis clamping mechanism
- ⑲ Rotating axis body/gear-box oil filling port
- ⑳ Work changer manual valve
- ㉑ Work changer rotary joint

- ②② Work changer clamping manifold
- ②③ Work changer unclamping manifold

3. Specification

3-1 Basis of designating automatic tilting multiple-mount table



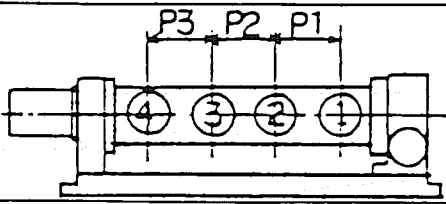
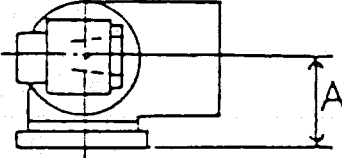
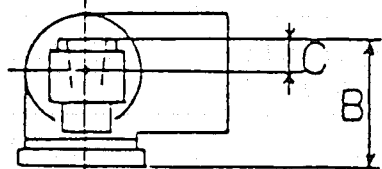
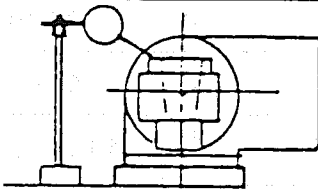
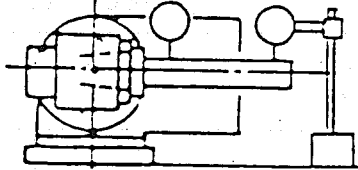
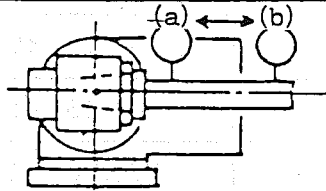
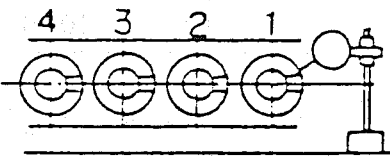
3-2 Specification

Axis	Type	5AX-4MT-120
	Item	
Tilting axis	Table diameter	Ø250
	Max. rotation speed	8.3 rpm
	Angle of movement *1	220° -110° to +110°
	Braking force (at hydraulic pressure of 35 kgf/cm ²)	35 kgf.m
	Minimum setting unit	0.001°
	Total reduction ratio	1 : 120
	Indexing accuracy	± 30 sec.
	Drive motor	FANUC AC 0S
	Detector	3000 PPR
Rotating axis	Table diameter	Ø105
	Max. rotation speed	11.1 rpm
	Angle of movement *1	360° at will
	Braking force (at hydraulic pressure of 35 kgf/cm ²)	15 kgf.m
	Minimum setting unit	0.001°
	Total reduction ratio	1 : 180
	Indexing accuracy	± 45 sec.
	Drive motor	FANUC AC 5S
	Detector	2000 PPR

*1 In case of special tables, the angle of movement would become small.

*2 In case of the OSP motor, the total reduction ratio will be different.

4. Accuracy standard

No.	Item	Location & wethod	Tolerance(mm)	Measured value(mm)		
1	Distance between axes		within 120 ± 0.02	P 1		
				P 2		
				P 3		
2	Height from bottom face to rotating axis center (A) (tilting axis center)		Within 0.02	№ 1		
				2		
				3		
				4		
3	Height from bottom face to rotating axis table top (end) face (B)		Within 0.02	№ 1		
				2		
				3		
				4		
4	Distance from tilt- ing axis center to table top (end) face (C)	$C = B - A$ Calculated value	Within 0.02	№ 1		
				2		
				3		
				4		
5	Runout & parallelism of rotating axis table top (end) face		Max-reading: within 0.015		Runout	Parallelism
				№ 1		
				2		
				3		
6	Runout of rotating axis table center hole		Root: within 0.015 150mm from tip: within 0.03		Root	Parallelism
				№ 1		
				2		
				3		
7	Rarallelism of rotating axis table center hole		Within 0.035 for every 200mm		(a)	(b)
				№ 1		
				2		
				3		
8	Rarallelism of rotating axis table drive key		Within 0.02	№ 1	0 (Basis)	
				2		
				3		
				4		
9	Indexing accuracy of tilting axis	Max. difference shall be measured by using Willed (swiss) optical index measuring machine	$\pm 30''$			
10	Indexing accuracy of rotating axis	-ditto-	$\pm 45''$			

5. Preparation for operation

When operating the CNC circular table after purchasing, the next preparations and trial run etc. are necessary.

- 1) Unpacking, transportation and installation
- 2) Pouring lubricating oil
- 3) Supply of hydraulic pressure for clamp and air vent
- 4) Electrical connection
- 5) Trial run
- 6) Setting zero-point return grid amount
- 7) Example of program

5-1 Unpacking, transportation and installation

① Unpacking and transportation

Take careful attention for transportation after unpacking.

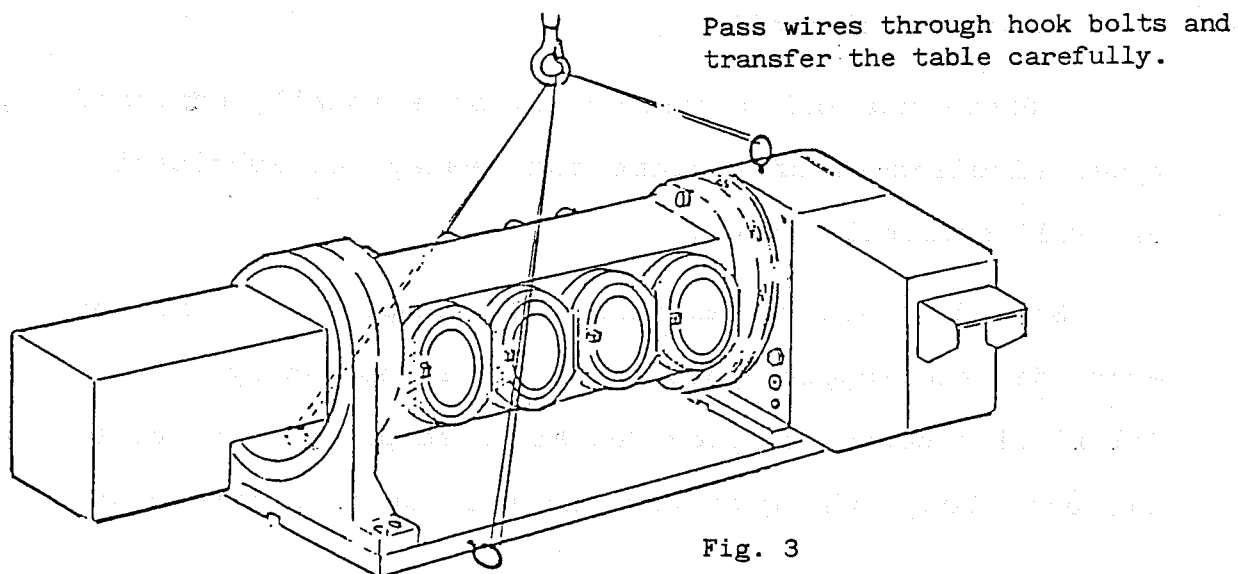


Fig. 3

② Removal of rust-preventive oil

Carefully wipe off rust-preventive oil which has been applied on the entire surfaces of table before shipping. Avoid use of benzine and gasoline which may cause rust.

③ Installation

After installing the table, securely tighten it according to the method and installation holes as previously discussed.

Further, in case when the tilting axis is used in a range of 180° ($-90^{\circ} \sim +90^{\circ}$), the rotating axis power cable and the feedback cable will be twisted so that a space of about 1 meter will be required at the rotating axis motor cover side.

5-2 Filling lubricating oil

Since the oil reservoir is of a totally enclosed type, mingling-in of coolant and leakage of lubricating oil will scarcely occur.

But, be sure to examine oil, inspect the oil pot every day and supply appropriate oil if necessary.

Oil filling ports are provided at three places: the tilting axis body, the gear box and the rotating axis body.

Incidentally, these bodies and gear box have been filled with Super-multi 100 before shipping, so that it is not necessary to fill oil at the initial operating state.

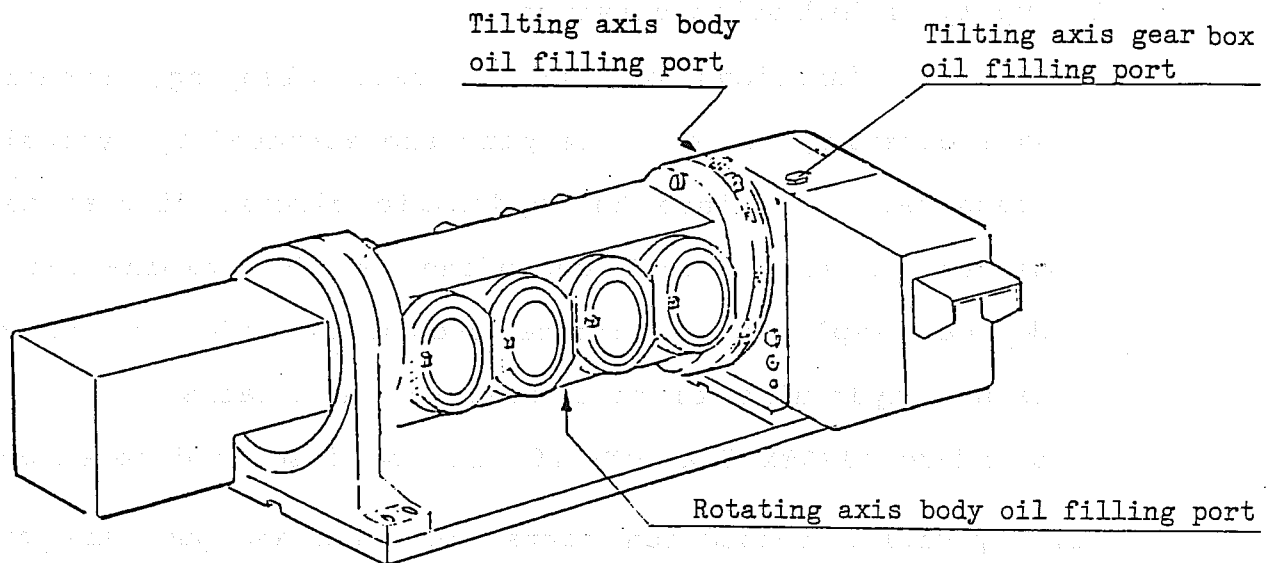


Fig. 4

Recommended oil

Oil maker	Brand name
Idemitsu	Super-multi 100
Kyodo sekiyu	Leductus 68 to 100
Cosmo oil	Bio-gear SP-68 to 100
Nippon sekiyu	Bonnock SP-68 to 100
Mitsubishi sekiyu	Diamond gear lub SP-100
Mobil oil	Mobil gear 626
Esso standard	Spaltan EP-68
Shell oil	Omala 68 to 100

5-3 Supply of hydraulic pressure for clamp and air vent

① Supply of hydraulic pressure

All functions of tilting axis clamping, rotating axis clamping and work clamping are actuated by hydraulic pressure. Since the hydraulic circuit diagram will differ to some extent depending on the combination of devices employed, reference should be made to the attached hydraulic circuit diagram in details. The standard NIKKEN 5AX-4MT-120 will be described hereunder.

- 1) Hydraulic connection ports for tank and pump are provided at the right side of tilting axis CNC250. The ports provide PT 3/8 female threads.
- 2) Use hydraulic pressure of 35 kgf/cm^2 or less.
- 3) Avoid back pressure as far as possible (1.5 kgf/cm^2 or less).
- 4) Normally, AC100V solenoid valves are provided for clamping the tilting axis and rotating axis, and a manual valve is provided for clamping the work.
- 5) Normal functioning states are as follows when the solenoid valves are energized and the manual lever is pulled.

