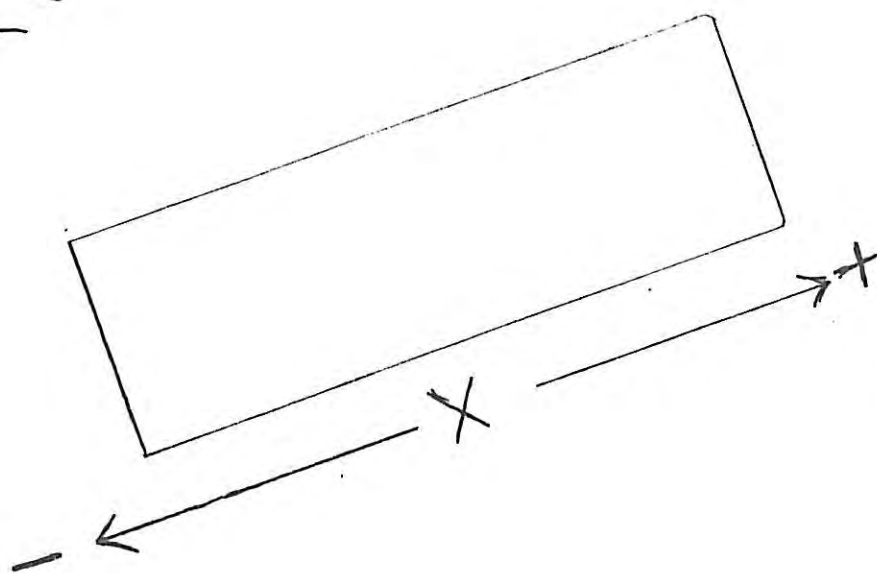
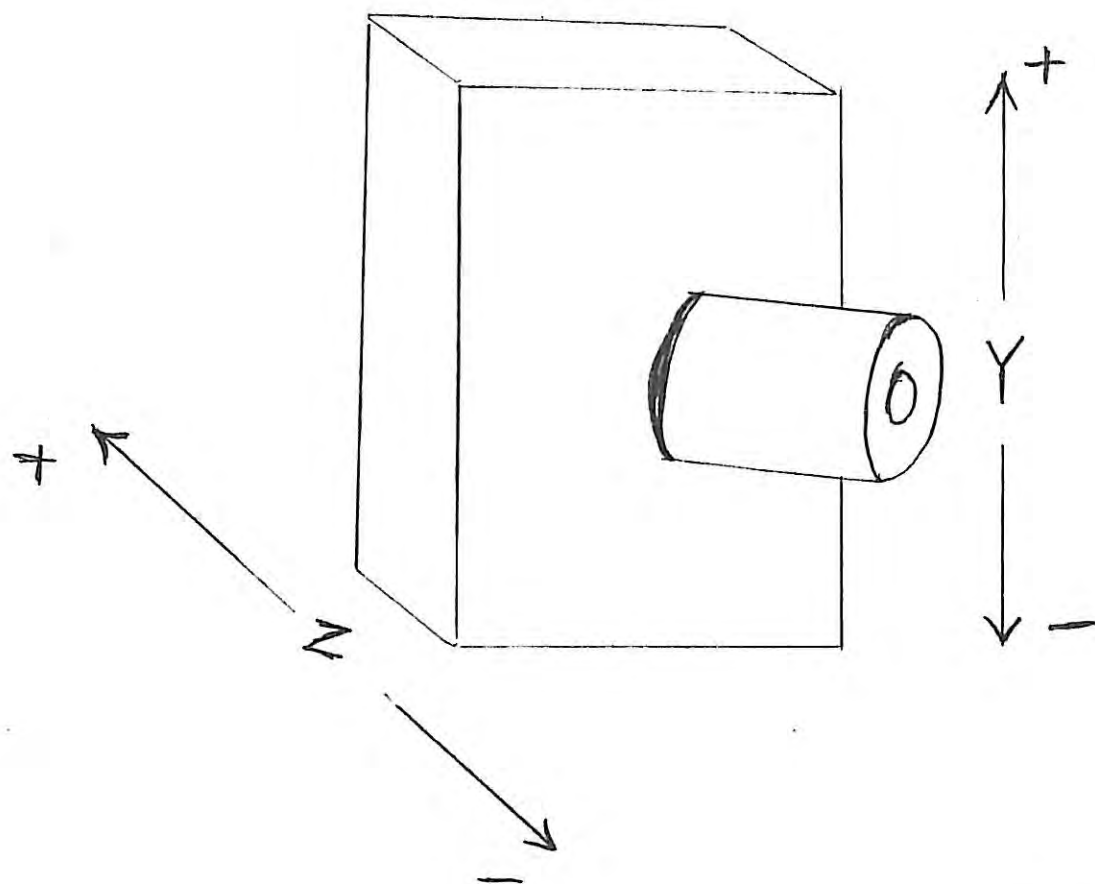
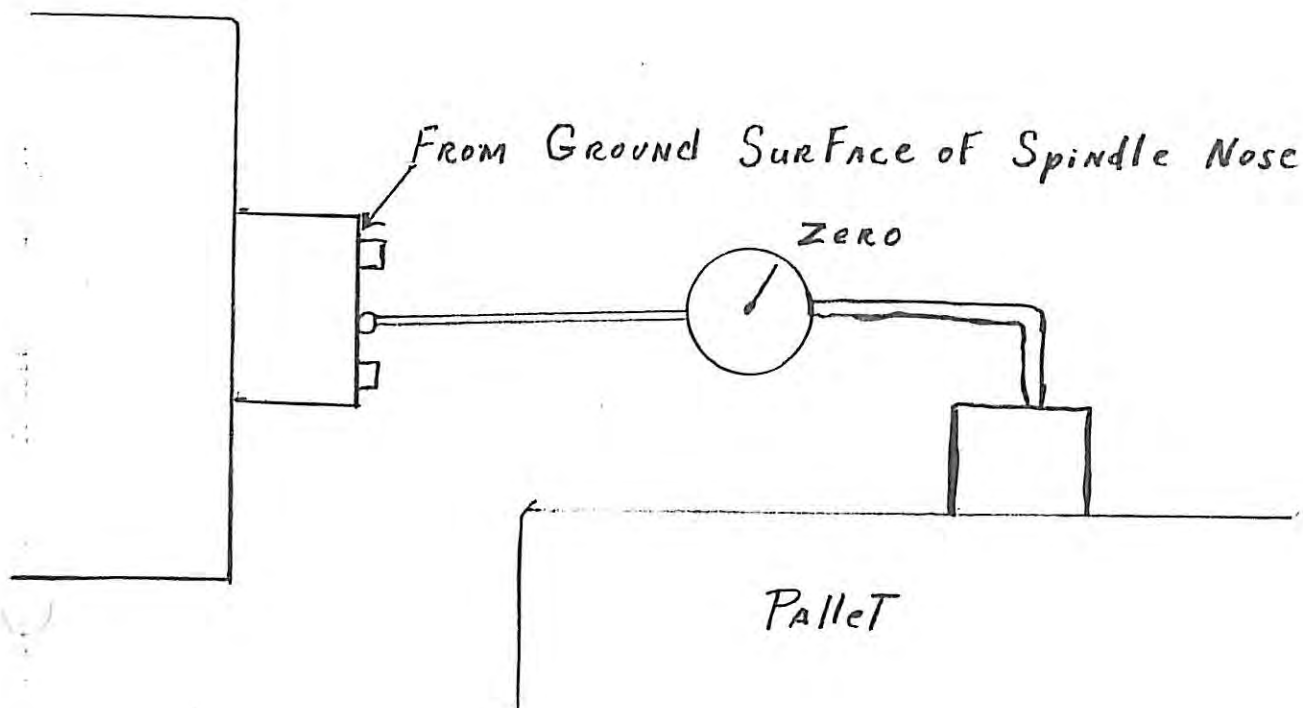
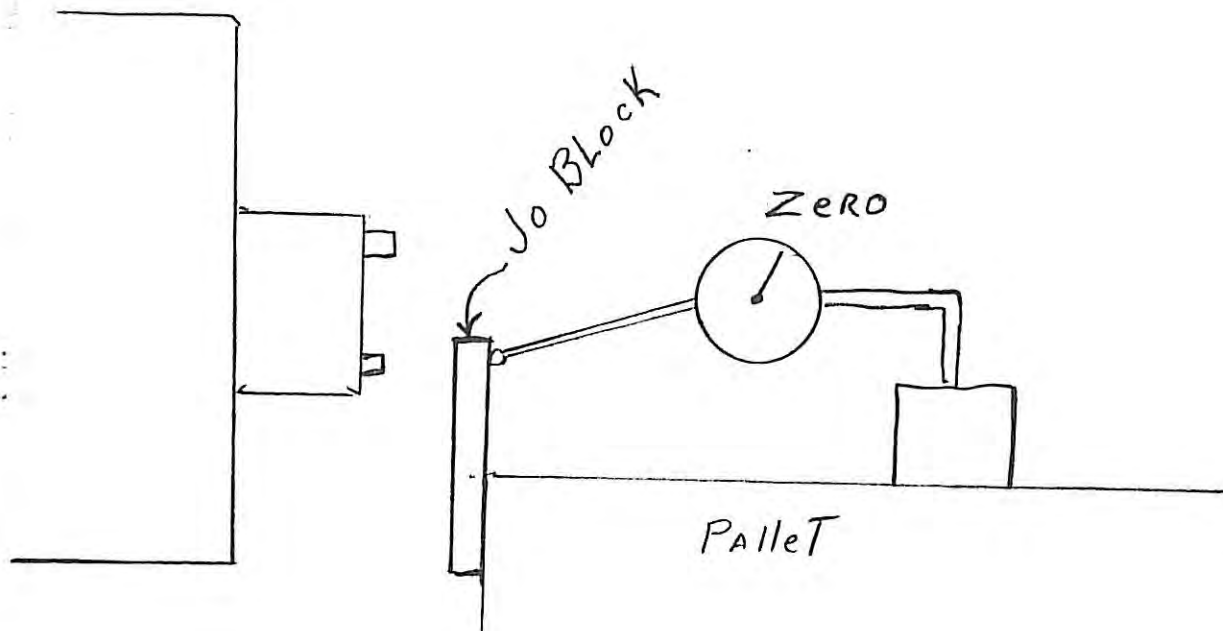


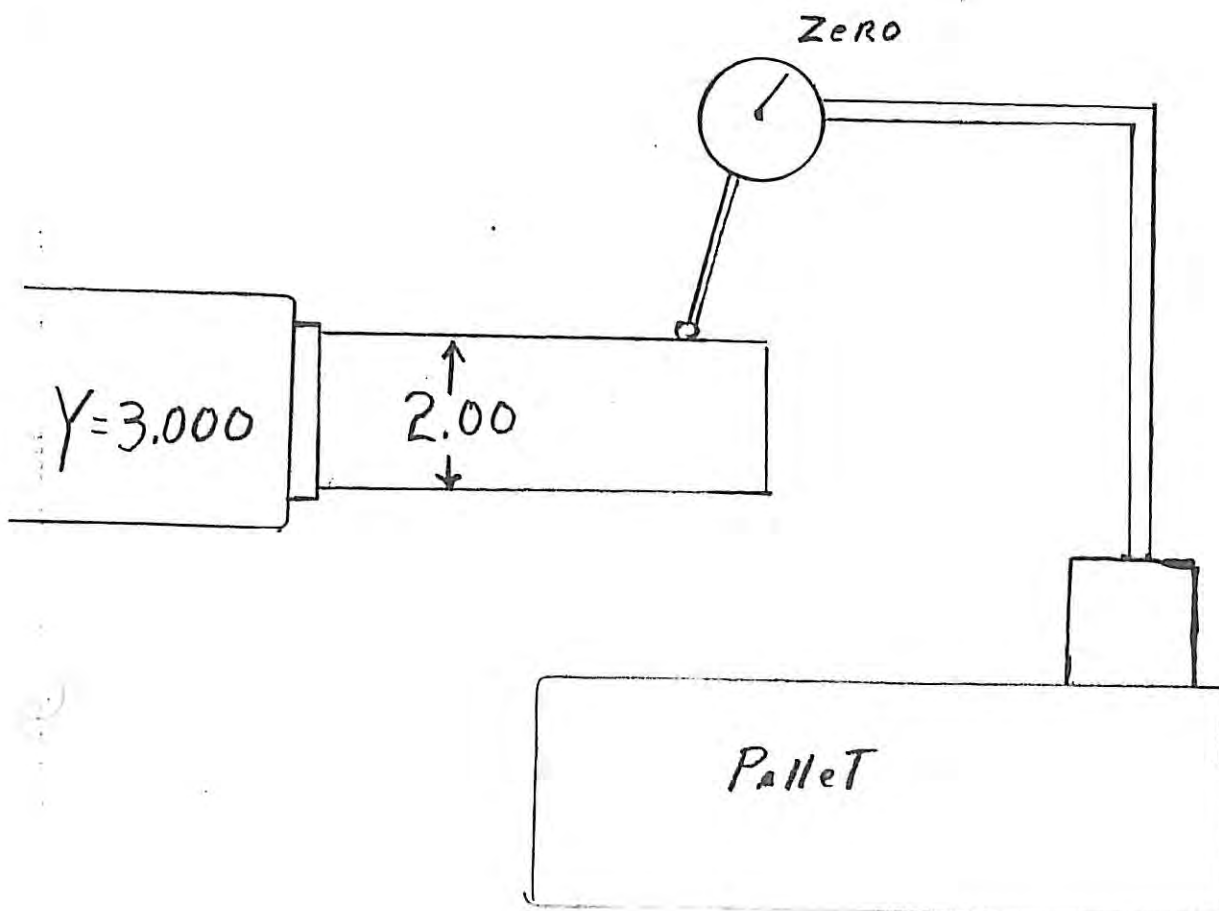
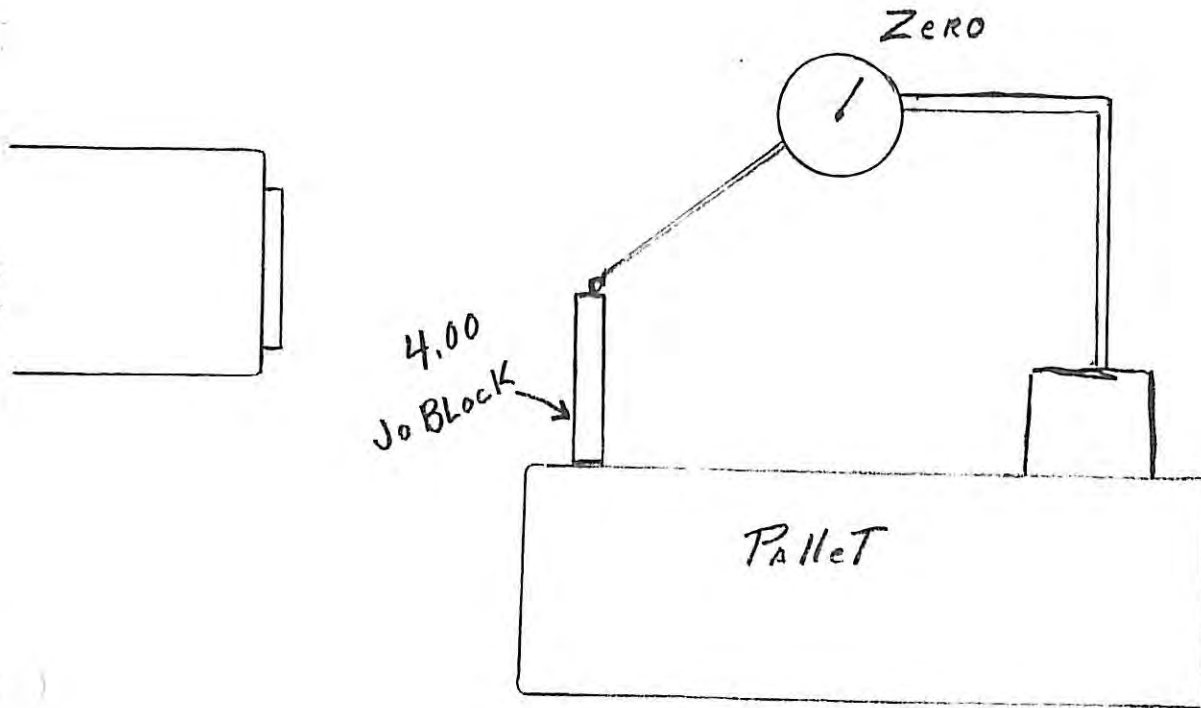


Finding Z AXIS ZERO

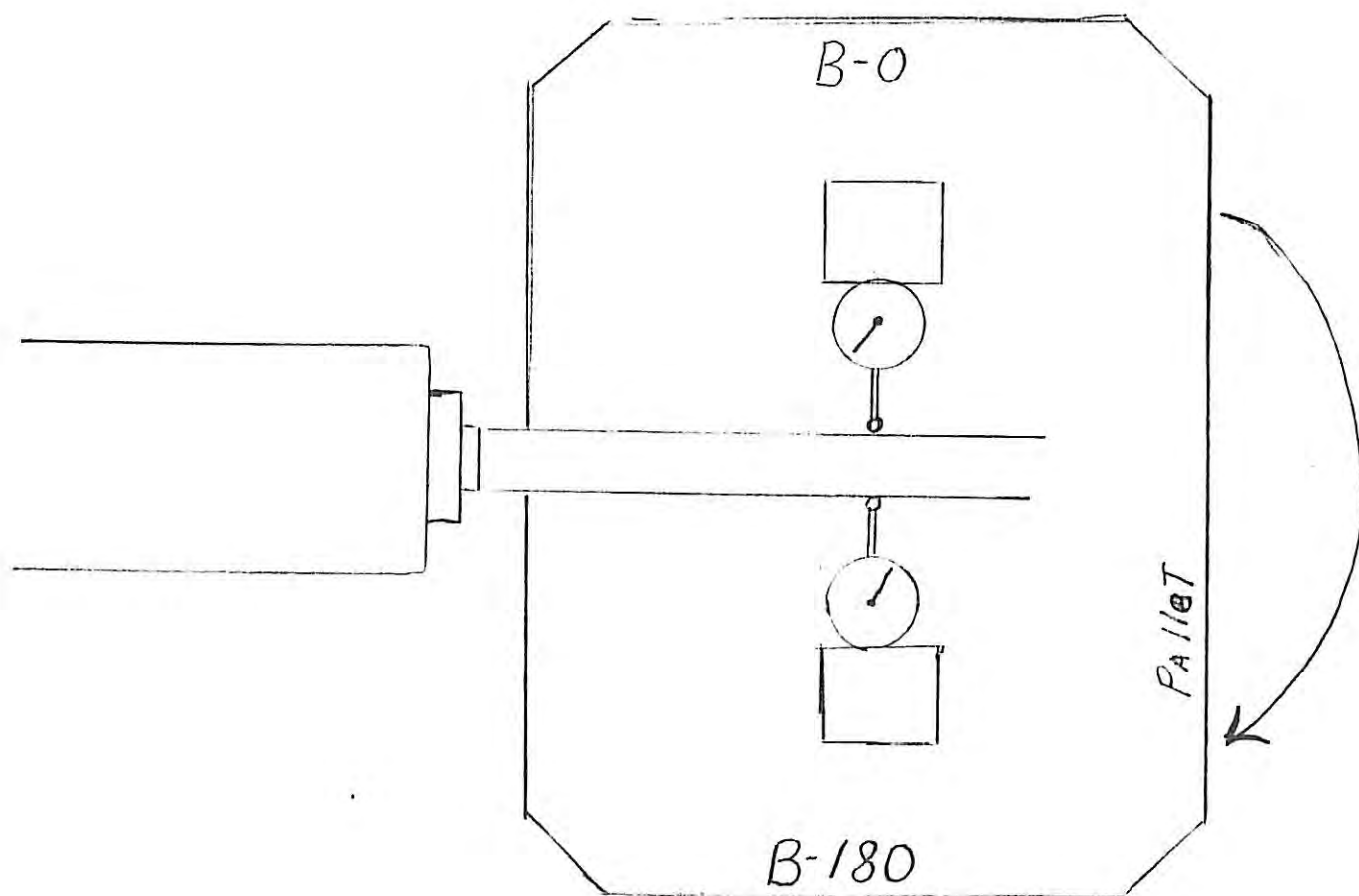


Finding "Y" Axis Zero

MAke Sure There ARE NO FixTure off sets
Mdi G15 HO WRIGHT Cyl START

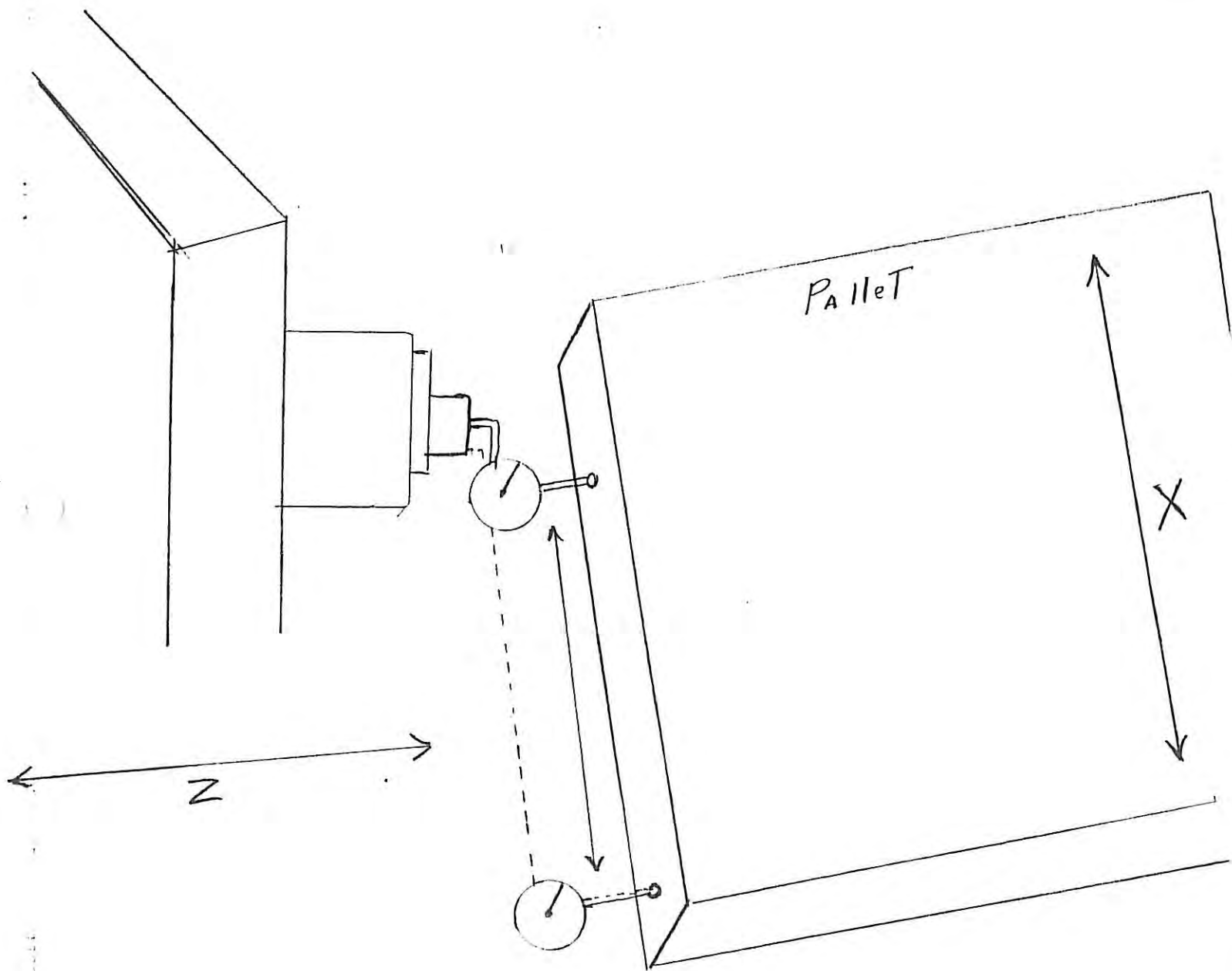


Finding X Axis Zero



Index Pallet 180°

Finding B Axis Zero

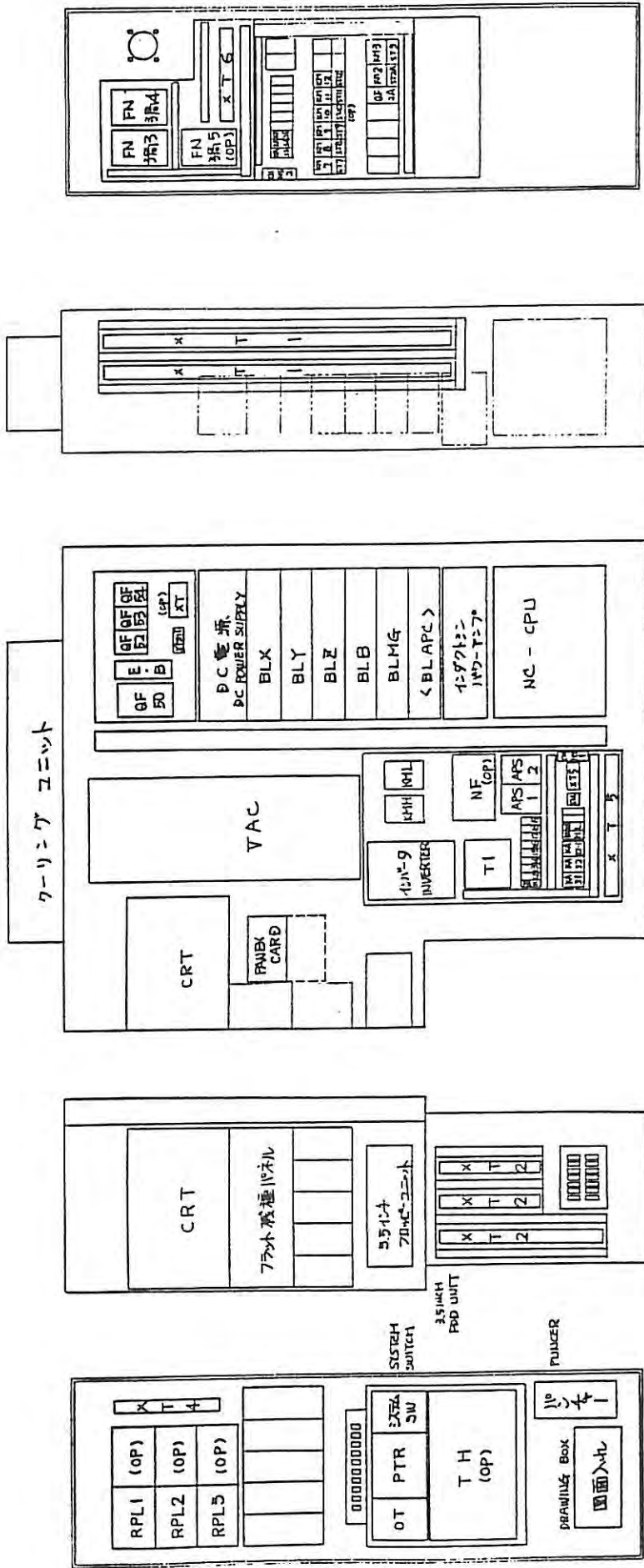


SECTION 1 SPECIFICATIONS

1. Machine Specifications

Item	Unit	Description	
		With rotary table	With APC
MAX. MACHINING CAPACITY	mm (in.)	560 × 460 × 510 (22.05 × 18.11 × 20.08)	
TRAVEL			
X-axis	mm (in.)	560 (22.05)	
Y-axis	mm (in.)	460 (18.11)	
Z-axis	mm (in.)	510 (20.08)	
Spindle center to table (pallet) upper surface	mm (in.)		50 - 510 (1.97 - 20.08)
Spindle end to table (pallet) center	mm (in.)	150 - 660 (5.91 - 25.98)	
TABLE			
Table (pallet) size	mm (in.)		400 × 400 (15.75) × 15.75)
Index positions			
Standard		72 positions (5° increments, direct command)	
Optional		360 positions (1° increment, direct command) 360,000 positions (0.001° increments, direct command)	
Max. load capacity	kg (lb)		400 (880)
SPINDLE			
Taper hole		NT No. 40	
Spindle diameter (at front bearing)	mm (in.)	Ø70 (2.76)	
Spindle speed range	rpm	45 to 7,000	
Number of spindle speeds		Infinitely variable (Direct 4-digit S command)	
FEEDRATE			
Rapid feedrate (X-/Y-/Z-axis)	mm/min (ipm)	X-/Y-axis 25,000 (984.25) Z-axis 25,000 (984.25)	
Jog feedrates (X-/Y-/Z-axis)	mm/min (ipm)	1 to 10,000 (0.04 to 393.70)	

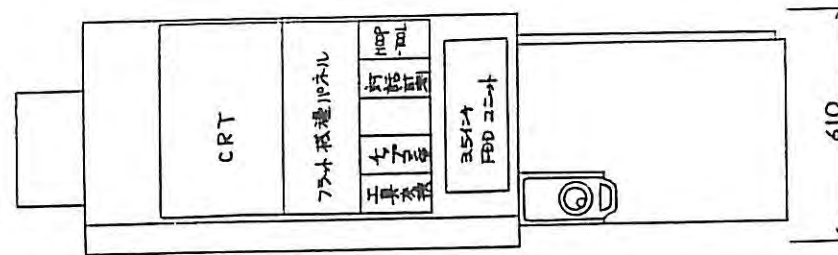
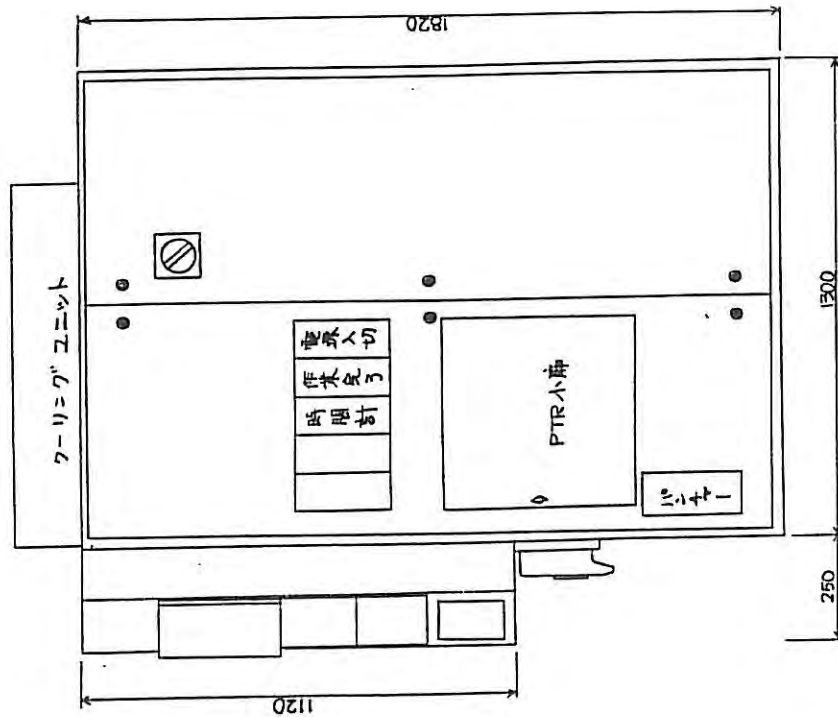
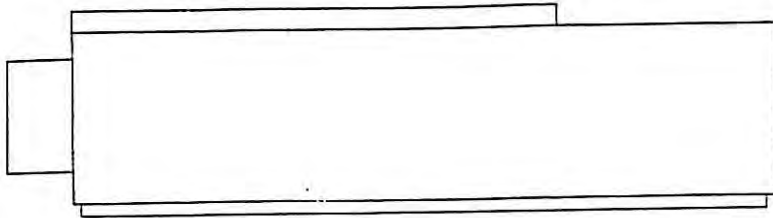
Item	Unit	Description		
MOTOR		With rotary table	With APC	
Spindle drive	kW (hp)	VAC 11/7.5 (15/10) (30 min/cont.)		
Hydraulic power unit	kW (hp)	AC 2.2 (3)		
X-axis feed	kW (hp)	AC 2.4 (3.2) servomotor		
Y-axis feed	kW (hp)	AC 2.4 (3.2) servomotor		
Z-axis feed	kW (hp)	AC 3.6 (4.8) servomotor		
Table indexing				
Standard	kW (hp)	AC 1.0 (1.3) (1°/5° index)		
Optional	kW (hp)			
Magazine indexing (40-tool ATC)	kW (hp)	AC 1.0 (1.6) servomotor		
APC drive (rotary type 2-pallet)	kW (hp)	AC 1.0 (1.6) servomotor		
ATC				
Tool magazine capacity				
Standard		32 tools		
Optional		50/70 tools		
Tool selection		Memory random		
Tool shank system		MAS BT40	CAT	
Pull-stud.bolt type		MAS Type 1	MAS Type 2	CAT
Max. tool diameter				
With adjacent tools	mm (in.)	Ø100 (3.94)		
Without adjacent tools	mm (in.)	Ø150 (5.91)		
Max. tool length	mm (in.)	300 (11.81)		
Max. tool weight	kg (lb)	10 (22)		
MACHINE HEIGHT	mm (in.)	2,600 (102.36)		
FLOOR SPACE	mm (in.)	2,200 × 3,580 (86.61 × 140.94)		
MACHINE WEIGHT	kg (lb)	8,800 (19,360)		



序

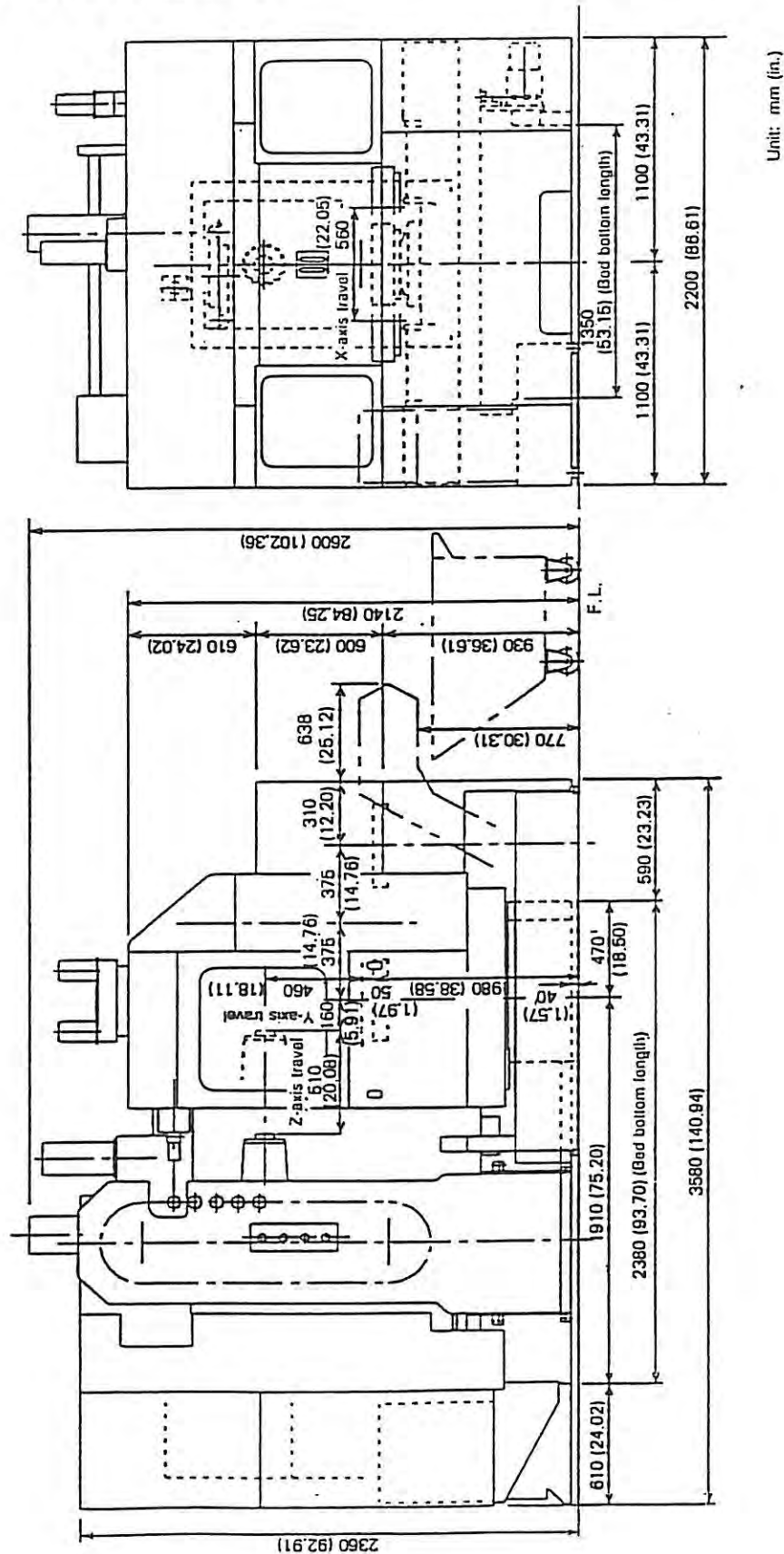
監製

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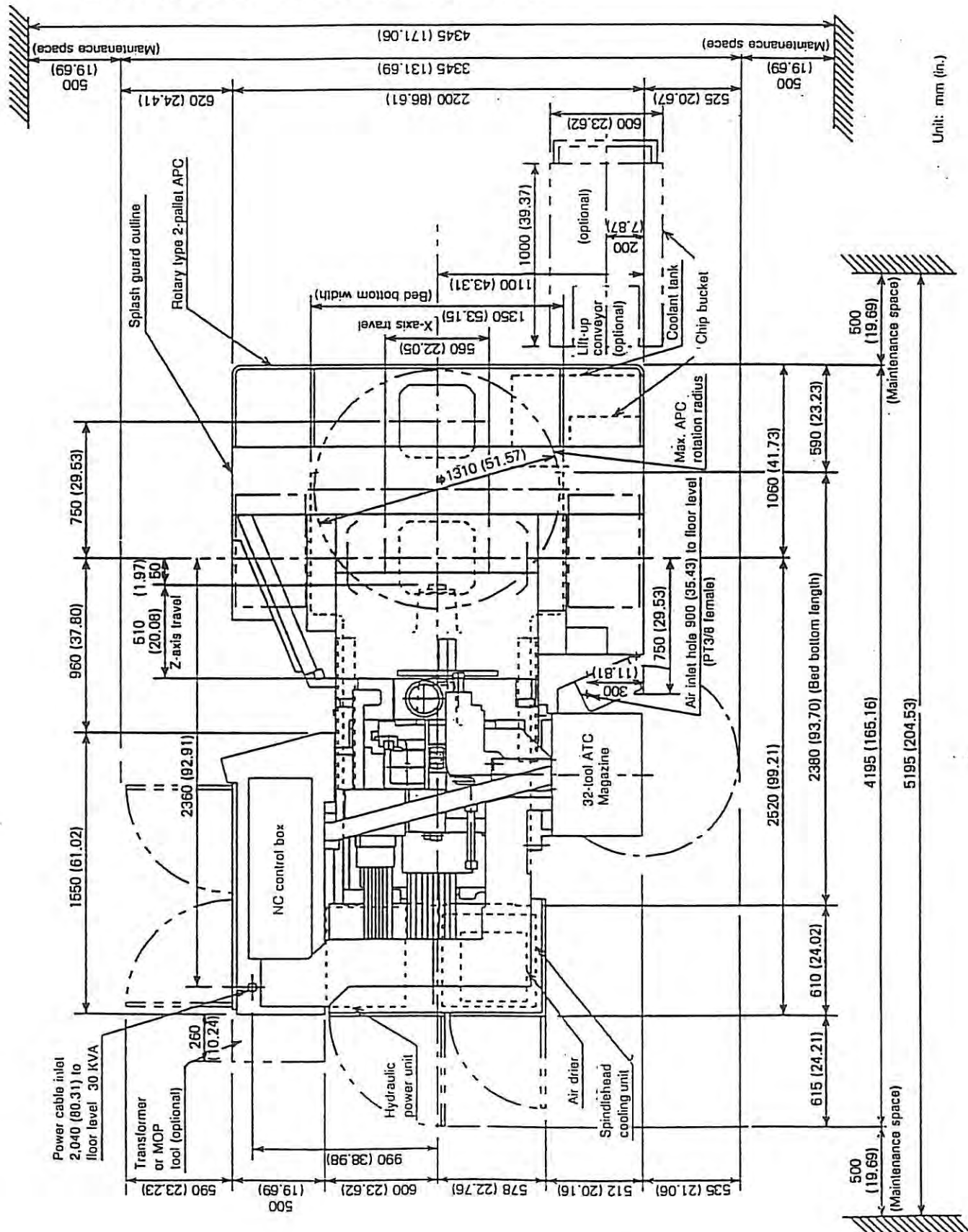
2. Dimensional Drawing

Rotary Type 2-pallet APC & 32-tool ATC



3. Installation Plan

Rotary Type 2-pallet APC & 32-tool ATC (to #0024)



SECTION 1 OUTLINE OF OSP5020M SERIES

1. Special Features of OSP5020M Series

Based on the OSP series that has an outstanding production record as a CNC all over the world, the OSP5020M series is a high-performance computerized numerical control system that functions as an Intelligent Manufacturing Cell (IMC) forming an operator untended production system.

(1) A Multiprocessor CNC System

The OSP5020M is a multiprocessor CNC system using plural high-performance microprocessors, and features architectures capable of coping of high-level NC functions.

(2) Versatility

Through distributed processing by the multiprocessor, the OSP5020M provides versatile functions not available on existing NCs, such as alarm monitor data processing, link with high-level computers, advanced online automatic programming function, and large-capacity part program storage. This CNC is complete also with functions such as diagnostics and operation guides, display of alarm data and display of production control information, by means of the CRT.

(3) Tremendously Expandable, Never Obsolete

The computer software is stored in the bubble memory. Therefore, it is easy to change the software, enabling any addition and alteration of functions in the future, and this OSP5020M can be used always as a most up-to-date system ready to meet the customer's application needs.

(4) High Reliability

High reliability is ensured by various kinds of functions such as automatic memory error correction, perfect noise isolation by a photo-coupler, high integration of hybrid ICs and LSIs, etc., reduced consumption power and thorough monitoring of CPU power supply, and by a simple structure mounted in the totally enclosed cabinet.

(5) Uniquely Designed for Easy Operation

Since a large-sized CRT is provided as standard on an pendant type operation panel, it is exceedingly easy to operate.

3. Structure of OSP5020M

This section outlines the overall structure of the OSP5020M. For further information, consult the following sections of this manual.

Section 2, 3. "Operation and Structure of the NC"

Section 3, "Trouble and Troubleshooting"

3-1. CPU and Power Supply Unit

This is the heart of the CNC system and consists of the following printed circuit board modules and units:

Printed Circuit Board:

MAIN BOARD-II B	.....	Main processor
MAIN CARD 13		
MAIN CARD 11		
MAIN CARD 15	}	Either MAIN CARD 15 or MAIN CARD 16 is selected in accordance with the NC unit specification.
MAIN CARD 16		
BUBBLE CARD	.....	Bubble memory
CRP BOARD-II C	.....	CRT operation panel control processor
SVP BOARD-II D	}	Axis control processor
SVP CARD 1		
ECP BOARD-II A	.....	Control processor for the machine except for axis control
FN CARD	.....	Interface for field network
Optional:		
FDC BOARD II	.....	Printed circuit board to control reading and duplication of data stored on floppy disks.

The parts listed above are for standard system specifications. For optional specifications, printed circuit boards for selected functions will be added.

Power Supply Unit:

This supplies all the power required for CPU operation.

3-2. Electrical Control Unit (Field Network)

The interfaces input and output signals from and to the ECP board to control output to solenoids, magnets and other devices on the machine and input from machine mounted limit switches.

Power Supply Unit:

This supplies all the power required for the EC control unit.

3-8. Control Enclosure

Arranged in a single enclosure are the CPU, drive unit, relay magnetic circuits, spindle motor drive unit and others.

The totally enclosed construction provides reliable protection against the entry of oil mist, chips, dust and dirt, ensuring stable performance of semiconductors, relays and magnetic switches.

Mounted on the common machine base, this space-saving CNC package forms a compact machine-control combination.

3-9. Operation Panel

All the controls necessary for operating the machine such as operating switches, manual switches and the pulse handle are incorporated into and mounted to this accessible pendant operation panel. A large-sized CRT is provided as standard, assuring ease of operation.

3-10. Absolute Position Feedback Encoders

To each servomotor for the X-, Y-, and Z-axis, the absolute position feedback encoder that produces accurate information concerning the instantaneous position of each axis is provided. The output signals from these encoders are fed into the CNC system for accurate positioning of each axis.

Attached to the main spindle is a main spindle pulse generator to detect the spindle speed.

Also, a position feedback encoder used to detect the position of the magazine to store cutting tools. A position feedback encoder for an additional axis is provided when the machine is equipped with an option such as rotary table.

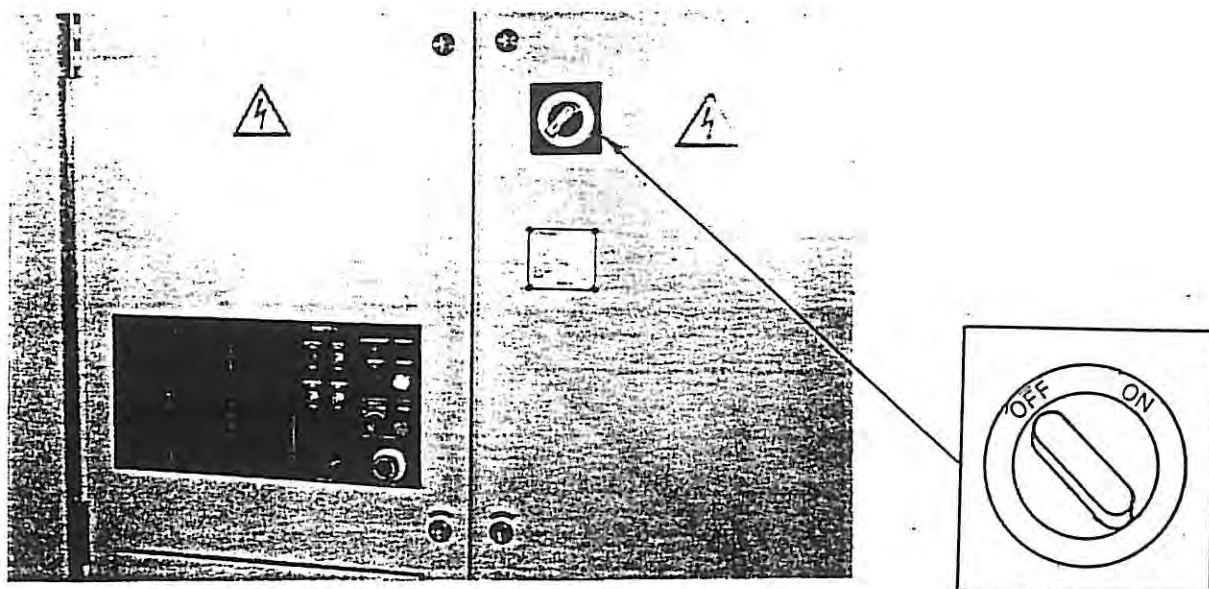
3-11. Cooling Unit

The cooling unit provided at the top of the control box keeps the temperature inside the control enclosure less than 8°C (46.4°F) over room temperature. This provides the CNC system with higher reliability.

2. Manual Operations

2-1. Turning ON/OFF Power

- (1) Turn the lever switch of the circuit breaker at the upper right of the rear side of the NC control enclosure to the ON position. This turns on power to the control system. If power is not supplied, check the shop power board.



- (2) Press the **POWER ON** button above the tape reader. Check to be sure that the **READY** lamp above the **POWER ON** button is on. If not, one of the **EMG. STOP** buttons has been activated and is still in a locked position. Check and reset the **EMG. STOP** button.

The following units will start operations.

- Hydraulic power unit
- Spindlehead lubrication unit

Check the pressure of each pump unit.

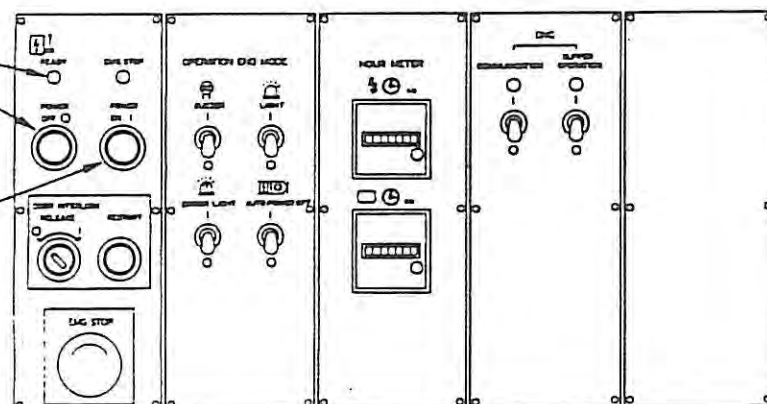
POWER ON indicating lamp

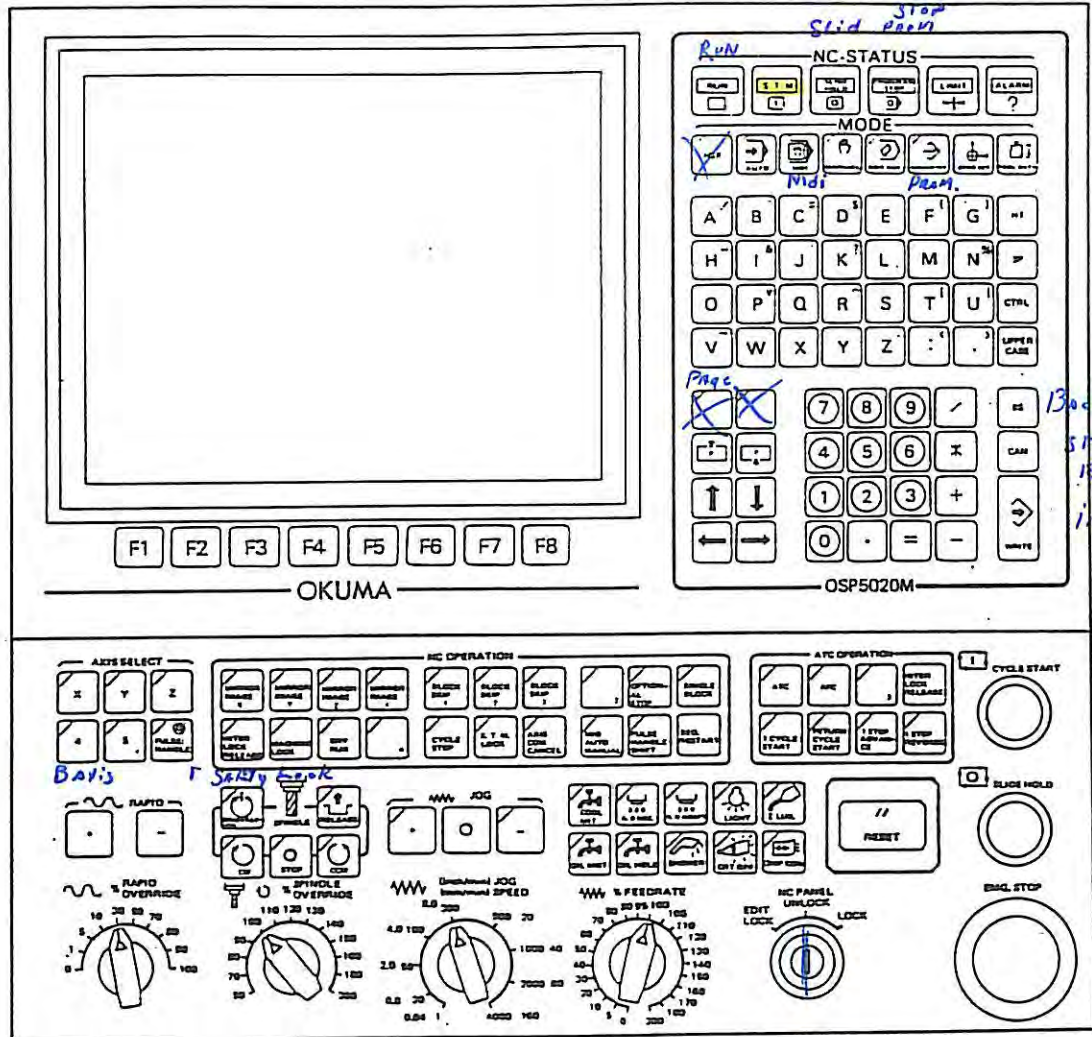
POWER OFF pushbutton

This turns off control power supply.

POWER ON pushbutton

The lamp in the pushbutton comes on.





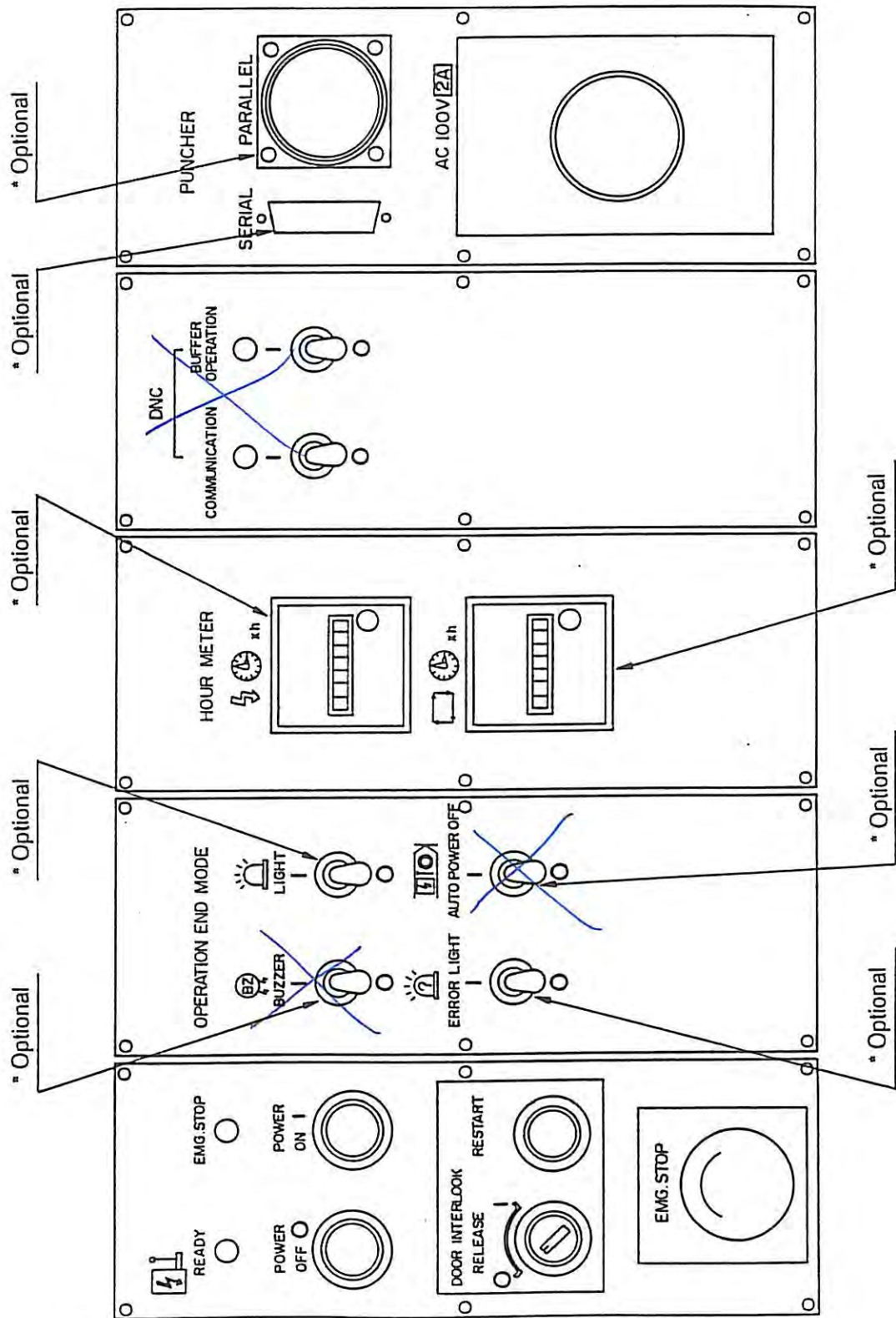
Main Operation Panel



Pulse Handle

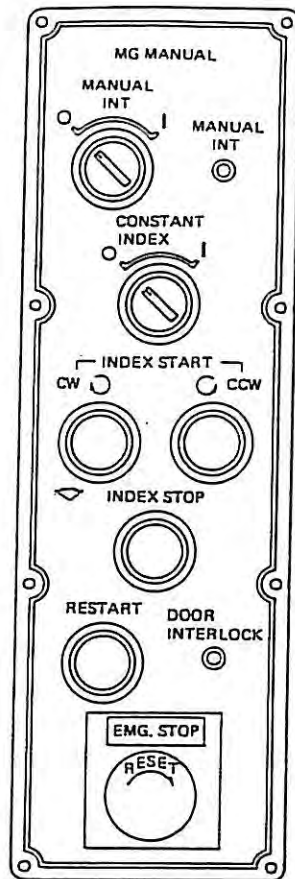
SECTION 4 OPERATIONS

1. Operation Panel

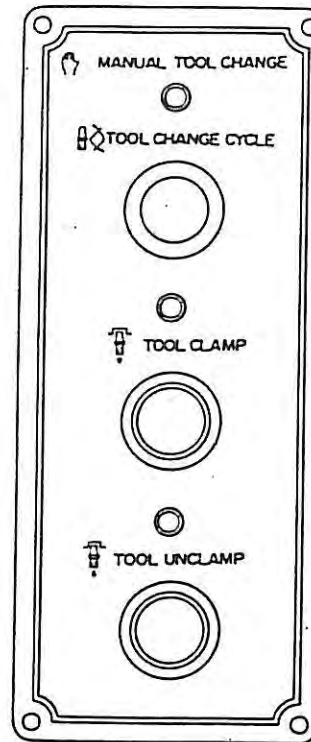


Operation Panel above Tape Reader

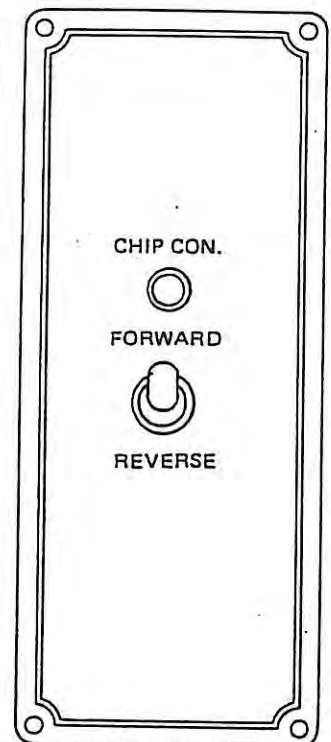
Controls marked by "*" are optional (available upon request)



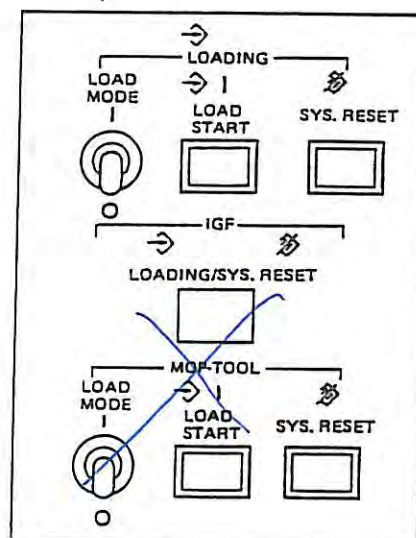
ATC Magazine Operation Panel



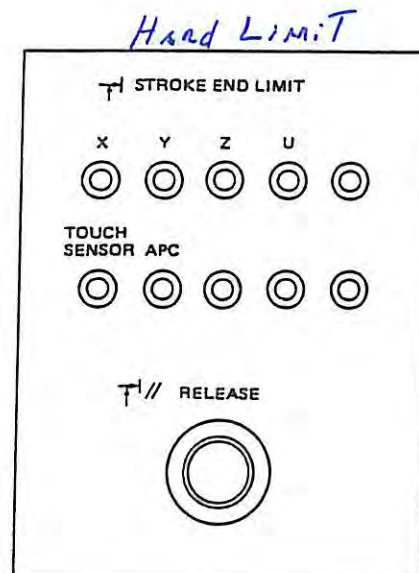
Manual Tool Change
Operation Panel



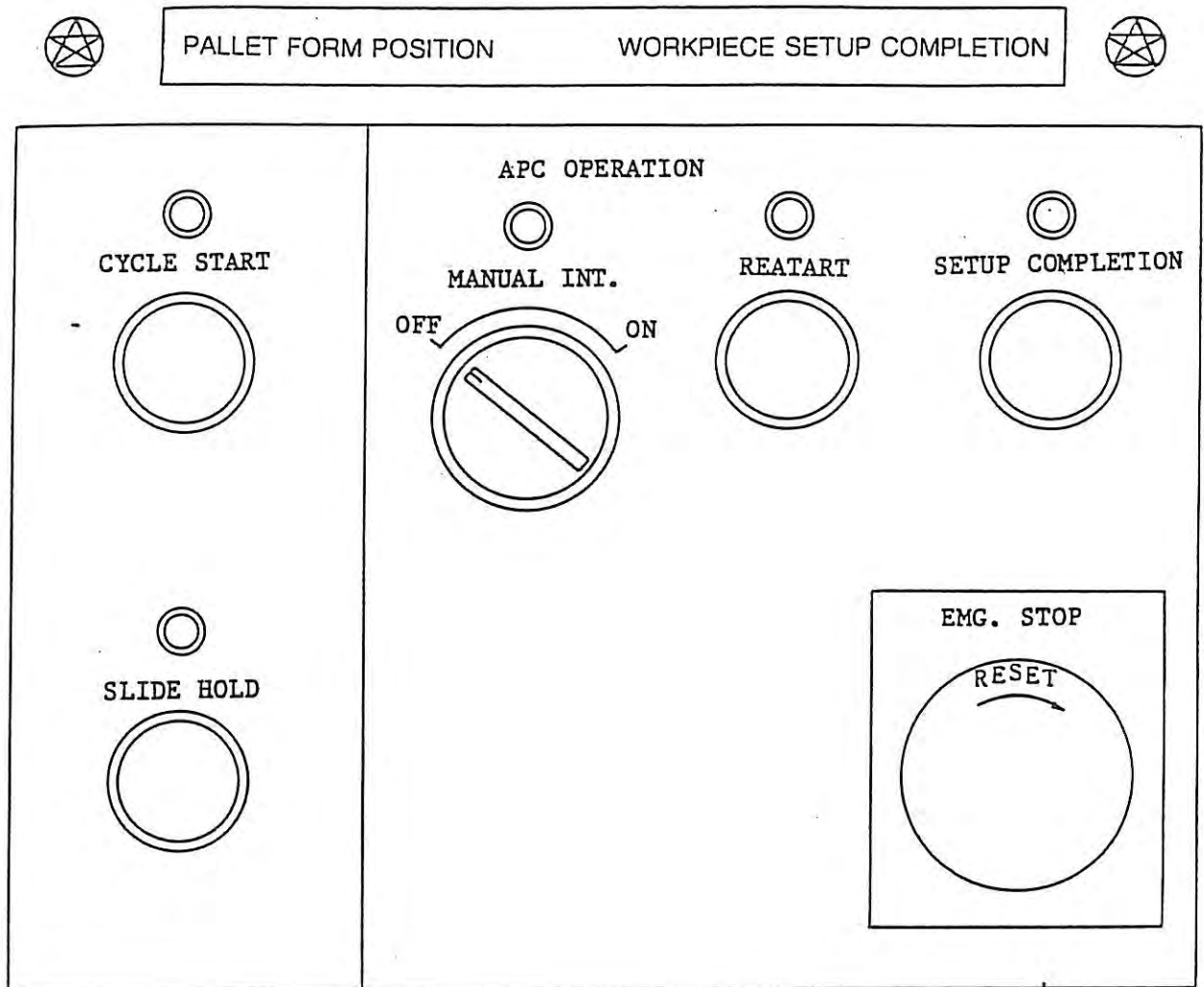
Chip Conveyor
Operation Panel



Check Panel



Booth Lights Must be ON For Pallet Change



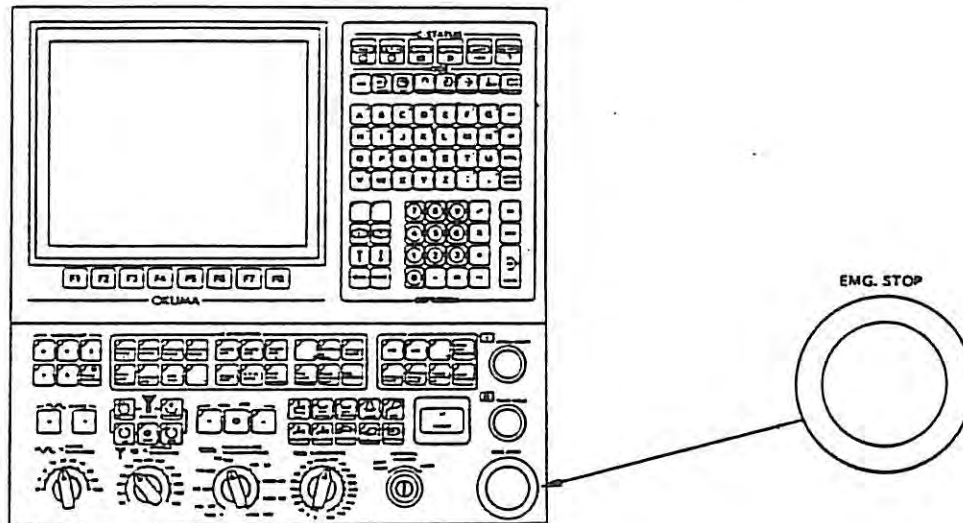
Rotary Type 2-pallet APC Operation Panel
(Front right side of the splash guard)

2-2. Emergency Stop

When it becomes necessary to stop the machine immediately during any of the MANUAL, AUTO and MDI modes, press the red EMG. STOP button on any of the following operation panels. Control power is shut off and the machine stops immediately.

An EMG. STOP button is provided on the following operation panels:

- Main operation panel
- Operation panel above tape reader
- Operation panel on ATC magazine
- Operation panel on APC

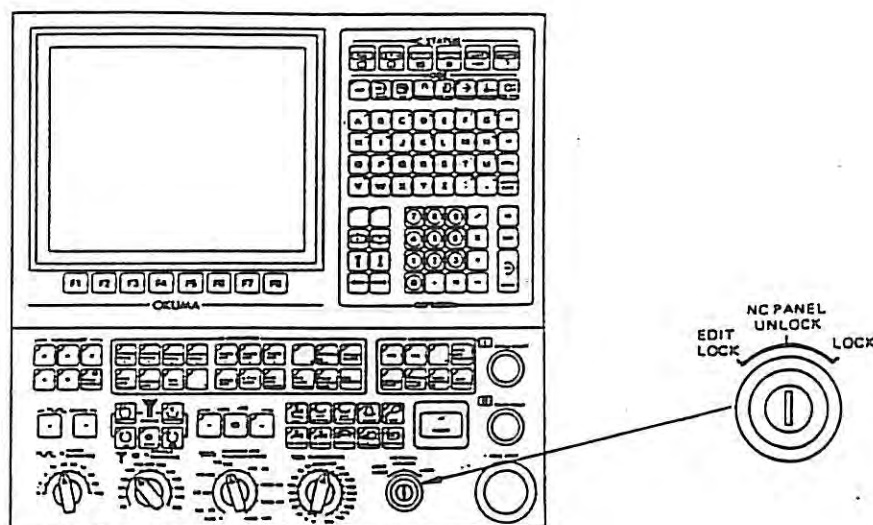


CAUTION

Pressing an EMG. STOP button only shuts off control power. Power to the circuit breaker stays on.