Tilting axis: Unclamp

Rotating axis: Unclamp

Work clamp device: Unclamp

Air vent hole for
rotating axis brake

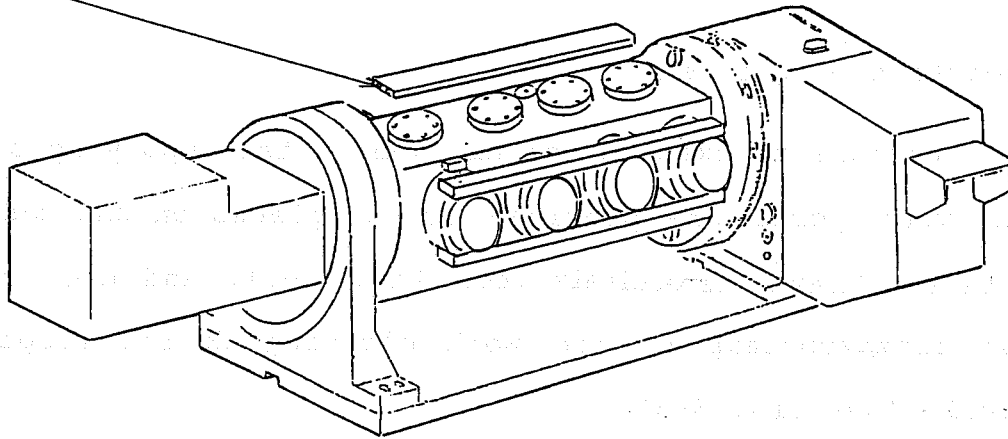


Fig. 5-1

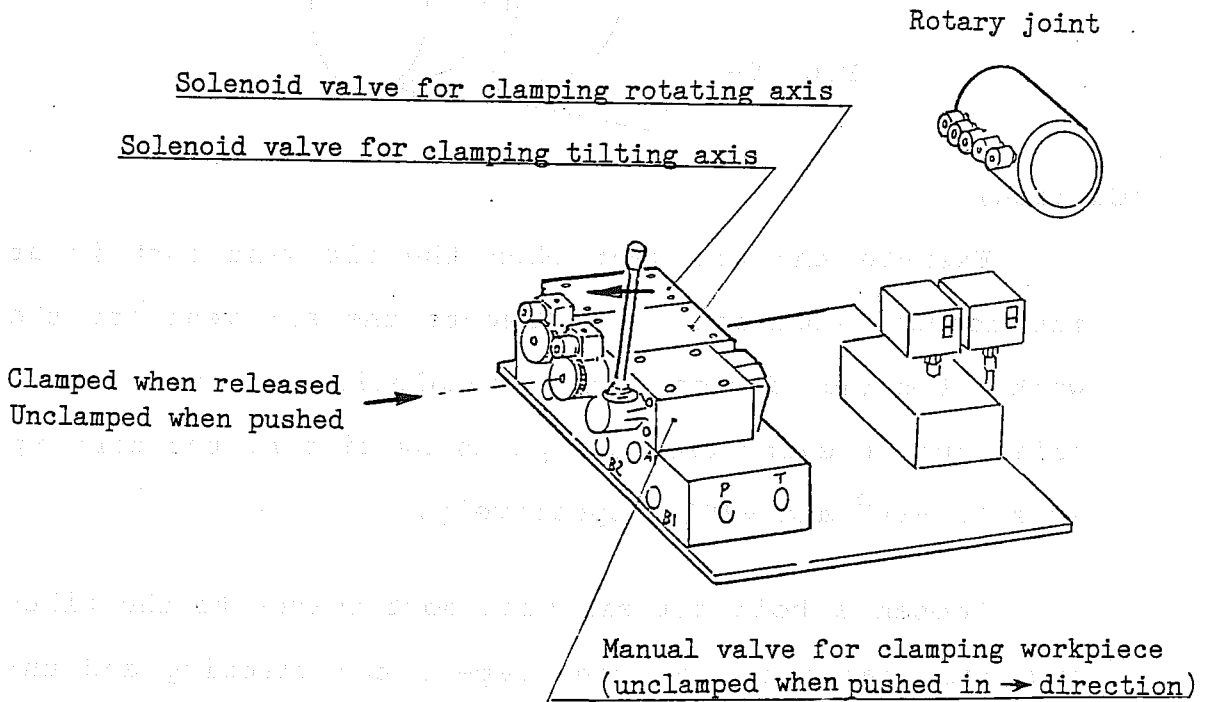
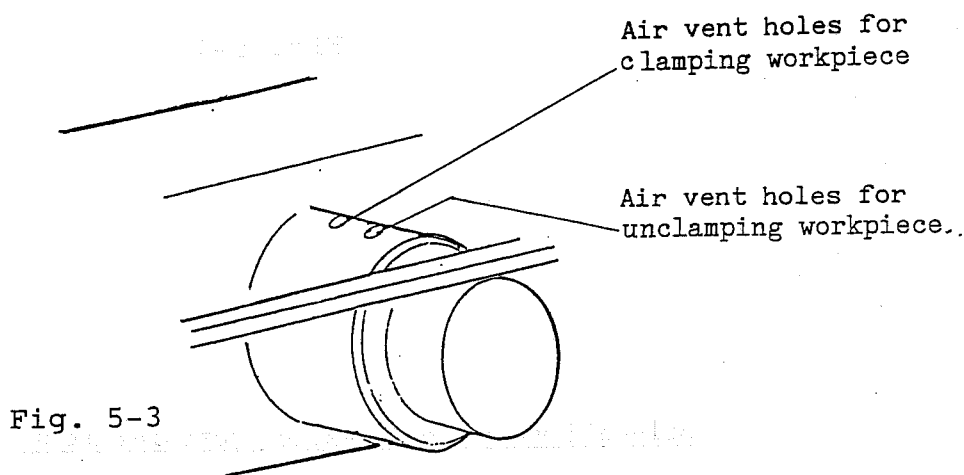


Fig. 5-2 View A of standard 5AX-4MT-120 ①

② Execution of air vent

Be sure to execute the air vent after supplying oil. Air vent ports are provided at two places on the manifold for brake respectively (see Fig. 5-1), and each two for clamp/unclamp of the work clamping device respectively (see Fig. 5-3).



(Caution)

Execute the air vent when the air vent port is at its topmost position. Execute the air vent for the work clamping device after completion of the entire trial run on every two vent ports by tilting the tilting axis to -90° and $+90^{\circ}$ respectively.

Loosen a bolt for air vent port nearer to the tilting axis table one by one, repeat the clamping and unclamping operation, and tighten the bolt when oil spills out.

When the above procedures are completed for all the four ports, repeat the above-mentioned operations again from the port nearer to the tilting axis and ensure the air is completely vented out.

- ③ Adjustment of hydraulic power chuck (for particular specification)

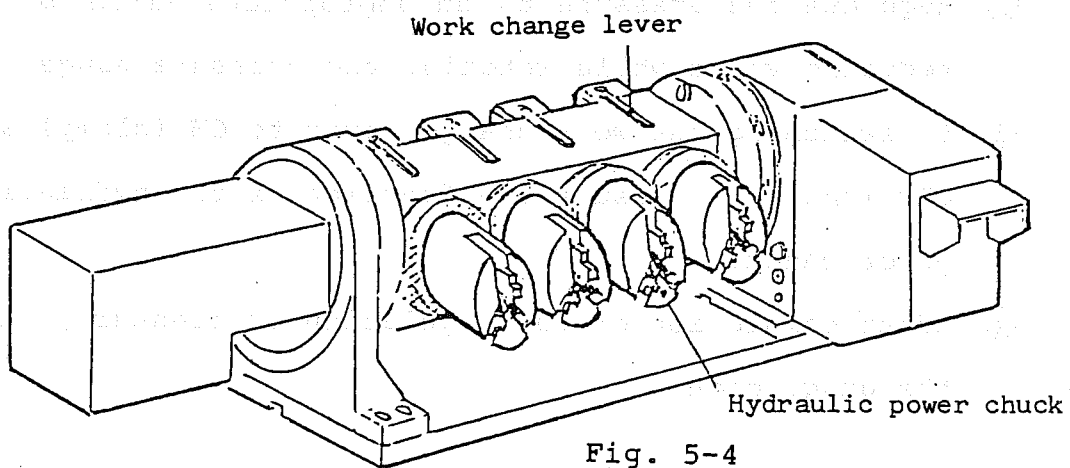


Fig. 5-4

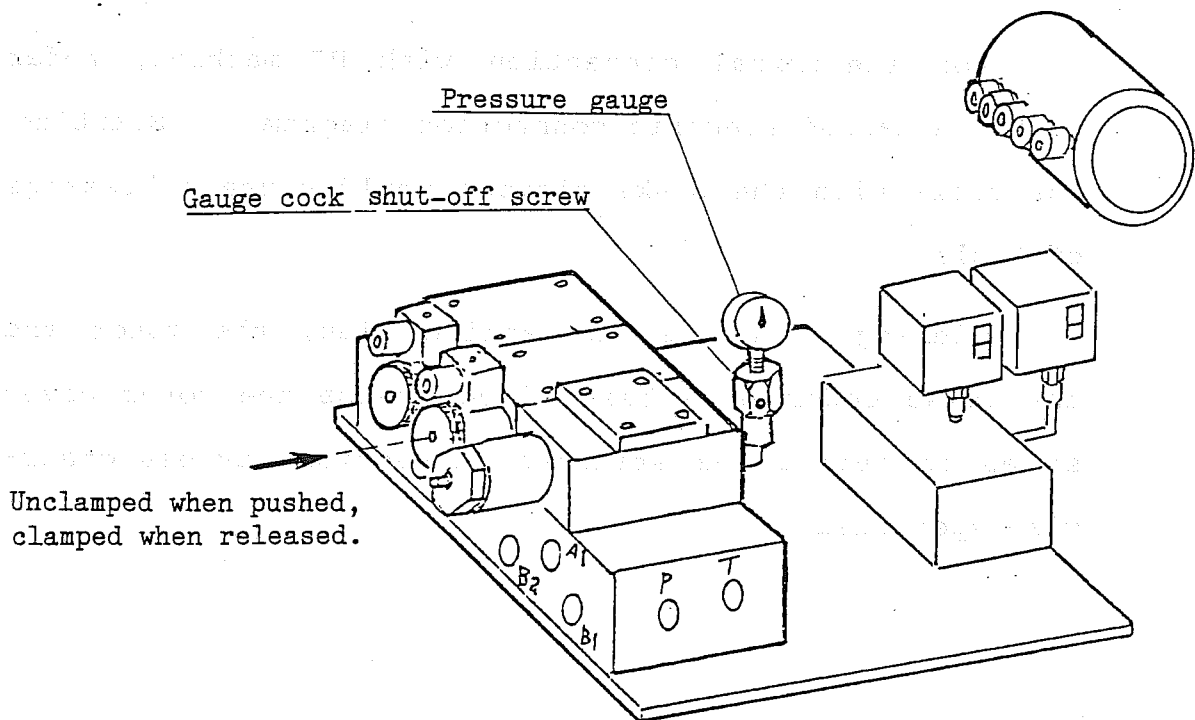


Fig. 5-5 Arrangement for changing work one by one using the hydraulic power chuck

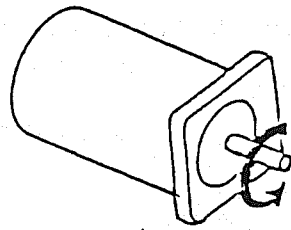
In this case, the reducing valve, gauge cock and pressure gauge are provided in place of the manual valve for clamping work. Since the work change levers are provided on each rotating table, the following procedures should be performed.

- ① Open the gauge cock.
- ② Regulate the pressure to an appropriate value by the reducing valve while watching the pressure gauge.
- ③ By switching the work change lever to ON (clamp) and OFF (unclamp), ensure the function of the hydraulic power chuck.
- ④ After completion of the regulation of pressure, close the gauge cock.

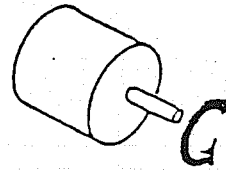
5-4 Electrical connection

For electrical connection with NC machine, refer to the attached electric connection diagram. Starting the table with the brake clamped would cause a breakage of table !