To turn on power after pressing the EMG. STOP button, reset the button by turning it clockwise after fixing the problem. Then press the POWER ON button.

- (3) Set the key-lock type NC panel operation selection switch to the "UNLOCK" position.



Indicating lamps and the CRT will turn on.

- (4) To turn off the power supply, press the **POWER OFF** button above the tape reader.
If the operation must be stopped immediately, press the **EMG. STOP** button.
Then turn the main power switch off. Unless this switch is turned off, all units remain energized.

WARNING

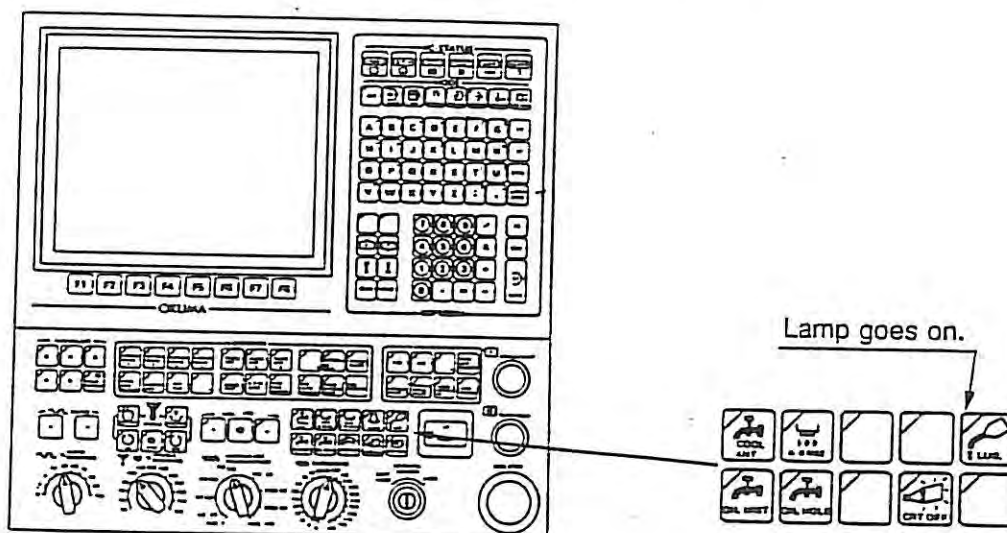
BEFORE TURNING ON POWER, BE SURE TO CARRY OUT INSPECTION AND ADJUSTMENTS - DAILY INSPECTION.

2-3. Lubrication Switch

- (1) When control power is turned on, the lubrication timer in the control system starts timing. The centralized lubricating unit pump operates at intervals set on the timer to automatically feed lubricating oil to each of lubricating points.

The pump operation interval is usually set to 10 minutes.

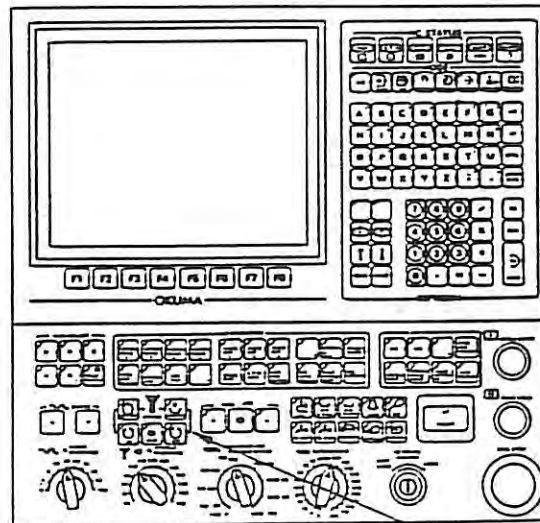
In addition to this automatic lubrication, manual lubrication is possible as needed by pressing the LUB. key on the main operation panel. Each time this switch is pressed, the pump operates for 60 seconds irrespective of the timer setting, feeding lubricating oil to the lubricating points.



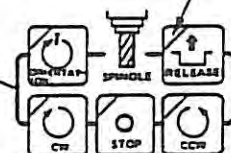
- (2) Since the lubrication interval is set as parameter data, it can be changed by altering the parameter data. For details, refer to Section 3, 5. "Automatic Centralized Lubrication".

2-4. Rotating Spindle by Hand (Spindle Release)

- (1) It is often required to rotate the spindle slightly while the spindle is at a still, for example when aligning the cutting tool to the workpiece, manual removal and setting of a cutting tool from and to the spindle, and inspection of cutting bits. Press the **SPINDLE RELEASE** flat key on the pendant operation panel, and the spindle driving gears are set in neutral, allowing the spindle to be rotated by hand.
- (2) Conditions for Operations
 - a) Control power ON.
(Hydraulic pressure at 60 kgf/cm² (853 psi))
 - b) Spindle is at a still.
 - c) Spindle tool must not be unclamped.
 - d) Machine is not in the automatic tool change cycle.



Lamp goes on.



CAUTION

- (1) *Never press the RELEASE key while touching the spindle or a cutting tool.*

Before pressing this RELEASE key, check to be sure that the tool in the spindle will not interfere with the workpiece, fixture or anything else on the table, even when starts rotating.

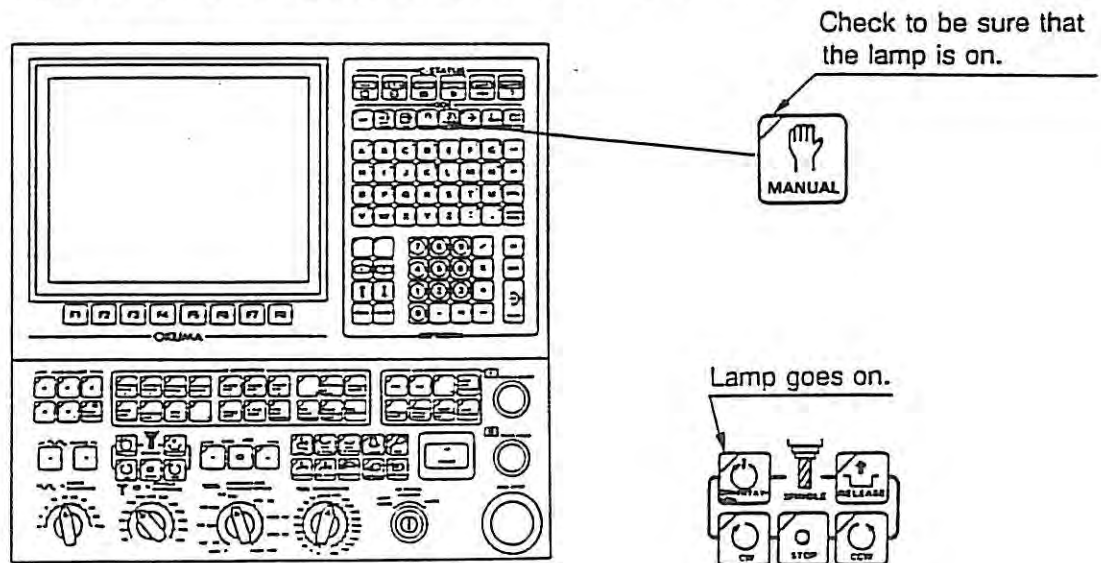
- (2) *The operator should be sure that no other operators inadvertently start the spindle while he/she is working with the spindle in neutral.*
- (3) *To start the spindle after bringing it to neutral by pressing the RELEASE key, enter a spindle speed command and then start the spindle.*
- (4) *While the spindle is in neutral, tape reader operations and machine operations with commands manually inputted are impossible.*

2-5. Spindle Orientation

- (1) Spindle orientation is carried out to clamp the spindle after indexing it to a definite angular position. Rotation of the spindle is made by the spindle drive motor and, therefore, the spindle orientation is controlled electrically.
- (2) Conditions for Operations
 - a) Control power ON.
(Hydraulic pressure at 60 kgf/cm² (853 psi))
 - b) The MANUAL mode is selected.
(If the mode is AUTO or MDI, operation in the selected mode is possible.)
 - c) Tool in the spindle is clamped.
 - d) The ATC tool change arm is not at the spindlehead.

(3) Operation Procedure

Press the **SPINDLE ORIENTATION** and **INTERLOCK RELEASE** keys simultaneously.



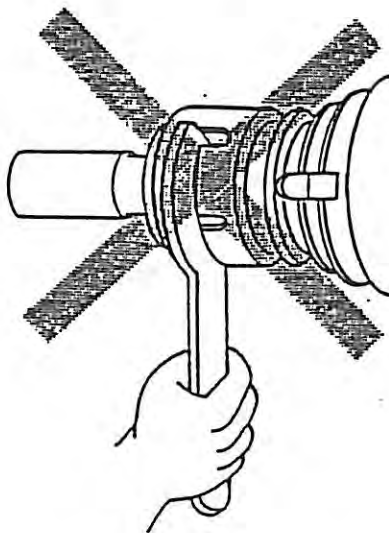
- (4) The spindle orientation mode is reset when the spindle is started or the **SPINDLE RELEASE** key is pressed.

WARNING

- (1) *Never touch the spindle while in the spindle orientation mode.*
- (2) *The spindle should stop at the first orientation position while rotating in the forward direction. However, it might rotate two to three turns.*

If a rotating torque is applied to the spindle right after the completion of spindle orientation, tightening the milling chuck, for instance, is very dangerous since there is a possibility of spindle rotation.

DANGER



2-6. Clamp/Unclamp of Tool in Spindle

- (1) The machine has manual tool change buttons to manually remove a tool set in the spindle by the ATC or to manually set a tool, which cannot be handled by the ATC, in the spindle.
- (2) A tool set in the spindle is drawn into the spindle by means of the pull stud, thus reducing the tool change time. The pull stud which is fitted at the rear of the toolholder is drawn by the collet and the belleville spring, housed in the spindle, into the spindle. Thus the tool is securely clamped in the spindle.

At the time of tool removal, a hydraulic cylinder at the rear of the spindlehead opens the collet which is closed by the spring force and pushes the tool out of the spindle. This tool push-out stroke is about 0.5 mm (0.02 in.).

- (3) Conditions for Operations
 - a) Use a pull stud and a toolholder complying with the specifications given in Section 6, "Automatic Tool Changer".
 - b) The MANUAL mode has been selected.
 - c) The spindle is at a still. The spindlehead may be located at any convenient position for manual tool changing.
- (4) Operation Procedure
 - a) Press the **SPINDLE RELEASE** key on the main operation panel.
 - b) Press the **TOOL CHANGE CYCLE** button on the operation panel at the side of the main operation panel. The indicating lamp above the **TOOL CHANGE CYCLE** button will flicker.
 - c) Rotate the spindle by hand so that the spindle drive key is vertically aligned (the allowable angular error is within $\pm 15^\circ$).

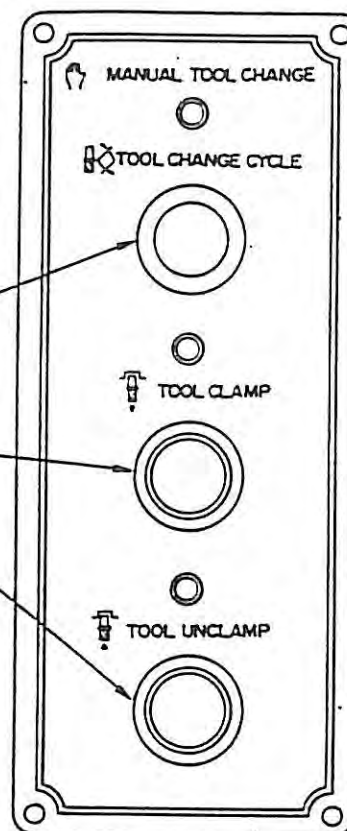
The indicating lamp above the **TOOL CHANGE CYCLE** button will come on. To assure the safety of the operator, the **TOOL CLAMP** and **TOOL UNCLAMP** buttons are inoperative unless the **TOOL CHANGE CYCLE** pushbutton is pressed, thus preventing the tool in the spindle from falling out even if **TOOL UNCLAMP** button is carelessly pressed.

Manual Tool Change Operation Panel

While the **TOOL CHANGE CYCLE** button is on and the spindle drive key is located in the horizontal direction, the indicating lamp will flicker. While the **TOOL CHANGE CYCLE** button is on and the spindle drive key is located in the vertical direction (angular error within $\pm 15^\circ$ allowable), the indicating lamp will go on.

While the **TOOL CLAMP** button is on, this indicating lamp is illuminated.

While the **TOOL UNCLAMP** button is on, this indicating lamp is illuminated.



Tool Removal

Holding the tool by hand, press the **TOOL UNCLAMP** button and the tool in the spindle will be unclamped in about three seconds. The tool can then be removed from the spindle.

A time delay of three seconds in this tool unclamp operation allows the operator to hold a heavy tool with both hands after pressing the button.

Tool Setting

After inserting a new tool in the spindle by aligning the key and the keyway, press the **TOOL CLAMP** button. The tool is secured in the spindle.

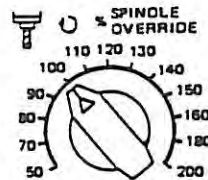
Note: The **TOOL CLAMP** and **TOOL UNCLAMP** buttons are inoperative unless the indicating lamp above the **TOOL CHANGE CYCLE** button is ON.

CAUTION

- (1) Clean the spindle nose and tool shank tapers before setting a tool in the spindle.
- (2) When the tool is heated due to a long cutting operation by the same tool or through heavy cutting, the tool cannot be removed from the spindle. To avoid these troubles, it is advisable to coat the taper section of the tool shank and the spindle with powder lubricant such as aerosol molybdenum disulfide.

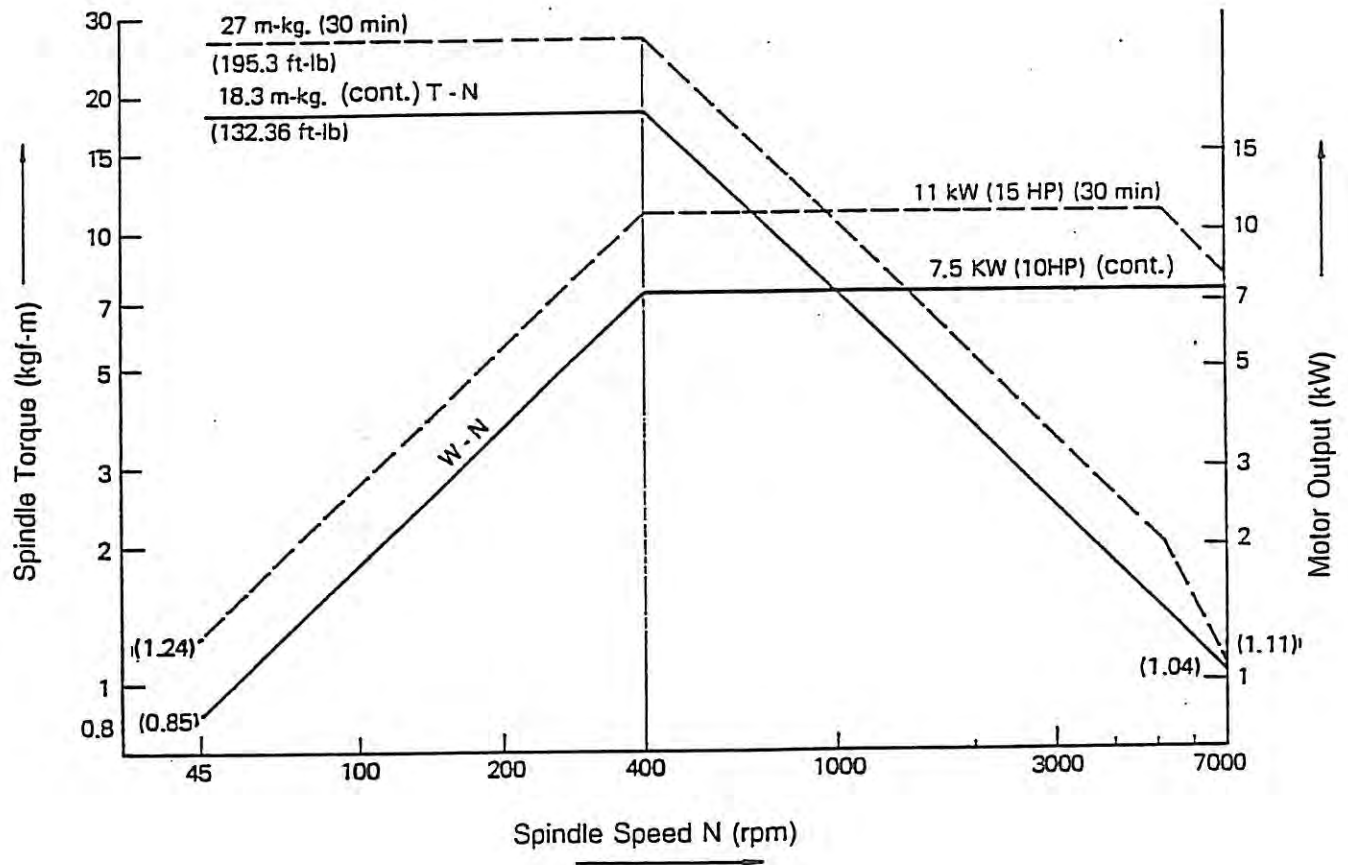
2-8. Spindle Speed Selection

- (1) The machine is not equipped with controls for manually selecting the spindle speed.
- (2) The spindle speed is changed by a direct 4-digit S-coded command entered either as a taped command or through the MDI keyboard.
- (3) The diagrams showing the relationship between the spindle speed and the torque or the output is given in 2-9.
- (4) You can select the desired spindle speed in wide range between 45 to 7,000 rpm. The range from 400 to 7,000 rpm is the so called the constant output range, where machining is made by the full power of the spindle drive motor. The range from 45 to 400 rpm is the constant torque range.
- (5) If a spindle speed command specifying lower than 45 rpm or higher than 7,000 rpm is programmed, the spindle does not rotate but it stops.
- (6) The SPINDLE SPEED OVERRIDE dial is used to override the commanded spindle speed in a range from 50 to 200%. Changing this override dial setting during spindle rotation is effective. However, if the resultant speed exceeds the specification, i.e., either lower than 45 rpm or higher than 7,000 rpm, the override dial setting is ineffective.



2-9. Spindle Speed - Torque/Output Diagram

(11/7.5 kW (15/10 hp) Motor, 7,000 rpm Standard Specification)

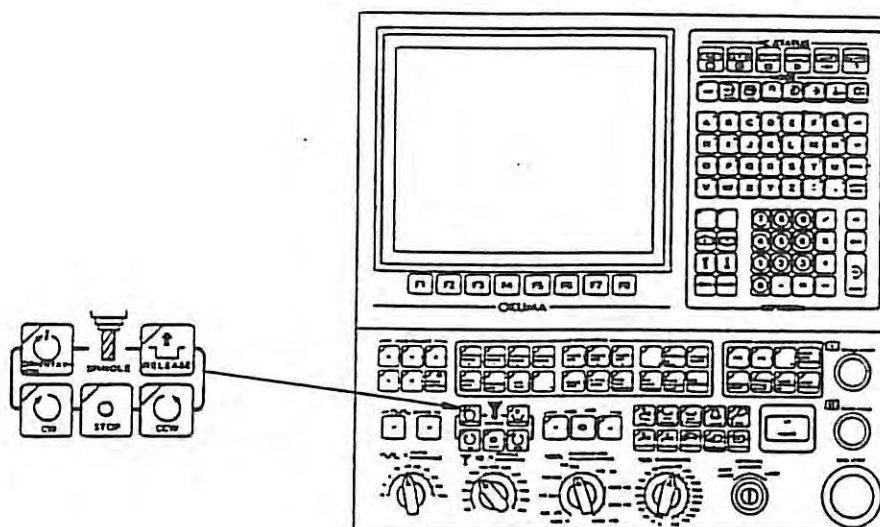


2-10. Spindle Start (CW/CCW)/Stop Operation

- (1) Since the machine has been designed to carry out cutting according to the programmed commands (entered through a tape or the MDI keyboard), only the controls for spindle CW/CCW rotation and spindle stop are used and the control for manually selecting a spindle speed is not used.
- (2) Spindle speed selection must be made by an S command entered either through a tape or the MDI keyboard. Refer to 2-7. "Spindle Speed Selection".
- (3) Conditions for Operations
 - a) Control power is ON.
(Hydraulic pressure at 60 kgf/cm² (853 psi))
 - b) The MANUAL mode is selected.
In the AUTO or the MDI mode, this operation is effective when the control is in the SLIDE HOLD mode.
 - c) Tool in the spindle is clamped.
 - d) The tool change unit is at the standby position.
 - e) An S command has been given.

The commanded spindle speed must be within a range from 45 to 7,000 rpm.

(5) Operation



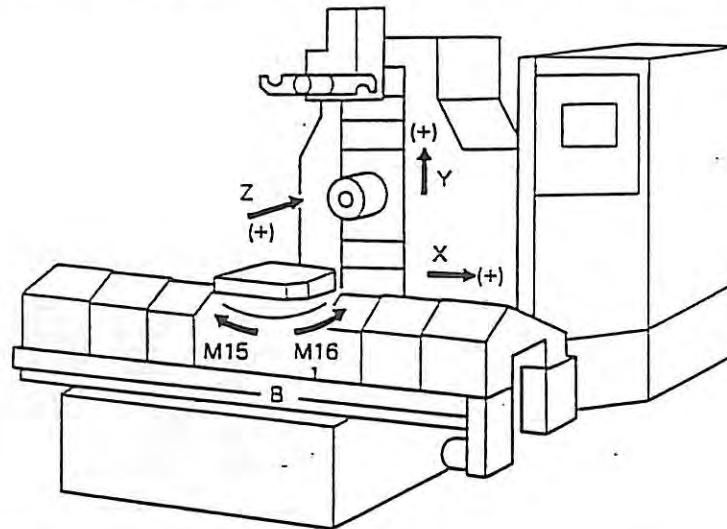
Note : Pressing the **SPINDLE STOP** switch stops the spindle by a brake applied to the spindle drive motor.

CAUTION

- (1) Switching the CNC operation mode does not affect the spindle rotation conditions.
- (2) When the **RESET** button on the NC operation panel is pressed, the spindle stops.
- (3) A spindle speed command exceeding the available spindle speed range causes the spindle to stop.
- (4) If the spindle drive motor load exceeds the motor capacity (120% of ammeter reading in constant output range), the spindle stops.

2-11. Axis Nomenclature and Axis Feed

(1) Axis nomenclature on model MC-400H is indicated below.



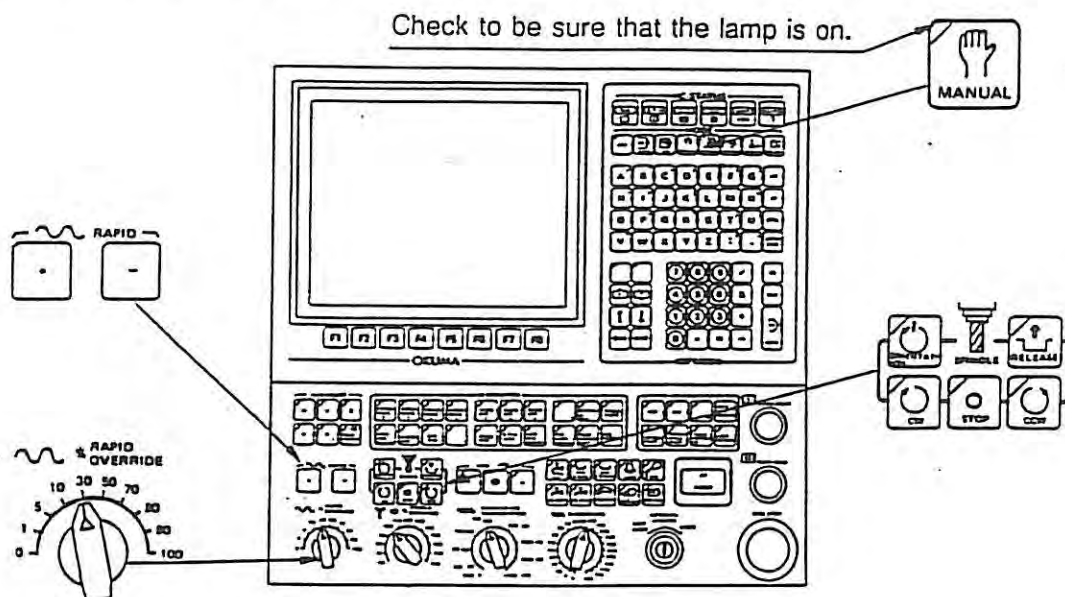
	Movement	+ direction
X-axis	Table left/right movement	Rightward
Y-axis	Spindlehead up/down movement	Upward
Z-axis	Column front/back movement	To back

(2) Conditions for Operations

- The MANUAL mode is selected.
- The axis selected should be other than PULSE HANDLE.
- Axis to be controlled is not at the travel end position.
- The tool change unit is at the standby position.

(3) Rapid Traverse Operation Procedure

- a) Select the axis to be moved with the AXIS SELECT switches.



- b) Select the desired rapid feedrate override percentage from 0, 1, 5, 10, 30, 50, 70, 80, 90, and 100.

This selection can be done during axis rapid feeding.

- c) Press either the RAPID + or the RAPID - switch. The axis moves in the selected direction while the switch is pressed. Release the switch to stop axis rapid feeding.

CAUTION

The axis rapid feedrate is as high as 25 m/min (984.25 ipm) for all three axes. Take special care when feeding an axis at a rapid feedrate so that the cutting tool will not strike against the workpiece, the fixture or anything else. If you are not familiar with the machine operation or when careful operation is required, it is recommended to select a low override ratio.

(4) Running-in Operations

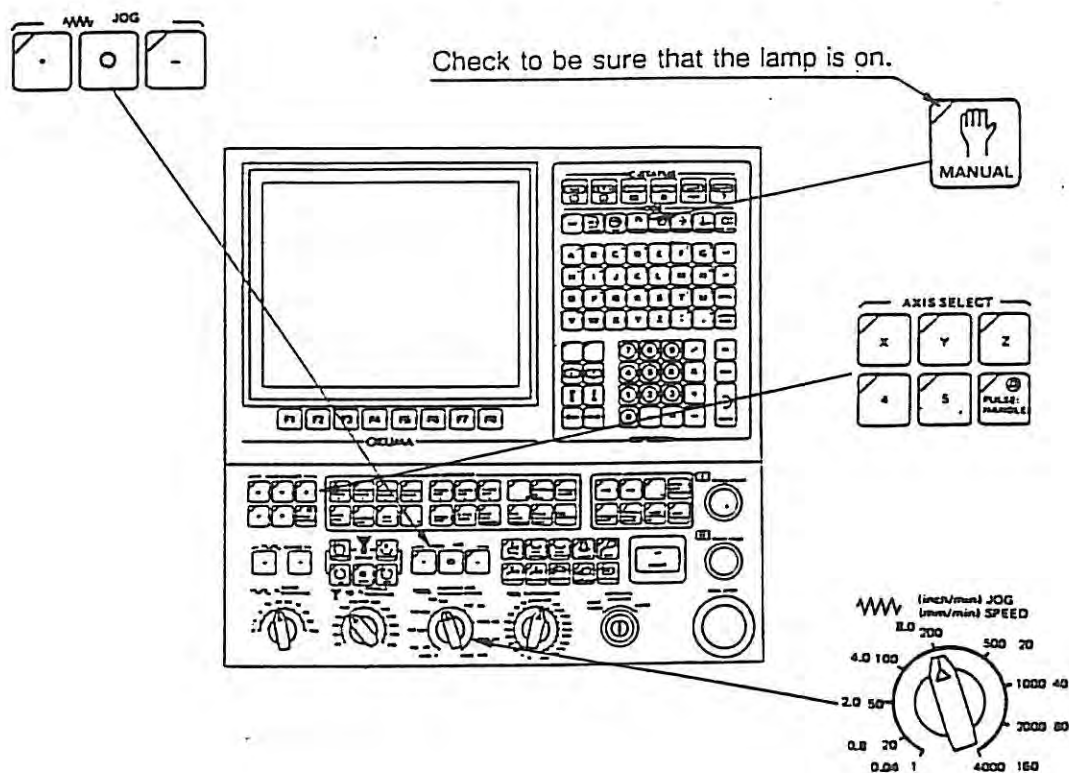
Follow the steps below to carry out run-in operation for axis feed.

Operating procedure:

- 1) Press the LUB. key two to three times in intervals of approximately one minute.
- 2) Feed an axis in its entire stroke for 20 - 30 minutes with the rapid feed override setting at 10%.

(5) Manual Cutting Feed Operation

- a) Select the axis to be moved with the AXIS SELECT switches.



- b) Select the desired feedrate on JOG SPEED selector switch within a range from 1 mm/min (0.04 ipm) to 10,000 mm/min (393.70 ipm).

This selection can be done during an axis feed.

- c) Press the JOG + or the JOG - switch. The selected axis starts moving in the direction selected by these switches at the selected feedrate.

- d) To stop the axis feed, press the JOG OFF (○) switch.

(6) Automatic Axis Feed

Automatic axis feed is made by a command entered through a tape or the keyboard. For details, please consult the Programming Manual.

Programmed feedrates can be overridden within a range from 0 to 200% in 24 steps. The axis will be fed at the programmed feedrate when this FEEDRATE selector switch is set at 100%.

2-12. Manual Pulse Feed

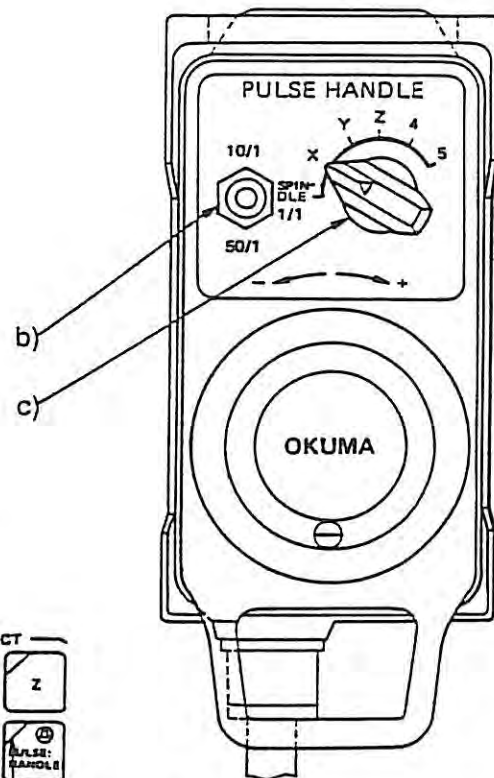
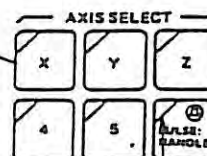
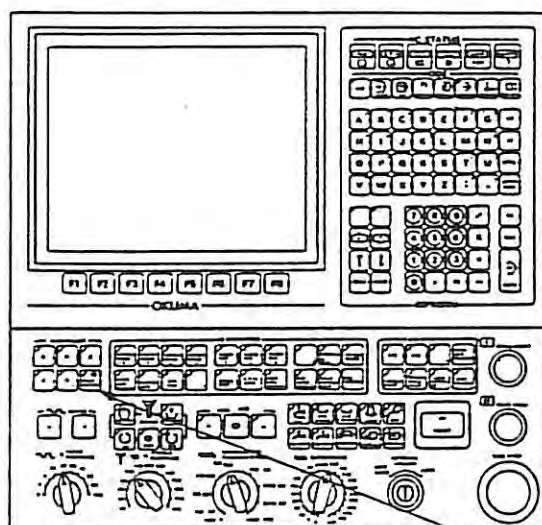
The pulse handle will be effectively used for feeding an axis by a relatively short distance at a low feedrate in such as aligning a cutting tool to a workpiece and manually infeeding an axis in a trial cut.

(1) Conditions for Operations

The MANUAL mode has been selected.

(2) Operation Procedure

Check to be sure that the lamp is on.



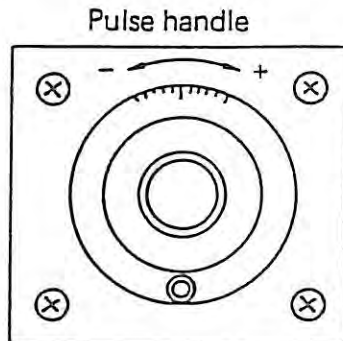
Lamp goes on.

- Press the PULSE HANDLE switch.
- Select a desired multiplication factor. This is to multiply the axis feed amount per pulse.

Set Unit	Multiplication Factor		
	1	10	50
0.001 mm (0.0001 in.)	0.001 (0.0001)	0.01 (0.001)	0.05 (0.005)

- Select the axis to be controlled with the **AXIS SELECT** switch on the pulse handle operation panel.

Rotating the pulse handle clockwise feeds the axis in the positive (+) direction and counterclockwise rotation feeds the axis in the negative (−) direction.

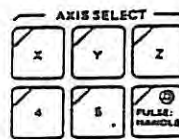


One turn of the pulse handle generates 100 pulses.

The pulse handle unit is removable from the pendant operation panel. This facilitates aligning work to be carried out near the workpiece.

CAUTIONS

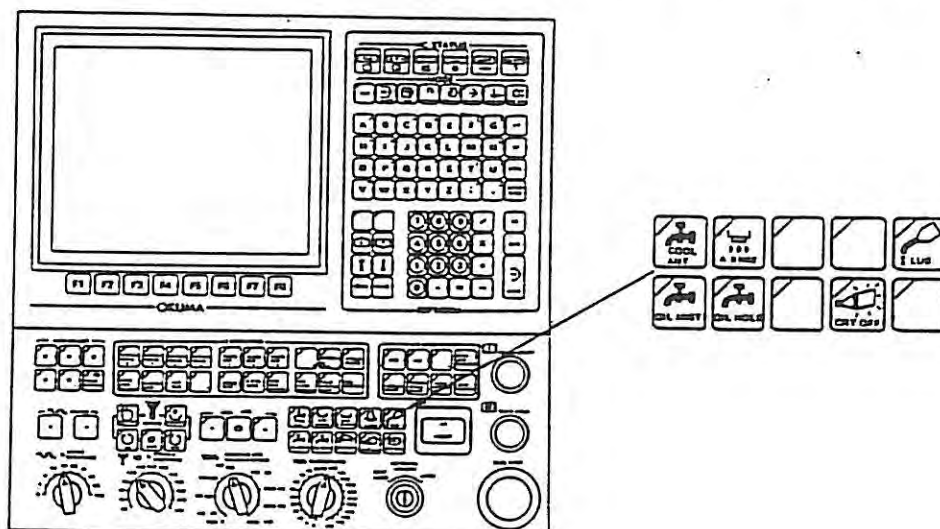
- (1) *When the pulse handle is turned quickly with a high multiplication factor setting, an alarm results if the feedrate exceeds the allowable maximum axis feedrate.*
- (2) *It is necessary to adjust the set backlash amount when an axis does not move even when the pulse handle is turned to generate several pulses.*
- (3) *Select any axis other than PULSE HANDLE while pulse feeding of axis is not necessary in order to prevent the axis from unexpectedly starting even if the pulse handle is carelessly touched.*



(2) Operation

a) In MANUAL Mode

Press the COOLANT key on the main operation panel for the coolant pump motor to start operating to deliver coolant. To stop the coolant supply, press the switch again.



b) In the AUTO and MDI Modes

M codes:

M08	Coolant Pump ON
M09	Coolant Pump OFF

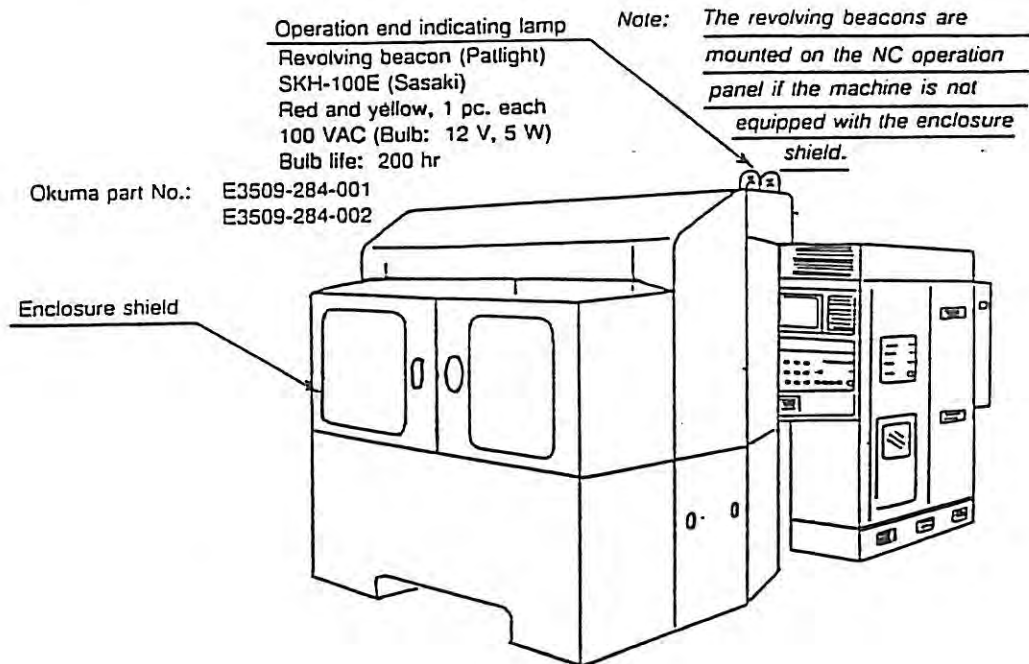
In the AUTO mode operation, punch these M codes on a tape.

In the MDI mode operation, press the CYCLE START button after entering the codes through the keyboard.

CAUTIONS

- (1) When any of the following M codes is given while the coolant pump is operating, the coolant pump stops:
M00, M01, M02, M30, M50, and M51
- (2) ON/OFF commands and COOLANT switch setting:
ON/OFF commands and the switch setting, whichever comes later becomes effective. That is, turning the COOLANT switch OFF while the coolant pump is operating, activated by the taped command, stops coolant supply.
- (3) Coolant flow rate is adjustable with the lever cock near the nozzle. It is possible to shut off the coolant supply with this stopcock while the pump is operating. However, since such operation will cause the coolant temperature to rise, it is advisable not to shut off coolant with this stopcock for a long time.

2-23. Operation End Lamp/Buzzer and Automatic Power Shutoff (optional)



(1) Operation End Indicating Lamp

a) Operation end lamp (Yellow)

Goes on when M00, M01, M02 or M30 is executed.

For the APC model, this lamp will also come on if the **W. LOAD FINISHED** pushbutton switch is not pressed at the time M60 is executed.

b) Alarm Lamp (Red)

Goes on when NC or EC alarm takes place.

Pressing the **RESET** button on the NC operation panel turns off the lamp.

(2) Operation End Indicating Buzzer

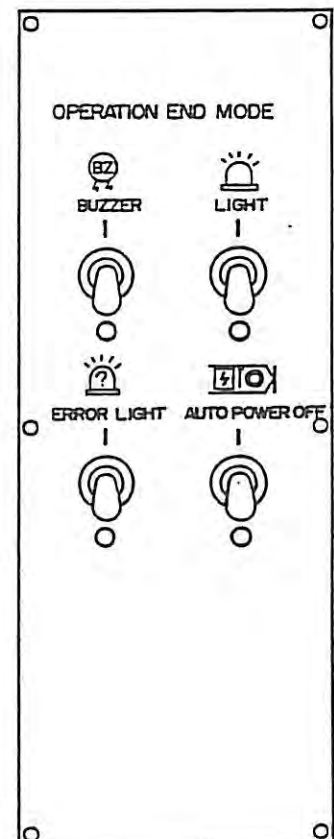
Operates in the same conditions as the operation end indicating lamp and the error lamp.

Can be used in combination with these lamps.

(3) Automatic Power Shutoff

After M02, M30 or END is executed, power supply is turned off.

For the APC model, power is also shut off if the **SETUP COMPLETION** pushbutton switch is not pressed at the time M60 is executed.



For the functions above, toggle switch is provided for each of them to turn on and off the functions as required.

2-24. Table Indexing Operation

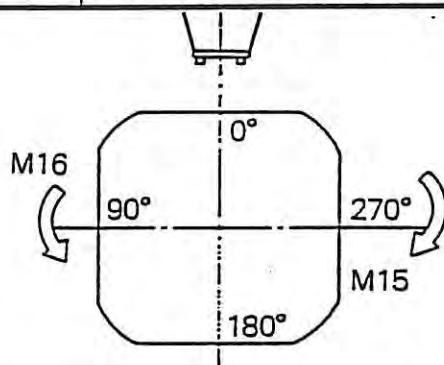
The machine is not equipped with table indexing manual switches, and table indexing operation is performed by the commands entered through the keyboard or a tape.

Minimum input increment ($0^\circ \leq B \leq 360^\circ$)

5° index increment type	5 deg.
1° index increment type	1 deg.
NC rotary table	0.001 deg.

Direction of the table index is commanded by a proper M code.

M15	Table Clockwise Rotation
M16	Table Counterclockwise Rotation



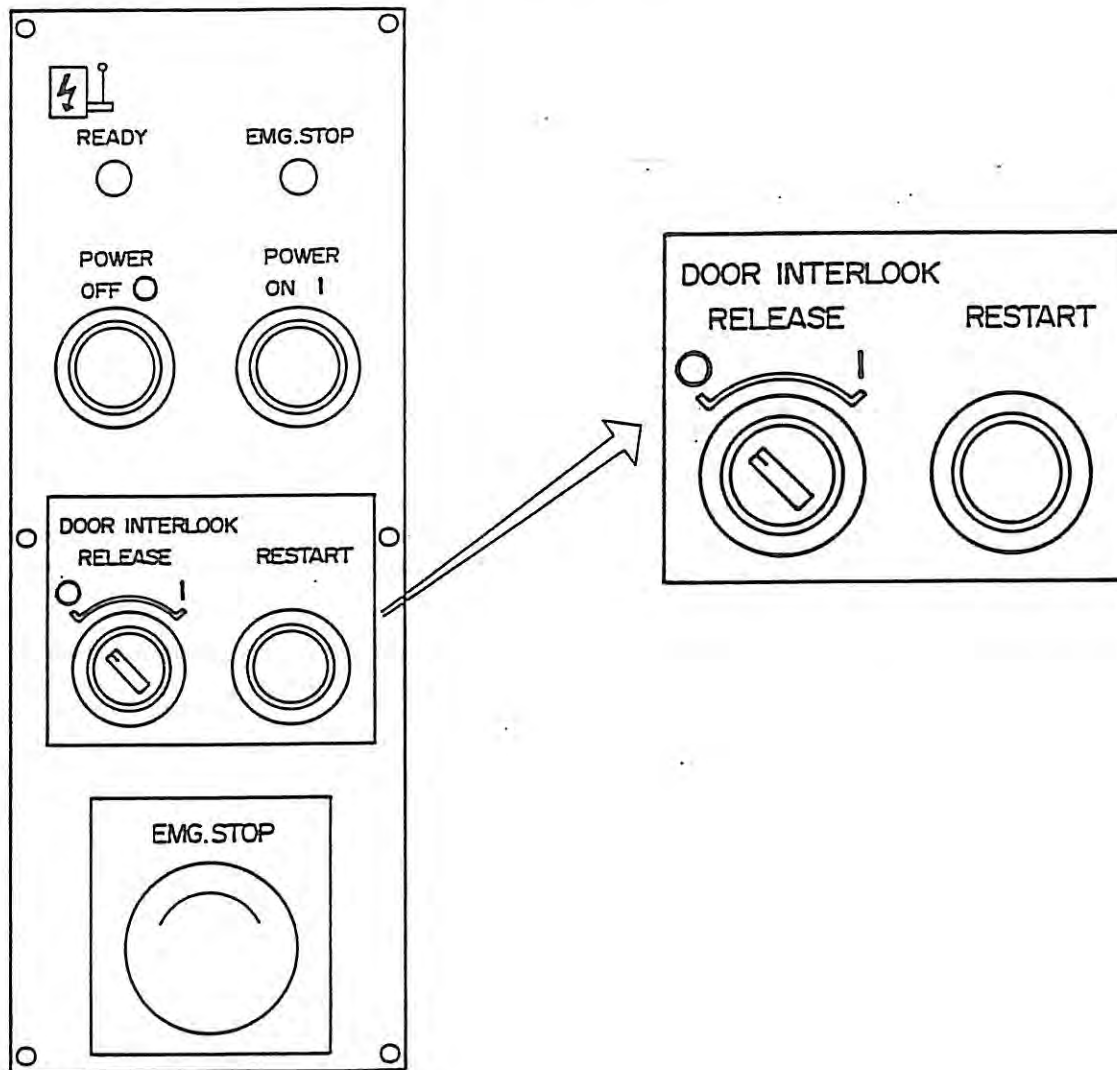
The index table is provided with angle indication lines of 0 degrees to 360 degrees.

Note that the table indexing angular position is fixed. In other words, table indexing is made by an absolute value.

Procedure for entering a table indexing command through the keyboard:

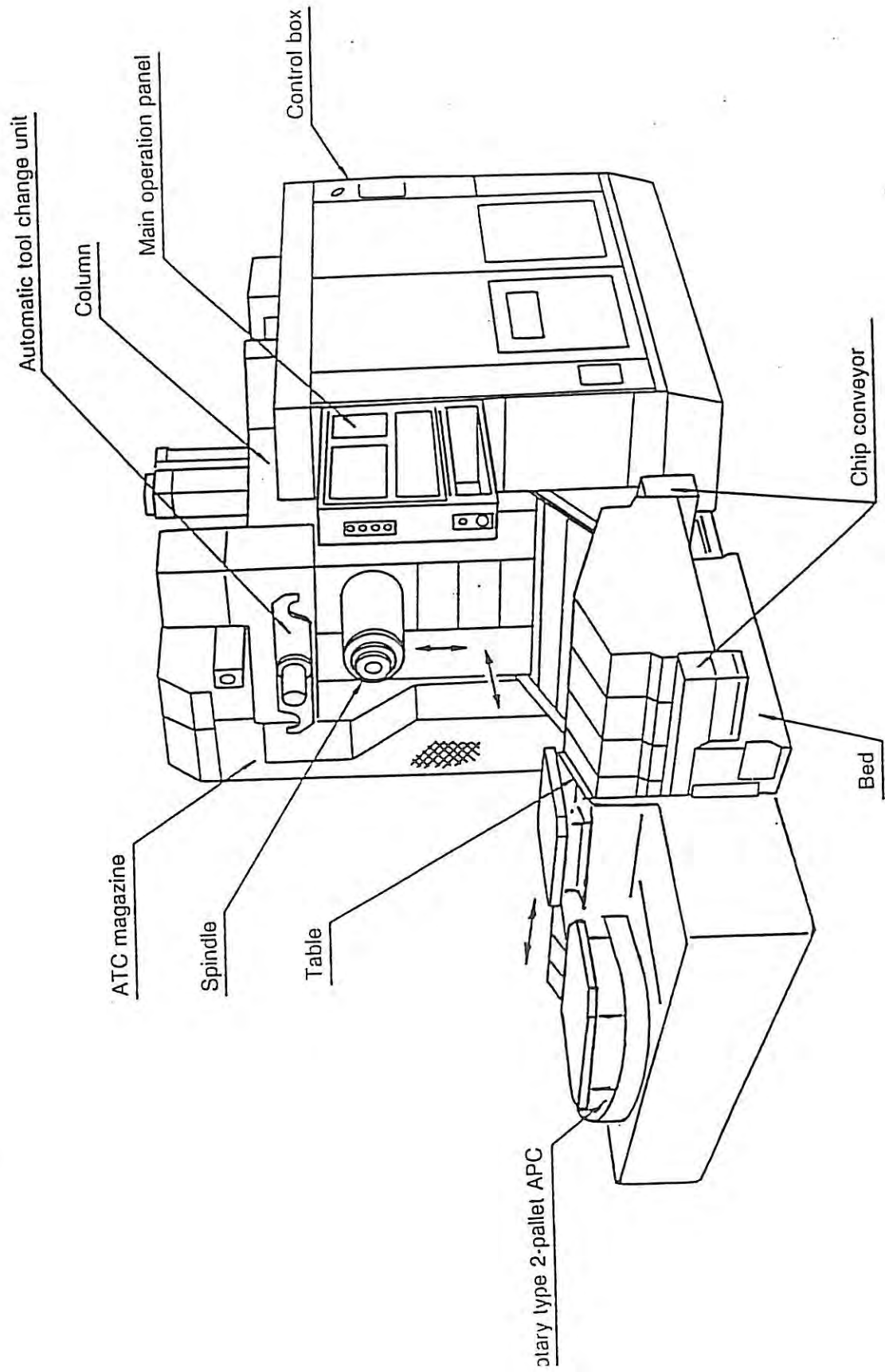
- 1) Select the MDI mode by pressing the **MDI** key.
- 2) Press the function key [F3] (PROGRAM).
- 3) Enter the index rotation direction command, M15 or M16 as desired and then the required table index angle. Make sure that the data has been correctly entered.
- 4) Press the **WRITE** key. The input data display disappears and the data is displayed in the buffer column, instead.
- 5) Press the **CYCLE START** button. The table is indexed in accordance with the entered data.

2-25. Door Interlock Release/Restart Operation



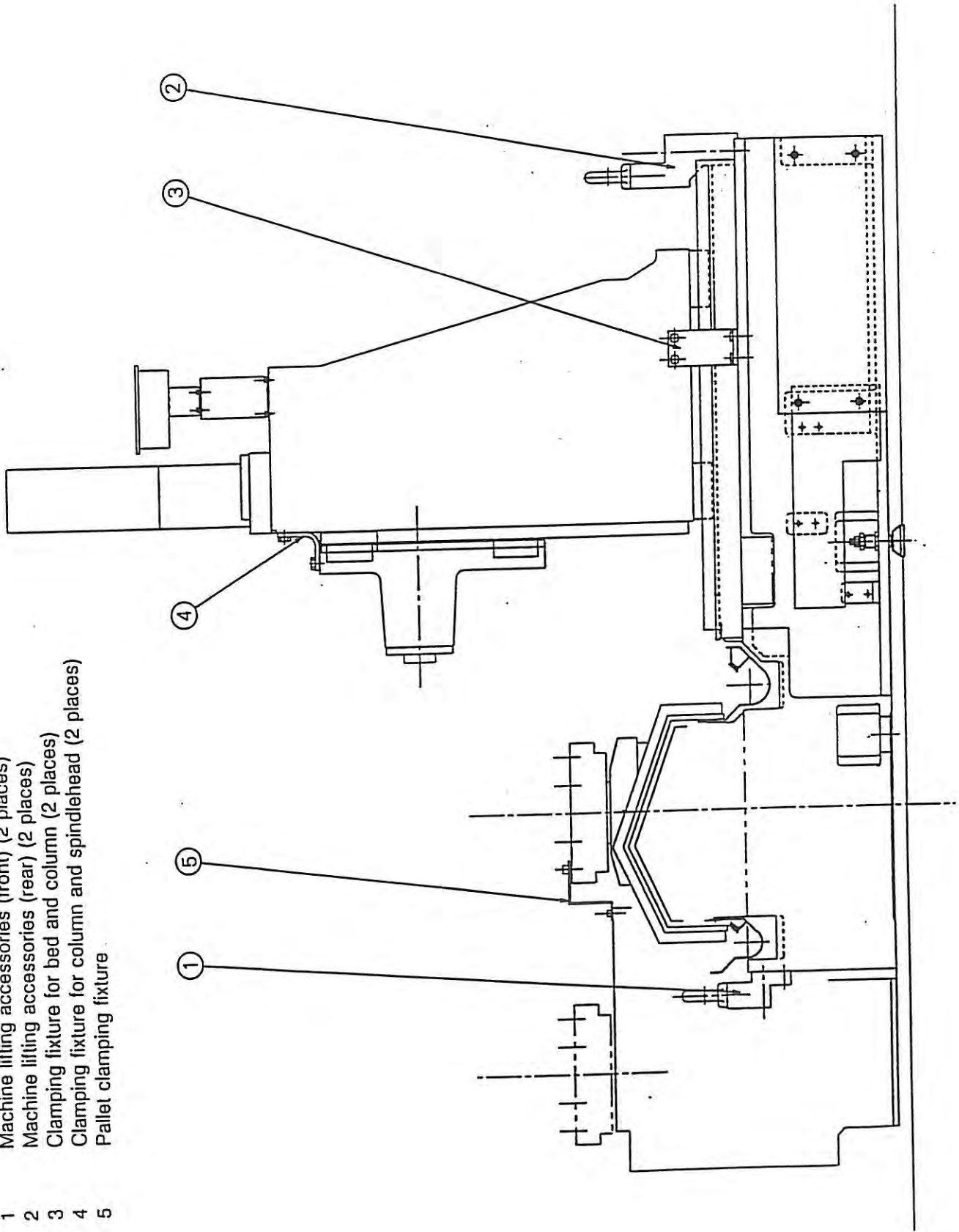
- (1) If the machine door at the side of the main operation panel is opened, operations such as axis feed and spindle rotation are stopped. To resume operation, close the machine door and press the **RESTART** button.
- (2) To release the door interlock function, set the **RELEASE** switch to the OFF position by turning it to the right.
- (3) Set the **RELEASE** switch to the ON position and keep the door interlock function effective during machine operation.
- (4) When the door interlock function has to be released in order to allow entry inside the enclosure shield, pay due attention to machine motion.

4. Nomenclature



SECTION 2 HANDLING AND INSTALLATION OF MACHINE

- 1 Machine lifting accessories (front) (2 places)
- 2 Machine lifting accessories (rear) (2 places)
- 3 Clamping fixture for bed and column (2 places)
- 4 Clamping fixture for column and spindlehead (2 places)
- 5 Pallet clamping fixture



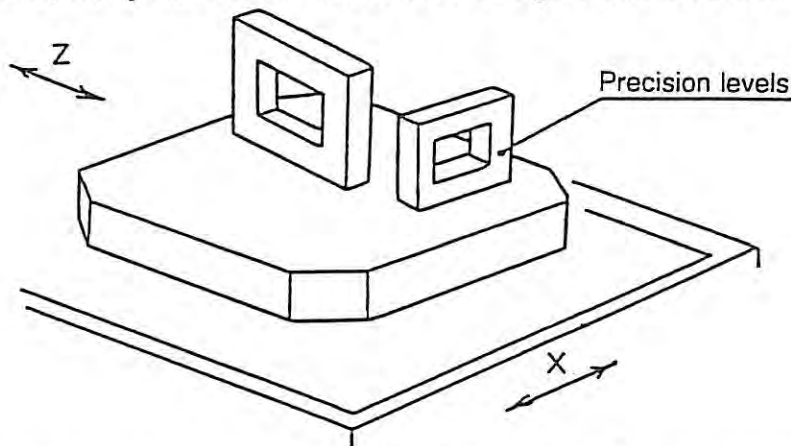
7-3. Levelling the Machine

Since machine level greatly affects machining accuracy and service life, the machine should be carefully levelled during installation.

Use precision levels (0.02 mm/m per division) to measure the machine level.

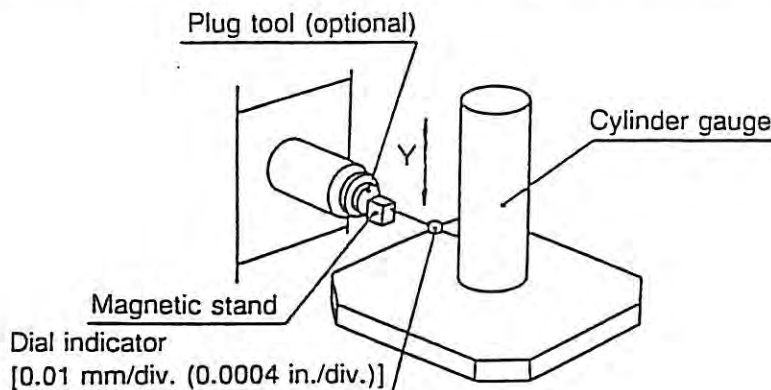
Level the machine as follows:

- (1) Position the spindlehead at the center of Y-axis travel.
- (2) Position the table at the center of the bed, where the table center and the spindle center are aligned.
- (3) Position the column at the center of Z-axis travel.
- (4) With precision levels placed near the center of the table (pallet) along the X- and Y-axis directions, slowly move the table over the full range of X-axis travel and take readings.



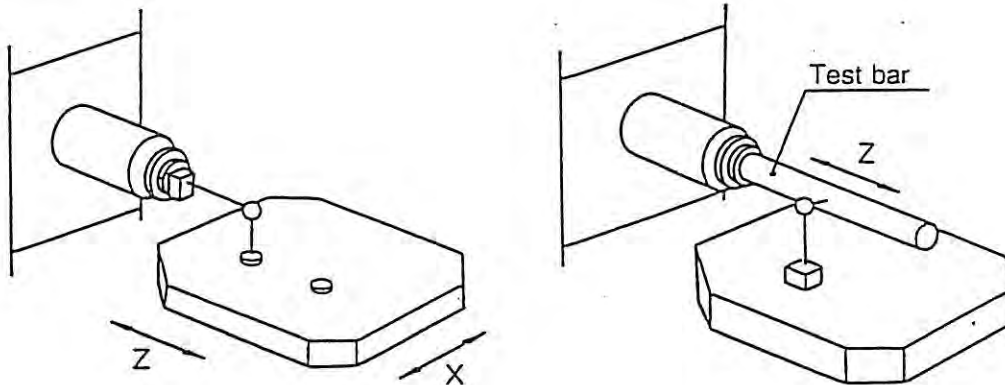
Adjust the machine level to the permissible limits specified in the Static Accuracy Test Chart.

- (5) Then place a cylinder gauge on the table and measure the vertical movement of the spindlehead with a dial indicator fixed to the spindle. Adjust the column inclination to the permissible limits specified in the Static Accuracy Test Chart supplied with the machine.



SECTION 2 HANDLING AND INSTALLATION OF MACHINE

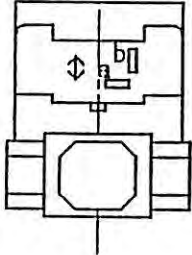
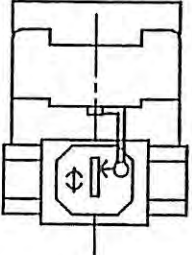
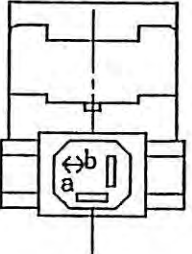
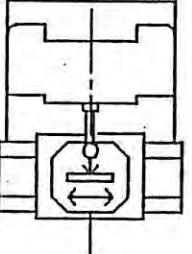
- (6) Place the stem of the dial indicator fixed on the spindle onto the table and move the column (Z-axis) or the table (X-axis) to confirm the level of the table.
- (7) Set a test bar in the spindle and place the stem of the dial indicator fixed on the table onto the test bar. Move the column in the crosswise direction (back and forth direction) to adjust the parallelism of column (Z-axis) movement to the spindle center line.

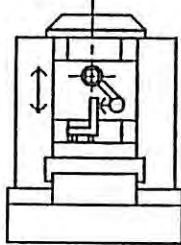
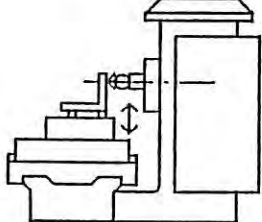
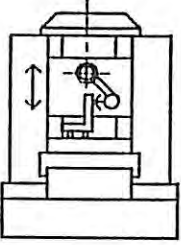
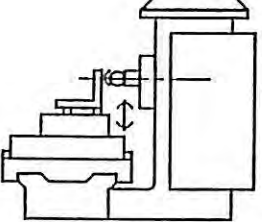
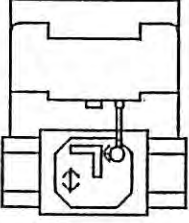
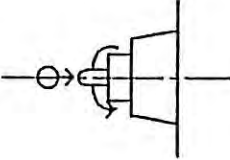


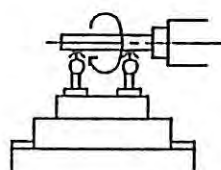
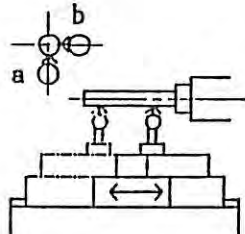
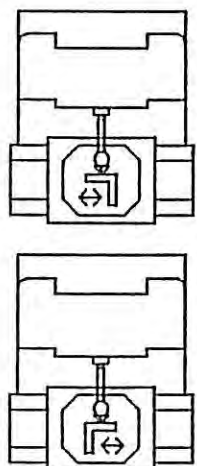
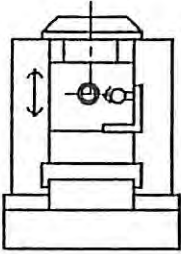
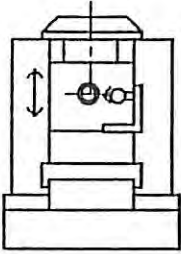
- (8) Adjustment of the machine level is carried out with eight jack screws under the bed.
- (9) After the completion of adjustments, secure the jack screws with respective lock nuts, tighten foundation bolts and recheck the machine level.

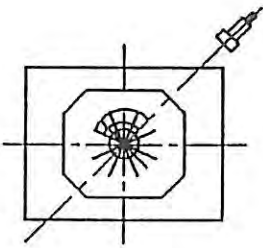
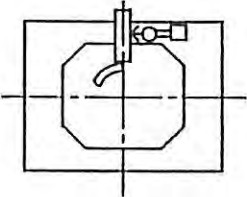
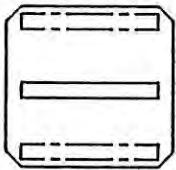
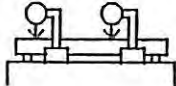
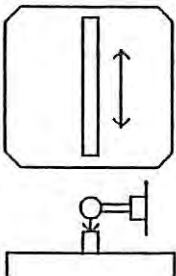
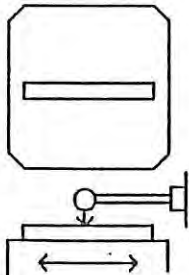
TEST CHART
for
MACHINING CENTER

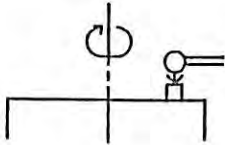
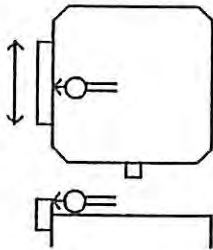
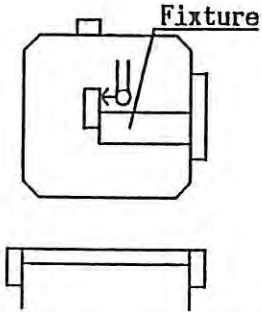
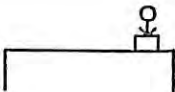
Messrs.

Type of Machine: M C - 4 0 0 H		Nominal Size:		Serial No. of Machine: 0 0 8 5	
ACCURACY TEST					Date: MAY 11 1992
					Unit : mm
No.	Test to be Applied			Permissible Error (Reference JIS Std)	Actual Result
	Item		Illustration		
1	Straightness of column motion in Z-axis direction:	a on X-Y plane		0.02/m on full stroke (0.04/m) (on full stroke)	0.010
		b on Y-Z plane		0.02/m on full stroke (0.04/m) (on full stroke)	0.020
		on Z-X plane		0.005 per 500 (0.01 per 500)	0.003
2	Straightness of table motion in Y-axis direction:	a on X-Y plane		0.02/m on full stroke (0.04/m) (on full stroke)	0.020
		b on Y-Z plane		0.02/m on full stroke (0.04/m) (on full stroke)	0.020
		on Z-X plane		0.005 per 500 (0.01 per 500)	0.003

No.	Item	Illustration	Reference JIS Std	Result
3	Straightness of spindlehead motion in Y-axis direction:	on X-Y plane 	0.005 on full stroke (0.01 per 500)	0.003
		on Y-Z plane 	0.005 on full stroke (0.01 per 500)	0.003
4	Squareness of each axis motion with respect to other axis motion:	X-axis Y-axis 	0.008 per 300 (0.015 per 300)	0.007
		Y-axis Z-axis 	0.008 per 300 (0.015 per 300)	0.006
		Z-axis X-axis 	0.008 per 300 (0.015 per 300)	0.007
5	Play of spindle in Z-axis direction		0.003 (0.005)	0.001

No.	Test to be Applied		Permissible Error (Reference JIS Std)	Actual Result
	Item	Illustration		
6	Runout of spindle inner taper:		0.004 at fixed end of test bar (0.008)	0.003
			0.01 at free end (300 point) of test bar (0.02)	0.010
7	Parallelism of table Z-axis direction motion with respect to spindle center line:		0.008 per 300 (0.015 per 300)	0.006
			0.008 per 300 (0.015 per 300)	0.006
8	Squareness in rotary table indexing		0.007 per 300	0.005
			(0.01 per 300)	
9	Positioning accuracy	X-axis		± 0.004
		Y-axis		± 0.004
		Z-axis		± 0.004
10	Repeatability	X-axis		± 0.001
		Y-axis		± 0.001
		Z-axis		± 0.001

No.	Test to be Applied		Permissible Error (Reference JIS Std)	Actual Result
	Item	Illustration		
11	Positioning accuracy		$\pm 3 "$ (30 ")	$\pm 3 "$
12	Repeatability		$\pm 2 "$ ($\pm 10 "$)	$\pm 2 "$
13	Straightness of pallet upper surface	on X-Y plane 	0.006 per 400 Concave only (0.015 per 500)	0.006
		on Y-Z plane 	0.006 per 400 Concave only (0.015 per 500)	0.006
14	Parallelism of X-axis motion with respect to pallet upper surface		0.01 per 400 (0.025 per 500)	0.010
15	Parallelism of Z-axis motion with respect to pallet upper surface		0.01 per 400 (0.025 per 500)	0.010

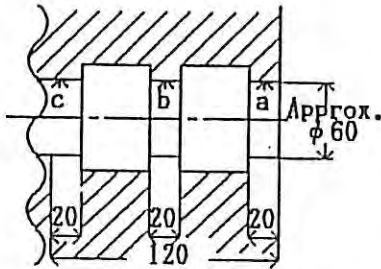
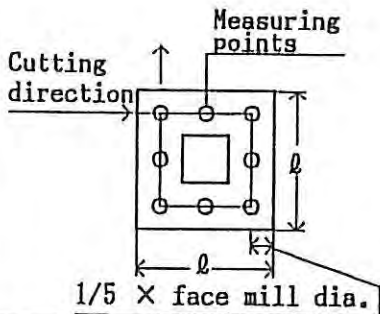
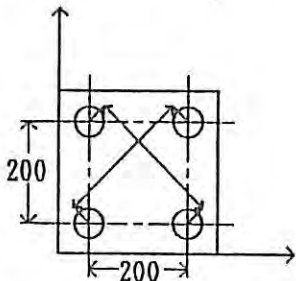
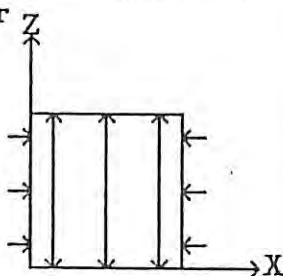
No.	Test to be Applied		Permissible Error (Referende JIS Std)	Actual Result
	Item	Illustration		
16	Waviness of pallet upper surface		0.01 per 400 (0.025 per 500)	0.008
17	Parallelism of X-axis motion with respect to datum surface on edge locator		0.008 per 200 (0.015 per 300)	0.007
18	Distance between datum surface on edge locator and index center		± 0.01 (± 0.02)	± 0.010
19	Pallet positioning accuracy (Repetitive accuracy)	X-axis	0.01 (0.02)	0.005
		Y-axis	0.005 (0.02)	0.004
		Z-axis	0.01 (0.02)	0.005
20	Pallet thickness mutual difference (Y-axis direction)		0.015 (0.03)	0.010

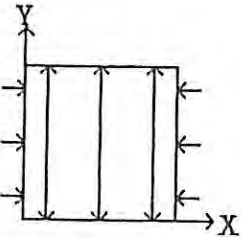
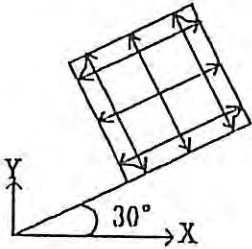
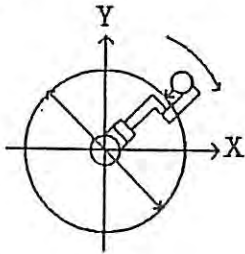
PERFORMANCE TEST

Date: MAY 11 1992

WORKING ACCURACY TEST (1)

Unit: mm

No.	Item and Illustration	Cutting conditions	Permissible Error (Reference JIS Std)	Actual Result
1	Boring accuracy 	Cutting tool: Carbide tip Material: JIS FC25 Cast iron Spindle speed: 500 rpm Cutting speed: Approx. 100 m/min Depth of cut: 0.1 mm Feedrate: 0.05 mm/rev	Roundness: 0.005 per 60 (0.01 per 60) Cylindricity: 0.005 per 100 (0.01 per 100)	0.003 0.003
2	Accuracy in face milling using face mill cutter 	Cutting tool: Carbide tip 4R face mill 5 blades Material: JIS FC25 Cast iron Spindle speed: 300 rpm Cutting speed: Approx. 80 m/min Depth of cut: 0.1 mm Feedrate: 0.05 mm/blade	Flatness: 0.007 (0.01) Step: 0.005 (0.01)	0.006 0.004
3	Positioning and bore diameter accuracy in boring 	Cutting tool: Carbide tip Material: JIS FC25 Cast iron Spindle speed: 800 rpm Cutting speed: Approx. 100 m/min Depth of cut: 0.1 mm Feedrate: 0.05 mm/rev	Positioning accuracy along axes: 0.012 per 200 (0.025 per 200) Diagonal positioning accuracy: 0.017 per 283 (0.035 per 283)	0.010 0.011
4	Accuracy in four faces cutting with face mill cutter 	Cutting tool: Carbide tip 4R face mill 5 blades Material: JIS FC25 Cast iron Spindle speed: 300 rpm Cutting speed: Approx. 80 m/min Depth of cut: 0.1 mm Feedrate: 0.05 mm/blade	Parallelism: 0.015 per 230 (0.03 per 300) Squareness: 0.01 per 230 (0.02 per 300)	0.007 0.007

No.	Item and Illustration	Cutting conditions	Accuracy (Reference JIS Std)	Result
5	Accuracy in side face cutting with end mill 	Cutting tool: Carbide tip end mill Material: JIS FC25 Cast iron Spindle speed: 800 rpm Cutting speed: Approx. 80 m/min Depth of cut: 0.1 mm Width of cut: 20 mm Feedrate: 0.1 mm/blade	Parallelism: 0.01 per 160 (0.03 per 300)	0.005
6	Accuracy in end milling under linear interpolation mode 	Cutting tool: Carbide tip end mill Material: JIS FC25 Cast iron Spindle speed: 800 rpm Cutting speed: Approx. 80 m/min Depth of cut: 0.1 mm Width of cut: 20 mm Feedrate: 0.1 mm/blade	Parallelism: 0.01 per 130 (0.04 per 300)	0.007
7	Accuracy in end milling under circular interpolation mode 		Accuracy: 0.012 per 150 (0.04 per 250)	0.009

Inspected by:

Assembled by:

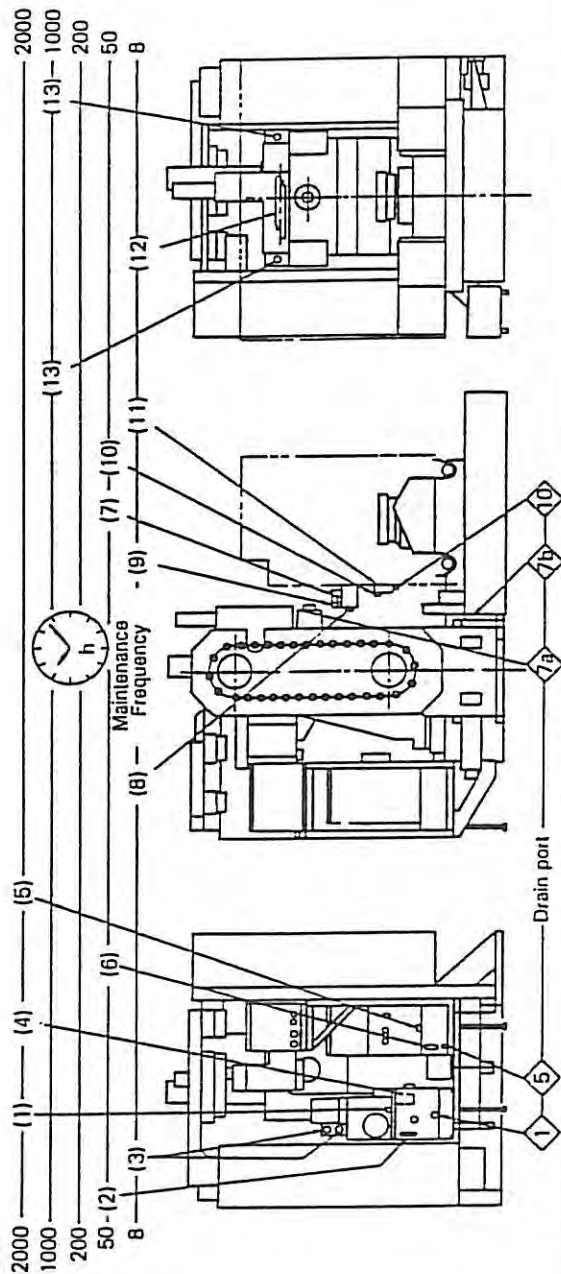
Checked by:

Production Department

Inspection Department

1-1. Lubrication Chart

1-1-1. Machine



Machine Component	Hydraulic Power Unit				Spindlehead Cooling Unit				Centralized Lubrication Unit				Lubricator	Tool Changer Arm	ATC Door
Action Point No.	1	2	3	4	5	6	7	8	9	10	11	12	13		
Symbol of Action															
Nature of Action															
Check		50	8			50		8	8		8	8			
Replenish							50			50					1000
Clean or Replace				2000											
Change	2000				2000										
Lubricating Oil Designation	HM32 *				FC2				G68				G68	G68	XM2
Reservoir Capacity [ℓ (gal)]	45 (11.9)				42 (11.1)				6 (1.6)					2 (0.5)	
Replenish Amount [ℓ (gal)]	—				—				2.5 (0.66)				0.05 (0.013)	—	As needed

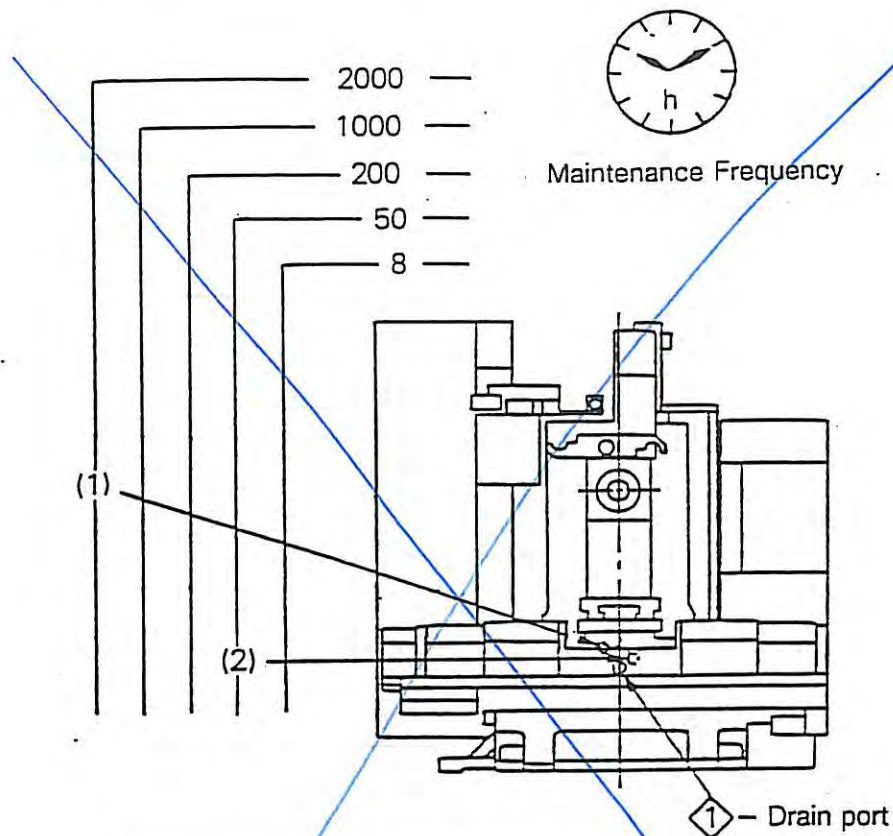
Note: Clean service points before changing lubricating oil.

* Under normal environment, use HM32.

In environment where temperature is lower than 10°C, use FC22 (viscosity index 140 or higher).

SECTION 3 PREPARATION OF MACHINE FOR OPERATION

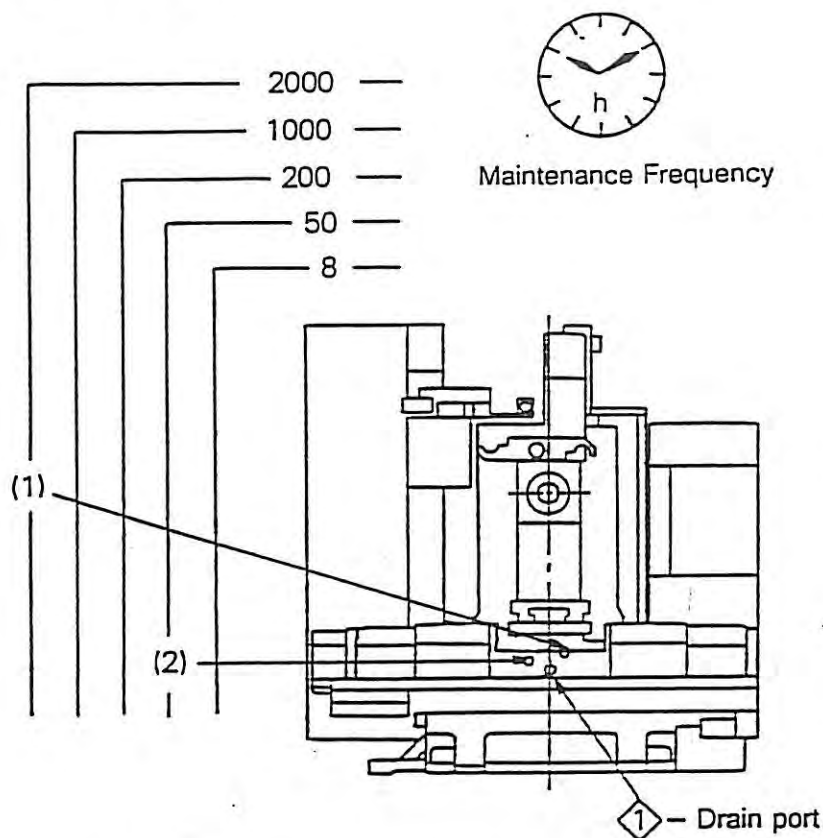
1-1-2. 1°/5° Table



Machine Component	Table Gearbox	
Action Point No.	1	2
Nature of Action		
Check		50
Replenish		
Clean or Replace		
Change	2000	
Lubricating Oil Designation	CC150	
Reservoir Capacity [ℓ (gal)]	4 (1.1)	
Replenish Amount [ℓ (gal)]	—	

SECTION 3 PREPARATION OF MACHINE FOR OPERATION

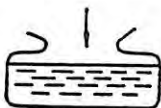
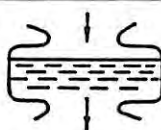
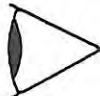
1-1-3. NC Rotary Table



Machine Component	Table Gearbox	
Action Point No.	1	2
Nature of Action		
Check		50
Replenish		
Clean or Replace		
Change	2000	
Lubricating Oil Designation	G68	
Reservoir Capacity [ℓ (gal)]	4.5 (1.19)	
Replenish Amount [ℓ (gal)]	—	

SECTION 3 PREPARATION OF MACHINE FOR OPERATION

1-2. Lubrication Symbols

Meaning	Symbol	Remarks
Oil Level		
Replenish		
Change		
Pressure Gauge	 kgf/cm ²	
Thermometer		
Oil Filter		- Clean or change filter elements. - Check filter element condition (cleanliness).
Flow Sight		- Check flow of oil through window, gear, rotary ring or spout type devices.
Oil Pump		- Operation of lever or button for manual pump.
Separator		- Cleaning of magnetic coolant separator.
Time (intervals)		
Inspection		- This symbol is used in combination with other symbols.

SECTION 3 PREPARATION OF MACHINE FOR OPERATION

1-3. Lubricating Oil Specifications

Application	Code	Esso	Shell	Mobil
Gears	CB32	Unipower 32	Tetra Oil 32	DTE Oil Light
	CB68	Unipower 68	Tetra Oil 68	DTE Oil Heavy Medium
	CC150	Spartan EP150	Omala Oil 150	Gear Oil 629
Bearing	FC2	————	Tetra Oil 2	Velocite No. 8
	FC10	Spinesso 10	Tetra Oil 10	Velocite No. 6
Slideway	G32	————	Tonna Oil T32 (XHVI)	Vactra No. 1
	G68	Febis K68	Tonna Oil T68 (XHVI)	Vactra No. 2 LG <i>Do Not use</i>
	G220	Febis K220	Tonna Oil T220 (XHVI)	Vactra No. 4 LC
Hydraulic Fluid	HM32	Unipower SQ32	Tetra Oil 32	DTE 24
Grease	XM2	Litltan 2	Alvania Grease 2	Mobilux 2

Note 1: Always use the specified lubricating oil for slideways.

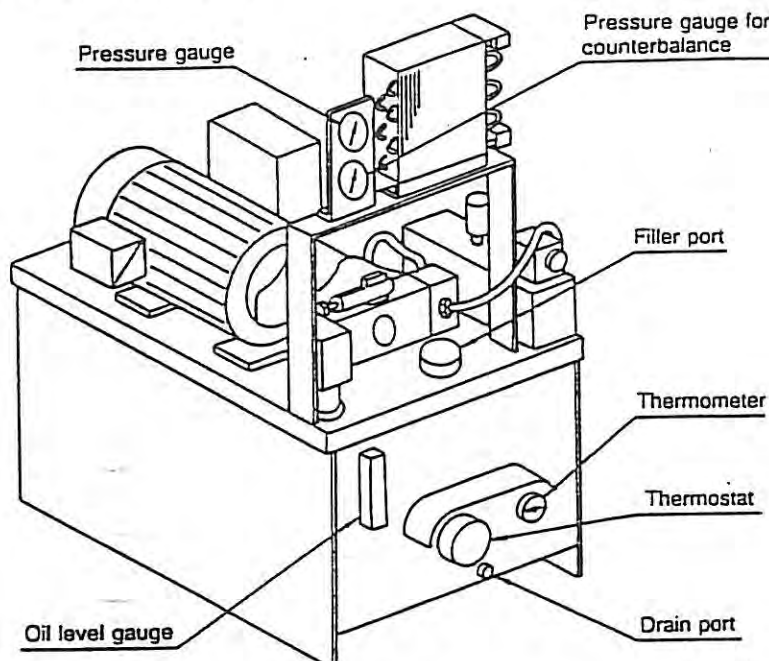
Never use the oil marketed for use for both hydraulic unit and slideway lubrication.

Note 2: For the service ports and amounts of oil for each machine unit, refer to the LUBRICATION CHART for the corresponding machine model.

Note 3: When the lubricating oil is specified on the LUBRICATION CHART, always use the specified oil.

2. Methods of Lubrication and Inspection

2-1. Hydraulic Power Unit



Oil Specification	HM32 Typical Brand: Mobil DTE 24 Oil Light
Quantity	45 liter (11.9 gal) After filling up, operate the machine once and then replenish the oil.
Oil Change Interval	Change every 2,000 hours of operation - Once every 10 months for 200 hours of operation per month - Once every 4 months for 500 hours of operation per month

Note 1: When the oil level drops below the specified level, an alarm results. However, if this alarm occurs, power supply to the machine is cut off which will then cause problems for machine operation. Therefore, the oil level must be checked before the start of the operation.

Note 2: For operations of the hydraulic power unit, refer to Section 5.

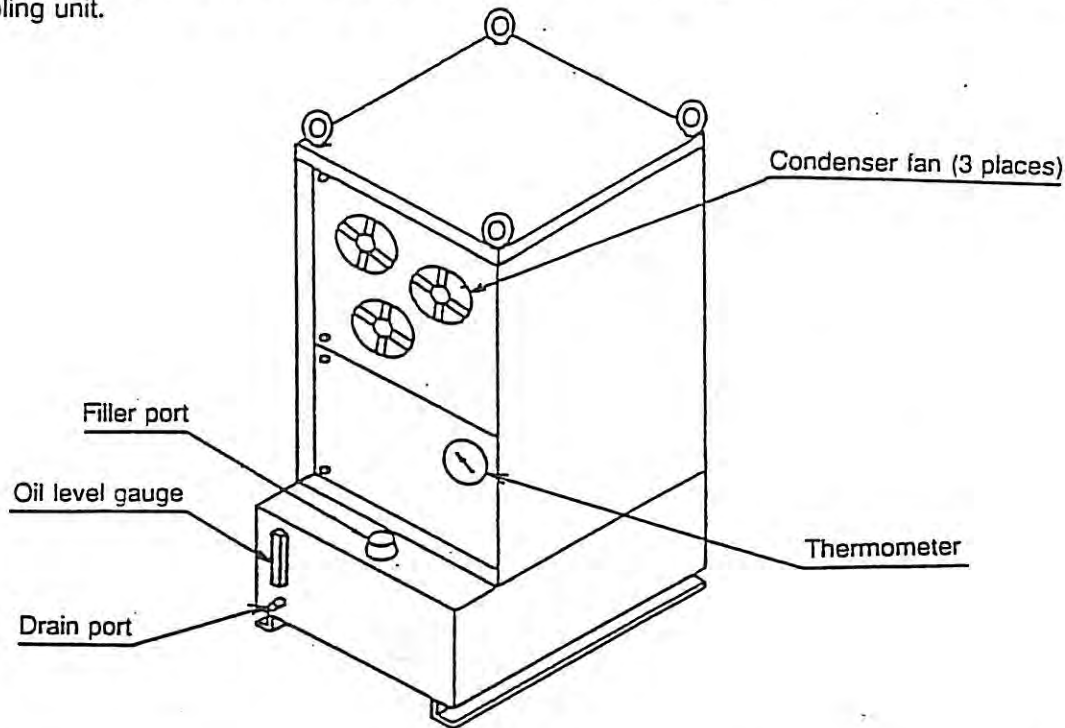
For detailed operation procedures, refer to the appended instruction manual for the hydraulic power unit.

Note 3: In the environment where ambient temperature is lower than 10°C (50.0°F), use hydraulic oil of FC22 (viscosity index of 140 or higher).

2-2. Spindlehead Lubricating Oil Cooling Unit

The lubricating oil cools the spindlehead.

The lubricating oil in the tank is pumped and fed to the spindlehead through the lubricating oil cooling unit.



Oil Specification	FC2 Typical Brand: Mobil Velocite Oil No. 3
Quantity	42 liter (11.1 gal) After filling up, operate the machine once and then replenish the oil.
Oil Change Interval	Change every 2,000 hours of operation - Once every 10 months for 200 hours of operation per month - Once every 4 months for 500 hours of operation per month

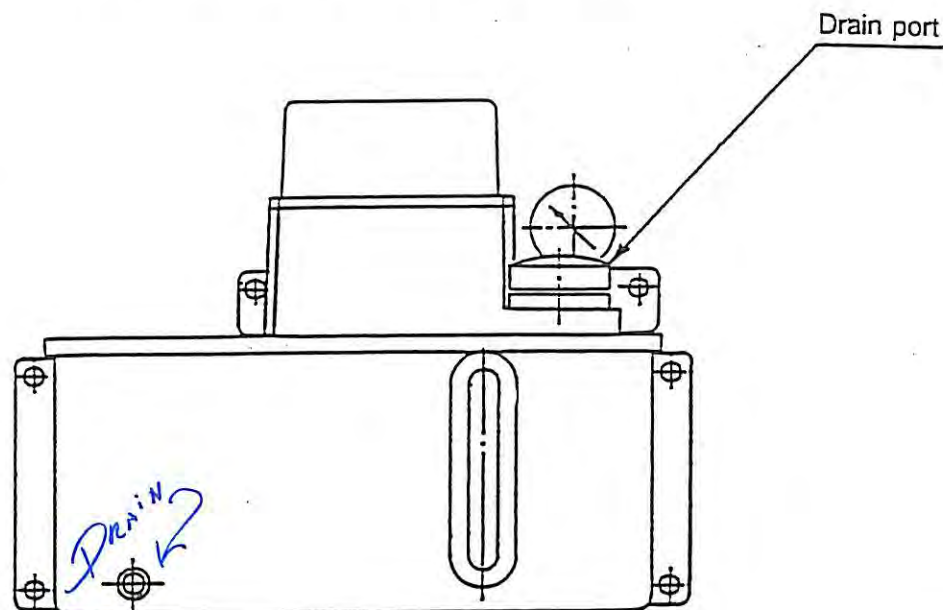
Note 1: When the oil level drops below the specified level, an alarm results. However, if this alarm occurs, power supply to the machine is cut off which will then cause problems for machine operation. Therefore, the oil level must be checked before the start of the operation.

Note 2: Use of lubricating oil other than those specified in the LUBRICATION CHART may lead to poor cooling performance.

SECTION 3 PREPARATION OF MACHINE FOR OPERATION

2-3. Centralized Lubrication Unit

The centralized lubrication unit, mounted at the side of the magazine, feeds lubricating oil to the guideways. When power is turned on, the unit pump operates at a predetermined time interval to provide an intermittent supply of oil to the guideways of X-, Y- and Z-axis, magazine link and ATC unit through the metering valves mounted on the spindlehead.



Oil Specification	G68 Typical Brand: Mobil Vacira Oil No. 2
Quantity	6 liter (1.6 gal)
Oil Change Interval	The lubricating oil might be consumed rapidly depending on timer setting or if the machine is operated of a long time continuously. Check the lubricating oil level and replenish as needed. The reservoir has a float switch which gives a warning signal when the level becomes low.

Note 1: For alarms concerning lubrication, refer to 3. "Lubrication Warning System - Lubrication Alarm".

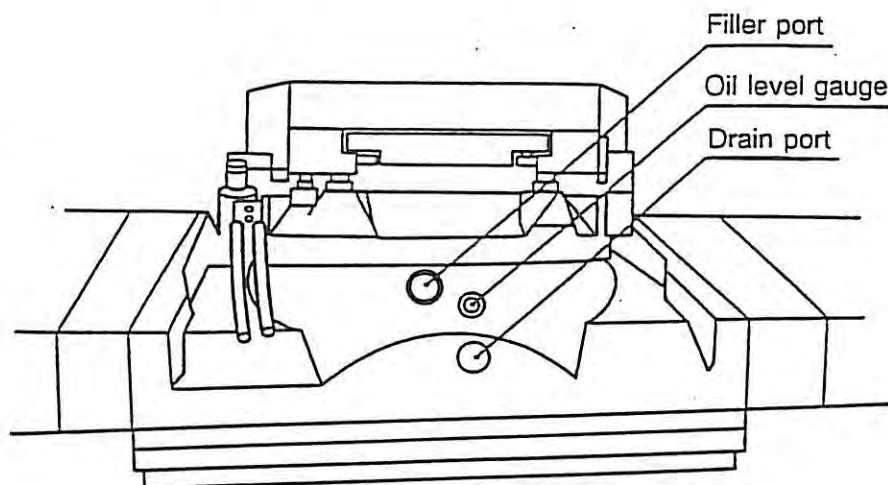
Note 2: For instructions on lubricating oil filling, refer to 4. "Manual Lubrication".

Note 3: For timer setting procedure, refer to 5. "Automatic Centralized Lubrication".

SECTION 3 PREPARATION OF MACHINE FOR OPERATION

2-4. Table (Pallet) Drive Gearbox

The table or the pallet is driven by the combination of the worm and worm wheel. If they are not lubricated well, the service life will be considerably shortened due to rapid wear of them. Therefore, the lubricating condition of them should be checked carefully.



	MC-400H 1°/5° table	MC-400H NC rotary table
Oil Specification	CC150 Typical Brand: Mobil Gear 629	G68 Typical Brand: Mobil Tonna Oil T68
Quantity	Approx. 4 liter (1.1 gal)	Approx. 4.5 liter (1.19 gal)
Oil Change Interval	Change every 2,000 hours of operation. - Once every 10 months for 200 hours of operation per month - Once every 4 months for 500 hours of operation per month	

2-5. Oil Filling to Lubricator

Fill the lubricator of the air control unit for the ATC and tool clamp/unclamp cylinder with the specified lubricating oil.

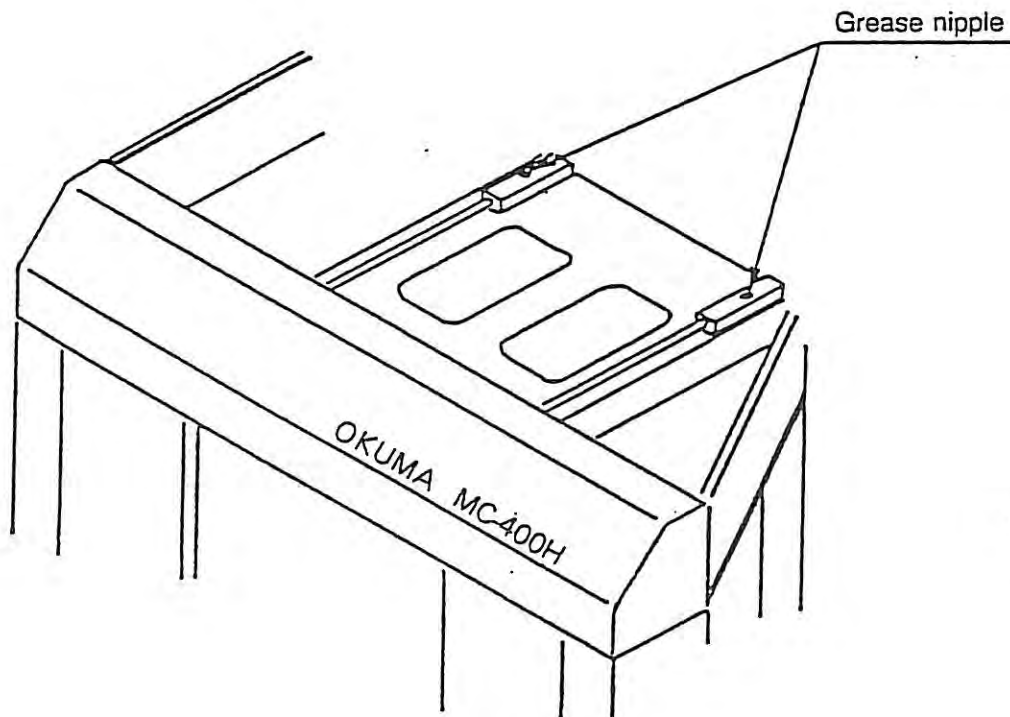
If the lubricating oil in the lubricator is not sufficient, it will cause rusting.

Oil Specification	68 ^{or} <u>HM32 DTE 24</u> Typical Brand: Mobil Vactra Oil No. 2
Quantity	0.05 liter (0.013 gal) Check every day and supply as needed.

Note: Supply the specified lubricating oil from the filler port on the lubricator after releasing the air pressure while the machine is at a still.

2-6. ATC Cover Guide

Apply grease to the ATC cover (at the upper face of splash guard guide) through the grease nipples on the right and left sides of it every three months.



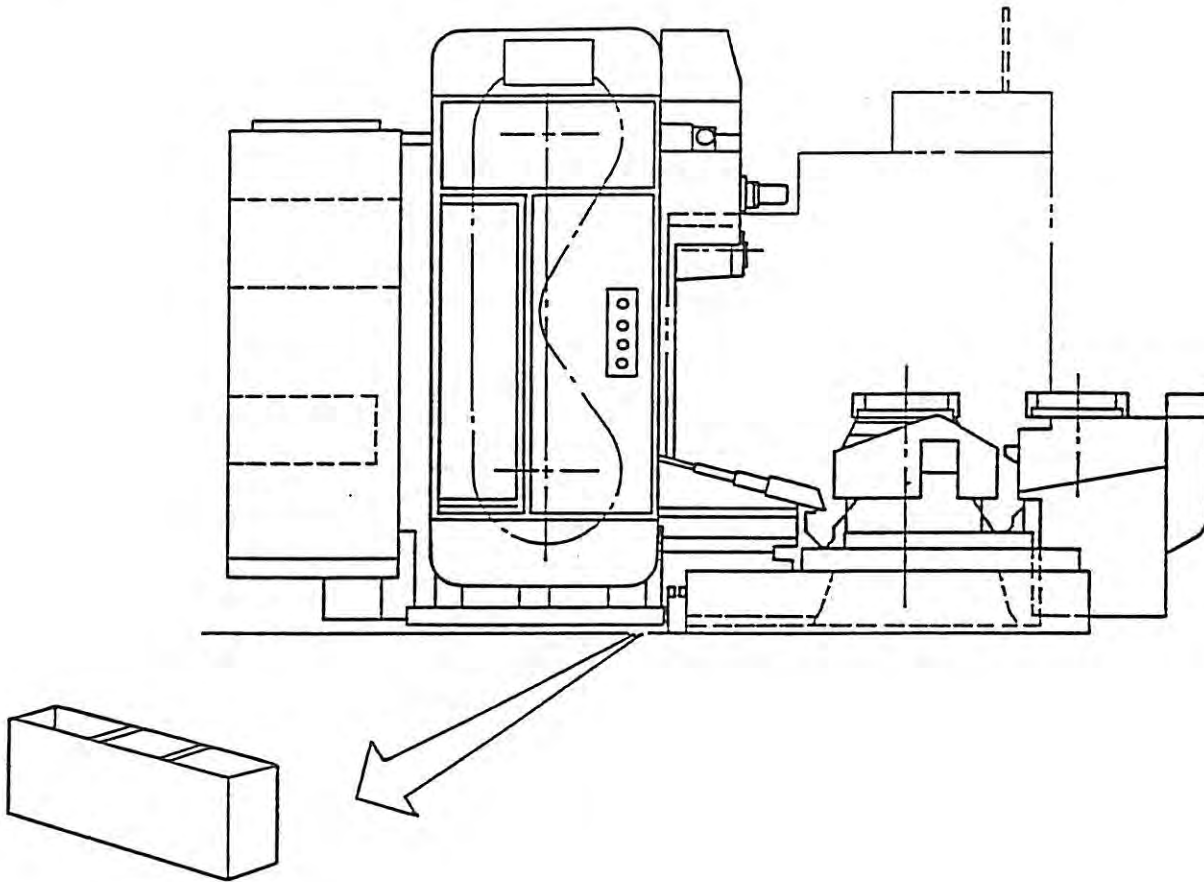
Oil Specification	XM2
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2-7. Lubricating Oil Drain Tanks

Lubricating oil supplied to the X-, Y- and Z-axis slideways from the centralized lubrication unit is collected to the drain oil tanks at the side of the coolant tank through the drain oil passage around the bed.

Capacities of the drain tank is about 6 liters (1.6 gal).

When the centralized lubrication unit is replenished, discharge the drained lubricating oil.



3. Lubrication Warning System - Lubrication Alarm

Poor lubrication affects machine accuracy and causes breakdowns. As a safeguard, the automatic centralized guideway lubrication system is provided with the following warning devices.

(1) Low Oil Level in Tank

An alarm is displayed when the level in the tank drops below the lower limit.

(2) Low Lubrication Pressure

A pressure switch is used to detect the pump output pressure. Switch actuation is checked when the pump is set into operation. If pressure does not rise, an alarm is displayed.

(3) Excessive Lubrication Pressure

The above pressure switch is used to detect pump stoppage and whether pump output pressure has dropped to the specified level. If pressure does not drop, an alarm is displayed.

(4) Tripping of Overload Protective Relay of the Centralized Lubrication System Pump Motor

When any of the above four alarms takes place, the alarm message is displayed with a three-digit alarm number on the CRT. Note that even when an alarm (1) takes place, operation from the programmed commands continues.

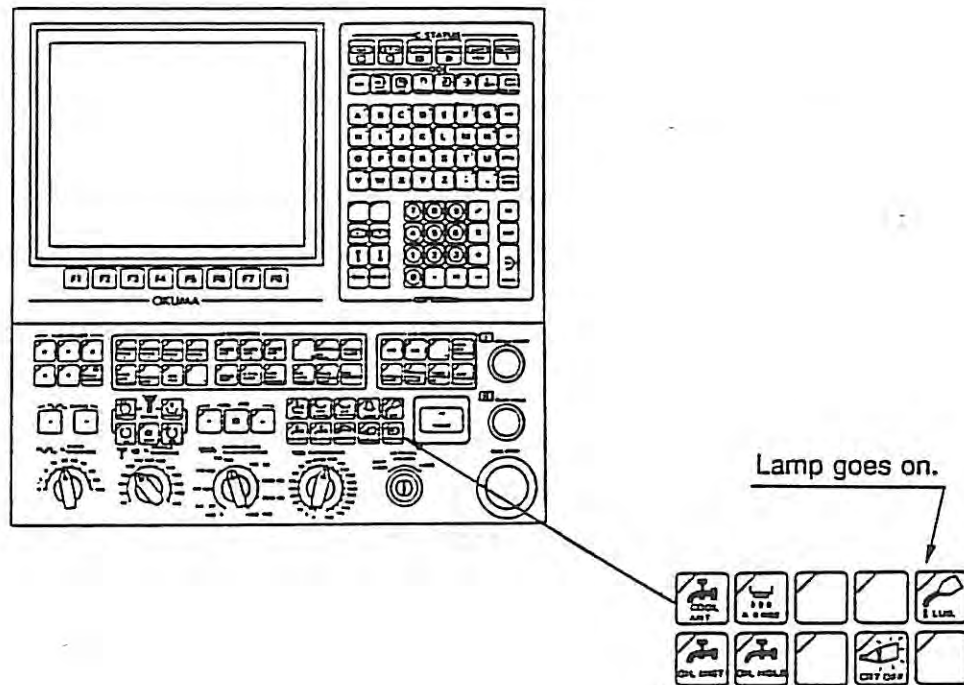
Alarm No.	Alarm Message	How to Reset
910	Axis lube level low	Replenish with specified oil.
543	Axis lube pressure ON confirmation	Inspect the lubrication unit and take necessary measures so that correct pump output pressure can be obtained.
544	Axis lube pressure OFF confirmation	Inspect the lubrication unit and take necessary measures so that correct pump output pressure can be obtained.
542	Axis lube motor overload	Reset the tripped overload relay.

If an alarm occurs, check the contents of the alarm. Take necessary measures to reset the alarm so that machine accuracy will not be affected and serious trouble may be prevented. Then proceed to the next operation.

4. Manual Lubrication

Since the machine is provided with the automatic lubrication unit, manual lubrication is not usually required.

Manual mode lubrication is also used before starting operation, in cold weather, after long rests or whenever lubrication seems insufficient. Press the **LUB.** key; this starts the lubrication unit pump and feeds the lubricating oil to each lubricating point at the preset timing intervals. For the time setting procedure refer to 5. "Automatic Centralized Lubrication".



5. Automatic Centralized Lubrication

5-1. Pump Off-Time Display

The time interval of the automatic lubrication cycle, that is, the duration of "OFF" time, is set as a parameter in the CNC system. Before shipment, "OFF" time is usually set to 10 minutes and "ON" time for pump actuation to a fixed 60 seconds.

"OFF" time is displayed on the CRT of the pendant operation panel by the following procedure:

MC USER PARAMETER (WORD)		(1) Press the PARAMETER key on the operation panel.
No.		(2) Press function key [F7] (ITEM) until the display as shown left appears.
1	AXIS LUBE TIME 10	(3) The data given as the AXIS LUBE TIME is the lubrication interval expressed in minute units.
2	CROSSRL LUBE TIME 00	
3	AXIS PUMP TIME 60	

5-2. Parameter Data Setting for the Automatic Lubrication Timer

(1) Check to see the current time interval of the automatic lubrication cycle according to 5-1. described above.

(2) Locate the cursor to the data given as the **AXIS LUBE TIME**.

(3) Press the function key [F1] (SET).

Character "S" will be displayed on the 21st line of the CRT.

(4) Key in the time interval data in units of minutes.

Keyed in data is displayed following the character "S" on the 21st line.

(5) Press the **WRITE** key.

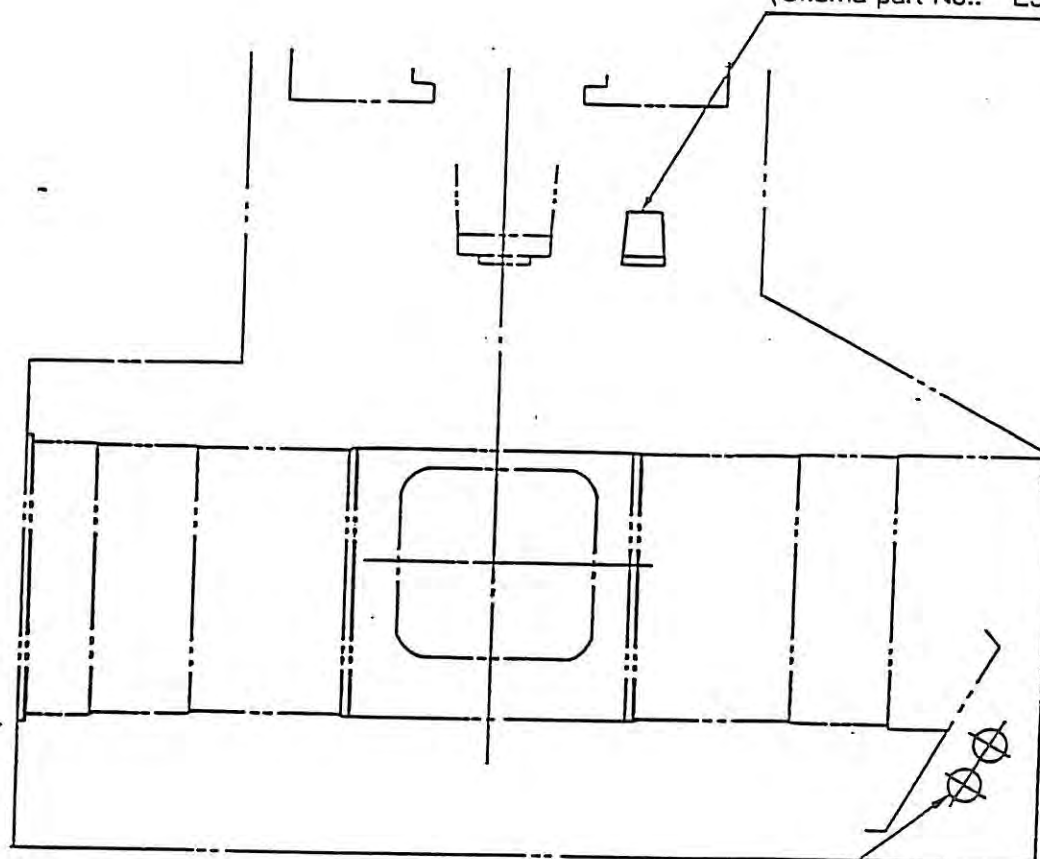
This renews the **AXIS LUBE TIME** data.

Reference: Time setting range is indicated below.

No. 1	AXIS LUBE TIME	0 to 120 minutes
No. 2	CROSSRL LUBE TIME	0 to 120 minutes
No. 3	AXIS PUMP TIME	15 to 60 minutes

2-16. Work Lamp

Work lamp
Mini-halogen bulb STH35340-17
12 V, 50 W Matsushita
Lamp life: 2,000 hr
(Okuma part No.: E3589-800-001)



(Okuma part No.:
50 Hz E3534-490-013
60 Hz E3534-490-012)

Work lamp
Fluorescent lamp FT-22084K (Lamp FL20S×2)
100V, 20 W Toshiba
Lamp life: Approx. 7,500 hr

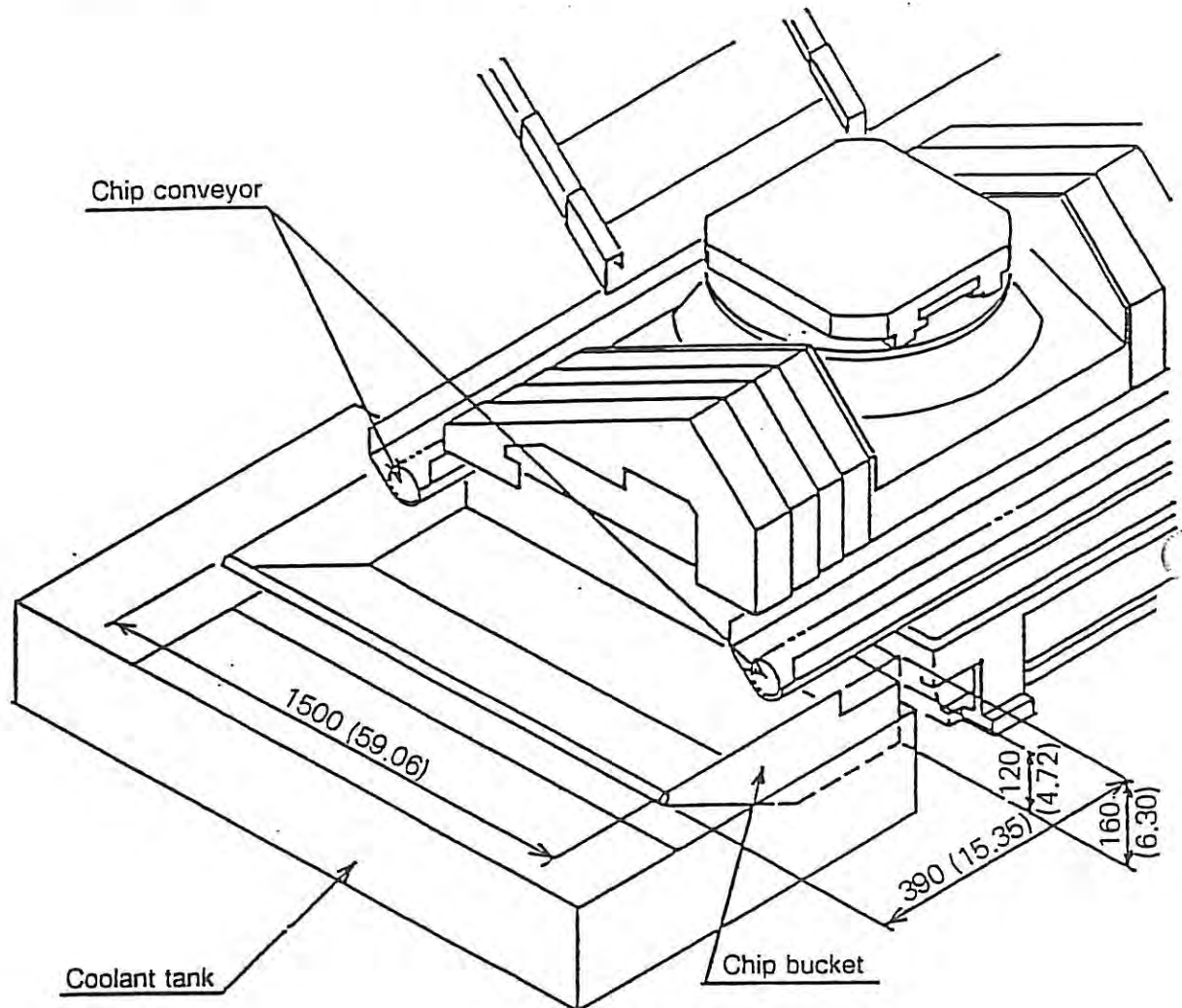
This work lamp is turned on and off by a switch on the main operation panel.

2-15. Chip Bucket (Standard)

Chip bucket is not supplied when a lift-up conveyor is selected.

Chips discharged from the chip conveyor are accumulated in this chip bucket.

Chip bucket capacity is about 75 liters (19.8 gal).

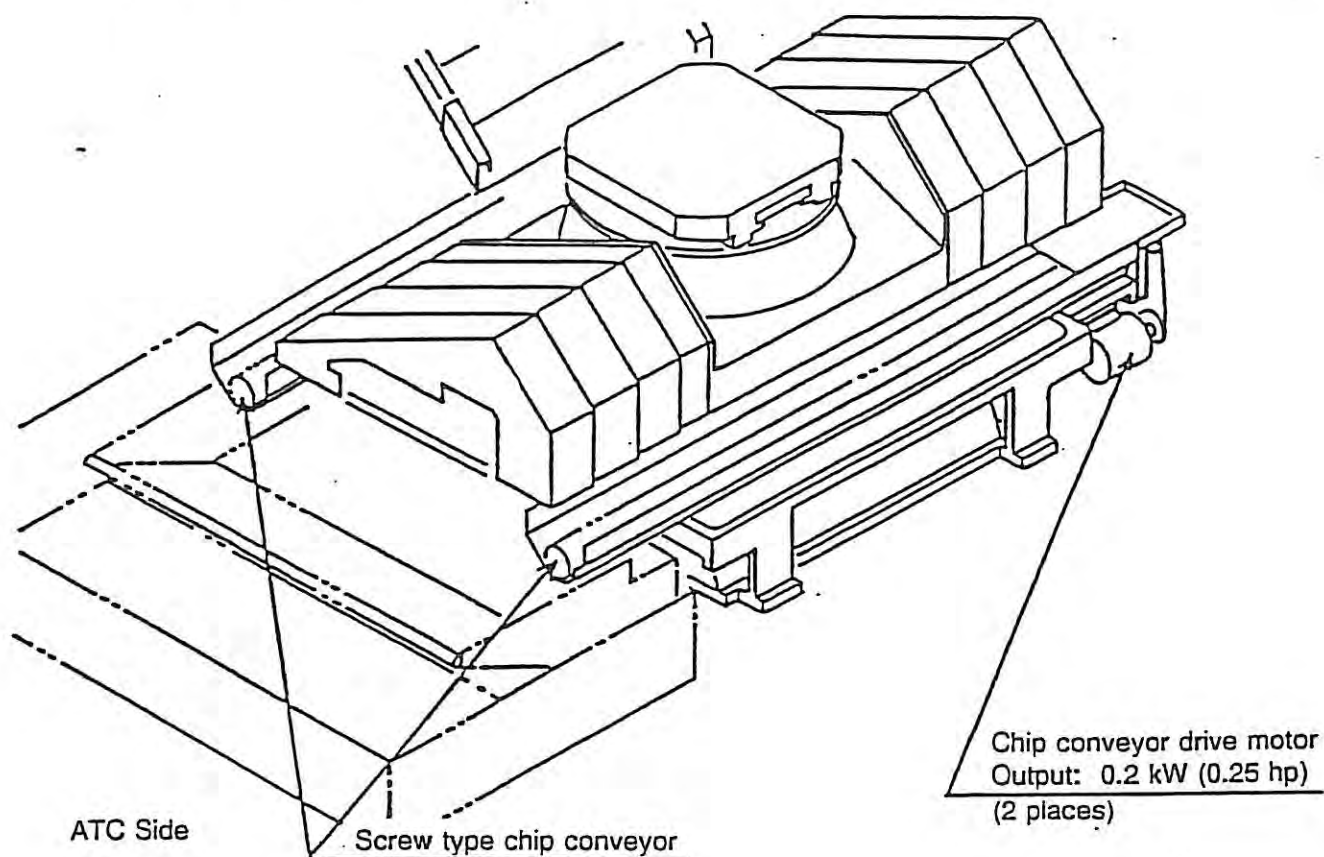


Due to chip conveyor arrangement, chips will accumulate at both ends of the chip bucket; remove chips from the chip bucket when chips accumulate on them.

This construction is not adequate for aluminum material or workpiece material which generates large volume of fine chips.

2-14. Chip Conveyor

The machine is equipped with screw type chip conveyors at the front and the rear of the table. The chip conveyor is so installed to permit the coolant to flow to the ATC side to be returned to the coolant tank. Chips are discharged to the ATC side by the rotation of the screws and accumulated in the chip bucket.



While the machine is operating, continuously operate the chip conveyor to prevent excessive accumulation of chips on the conveyor.

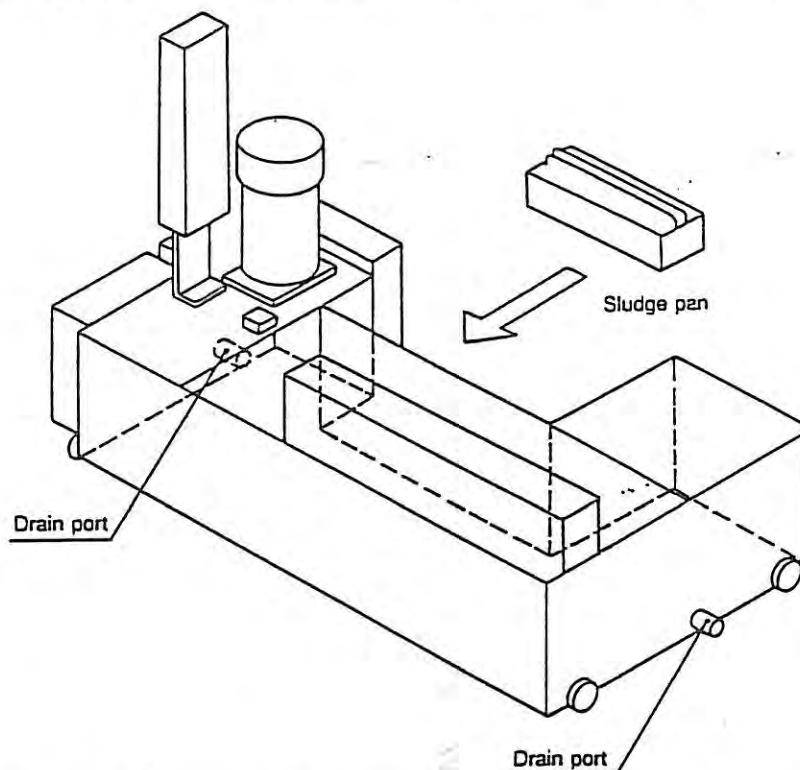
In case the chip conveyor has stopped due to accumulation of excessive amount of chips, repeat the forward and reverse operation of the chip conveyor. This allows the accumulated chips to be removed and the chip conveyor can operate normally.

If the enclosure shield is opened at the operator side, chip conveyors stop operation for safety.

Screw rotation speed	12.5 rpm
Chip transfer amount	20 liter/min (5.3 gpm)

(3) Cleaning

Clean the coolant tank periodically according to the machine operating conditions.



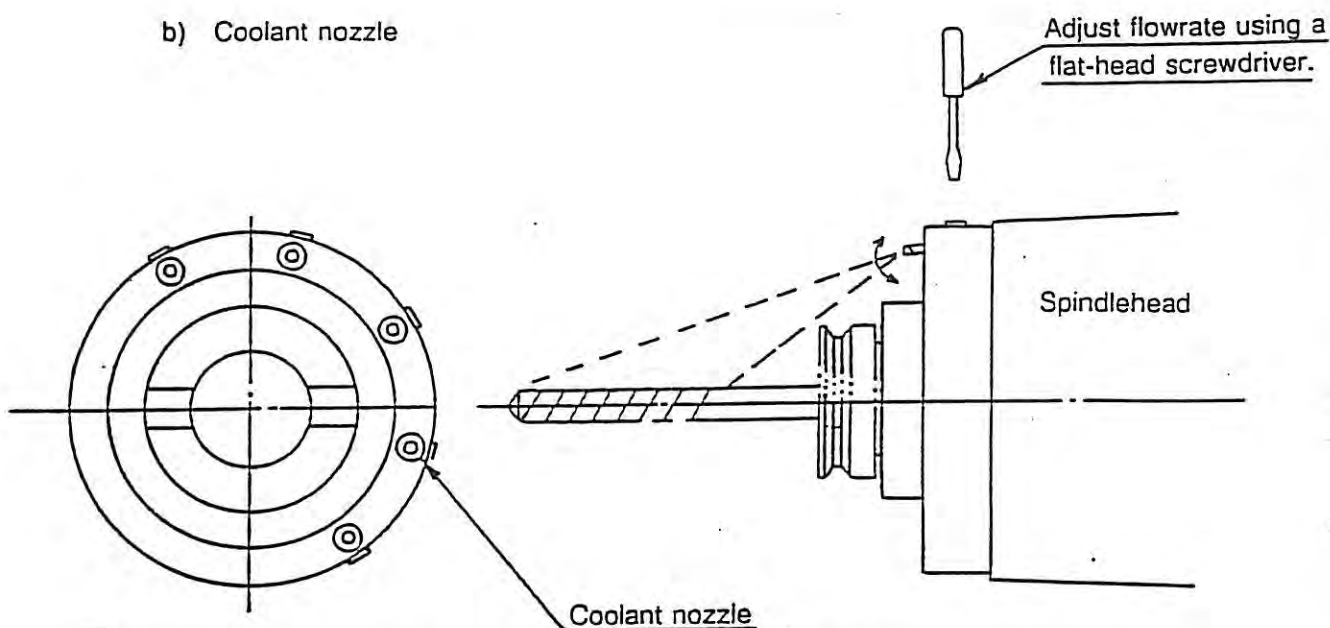
Inside the tank at the tank opening, there is a sludge pan with handles. Lift the pan and discard the accumulated sludge.

Also clean the tank inside periodically.

CAUTIONS

Prime the pump before starting the coolant supply system after replacing the coolant or after a stop of the coolant supply system for a long time.

b) Coolant nozzle



- 1) Five coolant nozzles are arranged on the spindlehead.
- 2) The use of flexible nozzles permits easy angle setting.
- 3) Setting the five nozzles with different angles so that the coolant will be supplied at different points, frees the operator from nozzle setting each time tools are changed.
- 4) Coolant supply amount from the nozzles is independently adjustable with a flat-head screwdriver.

CAUTION

For selection of coolant, consult its maker since some types of coolant may chemically damage packings, cause abnormal rusting of wipers, or cause other problems with parts used on this machine.

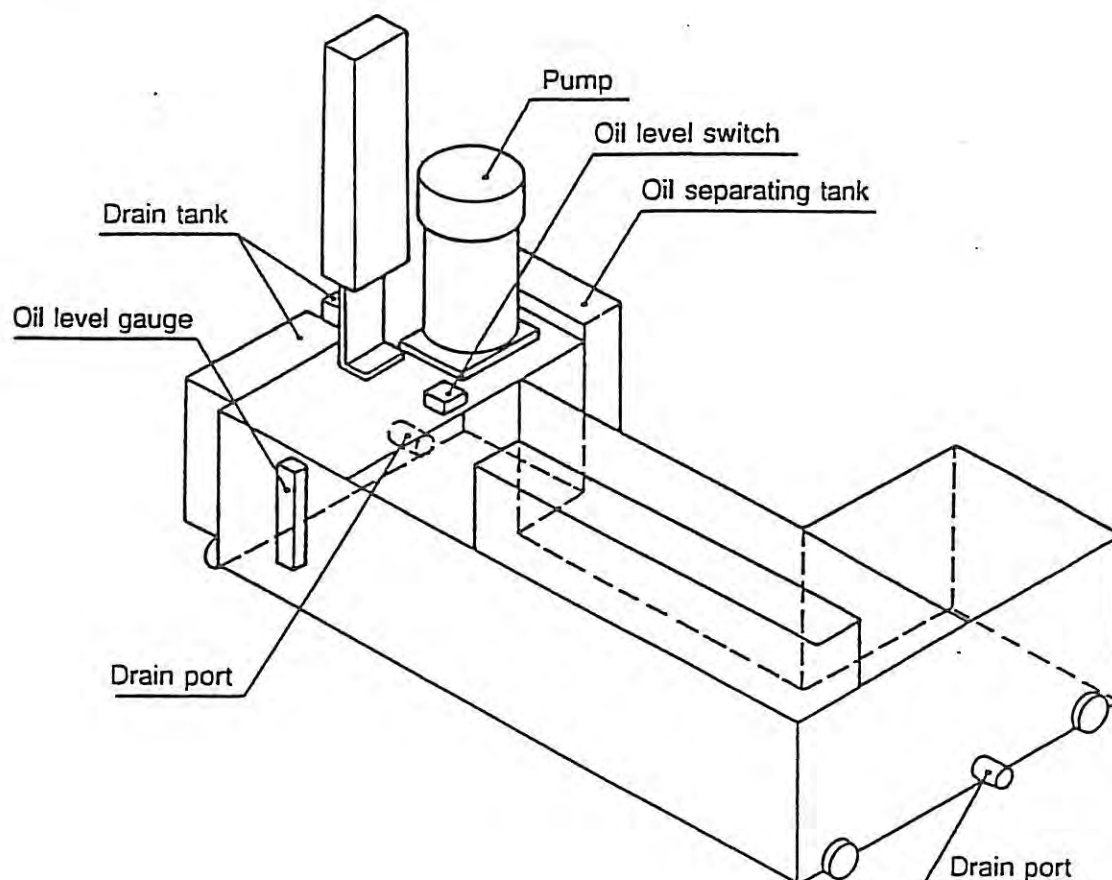
2-13. Coolant Supply Unit

(1) Specifications

		Standard	With lift-up conveyor
Coolant tank capacity		150 liter (39.6 gal) [Effective: 84 liter (23.2 gal)]	238 liter (9.4 gal) [Effective: 176 liter (46.5 gal)]
Coolant type		Water-soluble type Low viscosity non-soluble type	
Pump motor	Capacity	200 V, 50/60 Hz, 400 W (0.5 hp) Kyokuto Kikai LSW25A0. 4-280R	
	Delivery	150 liter/min (40 gpm)	
Float switch		WS32-2/235N (Willy Vogel)	
No. of coolant nozzles		5 (direction adjustable)	

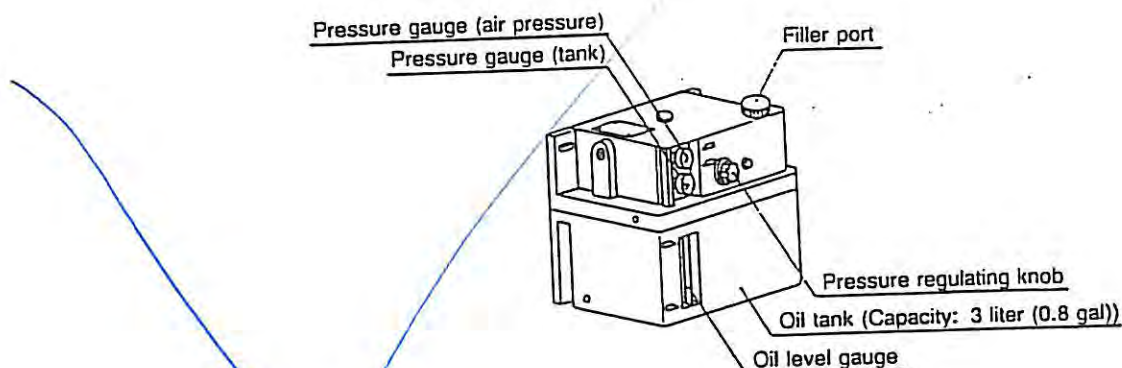
Note: For coating of the machine, acrylic system coating EX-B is used. Therefore, always use emulsion type water-soluble coolant. If a water-soluble coolant is used, coating might be attacked.

a) Coolant tank



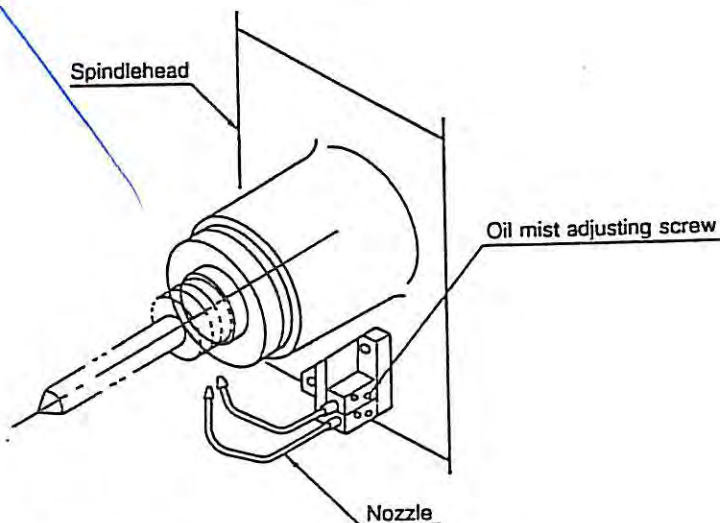
2-17. Oil Mist Coolant Supply System (optional)

(1) Spray Mist Tank



This tank is installed at the side of the magazine.

(2) Flexible Nozzle



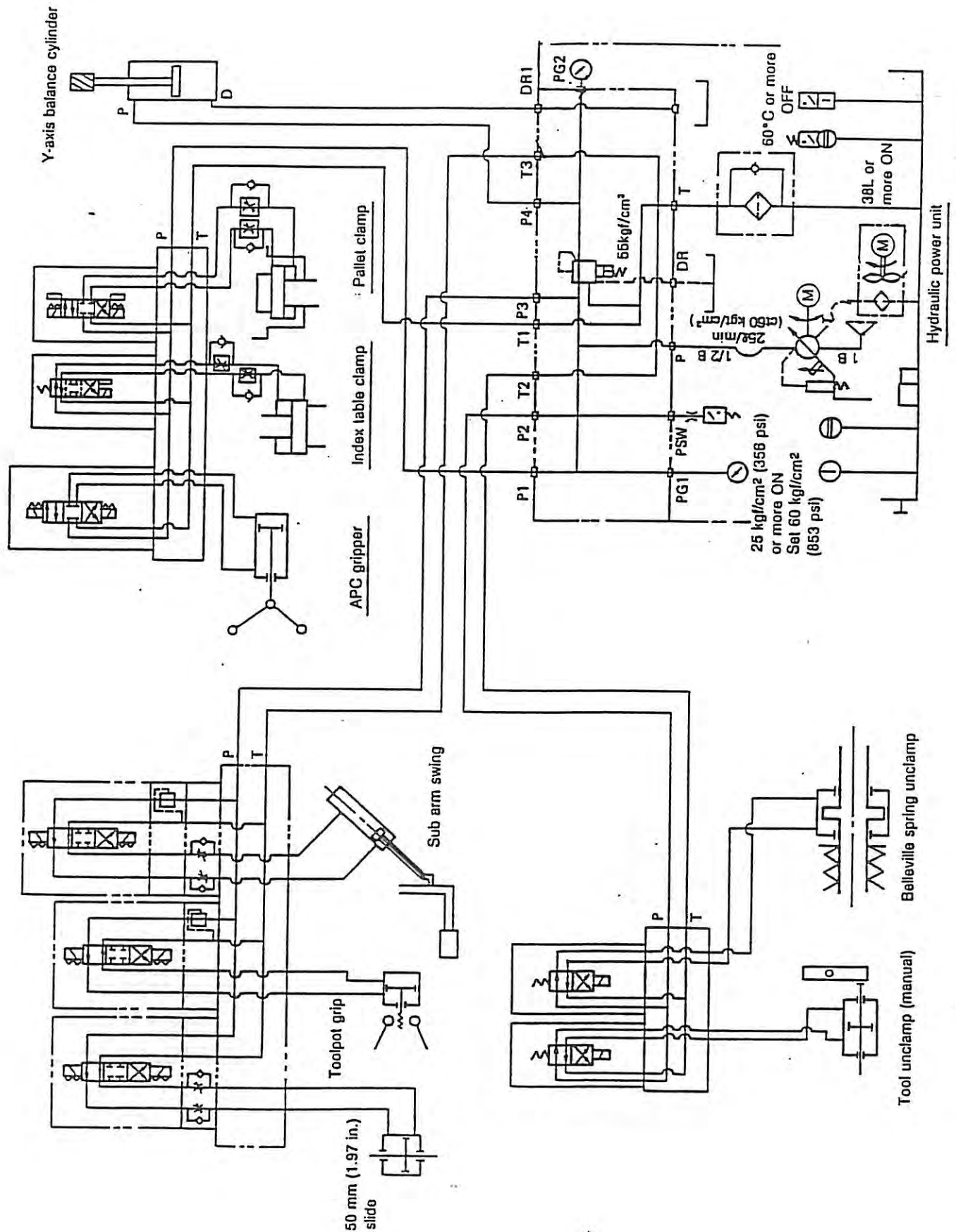
- Two nozzles are provided.
- The flexible nozzle can be bent freely, and coolant mist applied to any desired point.
- M codes used for turning ON/OFF oil mist coolant

M07	Oil Mist Coolant ON
M09	Oil Mist Coolant OFF

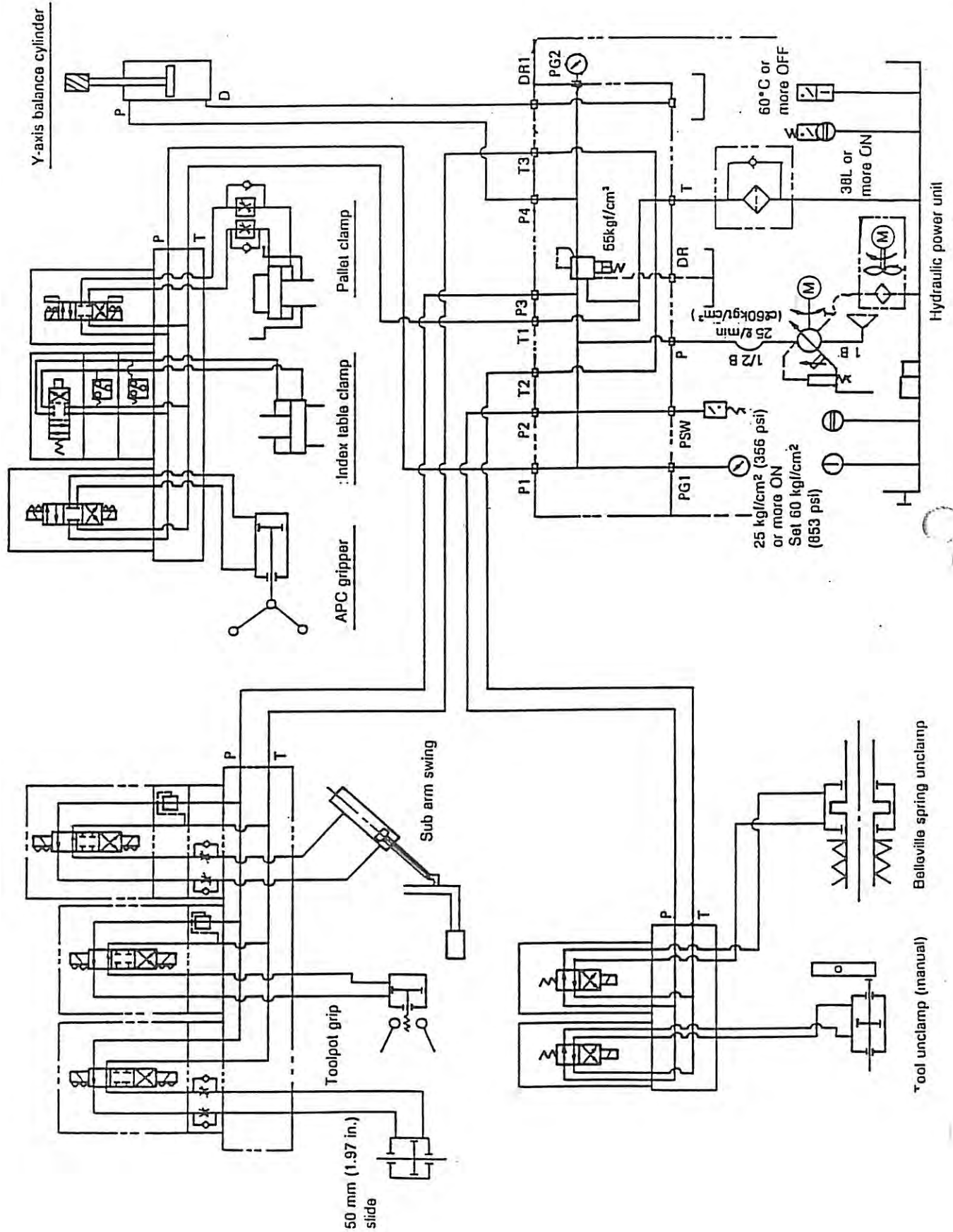
d) Replenishing coolant

Before replenishing coolant, stop air supply to the machine. Remove the filler hole cap and add coolant. Note that the machine must be stopped for coolant replenishing operation.