Viewing from the NC machine side, the motor and the pulse coder have been wired inside the motor cover so as to become the standard connection, unless otherwise specified.



Motor & tachogenerator

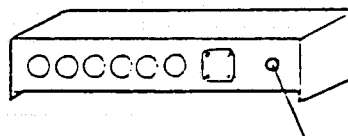


Pulse-coder

The tilting axis is equipped with the limit switch for preventing over-travel. Be sure to have the limit switch for preventing over-travel actuate by hand to check its emergency stop function after the electrical connection. Thereafter, be sure to ensure the function of over-travel bypass switch (to check that the emergency stop does not function when the limit switch for preventing over-travel is actuated with the over-travel bypass switch turned to ON as it is.)

The over-travel bypass switch is provided on the junction box in preparation for driving the tilting axis by the NIKKEN 8800DX.

Junction box



Over-travel bypass switch (red)

General electric connection diagram for 5AX-4MT-120WT in combination with hydraulic unit is shown in Fig. 6-1, and general electric connection diagram for 5AX-4MT-120DX in combination with hydraulic unit is shown in Fig. 6-2.

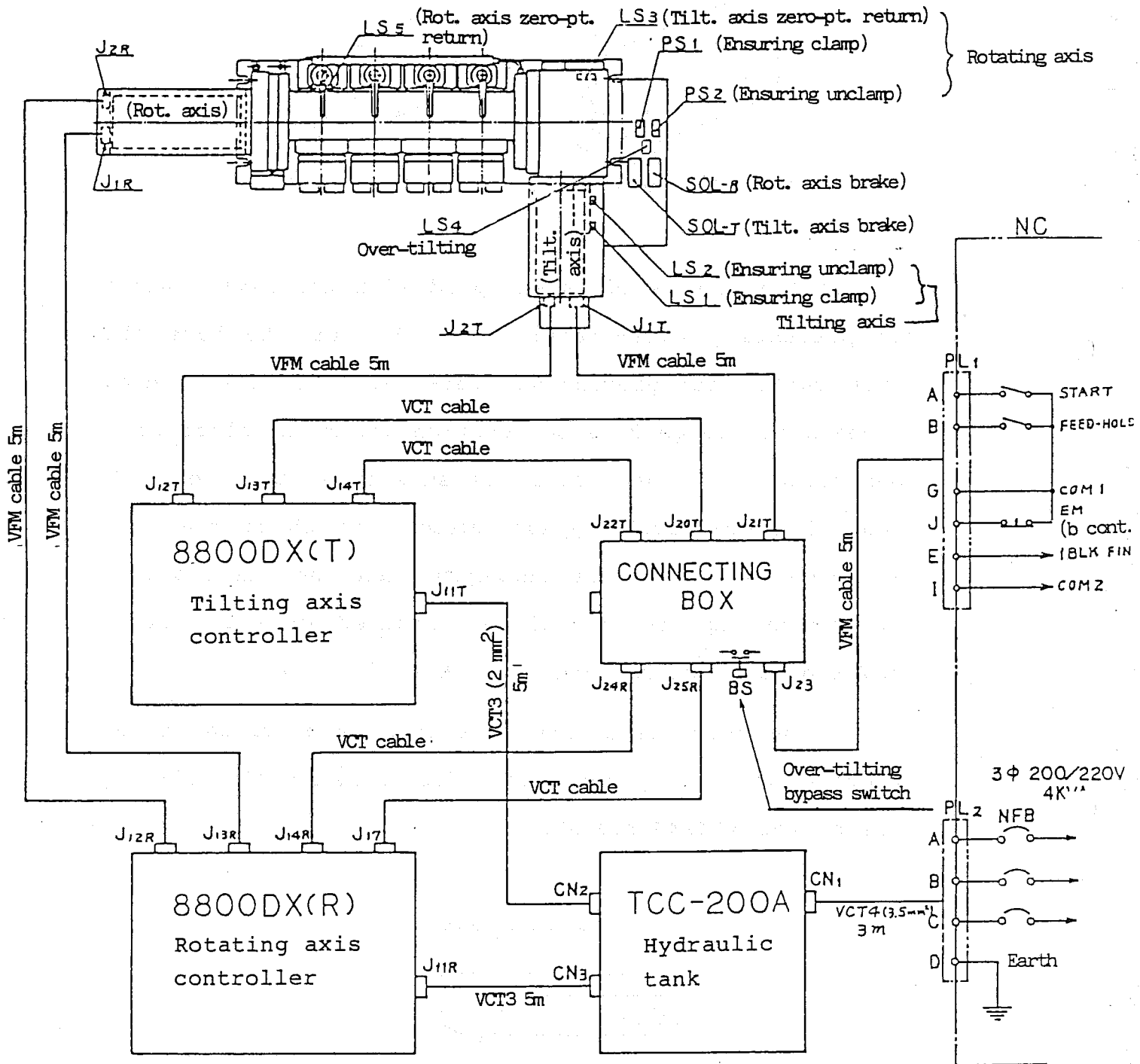
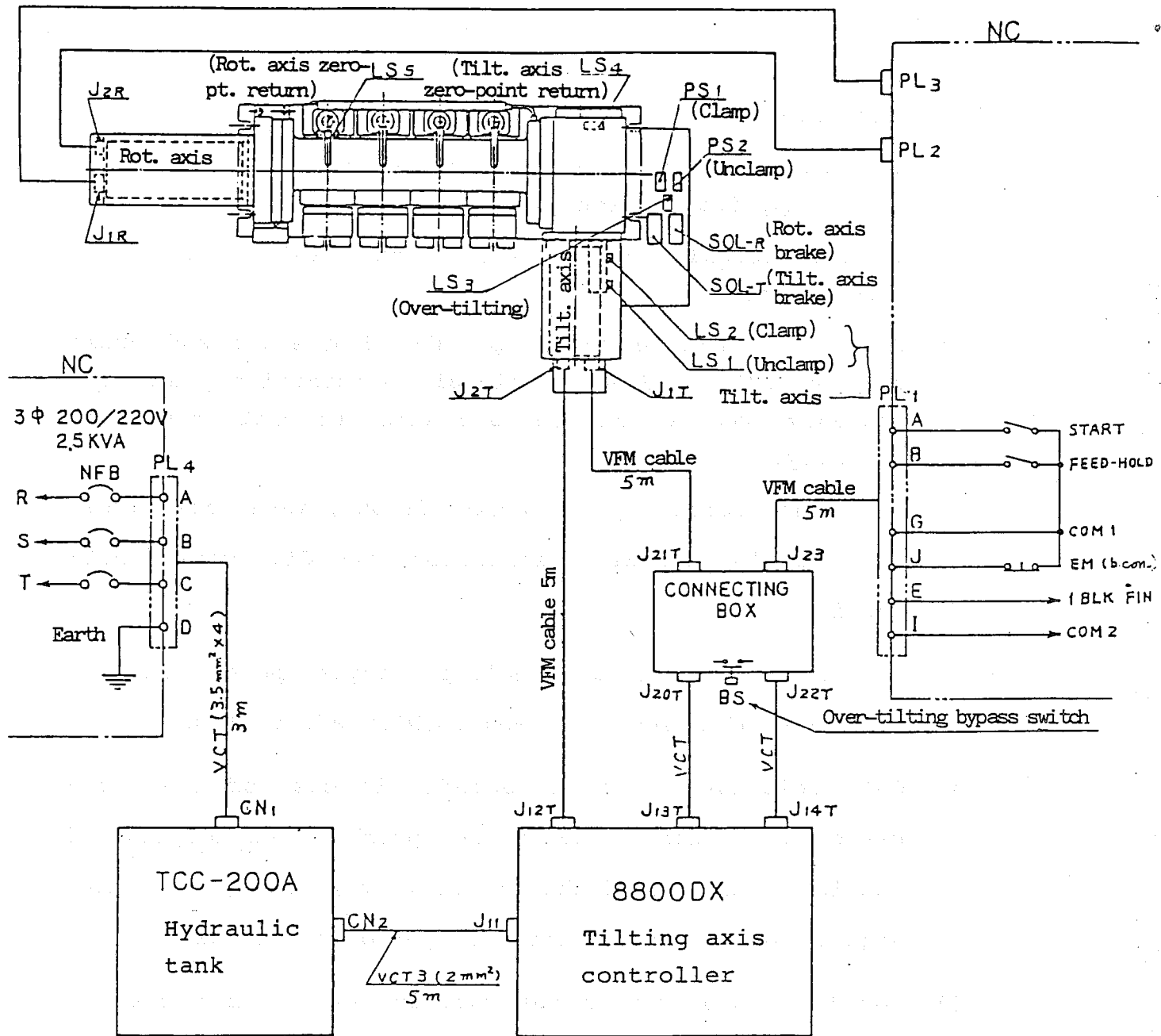


Fig. 6-1 General electric connection diagram for 5AX-4MT-120WT in combination with TCC-200A (hydraulic unit)



Note) PL4 receptacle, J1R & J2R straight plugs,
 PL2 & PL4 receptacles & straight plugs
 and cables connecting therebetween are not
 supplied.

Fig. 6-2 General electric connection diagram for 5AX-4MT-120DX in combination with TCC-200A (hydraulic unit)

5-5 Trial run

- 1) Connect hydraulic pressure to the table to make sure it is supplied correctly.
- 2) Do not install a work piece on the table to apply no load thereon.
- 3) Give the table brake clamp (M10, M68 etc.) and brake unclamp (M11, M69 etc.) signals alternatively and repeatedly from NC unit to make sure the brake functions normally.

When driven by the NIKKEN 8800DX, make sure by using the G10 (unclamp instruction) and G11 (clamp instruction).

NO00 G10 G13 (unclamp, single operation mode)

NO01 JO00 G11 (jump to NO00 after clamp)

- 4) Call relevant M code repeatedly in case of the automatic work change and repeat pushing and pulling of the lever in case of the manual valve, to make sure the work clamp/unclamp function is performed normally.
- 5) For the trial run of the rotating axis, carry out the break-in by making the axis rotate in both normal & reverse directions for about twice at a low feeding speed (about F360) to make sure of smooth rotation. Then, increase the rotation speed gradually.

For the trial run of the tilting axis, carry out the break-in by making the tilting axis rotate in both normal and reverse directions for about twice at a

low feeding speed while ensuring its position so as not to permit the axis enter into the over-travel region. Then, after ensuring the smooth rotation, increase the feeding speed gradually.

5-6 Setting zero-point return grid (required only for additional axis specification)

Zero-point positions of the tilting axis and rotating axis are shown hereunder.

The zero-point of the tilting axis means a position where the multitable becomes horizontal (the work positioning at the topmost position).

The zero-point of the rotating axis means a position where the key of multitable is at left side and the top face of key becomes horizontal when viewed from front side.