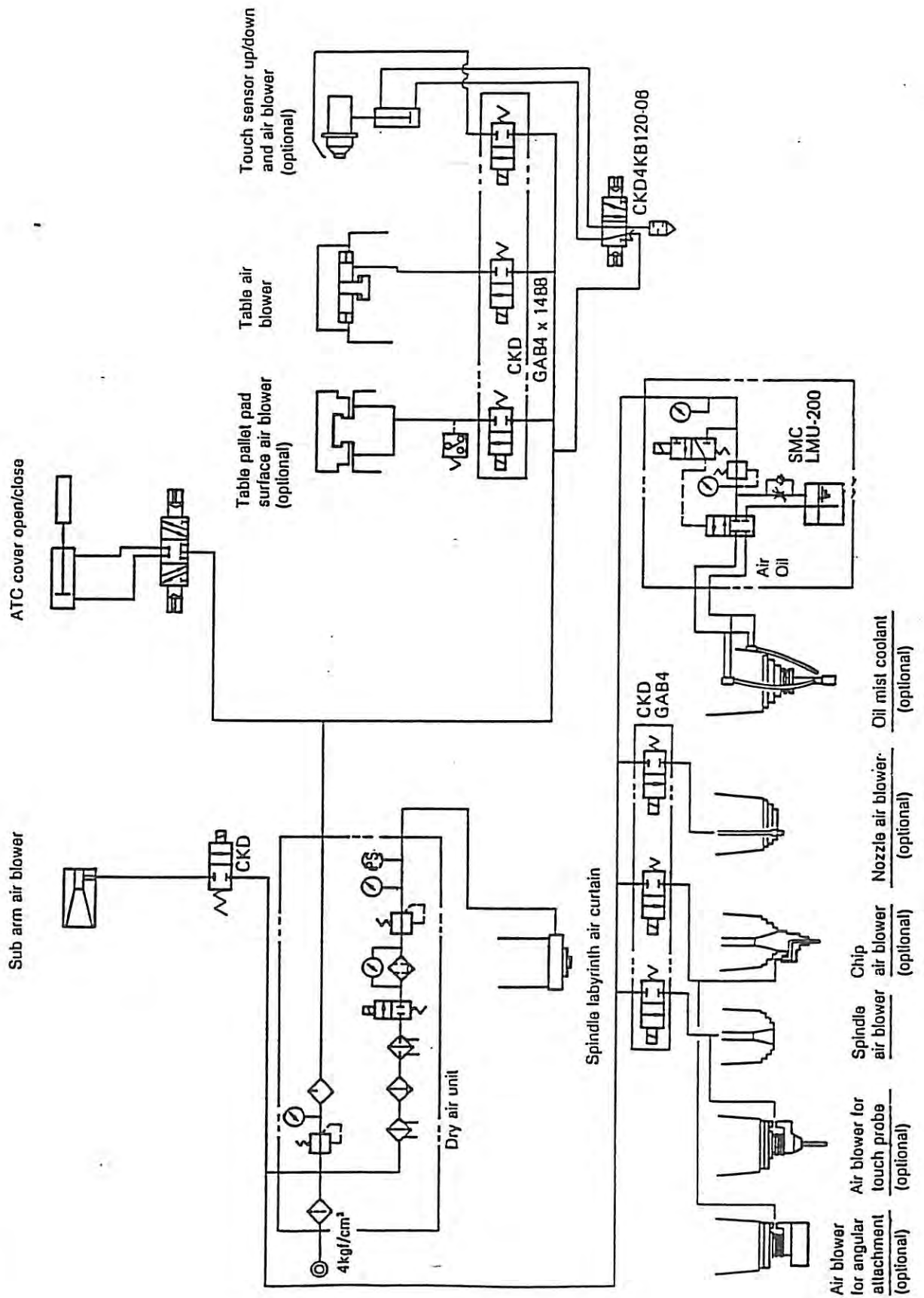
Hydraulic Circuit Diagram - 1°/5° Index Rotary Table



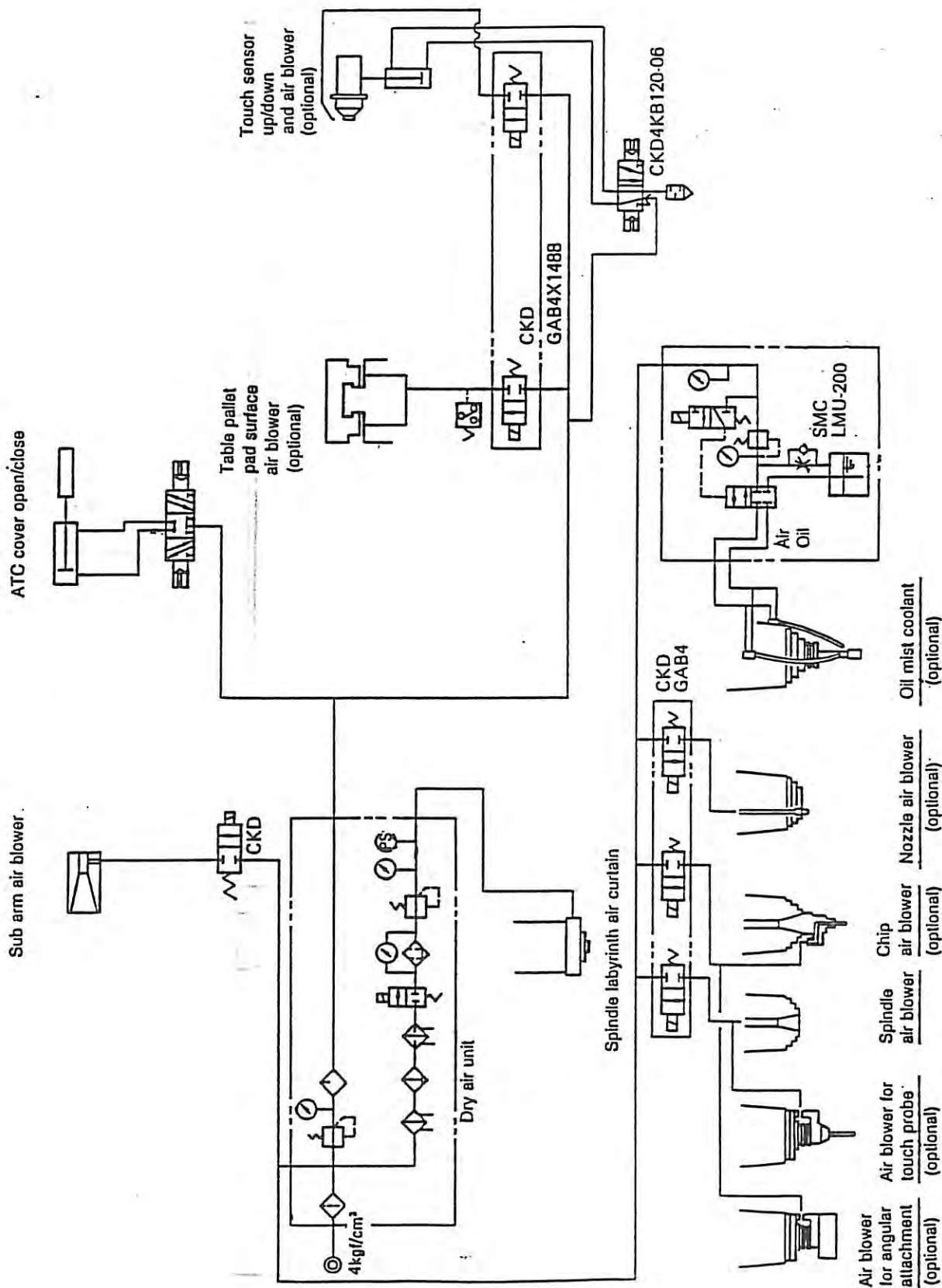
Hydraulic Circuit Diagram - NC Rotary Table



Pneumatic Circuit Diagram - 1°/5° Index Rotary Table

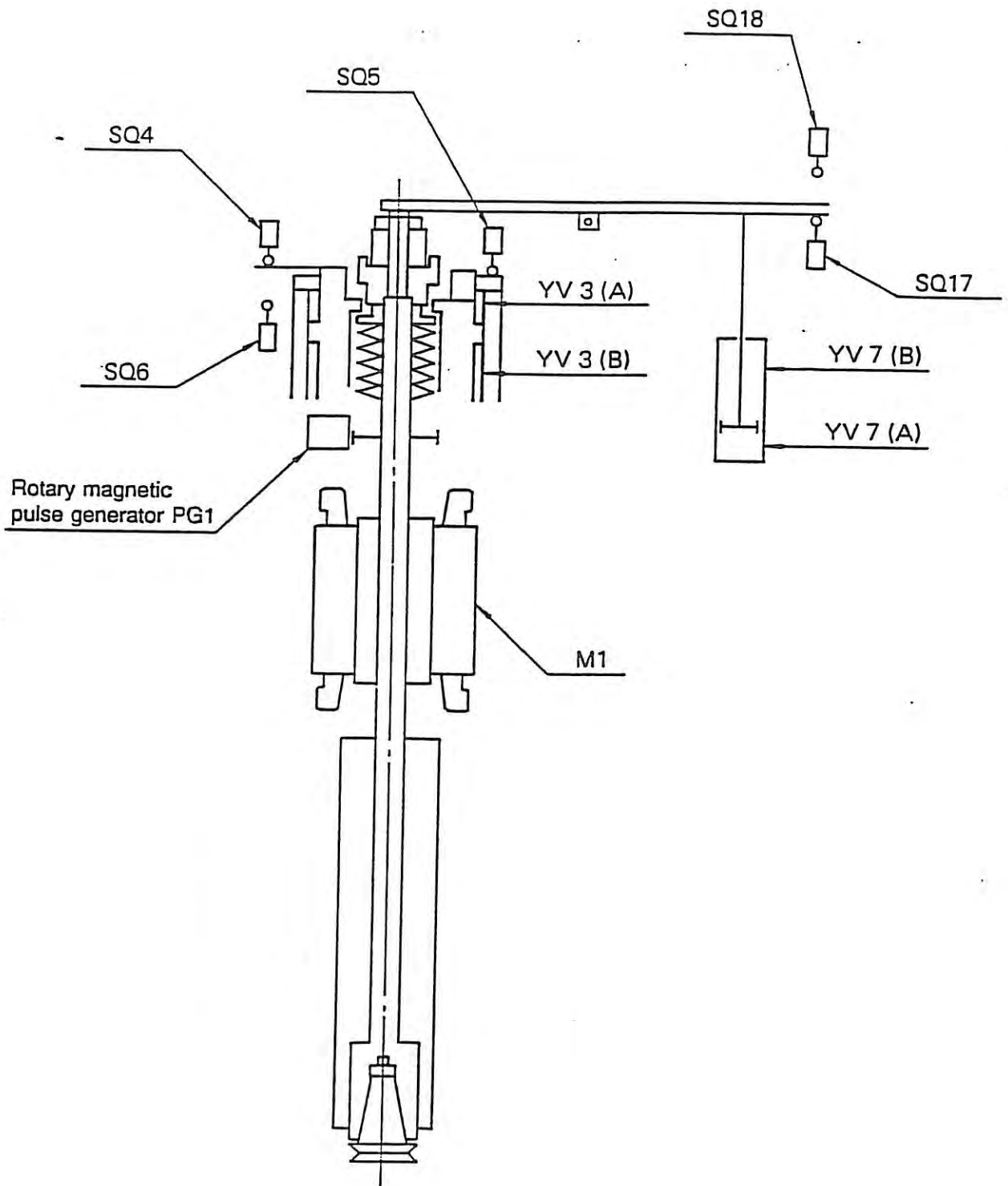


Pneumatic Circuit Diagram - NC Rotary Table

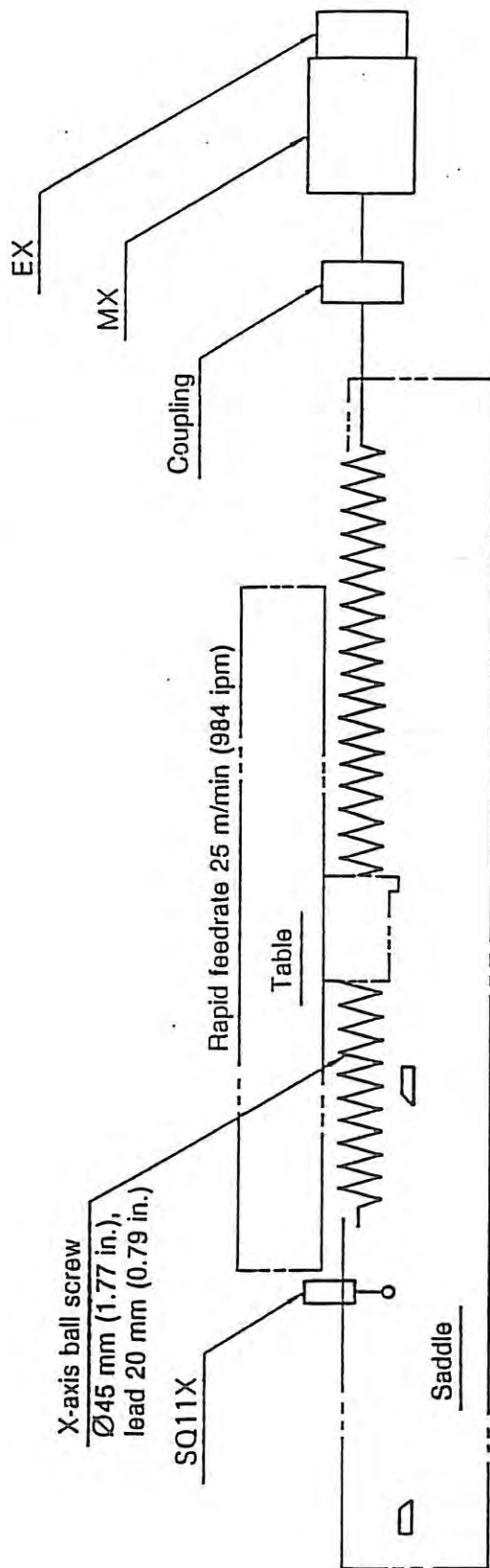


Skeleton Diagram - Spindle Drive Mechanism

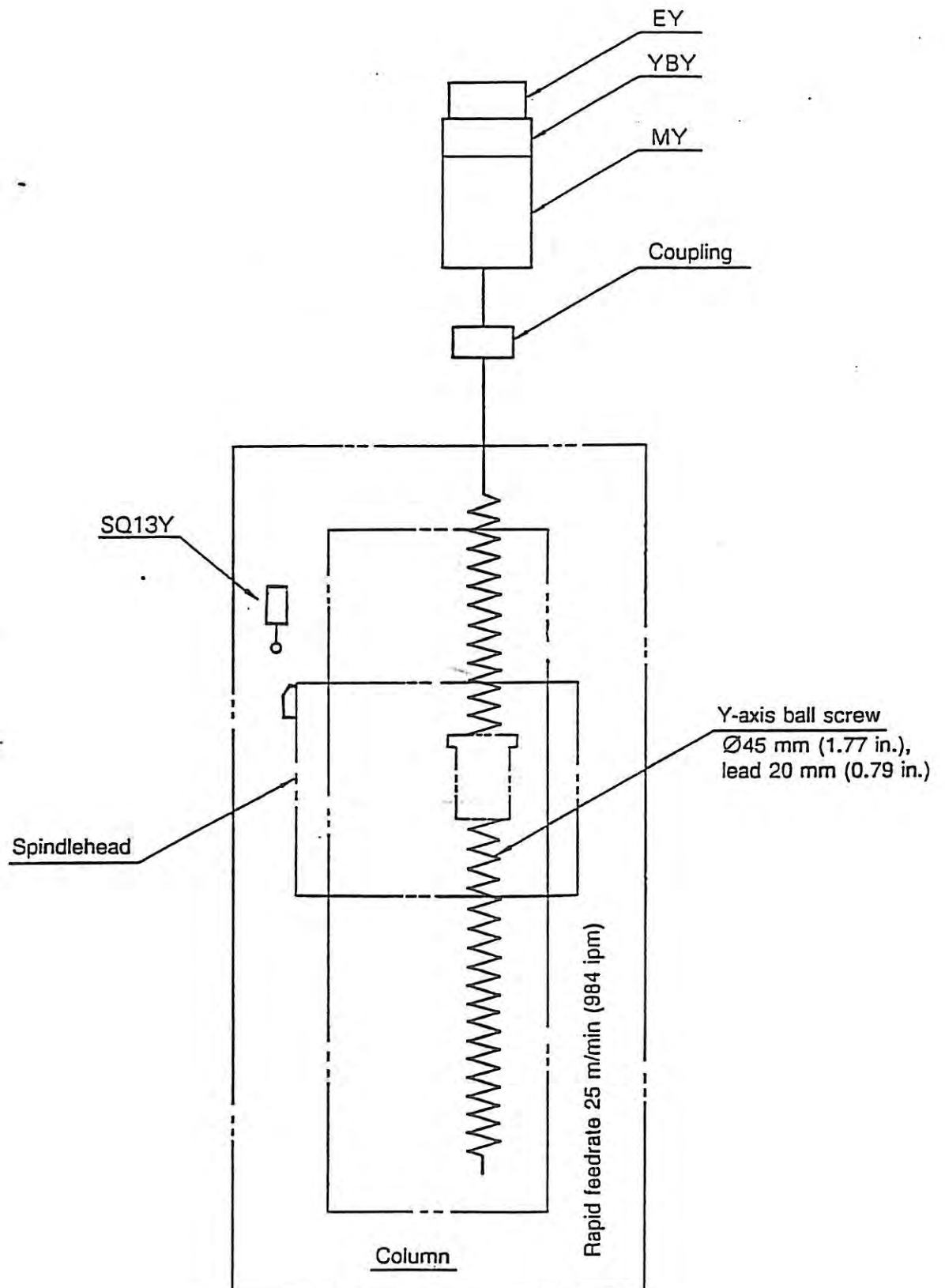
~~Sa-LS~~



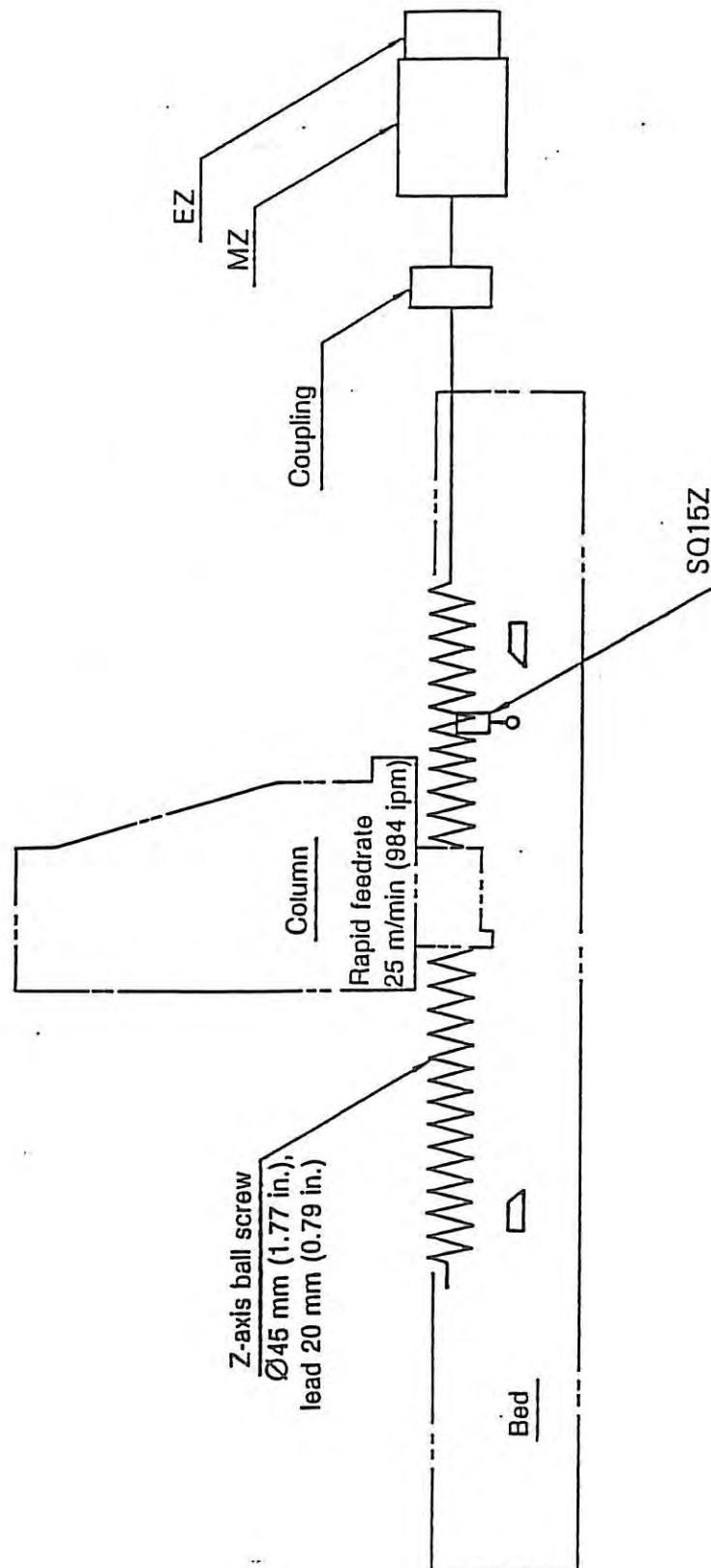
Skeleton Diagram - X-axis Drive Mechanism



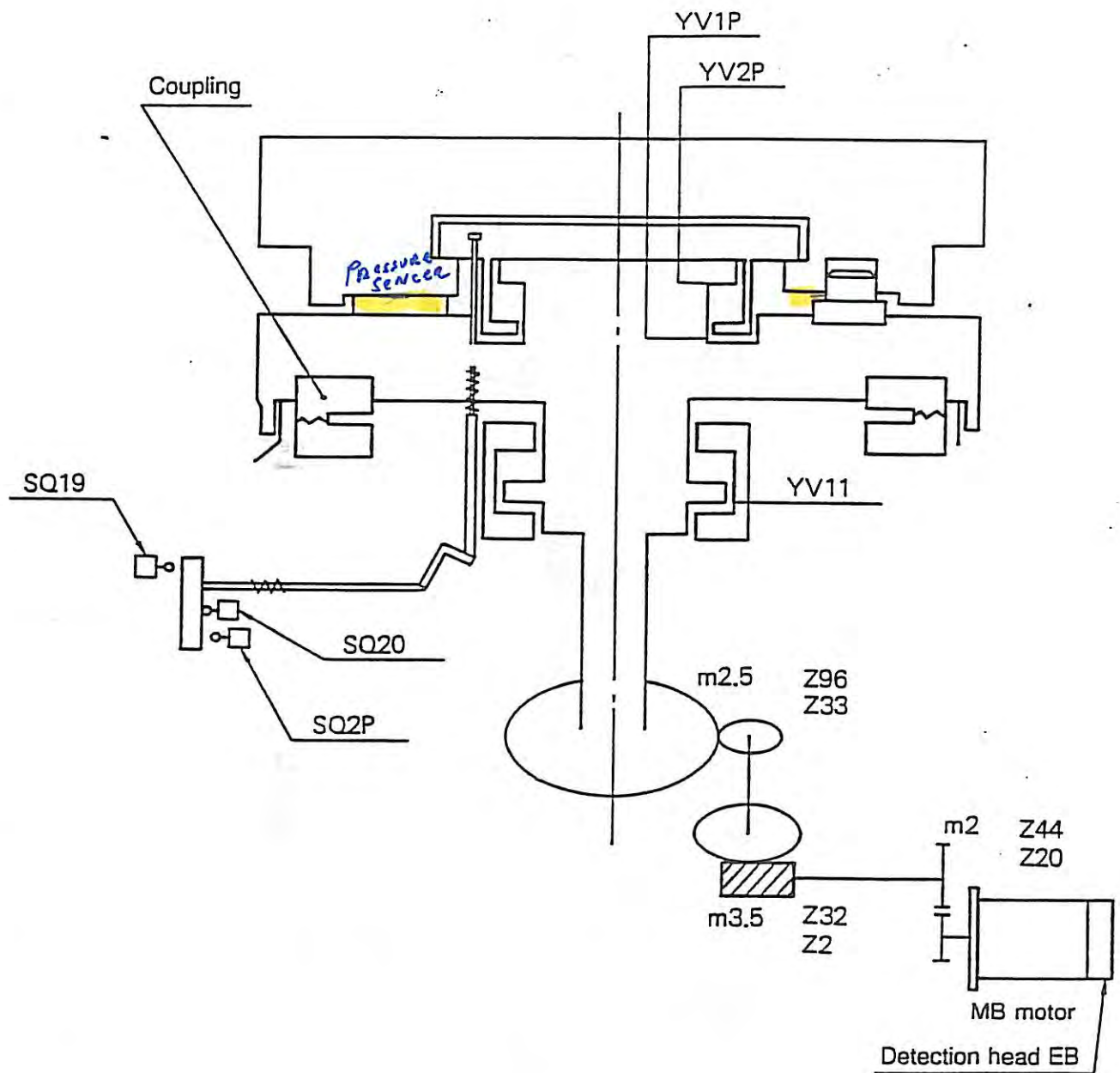
Skeleton Diagram - Y-axis Drive Mechanism



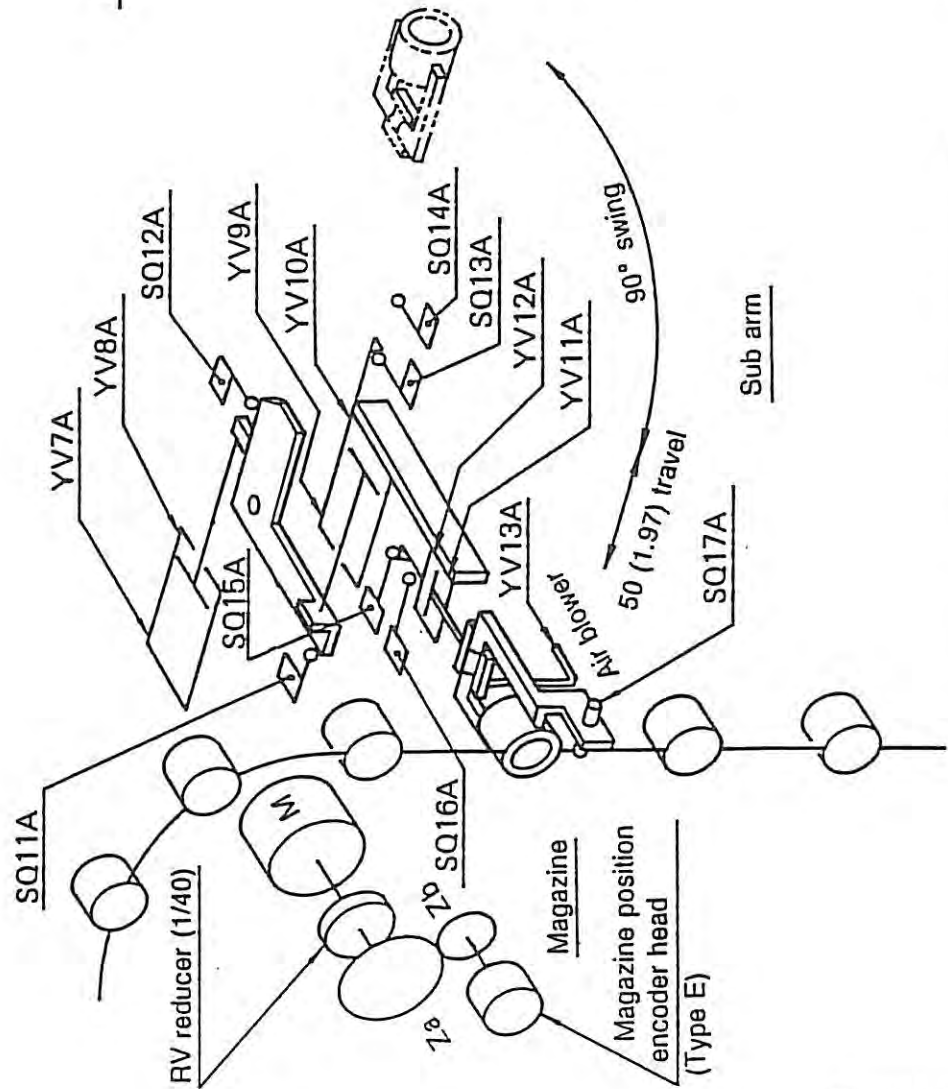
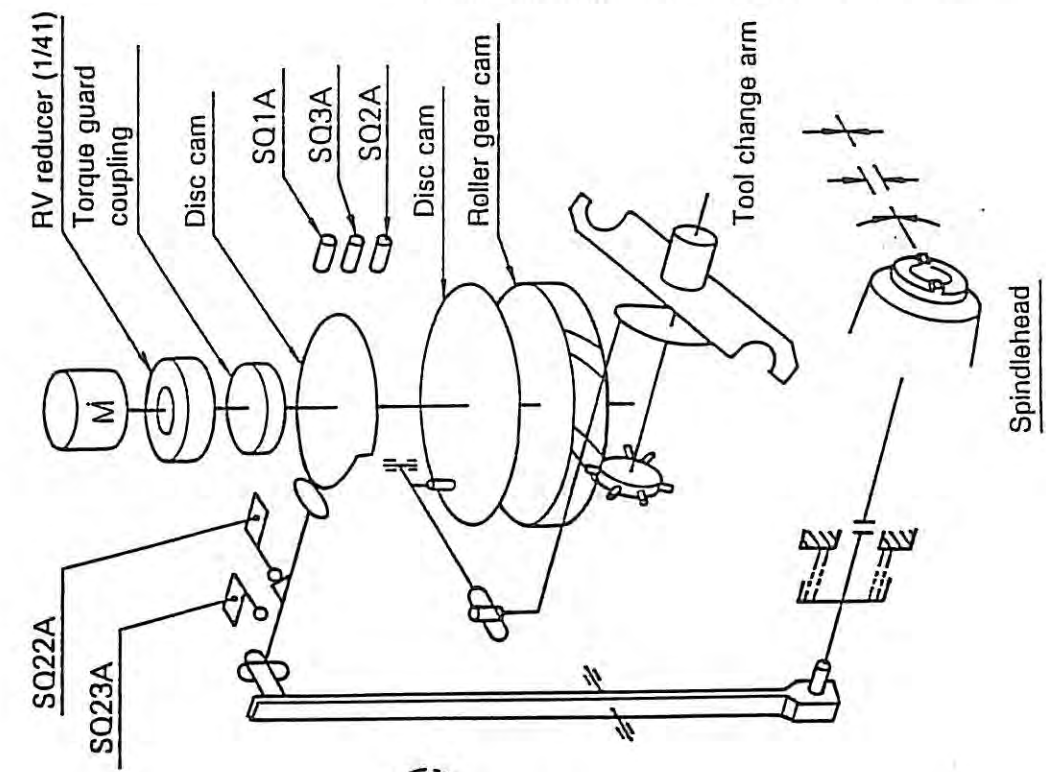
Skeleton Diagram - Z-axis Drive Mechanism



Skeleton Diagram - $1\frac{1}{5}^\circ$ Index Rotary Table

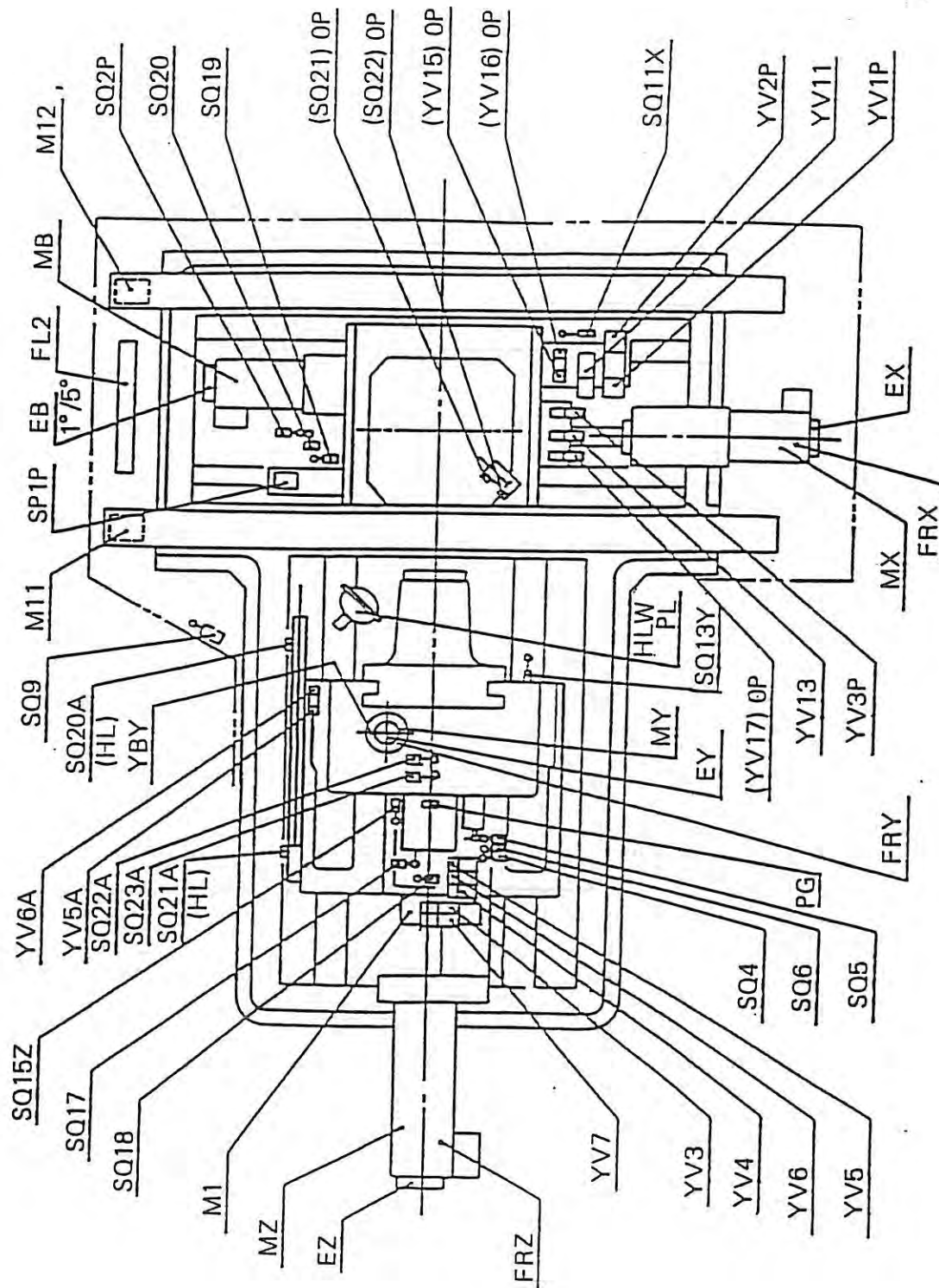


Skeleton Diagram - ATC Drive Mechanism

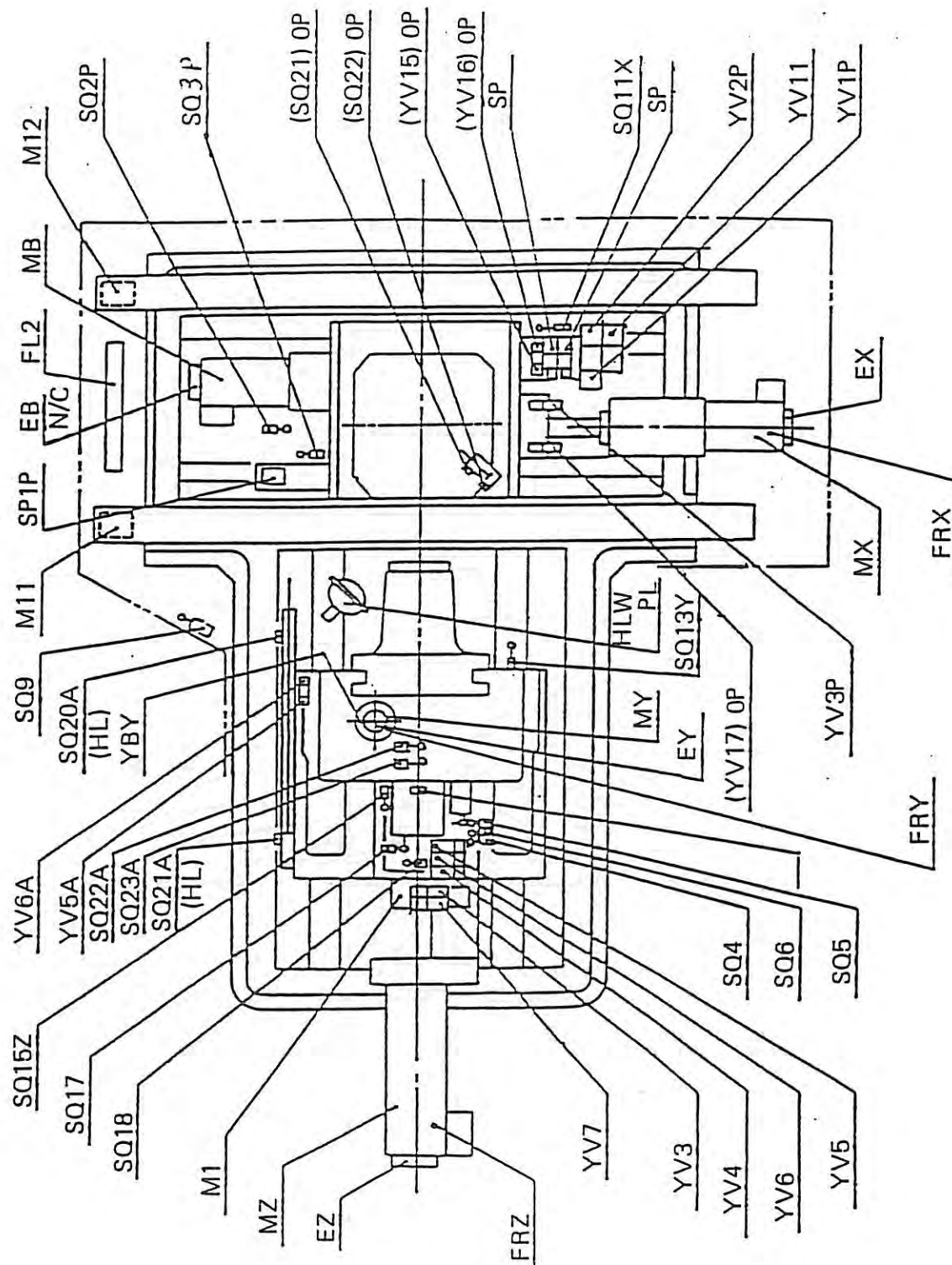


Magazine	32-tool	50-tool	70-tool
Za	81	144	144
Zb	36	100	70

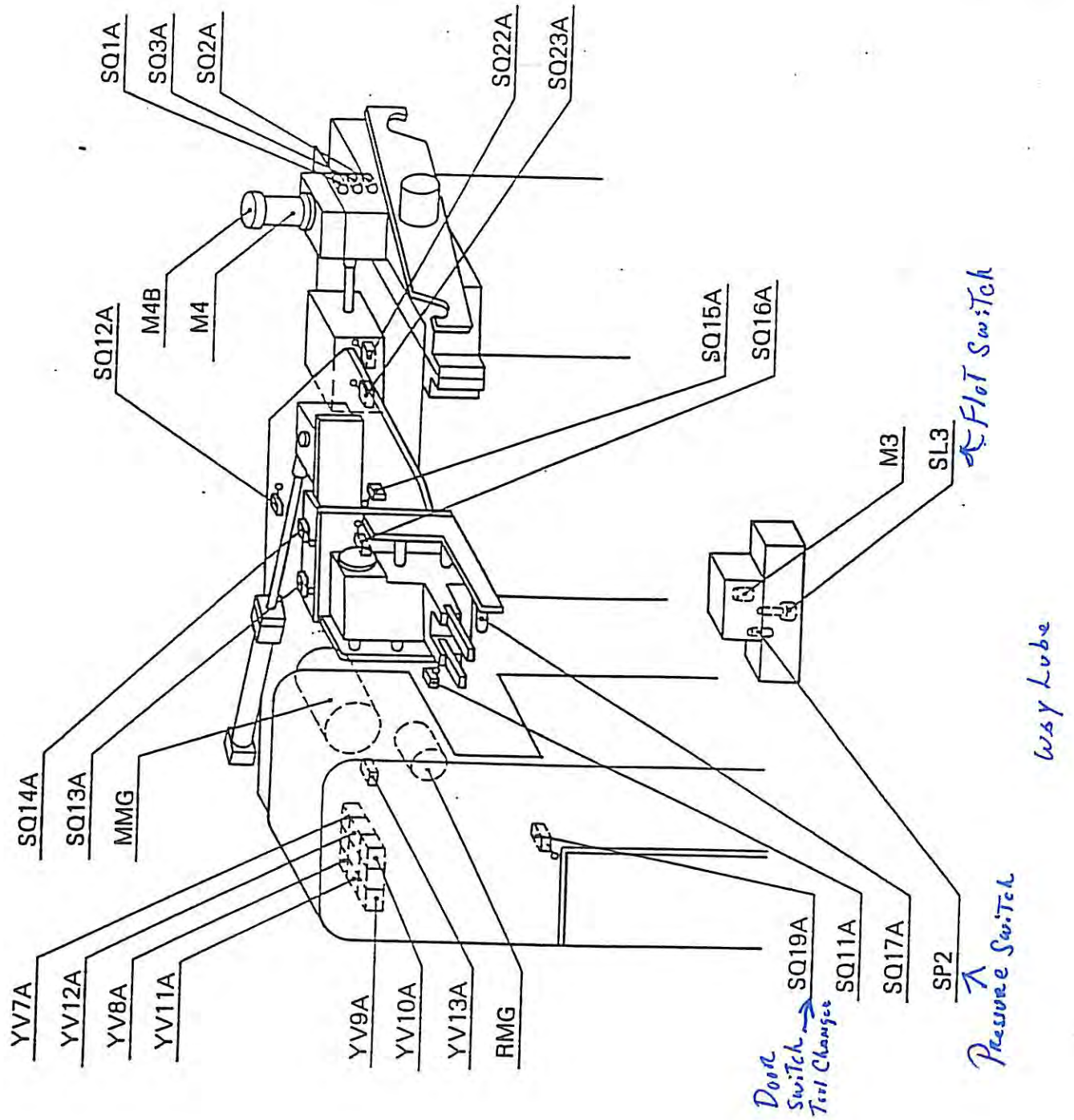
Arrangement of Limit Switches and Solenoid Valves - 1°/5° Index Rotary Table



Over

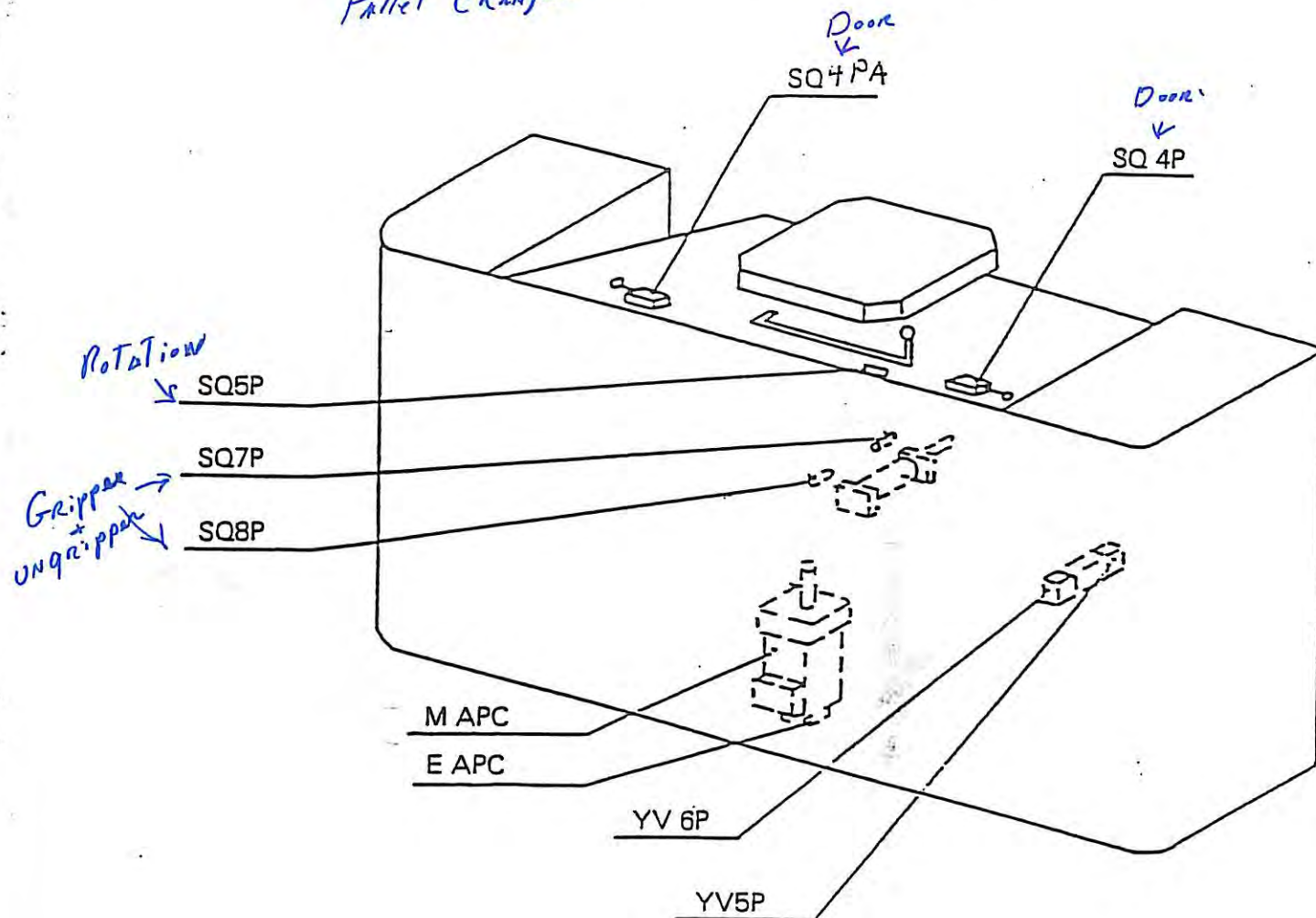


Arrangement of Limit Switches and Solenoid Valves - ATC

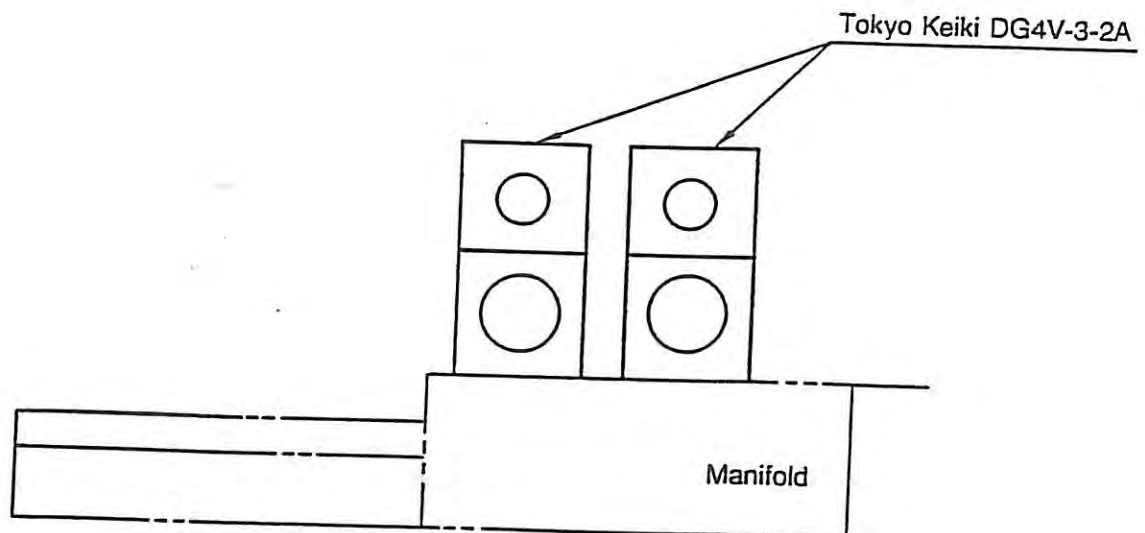
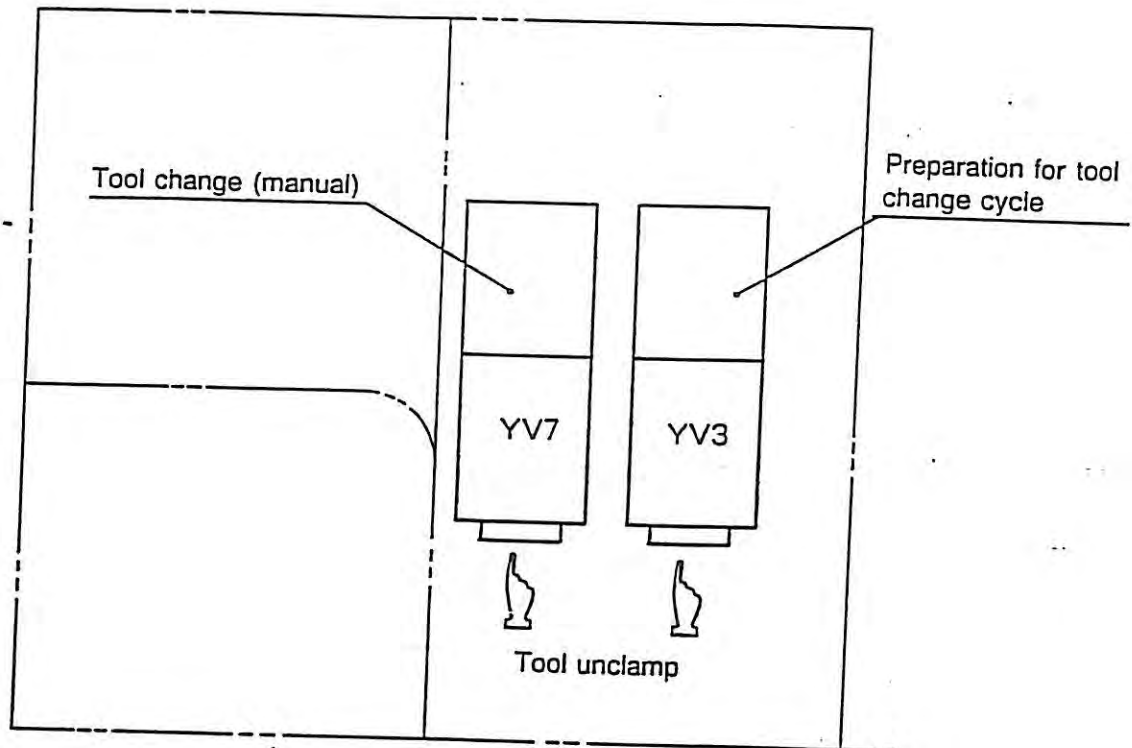


Arrangement of Limit Switches and Solenoid Valves - APC

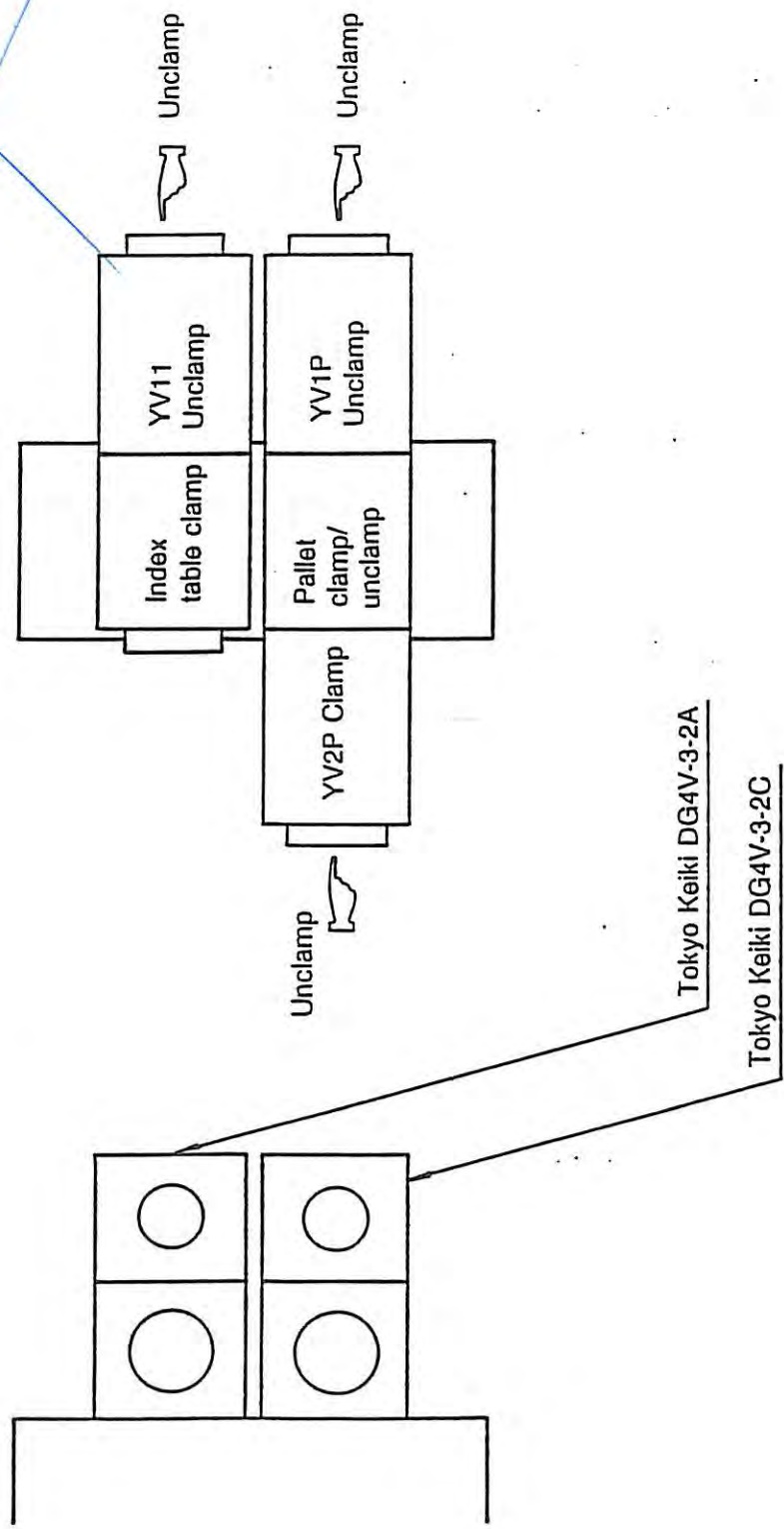
Pallet Changer



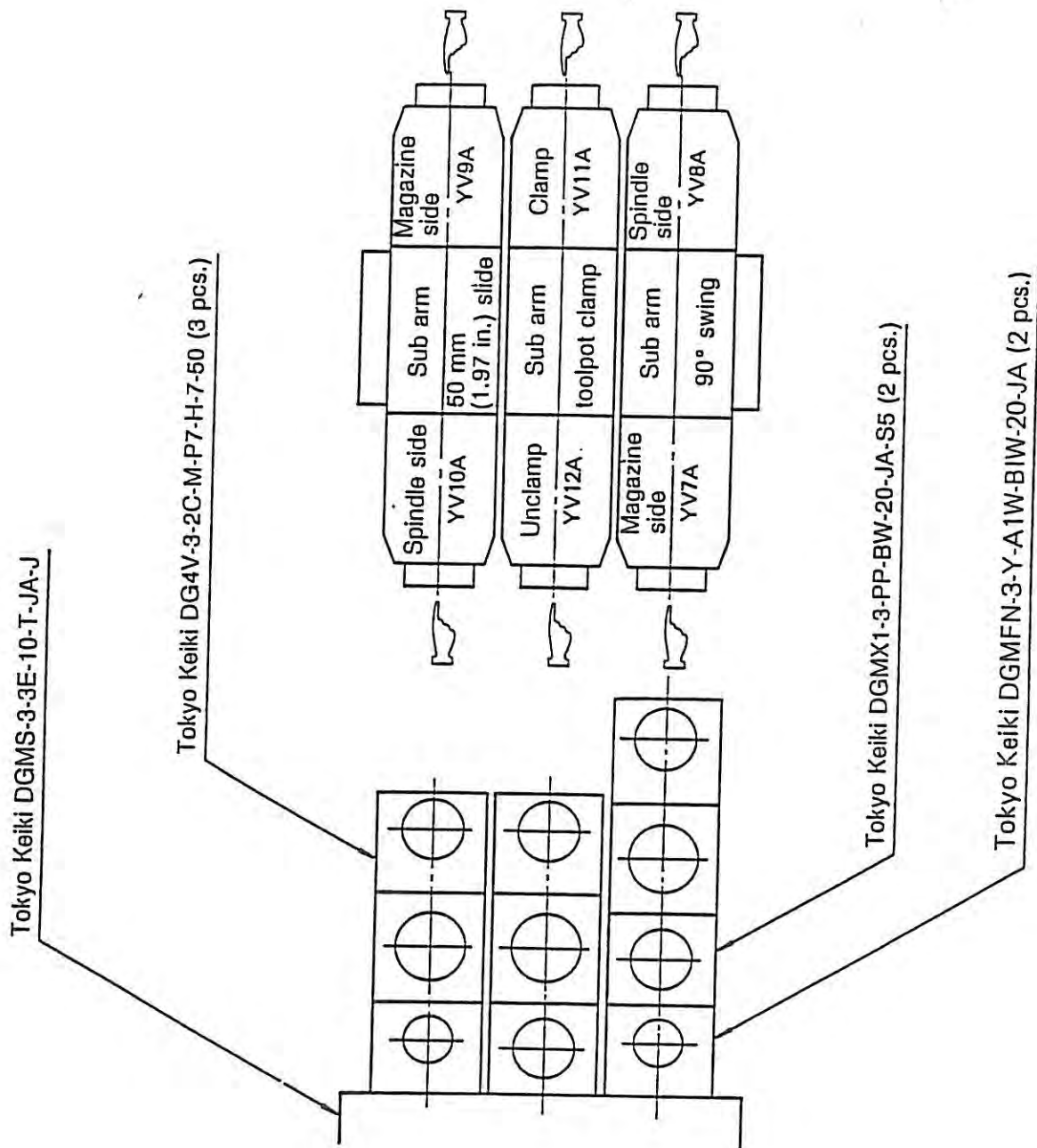
Arrangement of Solenoid Valves - Spindlehead



Arrangement of Solenoid Valves - 1°/5° Index Rotary Table



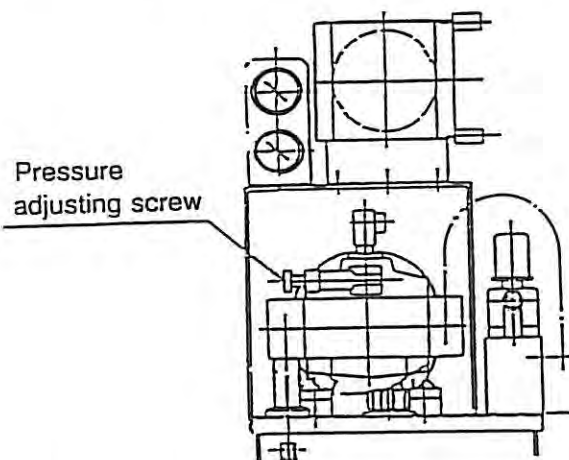
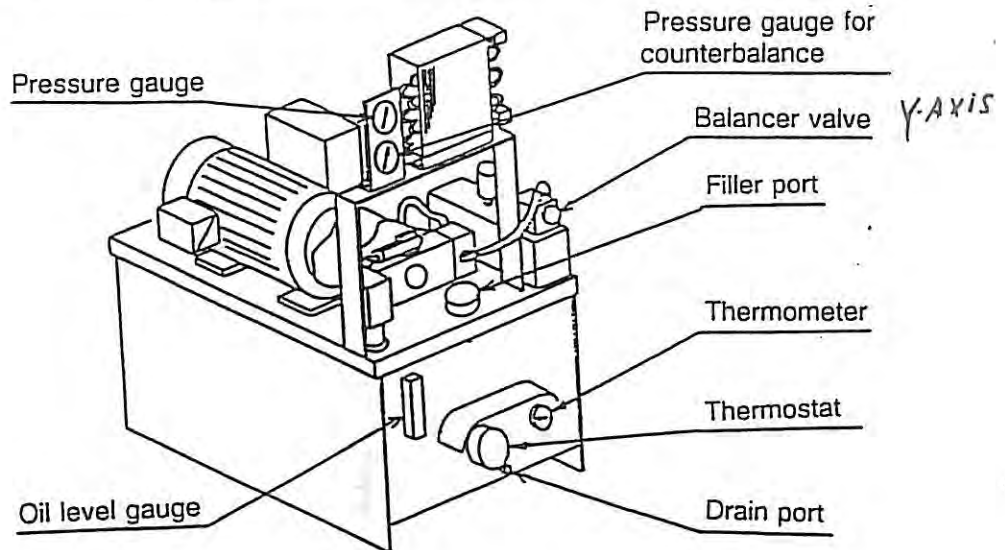
Arrangement of Solenoid Valves - ATC



2. Hydraulic Pressure Adjustment

2-1. Hydraulic System Pressure Indication and Adjustment

Hydraulic System Pressure	65 kgf/cm ² (924 psi)
Pressure Switch Setting (Pressure switch actuation)	25 kgf/cm ² (356 psi) minimum <i>Kick Out</i>



To adjust the hydraulic system pressure, use the pressure adjusting screw on the variable delivery pump. A clockwise turn increases the output pressure while a counterclockwise turn decreases the pressure.

For detailed operation procedures, refer to the appended instruction manual for the hydraulic power unit.

2-2. Spindlehead Counterbalance Pressure Adjustment

Both the oil pressure gauge and the counterbalance valve are provided in the hydraulic power unit.

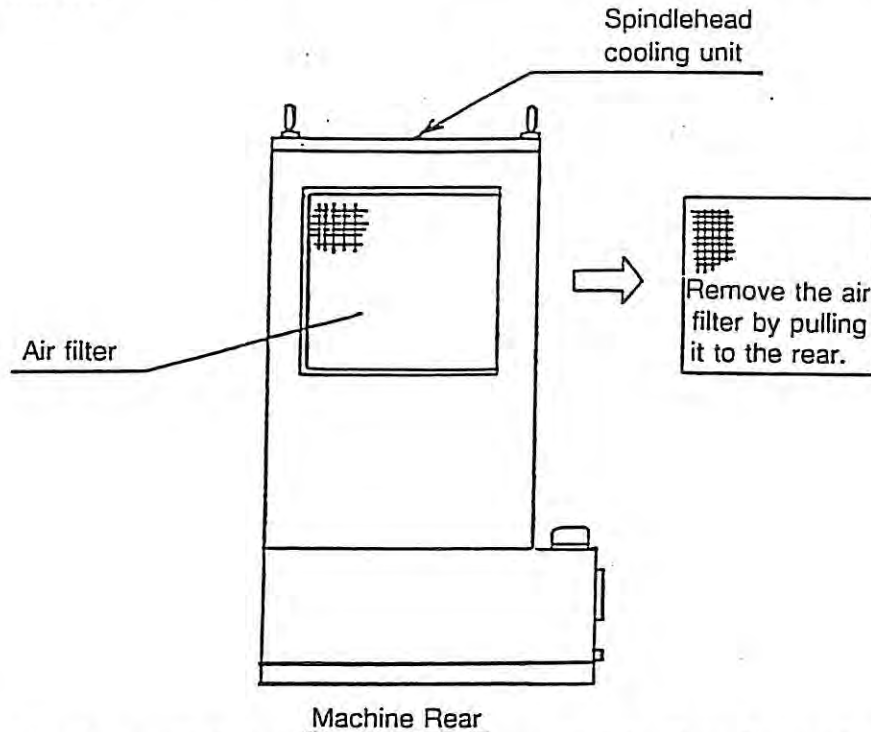
Typical line pressure during Y-axis at a still is as follows, with slight variances according to machine:

60 kgf/cm² (853 psi)

Adjustment should be made by turning the pressure regulating handwheel on the counterbalance valve so that the Y-axis motor load ammeter indicates the same reading for spindlehead upward and downward motion. After the adjustment, secure the hex. nut on the handwheel tight to lock it.

3. Cleaning of Air Filter for Cooler (Spindlehead Cooling System)

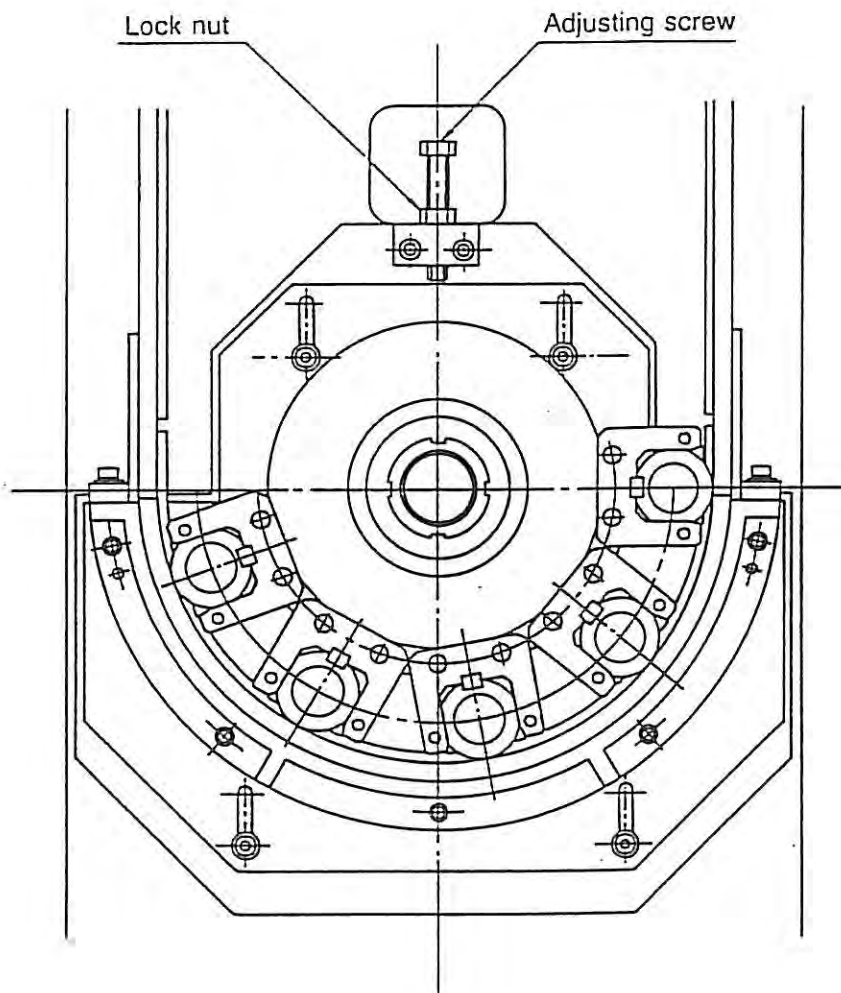
Clean the air filter for cooler of the spindlehead cooling system (combination unit) at the rear of the machine as follows:



- (1) An air filter is provided at the left side of the spindlehead cooling system and it can be removed when pulled forward.
- (2) Be sure to clean the air filter about twice a month.
- (3) If you neglect the cleaning of the air filter, the thermal relay of the refrigerator motor may be tripped, and a significant drop of the cooling capacity may occur.
- (4) If the thermal relay for the refrigerator is tripped, check the cause of the overload such as the clogging of the air filter, ambient temperature (should be less than 45°C), etc. Do not change the setting of the thermal relay.

4. Adjustment of Automatic Tool Changer (ATC)

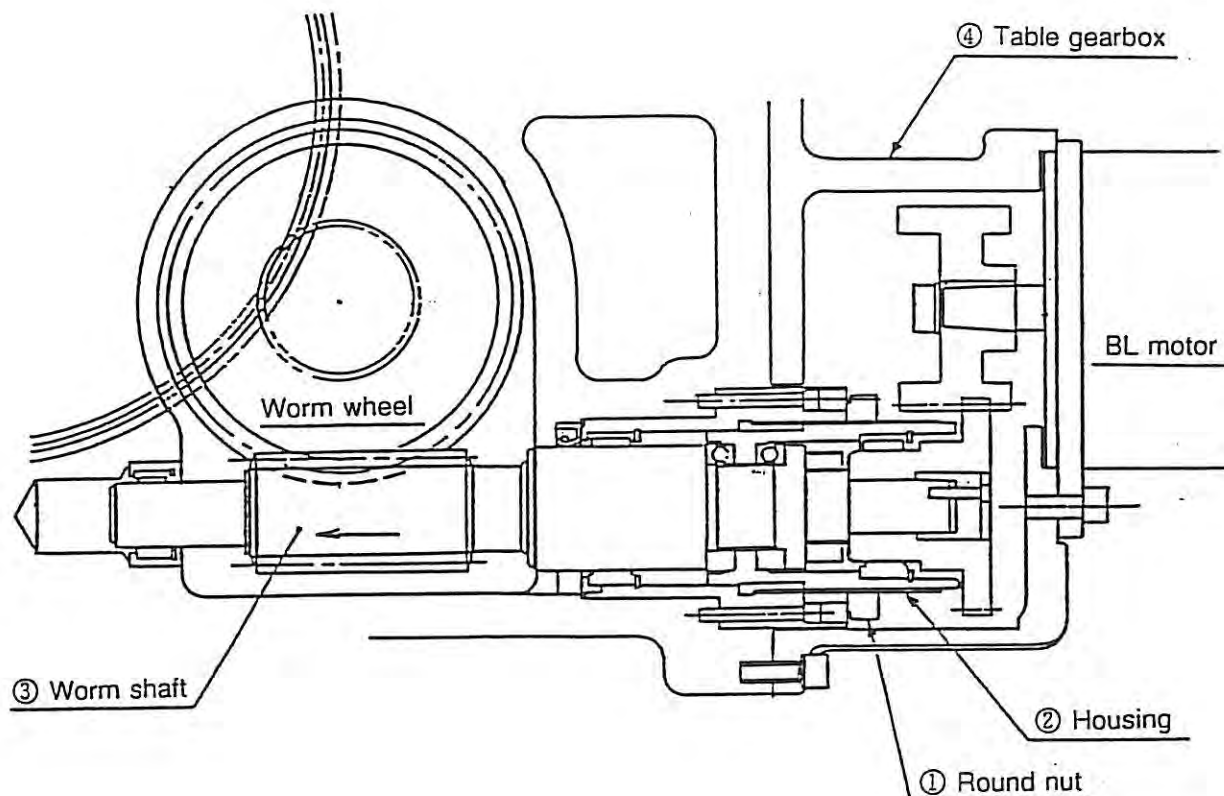
Adjustment of Magazine Chain Tension



When magazine link chain has become loose after a long time of service, resulting in vibration during magazine rotation, its tension should be adjusted. To adjust the tension, position of the chain guide should be adjusted - tightening the adjusting screws after loosening the clamping nut will increase the tension. Note that excessively high tension causes low magazine rotation speed.

5. Backlash Adjustments for Table Drive Worm Gear

Worm gear backlash amount can be adjusted to an optimum value using the dual-lead mechanism. If backlash amount is too large, a play will be generated between the worm gear and the worm wheel, resulting in table indexing error.



Backlash Adjustment Procedure:

After loosening the round nut (1), turn the housing (2) to tighten it, and the worm shaft (3) is moved in the arrow indicated direction to reduce backlash amount.

Note: Adjustment of backlash amount requires removal of the table drive gearbox (4), which causes the worm shaft gear and the motor shaft gear to be disengaged each other. Therefore, after the completion of backlash adjustment and installation of the gearbox, it is necessary to change the zero position data, soft-limit data, etc.

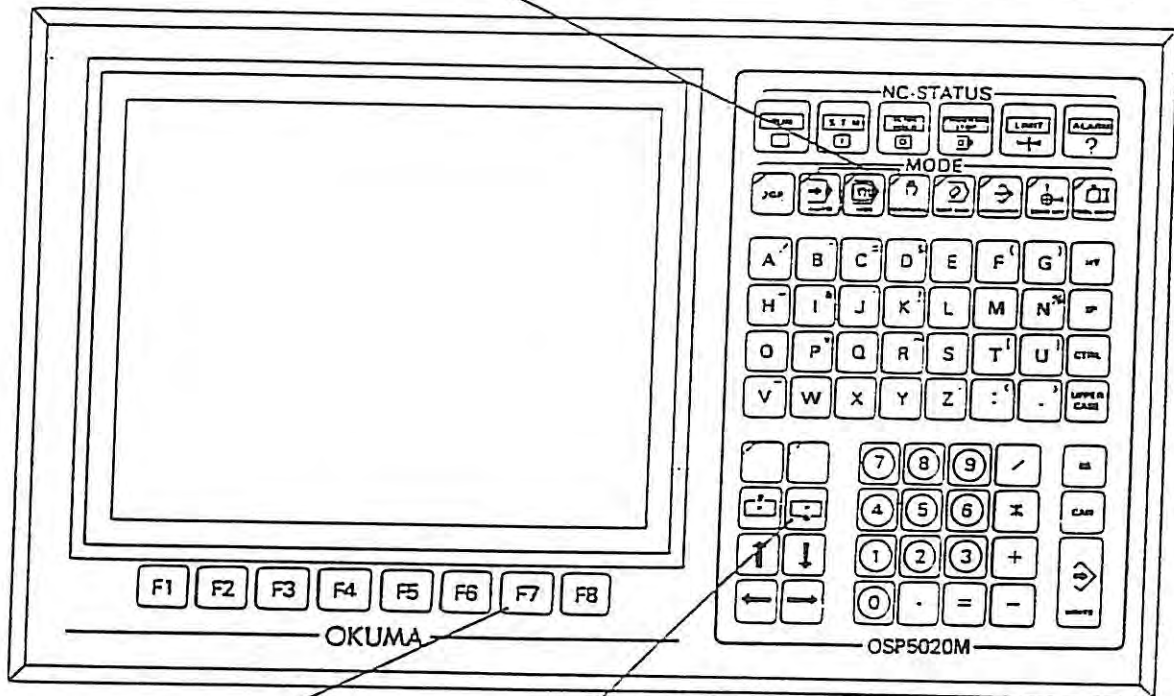
2. Check Data Display

The CNC constantly monitors internal conditions of the CNC and input/output signals of the NC, and the operator can see these data through check data displayed on the CRT.

Check data displayed on the CRT and its contents are shown in the following display screens.

Operation procedures for check data display are as follows:

- 1) Press any of AUTO, MANUAL and MDI keys.



- 3) Press page keys and advance the display page by one.

- 2) Press function key [F7] (CHECK DATA).

- 1) Press any of AUTO, MANUAL and MDI keys.

The function keys are assigned the same functions for [F2] through [F7]. Functions available with function key [F1] depends on the mode selected:

=CH							
=							
PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH		CHECK DATA	[EXTEND]
F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8

AUTO	.....	PROGRAM SELECT
MDI	.....	DATA INPUT
MANUAL	.....	None

- 2) Press function key [F7] (CHECK DATA).

The displays the check display screen.

- 3) Press page keys  and  until the desired display screen is obtained.



advances the display screen by one.



returns the display screen by one.

Note that required display screen can be accessed using the search command instead of using page keys.

Procedure to display the required display screen using the search command is as follows:

First follow steps 1) and 2) above to select the check display screen display mode.

- 4) Press the function key [F5] (SEARCH).

Prompt "= F" will be displayed on the console line.

- 5) Key in the display screen number of the required display screen through the keyboard.

The data key-in is displayed following "= F__".

Example: = F__ 10

- 6) Press **WRITE** key.

The required check data display screen will be displayed. The data accessed on the check data display screens is summarized on the following display screens.

On display screens that follow provided are the check data tables of PANEL INPUT, PANEL OUTPUT, NC INPUT, NC OUTPUT, MACHINE INPUT and MACHINE OUTPUT which are often used.

Panel Input

C e "CHECK DATA "PANEL INPUT"" display screens, the on/off status of individual switches on the machine operation panel are displayed. Provided on the following display screens are the CRT display and corresponding signal names. The numerals, a combination of 0s and 1s, at the left side of the CRT signify the on/off status of the corresponding switches.

- 1 Switch ON (normal state for contact "B")
- 0 Switch OFF (active state for contact "B")

* Contact "B" represents normally close contact.

Panel Input

AUTO OPERATION N 8

CHECK DATA *PANEL INPUT* PAGE 1 1mm

NO.	data	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1	00000000-00	CRTF	JOGP	JGF	JOGN	RSTR		SP2	RST
2	00000000-00	RDPD	RPDN	PH	SAKS	4AKS	ZAKS	YAKS	XAKS
3	00000000-00	PHAD	MINT	OPST	SLBK	SSTP	BLS3	BLS2	BLS1
4	00000000-00	ITLK	MLOK	DRYR	STML	ZLOK	MRIZ	MRIY	MRIX
5	00000000-00	MRI4	SP4	Q-PC	SORT	SNTR	SSP	SCCH	SCW
6	00000000-00	COL	WRN	WPA	LGHT	LUBE	OLM	OH4	OHL
7	00000000-00	ILKR	CYST	RTCY	STAV	STR4	ATC	APC	SP3
8	10111110-0E	JOV7	JOV6	JOV5	JOV4	JOV3	JOV2	JOV1	JOV0
9	01010101-55	SOV3	SOV2	SOV1	SOV0	ROV3	ROV2	ROV1	ROV0
10	00001101-0D				FOV4	FOV3	FOV2	FOV1	FOV0
11	00001100-04	PNPP	PNIP	PSV	PH6	6AKS	NIS1	NSTR	
12	00000000-00	PH5B	PH1B	PH1	PH5	PH4	PHZ	PHY	PHX

-CH

PROGRAM	ACTUAL	PART	BLOCK	SEARCH	ATC/APC	CHECK	[EXTEND]
SELECT	POSIT.	PROGRAM	DATA			DATA	

F 1
F 2
F 3
F 4
F 5
F 6
F 7
F 8

No.	bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Connector	Interface	
1		CRT display OFF	Cutting feed (+)	Cutting feed OFF	Cutting feed (-)	Sequence restart			NC reset	CN-P-2	Common panel PANEX CARDS	
2		Rapid feed (+)	Rapid feed (-)	Pulse handle	5th	4th	Z	Y	X			
3		Pulse handle overlap	Manual intervention	Optional stop	Single block	Cycle stop	Block skip 3	Block skip 2	Block skip 1			
4		Interlock release	Machine lock	Dry run	STM lock	Axis com. cancel	Mirror image Z	Mirror image Y	Mirror image X			
5		Mirror image 4		Chip conveyor	Orientation	Release	Stop	CCW	CW	CN-P-3		
6		Coolant	Chip air blower nozzle	Chip air blower adaptor	Work light	Slideway lubrication	Oil mist	Through-the-tool coolant	Shower cleaning			
7		Interlock release	1 cycle start	Return cycle	1 step advance	1 step reverse	ATC	APC				
8					Manual cutting feed selection (Note)							
9		Spindle speed override (See Table 5-2.)				Rapid traverse override (See Table 5-1.)						CN-P-4
10					Cutting feed override (See Table 5-3.)							CN-P-5
11		NC panel limited use	NC panel disabled	Power save	Axis select for pulse handle 6th	Axis select for manual feed 6th	NC slide hold	NC cycle start		CN-PA5-3		
12		P.H. multiplication ratio			Axis select for pulse handle							
		× 100	× 50	× 10	5th	4th	Z	Y	X			

Panel Input

F 1 F 2 F 3 F 4 F 5 F 6 F 7 F 8

[illegible]

Table 5-1 Rapid Feedrate Override

bit Rapid Feedrate Override	ROV3	ROV2	ROV1	ROV0
0%	0	0	0	1
1%	0	0	1	0
5%	0	0	1	1
10%	0	1	0	0
30%	0	1	0	1
50%	0	1	1	0
70%	0	1	1	1
80%	1	0	0	0
90%	1	0	0	1
100%	1	0	1	0

Table 5-2 Spindle Speed Override

bit Spindle Speed Override	SOV3	SOV2	SOV1	SOV0
50%	0	0	0	1
70%	0	0	1	0
80%	0	0	1	1
90%	0	1	0	0
100%	0	1	0	1
110%	0	1	1	0
120%	0	1	1	1
130%	1	0	0	0
140%	1	0	0	1
150%	1	0	1	0
160%	1	0	1	1
180%	1	1	0	0
200%	1	1	0	1

Table 5-3 Cutting Feedrate Override

Cutting Feedrate Override \ bit	FOV4	FOV3	FOV2	FOV1	FOV0
0%	0	0	0	0	1
5%	0	0	0	1	0
10%	0	0	0	1	1
20%	0	0	1	0	0
30%	0	0	1	0	1
40%	0	0	1	1	0
50%	0	0	1	1	1
60%	0	1	0	0	0
70%	0	1	0	0	1
80%	0	1	0	1	0
90%	0	1	0	1	1
95%	0	1	1	0	0
100%	0	1	1	0	1
105%	0	1	1	1	0
110%	0	1	1	1	1
120%	1	0	0	0	0
130%	1	0	0	0	1
140%	1	0	0	1	0
150%	1	0	0	1	1
160%	1	0	1	0	0
170%	1	0	1	0	1
180%	1	0	1	1	0
200%	1	0	1	1	1

(2) Panel Output

On the "CHECK DATA *PANEL OUTPUT*" display screens, the on/off status of individual indicating lamps on the machine operation panel are displayed. Provided on the following display screens are the CRT display and corresponding signal names. The numerals, a combination of 0s and 1s, at the left side of the CRT signify the on/off status of the corresponding indicating lamps.

1	Lamp ON
0	Lamp OFF

Panel Output

AUTO OPERATION N 8

CHECK DATA =PANEL OUTPUT= PAGE 5 1mm

NO.	data	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1	00000000-00	ILCL	MJCL	DRYL	SLJL	ZJCL	MRZL	MRYL	MRXL
2	00000000-00	MR4L	SP4L	SP2L	CHPL	ORTL	NTRL	CO4L	SCHL
3	00000000-00	COLL	WANL	WAPL	LGH	LJEL	OLJL	OHLL	OHLL
4	00000000-00								
5	00000000-00								
6	00000000-00								
7	00000000-00								
8	00000000-00								
9	00000000-00	JGPL	JGIL	PHL	5AXL	4AXL	ZAXL	YAXL	XAXL
10	00000100-04	CRTL	1CYL	RTCL	1SAL	1SRL	APCL	SPCL	
11	00000000-00	PHAL	MINL	OSPL	SBL	SSTL	BSCL	BSCL	BSCL
12	00000110-06	DNBL	DNCL	PSVL		6AXL	5AXL	5AXL	TCPL

=CH

PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH	ATC/APC	CHECK DATA	EXTEND
-------------------	------------------	-----------------	---------------	--------	---------	---------------	--------

F1 F2 F3 F4 F5 F6 F7 F8

No.	bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Connector	Interface
1	Interlock release	Machine lock	Dry run	STM lock	Axis com. cancel	Mirror image Z	Mirror image Y	Mirror image X		CN-P-6	Common panel
2	Mirror image 4			Chip conveyor	Orientation	Release	CCW	CW			
3	Coolant	Chip air blower nozzle	Chip air blower adaptor	Work light	Slideway lubrication	Oil mist	Through-the-tool coolant	Shower cleaning			
4											
5										CN-PA5-2	PANEX CARDS
6											
7											
8											
9	Cutting feed (+)	Cutting feed (-)	Pulse handle	5th	4th	Z	Y	X			
10	CRT display OFF	1 cycle start	Return cycle	1 step advance	1 step reverse	ATC	APC				
11	Pulse handle overlap	Manual intervention	Optional stop	Single block	Cycle stop	Block skip 3	Block skip 2	Block skip 1			
12	DNC buffer operation	DNC communication ON	Power save		Axis select 6th	Tool in spindle unclamp	Tool in spindle clamp	Tool change cycle			

Panel Output

AUTO OPERATION N 8

CHECK DATA =PANEL OUTPUT= PAGE 6 1mm

NO.	data	bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
13	00000000-00	F8L F7L F6L F5L F4L F3L F2L F1L
14	00000000-00	
15	00000000-00	
16	00000100-04	IGPL IPRL IGPL
17	00000000-00	
18	00000000-00	
19	00000000-00	
20	00000000-00	
21	00000000-00	
22	00000000-00	
23	00000000-00	
24	00000000-00	

=CH

PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH	ATC/APC	CHECK DATA	[EXTEND]
-------------------	------------------	-----------------	---------------	--------	---------	---------------	----------

F 1
F 2
F 3
F 4
F 5
F 6
F 7
F 8

No.	bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Connector	Interface
13		F8	F7	F6	F5	F4	F3	F2	F1	CN-PAS-2	PANEX CARDS
14											
15											
16							IGF panel initializa- tion finished	IGF pro- gram trans- mission request	IGF panel switching		
17											
18											
19											
20											
21											
22											
23											
24											

(3) NC Input

On the "CHECK DATA "NC INPUT"" display screens, the on/off status of individual input signals to the NC processor are displayed. Provided on the following display screens are the CRT display and corresponding signal names. The numerals, a combination of 0s and 1s, at the left side of the CRT signify the on/off status of the corresponding input signals.

1 Input signal ON

0 Input signal OFF

NC Input

AUTO OPERATION 0 N 1

CHECK DATA *NC INPUT* PAGE 9 1mm

NO.	data	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1	00000000-00	SALM							
2	00000000-00	ERLM	AMDT		AXD0	AML2	AML1	AML0	
3	00000000-00					AXD3	AXD2	AXD1	AXD0
4	00000000-00	ERSF							
5	00000000-00		LOKJ	LOKV	LOKJ	LOKZ	LOKY	LOKX	
6	00000000-00					LOK0	LOK8	LOKA	
7	00000000-00	HP7	HP6	HP5	HP4	HP3	HP2	HP1	HP0
8	00000000-00	HP31	HP30	HP29	HP28	HP27	HP26	HP25	HP24
9	00000000-00	SAB	TAB	MAB	RTAB	RSAB	PRST		
10	00100000-20	ERST	ESTR	ETSP					
11	00100000-20		CLS4	CLSV	CLSU	CLS2	CLS1	CLSX	
12	00000000-00					CLSC	CLSB	CLSA	

PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH		CHECK DATA	[EXTEND]
-------------------	------------------	-----------------	---------------	--------	--	---------------	----------

F 1
F 2
F 3
F 4
F 5
F 6
F 7
F 8

No.	bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Connector	Interface		
1	System alarm												
2	EC alarm					Axis command given	Alarm level (See Table 5-4.)						
3						Axis code (See Table 5-5.)							
4	EC reset fin.												
5			Feed release (Axis movement enabled)										
			W	V	U	Z	Y	X					
6						Feed release (Axis movement enabled)							
						C	B	A					
7	Home position												
	7	6	5	4	3 (B pallet)	2 (A pallet)	1	0 (ATC)					
8	Home position												
	31	30	29	28	27	26	25	24					
9	Completion of command					External program execution command							
	S	T	M	RT	RS								
10	External												
	Reset	Start	Slide hold										
11	Axis clamp												
			W	V	U	Z	Y	X					
12	Axis clamp												
						C	B	A					

NC Input

AUTO OPERATION 0 N 1

CHECK DATA =NC INPUT= PAGE 10 Imm

NO.	data	bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
13	00000000-00	PSVN CUFM SPCR SPZ
14	00000000-00	ADDC ADDB ADDA
15	00000000-00	
16	00000000-00	HP23 HP22 HP21 HP20 HP19 HP18 HP17 HP16
17	00000000-00	HP15 HP14 HP13 HP12 HP11 HP10 HP9 HP8
18	00100000-20	SVRW SVRV SVRU SVRZ SVRY SVRX
19	00000000-00	SVRC SVRB SVRH
20	00000000-00	
21	00000000-00	S2S4
22	00000000-00	CSTB
23	00000000-00	RATL RATL NATL PALK PALK NALK
24	10000000-00	PRLK RTLK PTLK NTLK HPVU CHER CHCK

PROGRAM ACTUAL PART BLOCK

SELECT POSIT. PROGRAM DATA SEARCH

CHECK DATA [EXTEND]

F 1
F 2
F 3
F 4
F 5
F 6
F 7
F 8

No.	bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Connector	Interface
13		In power save	Robot coupling mode					Spindle const. speed	Spindle zero speed		
14							C	Additional axis B	A		
15											
16	23	22	21	20	19	18	17	16			
17	15	14	13	12	11	10	9	8			
18			W	V	U	Z	Y	X			
19							C	B	A		
20											
21									S2-digit/S4-digit input		
22									Diagnosis execution command		
23		Return attachment	Active attachment	Next attachment	Return attachment	Active attachment	Next attachment				
24		Parameter interlock	Return tool	Active tool	Next tool		HP velocity parameter ineffective	Setting error	Check (in.		

Table 5-4 Alarm Level

Symbol Mark Alarm Level	AML2	AML1	AML0
No alarm	0	0	0
Alarm P	1	0	0
Alarm A	0	1	1
Alarm B	0	1	0
Alarm C	0	0	1

Table 5-5 Axis Code

Symbol Mark Axis	(bit 3)	AXD2	AXD1	AXD0
X	0	0	0	1
Y	0	0	1	0
Z	0	0	1	1
U	0	1	0	0
V	0	1	0	1
W	0	1	1	0
A	0	1	1	1
B	1	0	0	0
C	1	0	0	1

(4) NC Output

On the "CHECK DATA "NC OUTPUT"" display screens, the on/off status of individual output signals from the NC processor are displayed. Provided on the following display screens are the CRT display and corresponding signal names. The numerals, a combination of 0s and 1s, at the left side of the CRT signify the on/off status of the corresponding output signals.

1 Output signal ON

2 Output signal OFF

NC Output

AUTO OPERATION 0 N 1

CHECK DATA =NC OUTPUT= PAGE 11 1mm

NO.	data	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1	00000000=00						MAL2	MAL1	MAL0
2	00000000=00	ERSS							MARS
3	00000000=00			DRVW	DRVV	DRVU	DRVZ	DRVY	DRVX
4	00000000=00						DRVC	DRVB	DRVA
5	00000000=00			UCLW	UCLV	UCLU	UCLZ	UCLY	UCLX
6	00000000=00						UCLC	UCLB	UCLA
7	00000000=00	HF7	HF6	HF5	HF4	HF3	HF2	HF1	HF0
8	11111111=FF	HF31	HF30	HF29	HF28	HF27	HF26	HF25	HF24
9	00000000=00			HPFW	HPFV	HPFU	HPFZ	HPFY	HPFX
10	00000000=00						HPFC	HPFB	HPFA
11	00000001=01	SF	TF	MF	RTF	RSF	PRSA		ALIP
12	00000000=00	SVDI					MINT	ZLOK	SLOK

PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH	CHECK DATA	(EXTEND)
-------------------	------------------	-----------------	---------------	--------	---------------	----------

F 1
F 2
F 3
F 4
F 5
F 6
F 7
F 8

No.	bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Connector	Interface
1							Alarm				
2	Reset command								Mode reset		
3			W	V	U	Z	Y	X			
4							C	B	A		
5			W	V	U	Z	Y	X			
6							C	B	A		
7	7	6	5	4	3 (B pallet)	2 (A pallet)	1	0 (ATC)			
8	31	30	29	28	27	26	25	24			
9			W	V	U	Z	Y	X			
10							C	B	A		
11	S	T	M	RT	RS	Execution program selection answer			Distribution completed all axis positioning completed		
12	Spindle speed over inhibited				In manual int.	Z-axis cancel	In STM lock	In machine lock			

NC Output

AUTO OPERATION 0 N 1

CHECK DATA *NC OUTPUT* PAGE 12 1mm

NO.	data	bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
13	00000000-00	PPCF PRUN FCYC FG00 FG01
14	00000000-00	LMTH LMTV LMTU LMTZ LMTY LMTX
15	00000000-00	LMTC LMTB LMTA
16	11111111-FF	HP23 HP22 HP21 HP20 HP19 HP18 HP17 HP16
17	11111111-FF	HP15 HP14 HP13 HP12 HP11 HP10 HP9 HP8
18	00000000-00	SOK4 SOKV SOKU SOKZ SOKY SOKX
19	00000000-00	SOKC SOKB SOKA
20	00000000-00	
21	00000000-00	
22	00000000-00	
23	00000000-00	FACS TSTB CHAQ
24	00000000-00	PTRF ULD UWD USD SLD SHD SBD

PROGRAM
SELECT

ACTUAL
POSIT.

PART
PROGRAM

BLOCK
DATA

SEARCH

CHECK
DATA

[EXTEND]

F 1
F 2
F 3
F 4
F 5
F 6
F 7
F 8

No.	bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Connector	Interface
13		M02 lin.	Program running				In fixed cycle	In G00	In cutting		
14				W	V	U	Limit ON Z	Y	X		
15							Limit ON C	B	A		
16	23	22	21	20	19	18	17	16			
17	15	14	13	12	11	10	9	8			
18			W	V	U	Servo OK Z	Y	X			
19						Servo OK C	B	A			
20			W.	V	U	Second soft-limit Z	Y	X			
21						Second soft-limit C	B	A			
22											
23						AAC set execute command	Tool data setting strobe	Diag. request			
24		PTR Input lin.	User parameter data			System parameter data					
			Long word	Word	Byte	Long word	Word	Byte			

(5) Machine Input

On the "CHECK DATA "MACHINE INPUT"" display screens, the on/off status of individual input signals from the limit switches are displayed. Provided on the following display screens are the CRT display and corresponding signal names. The numerals, a combination of 0s and 1s, at the left side of the CRT signify the on/off status of the corresponding input signals.

- 1 Switch ON (normal state for contact "B")
- 0 Switch OFF (active state for contact "B")

AUTO OPERATION		N	0
CHECK DATA	MACHINE INPUT=	PAGE 13	Imm
NO.	data	bit7	bit6 bit5 bit4 bit3 bit2 bit1 bit0
1	01111111=7F	MGFR	MGOK OLA/ OLM/ OLB/ PLZ/ QLY/ QLY/
2	10111111=BF	EXAM	WKSX OLHM COLUM LUBM APFR APOK
3	01001100=4C	INDV	SVOK STEN AXE/ RRDN CIPN
4	00000000=00	WAR/ DIRS	DILE ERDL WKBZ ERRAL WKLTL POFF
5	01110000=70	OHF/ OHTK	OLP/ HOCL THPO EXAB CPCC CPCJ
6	11111111=FF	BSOL BSCL	PSGN CRGN HODO OHTU OPFO HDIV
7	00001111=0F		OPDC DRYA LBPD LBPR
8	00000000=00		
9	00000000=00		
10	00000000=00		
11	00000000=00		
12	00000000=00		

PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH	ATC/APC	CHECK DATA	[EXTEND]
F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8

[illegible]

AUTO OPERATION

CHECK DATA

==MACHINE INPUT==

PAGE 14 1mm

NO.	data	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
13	00000000=00					TUCP	TCLP	SUCP	SLCP
14	00000000=00								
15	00000000=00								
16	00000000=00								
17	00000110=05	TAUC	TAUL			TAP3	TAP2	TA01	ATDC ATDO
18	00000000=00								
19	00000000=00								
20	00000000=00								
21	00010000=10	TSUR	TSUF			PSIT	PUEL		BCL/ BUEL
22	00000000=00								
23	00000000=00								
24	00000000=00								

PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH	ATC/APC	CHECK DATA	[EXTEND]
-------------------	------------------	-----------------	---------------	--------	---------	---------------	----------

F 1 F 2 F 3 F 4 F 5 F 6 F 7 F 8

[illegible]

F 1 F 2 F 3 F 4 F 5 F 6 F 7 F 8

[illegible]

(6) Machine Output

On the "CHECK DATA "MACHINE OUTPUT"" display screens, the on/off status of individual output signals to solenoids and relays are displayed. Provided on the following display screens are the CRT display and corresponding signal names. The numerals, a combination of 0s and 1s, at the left side of the CRT signify the on/off status of the corresponding output signals.

1	Solenoid/relay ON
0	Solenoid/relay OFF

display
input

display
input

[illegible]

Machine Output (Rotary type 2-pallet APC)

AUTO OPERATION N 0

CHECK DATA MACHINE OUTPUT PAGE 18 1mm

NO.	data	bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
25	00011010=1A	MGD/ MGMI SAO/ SAPP SAUG SAGR SAMG SASP
26	00000000=00	SAAR
27	00000000=00	
28	00000000=00	
29	10001000=08	PLUG PLGR RPM/ PAPP WKPL ENTL ENSL
30	00000000=00	
31	00000000=00	
32	00000000=00	
33	00000000=00	
34	00000000=00	
35	00000000=00	
36	00000000=00	

PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH	ATC/APC	CHECK DATA	[EXTEND]
-------------------	------------------	-----------------	---------------	--------	---------	---------------	----------

F 1
F 2
F 3
F 4
F 5
F 6
F 7
F 8

No.	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Connector	Interface
25	Magazine door interlock	Magazine manual intervention ON	Sub arm at home position YV10A	Sub arm at toolpost position YV9A	Sub arm ungrip YV12A	Sub arm grip YV11A	Sub arm swing to magazine side YV7A	Sub arm swing to spindle side YV8A		
26								Sub arm air blower YV13A		
27										
28										
29	Pallet ungrip YV2P	Pallet grip YV1P		APC manual intervention HL5P	Pallet in-position HL4P	Work setup completion HL3P	External NC slide hold HL2P	External NC cycle start HL1P		
30										

(7) Machine Extend Input

On the "CHECK DATA *MACHINE EX INPUT*" display screens, the on/off status of individual input signals from the limit switches are displayed. Provided on the following display screens are the CRT display and corresponding signal names. The numerals, a combination of 0s and 1s, at the left side of the CRT signify the on/off status of the corresponding input signals.

- 1 Switch ON (normal state for contact "B")
- 0 Switch OFF (active state for contact "B")

rid
eens
; and

F 1 F 2 F 3 F 4 F 5 F 6 F 7 F 8

[illegible]

(8) Machine Extend Output

On the "CHECK DATA "MACHINE EX OUTPUT"" display screens, the on/off status of individual output signals to solenoids and relays are displayed. Provided on the following display screens are the CRT display and corresponding signal names. The numerals, a combination of 0s and 1s, at the left side of the CRT signify the on/off status of the corresponding output signals.

1 Solenoid/relay ON
0 Solenoid/relay OFF

Machine Extend Output

AUTO OPERATION

0 N 1

CHECK DATA

MACHINE EX OUTPUT

PAGE 25

1mm

NO.

data

bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0

1 00000000-00

2 00000000-00

3 00000000-00

4 00000000-00

5 00100000-20

VIEW DATA VIEW

PROGRAM SELECT

ACTUAL POSIT.

PART PROGRAM

BLOCK DATA

SEARCH

CHECK DATA

[EXTEND]

F 1

F 2

F 3

F 4

F 5

F 6

F 7

F 8

No.	bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Connector	Interface
1											
2											
3											
4											
5											

(9) NC Axis Data

AUTO OPERATION				O	N	I
CHECK DATA	*NC AXIS DATA*		PRG	30	1mm	
	X	Y	Z			
RDIF	0.000	0.000	0.000			
ODIF	0.000	0.000	0.000			
RCON	3399.999	3499.999	1400.000			
RAPA	3399.999	3499.999	1400.000			
RSAPA	0.000	0.000	0.000			
RSVVAR1	0.000	0.000	0.000			
RSVVAR2	0.000	0.000	0.000			

PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH	CHECK DATA	(EXTEND)
----------------	---------------	--------------	------------	--------	------------	----------

F1 F2 F3 F4 F5 F6 F7 F8

AUTO OPERATION				O	N	I
CHECK DATA	*NC AXIS DATA*		31	1mm		
	ODIF	RAPA				
X	0.000	3399.999				
Y	0.000	3499.999				
Z	0.000	1400.000				

PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH	CHECK DATA	(EXTEND)
----------------	---------------	--------------	------------	--------	------------	----------

F1 F2 F3 F4 F5 F6 F7 F8

RDIF Difference between calculated value and detected value
 ODIF Difference between calculated value with acceleration/deceleration taken into account and detected value
 RCON Calculated value
 RAPA Detected value
 RSAPA Position detected value when contact with touch sensor
 RSVVAR1 } Sensor data
 RSVVAR2 } (values designated by NC optional parameter (word) No. 10)

(10) Machine Axis Data

AUTO OPERATION				N	1
CHECK DATA		*MACHINE AXIS DATA*		PAGE 24	1
		CA	MG1		
RDIF		0	0		
RCON		0	72703		
RAPA		0	72703		
RCOM		0	77947		

PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH	CHECK DATA	(EXTEND)
F1	F2	F3	F4	F5	F6	F7 F8

CA : ~~(Not used)~~

MG1 : Magazine axis

MG3 : ~~Pallet magazine axis~~

W : APC shifter axis

(displayed by pressing the function key [F6] (AXIS CHANGE) after pressing the function key ~~[F7]~~ (EXTEND).)

F8

RDIF Difference between calculated value and detected value

RCON Calculated value

RAPA Detected value

RCOM Commanded value

*Important
over*

3. NC Diagnostic Display

The state of memory within the NC can be grasped by the diagnostic display on the CRT. Also, it is convenient because the display form can be selected among decimal number, hexadecimal, floating-point number, bit-string, etc.

AUTO OPERATION				O	N	!														
CHECK DATA	MEMORY DATA		PAGE 22	1999																
MACHINE COORDS	X	Y	Z																	
	299.999	999.999	-1109.000																	
DIT-P8	\$02000000																			
1	\$02000000																			
DIT 2	\$02000000																			
3	\$02000000																			
HCX 4	\$02000000																			
5	\$02000000																			
FLW 6	\$02000000																			
7	\$02000000																			
BIT 8	\$02000000																			
9	\$02000000																			
<table border="1"> <thead> <tr> <th>PROGRAM</th> <th>ACTUAL</th> <th>PART</th> <th>BLOCK</th> <th>SEARCH</th> <th>CHECK</th> <th></th> </tr> </thead> <tbody> <tr> <td>SELECT</td> <td>POSIT.</td> <td>PROGRAM</td> <td>DATA</td> <td></td> <td>DATA</td> <td>(EXTEND)</td> </tr> </tbody> </table>							PROGRAM	ACTUAL	PART	BLOCK	SEARCH	CHECK		SELECT	POSIT.	PROGRAM	DATA		DATA	(EXTEND)
PROGRAM	ACTUAL	PART	BLOCK	SEARCH	CHECK															
SELECT	POSIT.	PROGRAM	DATA		DATA	(EXTEND)														
[F 1] [F 2] [F 3] [F 4] [F 5] [F 6] [F 7] [F 8]																				

When this page is to be used, please consult your local Okuma representative.

4. Machine Diagnostic Display

When any of the requirements for the operation of the machine is not fulfilled, it can be seen through diagnostic data displayed on the CRT which condition is not fulfilled, preventing the operation. The cause of the machine trouble will be easily found out by checking the input and output signal status display explained on pages 146 through 154 along with this machine diagnostic display.

SECTION 6 MACHINE OPERATIVE CONDITIONS, DIAGNOSIS MESSAGES AND LOGIC TABLES

1. Machine Operative Conditions

Item		Condition
Main Spindle Rotation		1) Spindle tool is clamped. 2) Tool is not being changed. 3) ATC interlocking is released. 4) Tool change arm is at the home position.
Spindle Indexing		Same as the main spindle rotation conditions.
Spindle Release		Main spindle is at a still.
Spindle Speed Change Gear Selection (Including S command)		1) Main spindle is at a still. 2) Spindle tool is clamped. 3) Tool is not being changed. 4) ATC interlocking is released. 5) Tool change arm is at the home position.
Allowable Range	All axes	1) Interlock by ATC sequence is released. 2) Interlock by APC sequence is released.
	X-axis	1) B-axis is clamped. 2) APC arm is retracted. (Rotary type 2-pallet APC specification) 3) Touch sensor is either at the upper end or at the lower end. (Sensor specification)
	Y-axis	1) B-axis is clamped. 2) Tool change arm is at the home position. 3) Touch sensor is either at the upper end or at the lower end. (Sensor specification)
	Z-axis	1) B-axis is clamped. 2) Tool change arm is at the home position. 3) Touch sensor is either at the upper end or at the lower end. (Sensor specification)
	B-axis	1) B-axis is unclamped. 2) Touch sensor is at the lower end.(Sensor specification)
Magazine Indexing		Sub arm is either at spindle side or at magazine pot position.

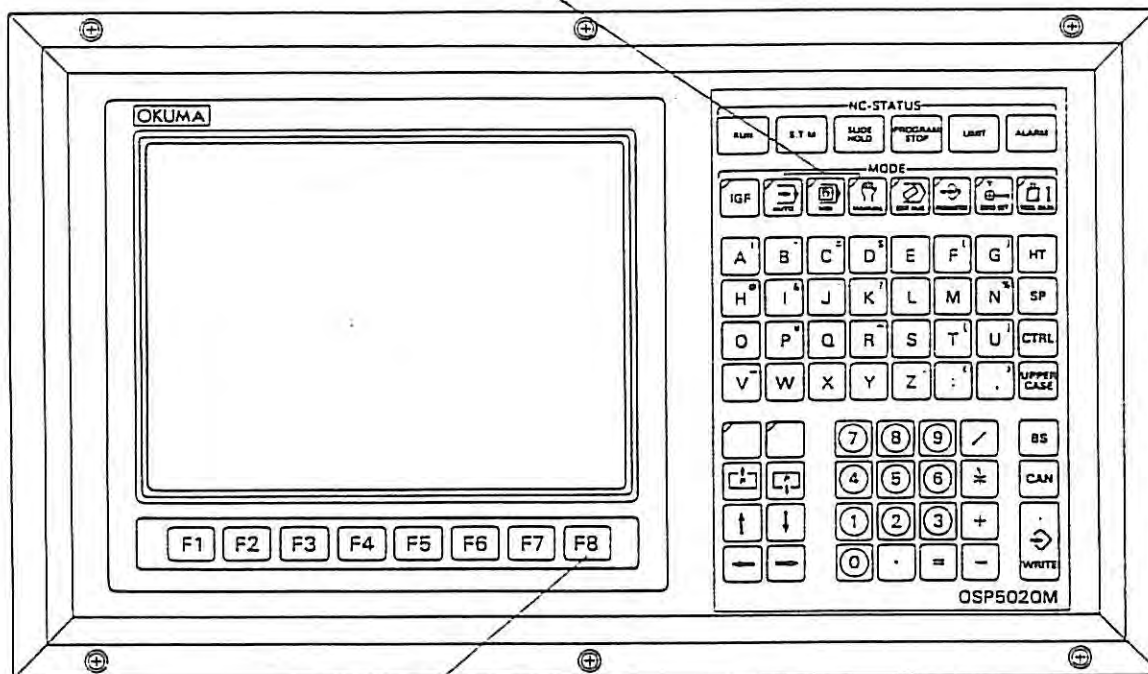
2. Diagnosis Message Display

The diagnose message display function indicates conditions required for the intended step but not satisfied on the display.

This message display function can be indicated in the automatic, MDI and manual modes.

Operation Procedure:

1) Press any of **AUTO**, **MANUAL** and **MDI** keys.



2) Press function key [F8] (EXTEND).

1) Press any of **AUTO**, **MDI** and **MANUAL** keys.

The function keys are assigned the same functions for [F2] through [F8]. Functions available with function key [F1] depends on the mode selected:

=CII							
=							
PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH		CHECK DATA	[EXTEND]
F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8

AUTO	.....	PROGRAM SELECT
MDI	.....	DATA INPUT
MANUAL	.....	None

- 2) Press function key [F8] (EXTEND).

This changes function key guide messages.

LIBRARY P SET		TOOL DISPLAY	PER- SONAL	DIAG- NOSIS		MESSAGE	[EXTEND]
F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8

- 3) Press function key [F5] (DIAGNOSIS).

- 3) Press function key [F5] (DIAGNOSIS).

The diagnose messages will be displayed on the CRT.

The messages displayed are indicated on the following pages.

Diagnosis Message List

- 3000 X-axis servo is not OK**
This message is displayed when the X-axis servo drive unit ON signal is not turned on.
- 3001 Y-axis servo is not OK**
This message is displayed when the Y-axis servo drive unit ON signal is not turned on.
- 3002 Z-axis servo is not OK**
This message is displayed when the Z-axis servo drive unit ON signal is not turned on.
- 3005 B-axis servo is not OK**
This message is displayed when the B-axis servo drive unit ON signal is not turned on.
- 3006 C-axis servo is not OK**
This message is displayed when the C-axis servo drive unit ON signal is not turned on.
- 3011 B-axis UNCLAMP LS is not ON**
This message is displayed when the B-axis unclamp LS is not turned on when the B-axis rotation command is given.
- 3012 C-axis UNCLAMP LS is not ON**
This message is displayed when the C-axis unclamp LS is not turned on when the C-axis rotation command is given.
- 3029 B-axis CLAMP LS is not OFF**
This message is displayed when the B-axis clamp LS is not turned off when the B-axis rotation command is given.
- 3030 C-axis CLAMP LS is not OFF**
This message is displayed when the C-axis clamp LS is not turned off when the C-axis rotation command is given.

3031 ATC sequence is in axis move inhibit

An interlock is provided to disable axis movements while the tool change arm is not in the standby position.

That is, axis movements are disabled if the ATC operation sequence number is within the range indicated below. To operate the axes, advance or return the ATC operation sequence number through the keys on the operation panel.

11, 19

3032 APC sequence is in axis move inhibit

In the sequences from pallet door open to pallet door close, axis movements are disabled except the sequences in which the pallet on the table should move.

That is, X-axis and B-axis movement is disabled if the ATC operation sequence number is within the range indicated below.

3 - 15

3039 Spindle is not constant rotation

This message is displayed when the spindle is not rotating at a constant speed or the constant rotation signal in the spindle drive unit is not turned on.

The spindle "constant rotation" refers to the state in which the spindle is rotating at a speed within $\pm 20\%$ of the programmed speed.

3040 Spindle has not stopped

This message is displayed when the spindle speed is not below 5 rpm or the spindle zero speed signal in the spindle drive unit is not turned on. For the automatic tool change cycle, an interlock is provided to disable the tool change arm operations (tool change arm rotation and tool change arm advance/retraction) unless the spindle is at a still. This message is displayed to inform that tool change arm movement is required under the interlocked state.

In other words, the message is displayed when the spindle is not at a still when the ATC operation sequence number is within the following range:

9 - 11, 15 - 19

3041 ATC sequence is in spindle rotation inhibit

An interlock is provided so that the spindle will not start if the tool change arm is not at the retract position.

That is, the spindle rotation is disabled when the ATC operation sequence number is within following range. If the spindle rotation command is active under this condition, this message is displayed.

11, 19

3052 External M command answer back is not ON

This message is displayed until the external M completion signal is turned on when an external M signal (M181 - M199) is given.

3053 External M command answer back is not OFF

The OSP5020M assumes that the external M signal (M181 - M199) is completed at the time the answer back signal is turned off after it has been turned on once. Therefore, this message is displayed while the answer back signal stays on.

3054 Touch sensor ADVANCE LS is not ON

This message is displayed until the advance end confirmation LS is turned on when the touch sensor advance command (M144) is given.

3055 Touch sensor RETRACT LS is not ON

This message is displayed until the retract end confirmation LS is turned on when the touch sensor retract command (M145) is given.

An interlock is provided to preclude axis movements unless the touch sensor retract confirmation LS is turned on. This message is displayed if an axis move command is designated while the touch sensor retract confirmation LS is not turned on.

3133 Spindle drive unit is not READY

This message is displayed if the spindle ready completion signal from the spindle drive unit is not ON when the spindle rotation command is given.

3150 Spindle orientation is not completed

For the automatic tool change cycle, an interlock is provided to disable the tool change arm operations (rotation, insert, or extract) unless the spindle is orient-stopped. That is, the ATC cannot operate and this alarm is displayed if the spindle is not orient-stopped while the ATC operation sequence number is within the following range:

8

Note: The spindle orientation position is set at SPINDLE ORIENT of the machine system parameter (long word) No. 48.

3151 HP 1 is not completed

In the tool change cycle, the ATC operation sequence might not advance to the next unless any of the axes is located at the tool change position. This message is displayed under such conditions.

This message is displayed under such conditions.

10 - 11, 18 - 19 . . X-/Y-/Z-axis

3153 HP 3 is not completed

For the automatic pallet change cycle, the APC operation might not advance to the next sequence unless any of the axes is located at the pallet position. This message is displayed under such conditions.

The axes which must be at the pallet change position are as follows:

2 X-/Z-/B-axis

The pallet change position of individual axes is set by the HOME POSITION 3 of system parameter.

3183 Magazine index is not completed

For the automatic tool change operation, the ATC operation might not advance to the next sequence unless the magazine pot is indexed in position. This message is displayed under such conditions.

The ATC operation will not advance to the next sequence if the magazine pot is indexed in position while the ATC operation sequence number is within the following range:

2 - 4, 15 - 16

3188 ATC sequence is in magazine index inhibit

In the automatic tool change cycle, magazine rotation is disabled when the ATC operation sequence number is within the following range. This message is displayed under such conditions.

3 - 5, 12 - 14, 16 - 18, 22 - 24

3189 Magazine pot is safety tool

This message is displayed when the pot for which a dummy tool is assigned is indexed to the tool change position while the ATC operation sequence number is within the following range:

2, 13

3191 Magazine manual interruption is not OFF

The magazine manual interruption is given a top priority and this message is displayed if the operation other than magazine rotation is attempted while the magazine manual interruption signal is on.

That is, if any switch on the ATC operation panel or the machine operation panel is touched while the **MG MANUAL - MANUAL INT.** switch is on, then this message is displayed.

This message is also displayed if the magazine manual interruption switch is turned on while the M06 command is being executed.

3192 Spindle tool CLAMP LS is not ON (manual)

The procedure to clamp the tool in the spindle is as follows:

Press the **TOOL CHANGE CYCLE** button on the manual tool change operation panel first. Then, press the **TOOL UNCLAMP** button and the **TOOL CLAMP** button in this sequence. This message is displayed if the spindle tool clamp LS is not turned on after the completion of the sequence above.

3193 Spindle tool CLAMP LS is not OFF (manual)

The procedure to unclamp the tool in the spindle is as follows:

Press the **TOOL CHANGE CYCLE** button on the manual tool change operation panel first, then, press the **TOOL UNCLAMP** button. This message is displayed when the spindle tool clamp LS is not turned off after the completion of the sequence above.

3194 Spindle tool UNCLAMP LS is not ON (manual)

The tool in the spindle is unclamped when the **TOOL CHANGE CYCLE** and the **TOOL UNCLAMP** buttons on the manual tool change operation panel in this sequence. This message is displayed when the spindle tool unclamp LS is not on after the completion of the operations above.

3195 Spindle tool UNCLAMP LS is not OFF (manual)

When exchanging tools manually, the operator should press the **TOOL CHANGE CYCLE** button on the manual tool change operation panel first and then press the **TOOL UNCLAMP** button. This allows the tool in the spindle to be removed and the operator can set a new tool in the spindle. Then, he should press the **TOOL CLAMP** button to clamp the tool in the spindle. This message is displayed when the tool in the spindle unclamp confirmation signal is not off at this point.

3192 Spindle tool CLAMP LS is not ON (automatic)

The spindle tool unclamp signal is off while the ATC operation sequence number is within a certain range. In this case, if the spindle tool clamp LS is not on, this message is displayed. The range of ATC operation sequence numbers where the spindle tool clamp signal is not on is as follows:

1 - 24

3195 Spindle tool UNCLAMP LS is not OFF (automatic)

This message is displayed if the spindle tool unclamp confirmation signal is not off when the ATC operation sequence number is within the following range:

1 - 24

3192 Spindle tool CLAMP LS is not ON (belleville spring)

The procedure to clamp the tool in the spindle is as follows:

Press the **TOOL CHANGE CYCLE** button on the manual tool change operation panel first. Then, press the **TOOL UNCLAMP** button and the **TOOL CLAMP** button in this sequence. This message is displayed if the spindle tool clamp LS is not turned on after the completion of the sequence above.

The spindle tool unclamp signal is off while the ATC operation sequence number is within a certain range. In this case, if the spindle tool clamp LS is not on, this message is displayed. The range of ATC operation sequence numbers where the spindle tool clamp signal is not on is as follows:

1, 22 - 24

3194 Spindle tool UNCLAMP LS is not ON (belleville spring)

The tool in the spindle is unclamped when the **TOOL CHANGE CYCLE** and the **TOOL UNCLAMP** buttons on the manual tool change operation panel in this sequence. This message is displayed when the spindle tool unclamp LS is not on after the completion of the operations above.

The spindle tool unclamp signal stays on while the ATC operation sequence number is within a certain range. This message is also displayed if the spindle tool unclamp confirmation signal is not on under such conditions. The ATC operation sequence number range where the spindle tool unclamp signal is on is as follows:

10 - 19

3222 Sub arm magazine LS is not ON

This message is displayed when the sub arm magazine position confirmation LS is not on when the ATC operation sequence number is within the following range:

1 - 4, 12 - 17, 22 - 24

3223 Sub arm magazine LS is not OFF

This message is displayed when the sub arm magazine position confirmation LS is not off when the ATC operation sequence number is within the following range:

5 - 11, 18 - 21

3224 Sub arm RETRACT LS is not ON

This message is displayed when the sub arm retract position confirmation LS is not on when the ATC operation sequence number is within the following range:

4 - 12, 17 - 22

3225 Sub arm RETRACT LS is not OFF

This message is displayed when the sub arm retract position confirmation LS is not off when the ATC operation sequence number is within the following range:

1 - 3, 13 - 16

3260 Sub arm ADVANCE LS is not ON

This message is displayed when the sub arm advance position confirmation LS is not on when the ATC operation sequence number is within the following range:

1 - 3, 13 - 16, 23 - 24

3261 Sub arm ADVANCE LS is not OFF

This message is displayed when the sub arm advance position confirmation LS is not off when the ATC operation sequence number is within the following range:

4 - 12, 17 - 22

3352 Tool change arm door OPEN LS is not ON

This message is displayed when the tool change arm door open confirmation LS is not on when the ATC operation sequence number is within the following range:

10 - 20

3353 Tool change arm door CLOSE LS is not ON

This message is displayed when the tool change arm door close confirmation LS is not on when the ATC operation sequence number is within the following range:

22 - 23

3358 Tool change arm retract position LS is not ON

This message is displayed when the tool change arm retract position confirmation LS is not on when the ATC operation sequence number is within the following range:

1 - 24

3366 Sub arm spindle LS is not ON

This message is displayed when the sub arm spindle position confirmation LS is not on when the ATC operation sequence number is within the following range:

5 - 11, 18 - 21

3367 Sub arm spindle LS is not OFF

This message is displayed when the sub arm spindle position confirmation LS is not off when the ATC operation sequence number is within the following range:

1 - 4, 12 - 17, 22 - 24

3368 Sub arm GRIP LS is not ON

This message is displayed when the sub arm grip confirmation LS is not on when the ATC operation sequence number is within the following range:

3 - 13, 16 - 23

3370 Sub arm UNGRIP LS is not ON

This message is displayed when the sub arm ungrip confirmation LS is not on when the ATC operation sequence number is within the following range:

1 - 2, 14 - 15, 24

3400 APC manual interruption is not OFF

This message is displayed when the **MANUAL INT.** switch on the manual APC operation panel is turned on while the pallet change command (M60 for rotary type 2-pallet APC) is being executed.

This message is also displayed when any of the APC operation switches on the machine operation panel is operated with the **MANUAL INT.** switch turned on since the setting of the **MANUAL INT.** switch is given top priority.

3401 Work setup is not completed

This message is displayed when the work setup has not been completed on the pallet to be exchanged when the pallet change command (M60 for rotary type 2-pallet APC) is issued.

The work setup completion is confirmed by the pressing of the **SETUP COMPLETION** button.

3414 Pallet seated PS is not ON

This message is displayed when the pallet seated confirmation PS is not on when the APC operation sequence number is within the following range:

9

3418 Pallet UNCLAMP LS is not ON

This message is displayed when the pallet unclamp confirmation LS is not on when the APC operation sequence number is within the following range:

4 - 7

3566 Pallet UNGRIP LS is not ON

This message is displayed when the pallet ungrip confirmation LS is not on when the APC operation sequence number is within the following range:

1 - 4, 7 - 9

3567 Pallet UNGRIP LS is not OFF

This message is displayed when the pallet ungrip confirmation LS is not off when the APC operation sequence number is within the following range:

5 - 6

SECTION 6 MACHINE OPERATIVE CONDITIONS, DIAGNOSIS MESSAGES AND LOGIC TABLES

3568 Pallet GRIP LS is not ON

This message is displayed when the pallet grip confirmation LS is not on when the APC operation sequence number is within the following range:

5 - 6

3569 Pallet GRIP LS is not OFF

This message is displayed when the pallet grip confirmation LS is not off when the APC operation sequence number is within the following range:

1 - 4, 7 - 9

3582 APC arm standby POS. is not completed

This message is displayed when the APC arm is not positioned at the arm standby position when the APC operation sequence number is within the following range:

2, 9

3583 APC arm grip POS. A is not completed

This message is displayed when the APC arm is not positioned at the arm pallet gripping position A when the APC operation sequence number is within the following range:

3

3584 APC arm grip POS. B is not completed

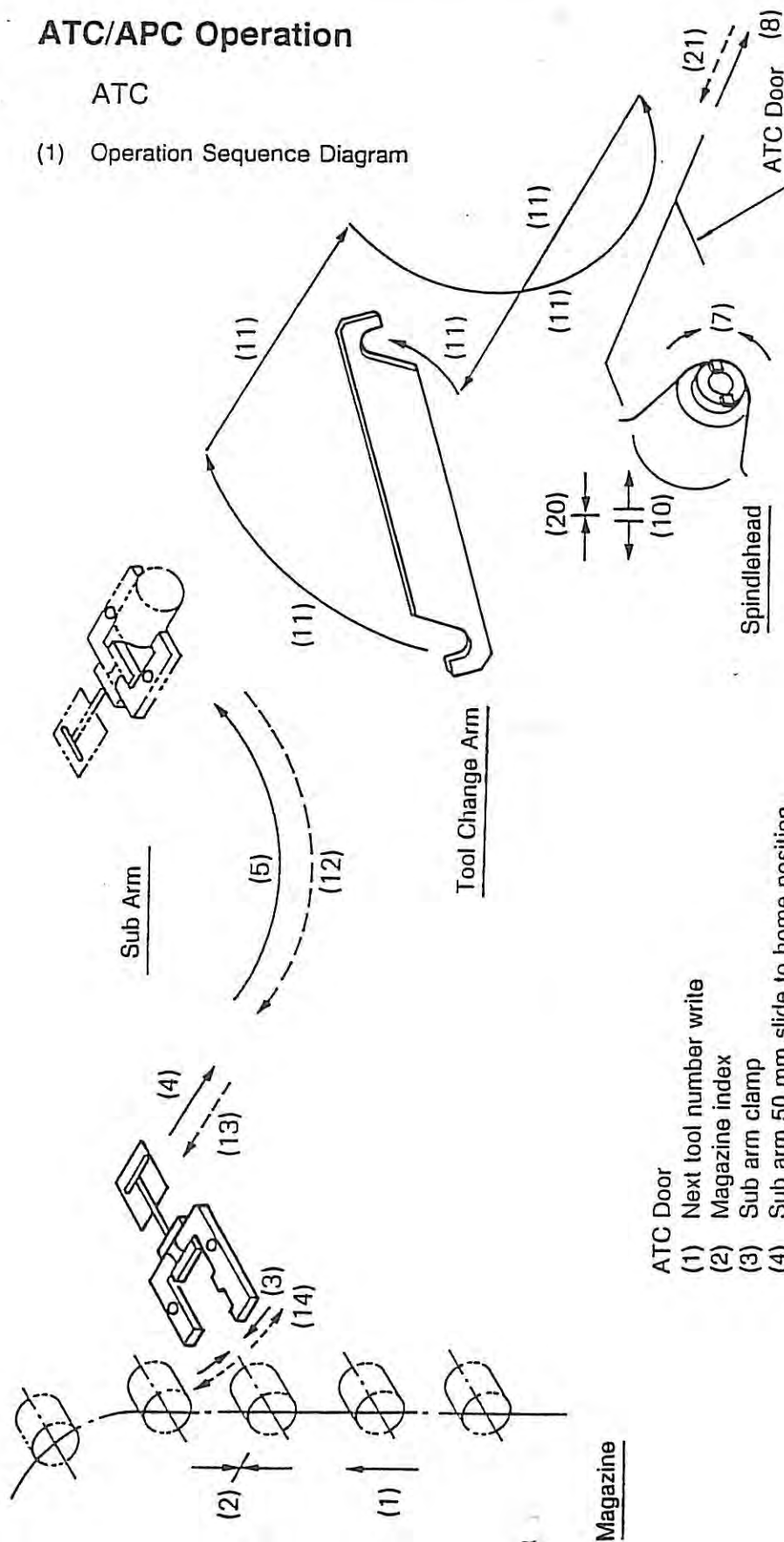
This message is displayed when the APC arm is not positioned at the arm pallet gripping position B when the APC operation sequence number is within the following range:

6

3. ATC/APC Operation

3-1. ATC

(1) Operation Sequence Diagram



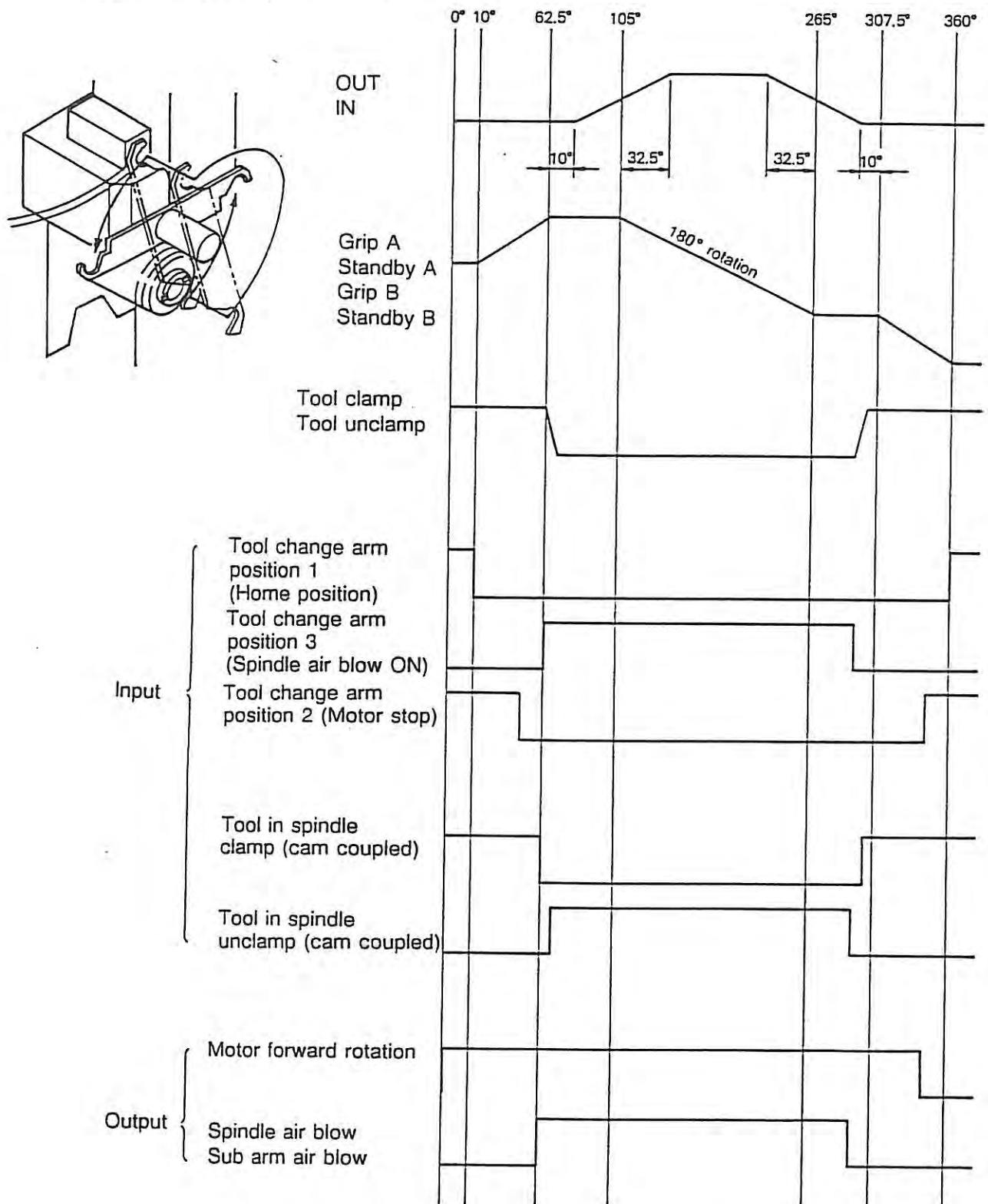
ATC Door

- (1) Next tool number write
- (2) Magazine index
- (3) Sub arm clamp
- (4) Sub arm 50 mm slide to home position
- (5) Sub arm swing to spindle side
- (6) Waiting for M06
- (7) Spindle index
- (8) ATC door open
- (9) Shift to tool change position
- (10) Spindle Belleville spring unclamp
- (11) Tool change arm rotation
- (12) Sub arm swing to magazine side
- (13) Sub arm slide to toolpot
- (14) Sub arm unclamp

11 TURNS 2-1
12 22
13 23
14 24

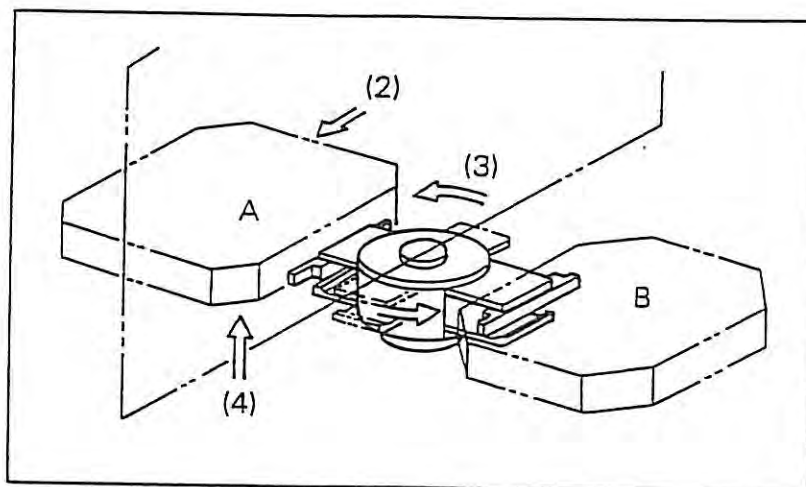
Magazine

(2) Timing Chart for Tool Change Arm Motion

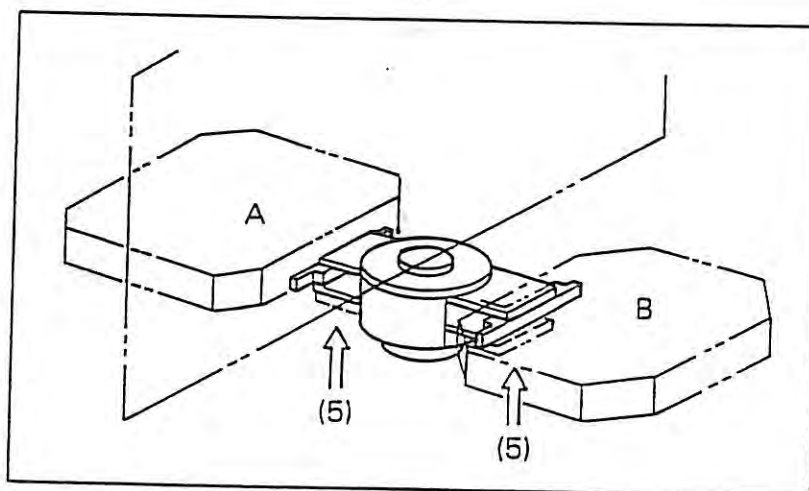


Tool unclamp after the tool change arm has gripped the cutting tool in the sub arm and tool clamp after the tool change arm has inserted the cutting tool to the sub arm are both controlled by the tool change arm drive cam.