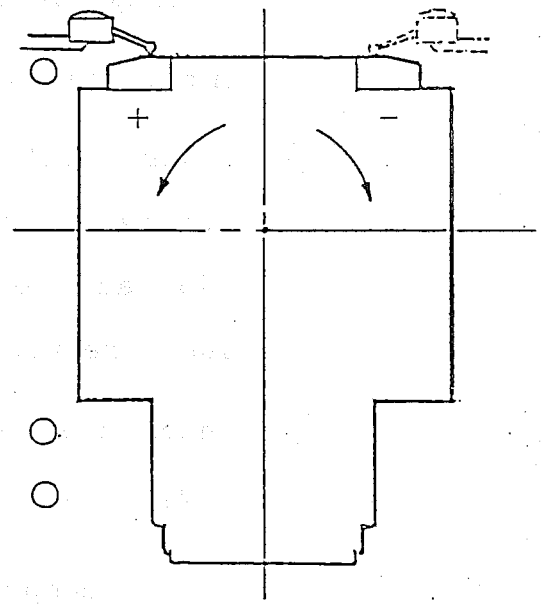


Fig. 7-1

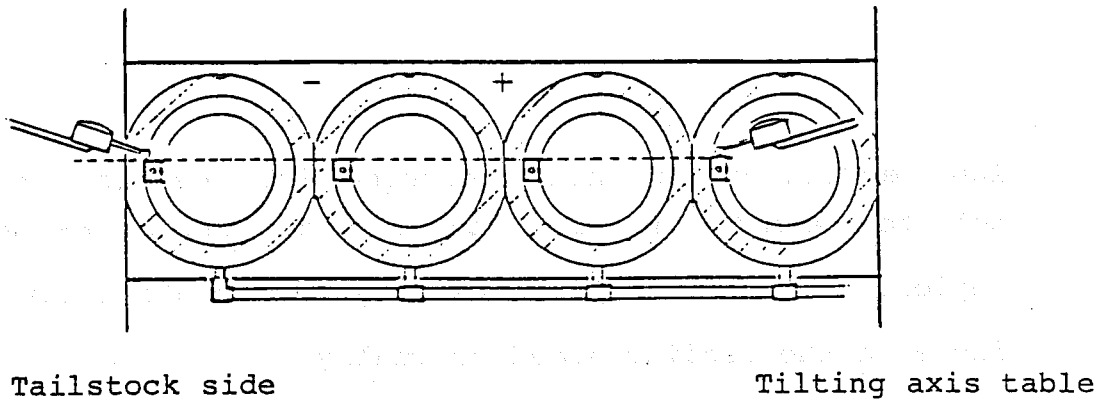


Fig. 7-2 (In this case, the tilting angle is 90° at the absolute position)

The grid shift amount is written in the parameter table when shipping. Making the written value as a compensation value, execute the following steps.

- ① Enter the compensation value into the grid shift amount.
- ② Under "JOG" mode, move the axis about several degrees clockwise if it is rotating axis or move it to around -45° at the absolute position if it is tilting axis. Then, return the axis to the machine origin.
- ③ Check the zero-point position of table using the dial gauge and adjust the compensation value.

A compensation value, which is obtained by repeating the above procedures ① - ③ and ensuring the horizontalness, is the correct grid shift amount.

5-7 Example of program for trial run

The following is an example for driving both the rotating and tilting axes by the NIKKEN 8800DX (WX-type).



8800DX for rotating axis

8800DX for tilting axis

G62: 8800DX for tilting axis start

G12: Consecutive operation mode

G13: Single operation mode

	MAN mode	MAN	AUT mode	AUT
N000				
		G12		
1	00.	G92 G91		
2	0360 DIV6	FO		
3	015.			
4	030. F200			
5	015. FO			
6	060.			
7	P3 Q6 L2	G27		
8	P3 Q5 L1	G27		
9	060.	G62	N000	0315.
N010	0360. DIV12			
1		G62	1	0270.
2	090.			
3	0-60.		2	0250.
4	010. F100			
5	0120. FO		3	0100.
6	0-30. F150			
7	0100. DIV10 FO		4	JO 00.
8	0130.			
9		G62		
N020		G62		
N021		G62		
N022	JO	G13		

For details of program, refer to the instruction manual of NC unit.

Now, the preparation for operation is completed. In practical machining, install the work piece and jig precisely to accomplish a stable machining.

6. Mechanism and adjustment of major functioning part

6-1 Adjustment of backlash (tilting axis)

The worm shaft rotates in the totally-enclosed oil bath and the reduction mechanism is composed of a combination of the special ion-nitrided worm gear and the carbide worm screw, so that it is not necessary to adjust the backlash until four to five years have elapsed after the table is put in service.

However, if necessary, the backlash can be adjusted easily according to the following procedures.

- 1) Return the rotating axis to its zero-point and clamp it (brake: ON).
- 2) Return the tilting axis to its zero-point and open the brake.
- 3) Ensuring the backlash

Read a deflection of the dial gauge (G) by inserting a flat steel plate (H) into a T-slot and shaking the table left and right through the plate with hand.

Be sure, in this instance, to keep the dial gauge (G) in contact with the T-slot. A backlash of within 5 ~ 15 μ is normal, and the adjustment is required in the event when a backlash of above 0.05 mm is observed.

The adjustment is to be done on the following five spots:

0° (zero-point), 45° , 90° , $-45^\circ(315^\circ)$ & $-90^\circ(270^\circ)$

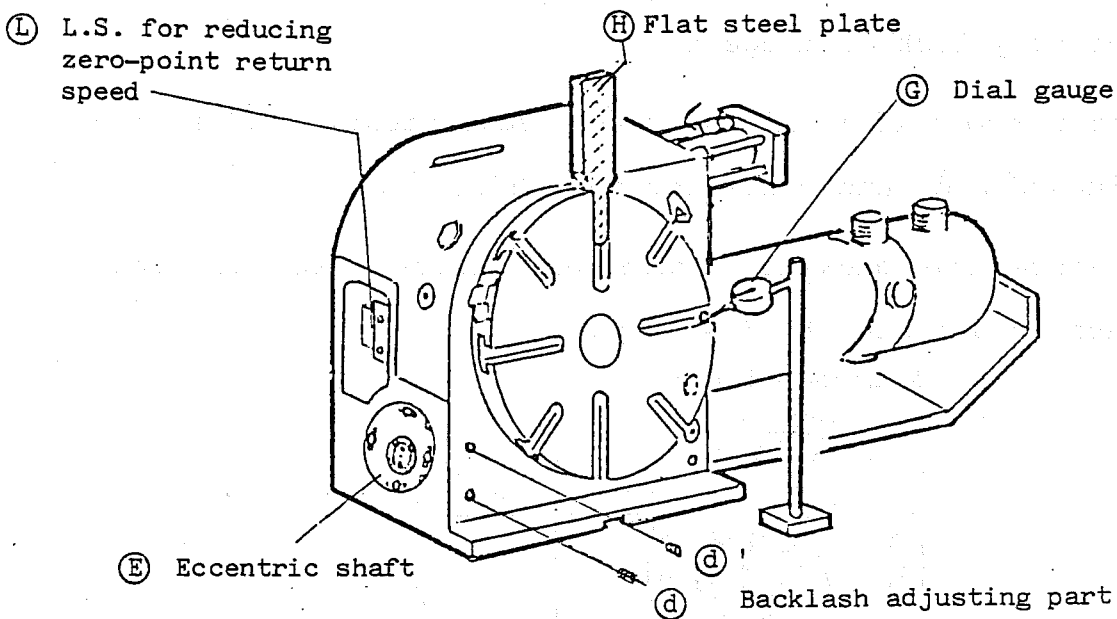


Fig. 8

6-1-1 Adjustment of backlash between worm gear and worm screw

- 1) Loosen four cap screws which fasten the eccentric shaft (E).
- 2) Take out the screw plgs (d) and (d') of Fig. 2 and the backlash adjusting bolts (h) & (g) will be provided therein.
- 3) Here, reset the dial gauge (G) as shown in Fig. 4,

loosen the screw (h) and tighten the screw (g) clockwise, then the eccentric shaft will turn in the direction of arrow. Thus, the backlash between the worm gear and the worm screw will get near to zero. Adjust the backlash to 10 ~ 15 μ by using the screws (g) & (h) watching the deflection of the dial gauge (G) while shaking the outer periphery of circular table, then securely lock them again.

- 4) After completion of the above adjustment, tighten the plugs (d) & (d') and bolts for the shaft (E).
- 5) Measure the backlash again and ensure that the backlash is adjusted to 5 ~ 10 μ .

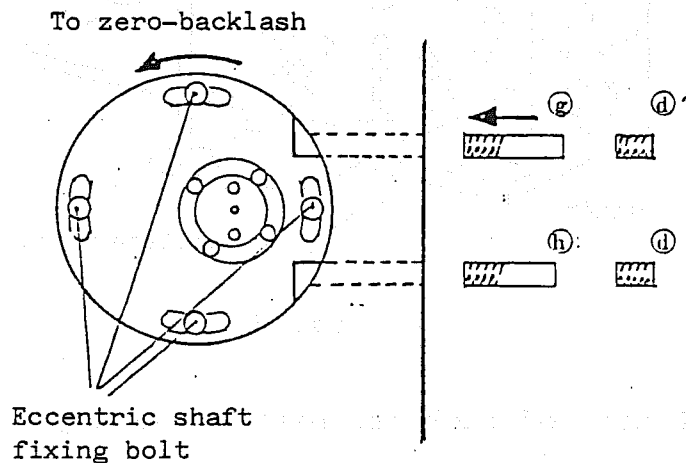


Fig. 9

- 6) After completion of the adjustment of backlash, make sure of the motor load. Turn on the power supply, let the circular table rotate on the jog mode to check the motor shaft for gear noise.

* If abnormal sound is recognized, loosen the attaching bolt of Fig. 10 and slowly turn adjusting screw clockwise, then it will become normal sound.

* If the gear noise is too light as compared with former one, a backlash would have been produced in the motor shaft.

Apply the dial gauge ③ on the T-slot again as shown in Fig. 8 and jog the button to examine behavior of the gauge pointer. Turn the adjusting screw counter-clockwise while operating both the CW & CCW jog buttons, and the backlash of the motor shaft will get near to zero.

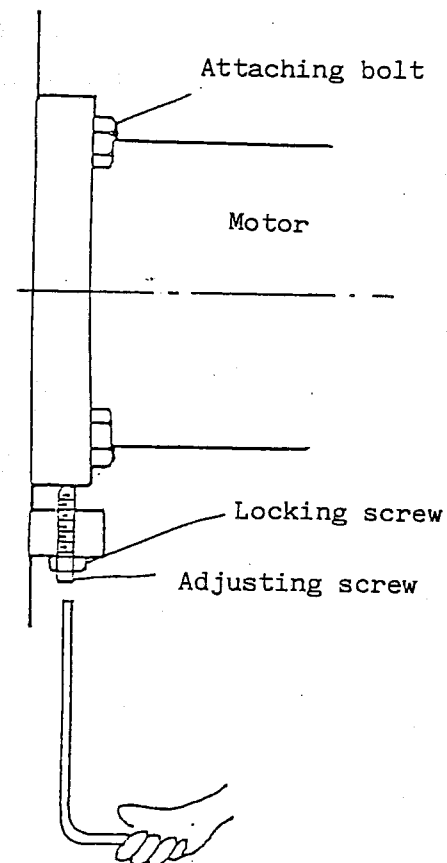


Fig. 10

Cautions:

1. The adjustment of backlash is a very delicate work, so be careful when executing it.
2. Completely seal the threads of plugs ④ & ④' using a seal tape etc., without fail !

Carefully check the seals because long-year's ingress of cutting fluid or oil from these plugs would cause various troubles.

3. Retighten the locking screw and the motor attaching bolt shown in Fig. 10.

6-2 Brake mechanism (tilting axis)

The brake is incorporated in the backside of the CNC 250 body, and its mechanism is illustrated in Fig.11. The brake rod is directly coupled to the hydraulic cylinder which exerts a clamping torque of 35 kgf.m at a hydraulic pressure of 35 kg/cm² (disc brake type).

Since this brake mechanism requires a fine adjustment, by no means disassemble it indiscriminately.

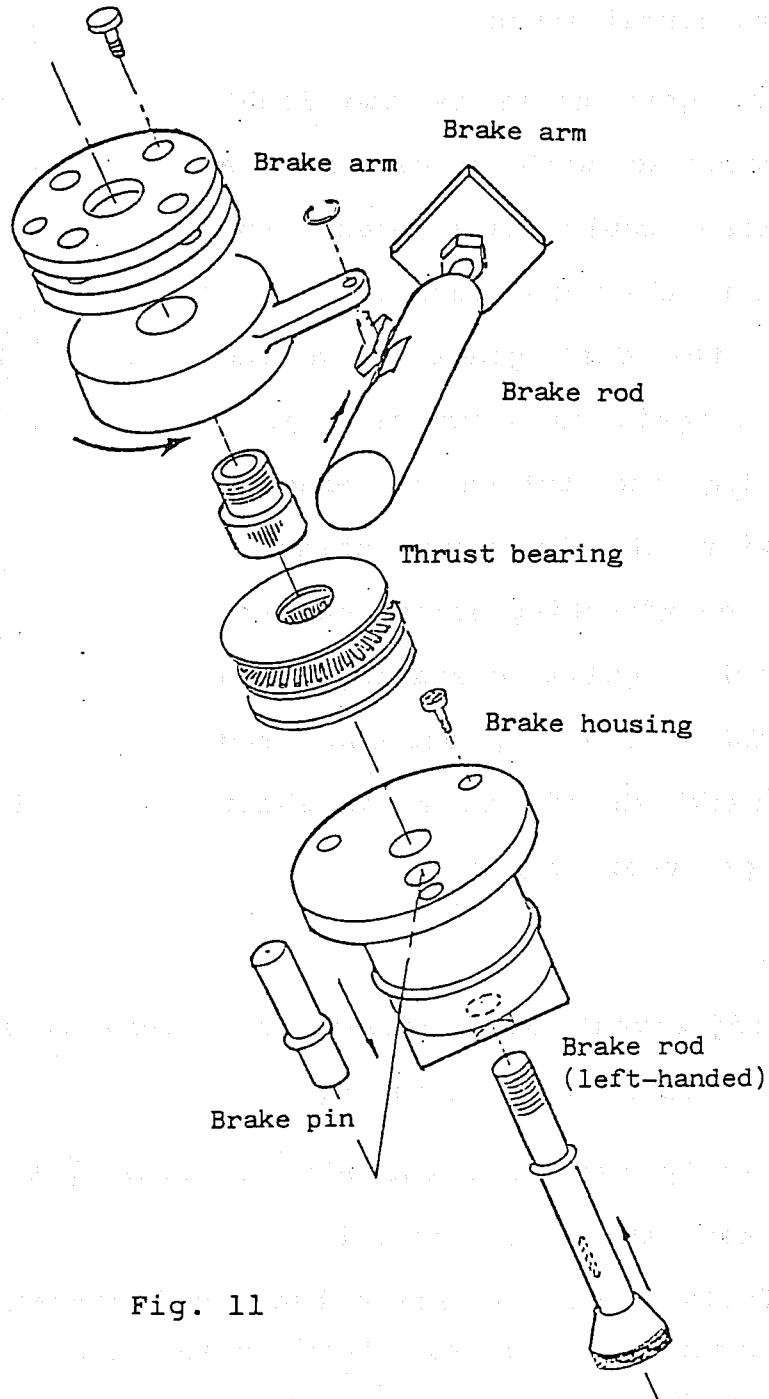


Fig. 11

6-3 Clamp/unclamp ensuring mechanism (tilting axis)

The sensors for ensuring clamp/unclamp are provided on the hydraulic cylinder as shown in Fig. 12.

The hydraulic cylinder is directly coupled to the brake rod, so that the clamp/unclamp ensuring sensors sense a movement of the magnetic generator in the cylinder to directly output a contact signal.

The unclamp ensuring sensor is positioned at 4 ~ 5 mm from hydraulic cylinder flange, and the clamp ensuring sensor is positioned at 34 ~ 35 mm therefrom.

In the event of wrong sensor positions with no trouble in the solenoid valve, brake etc., loosen the sensor attaching bolts and adjust the positions as described above.

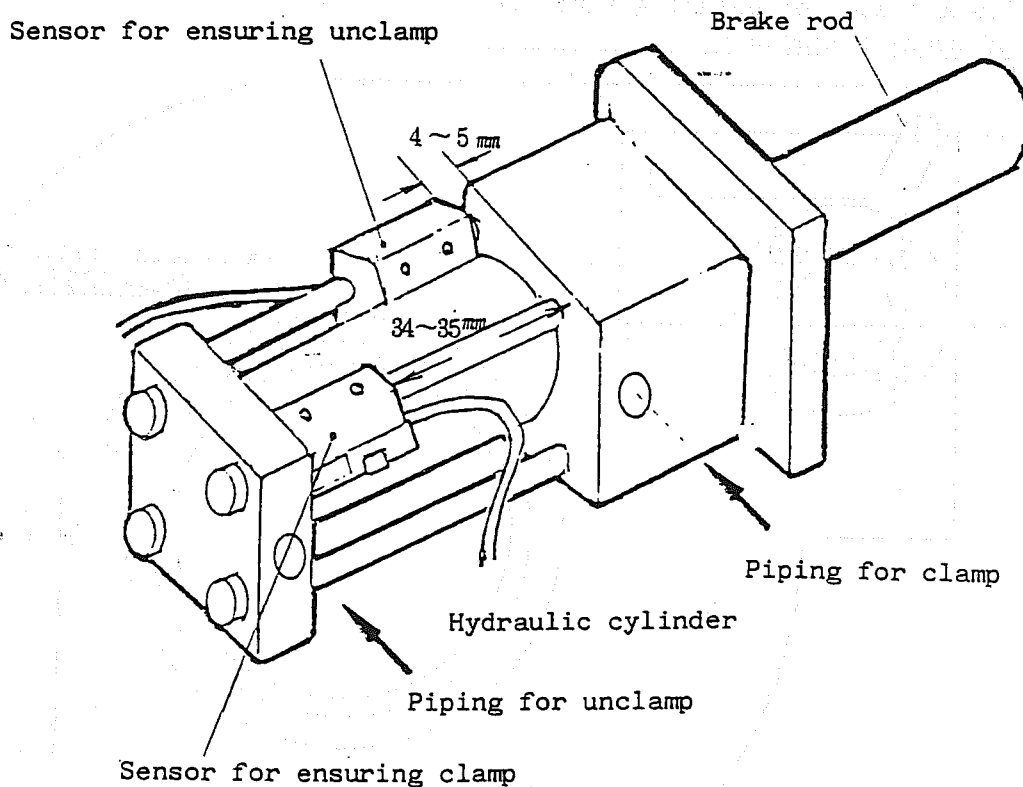


Fig. 12

6-4 Zero-point return mechanism (tilting axis)

- 1) The limit switch for zero-point return is disposed in Fig. 2-4. The dog attached to the outer periphery of table actuates this limit switch to have it output the speed reduction signal.
- 2) Adjustment of dog position
Bring the dog under the jog mode to a position where the adjustment can be done easily.
- 3) Loosen the dog fastening bolts, and shift the dog to a proper position (See Fig. 13.).

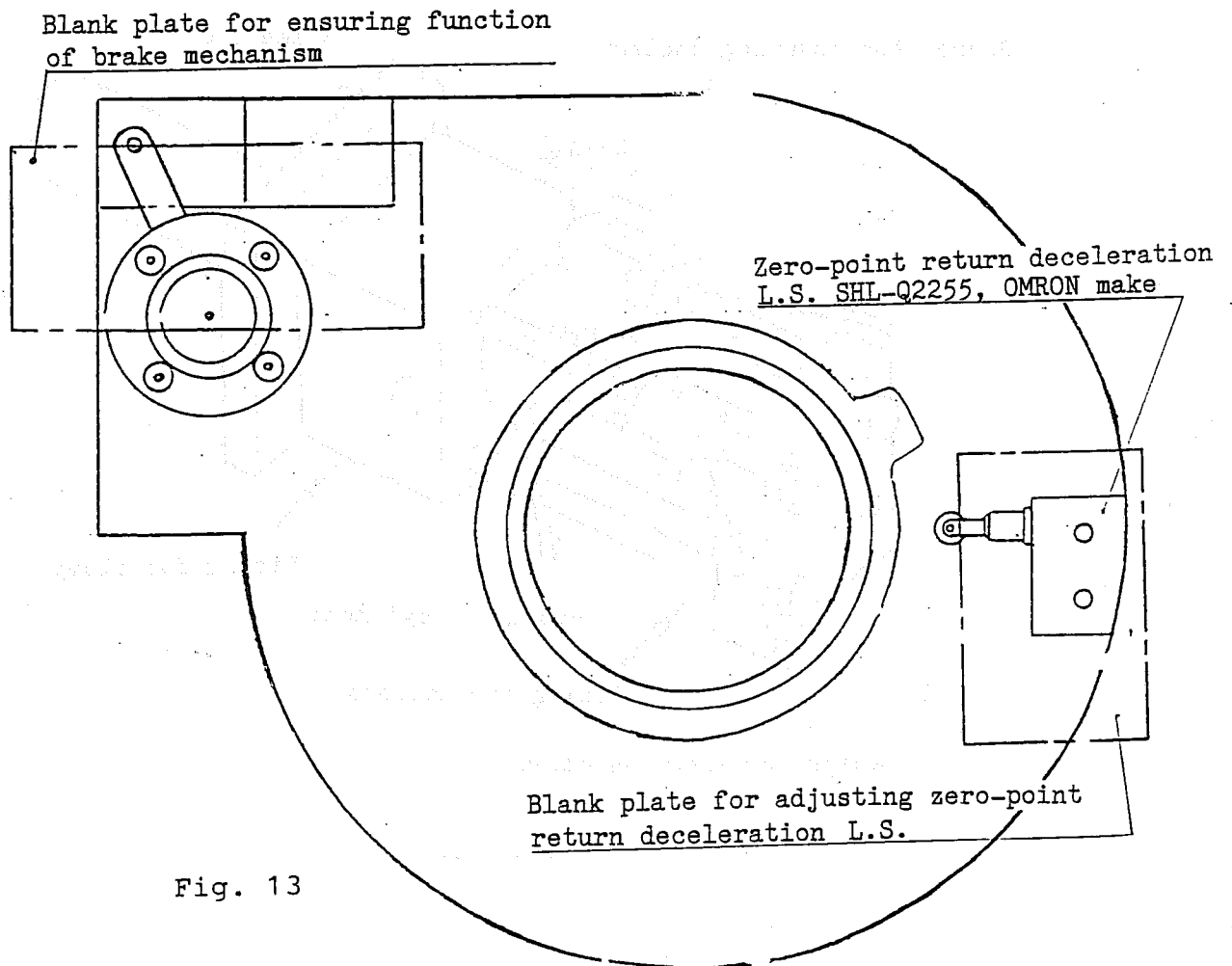


Fig. 13

6-5 Over-travel prevention mechanism (tilting axis)

The moving range of machine for tilting axis CNC250 is $-110^{\circ}(250^{\circ}) \sim 110^{\circ}$ when a 120ϕ work is fitted.

The dogs and limit switch for detecting over-travel are set on the CNC250 side : so as to actuate at axis angles $-112^{\circ} (248^{\circ})$ and 112° respectively in consideration of the braking distance at the time of emergency stop (See Fig. 14.).

When the table is shipped, the software limit value for the tilting axis 8800DX in case of operating the 5AX-4MT-120 by the NIKKEN 8800DX has been set to 110.5° (PRM#33) for the plus side and 249.5° (PRM#34) for the minus side.

In the event when the software limit value is changed by customers, be sure to observe the following steps.

- * Turn off the power for 8800DX.
- * After waiting a little, turn the power on.
- * Then, perform the M zero-point return operation by pushing the key

M
ZRN

 .

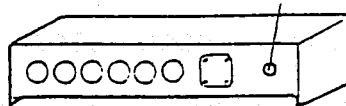
Further, change the parameter value of the parameter sheet (Individual function specification).

Take the following steps to release the emergency stop mode in general operation, although they may differ to some extent depending on an NC unit to be connected.

- ① Turn the power off.
- ② Turn the power on while the overtravel by-pass switch kept turned on, and move the table to the safety zone under the JOG mode.
- ③ Turn the overtravel bypass switch off, because the next overtravel can not be detected.
- ④ Return the table to the M zero-point.

In case of the NIKKEN 8800DX, the bypass switch is provided on the junction box. To release the emergency stop mode, take the same steps as described above.

By-pass switch (red)



6-6 Mechanism of rotary joint for tilting axis

The rotary joint is installed at the backside of the CNC250 for tilting axis.