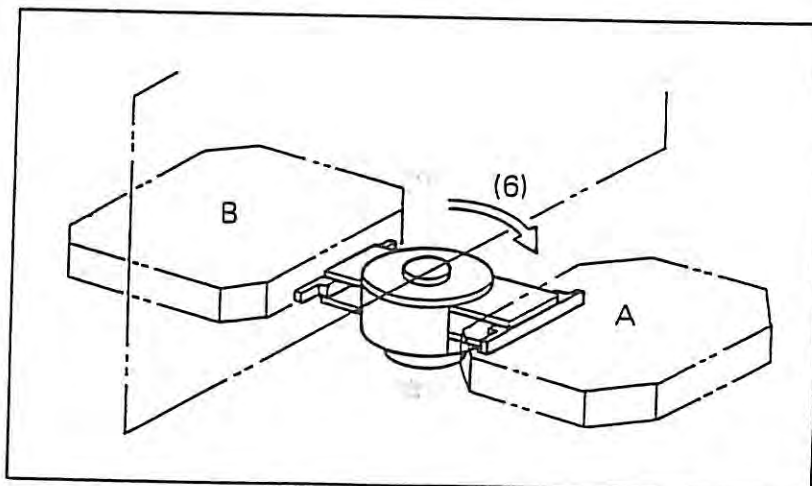
3-2. Rotary Type 2-pallet APC



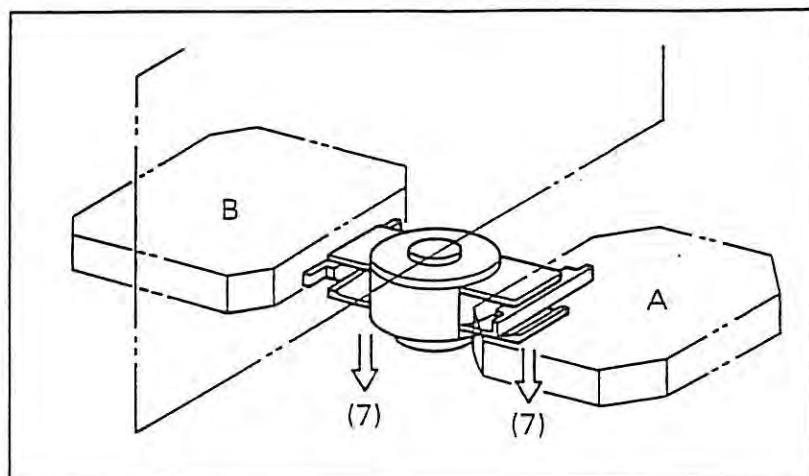
- (1) APC ready position
Work setup completion confirmation
- (2) X-/Z-axis positioning at pallet change position
- (3) Gripper arm at A pallet position
Gripper arm 90° rotation
- (4) Pallet unclamp



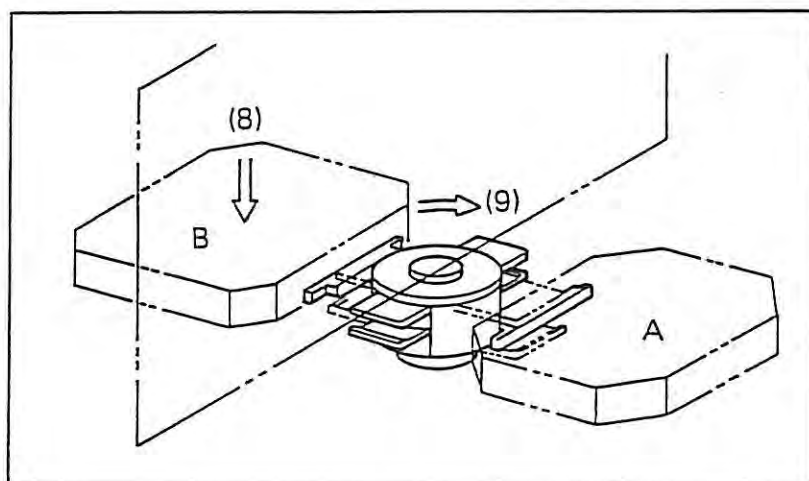
- (5) Pallet grip



- (6) Gripper arm at B pallet position
Gripper arm 180° rotation



(7) Pallet ungrip



(8) Pallet clamp

(9) Gripper arm at ready position
Gripper arm 90° rotation

Conditions for Automatic Pallet Change Operations:

- a) A pallet is set on the machine.
- b) Another pallet is set on the APC. Note that pallet change operation always requires two pallets.
- c) The pallet on the APC is positioned at the correct position (in position) by means of the location pin.
- d) The **SETUP COMPLETION** button is pressed.

The work setup completion state can be canceled by turning the **APC MANUAL INT.** selector switch in the ON position.

- e) NC operation mode is either automatic or MDI.

4-2. Code Table for System Condition Judgment

Code Table for ATC System Condition Judgment

The code number below is displayed with the alarm message "911 ATC system condition".

A test

- (101) Sub arm at spindle side confirmation LS is not ON.
- (102) Sub arm at magazine side confirmation LS is not ON.
- (104) Sub arm grip confirmation LS is not ON.
- (108) Sub arm ungrip confirmation LS is not ON.
- (110) Sub arm at magazine pot position confirmation LS is not ON.
- (120) Sub arm at home position confirmation LS is not ON.
- (140) Sub arm tool in the toolpot confirmation LS is not ON.
- (180) No magazine toolpot empty confirmation LS is not ON.
- (201) Spindle belleville spring clamp confirmation LS is not ON.
- (202) Spindle belleville spring unclamp confirmation LS is not ON.
- (204) Automatic tool in spindle clamp confirmation LS is not ON.
- (301) ATC door open confirmation LS is not ON.
- (302) ATC door close confirmation LS is not ON.
- (304) Tool change arm at home position confirmation LS is not ON.
- (601) Tool change arm rotation is not complete.
- (701) Spindle is not orient-stopped.
- (702) Spindle does not stop.
- (802) Magazine index is not completed.
- (901) Positioning to the tool change position (HP 1) is not complete.

B test

- (1101) Sub arm at spindle side confirmation LS is not OFF.
- (1102) Sub arm at magazine side confirmation LS is not OFF.
- (1104) Sub arm grip confirmation LS is not OFF.
- (1108) Sub arm ungrip confirmation LS is not OFF.
- (1110) Sub arm at magazine pot position confirmation LS is not OFF.
- (1120) Sub arm at home position confirmation LS is not OFF.
- (1204) Automatic tool in spindle clamp confirmation LS is not OFF.
- (1208) Automatic tool in spindle unclamp confirmation LS is not OFF.

Code Table for APC System Condition Judgment

The code number below is displayed with the alarm message "912 APC system condition".

A test

- (102) Pallet ungrip confirmation LS is not ON.
- (104) Pallet grip confirmation LS is not ON.
- (108) Pallet unclamp confirmation LS is not ON.
- (110) Pallet seated confirmation LS is not ON.
- (120) B-axis clamp confirmation LS is not ON.
- (B01) Gripper arm positioning to the pallet gripping position (B-position) is not complete.
- (B02) Gripper arm positioning to the pallet gripping position (A-position) is not complete.
- (B04) Gripper arm positioning to the standby position is not complete.

B test

- (1102) Pallet ungrip confirmation LS is not OFF.
- (1104) Pallet grip confirmation LS is not OFF.
- (1108) Pallet unclamp confirmation LS is not OFF.
- (1280) APC manual intervention button is not OFF.

4. Manual ATC Operation

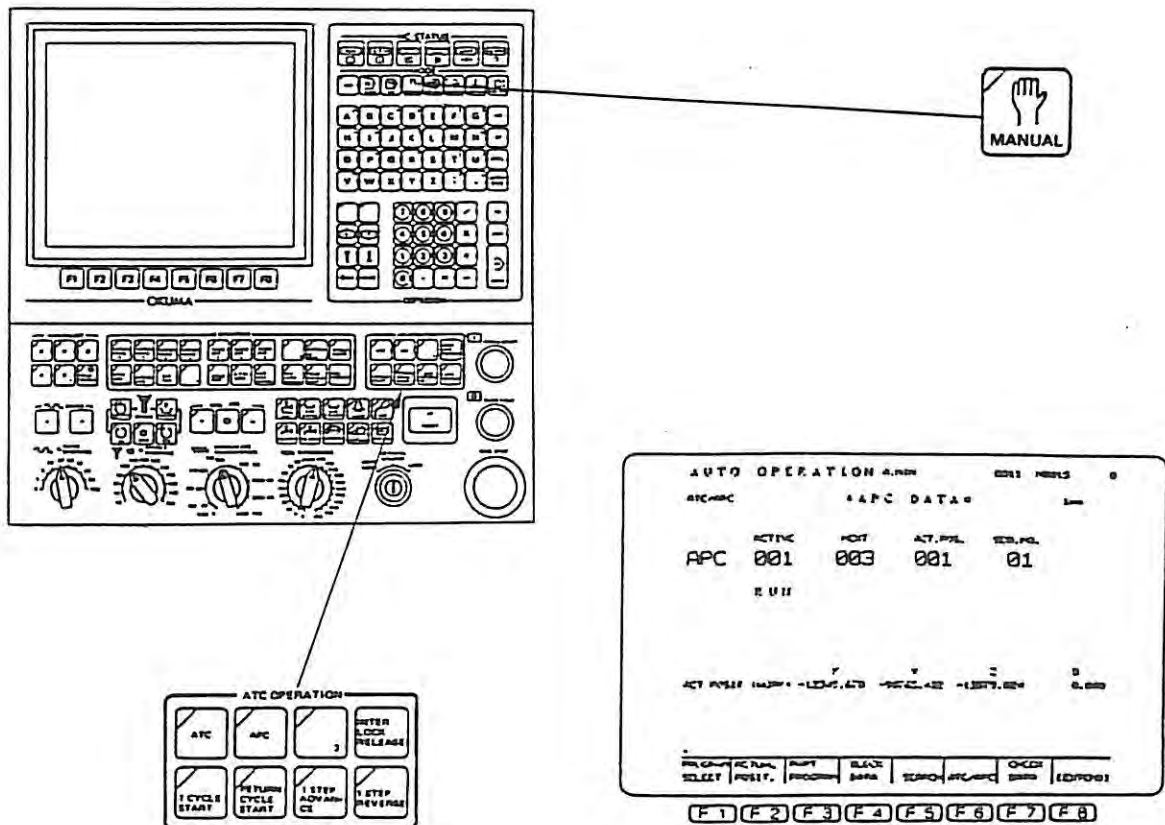
The automatic tool changer can be manually operated in addition to the automatic operation in the AUTO or MDI modes by the controls on the pendant operation panel.

4-1. One Step Advance and One Step Reverse

In the one step advance and one step reverse operation, the automatic tool change cycle advances or reverses according to its operation sequence. This type of operation is not carried out during normal machine operation. However, such operation becomes necessary for checking the ATC operation or in locating the ATC at a sequence. This allows the return to initial conditions for the automatic tool changing cycle after the EMG. STOP button has been pressed.

Procedure:

- (1) Press the MANUAL key.
- (2) Press the ATC key under ATC operation section on the main operation panel.
- (3) Press either the 1 STEP ADVANCE or the 1 STEP REVERSE key.



4-2. One Cycle Start and Return Cycle Start

The **1 CYCLE START** key initiates a series of tool change cycles in which the tool picked up from the magazine is set in the spindle and the tool that was set in the spindle is returned to the magazine.

The operation is possible when the **READY** lamp is ON.

The **RETURN CYCLE START** key is used for carrying out the remaining cycle if the automatic tool change cycle has been interrupted.

4-3. Precautions for Manual ATC Operation

- (1) When the **RUN** lamp is on, ATC operation keys such as **1 CYCLE START**, **RETURN CYCLE START**, **1 STEP ADVANCE** and **1 STEP REVERSE** are inoperative.

Press the **RESET** button to turn off the **RUN** lamp.

- (2) If the **EMG. STOP** button is pressed while the tool change arm is operating, the signals **AHP** (Y- and Z-axis tool change position) and **SHP** (spindle orientation completion) turn off. In this case, the **1 STEP ADVANCE**, **1 STEP REVERSE** and **RETURN CYCLE START** keys sometimes become inoperative. In this case, press the **1 STEP ADVANCE** key while pressing the **INTERLOCK RELEASE** key, and the tool change sequence advances to the next.
- (3) The tool in the spindle will be clamped when the automatic tool change cycle is interrupted by the activation of the **EMG. STOP** button. This causes the **1 STEP ADVANCE**, **1 STEP REVERSE** and **RETURN CYCLE START** keys to be inoperative. In this case press the **TOOL UNCLAMP** button on the operation panel at the side of the main operation panel.

5. Initial Conditions for Continuous ATC Operation

In the AUTO and MDI mode operation, the automatic tool change cycle is carried out when the following commands are given:

Tool number command 2-digit T code

Tool change command M06 (M19 spindle orientation included)

However, it will be necessary to confirm that the following initial conditions have been met before pressing the **CYCLE START** pushbutton.

- (1) ATC sequence number should be "01".

This is the sequence reached when the sub arm has completed the tool return cycle. If the sequence number is not "01", set the tool change unit position to "01" in the 1 step operation explained in 4. "Manual ATC Operation".

- (2) Both the active and next tool numbers should be "00". If not, set them to "00".

AUTO OPERATION A. MIN 0011 00015 0

ATC APC *ATC DATA* 1==

	ACTIVE	NEXT	ACT. POS.	SEQ. NO.
ATC	000	000	020	01
RUN				

(2) Both of them must be "00"

(1) This must indicate "01"

ACT POSIT (WORK) X Y Z B

 -12345.678 -98765.432 -13579.024 0.000

-PO
-PR
-AT
=

PROGRAM SELECT	ACTUAL POSIT.	PART PROGRAM	BLOCK DATA	SEARCH	ATC/APC	CHECK DATA	[EXTEND]
F1	F2	F3	F4	F5	F6	F7	F8

- (3) The mode selected should be either AUTO or MDI.

In addition to the conditions indicated above, other preparatory steps necessary for starting the automatic operation must be performed in advance.

6. Automatic Tool Change Sequence

When any of the tool numbers T01 through T32 are specified, they are displayed as NEXT TOOL NUMBER and the magazine indexes the toolpot corresponding to the specified tool number. Then sub arm removes the tool from the toolpot, transfers it to the ready station. The ready station moves to SPINDLE position and waits for an M06 command. Upon execution of M06, the spindlehead moves to the tool change position and the spindle orientation is carried out. The tool change arm exchanges the new and old tools and returns the old tool to the magazine.

In final machining which requires no next tool, specify M63. With an M63 command, the sub arm and ready station do not transfer any tool from the magazine but carry out only the tool return cycle.

When next process tool preparatory operation is attempted during end face finish cutting, there might be cases in which the finished surface is affected. In such cases, designate the dwell command.

A series of tool change cycles are indicated in the diagram provided on the following pages. ATC sequence numbers are displayed on the ATC DATA display unit on the pendant operation panel.

The following pages provide details on the tool change cycle.

Machine & Control	Operation	Sequence No. <i>MCTATC</i>
-------------------	-----------	----------------------------

"CYCLE START"

TOOL NUMBER COMMAND
"T01" for example to be used
for the initial process

Spindle Orientation
Positioning of X-/Y-/Z-axis
Table Indexing

TOOL CHANGE COMMAND
(M06)

Positioning of X-/Y-/Z-axis
(Start of Cutting)

Preparation of Tool No. 1

- (1) : Next tool number [01] is displayed.
- (2) : Magazine is indexed to T01.
- (3) : Sub arm toolpot clamp
- (4) : Sub arm slide for 50 mm to standby position
- (5) : Sub arm swing to spindle side

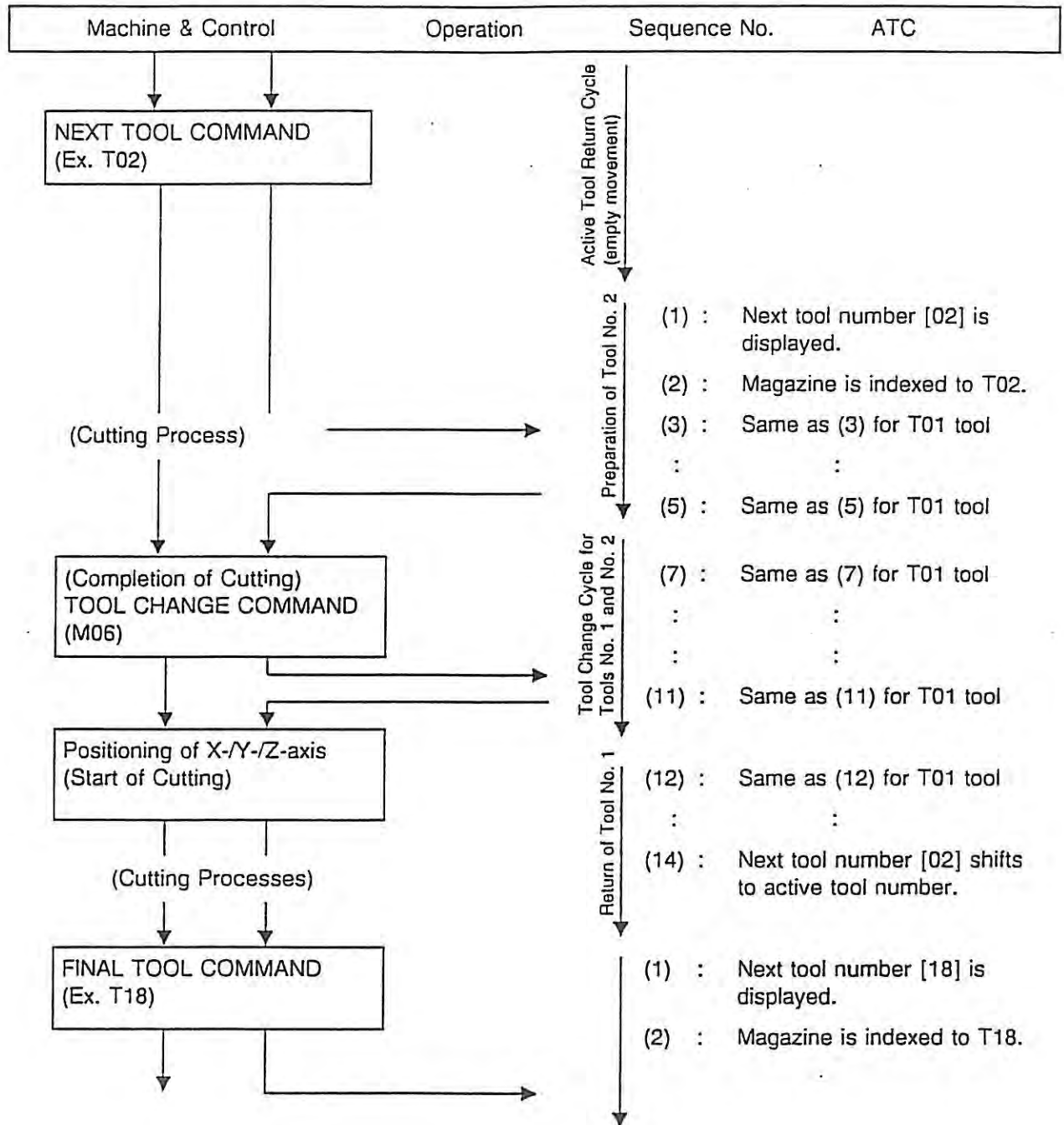
Tool Change Cycle for Tool No. 1

- (7) : Spindle orientation
- (8) : ATC arm cover open
- (10) : Spindle belleville spring unclamp
- (11) : ATC arm at tool grip position
- (11) : ATC arm tool extraction (ATC/spindle air blow)
- (11) : ATC arm 180° rotation
- (11) : ATC arm tool insertion (ATC/spindle air blow)
- (11) : Tool in spindle clamp
- (11) : ATC arm to standby position

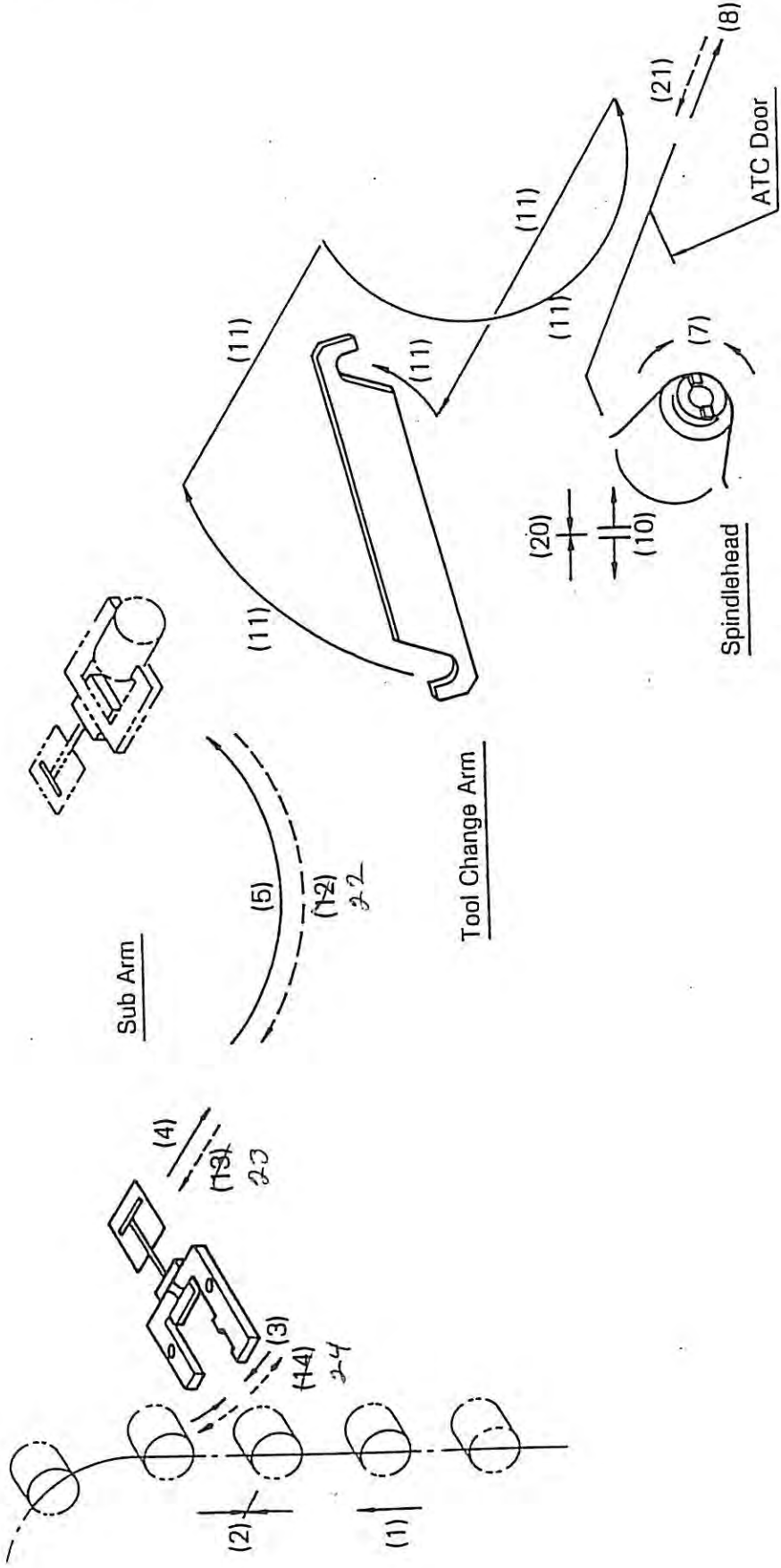
22 (12) : Sub arm swing to magazine side

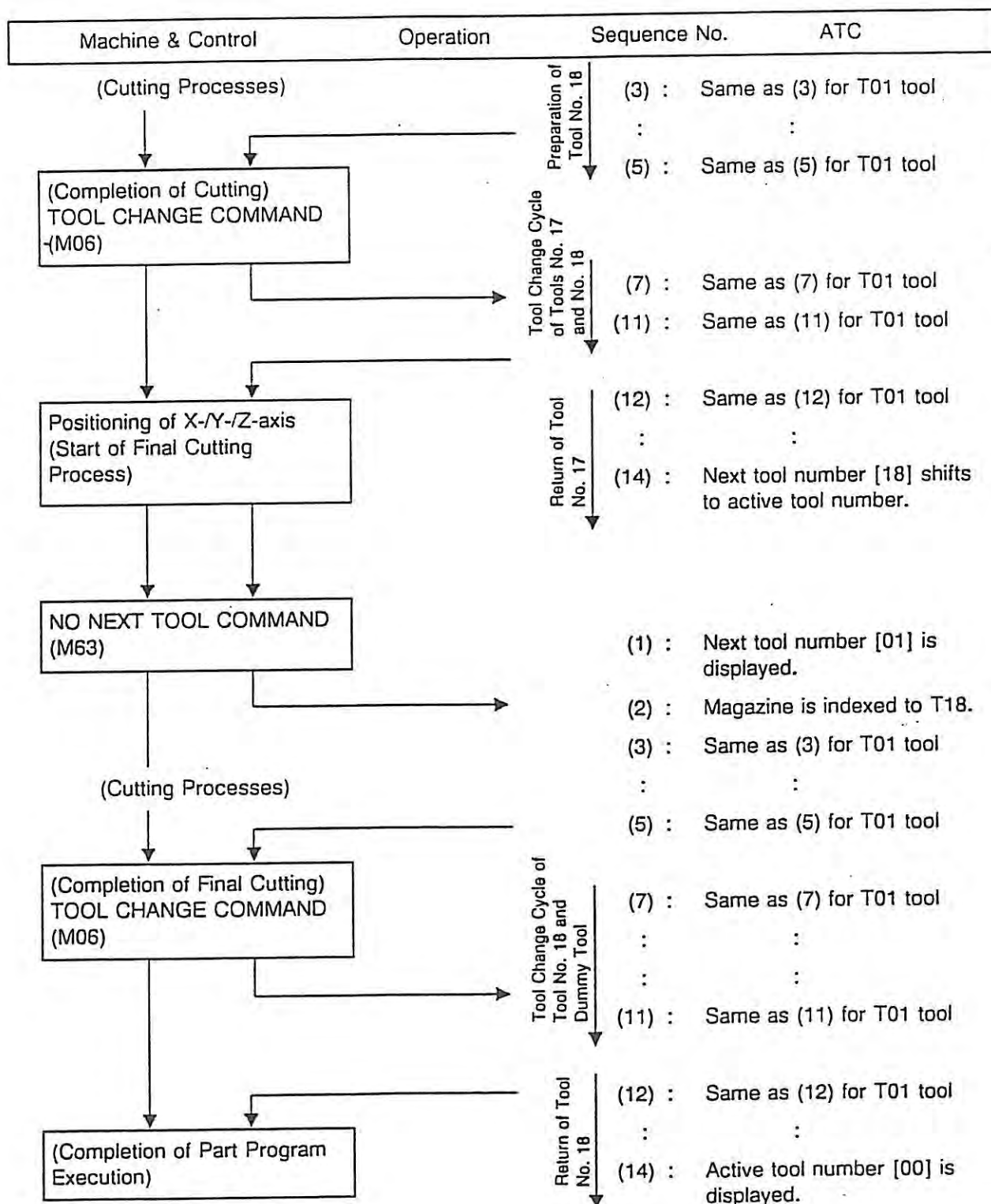
23 (13) : Sub arm slide to toolpot side

24 (14) : Sub arm toolpot unclamp



ATC Operation Position





7. Safety Precautions for ATC Operation

- (1) The tool change arm moves downward 118 mm (4.65 in.) from the spindle end face to extract the tool from the spindle bore. It then rotates 180°.

Make sure there is no interference between tool and workpiece before a tool change is made.

- (2) The magazine, tool change arm, and spindle are designed to grip the tool positively. However, tools with sharp cutting edges are turned around during ATC cycle and may drop due to interference with workpieces or covers. DO NOT get close or touch any parts during ATC cycle.
- (3) Dirt, dust, and chips on the guide rails of the magazine, the ready station, the sub arm, the tool change arm and other tool change units may cause an ATC malfunction. Clean from time to time. Avoid the use of compressed air when cleaning. The air could blow chips into working units and lead to major trouble. Cleaning and other maintenance work should never be made while the ATC is in motion.
- (4) Some tools get easily entangled with chips. Prevent chips from getting into the ATC (magazine).
- (5) Use the **EMERGENCY STOP** button to interrupt ATC operation. The **SLIDE HOLD** button on the pendant operation panel does not stop the cycle.

APC-Operation Name

4	Sub arm ungrasp → 1
5	Waiting for unloading cycle completion → 21
6	Tool change arm rotation → 20

[illegible]

-Rotary-Type 2-pallet-APC Output Logic

APC Operation Name

SQL Symbol

Ident tool number with

Magazine Index

Sub: **and** **and**

Sub aim scale to home position

These efforts at Dimes were good

Waiting for machining cycle end

Specific orientation

WEDNESDAY

Enjottia bellavillei novae maderensis

Tool changes are critical

Substrat zur Gewinnung von Nucleosiden

Sub arm slide to footpad position

Substrat

Mazurine Index

Sub menu

Sub team slide in home position

Sum now coming in quarterly

Spindle balling and spindle
restoration of broken wheels

AIC done / June

Sub-entubum ut dicitur in quibus

Subnet mask in dotted notation

Sich nicht angeln

[illegible]

12345678910

— 100 —

1

1000

10

1

100

[illegible]

1

SECTION 7 AUTOMATIC PALLET CHANGER (APC)

1. Outline of Rotary Type 2-pallet APC

(1) Construction

The APC consists of the automatic pallet changer frame, the gripper arm and the pallet clamber. The APC frame installed in front of the machine can hold pallets and is equipped with the servo driven gripper arm which swivels pallets. The pallet clamber is provided on the machine table.

When the machine is equipped with the splash guard, its door automatically rotates in synchronization with the pallet change cycle.

Positioning of a pallet on the machine table is made using two location pins and reference pads. High accuracy of pallet positioning on the machine table is assured by the air blower function which jets compressed air to the location pins and reference pads each time pallet rotation is carried out to blow chips and other foreign matter off them. Furthermore, the pallet seated conditions on reference pads are checked so that alarm signal will be outputted when any foreign matter between the pallet and pads is detected.

(2) Specifications

For pallet dimensions, refer to separately attached sheet.

	MC-400H
Pallet Standard	MAS405-1975
Pallet Dimensions	□400 mm (15.75 in.)
Maximum Load	400 kg (880 lb)

2. Pallet Change Operation Sequences

(1) Conditions for Automatic Pallet Change Operations

- a) A pallet is set on the machine.
- b) Another pallet is set on the APC. Note that pallet change operation always requires two pallets.
- c) The pallet on the APC is positioned at the correct position (in position) by means of the location pin.
- d) The **SETUP COMPLETION** button is pressed.

The work setup completion state can be canceled by turning the APC MANUAL INT. selector switch in the ON position.

- e) NC operation mode is either automatic or MDI.

(2) M Code

The M code to be programmed for automatic pallet change operation is M60.

M60	Automatic Pallet Change Cycle
-----	-------------------------------

(3) Operation Sequence

The pallet change cycle called by the M60 command is carried out in the following sequence.

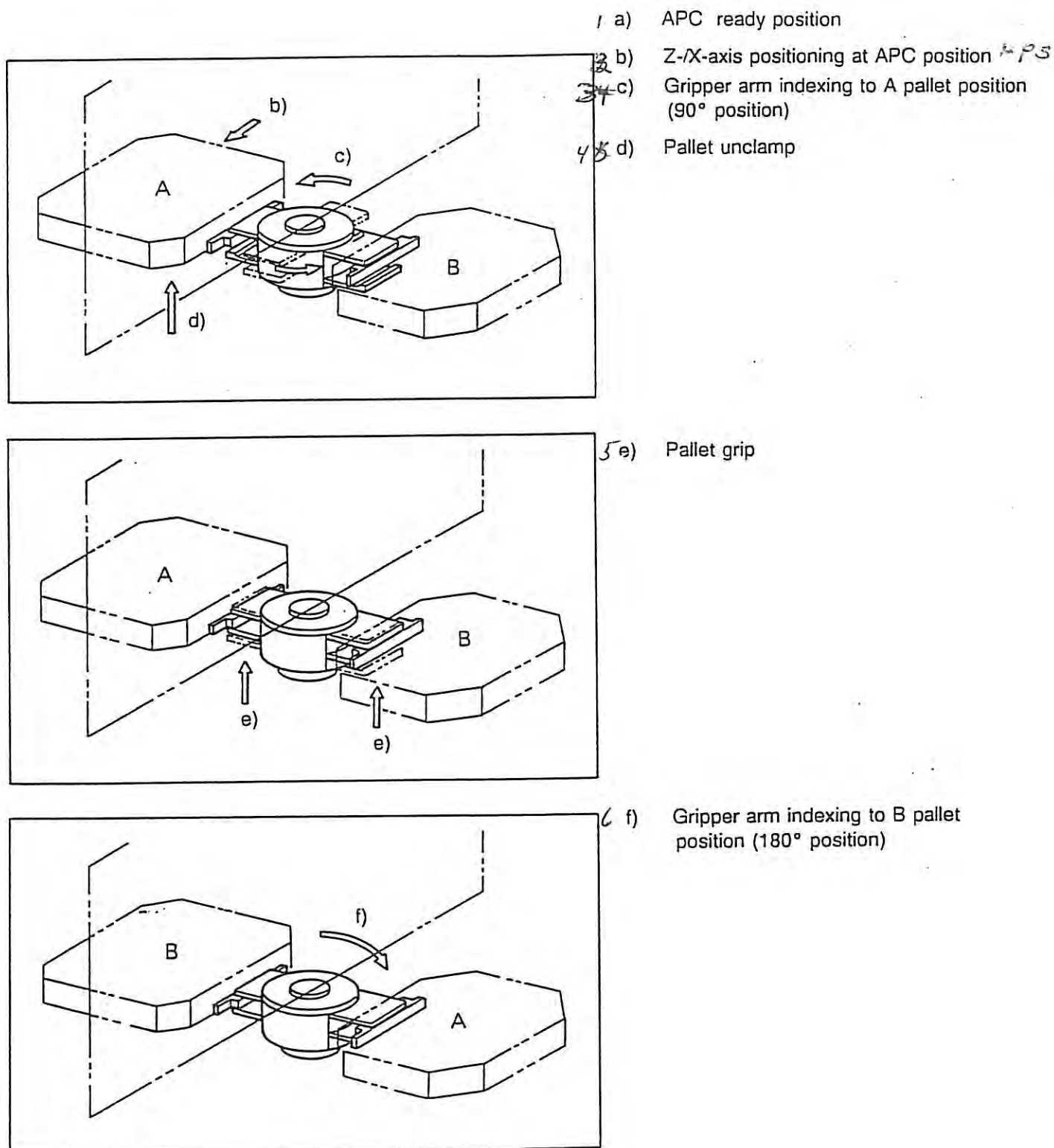
- a) APC at ready position

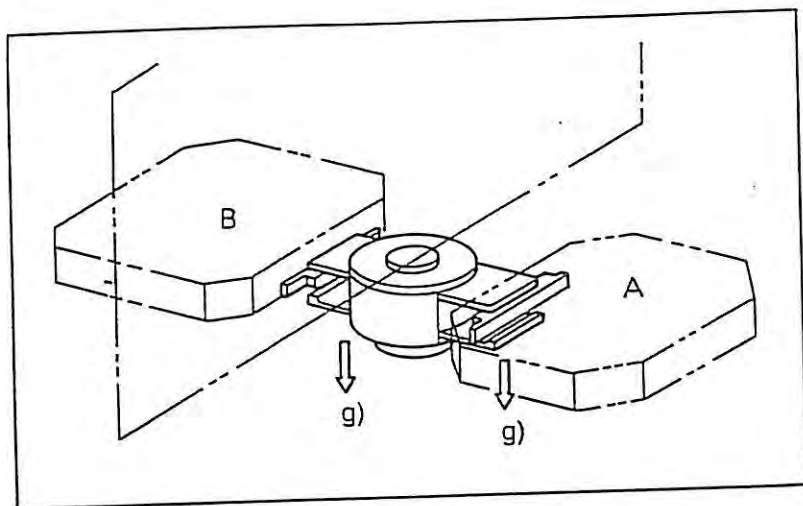
The NC checks whether the **SETUP COMPLETION** button has been pressed or not.

- b) X- and Z-axis positioning at L pallet change position
Machine table indexing to 0° position
- c) Gripper arm at A pallet position
- d) Pallet unclamp
- e) Pallet grip
- f) Gripper arm at B pallet position
- g) Pallet ungrip
- h) Pallet clamp
- i) Gripper arm at ready position

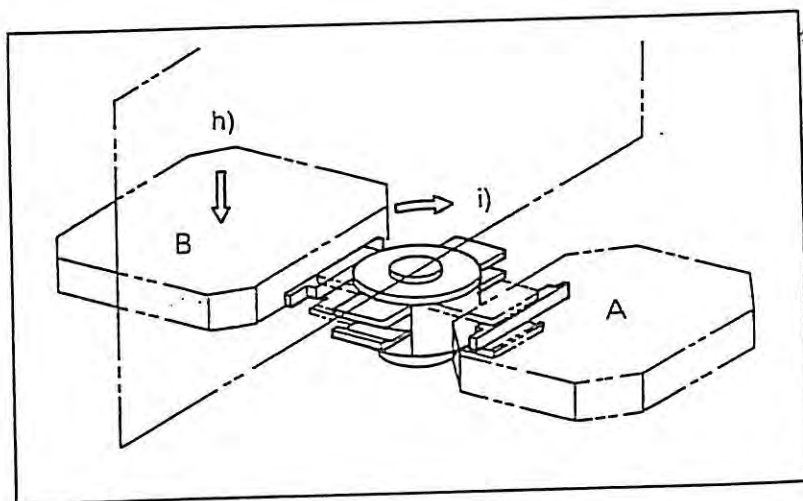
The cycle above assumes to change the pallet on the machine with the pallet at APC ready position.

3. Operation Sequence Diagram





7g) Pallet ungrip



h) Pallet clamp
i) Gripper arm indexing to APC ready position (90° position)

4. Initial Conditions for APC Continuous Operations

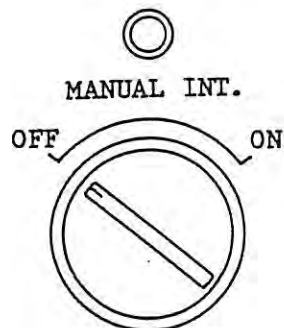
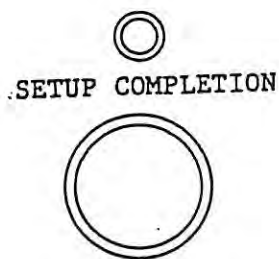
- (1) A pallet is placed on the machine.
- (2) Another pallet is set at the APC ready position.

The automatic operation using the automatic pallet changer always requires two pallets. Therefore, even when machining of only one workpiece is required, it is necessary to use two pallets.

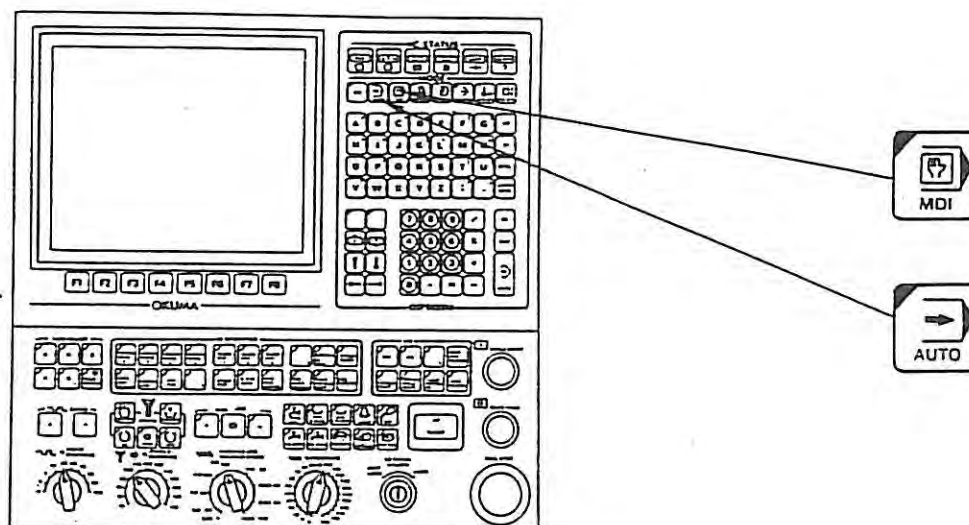
- (3) The pallet on the APC is positioned at the correct position (in-position) by means of the location pin.
- (4) **SETUP COMPLETION** button has been pressed.

After the completion of setting up on the pallet, this button should be pressed. The indicating lamp above the button comes on, enabling the next APC command. This button is provided to assure safety of the operator by preventing pallet change cycle start while work setting up is being carried out.

If the work setup completion status established by pressing the **SETUP COMPLETION** button is required to be canceled, turn the **MANUAL INT.** selector in the **ON (I)** position.



- (5) The operation mode selected should be either AUTO or MDI.



Under the conditions indicated above, the automatic pallet change cycle can be started in response to the M60 command when the **CYCLE START** button is pressed. The **CYCLE START** button is provided on the APC operation panel in addition to the main operation panel.

If it is required to stop the automatic pallet change cycle during its execution, press the **EMG. STOP** button. Note that the **SLIDE HOLD** button is provided for disabling axis movements and, therefore, it is not effective to interrupt the automatic tool and pallet change cycles.

5. Manual APC Operations

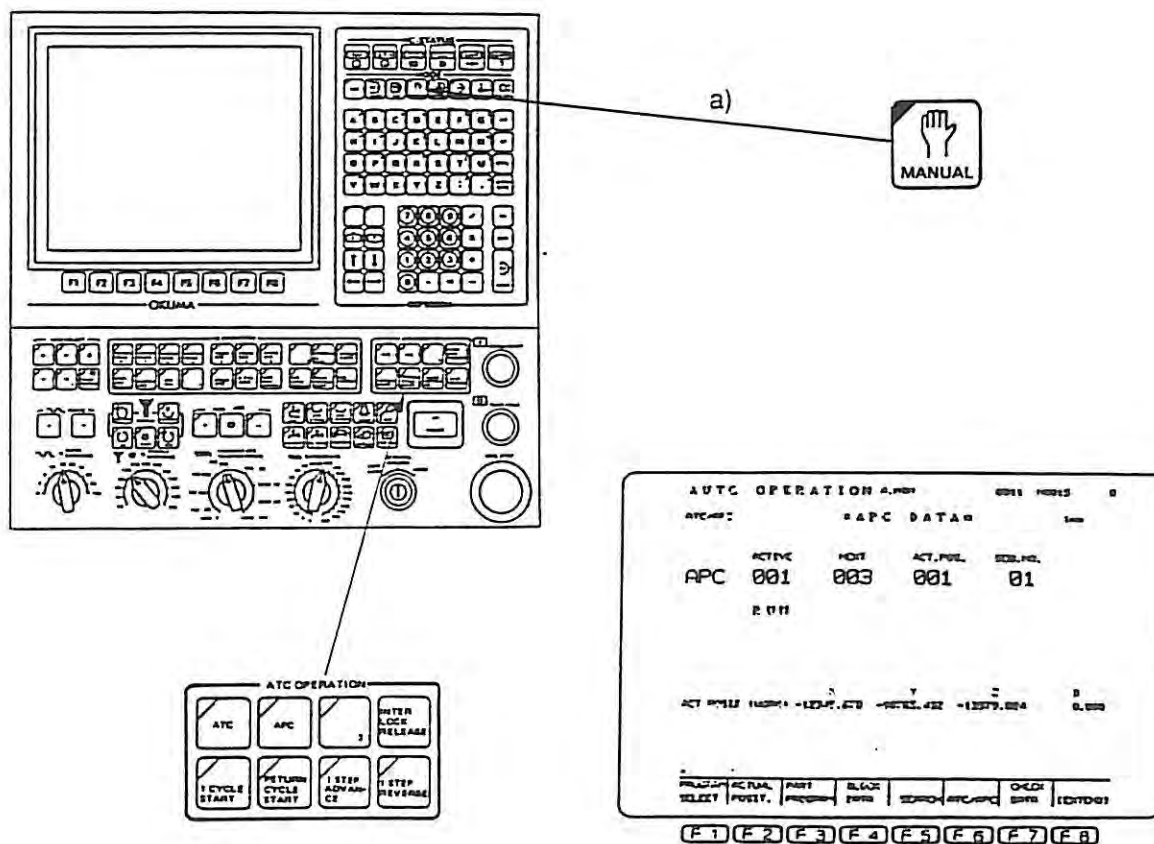
The automatic pallet changer can be manually operated using switches on the main operation panel in addition to automatic pallet change cycle called by the M60 command.

5-1. One Step Advance and One Step Reverse

In the one step advance and one step reverse operation, the automatic pallet change cycle advances or reverses according to its operation sequence. This type of operation is not carried out during normal machine operation. However, such operation becomes necessary for checking the APC operation or in locating the APC at a sequence. This allows the return to initial conditions for the automatic pallet changing cycle after the EMG. STOP button has been pressed.

Procedure:

- (1) Press the **MANUAL** key.
- (2) Press the **APC** switch at ATC operation section on the main operation panel.
- (3) Press either the **1 STEP ADVANCE** or the **1 STEP REVERSE** key.



5-2. 1 Cycle Start and Return Cycle Start

The **1 CYCLE START** key is used for starting a series of automatic pallet change cycle in which the pallet on the machine is unloaded to the APC and the pallet on the APC is loaded to the machine.

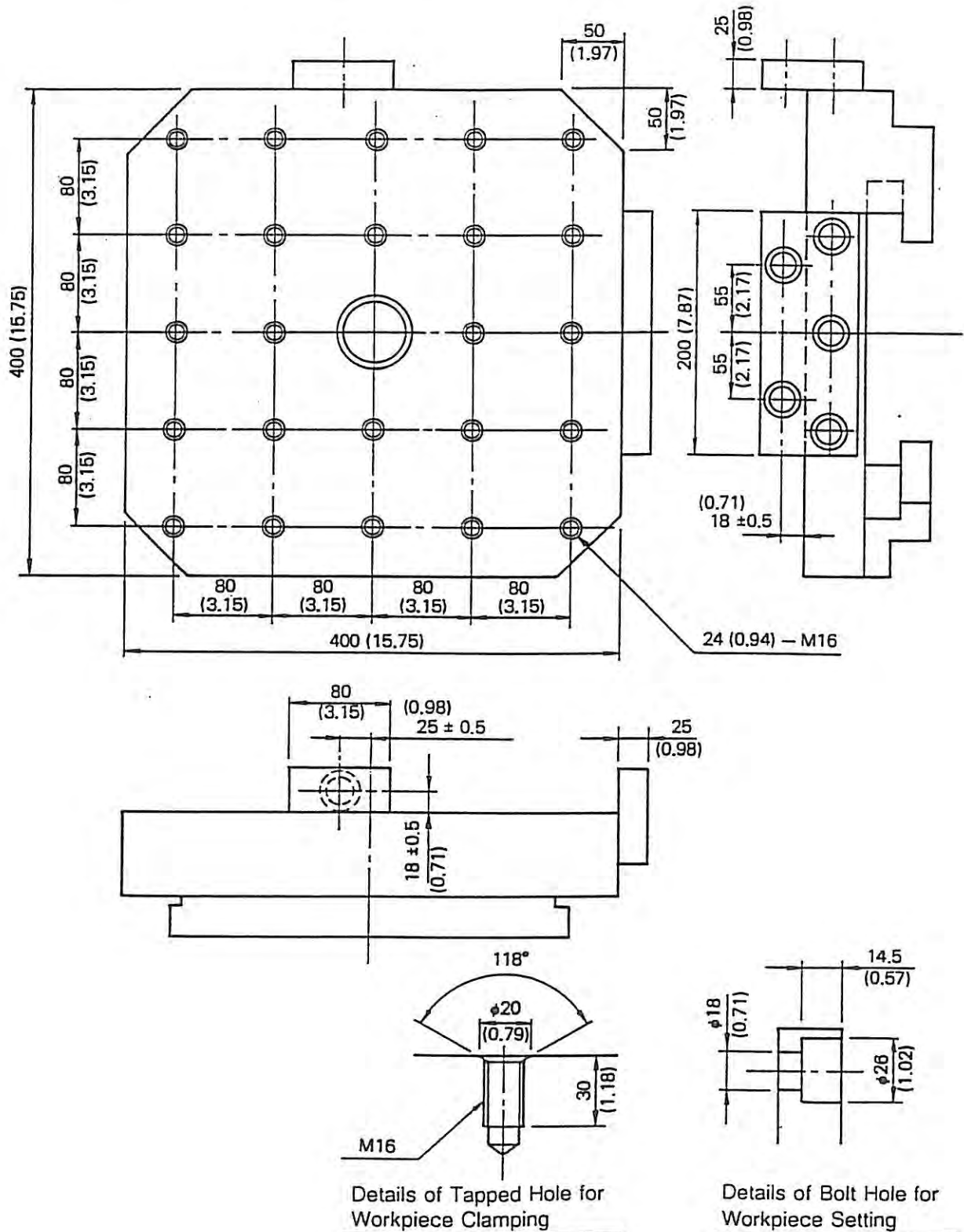
The operation is possible when the **READY** lamp is ON.

5-3. Precautions for Manual APC Operation

- (1) While the **RUN** lamp is on, all manual APC control keys - **1 STEP ADVANCE**, **1 STEP RETURN**, **1 CYCLE START** and **RETURN CYCLE START** - are ineffective. To manually operate the APC while the **RUN** lamp is on, press the **RESET** pushbutton to turn off the **RUN** lamp.
- (2) If the **EMG. STOP** pushbutton is pressed while the gripper arm is moving, shifter retraction position signal is turned off, which, in turn, might disable **1 STEP ADVANCE**, **1 STEP RETURN** and **RETURN CYCLE START** keys. In this case, press the **1 STEP ADVANCE** key while pressing the **INTERLOCK RELEASE** key. This advances the automatic pallet change cycle one step independent of interlock conditions.

5-4. Pallet Dimensions

(1) Standard Pallet (Metric System)



Unit: mm

[illegible]

APC Operation Sequence Number		APC Operation Name	Rotary Type 2-pallet APC Output Logic	SOL Symbol
1	APC ready			
2	Move to APC position			
3	Gripper arm at pallet grip position A			
4	Pallet unclamp			
5	Pallet grip			
6	Gripper arm at pallet grip position B			
7	Pallet clamp			
8	Pallet ungrasp			
9	Gripper arm at home position			
10				
11				
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100				

SECTION 4 SPINDLE DRIVE UNIT FOR VAC MOTOR (VACII)

1. Outline

Okuma VAC motors, providing sufficient performance as a spindle driver for machine tools, feature high reliability, wide constant output range, compact construction, etc.

Okuma VAC drive unit is a vector control type driver, using 16-bit micro-processors. It provides quick response and stable control.

2. Periodical Inspection and Maintenance

VAC motor and VAC drive unit do not require daily inspection. However, to maintain their high performance for a long period, it is recommended to inspect and clean the following points at least every six months.

For each of the inspection items, change inspection intervals depending on contamination degree.

Table 4-1 Inspection Items

Items to Check	How to Check	Measures to Take
VAC motor VAC drive unit: Cooling fan Fan guard (mesh) Ventilation hole	Check whether dust is accumulating.	Clean or blow away with compressed air or vacuum cleaner.

3. Constructions

The VAC drive unit construction is illustrated in Fig. 4-1.

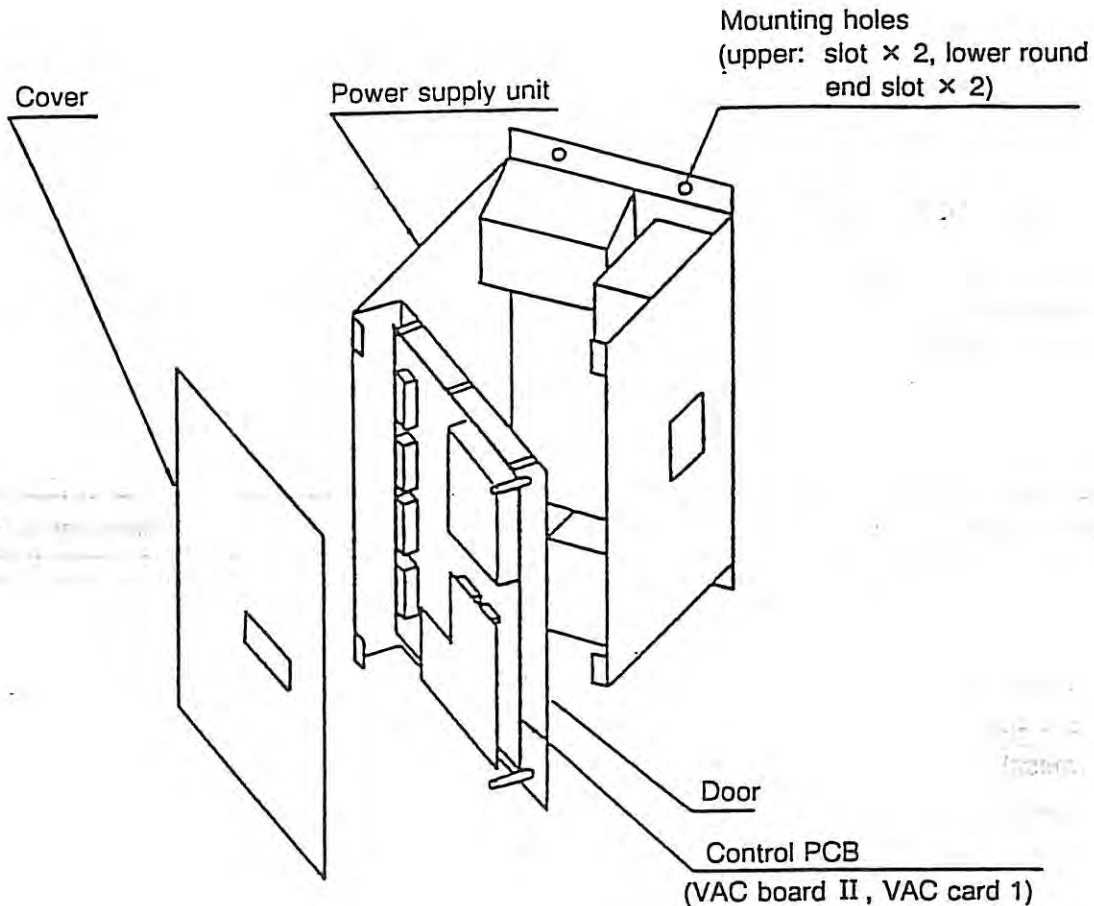


Fig. 4-1 VAC Drive Unit Construction (D3, D6, D8)

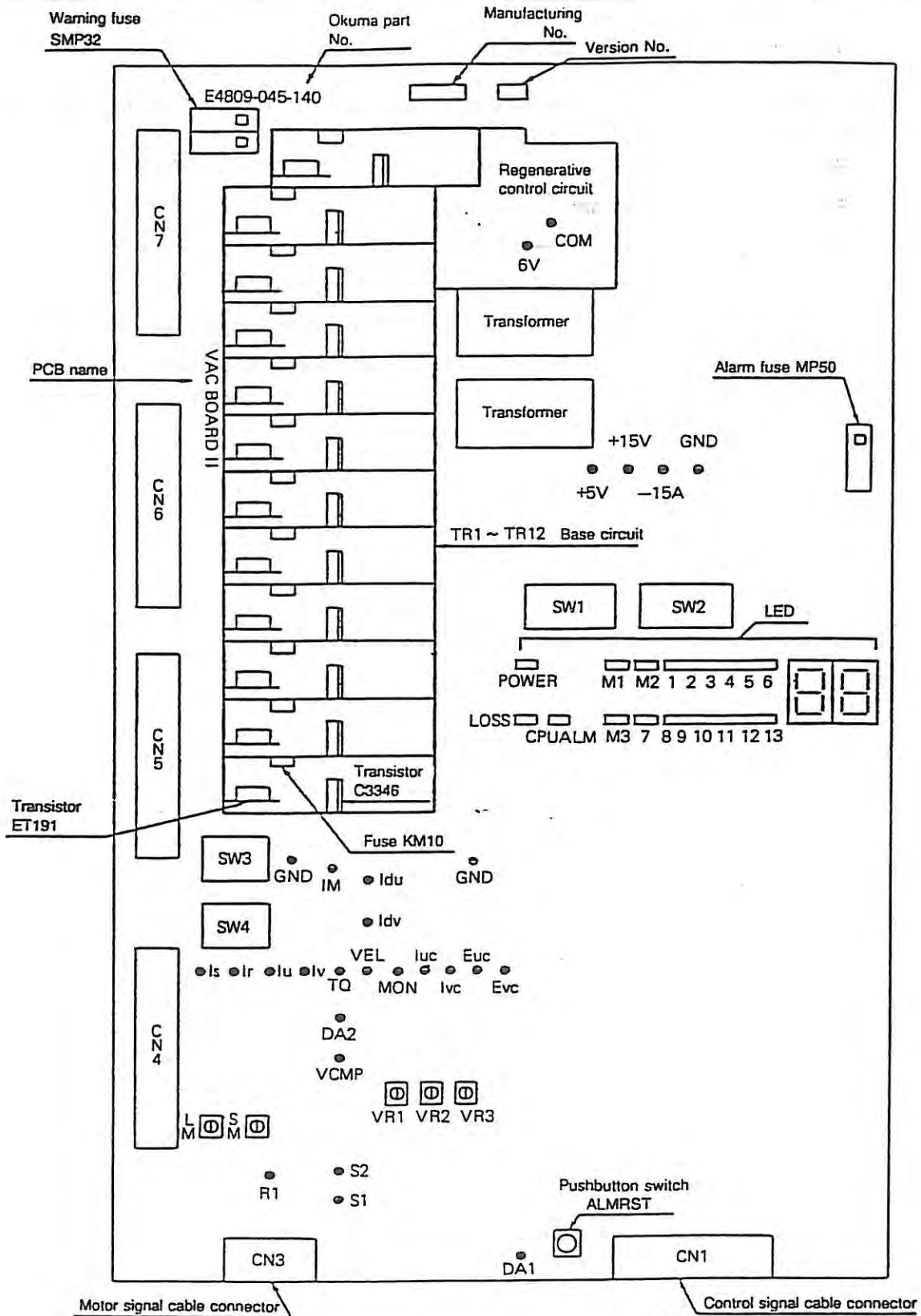
The control PCB and the cover are fixed to the power supply unit door with the screws. The power supply unit door can be opened by removing the screws at the upper and low right sides.

Arrangement of major component parts on the control PCB and the power supply unit are shown in Figs. 4-2 to 4-7.

3-1. Arrangement of Major Component Parts

Arrangement of component parts which should be checked at an occurrence of a problem is shown in Figs. 4-2 through 4-7.