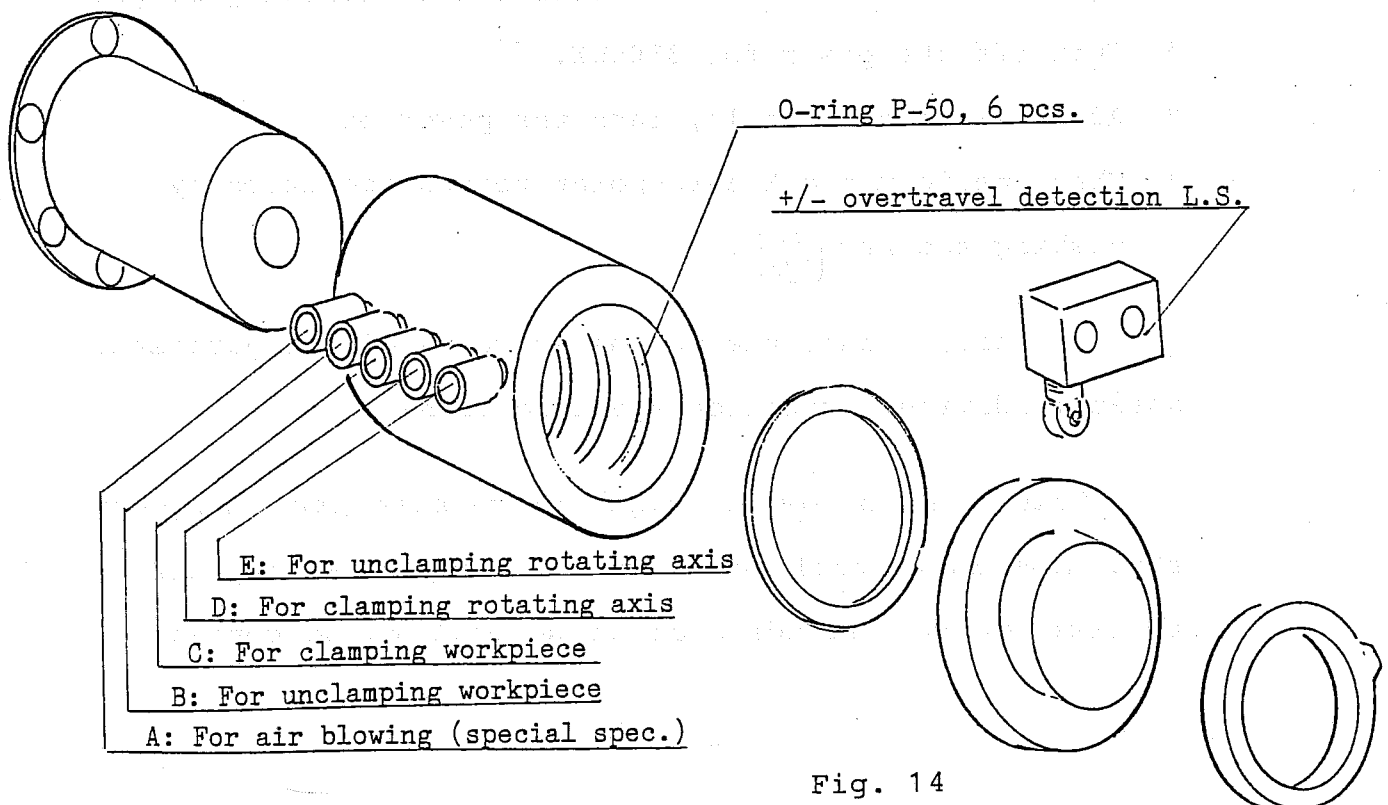


Fig. 14

6-7 Adjustment of backlash (rotating axis)

The worm shaft rotates in the totally-enclosed oil bath and the reduction mechanism is composed of a combination of the special ion-nitrided worm gear and the carbide worm screw, so that it is not necessary to adjust the backlash until four to five years have elapsed after the table is put in service.

However, if necessary, the backlash can be adjusted easily according to the following procedures.

- 1) Move the tilting axis to -90° (270°) position and clamp it (brake: ON).
- 2) Return the rotating axis to its zero-point and open the brake.
- 3) Measuring the backlash

Apply the dial gauge on the key top face and shake the table outer periphery right and left with hand. A dial gauge reading of within 0.03 mm is normal, and the adjustment is required in the event when a backlash of above 0.05 mm is observed.

The measurement is to be done at rotating axis positions of 0° and 180° for all four quadruple-mount tables.

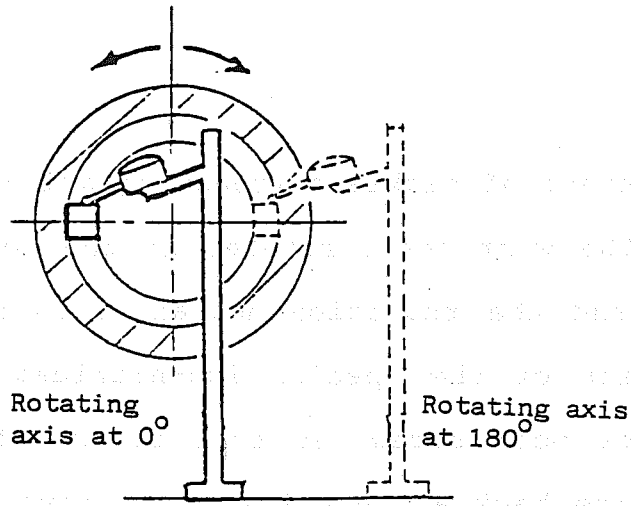


Fig. 15

6-7-1 Adjustment of backlash

The backlash is adjusted by decreasing the inter-meshing pitch between the spindle center and the worm shaft center.

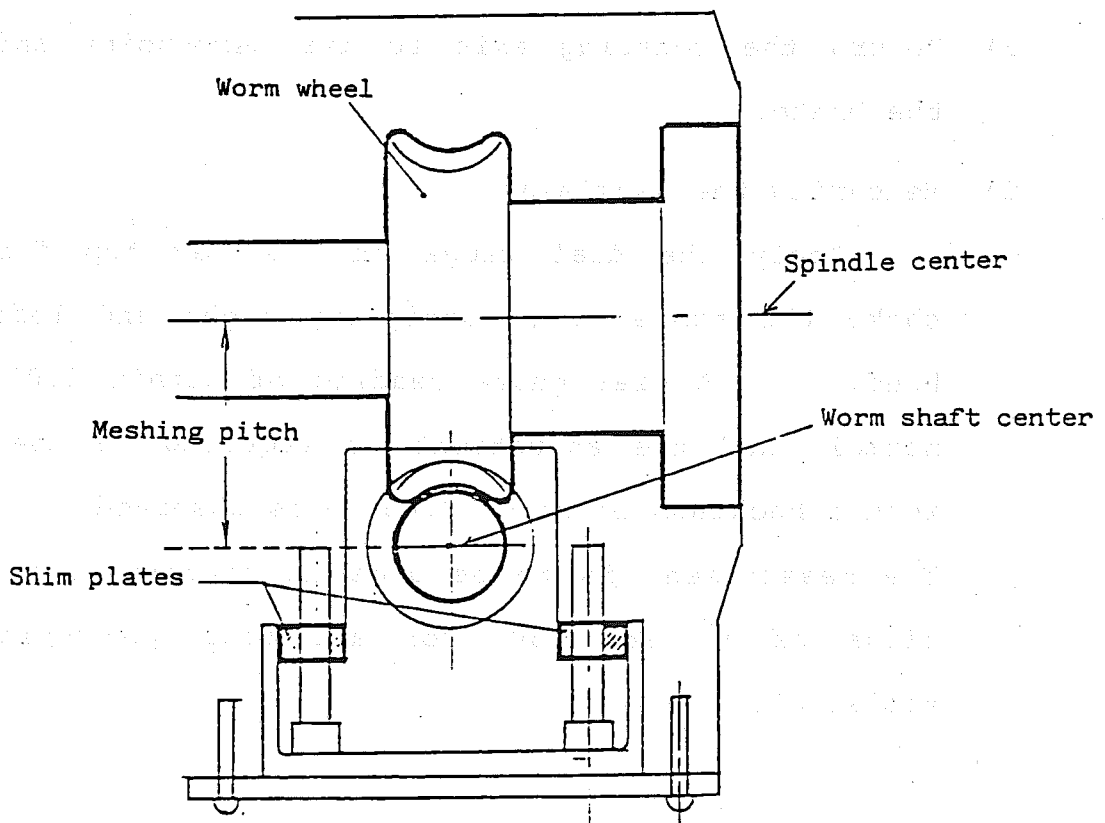


Fig. 16 Backlash adjusting mechanism for rotating axis

The adjusting mechanism is as illustrated by Fig. 16. To adjust the backlash, take out the shim plates and thin them by using a surface grinder etc. In order to decrease the backlash by 0.01 mm, thin the shim plates by about 0.019 mm.

(Note) To avoid an excessive thinning of the shim plates, thin them carefully and gradually.

6-8 Clamping mechanism (rotating axis)

History of revision of rotating axis for clamping mechanism

Mfg No.	Clamping mechanism	Setting of pressure SW
#1000 to #1024	Clamping sleeve system ((hydraulic clamping)	SANYO KEIKI JP-B1 & JPB2 Clamp ensuring: 25 to 28 kgf/cm ² Unclmp ensuring: 5 to 10 kgf/cm ² at hydraulic supply pressure of 35 kgf/cm ²
#1025 to #1048		TOYOOKI HW1-3T1-02 Clamp ensuring: 25 to 28 kgf/cm ² Unclmp ensuring: 5 to 10 kgf/cm ² at hydraulic supply pressure of 35 kgf/cm ²
#1049 to #1050	Clamping system by lifting worm shaft to make backlash to "zero" (pneumatic clamping)	SHOKETSU VRZ 460 Clamp ensuring: 3.5 to 4 kgf/cm ² Unclamp ensuring: 3.5 to 4 kgf/cm ² at pneumatic supply pressure of 5 kgf/cm ²
#1051 and larger	Clamping system by lifting worm shaft to make backlash to "zero" (hydraulic clamping)	TOYOOKI HW1-3T1-02 Clamp ensuring: 25 to 28 kgf/cm ² Unclamp ensuring: 25 to 28 kgf/cm ² at hydraulic pressure of 35 kgf/cm ²