- Fig. 4-2 Major Component Parts Arrangement on Control PCB - VAC Board II
- Fig. 4-3 Major Component Parts Arrangement on Control PCB - VAC Card 1
- Fig. 4-4 Major Component Parts Arrangement for Power Supply Unit - D6A, D8A
- Fig. 4-5 Major Component Parts Arrangement for Power Supply Unit - D11A
- Fig. 4-6 Major Component Parts Arrangement for Power Supply Unit - D22A
- Fig. 4-7 Major Component Parts Arrangement for Power Supply Unit - D37A



Remark:

- ⊕ : Check terminal
- ⓪ : Variable resistor

Fig. 4-2 Major Component Parts Arrangement on Control PCB - VAC Board II

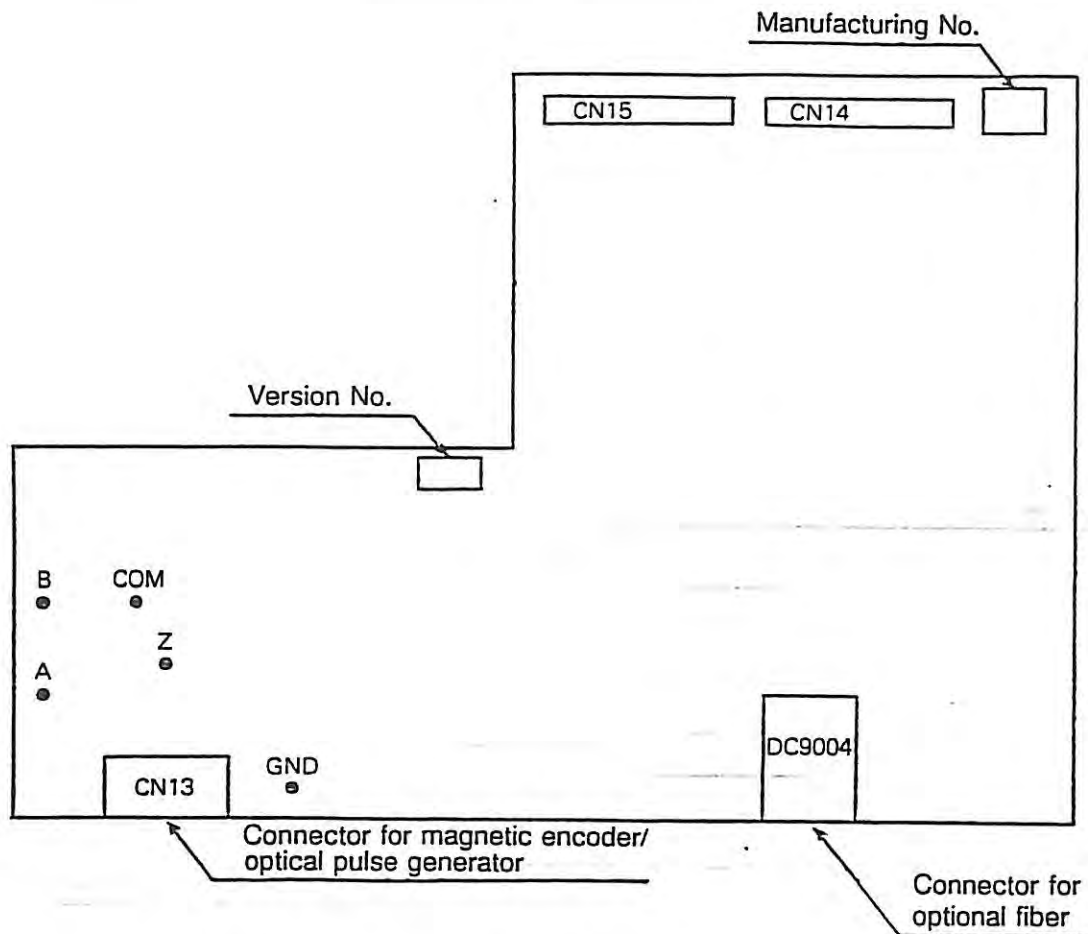


Fig. 4-3 Major Component Parts Arrangement on Control PCB - VAC Card 1

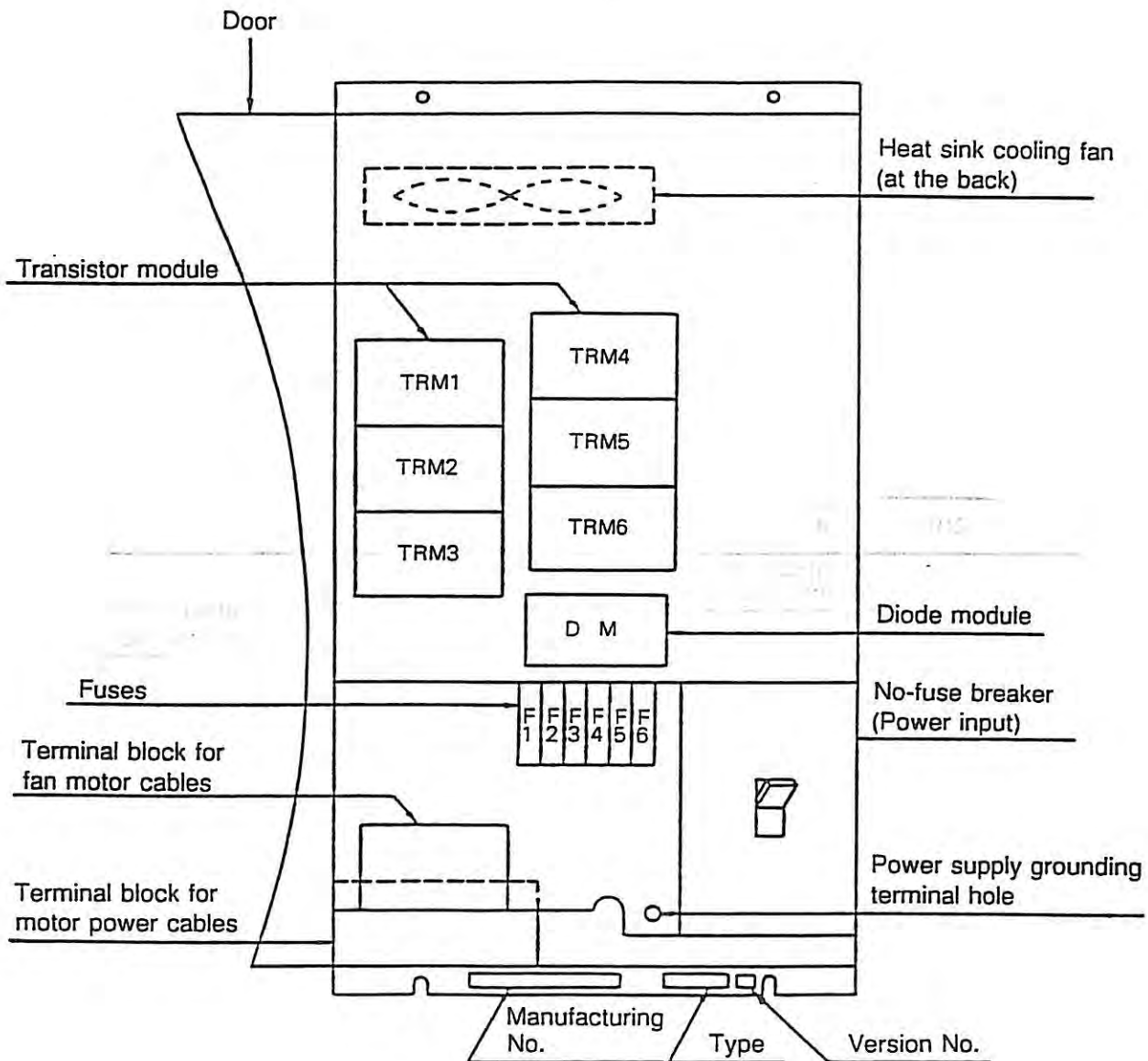


Fig. 4-4 Major Component Parts Arrangement for Power Supply Unit - D6A, D8A

SECTION 4 SPINDLE DRIVE UNIT FOR VAC MOTOR (VACII)

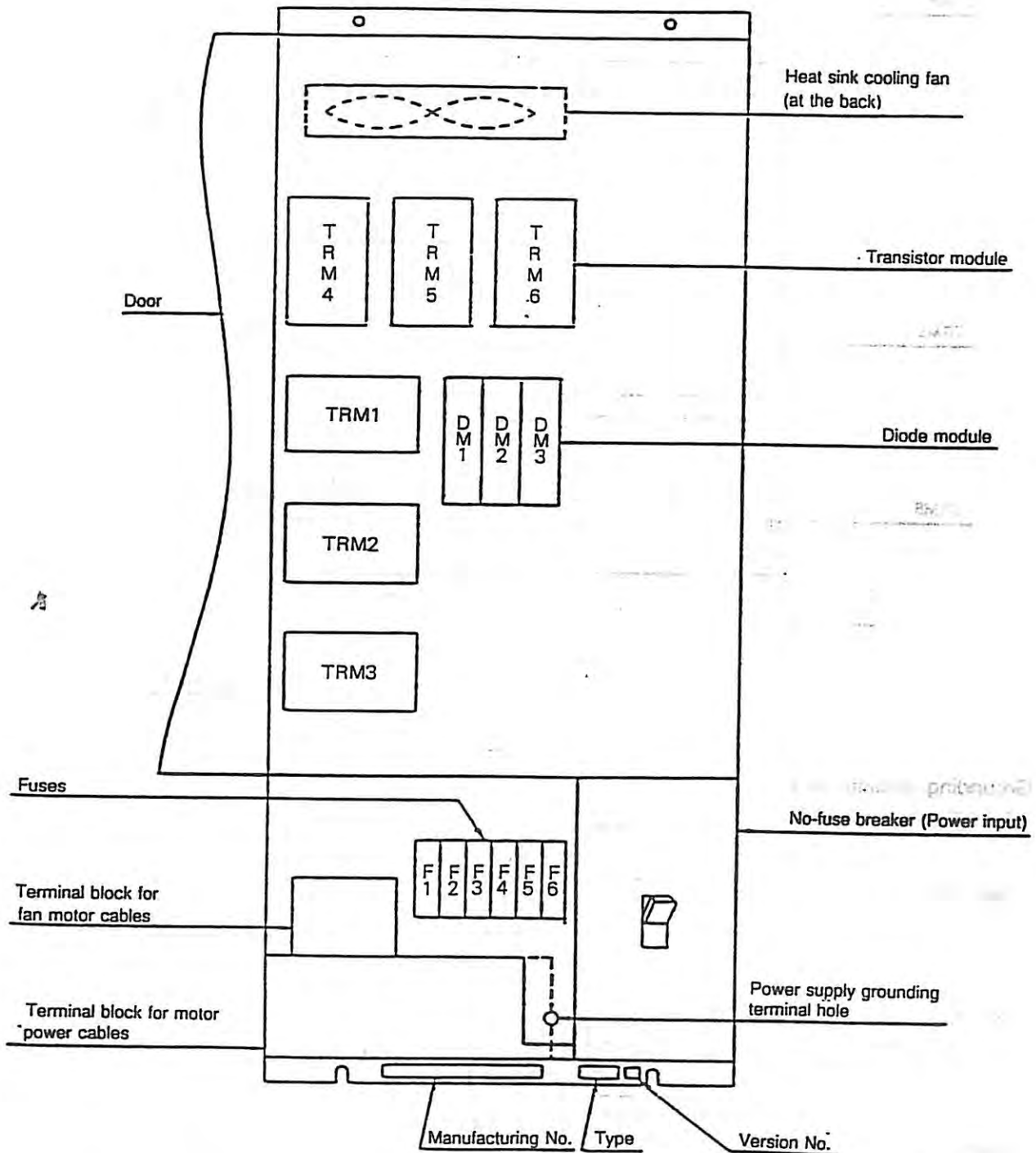


Fig. 4-5 Major Component Parts Arrangement for Power Supply Unit - D11A

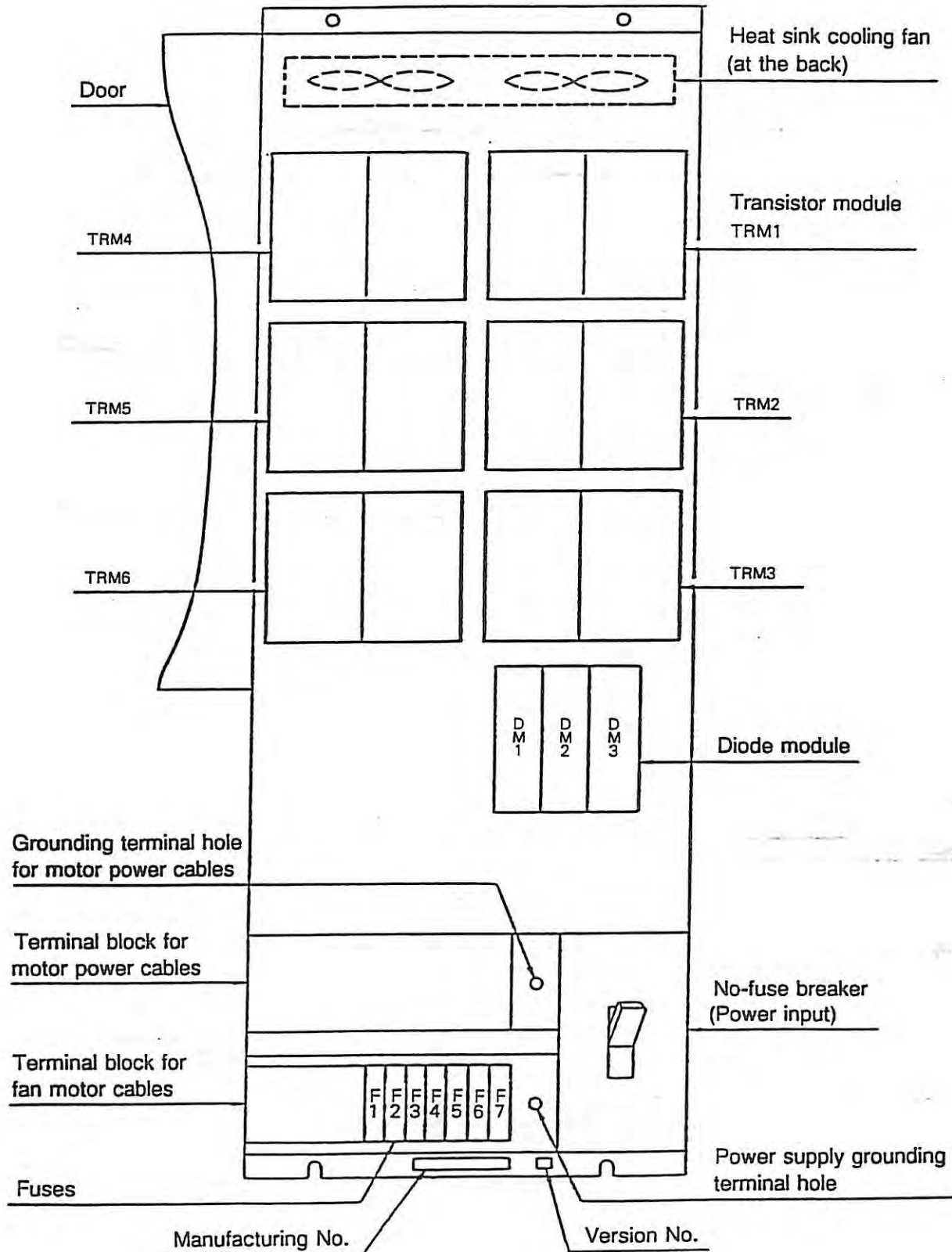


Fig. 4-6 Major Component Parts Arrangement for Power Supply Unit - D22A

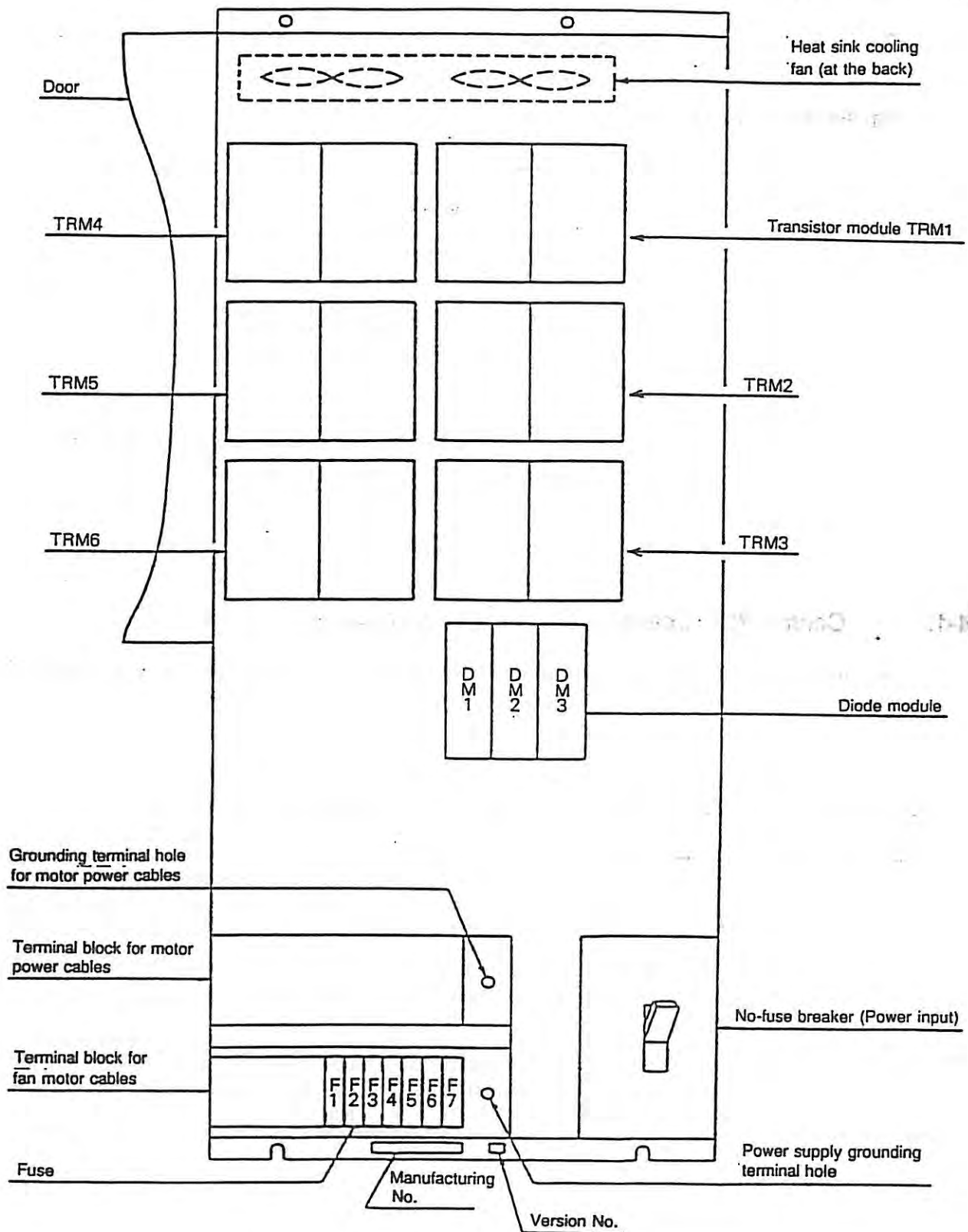


Fig. 4-7 Major Component Parts Arrangement for Power Supply Unit - D37A

D22

4. Operation Status Indication

The VAC drive unit has LED's on the control printed circuit board to indicate the operation status. Lighting conditions of the LED's can be checked through the opening in the cover.

Fig. 4-8 shows the LED names.

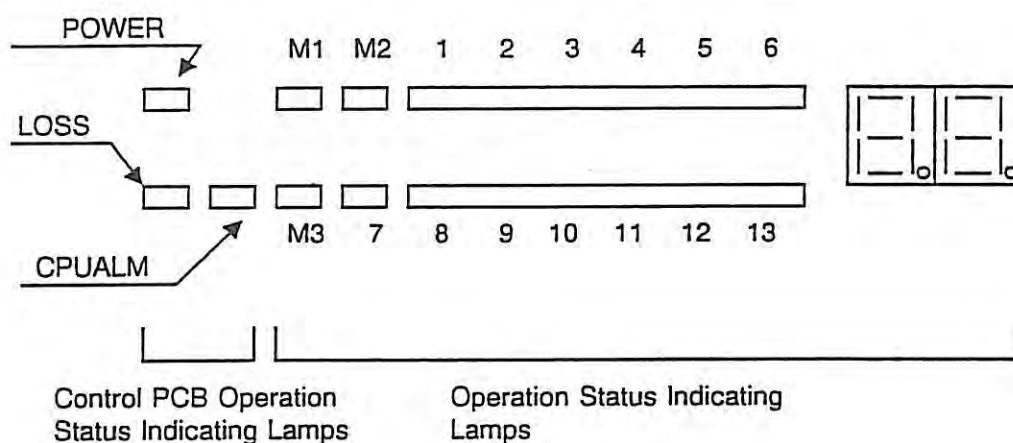


Fig. 4-8 LED Names

4-1. Control PCB Operation Status Indicating Lamps

The following three LED's indicate the operation status of the VAC drive unit. The relationship between the lamp illumination and PCB operation status is indicated in Table 4-2.

Table 4-2 Relationship between LED Illumination and PCB Operation Status

Name	Color	Operation	Remarks
POWER	Green	Power supply for VAC drive unit control circuit is being supplied.	If this is not illuminating while power supply to the VAC drive unit is on, it indicates an occurrence of a trouble.
LOSS	Red	Voltage in the calculation circuit of the VAC drive unit is outside the specification.	If this LED is turned on, the calculation circuit is not functioning normally.
CPUALM	Red	The lamp indicates an occurrence of a problem in the calculation circuit in the VAC drive unit.	Contents of the problem are indicated by the operation status indicating lamps.

4-2. Operation Status Indicating Lamps

The LED's M1, M2 and M3 indicate the operation status of the VAC drive unit and the VAC motor.

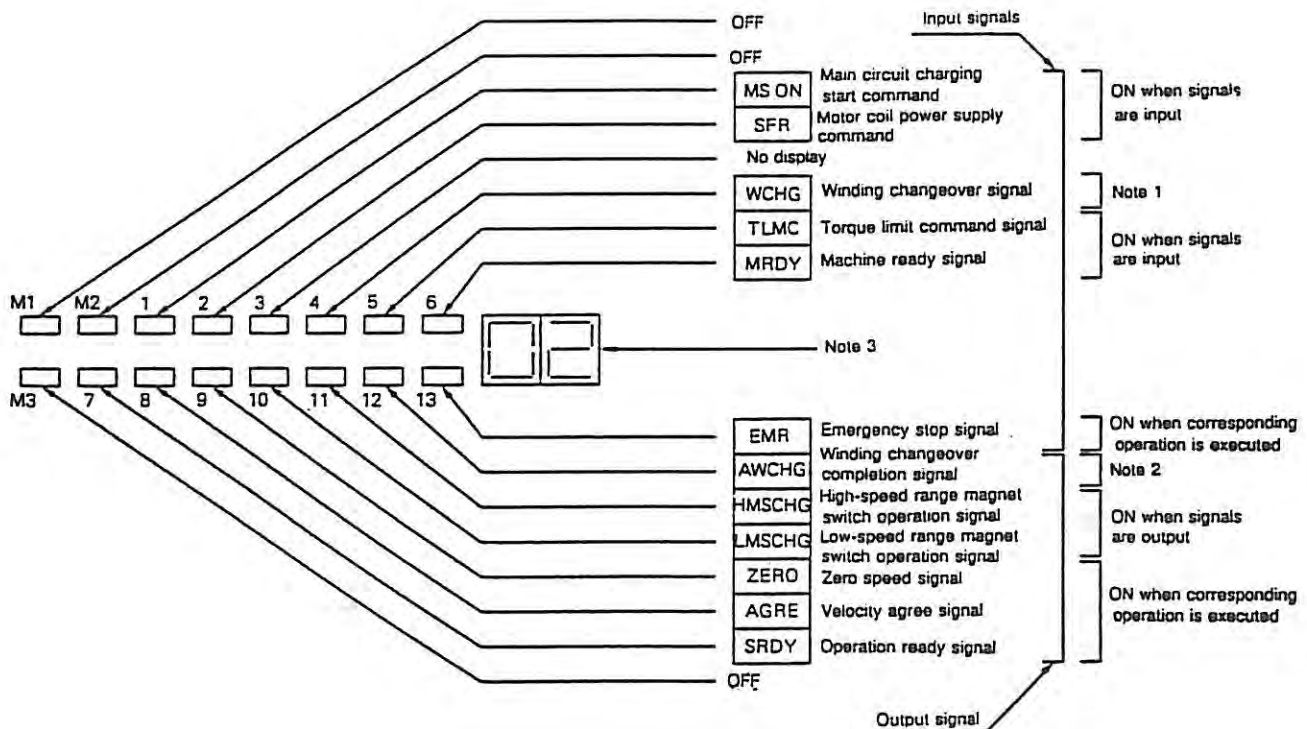
There are two different operations status as "normal operation" and "faulty operation". They are indicated by the following LED illumination conditions.

Normal operation . . . M1, M2 and M3 are all OFF

Faulty operation . . . M1, M2 and/or M3 is ON or flickering.

4-2-1. Normal Operation Status Indication

While the VAC drive unit is operating normally, the LED's indicate the input/output status of the input/output signals. These input/output signals are shown in Fig. 4-9 (for the standard and winding changeover specifications).



Note 1: WCHG Winding changeover signal

ON when the high-speed range winding selection command is input
OFF when the low-speed range winding selection command is input

Note 2: AWCHG Winding changeover completion signal

ON when the high-speed range winding selection is completed
OFF when the low-speed range winding selection is completed

Note 3: When the power to the machine is turned on, it indicates "01". When the control power is turned on and the NC is ready, the indication changes to "02".

Fig. 4-9 Signal Assignment at LED's for Normal Operation

4-2-2. Failure Operation Status Indication

A faulty operation status is indicated by the LED's M1 and M2 in the following conditions.

- a) M1 and M2 flicker simultaneously.
- b) M1 lights up.
- c) M2 lights up.

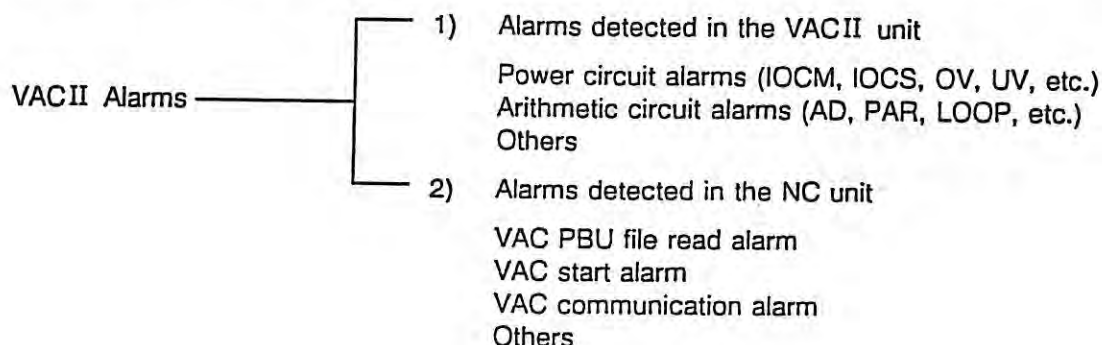
LED's other than M1 and M2 light up corresponding to the failure conditions occurred to indicate them.

On the VACII control PCB, the 7-segment LED displays the failure operation status by the 2-digit number.

The alarm information is transferred to the NC unit, and alarm name and alarm data are displayed on the CRT screen of the NC operation panel.

(1) Alarm Type

There are two types of alarm with the VACII unit. One is detected in the VACII unit, and the other is detected in the NC.



(2) Alarm Indication

The VACII alarm is indicated in the following three places.

- 1) CRT screen of the NC operation panel
Alarm name and alarm data are displayed.
- 2) 7-segment LED on the VAC BOARD II
Alarm number is displayed.
- 3) Single LED on the VAC BOARD II
The LED corresponding to the alarm contents lights up.

Table 4-3

	1) CRT screen on the NC operation panel	2) 7-segment LED on the VAC BOARDII	3) Single LED on the VAC BOARDII
1) Alarms detected in the VACII unit	○	○	○
2) Alarms detected in the NC unit	○	×	×

Remarks:

1. "○" indicates "displayed", and "×" indicates "not displayed".
2. When more than one alarm occurred, the alarm of the highest level is displayed. When the alarms of the same level occurred, the alarm detected first will be displayed.

Note the single LEDs corresponding to the alarms occurred will all light up.

3. For the alarm which occurred after the power to the NC is turned on but before the NC gets ready, "VAC start" is displayed on the CRT.

In this case, open the NC control box with the NC power ON, and check the alarm contents from the 7-segment LED and the single LED on the VAC BOARDII.

(3) Alarm Contents

- 1) Alarm indication on the CRT screen of the NC operation panel
Refer to the Alarm and Error List.
- 2) Alarm indication of the 7-segment LED on the VAC BOARDII
Refer to Table 4-4, "VACII Alarm List (1/2 - 2/2)".
- 3) Alarm indication of the single LED on the VAC BOARDII
Refer to Table 4-5, "Failure Operation Status Indication Mode".
Failure contents are detailed in Figs. 4-10 through 4-12.

Table 4-4 VACII Alarm List (1/2)

Alarm No.	Alarm Name	Alarm Level	Reset Level	Processing Level	Contents
1	VAC P.G. count abnormal	1b	2	2 (1) *1	The number of the detected PG counts exceeds the PBU data.
2	VAC motor acceleration rate	1a	1	1	The actual VAC motor speed is too high.
3	VAC APA speed	1b	2	2 (1) *1	The actual spindle speed is too high.
4	VAC CON speed	1b	2	2	Excessive velocity command value in the spindle control mode or excessive feedrate unit amount in the C-axis control mode Excessive feedrate unit amount per communication, or calculation of the CON is delayed from the timing of communication.
5	VAC DIFF overflow	2	3	3	DIFF over occurred in the C-axis control mode.
6	VAC resolver abnormal *2	1a	1	1	The VAC resolver signal is not output.
7	VAC RAM parity error	1a	1	1	Read/write from/to the RAM in the VAC unit cannot be carried out correctly.
8	VAC communication abnormal	1b	2	1	Communication data between the VAC and the OPUS is stopped, or communication data is faulty.
9	VAC instruction command NG.	1b	2	2	The command communicated is undefined or not executable.
10	VAC motor cable overcurrent	1a	1	1	Instantaneous overcurrent in the VAC motor cable
11	VAC inverter bridge short circuit	1a	1	1	Shortcircuit in the VAC inverter bridge arm
12	VAC power trans short circuit	1a	1	1	Overcurrent in the VAC regenerative main circuit
13	VAC power circuit overvoltage	1a	1	1	Excessive DC voltage in the VAC main circuit
14	VAC input voltage drop	1a	1	1	The three-phase input power supply voltage for the VAC is lower than the specified value.
15	VAC phase defect	1a	1	1	Any of the VAC three-phase input is open.
16	VAC arithmetic unit volt drop	1a	1	1	Control power supply voltage on the VAC board is low.

*1 When velocity control by the PG is active

*2 Not effective without a resolver

Table 4-4 VAC II Alarm List (2/2)

Alarm No.	Alarm Name	Alarm Level	Reset Level	Processing Level	Contents
17	VAC power circuit low voltage	1a	1	1	DC voltage in the VAC power circuit does not rise.
18	VAC interval loop error	1a	1	1	Interruption can not be performed correctly.
19	VAC motor overload	3	4 (3) *3	4 (3) *3	The temperature inside the VAC motor is higher than the permissible value.
20	VAC heat sink overload	3	4 (3) *3	4 (3) *3	The temperature of the heat sink in the VAC unit is higher than the permissible value.
21	VAC data setting	1b	2	2	The PBU data of the VAC or the on-line change parameter setting is abnormal. (The data outside the data setting range is set or sent.)
22	VAC internal speed command too fast	2	3	3	Excessive velocity command value during velocity control or position control in the VAC
23	VAC magnetic P.G. abnormal	1a	1	2 (1) *1	The magnetic pulse generator is faulty.
24	VAC P.G. marker data NG.	1b	2	2 (1) *1	The number of counts until the first marker is passed after the power has been turned on exceeds the PBU data.
25	VAC cycle overflow error	1a	1	1	A cycle over error occurred with the VAC.
26	VAC watchdog error	1a	1	1	The watch dog timer is not cleared.
27	VAC analog-to-digital access alarm	1a	1	1	A/D access is attempted during A/D conversion.
28	VAC board; CPU error	1a	1	1	A CPU error occurred on the VAC board.
29	VAC card; CPU error	1a	1	1	A CPU error occurred on the VAC card.
30	VAC speed deviation to large	1a	1	1	Excessive VAC motor velocity deviation
31	VAC coil switch	1a	1	1	The winding change-over MS is not turned on.
32	RAM abnormal	1a	1	1	The contents of the RAM cannot be cleared when the power is turned on.

*1 When velocity control by the PG is active

*3 Upgraded to level 3 in 30 seconds after the alarm occurred.

Table 4-5 Failure Operation Status Indication Mode

LED status				Failure Contents	
M1	M2	M3	Lighting LED No.		
Flash- ing	Flash- ing	Un- known (ON/OFF)	1	RES	Resolver alarm
			2	AD	A/D access alarm
			3	PAR	RAM parity error
			4	ACC	Microcomputer access error
			5	LOOP	INT6 loop error
			6	WDOG	Watchdog error
		ON	7	IOCM	Power transistor overcurrent
			8	IOCS	Power transistor short
			9	IOCR	Regeneration unit power transistor short
			10	OV	High voltage
			11	UV	Low voltage
			12	PH	Phase open (loss)
			13	LOSS	Power supply lost at calculation circuit
ON	OFF	OFF	1	OS	Over speed
			2	READ	Speed command read error
			3	UVP	Power circuit low voltage
			4	RAER	RAM error
			5	DSE	DIP switch setting error
			6	DSC	Excessive velocity deviation error
			7	LOOP4	INT4 loop error
			8	LOOP1	INT1 loop error
			9	WCHER	Winding changeover error
OFF	ON		1	OH	Heat sink overheat
			2	OL	Motor overload

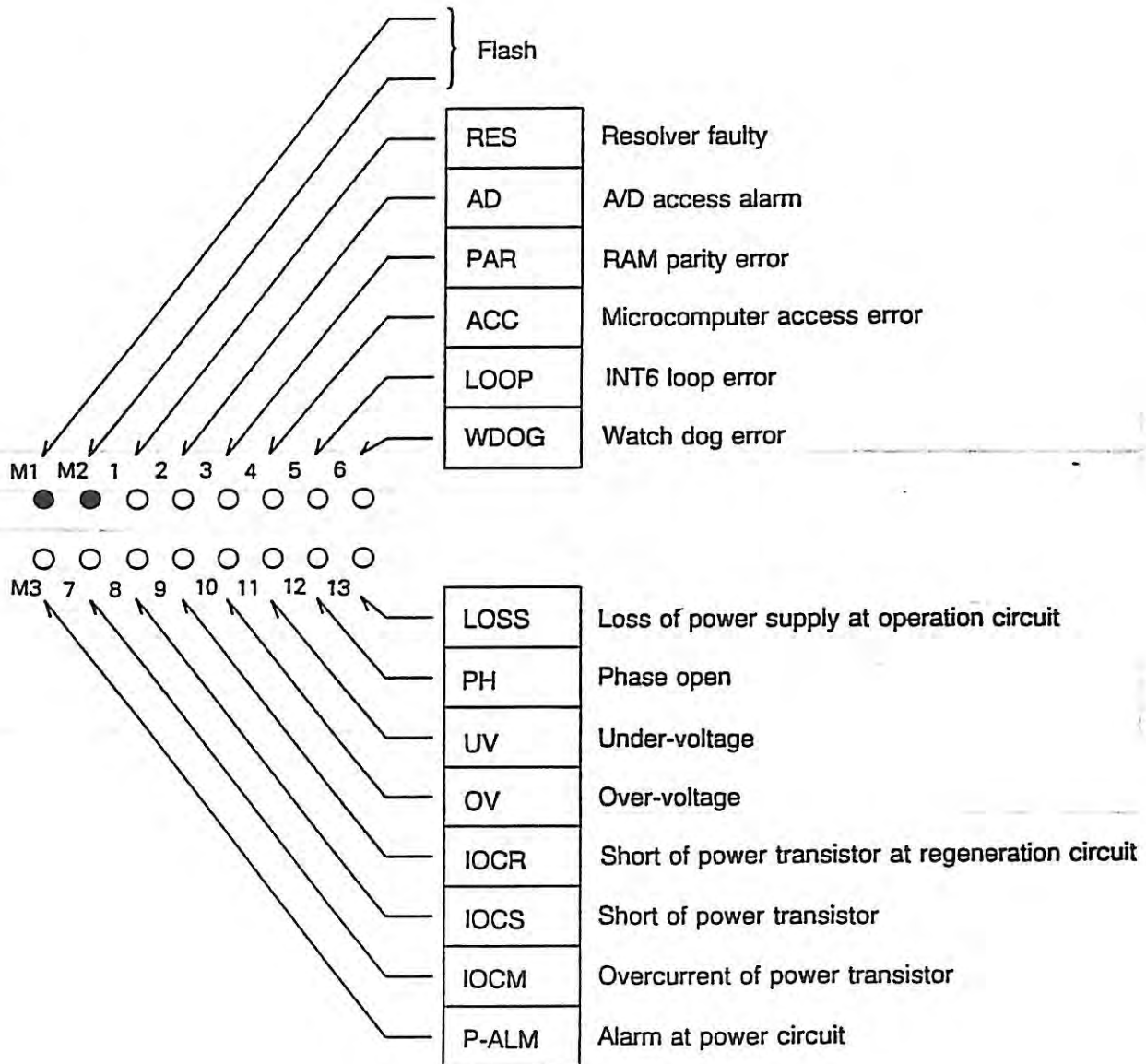


Fig. 4-10 Failure Indication by LED's
(with M1 and M2 LED's flickering)

SECTION 4 SPINDLE DRIVE UNIT FOR VAC MOTOR (VACII)

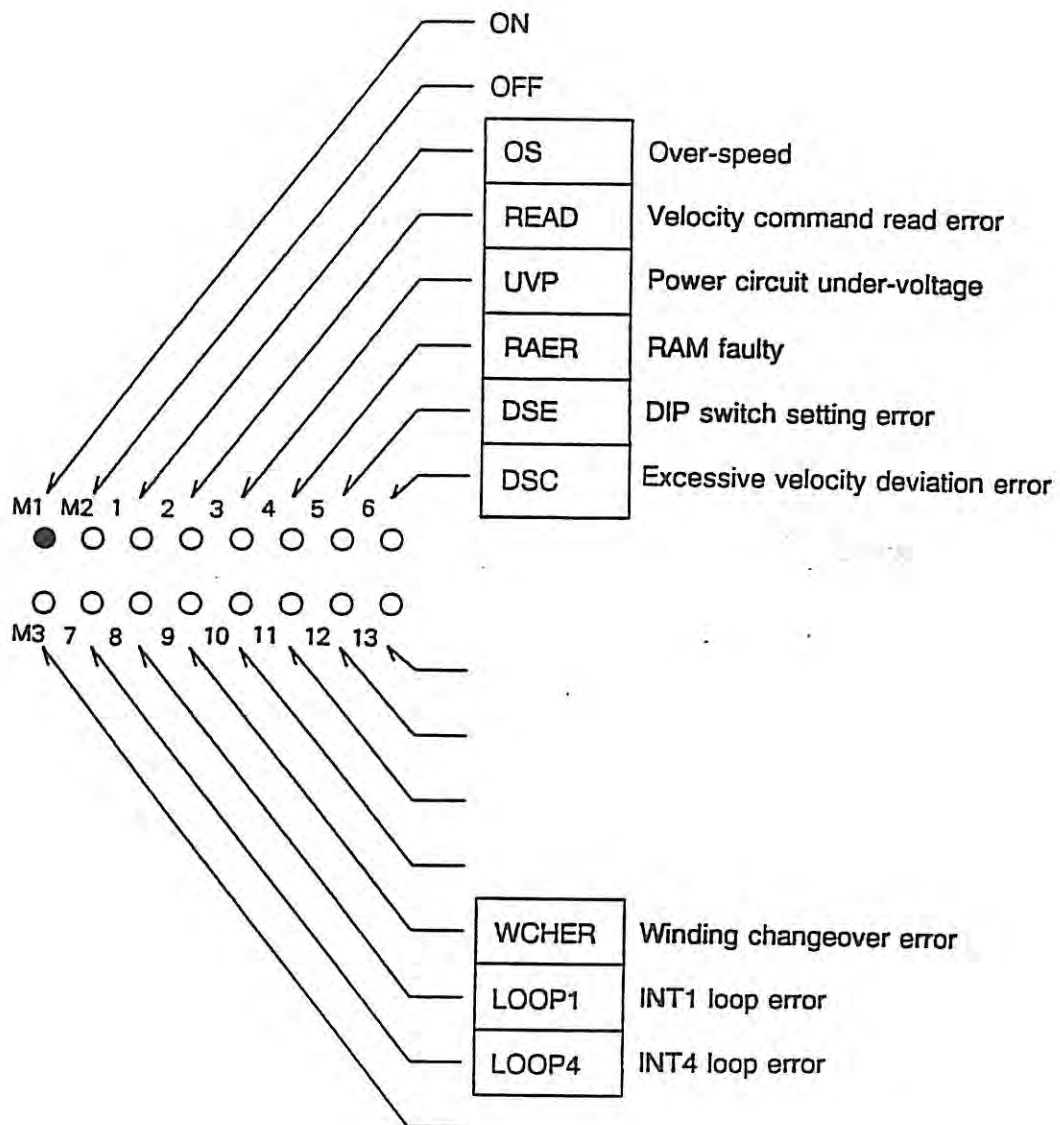


Fig. 4-11 Failure Indication by LED's
(with M1 ON)

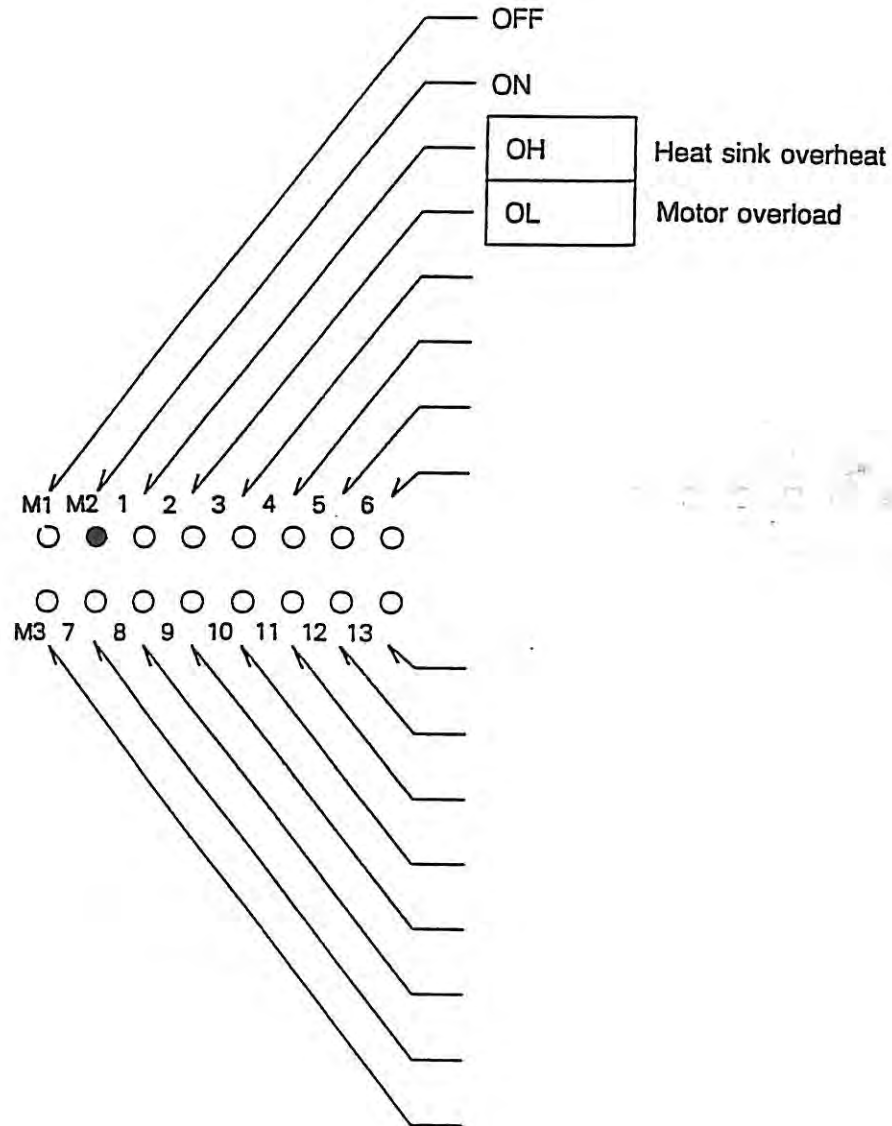


Fig. 4-12 Failure Indication by LED's
(with M2 ON)

5. Troubleshooting

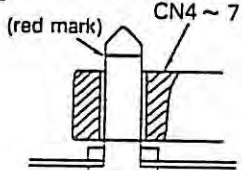
Measures to be taken when a problem has occurred are explained in 5-1. and 5-2, and measures to recover from the failure status are explained in 5-3. Locations of the component parts are shown in 3. "Constructions".

Since high voltage is applied to the VAC drive unit, first record the illuminating LED number(s) and turn off power supply to the VAC drive unit before attempting to touch inside the unit.

5-1. Confirmation of Power Supply and Connectors

Before carrying out the steps explained in 5-2., check the items according to Table 4-6.

Table 4-6 Confirmation of Power Supply and Connectors

Items to Check	How to Check	Measures to Take
Power supply	Measure voltage across input terminals R, S, T of no-fuse breaker and power supply grounding terminal to check if it is within the allowable range. Allowable range: AC 3-phase, 170 V to 240 V, 50/60 Hz, 1%	Correct input power supply so that it is within the allowable range.
Connector	- Make sure that the MR connectors (CN1, 2, 3) are all secured by screws. - For the PCB connectors (CN4 - CN7), make sure that the red mark on the connector guide can be seen at the surface of the connector on the control PCB.	Connect correctly. 

5-2. Trouble and Troubleshooting

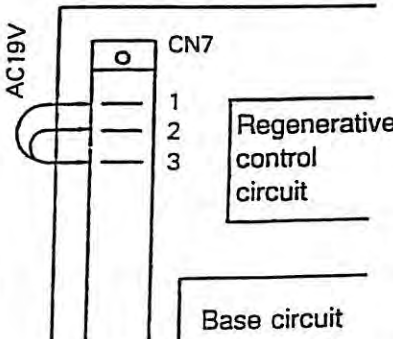
If a problem is found, take necessary procedures as indicated in Table 4-7.

Table 4-7 Classification of Failures

Failure	Reference	Failure will lie in	
		Control PCB	Power unit
POWER LED does not light up.	(1)	○	○
LOSS LED lights up.	(1)	○	○
LED's show failure occurrence condition.	(2)	○	○
Motor hunts.	(3)	○	○
Commanded motor speed cannot be obtained.	(4)	○	○
Motor does not rotate.	(4)	○	○
Low cutting performance	(5)	○	
Long acceleration and deceleration time	(6)	○	○
Excessive vibration and noise while the motor is rotating.	(7)	○	○

- (1) POWER LED does not light up.
LOSS LED lights up.

Table 4-8

Failure Factor	Check	Measures
Input power supply is abnormal.	See Table 4-6.	See Table 4-6.
Fuse F2, F3, F4 or F5 is blown.	Check whether the fuses have been blown or not. (Refer to 6-2. "Inspection and Replacement Procedure for Fuses".)	Replace blown fuse.
Warning fuse SMP32 or MP50 is blown.	Check whether the fuses have been blown or not. (Refer to 6-2. "Inspection and Replacement Procedure for Fuses".)	Replace blown fuse.
PCB connector CN7 is not inserted properly.	Check to be sure that the red mark on the connector guide can be seen at the surface of the connector on the control PCB.	Insert the connector properly.
Power is not supplied to the control PCB from the power supply unit, or supply voltage is other than 19V AC.	1) Detach the cover. 2) Check voltage across 1 and 3, and 2 and 3 of connector CN7 with a voltmeter voltage must be 19V AC.  Caution: High voltage is applied to the base circuit and the regeneration circuit.	Replace the power supply unit.
Control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.

SECTION 4 SPINDLE DRIVE UNIT FOR VAC MOTOR (VACII)

(2) LED's show failure occurrence condition.

When LED's show failure occurrence condition, take necessary measures in accordance with the alarm number displayed on the VAC BOARDII. For the alarm name and the alarm contents, refer to Table 4-4, "VACII Alarm List".

1) Alarm No. 1 "VAC P.G. count abnormal" is displayed.

Table 4-9

Failure Factor	Check	Measures
The magnetic encoder sensor or the gear is faulty.	Rotate the spindle by hand and check the output signals of the encoder. (Refer to 5-4. "Check Terminals" when checking the output signals.)	Replace the sensor or the gear.
The control PCB (VAC card 1) is faulty.	Make sure that all the items above are correct.	Replace VAC card 1.

2) Alarm No. 2 "VAC motor acceleration rate" is displayed.

Table 4-10

Failure Factor	Check	Measures
The resolver is faulty.	Rotate the resolver by hand and check the output signals. (Refer to 5-4. "Check Terminals" when checking the output signals.)	Replace the VAC motor.
The magnetic encoder sensor or the gear is faulty.	Rotate the spindle by hand and check the output signals of the encoder.	Replace the sensor or the gear.
Loose connection of the connectors of motor signal cables or magnetic encoder signal cables	Check whether connector CN3, CN13, and the connector in the VAC motor terminal box are inserted properly.	Insert them properly.
Broken motor signal cables or magnetic encoder signal cables	Remove the motor signal cables or the magnetic encoder signal cables and conduct the continuity test.	Replace the motor signal cables or the magnetic encoder signal cables.
The control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.

SECTION 4 SPINDLE DRIVE UNIT FOR VAC MOTOR (VACII)

3) Alarm No. 3 "VAC APA speed" is displayed.

Table 4-11

Failure Factor	Check	Measures
The magnetic encoder sensor or the gear is faulty.	Rotate the spindle by hand and check the output signals of the encoder.	Replace the sensor or the gear.
Loose connection of the connector of magnetic encoder signal cables	Check whether connector CN13 is inserted properly.	Insert the connector properly.
Broken magnetic encoder signal cables	Remove the magnetic encoder signal cables and conduct the continuity test.	Replace the magnetic encoder signal cables.
The control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.

4) Alarm No. 4 "VAC CON speed" is displayed.

Table 4-12

Failure Factor	Check	Measures
Faulty NC software	Check the setting value.	Change the setting value.

5) Alarm No. 5 "VAC DIFF overflow" is displayed.

Table 4-13

Failure Factor	Check	Measures
Operation in overloaded condition	Check the cutting conditions. Check the machine for mechanical troubles: lubricating oil, etc.	Change the cutting conditions. Remove the mechanical trouble factor.
The control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.

SECTION 4 SPINDLE DRIVE UNIT FOR VAC MOTOR (VAC II)

- 6) Alarm No. 6 "VAC resolver abnormal" is displayed.

Table 4-14

Failure Factor	Check	Measures
Loose connection of the connectors of motor signal cables	Check whether or not connector CN3 and the connector in the VAC motor terminal box are inserted properly.	Insert them properly.
Broken motor signal cables (Resolver signal)	Remove the motor signal cables and conduct the continuity test.	Replace the motor signal cables.
The control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.
The resolver is faulty.	Make sure that the RES is indicated even after the replacement of the control PCB.	Replace the resolver in the VAC motor.

Remarks: 1) Normally, resolver resistance measured at the connectors in the VAC motor terminal box is as indicated below.

Approx. 20 - 25Ω across: S1 - S3, S2 - S4, R1 - R2

- 2) Checking Resolver Signals

Resolver signals can be observed with an oscilloscope after turning on power.

To check them while rotating the motor by hand, do so only while the operation command signals (SFR or SRV) are off or while the machine ready signal (MRDY) is off.

- 7) Alarm No. 7 "VAC RAM parity error" is displayed.

Replace the control PCB.

- 8) Alarm No. 8 "VAC communication abnormal" is displayed.

Table 4-15

Failure Factor	Check	Measures
Loose connection of the connectors of optical fiber cables	Check whether or not connectors of optical fiber cables of VAC card 1 are inserted properly.	Insert them properly.
Broken optical fiber cables	Check whether or not optical fiber cables are broken.	Replace the optical fiber cables.
SPC6 (card on the SVP board) on the NC is faulty.	Make sure that all the items above are correct.	Replace SPC6 card.
The control PCB (VAC card 1) is faulty.	Make sure that all the items above are correct.	Replace VAC card 1.

- 9) Alarm No. 9 "VAC instruction command NG." is displayed.

Table 4-16

Failure Factor	Check	Measures
Faulty NC software (Undefined instruction or non-executable instruction is communicated.)	Check the communication in which an alarm occurs.	Correct the NC software.

- 10) Alarm No. 10 "VAC motor cable overcurrent" is displayed.

Table 4-17

Failure Factor	Check	Measures
Loose connection of motor power cables at terminal block	Check motor power cable connection at the terminal block of the motor and the VAC drive unit.	Connect the cables securely.
Motor power cables are broken, short-circuited, or grounded.	Disconnect the motor power cables from the VAC drive unit and the motor, and check continuity.	Replace the cables.
Loose connection of the motor signal cables	Check the connectors at the VAC drive unit (CN3) and in the VAC motor terminal box - are they inserted properly?	Insert the connector properly.
The VAC motor is faulty.	Measure resistance between the VAC motor power cable terminal and the frame using a Megger insulation tester.	Replace the VAC motor.
The control PCB is faulty.	Make sure that all the items above are correct. (Check the settings at DIP switches SW3 and SW4.)	Replace the control PCB.
The power supply unit is faulty.	Make sure that the IOCM is indicated even after the replacement of the control PCB.	Replace the power supply unit.

Remark: For the VAC motor of the winding changeover specification, malfunction of the magnet switch for changing winding or magnet switch drive relay must also be checked.

For the procedure to check them, refer to the maintenance manual for the machine.

11) Alarm No. 11 "VAC inverter bridge short circuit" is displayed.

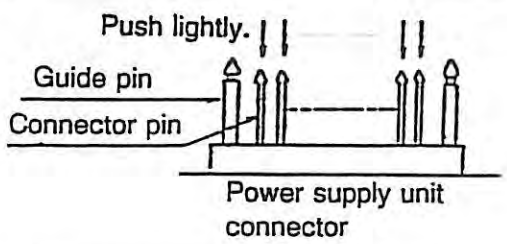
Table 4-18

Failure Factor	Check	Measures
The control PCB or the power supply unit is faulty.	Refer to Table 4-19.	Refer to Table 4-19.
Motor power cables are broken, short-circuited, or grounded.	Disconnect the motor power cables from the VAC drive unit and the motor, and check continuity.	Replace the cables.
The VAC motor is faulty.	Measure resistance between the VAC motor power cable terminal and the frame using Megger insulation tester.	Replace the VAC motor.

Remark: For the VAC motor of the winding changeover specification, malfunction of the magnet switch for changing winding or magnet switch drive relay must also be checked.

For the procedure to check them, refer to the maintenance manual for the machine.

Table 4-19

Process	Contents
1,	Turn off power supply.
2	Check the fuses in the TR1 - TR6 base circuits.
3	Check the transistors in the TR1 - TR6 base circuits.
4	Remove the control PCB and check to be sure that the connector pins at the supply unit side of the connector CN5 or CN6 are fixed to the connector. If not pull, the connectors pin up to fix them. 
5	Check the transistor modules TRM1 - TRM3.
6	Install the control PCB.
7	Run the VAC drive unit. Check whether the IOCS lamp lights up.
8	If the IOCS lamp lights up again, replace the control PCB and then run the VAC drive unit.
9	If the IOCS lamp still lights up, replace the power supply unit.

12) Alarm No. 12 "VAC power trans short circuit" is displayed.

Table 4-20

Failure Factor	Check	Measures
An instantaneous power failure occurs while the motor is stopped.	Check the power supply.	Reset and restart.
The control PCB or the power supply unit is faulty.	Refer to Table 4-21.	Refer to Table 4-21.

Table 4-21

Process	Contents
1	Turn off power supply.
2	Check the fuses in the TR7 - TR12 base circuits.
3	Check the transistors in the TR7 - TR12 base circuits.
4	Remove the control PCB and check to be sure that the connector pins at the supply unit side of the connector CN6 and CN7 are fixed to the connector.
5	Check the transistor module TRM4 - TRM6.
6	Install the control PCB.
7	Run the VAC drive unit. Check whether the IOCR lamp lights up.
8	If the IOCR lamp lights up again, replace the control PCB and then run the VAC drive unit.
9	If the IOCR lamp still lights up, replace the power supply unit.

13) Alarm No. 13 "VAC power circuit overvoltage" is displayed.

Table 4-22

Failure Factor	Check	Measures
Source voltage is abnormally high.	See Table 4-6.	See Table 4-6.
Power supply cable terminal screws are loose.	1) Turn power supply off. 2) Check the screws if they are loose.	Secure the screws tightly.
The regeneration circuit is faulty.	Follow the steps in Table 4-21 to check if the OV lamp lights up.	See Table 4-21.
Power supply impedance is high.	The OV lamp lights up only while decelerating.	Use a power supply unit with a low impedance.

- 14) Alarm No. 14 "VAC input voltage drop" or Alarm No. 15 "VAC phase defect" is displayed.

Table 4-23

Failure Factor	Check	Measures
Power supply voltage is low, or one of three phases is open.	See Table 4-6.	See Table 4-6.
The no-fuse breaker is in the OFF position.	Check the no-fuse breaker setting visually.	Set the no-fuse breaker in the ON position.
The no-fuse breaker is tripped.	ON status Tripped OFF status No-fuse Breaker Handle Positions	Check the power supply unit following the procedure explained in Table 4-24.
Fuses F5, F6 or F7 is blown.	Check the fuses whether they have been blown or not. Refer to 6. "Fuse Replacement".	Replace blown fuse.
The screws in the diode module is loose.	Check the screws in the diode module. (Refer to Figs. 4-4 through 4-7.)	Secure the screws tightly.
The diode module is faulty.	Check the diode module.	Replace the diode module.
PCB connector CN6 is not plugged in properly.	See Table 4-6.	See Table 4-6.
Control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.
The power supply unit is faulty.	Check to be sure that the UV and/or PH lamp lights up even after the replacement of the control PCB.	Replace the power supply unit.
Power supply impedance is high.	The UV and/or PH lamp lights up only during acceleration and deceleration of the motor.	Use a power supply unit with a low impedance.

SECTION 4 SPINDLE DRIVE UNIT FOR VAC MOTOR (VAC II)

Table 4-24 Measures to Take when No-fuse Breaker is Tripped

Process	Contents
1	Turn off power supply.
2	Check the diode module, transistor module TRM4 - TRM6, TR7 - TR12 base circuit fuses, and transistor module. If any other failure state such as IOCM, IOCS and IOCR is indicated at the same time, then take measures for them.
3	Reset the no-fuse breaker handle in the ON position.
4	Run the VAC drive unit.
5	If the no-fuse breaker is tripped again, replace the power supply unit.

15) Alarm No. 16 "VAC arithmetic unit volt drop" is displayed.

Refer to Table 4-8.

16) Alarm No. 17 "VAC power circuit low voltage" is displayed.

Table 4-25

Failure Factor	Check	Measures
Source voltage is low.	See Table 4-6.	See Table 4-6.
The screws in the diode module is loose.	Check the screws in the diode module. (Refer to Figs. 4-4 through 4-7.)	Secure the screw tightly.
The diode module is faulty.	Check the diode module.	Replace the diode module.
PCB connector is not plugged in properly.	See Table 4-6.	See Table 4-6.
The power supply unit is faulty.	Make sure that all the items above are correct.	Replace the power supply unit.
The control PCB is faulty.	The UVP lamp lights up after the replacement of the power supply unit.	Replace the control PCB.

17) Alarm No. 18 "VAC interval loop error" is displayed.

Replace the control PCB.

18) Alarm No. 19 "VAC motor overload" is displayed.

Table 4-26 OL Lamp Lighting up during Motor Rotation

Failure Factor	Check	Measures
Operation in overloaded condition	Check the loaded conditions with the load meter.	Check the cutting conditions and cutting tools.
Fuse F1, F2 or F3 is blown.	Check whether the fuses have been blown or not. (Refer to 6-2. "Inspection and Replacement Procedure for Fuses".)	Replace the fuses.
Loose connection of the fan motor cables at terminal block	The motor cooling fan does not operate when power is turned on. Check fan motor cable connection at the terminal block of the motor and the VAC drive unit.	Connect the cables correctly.
Fan motor cables are broken.	The motor cooling fan does not operate when power is turned on. Check continuity.	Replace the fan motor cables.
Motor cooling fan is faulty.	The motor cooling fan does not operate when power is turned on.	Replace the motor cooling fan.
Motor cooling fan, fan guard, ventilation ports, etc. are contaminated.	Check contamination degree.	Clean with compressed air or using vacuum cleaner.
Control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.

Table 4-27 OL Lamp Lighting Always

Failure Factor	Check	Measures
Loose connection of the motor signal cables	Check the connectors at the VAC drive unit (CN3) and in the VAC motor terminal box - are they inserted properly?	Insert the connector properly.
Broken motor signal cables (Overload signal)	Remove the signal cables and conduct the continuity test.	Replace the signal cables.
The thermostat inside the VAC motor is faulty.	Measure the resistance between thermostat terminals of the connector in the VAC motor terminal box. If it is an infinite value (∞), it indicates that the thermostat is faulty.	Replace the VAC motor.
Control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.

19) Alarm No. 20 "VAC heat sink overload" is displayed.

Table 4-28

Failure Factor	Check	Measures
Fuse F1, F2 or F3 is blown.	Check whether the fuses have been blown or not. (Refer to 6-2. "Inspection and Replacement Procedure for Fuses".)	Replace the blown fuse.
PCB connector CN5 is not inserted properly.	See Table 4-5.	Insert the connector properly.
Heat sink cooling fan is faulty.	Check if the heat sink cooling fan is operating when power is turned on.	Replace the power supply unit.
Heat sink cooling fan and heat sink are contaminated.	Check contaminated condition at the back of the power supply unit.	Clean with compressed air or using vacuum cleaner.
Operation in overloaded condition	Check the loaded conditions with the load meter.	Check the cutting conditions and cutting tools.
Control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.
The power supply unit is faulty.	Make sure that the OH is indicated after the replacement of the control PCB.	Replace the power supply unit.

SECTION 4 SPINDLE DRIVE UNIT FOR VAC MOTOR (VACII)

20) Alarm No. 21 "VAC data setting" is displayed.

Table 4-29

Failure Factor	Check	Measures
Faulty NC software	Check the VAC PBU data or one-line change parameter.	Correct the faulty data.

21) Alarm No. 22 "VAC internal speed command too fast" is displayed.

Table 4-30

Failure Factor	Check	Measures
Mechanical trouble around the spindle (collision, overload, etc.)	Check the machine for the mechanical trouble factor.	Remove the mechanical trouble factor.

22) Alarm No. 23 "VAC magnetic P.G. abnormal" is displayed.

Table 4-31

Failure Factor	Check	Measures
The magnetic encoder sensor is faulty.	Rotate the spindle by hand and check the output signal of the encoder. (Refer to 5-4. "Check Terminals" when checking the output signals.)	Replace the sensor.
Loose connection of the connectors of magnetic encoder signal cables	Check whether connector CN13 is inserted properly.	Insert the connector properly.
Broken magnetic encoder signal cables	Remove the magnetic encoder cables and conduct the continuity test.	Replace the magnetic encoder signal cables.

23) Alarm No. 24 "VAC P.G. marker data NG." is displayed.

Table 4-32

Failure Factor	Check	Measures
The magnetic encoder sensor or the gear is faulty.	Rotate the spindle by hand and check the output signal of the encoder. (Refer to 5-4. "Check Terminals" when checking the output signals.)	Replace the sensor or the gear.

24) Alarm No. 25 "VAC cycle overflow error" is displayed.

Table 4-33

Failure Factor	Check	Measures
Loose connection of the connector between the control PCB's.	Check whether or not the connector between the control PCB's is inserted properly.	Insert them properly.
The control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.

- 25) Alarm No. 26 "VAC watchdog error" is displayed.
Alarm No. 27 "VAC analog-to-digital access alarm" is displayed.
Alarm No. 28 "VAC board; CPU error" is displayed.
Alarm No. 29 "VAC card; CPU error" is displayed.
Replace the control PCB.

26) Alarm No. 30 "VAC speed deviation to large" is displayed.

Table 4-34

Failure Factor	Check	Measures
Operation in overloaded condition	Check the loaded conditions with the load meter.	Check the cutting conditions and cutting tools.
Open or loose contact of motor power cables	Check the motor power cables.	Connect the motor power cables correctly.
Motor signal cables are faulty. (loose connection, miswiring, etc.)	Check the motor signal cables. To check the resolver signal, refer to Remark 2 for Table 4-14.	Connect the motor signal cables correctly.
The regeneration circuit is faulty.	Check whether DSC lamp lights up during the procedure as explained in Table 4-21.	Check the operation conditions. Are acceleration and deceleration repeated frequently?
The inverter circuit is faulty.	Check whether DSC lamp lights up during the procedure as explained in Table 4-19.	Refer to Table 4-19.
The control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.

Remark: For the VAC motor of the winding change specification, malfunction of the magnet switch for changing winding or magnet switch drive relay must also be checked.

For the procedure to check them, refer to the maintenance manual for the machine.

SECTION 4 SPINDLE DRIVE UNIT FOR VAC MOTOR (VAC II)

27) Alarm No. 31 "VAC coil switch" is displayed.

Table 4-35 WCHER Lamp Lighting with Winding Changeover Specification

Failure Factor	Check	Measures
Magnet switch and/or magnet switch drive relay for winding changeover is faulty.	Refer to the maintenance manual for the machine.	Replace magnet switch and/or magnet switch drive relay.
The control signal cable is faulty. (broken or loose contact) (magnet switch operation signal, confirmation signal)	Check the cables.	Connect the cables properly.
The control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.

28) Alarm No. 32 "RAM abnormal" is displayed.

Replace the control PCB.

(3) Motor hunts.

Table 4-36

Failure Factor	Check	Measures
Faulty motor power cables and motor signal cables (loose contact, miswiring, etc.)	Check the cables. To check the resolver signal, refer to Remark 2 for Table 4-14.	Connect the cables correctly.
Fuses in TR1 - TR6 base circuits are blown.	Check the fuses in the TR1 - TR6 base circuits. (Refer to 6-2. "Inspection and Replacement Procedure for Fuses".)	Replace blown fuse.
Transistors in TR1 - TR6 base circuits are faulty.	Check the transistors on the TR1 - TR6 base circuits.	Replace the control PCB.
Transistor modules TRM1 - TRM3 are faulty.	Check the transistor module TRM1 - TRM3.	Replace the transistor module.
Control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.

Remarks:

With the VAC motor winding change specification, the motor power cables are wired through the winding change magnet switch. Therefore, the possibility of loose contact, wiring error, etc. related with the magnet switch for changing winding must also be checked.

SECTION 4 SPINDLE DRIVE UNIT FOR VAC MOTOR (VACII)

- (4) Commanded motor speed cannot be obtained.

Motor does not rotate.

Table 4-37

Failure Factor	Check	Measures
The VAC drive unit is faulty.	When a rotation command is given, the LED's light up indicating the faulty operation condition.	See Table 4-9.
Broken or loose contact of the motor signal cables and power cables	Check the motor signal and power cables.	Connect the cables correctly.
The resolver is faulty.	To confirm the resolver signal, refer to Remark 2 on Table 4-14.	Replace the VAC motor.
The magnetic encoder is faulty.	Check the output signal of the encoder.	Replace the sensor of the encoder.
Control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.
The power supply unit is faulty.	Make sure that all the items above are correct.	Replace the power supply unit.

Table 4-38

Failure Factor	Check	Measures
Winding changeover signal WCHG does not correctly input.	Check if the winding changeover signal WCHG input correctly or not by LED's indication. (Note 2) (Refer to Fig. 4-9.)	Input the signal correctly.
Winding changeover magnet switch and/or magnet switch drive relay is faulty.	Refer to the maintenance manual for the machine.	Refer to the maintenance manual for the machine.

Note: With the winding changeover specification, motor speed range varies according to the selected winding.

High-speed winding : 0 - max. motor rpm

Low-speed winding : 0 - max. motor rpm in low-speed range

If a motor speed exceeding max. rpm in the low-speed range is specified while the low-speed winding is selected, the motor rotates at the max. speed in the low-speed range.

(5) Low cutting performance

Table 4-39

Failure Factor	Check	Measures
Torque limit command is provided.	Check the signal existing. See TLM in Fig. 4-9.	Clear the torque limit command.
Problem lies with the machine spindle.	Refer to the maintenance manual for the machine.	Refer to the maintenance manual for the machine.
Control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.

(6) Long acceleration and deceleration time

Table 4-40

Failure Factor	Check	Measures
Operation in overloaded condition	Check the loaded conditions with the load meter.	Reduce load.
Torque limit command is provided.	Check the signal existing. See TLM in Fig. 4-9.	Clear the torque limit command.
Source voltage is high.	See Table 4-6.	See Table 4-6.
Broken or loose contact of motor power cables	Check the motor power cables.	Connect the motor power cables correctly.
Fuses in base circuits are blown.	Check the fuses in base circuits. (Refer to 6-2. "Inspection and Replacement Procedure for Fuses".)	Replace blown fuse.
Transistors in the base circuits are faulty.	Check the transistors in the base circuits.	Replace the control PCB.
Transistor module is faulty.	Check the transistor module.	Replace the transistor module.
Control PCB is faulty.	Make sure that all the items above are correct.	Replace the control PCB.
Power supply impedance is high.	Only deceleration period is elongated.	Use a power supply unit with a low impedance.

(7) Excessive vibration and noise while the motor is rotating.

Table 4-41

Failure Factor	Check	Measures
Motor installation is loose; coupling with the spindle is loose.	Check motor installation or motor coupling to spindle.	Install the motor correctly.
VAC drive unit or connection of cables is faulty.	Refer to Table 4-36.	Refer to Table 4-36.
VAC motor is faulty.	Make sure that all the items above are correct.	Replace the VAC motor.

Remarks: To determine the cause of the problem, run the VAC motor freely. For this, follow the procedure below.

- 1) Start the VAC motor.
- 2) Trip the no-fuse breaker in the VAC drive unit to OFF.
- 3) The PH (phase-loss) alarm occurs and the VAC motor runs freely.

5-3. Recovery from Failure Status

When LED's indicate the faulty operation status, it is necessary to remove the cause of failure first and then reset the alarm state to recover the operations of the VAC drive unit.

VAC alarms are classified into the following four levels according to the operation at their occurrence and the way to reset them. Refer to Table 4-4, "VACII Alarm List".

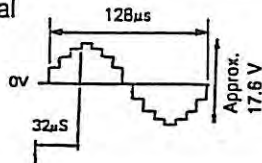
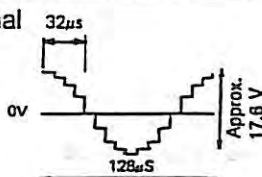
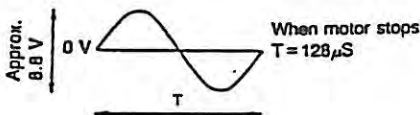
Table 4-42

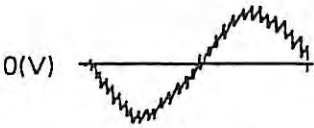
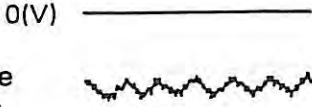
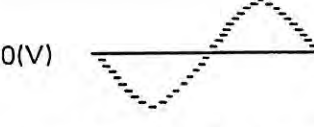
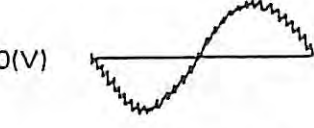
Alarm Level	Operation at Occurrence	How to Reset	Nature of Alarm
Level 1a	Transited to alarm level 1 (immediate power shutoff)	Set the three-phase breaker to the "OFF" position and then set it to the "ON" position again.	VAC hardware must be initialized. (for example exception alarm)
Level 1b	Transited to alarm level 1 (power shutoff after the motor is stopped.)	Turn off the power to the NC once and then turn it on again.	Parameters must be initialized. (for example DIFF OVER alarm)
Level 2	Transited to the alarm state in the mode in which the alarm occurred. (Operation varies depending on the mode in which the alarm occurred.)	Reset the NC from the operation panel. (The reset command is generated in each mode.)	Alarms which might be caused by cutting conditions.
Level 3	The VAC sends information to the NC that an alarm of level 3 has occurred. The VAC unit operates for 30 seconds after the alarm occurred, then the alarm level is transited to "2".	Reset the NC from the operation panel. (The reset command is generated in each mode.)	Overload-related alarms

5-4. Check Terminals

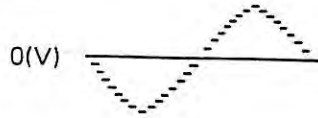
For the layout of the check terminals, refer to Fig. 4-2.