6-8-1 Clamping mechanism (rotating axis) Mfg. #1051 and larger

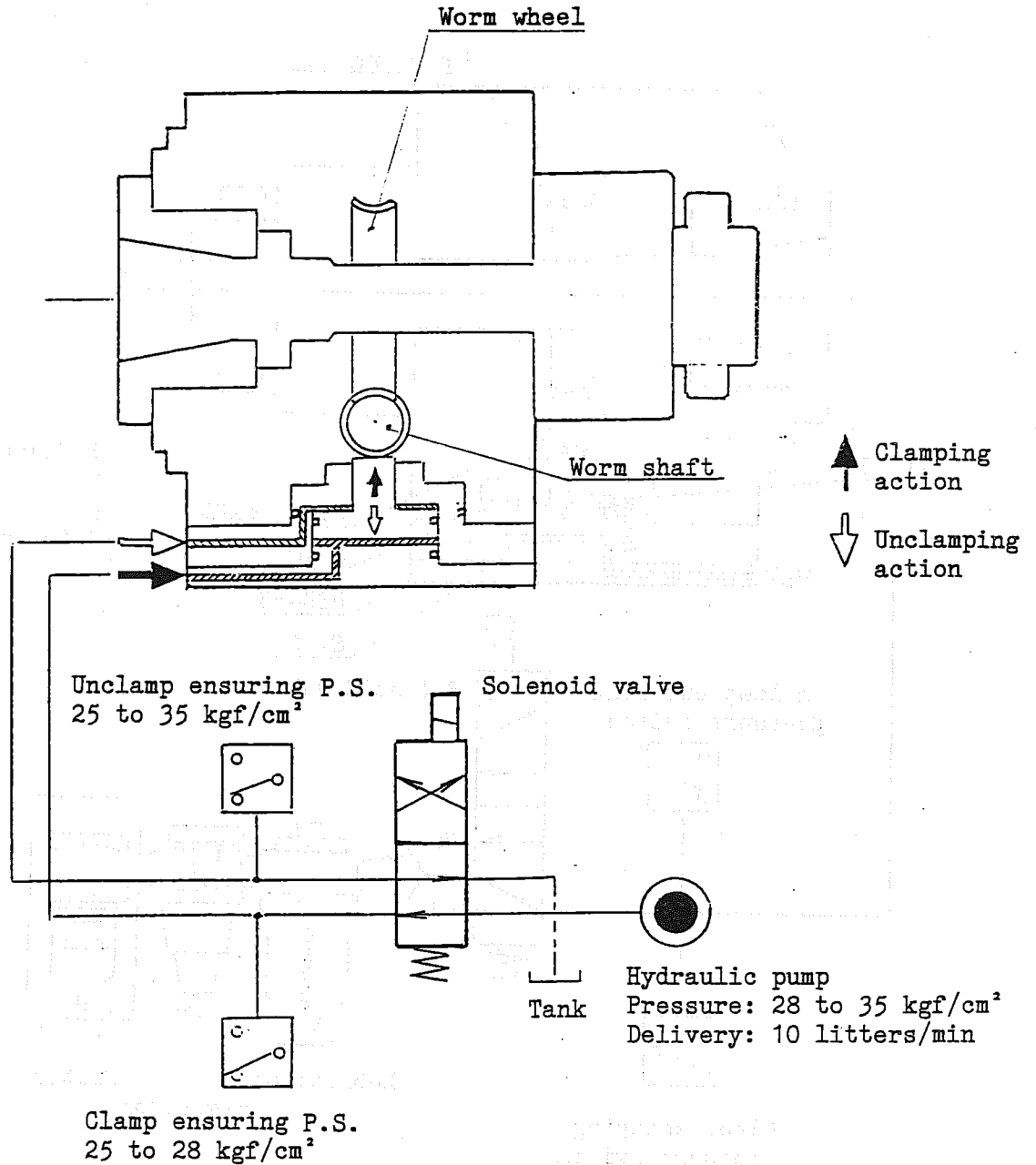


Fig. 17

The clamping mechanism for rotating axis is illustrated in Fig. 17. This mechanism is of a type which makes the backlash to "zero" by lifting up the worm shaft when clamping the table.

6-8-2 Pneumatic clamping system (Mfg. #1049 to #1050)

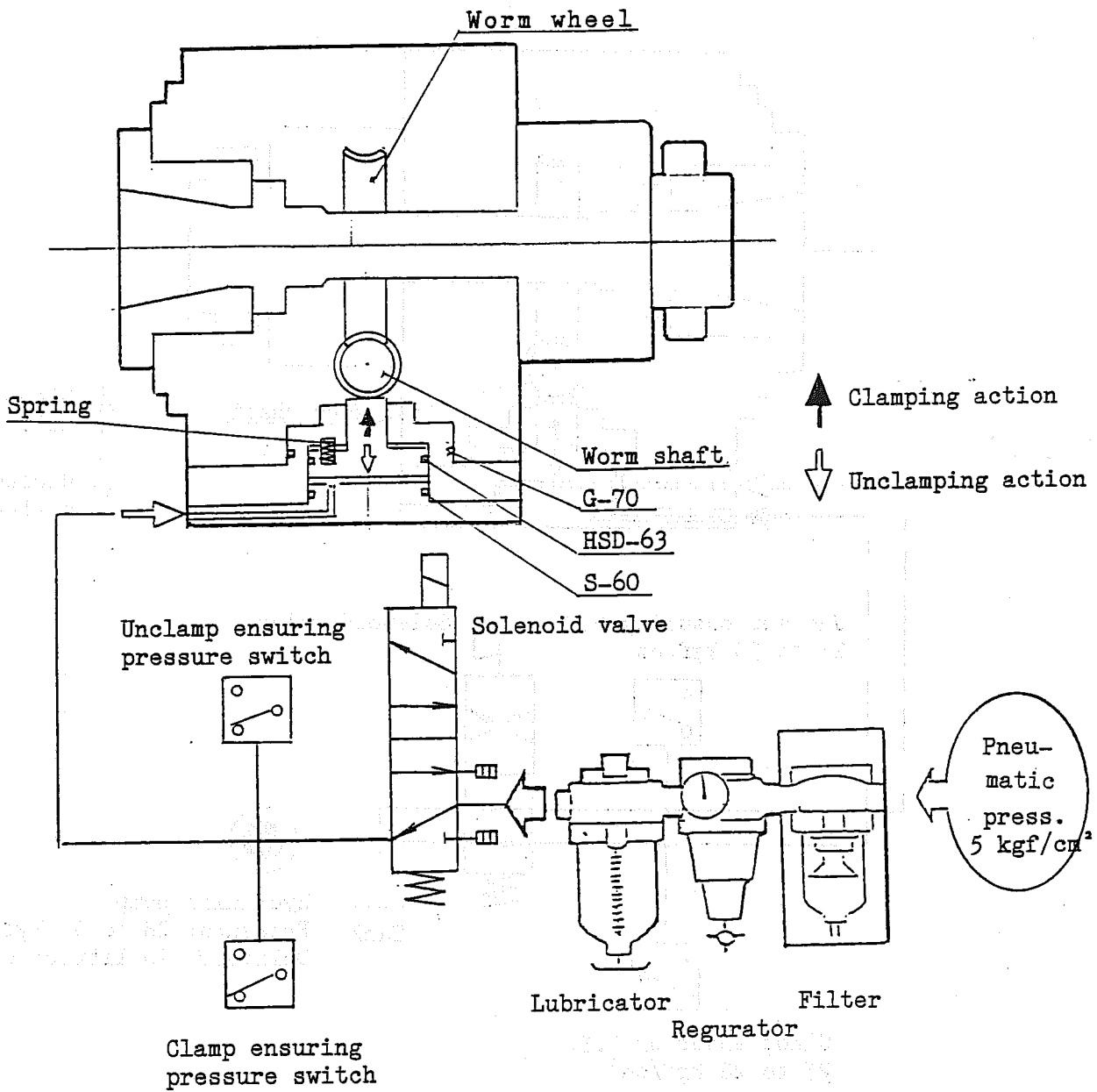


Fig. 17-1

The clamping mechanism for rotating axis is illustrated in Fig. 17-1. This mechanism is of a type which makes the backlash to "zero" by lifting up the worm shaft when clamping the table.

6-8-3 Clamping mechanism (rotating axis): Clamping sleeve system (Mfg. #1000 to #1048)

The clamping mechanism for rotating axis is illustrated in Fig. 17-2 (clamping sleeve system). The standard clamping supply is of hydraulic type, and the quadruple-mount tables are clamped by a torque of 15 kgf.m at a hydraulic pressure of 35 kgf/cm².

In the standard control system, the tables are released when the solenoid valve is energized.

The setting pressures are 5 to 10 kgf/cm² for the unclamp ensuring pressure switch and 25 to 28 kgf/cm² for the clamp ensuring pressure switch, when the table is shipped from our factory.

A system in which the table outer periphery is clamped by means of hydraulic force is employed.

(Clamping sleeve system)

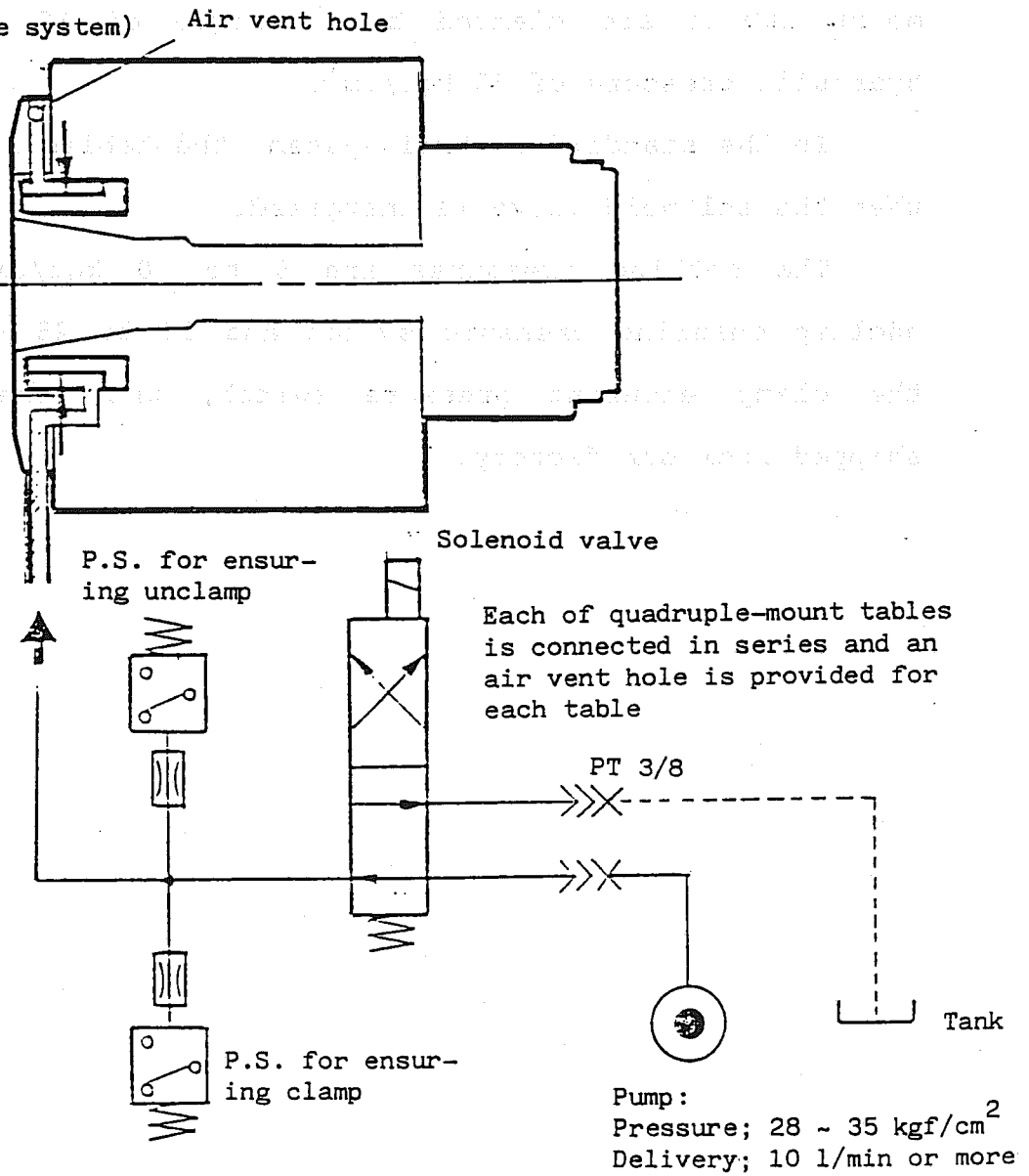
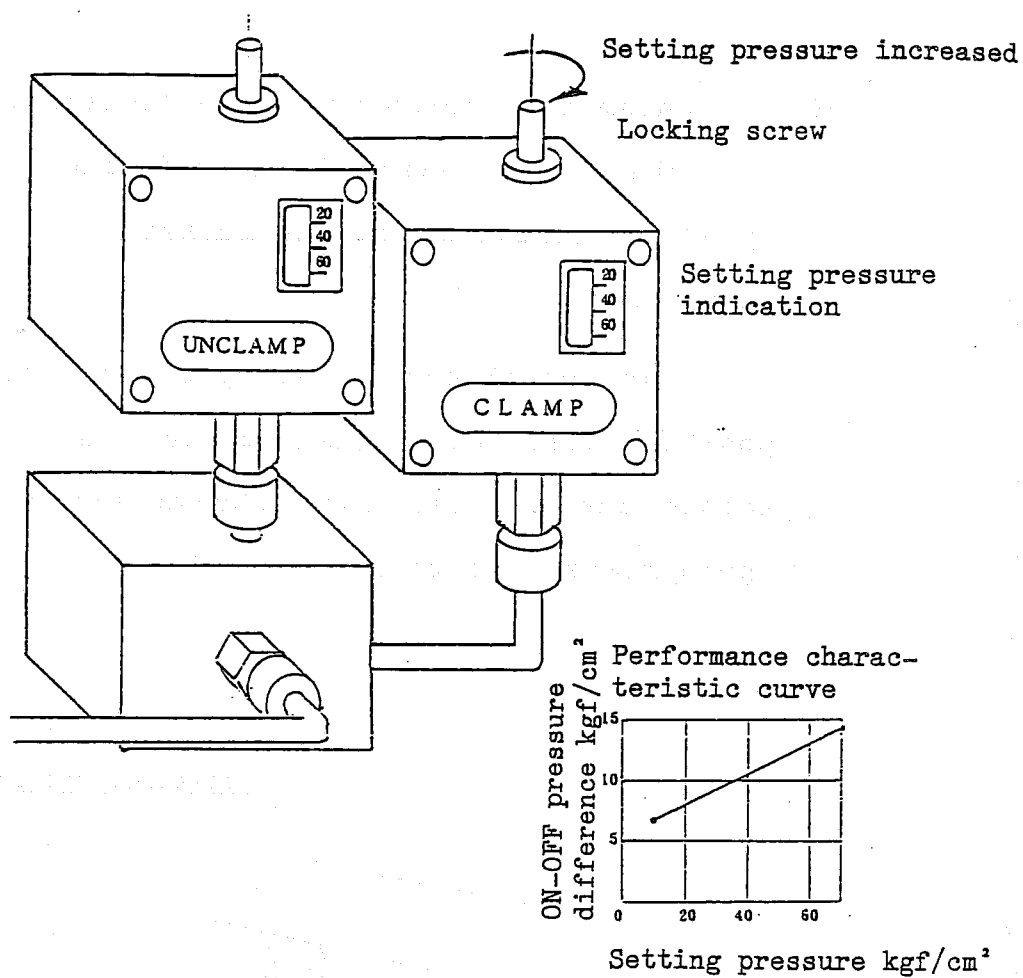


Fig. 17-2

6-8-4 Handling of pressure switch (HW1-3T1-02, TYOOKI make)



The pressure switches for Mfg. No. #1025 and after have been changed as follows:

From JP-B1 and JP-B2, SANYO make (conventional)
to HW1-3T1-02, TOYOOKI make (new)

6-9 Mechanism of zero-point return (rotating axis)

The limit switch for reducing zero-point return speed is installed at the backside of the table at tail-stock side.

For adjustment of dog position, bring the dog to a position where the adjusting work can be done easily. Loosen the dog fastening screws and move the dog to an appropriate position.

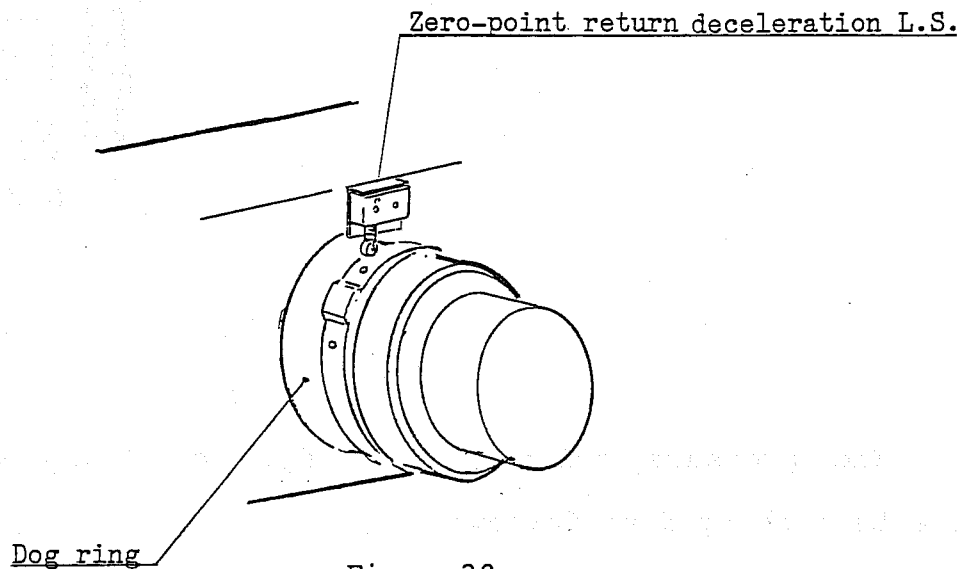
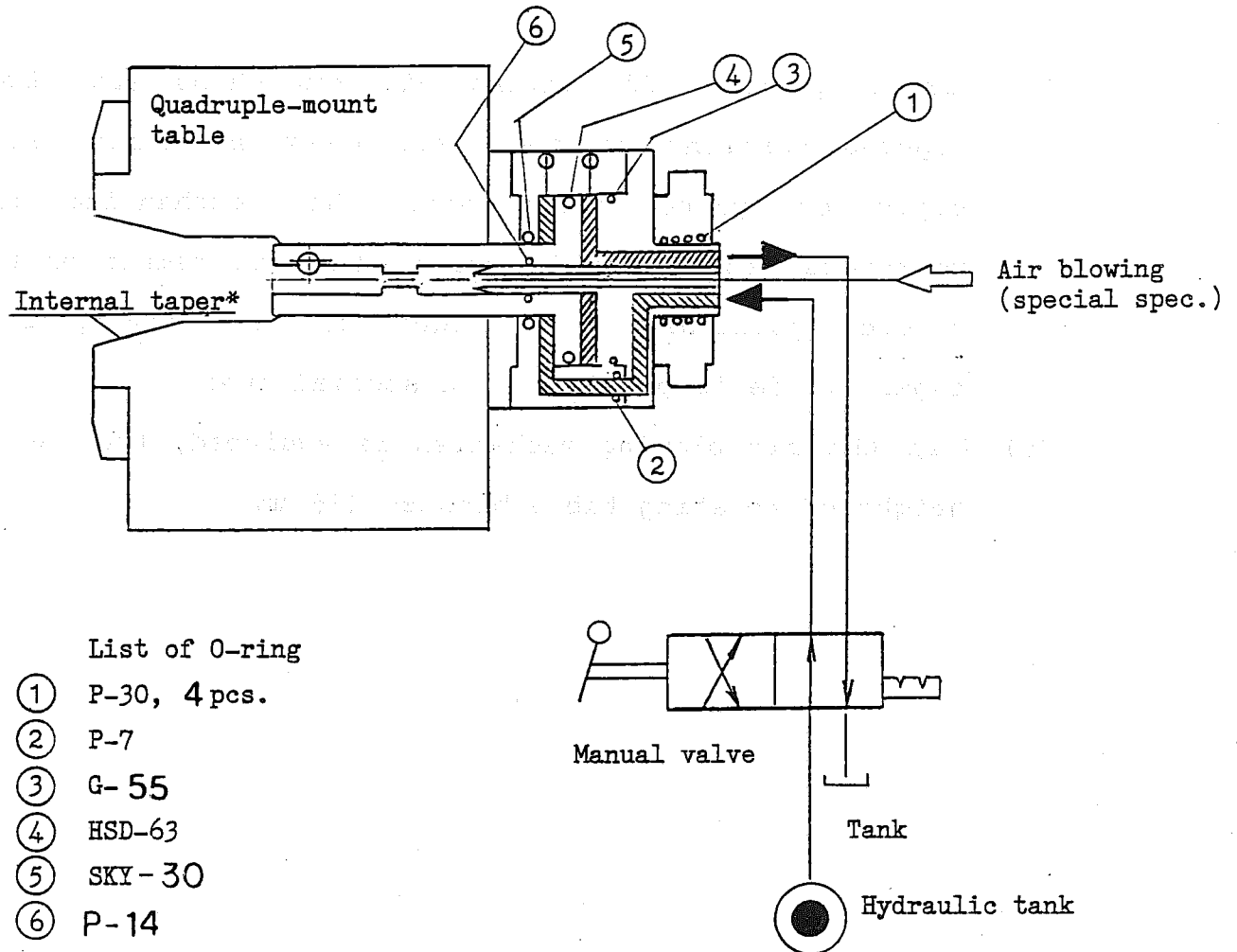


Fig. 20

6-10 Mechanism of work changer



The mechanism of work changer is illustrated in Fig. 21.

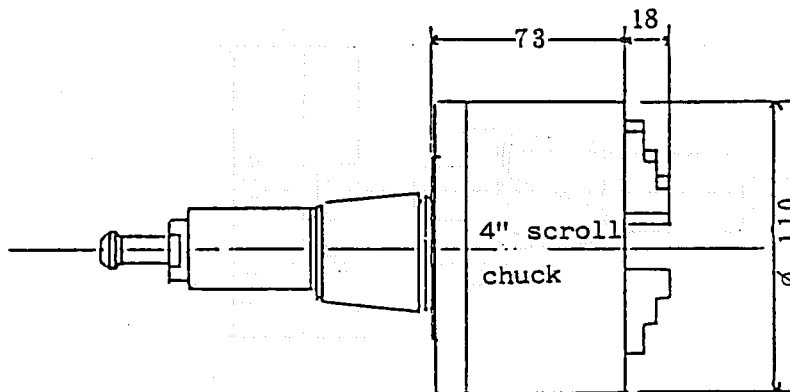
- (1) Please specify the internal taper* selecting from NIKKEN taper (12° taper) or NT#40 (7/24 taper).
- (2) The withdrawal force is 750 kgf/cm² at the hydraulic supply pressure of 35 kgf/cm².
- (3) Removal of the work holder is to be done after blowing off chips on the table surface and at a tilting angle of 0° (at a position where the workpiece is located at the topmost).

- (4) Carefully wipe off cutting oil and chips etc. from tapered portions of the quadruple-mount table using paper or waste cloth etc. when exchanging the workpiece, so as not to permit them to remain on the tapered portions. If required, air blowing from taper inside is possible as a special spec.
- (5) When the air blowing mechanism is equipped, the center height of rotating table becomes 235 mm.

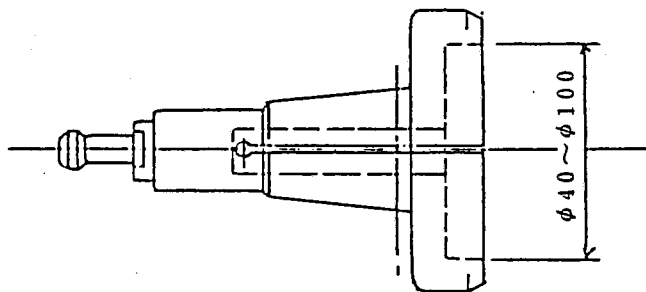
Appendix

Attachment (special accessories) Overall dimensions for 5AX-4MT-120°

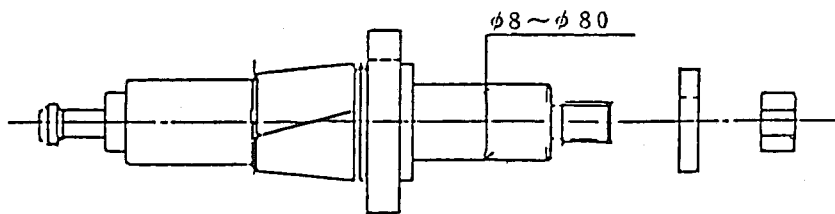
- ① 4" scroll chuck (4 pcs.)



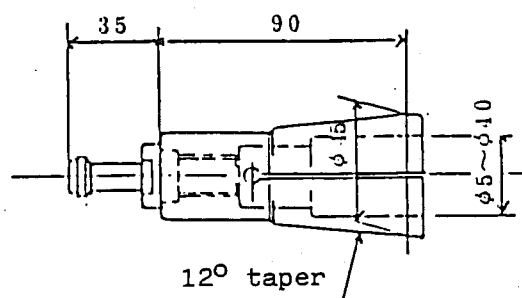
- ② Collet chuck for flange-shaped workpiece



- ③ Jig for ring-shaped workpiece



- ④ Collet chuck for bar-shaped workpiece



⑤ Jig plate