Table 4-43

Check Terminal	Probe Common Terminal	Contents	Remarks
GND	—	Separated from the regenerative control circuit, the input/output signal circuit, and the base circuit.	
S1	GND	Resolver excitation signal Sine wave 	
S2	GND	Resolver excitation signal Cosine wave 	
R1	GND	Resolver feedback signal  - Phase difference to the excitation signal changes as the motor rotates. - Frequency f (Hz) varies as indicated below according to the motor speed N (rpm). $f = 1/T = \frac{1}{128 \times 10^{-6}} \pm \frac{8N}{60}$ (+ in the forward rotation and - in the reverse rotation)	
VEL	GND	Velocity monitor The motor speed (rpm) is indicated. ± 10 [V] at the maximum motor speed	
TQ	GND	Torque monitor The motor output torque is indicated. ± 10 [V] at the maximum motor output	

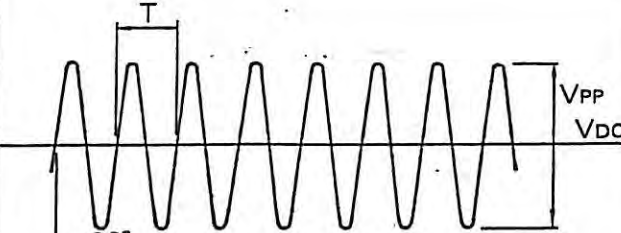
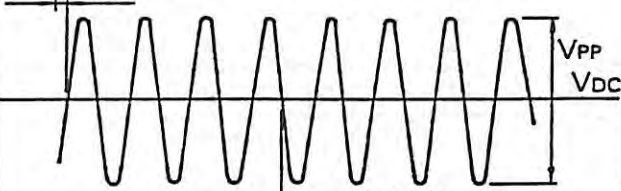
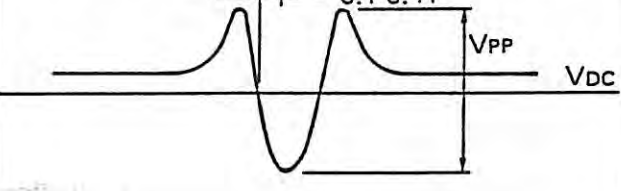
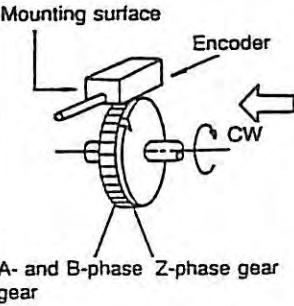
Check Terminal	Probe Common Terminal	Contents	Remarks
Is	GND	Inverter circuit current detection	The IOCS alarm occurs at higher than 250 [mV].
Ir	GND	Regenerative circuit current detection	The IOCR alarm occurs at higher than 250 [mV].
Iu	GND	U-phase current feedback signal	
Iv	GND	V-phase current feedback signal	
		 Cycle and amplitude changes depending on operation state.	
IM	GND	Current feedback three-phase full wave rectifying signal  - Cycle and amplitude changes depending on operation state. - With the type A control PCB, the current feedback signal is rectified to negative voltage. - With the previous control PCB, the current feedback signal is rectified to positive voltage.	The IOCR alarm occurs at lower than -6.6 V.
Iuc	GND	U-phase current feedback signal	
Ivc	GND	V-phase current feedback signal	
		 Cycle and amplitude changes depending on operation state.	
Idu	GND	U-phase current amplifier signal	
Idv	GND	V-phase current amplifier signal	
		 Cycle and amplitude changes depending on operation state.	

Check Terminal	Probe Common Terminal	Contents	Remarks
Euc	GND	U-phase induced voltage command signal	
Evc	GND	V-phase induced voltage command signal	
MON	GND		
+5 V	GND	Control circuit power voltage	
+15 V	GND	Control circuit power voltage	
-15 V	GND	Control circuit power voltage	
COM	—	Grounding in regenerative control circuit When checking the waveform in the regenerative circuit, use an insulated oscilloscope. Be careful that the COM terminal is not short-circuited with other circuit, for example with the GND terminal, in the oscilloscope.	
6V	COM	Regenerative control circuit power voltage	



Cycle changes depending on the motor speed.

SECTION 4 SPINDLE DRIVE UNIT FOR VAC MOTOR (VAC II)

Check Terminal	Probe Common Terminal	Contents	Remarks
A	GND		T is determined on the basis of the number of gear teeth and the speed.
B	GND		Z: Number of gear teeth N: Speed (rpm)
Z	GND		$T = \frac{1}{N \times 1/60 \times Z}$ (sec) Amplitude at A and B: $V_{DC} = 2.5 \text{ V}$ $V_{pp} = 3 \text{ V}$ Amplitude at Z: $V_{DC} = 2.5 \text{ V}$ $V_{pp} = 3 \text{ V}$
 The above waveforms are obtained when the encoder is installed as illustrated to the left and the gear is rotated in the CW direction viewing it from the Z-phase gear teeth.			

6. Fuse Replacement

6-1. Fuse Blown Condition

Blown conditions of fuses used in the VAC drive unit are shown in Table 4-44.

Table 4-44 Fuse Blown Conditions

Fuse Name	Blown Condition
Fuses F1 - F6 (A type motor) F1 - F4 (former type motor) After slight modification of D22 Excluding D22A	 Neon tube lighting up The neon lamp lights up as illustrated at the left when viewed from the front. (only when power is ON.)
Fuses F1 - F7 (D22A) F1 - F5 (After slight modification of D22)	 Blown fuse element The fuse element is blown as illustrated at the left when viewed from the front.
Warning fuse SMP32 MP50	 White The white fuse blown indication appears at upper portion of the fuse cartridge when viewed from the front.
Base circuit fuse KM10	 Blown fuse element The fuse element is blown as illustrated at the left when viewed from the front. There might be cases where the blown fuse element cannot be found visually.

6-2. Inspection and Replacement Procedure for Fuses

(1) Fuses F1 - F6 (After slight modification of D22, excluding D22A)

1) Preparation

D3, D6, D8:

Turn off power supply, then open the power supply unit door after removing the door clamping screws.

D11, D22:

Follow the procedure explained below when power is off or after turning it off if fuse blown indication is provided.

2) Grip the fuse holder knob and pull out the fuse holder assembly.

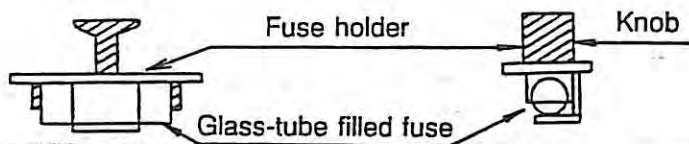


Fig. 4-13 Fuse and Fuse Holder

- 3) Measure resistance across the glass-tube filled fuse element using a multimeter. Reading must be 0Ω . When it is " ∞ " it indicates that the fuse has been blown.
- 4) If the fuse is blown, replace the fuse. Refer to 6-3. "Fuse Rating".
- 5) Set the fuse holder.
- 6) For D3, D6 and D8, close the door and fix it in place with screws.

- (2) Fuses F1 - F7
(After slight modification of D22, for D22A only)
- 1) Turn off power supply.
 - 2) Remove the fuse cover using a screwdriver.
 - 3) Remove the glass-tube filled fuse element using a screwdriver.
 - 4) Measure resistance across the glass-tube filled fuse element using a multimeter.
Reading must be 0Ω . When it is " ∞ ", it indicates that the fuse has been blown.
 - 5) If the fuse is blown, replace the fuse.
 - 6) Set the fuse holder. Refer to 6-3. "Fuse Rating".
 - 7) Place the fuse cover.

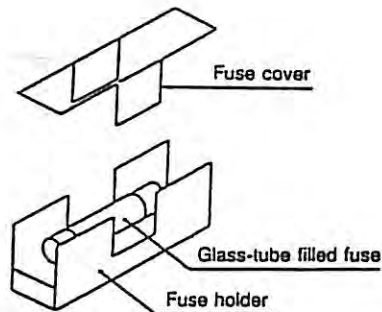


Fig. 4-14 Fuse for D22

- (3) Warning Fuse SMP32, MP50, and Base Circuit Fuse KM10

- 1) Loosen the screws and remove the cover.
- 2) Check the fuse.

Warning fuse:

Visually check the blown indication.

Base circuit fuse:

After removing the fuse, measure resistance between the terminals using a multimeter.

In either case, reading must be 0Ω . When it is " ∞ ", it indicates that the fuse has been blown.



Fig. 4-15 KM10

- 3) Remove the blown fuse and set a new fuse in the holder.
- 4) Place the cover and secure the screws.

6-3. Fuse Rating

For fuses F1 - F7 in the A type unit, use 5 A and 0.5 A rating fuses as indicated in Table 4-45. When replacing a fuse, always use the one with the same current rating.

Fuses used in the former type unit are all 5 A rating fuses.

Table 4-45 A Type Unit Fuse Current Rating

Unit Type	Fuse Rating (A)							Remark
	F1	F2	F3	F4	F5	F6	F7	
D6A, D8A, D11A	5	5	5	5	0.5	0.5	-	Only for power units of Ver.1.0, all fuses were 5 A rating.
D22A	5	5	5	5	5	0.5	0.5	Only for power units of Ver.1.0, all fuses were 5 A rating.

7. Spare Parts

The VAC drive units have the following spare parts as indicated in Table 4-46.

Table 4-46 Spare Parts

Fuse Name	Type	Parts No.	Q'ty
Fuse (F1, F2, F3, F4, F5)	200 V, 5 A, F7161	E2442-290-124	2
Warning fuse (SMP32)	SMP32, 3.2 A Daito tsushin	E2445-392-228	2
Warning fuse (MP50)	MP50, 5A Daito tsushin	E2445-392-215	1

4. Brushless Servomotor Drive Unit

4-1. BDU-A Series

Brushless servomotors are employed to control movement of each axis of X, Y, and Z at the feedrate and in the direction as commanded by the CNC. It is the brushless servo drive unit that accurately controls the rotating speed.

As described in "Operation and Structure of the NC" in Section 2, 3., OCON, the output from the CPU interpolator is compared with RAPA, the output from the position encoder which detects the actual position of each axis. The difference ODIF between OCON and RAPA is added to the commanded feedrate and the result, DA is obtained. The brushless servo unit functions to control the brushless motor, i.e., the present position of each axis so that the ODIF is always zero.

The brushless servomotor drive unit BDU-A has been developed by Okuma as the drive unit for the brushless servomotor especially for axis drive of machine tools. The brushless servomotor is also the product of Okuma, the supplier of mechatronics technology. The features of the BDU-A are as follows:

- (1) The use of a brushless servomotor does not require inspection and replacement of commutator brushes, which is the must with DC motors.
- (2) The transistor PWM system assures smooth and quick response.
- (3) It promises good acceleration/deceleration characteristics.
- (4) The high-resolution OSP position encoder directly coupled to the motor detects both the motor speed and position. Therefore, control and construction are quite simple.
- (5) Various measures to protect the motor are provided.

They include:

- motor overload detection
- no-fuse breaker
- overcurrent alarm
- input voltage detection
- circuit failure

4-1-1. Configuration of BDU-A

(1) General System Configuration

The BDU-A consists of the DC power supply and the servo amplifier unit. A DC power supply can supply power to multiple servo amplifiers (max. six axes) and one brushless servomotor requires one servo amplifier. Fig. 3-3 shows the configuration of the BDU-A in the six-axis control CNC.

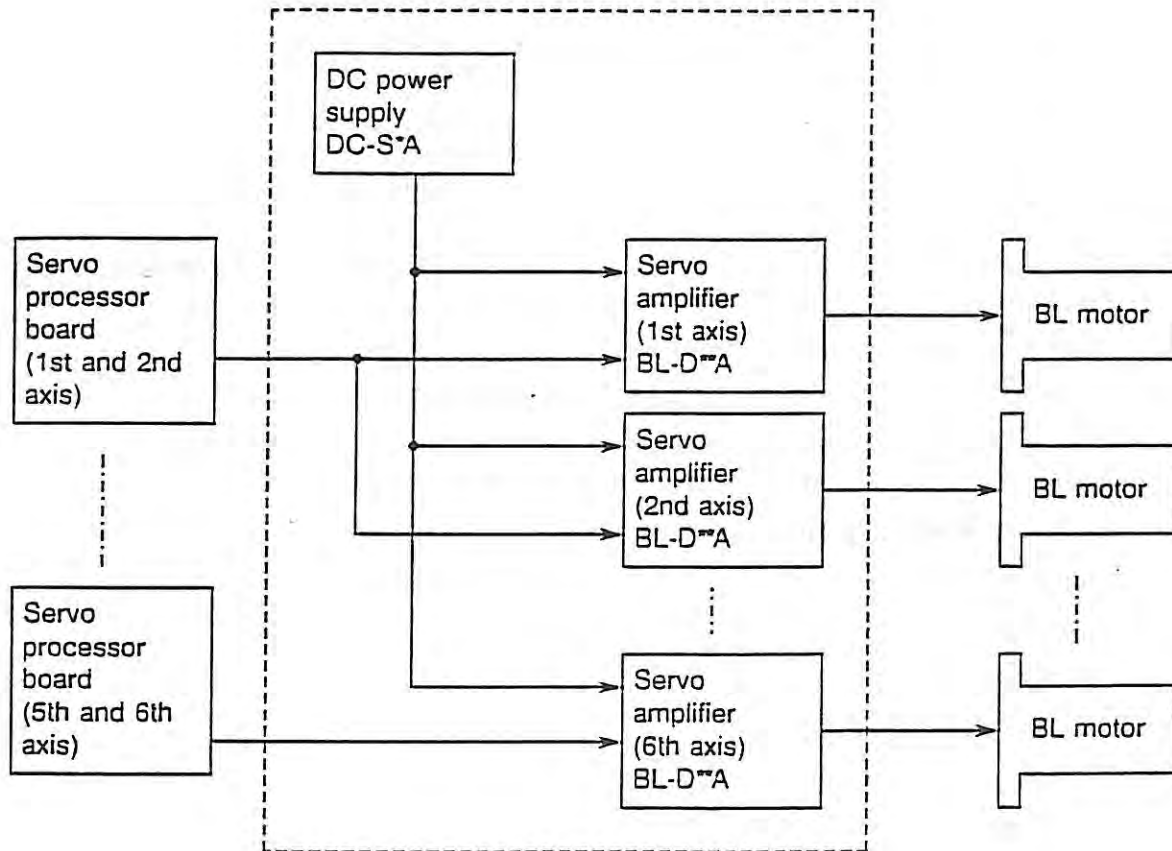


Fig. 3-3 BDU-A Configuration

(2) Configuration of DC Power Supply Unit

The DC power supply unit consists of the DC-PS board and the DC-S*A unit.

Table 3-1

Name	Model (Description)
DC-PS Board	PCB for two-axis control
	PCB for three-axis control
	PCB for four-axis control
	PCB for five-axis control
	PCB for six-axis control
DC-S*A Unit	DC-S1A†
	DC-S3A

† Conventional DC-S2 unit is replaced with the DC-S1A unit after the slight change in models.

(3) Configuration of Servo Amplifier

The servo amplifier consists of the SVC-A board and the BL-D**A unit.

Table 3-2

Name	Model (Description)
SVC-A Board	Change DIP switch setting according to motor model.
BL-D**A Unit	BL-D15A unit
	BL-D30A unit
	BL-D50A unit
	BL-D75A unit
	BL-D150A unit

(4) Construction of DC Power Supply, DC-PS Board and DC-S*A Unit

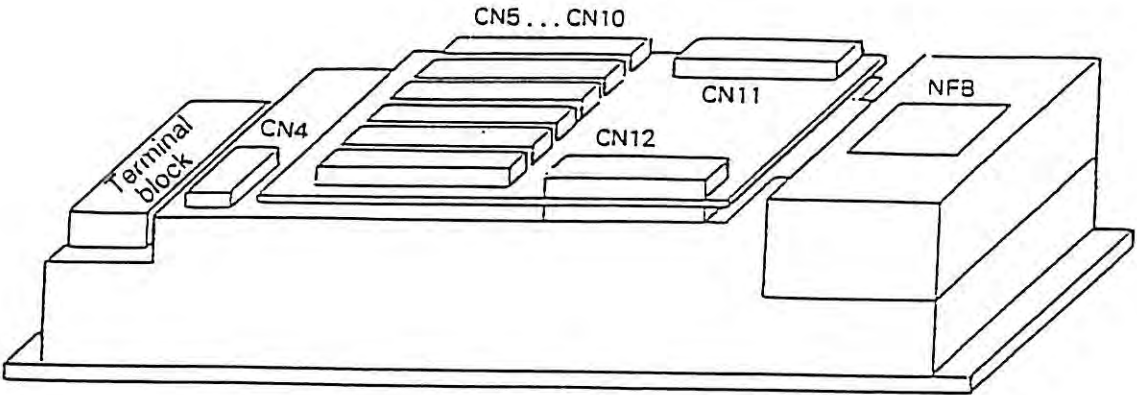


Fig. 3-4 Construction of the DC Power Supply

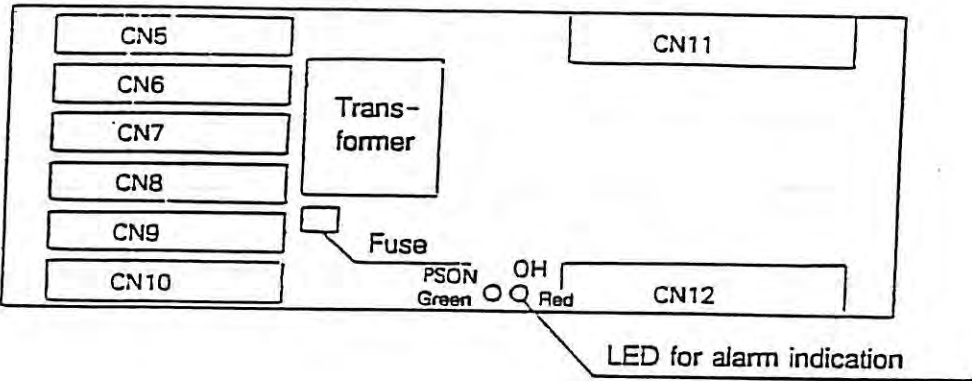


Fig. 3-5 Arrangement of Major Component Parts of DC-PS Board

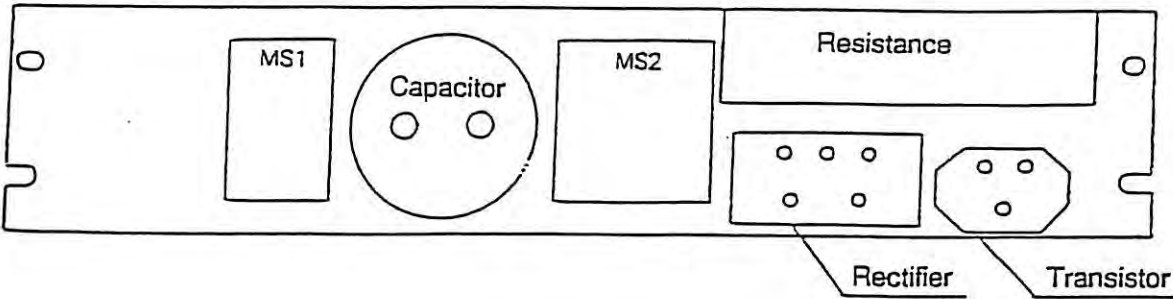


Fig. 3-6 Arrangement of Major Component Parts of DC-S*A Unit

- (5) Construction and Component Part Arrangement of Servo Amplifier
Servo Amplifier, SVC-A Board and BL-D™A Unit

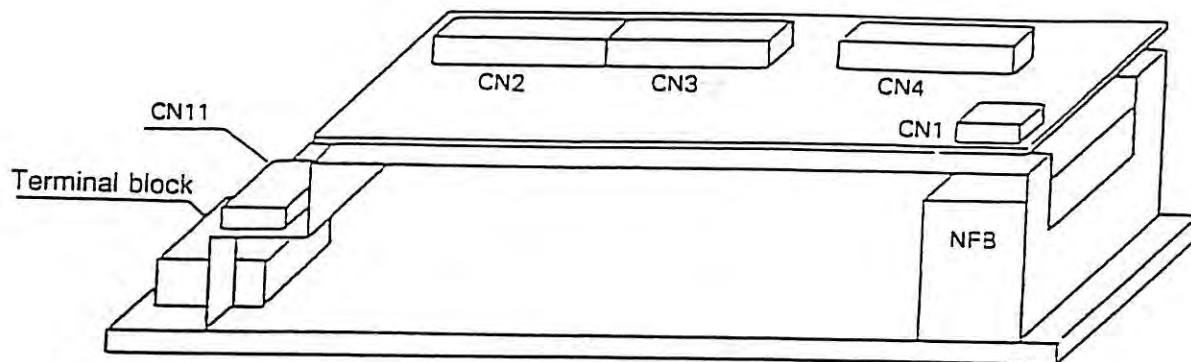


Fig. 3-7 Construction of the Servo Amplifier

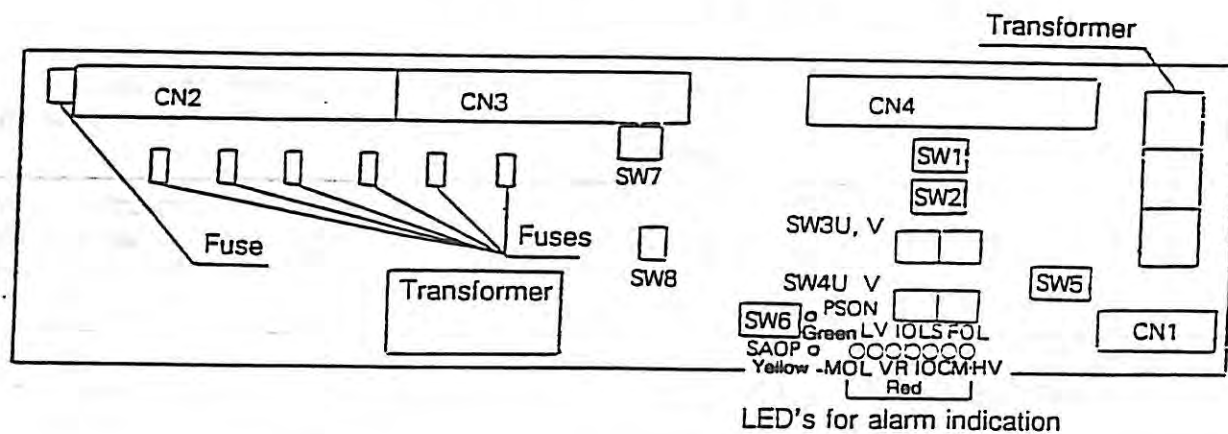


Fig. 3-8 Arrangement of Major Component Parts of SVC-A Board

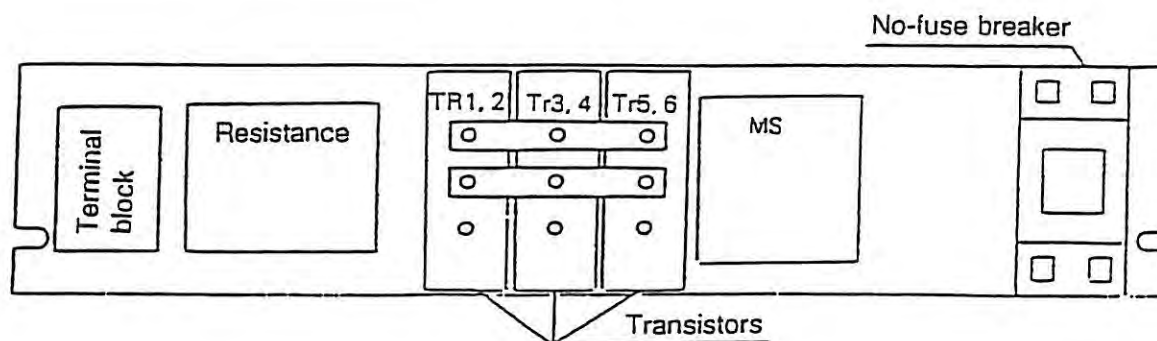


Fig. 3-9 Arrangement of Major Component Parts of BL-D™A Unit

4-1-2. Protection and Alarm Monitoring Function (BL-D**A Series)

Functions		Purposes and Contents
1	Grounding Protection	For grounding problem of the servo amplifier or motor, a high speed no-fuse breaker is tripped to shut off the power immediately. At this time, the motor stops safely with dynamic brake applied.
2	Base Circuit Protection	After a breakdown of a power transistor, the fuse connected in the base line protects the base circuit from over voltage.
3	Motor Overload Protection (MOL)	A thermostat in the motor armature winding detects overload state of the motor. When an overload is detected, the motor stops safely using dynamic brake.
4	Abnormal Temperature Rise of Heat Sink (FOL)	If the heat sink temperature rises abnormally due to heat generation-loss caused by deteriorated cooling condition and main circuit elements, this overheat state is detected. When an overheat is detected, motor stops safely using dynamic brake.
5	High/Low Voltage (HV/LV)	DC power supply output voltage is monitored to protect the main circuit elements from breakdown or irregular motor operation caused by abnormally high or low DC voltage. When an alarm is detected, the motor stops safely using dynamic brake.
6	DC Power Supply Short (IOC-S)	An overcurrent caused by the short in the inverter DC power supply due to failure of the main circuit elements or control circuit is detected to protect the main circuit elements from secondary breakdown. When an alarm is detected, the motor stops safely using dynamic brake.
7	Instantaneous Motor Overcurrent (IOC-M)	Instantaneous overcurrent in the motor circuit exceeding the preset level is detected to protect motor magnet from demagnetization. When an alarm is detected, the motor stops safely using dynamic brake.
8	Control Circuit Power Supply Alarm (VR-LOSS)	Voltage in the control circuit is detected if the voltage exceeds the value to guarantee safe motor operation to prevent irregular motor operation. When an alarm is detected, the motor stops safely using dynamic brake.
9	Regenerative Resistor Overheat (OH)	Overheating of the regenerative resistor is detected if current directly flows it due to a problem of the regeneration control circuit to protect it from burning down. When an alarm is detected, the motor stops safely using dynamic brake.

4-1-3. Trouble and Troubleshooting

The troubleshooting procedure is explained below.

(1) DC Power Supply Unit

No.	Trouble	Causes	Check	Measures
1	No-fuse breaker is tripped.	Incorrect wiring at terminals (VII, VL)	Check wiring.	Correct wiring.
		Grounding of output terminal (VII, VL) cables	Check the wiring for grounding.	Replace the cable.
		Grounding of the servo amplifier	Check the servo amplifier for grounding.	Replace the servo amplifier.
		Defective DC power supply	Check that the above indicated items are all correct.	Replace the DC power supply.
2	LED "OH" lights.	Defective discharge power transistor	Check the power transistor.	Replace the DC power supply.
		Loose connection of connector CN12	Check the connection of the connector CN12.	Connect the connector CN12 correctly.
		Defective DC power supply	Check that the above indicated items are all correct.	Replace the DC power supply.
3	The "DC PWR ON" LED is not turned off even after the power is turned off.	Defective DC power supply		Replace the DC power supply. (Before attempting replacement, confirm that the red DC PWR ON LED is off.)

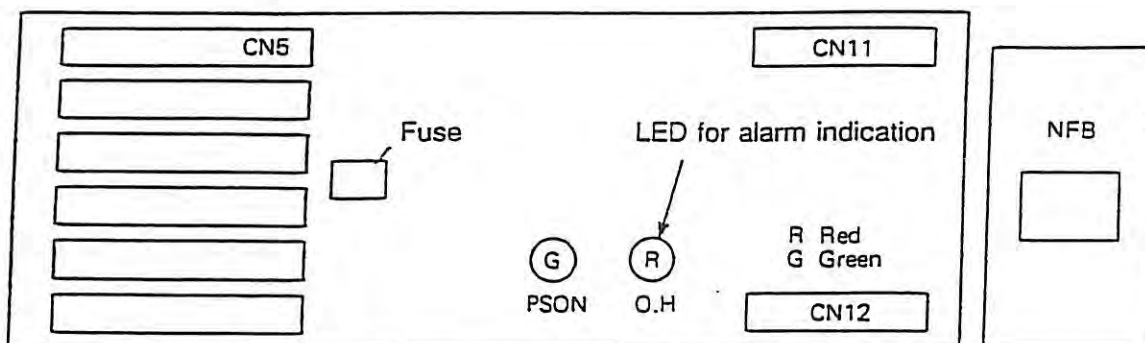


Fig. 3-10

(2) Servo Amplifier

No.	Trouble	Causes	Check	Measures
4	No-fuse breaker is tripped.	Incorrect wiring at terminals (U, V, W, E)	Check wiring.	Correct wiring.
		Grounding of output terminal (U, V, W, E) cables	Check the wiring for grounding.	Replace the cable.
		Defective power transistor	Check the power transistor.	Replace the servo amplifier.
		Defective servo amplifier	Check that the above indicated items are all correct.	Replace the servo amplifier.
5	LED "PS-ON" does not light.	Fuse (HM3.2) is blown.	Check if the fuse is blown.	Replace the fuse.
		Loose connection of connector CN10	Check the connection of the connector CN10.	Connect the connector CN10 correctly.
		Loose connection of connector CN2	Check the connection of the connector CN2.	Connect the connector CN2 correctly.
		Defective servo amplifier	Check that the above indicated items are all correct.	Replace the servo amplifier.
6	LED "LV" lights.	The no-fuse breaker for the servo amplifier or the DC power supply is OFF.	Check the no-fuse breaker position.	Turn ON the no-fuse breaker.
		3-phase input voltage is abnormally low.	Check the input 3-phase power with a multimeter.	Check the power capacity.
		One phase is lost in the 3-phase input power.	Check the input 3-phase power with a multimeter.	Check the power supply cable.
		Loose connection of connector CN3	Check the connection of the connector CN3.	Connect the connector CN3 correctly.
		Defective servo amplifier	Check that the above indicated items are all correct.	Replace the servo amplifier.
		Defective DC power supply	Check that the above indicated items are all correct.	Replace the DC power supply.
7	LED "VR" lights.	Defective SVC-A board	--	Replace the SVC-A board.

SECTION 3 TROUBLE AND TROUBLESHOOTING

No.	Trouble	Causes	Check	Measures
8	LED "IOCS"	Incorrect setting of SW7	Confirm that SW7 setting is as specified in the Servo Characteristic Chart.	Re-set SW7 according to the Servo Characteristic Chart.
		Incorrect wiring at terminals (U, V, W, E)	Check wiring.	Correct wiring.
		Grounding of output terminal (U, V, W, E) cables	Check the wiring for grounding.	Replace the cable.
		Defective power transistor	Check the power transistor.	Replace the servo amplifier.
		Defective servo amplifier	Check that the above indicated items are all correct.	Replace the servo amplifier.
9	LED "IOCM" lights.	Incorrect setting of SW1 and SW2	Confirm that SW1 and SW2 settings are as specified in the Servo Characteristic Chart.	Re-set SW1 and SW2 according to the Servo Characteristic Chart.
		Incorrect wiring at terminals (U, V, W, E)	Check wiring.	Correct wiring.
		Grounding of output terminal (U, V, W, E) cables	Check the wiring for grounding.	Replace the cable.
		Loose connection of connector CN1	Check the connection of the connector CN1.	Connect the connector CN1 correctly.
		Defective SVP board	Check that the above indicated items are all correct.	Replace the SVP board.
		Defective servo amplifier	Check that the above indicated items are all correct.	Replace the servo amplifier.
		Defective motor	Check that the above indicated items are all correct.	Replace the motor.
10	LED "FOL" lights.	Overload operation	Check load with the load meter.	Review the cutting conditions and cutting tool.
		Loose connection of connector CN4	Check the connection of the connector CN4.	Connect the connector CN4 correctly.
		Defective servo amplifier	Check that the above indicated items are all correct.	Replace the servo amplifier.

No.	Trouble	Causes	Check	Measures
11	LED "HV" lights.	3-phase input voltage is abnormally high.	Check the input 3-phase power with a multimeter.	Check the power capacity.
		Defective power transistor of DC power supply	Check the power transistor.	Replace the DC power supply.
		Defective DC power supply	Check that the above indicated items are all correct.	Replace the DC power supply.
		Defective servo amplifier	Check that the above indicated items are all correct.	Replace the servo amplifier.
12	LED "MOL" lights.	Overload operation	Check load with the load meter.	Review the cutting conditions and cutting tool.
		Loose connection of connector CN11	Check the connection of the connector CN11.	Connect the connector CN11 correctly.
		Loose connection of connector CN4	Check the connection of the connector CN4.	Connect the connector CN4 correctly.
		Defective servo amplifier	Check that the above indicated items are all correct.	Replace the servo amplifier.

(3) Others

No.	Trouble	Causes	Check	Measures
13	DIFF OVER error occurs.	Incorrect setting of SW1 and SW2	Confirm that SW1 and SW2 settings are as specified in the Servo Characteristic Chart.	Re-set SW1 and SW2 according to the Servo Characteristic Chart.
		Incorrect wiring at terminals (U, V, W, E)	Check wiring.	Correct wiring.
		Loose connection of connector CN1	Check the connection of the connector CN1.	Connect the connector CN1 correctly.
		Defective power transistor	Check the power transistor.	Replace the servo amplifier.
		Defective servo amplifier	Check that the above indicated items are all correct.	Replace the servo amplifier.
		Defective motor	Check that the above indicated items are all correct.	Replace the motor.
14	Motor hunts.	Loose connection of connector CN1	Check the connection of the connector CN1.	Connect the connector CN1 correctly.
		Incorrect wiring at terminals (U, V, W, E)	Check wiring.	Correct wiring.
		Defective power transistor	Check the power transistor.	Replace the servo amplifier.
		Defective servo amplifier	Check that the above indicated items are all correct.	Replace the servo amplifier.
		Defective SVP board or TB board	Check that the above indicated items are all correct.	Replace the SVP board or TB board.
		Defective encoder	Check that the above indicated items are all correct.	Replace the encoder.
		Defective motor	Check that the above indicated items are all correct.	Replace the motor.

(4) Checking Power Transistor

Procedure:

- 1) Remove the SVC-A board.
- 2) Disconnect the leads and bus bar for the power transistor to be checked.
- 3) Measure the resistance between terminals using a multimeter. Correct resistance is as indicated in Table 3-3.

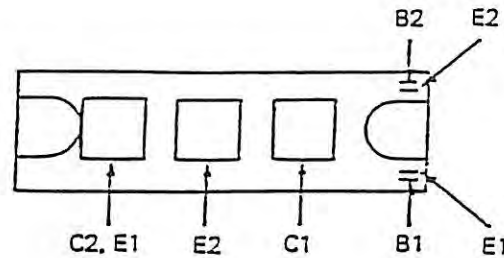


Fig. 3-11 Transistor Module Terminal Arrangement

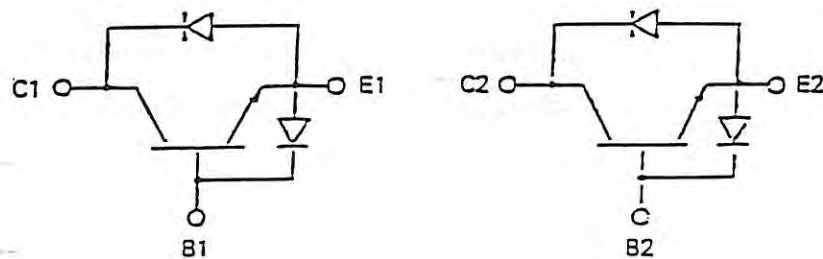


Fig. 3-12 Equivalent Circuit for Transistor Module

Table 3-3 Judgment Standard (Multi-meter setting: $\times 10$)

Transistor Terminals		Correct	Abnormal
Multimeter (+) probe	Multimeter (-) probe		
C1 (C2)	E1 (E2)	Tens to hundreds of ohms	0 Ω , ∞
E1 (E2)	C1 (C2)	∞	0 to hundreds of ohms
C1 (C2)	B1 (B2)	Tens to hundreds of ohms	0 Ω , ∞
B1 (B2)	C1 (C2)	∞	0 to hundreds of ohms
B1 (B2)	E1 (E2)	Hundreds of ohms	0 Ω , ∞
E1 (E2)	B1 (B2)	Hundreds of ohms	0 Ω , ∞

4-2. BDU-D Series Servo Drive Unit

The brushless motor servo drive unit (Type D) is used for the control of the tool magazine and crossrail automatic positioning. (optional)

4-2-1. Protection Functions

The BDU-D series servo drive unit has the following protection functions.

(1) DC-PS (DC Power Supply) Unit

a) Protection function using protection components

Type	Indication	Contents
No-fuse breaker	The no-fuse breaker lever is tripped to OFF. Light emitting diodes (LED), "PH", "LV" and "OVER DIS", light at the same time.	Protects the circuits from abnormal current flow caused by grounding of DC output line or short of output load.
Fuse	Fuse element is blown. When a fuse is blown, LED "PH" lights.	The fuse is blown when secondary side voltage of the control transformer is abnormal.

b) Protection function using circuits in PCB

Type	Indication	Contents
Phase-loss alarm	LED "PH" lights.	When any one of three input phases of AC power supply is lost, the protection function is activated and motor rotation is stopped with dynamic brake applied.
Low-voltage alarm	LED "LV" lights.	The protection function is activated when DC output voltage is lowered below 200 V and motor rotation is stopped with dynamic brake applied.
High-voltage alarm	LED "HV" lights.	The protection function is activated when DC output voltage is increased exceeding 430 V and motor rotation is stopped with dynamic brake applied.
Over-discharge alarm	LED "OVER DIS" lights.	The protection function is activated when discharge transistor (TR5) is turned on for longer than the specified period and motor rotation is stopped with dynamic brake applied.

(2) Servo Amplifier Unit

a) Protection function using protection components

Type	Indication	Contents
No-fuse breaker	1) No-fuse breaker lever is tripped to OFF. 2) LED "LV" lights. (SVC No. 2 board)	Protects the circuits from abnormal current caused by grounding of unit output line or short of loads. Protects the circuits from short of transistor bridge.
Fuse (control transformer primary input side)	1) Fuse element is blown. 2) When a fuse is blown, LED "PH" lights.	The fuse is blown when secondary side voltage of the control transformer is abnormal.
Fuse (secondary side of base circuit)	The base circuit protection fuse is blown.	Protects the base circuit from high voltage if power transistor is faulty.

b) Protection function using circuits in PCB

Type	Indication	Contents
Phase-loss alarm	LED "PH" lights. (SVC No. 2 board)	When any one of three input phases of AC power supply is lost, the protection function is activated and motor rotation is stopped with dynamic brake applied.
Low-voltage alarm	LED "LV" lights. (SVC No. 2 board)	The protection function is activated when DC input voltage is lowered below 200 V and motor rotation is stopped with dynamic brake applied.
Motor overcurrent alarm	LED "IOC-M" lights. (SVC No. 2 board)	The protection function is activated when overcurrent (more than 120% of current limit value) flows to generate an alarm and motor rotation is stopped with dynamic brake applied.
Inverter short alarm	LED "IOC-S" lights. (SVC No. 2 board)	The protection function is activated when overcurrent (more than 125% of transistor rating) flows the transistor bridge to generate an alarm and motor rotation is stopped with dynamic brake applied.
High-voltage alarm	LED "HV" lights. (SVC No. 2 board)	The protection function is activated when DC input voltage is increased exceeding 430 V and motor rotation is stopped with dynamic brake applied.

SECTION 3 TROUBLE AND TROUBLESHOOTING

Type	Indication	Contents
PCB control power supply alarm	LED "VR" lights.	The protection function is activated when ± 12 V power supply of the control circuit lowers below ± 10.8 V to generate an alarm and motor rotation is stopped with dynamic brake applied.
Encoder pattern data alarm	LED "E8" lights. (SVC No. 1 board)	This alarm is detected when data format of upper digit data sent from the motor incorporated encoder is abnormal. An alarm is generated and motor rotation is stopped with dynamic brake applied. (Equivalent to SVP pattern data alarm)
Encoder velocity alarm	LED "MPR" lights. (SVC No. 1 board)	This alarm is detected when lower digit numerical values sent from the motor incorporated encoder abnormally change. An alarm is generated and motor rotation is stopped with dynamic brake applied.
Encoder check data alarm	LED "APA" lights. (SVC No. 1 board)	This alarm is detected when upper digit numerical value read from the motor incorporated encoder does not conform to the numerical value obtained through the calculation of lower digit numerical value. An alarm is generated and motor rotation is stopped with dynamic brake applied. (Equivalent to SVP APA check data alarm)
Encoder alarm	LED "ALA" lights. (SVC No. 1 board)	This LED is turned on when any of the encoder alarm indicated above is detected.

Note:

An encoder alarm will be displayed until an alarm reset pulse is input from the ECPII board after power supply is turned on. This alarm display does not indicate actual occurrence of an alarm and may be ignored.

4-2-2. Trouble and Troubleshooting

If any problem occurs, locate the cause of the problem referring to the inspection items indicated below.

(1) DC-PS (DC Power Supply) Unit

No.	Problem	What to Check	Measures to Take
1	No-fuse breaker is tripped.	Connection at output terminals (VH, VL) for short, grounding and wrong connection	Correct wiring.
		Rectifier (REC)	Replace defective rectifier.
2	Fuse is blown.	Pin Nos. 1, 2 and 3 of output connectors (CN5, 6, 7, 8, 9 and 10)	Correct wiring.
		Wrong fuse	Replace fuse.
3	LED "PH" lights up. (Phase-loss alarm)	No-fuse breaker	Refer to No. 1.
		Phase-loss of 3-phase input power supply 1) If any one of three phases is lost, LED "PH" lights up. 2) If two phases are lost, neither of LED lights up because power is not supplied to control PCB.	Check 3-phase input power supply using a multimeter.
		Circuit breaker on control box	If circuit breaker tripped to OFF is reset to ON too quickly, LED "PH" might light up. Turn OFF the control box circuit breaker again then turn it back ON more than five seconds later.
		Connection of connector CN12	Check the connector.
		Malfunction of circuits on PCB	Replace the PCB.
4	LED "LV" lights up. (Low-voltage alarm)	Abnormally low voltage of 3-phase input power supply	Check input voltage with a multimeter.
		Phase-loss of 3-phase input power supply	Check input voltage with a multimeter.
		Connection of connector CN12	Check the connector.
		Malfunction of circuits on PCB	Replace the PCB.
5	LED "HV" lights up. (High-voltage alarm)	Wire broken in resistor RS2	Replace defective resistor.
		Transistor (TR)	Replace defective transistor.
		Connection of connector CN12	Check the connector.
		Malfunction of circuits on PCB	Replace the PCB.
6	LED "OVER DIS" lights up. (Over-discharge alarm)	Wire broken in resistor RS1	Replace defective resistor.
		Transistor (TR)	Replace defective transistor.
		Connection of connector CN12	Check the connector.
		Malfunction of circuits on PCB	Replace the PCB.

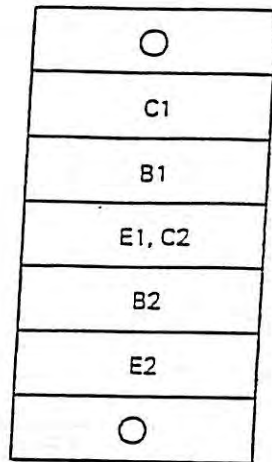
(2) Servo Amplifier Unit

No.	Problem	What to Check	Measures to Take
7	No-fuse breaker is tripped.	Connection at output terminals (U, V, W, and E) for short, grounding and wrong connection	Correct wiring.
		Transformer on BDC board	Replace defective transformer.
		Power transistors (TR1 - TR6)	Replace defective power transistor. <i>Note:</i> <i>If a power transistor is faulty, the fuse (base circuit protection fuse, 0.5 A) on the BDC board might be blown, or base current amplifying transistor (ET206) might be faulty. If this occurs, the BDC board itself must be replaced.</i>
8	Fuse at the primary side of the control transformer is blown. (on BDC board; 2 A × 3 pcs.)	Wiring to three BDC board transformers	Correct wiring.
		Transformers on BDC board	Replace defective transformer.
		Wrong fuse	Replace fuse.
9	Fuse at the secondary side of the base circuit is blown. (0.5 A fuse soldered on BDC board)	Power transistor (TR1 - TR6)	Replace defective power transistor. For replacing, refer to No. 7.
		Output transistor ET206	Replace defective output transistor ET206.
10	LED "PH" lights up. (Phase-loss alarm)	Refer to No. 3.	Refer to No. 3.
		Fuse (2A) on BDC board	Refer to No. 8.
		Transformers on BDC board	Replace defective transformer.
		Connection of the unit connector (CN10) and BDC board connector (CN7)	Check connectors.
		Malfunction of SVC No. 2 BDC board	Replace SVC No. 2 BDC board.
11	LED "LV" lights up. (Low-voltage alarm)	Tripping of no-fuse breaker of servo amplifier	Refer to No. 7.
		LED "LV" of DC-PS unit; is it lighted up?	Refer to No. 4.
		Connection of the BDC connectors (CN9, CN6) and SVC No. 2 board connector (CN5)	Check connectors.
		Malfunction of SVC No. 2 board and BDC board	Replace defective board, SVC No. 2 board, or BDC board.

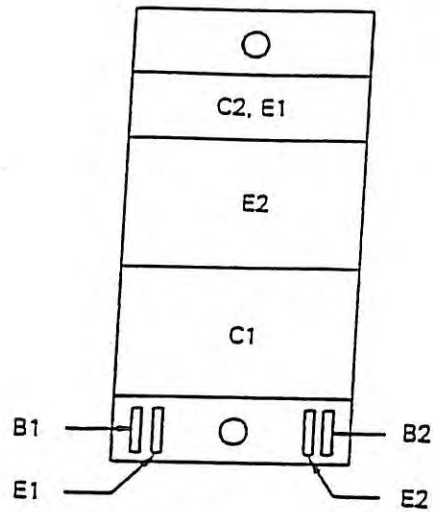
SECTION 3 TROUBLE AND TROUBLESHOOTING

No.	Problem	What to Check	Measures to Take
12	LED "IOC-M" lights up. (Motor overcurrent alarm)	Setting of SW1 and SW2 on SVC No. 2 board	Re-set SW1, SW2 according to Servo Characteristic Chart.
		Connection at output terminals (U, V, W, and E) for short, grounding and wrong connection	Correct wiring.
		Power transistor (TR1 - TR6)	Replace defective power transistor. For replacing, refer to No. 7.
		Connection of SVC No. 2 board connectors (CN7)	Check connectors.
		Malfunction of SVC No. 1 and No. 2 board	Replace defective board, SVC No. 1 board, or No. 2 board.
13	LED "IOC-S" lights up. (inverter short alarm)	Setting of SW7 on BDC board	Re-set SW7, according to Servo Characteristic Chart.
		Connection at output terminals (U, V, W, and E) for short, grounding and wrong connection	Correct wiring.
		Power transistor (TR1 - TR6)	Replace defective power transistor. For replacing, refer to No. 7.
		Connection of the BDC board connectors (CN9, CN6) and SVC No. 2 board connector (CN5)	Check connectors.
		Malfunction of SVC No. 2 board and BDC board	Replace SVC No. 2 board or BDC board.
14	LED "HV" lights up. (High-voltage alarm)	Refer to No. 5.	Refer to No. 5.
		Connection of the BDC connectors (CN9, CN6) and SVC No. 2 board connector (CN5)	Check connectors.
		Malfunction of SVC No. 2 board and BDC board	Replace SVC No. 2 board or BDC board.
15	LED "VR" lights up. (PCB control power supply alarm)	Voltage across COM and +12 V, and COM and -12 V at check terminals of SVC No. 2 board; they must be +12 V and -12 V, respectively.	Replace SVC No. 2 board or BDC board.
		Connection of the BDC connectors (CN6) and SVC No. 2 board connector (CN5)	Check connectors.
		Connection of connectors (CN1, CN2) in 5 V power supply (LT-1B) mounted on SVC No. 2 board	Check connectors.

Note 1: How to Check Power Transistors



(Screw Terminal Type)



(Faston Terminal Type)

E1-B1, C2
E2-B2, C2 } Check voltage across these terminals.

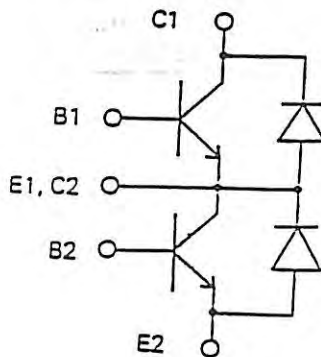


Fig. 3-13 Equivalent Circuit of Power Transistor

No.	Problem	What to Check	Measures to Take
16	LED "E8" lights up. (Encoder pattern data alarm)	Wiring between connector CN1 at SVC No. 1 board and ECP II, and between CN2 and motor incorporated encoder	Check connector and cable. (Mainly, upper digit signal line)
		Malfunction of motor incorporated encoder (upper digit)	Replace motor incorporated encoder.
		Malfunction of SVC No. 1 board	Replace SVC No. 1 board.
17	LED "MPR" lights up. (Encoder velocity alarm)	Wiring between connector CN1 at SVC No. 1 board and ECP II, and between CN2 and motor incorporated encoder	Check connector and cable. (Mainly, MPR signal line)
		Malfunction of MPR of motor incorporated encoder	Replace motor incorporated encoder.
		Malfunction of SVC No. 1 board	Replace SVC No. 1 board.
		Motor speed; higher than 3,750 rpm? (speed command voltage normal?)	Replace ECP II board. Check connector and cable.
18	LED "APA" lights up. (Encoder check data alarm)	Wiring between connector CN1 at SVC No. 1 board and ECP II, and between CN2 and motor incorporated encoder	Check connector and cable.
		Malfunction of motor incorporated encoder	Replace motor incorporated encoder.
		Malfunction of SVC No. 1 board	Replace SVC No. 1 board.
		Excitation signal from ECP II for motor incorporated encoder	Replace ECP II card, card 4, or distribution card.
		Is reset pulse (ALOFF) input to CN5 of SVC No. 2 board from ECP II after power supply is turned on?	Check connector and wiring.

(3) Brushless Servomotor Operations

No.	Problem	What to Check	Measures to Take
19	Servomotor does not rotate even when a command is given.	Are magnet switches in DC-PS unit and servo amplifier unit ON?	1) Check connector (CN4) in DC-PS unit. 2) Check connectors (CN5, 6, 7, 8, 9 and 10) on PCB in DC-PS unit. 3) Check connector (CN10) in servo amplifier unit.
		Is LED "SAOP" on SVC No. 2 board off?	1) Check SW6 of SVC No. 2 board. 2) Check connector (CN1) on SVC No. 1 board. 3) Replace the SVC board.
		Is input signal correct?	1) Check waveform at check terminals on SVC No. 2 board; COM-luo, COM-lvo. 2) Check connector (CN1) on SVC No. 1 board.
		DC-PS unit function	Refer to (1).
		Servo amplifier unit function	Refer to (2).
		Wiring to brushless servomotor	Correct wiring.
20	Irregular rotation of servomotor	Connector (CN5) of SVC No. 2 board	Check connector.
		Connection to brushless servomotor (loose connection)	Check wiring.
		Malfunction of SVC board and BDC board	Replace SVC board, or BDC board.
		Matching error between servo amplifier and machine	1) Lower position loop gain Kv value (VR - VCOM) 2) Change velocity loop gain (VR - VLG) 3) Change velocity feedback amount (VR - VNFB)
		Malfunctioning position encoder	Replace defective encoder.

4-2-3. Precaution to Observe for Maintenance

- (1) Before operating the no-fuse breaker of the DC power supply unit and servo amplifier unit, always turn off the no-fuse breaker (main circuit breaker) at the control box.
- (2) Before replacing fuses, or printed circuit boards, or checking terminal screws, always turn off the main circuit breaker at the control box and press the discharge pushbutton of the condenser for above 20 seconds.
- (3) When replacing the SVC board or BDC board, set the switches according to the Servo Characteristic Chart.

Since current feedback, overcurrent detection, and other setting are all made by the switches, power transistors will be faulty if setting is not made correctly.

- (4) If a power transistor is faulty, base circuit protection fuse might be blown depending on damaged mode, and output transistor ET206 might further be faulty. Therefore, check the power transistor and BDC board when carrying out repair.

SECTION 3 PARAMETERS

1. Kinds of Parameters Used by OSP5020M

With the OSP5020M, parameters are classified as indicated below and special display screens are prepared for individual parameter types to allow parameter setting by directly inputting a numerical value or setting required data in units of bits.

- (1) Common variable
- (2) User parameter
- (3) G/M code macro
- (4) Machine user parameter (long word)
- (5) Machine user parameter (word)
- (6) Machine user parameter (bit)
- (7) NC optional parameter (long word)
- (8) NC optional parameter (word)
- (9) NC optional parameter (bit)
- (10) Input unit system
- (11) Machine system parameter (long word)
- (12) Machine system parameter (word)
- (13) System parameter
- (14) Pitch error compensation

2. Parameter Table by Function

Setting Item	Parameter to be Set	Remarks
Travel end limit	SYSTEM PARAMETER P TRAVEL LIMIT N TRAVEL LIMIT	Factory-set by Okuma
Programmable limit	USER PARAMETER P PROG LIMIT WRK N PROG LIMIT WRK P PROG LIMIT MC N PROG LIMIT MC	Specified by user. Factory-set at the same value as the system parameter
Pitch error compensation	SYSTEM PARAMETER P PITCH ERR COMP N PITCH ERR COMP PITCH COMP SPAN PITCH POINT	Factory-set by Okuma
	NC OPTIONAL PARAMETER (WORD) NO. 33 (Number of pitch error compensation points)	
	PITCH ERROR COMP.	
In-position check amount (Exact stop check)	SYSTEM PARAMETER IN POSITION	Factory-set by Okuma
In-position check amount (Exact stop check at a home position command)	SYSTEM PARAMETER IN POSITION (H)	Factory-set by Okuma
Backlash compensation	USER PARAMETER BACKLASH	Factory-set by Okuma
Machine coordinate system offset value	SYSTEM PARAMETER ZERO OFFSET (MC)	Factory-set by Okuma
ATC home position	SYSTEM PARAMETER HOME POSITION 1	Factory-set by Okuma
Home position of: Parallel type 2-pallet APC-L Multi-pallet APC	SYSTEM PARAMETER HOME POSITION 3 <i>This is The Position We Have</i>	Factory-set by Okuma
Home position of parallel type 2-pallet APC-R	SYSTEM PARAMETER HOME POSITION 4	Factory-set by Okuma

Setting Item		Parameter to be Set	Remarks
Servo drive unit controlling constants		SYSTEM PARAMETER HARD SERVO COEFF KV VALUE SLOW-UP/DOWN	Factory-set by Okuma
Machine origin of magazine		MC SYSTEM PARAMETER (LONG WORD) No. 9 MAGAZINE OFFST 1 No. 10 MAGAZINE OFFST 2 No. 11 MAGAZINE OFFST 3	Factory-set by Okuma
ATC		ATC tool number entry for tool data setting NXT TOOL ACT TOOL	This setting should be limited to such cases where the recovery is impossible due to trouble in the ATC.
		MC SYSTEM PARAMETER (WORD) No. 1 ATC SEQUENCE NO. No. 5 TA ARM A.B MODE	
APC		MC SYSTEM PARAMETER (WORD) No. 2 APC SEQUENCE NO. No. 6 PALLET A.B MODE	This setting should be limited to such cases where the recovery is impossible due to a problem in the APC.
Spindle	Spindle orientation	MC SYSTEM PARAMETER (WORD) No. 21 SPDL ORIENT OFST	Factory-set by Okuma
	Spindle oscillation	MC SYSTEM PARAMETER (WORD) No. 27 SPINDLE OSCIL DA No. 28 OSCILLATE FREQCY No. 29 OSCILLATE PERIOD	
Uni-directional positioning		USER PARAMETER G60 OVERRUN AMT	Excess travel for uni-directional positioning Factory-set at 1 mm (0.04 in.)
		NC OPTIONAL PARAMETER (BIT) No. 19: bit 0 to bit 5	Final positioning direction for one-directional positioning Factory-set at P direction for all axes

Setting Item	Parameter to be Set	Remarks
Fixed cycle	NC OPTIONAL PARAMETER (LONG WORD) No. 1	Retraction for G73 cycle Factory-set at 0.3 mm (0.012 in.)
	NC OPTIONAL PARAMETER (LONG WORD) No. 2	Retraction for G83 cycle Factory-set at 1 mm (0.04 in.)
	NC OPTIONAL PARAMETER (LONG WORD) No. 11	Retraction for G76 and G87 before orientation Factory set at 0.5 mm (0.02 in.)
	NC OPTIONAL PARAMETER (BIT) No. 17: bit 0	Always keeps the fixed cycle's cycle axis at the Z-axis. Not factory-set at Z-axis
	NC OPTIONAL PARAMETER (BIT) No. 17: bit 1 & bit 2	Shift direction for fixed cycle
Tape punch	NC OPTIONAL PARAMETER (WORD) No. 1	Number of tape feed holes for tape punching Factory-set at 600
	NC OPTIONAL PARAMETER (WORD) No. 2	Individual tape length for incremental tape punching Factory-set at 180 meters (590 feet)
	NC OPTIONAL PARAMETER (BIT) No. 1: bit 0	Tape code for tape punching Factory-set at ISO code
Puncher	NC OPTIONAL PARAMETER (WORD) No. 6	Puncher's baud rate Factory-set at 600BPS
	NC OPTIONAL PARAMETER (BIT) No. 8: bit 0	Stop bit Factory-set at 2 stop bits
	NC OPTIONAL PARAMETER (BIT) No. 8: bit 1	Sets whether the DATA READY signal is controlled by an external signal Factory-set at "controlled by internal signal"

Setting Item	Parameter to be Set	Remarks
Parity Check	NC OPTIONAL PARAMETER (BIT) No. 8: bit 2	Parity check execution Factory-set at "not execute"
	NC OPTIONAL PARAMETER (BIT) No. 8: bit 3	Even parity Factory-set at odd parity
Tape Reading	NC OPTIONAL PARAMETER (BIT) No. 1: bit 0 No. 1: bit 1	Code for tape reading, such as fixed tape code and automatic recognition Factory-set at automatic recognition and ISO code
	NC OPTIONAL PARAMETER (BIT) No. 1: bit 2	TV check run Factory-set at "not execute"
	NC OPTIONAL PARAMETER (BIT) No. 1: bit 3	Tape delimiter code Factory-set at feed holes
	NC OPTIONAL PARAMETER (BIT) No. 1: bit 4	Verifying on tape rewinding after tape reading Factory-set at "not execute"
	NC OPTIONAL PARAMETER (BIT) No. 1: bit 5	Automatic tape rewinding after tape reading Factory-set at "not execute"
	NC OPTIONAL PARAMETER (BIT) No. 1: bit 6	Special code as an alarm Factory-set at an alarm
	NC OPTIONAL PARAMETER (BIT) No. 1: bit 7	Special code neglected Factory-set at "not neglected"
	NC OPTIONAL PARAMETER (BIT) No. 2: bit 0	A block including control statements such as CALL and GOTO is handled as a block. Not factory-set as such

Setting Item		Parameter to be Set	Remarks
Offset	Cutter radius compensation	NC OPTIONAL PARAMETER (LONG WORD) No. 4	Data for compensation vector check Factory-set at 0.05 mm (0.002 in.)
		NC OPTIONAL PARAMETER (LONG WORD) No. 5 No. 6	Starting/endpoint decelerating distance compensation corner override Factory-set at 0 for both points
		NC OPTIONAL PARAMETER (LONG WORD) No. 9	Data for errors in calculating minute arc and quasi-full circles Factory-set at 0.01 mm (0.0004 in.)
		NC OPTIONAL PARAMETER (WORD) No. 3	Decelerating rate for compensation corner override Factory-set at 100%
		NC OPTIONAL PARAMETER (WORD) No. 4	Internal identification angle for compensation corner override Factory-set at 90 degrees
		NC OPTIONAL PARAMETER (WORD) No. 5	Decelerating rate for compensation arc's internal override Factory-set at 100%
	Three-dimensional tool offset	NC OPTIONAL PARAMETER (LONG WORD) No. 7	Size of offset vector for three-dimensional tool offset Factory-set at 0 mm
Circular interpolation		NC OPTIONAL PARAMETER (LONG WORD) No. 3	Data for circular arc check (Difference in radius between starting and end points) Factory-set at 0.01 mm (0.0004 in.)
		NC OPTIONAL PARAMETER (BIT) No. 20: bit 1	For single-axis command, actual position or a point on the arc is taken as the command value for the axis not programmed. Factory-set at "actual position"

Setting Item	Parameter to be Set	Remarks
Unit system for setting	NC OPTIONAL PARAMETER (BIT) No. 9: bits 0 to 7 INPUT UNIT SYSTEM NC OPTIONAL PARAMETER (BIT) No. 3: bits 0 to 7	Change in the setting unit system Factory-set at 1 mm (0.04 in.), 1°, 1 sec, 1mm/min (0.04 ipm) and 1 mm/rev (0.04 ipr)
Display	NC OPTIONAL PARAMETER (BIT) No. 4: bit 4	Subprogram (SSB) not displayed Factory-set at "displayed"
	NC OPTIONAL PARAMETER (BIT) No. 4: bit 5	Program display, indicating the remaining amount of travel Factory-set at "not displayed"
	NC OPTIONAL PARAMETER (BIT) No. 4: bit 6	4 × 4 as the size of the enlarged display characters for the actual position Factory-set at 2 × 2
	NC OPTIONAL PARAMETER (BIT) No. 5: bits 0 to 4	Check display's screen mode Factory-set at I/O bit, specification bit, axis data, NC diagnostic data, system and I/O parameters
	NC OPTIONAL PARAMETER (BIT) No. 5: bit 7	Current value display including the addition of manual intervention Factory-set at the value obtained by addition
Processing at power on	NC OPTIONAL PARAMETER (BIT) No. 4: bit 1	Automatic program selection Factory-set at "execute"
	NC OPTIONAL PARAMETER (BIT) No. 18: bits 0 to 6	Selection of G code which is set automatically when power supply is turned on Factory-set at G00, G17, G53, G90, G94 and G23
Processing at resetting	NC OPTIONAL PARAMETER (BIT) No. 4: bit 2	NC reset, bringing the total sum of manual intervention to 0 Factory-set at 0
	NC OPTIONAL PARAMETER (BIT) No. 17: bit 3	NC reset, causing the mirror image to be normal for all axes Factory-set at "not normal"

Setting Item	Parameter to be Set	Remarks
Workpiece geometry enlargement/reduction	NC OPTIONAL PARAMETER (BIT) No. 6: bits 0 to 5	Execution of workpiece geometry enlargement or reduction Factory-set at "not execute" for all axes
Axis command cancel	NC OPTIONAL PARAMETER (BIT) No. 7: bits 0 to 5	Selection of the axis to be command canceled Factory-set at Z-axis command cancel
Display and setting of: System parameter Pitch error compensation Machine system parameter (long word) Machine system parameter (word) NC optional parameter (long word) No. 33 and trailing data NC optional parameter (word) No. 33 and trailing data NC optional parameter (bit) No. 17 and trailing data	NC OPTIONAL PARAMETER (BIT) No. 16: bit 7	Making all these parameters settable Factory-set at "not settable"
Lubrication	MC USER PARAMETER (WORD) No. 1: AXIS LUBE TIME	Axis lubricating interval timer Factory-set at 30 min
	MC USER PARAMETER (WORD) No. 2: CROSSRL LUBE TIME	Crossrail lubricating interval timer Factory-set at 2 min
	MC USER PARAMETER (WORD) No. 3: AXIS PUMP TIME	Axis lubricating pump ON time Factory-set at 30 sec
	MC USER PARAMETER (WORD) No. 4: CROSSRL PUMP TIME	Crossrail lubricating pump ON time Factory-set at 30 sec

Setting Item	Parameter to be Set	Remarks
ATC	MC USER PARAMETER (WORD) No. 5: TOOL UNCLAMP TIME	Spindle tool unclamp time Factory-set at 3 sec
	MC USER PARAMETER (WORD) No. 8: PLUG TOOL NO.	Plug tool number Factory-set at 0
End buzzer	MC USER PARAMETER (WORD) No. 7: END BUZZER TIME	End-of-operation buzzer ON time Factory-set at 10 sec
Power save	MC USER PARAMETER (WORD) No. 6: POWER SAVING TIME	Power save condition check time Factory-set at 30 min

3. Description of Parameter and Setting Procedure

3-1. Common Variables

The variables, which are common to schedule programs, main programs and subprograms, may be referenced and updated. For details, see Section 11, 1-2-1. "Common Variables" in the "Programming Manual for OSP-5020M" (Publication No. 3336-E)". There are 128 sets, from VC1 to VC128. Setting procedure is shown below.

- (1) Press the **PARAMETER** key.
- (2) Press the function key [F6] or [F7] (ITEM) until the COMMON VARIABLE screen appears.
- (3) One page of display includes 40 sets of data. If the particular page does not include desired data, switch page using the page keys [P ↑] and [P ↓], and position the cursor to the desired setting.

Alternatively, use the function key [F4] (SEARCH) to set the cursor at the desired data element.

PARAMETER SET

=COMMON VARIABLE= (VC—)

NO.	NO.	NO.	NO.
1 1.234	11 10.65	21 10.65	31 -5
2 320	12 105.205	22 39.296	32 300
3 100000	13 -1.5	23 -1.5	33 EMPTY(=)
4 500	14 -30.956	24 -30.7	34 EMPTY(=)
5 0	15 0	25 0	35 EMPTY(=)
6 10	16 -20	26 0	36 EMPTY(=)
7 0	17 0	27 0	37 EMPTY(=)
8 0	18 0	28 0	38 EMPTY(=)
9 0	19 0	29 0	39 EMPTY(=)
10 0	20 0	30 0	40 EMPTY(=)

Cursor points to NO. 1, value 1.234

ACT POSIT (WORK) X Y Z
-250.320 -250.320 99.680
A=fitd

=S 1.234

SET ADD SEARCH ITEM+ ITEM- [EXTEND]

F1 F2 F3 F4 F5 F6 F7 F8

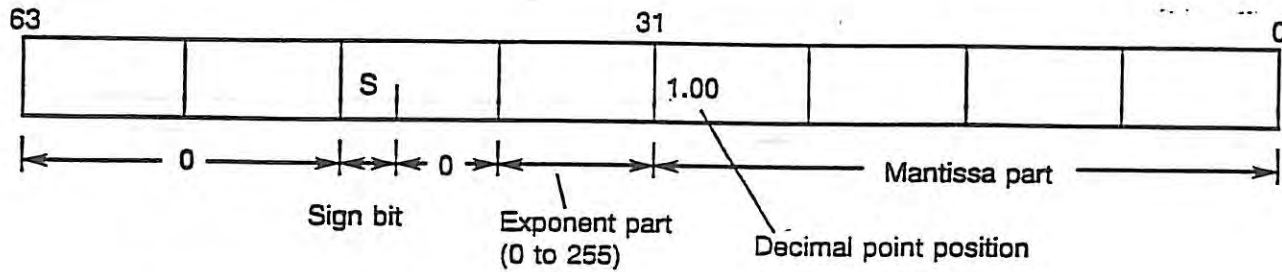
Entry data points to F1 and F2

Press the function key [F1] (SET) or [F2] (ADD).

- (4) Setting
 - (a) When the value of a common variable is known, then press the function key [F1] (SET) and enter that value.
 - (b) When the value has already been set and the increment/decrement from that value is to be set, press the function key [F2] (ADD) and enter those values.
- (5) Press the **WRITE** key.

This allows the value to be written at the position indicated by the cursor.

Note: Up to eight digits of data elements may be entered. Internally, they are floating point numbers which are eight bytes long.



Key in " " as entry data and press the WRITE key. This results in setting EMPTY. The EMPTY data is displayed as EMPTY(*). For EMPTY, refer to Section 11, 1-2. "Variables Function" in the "Programming Manual for OSP5020M".

3-2. User Parameters

The following user parameters are available.

No.	CRT Display	Contents	Factory-set Initial Value	Setting Range
1	P PROG LIMIT WRK	Software-based P-directional and N-directional travel end limits disclosed to users. Displayed in the work coordinate system.	Depends on machine specification	-99999999 to +99999999
2	N PROG LIMIT WRK		Same as above	-99999999 to +99999999
3	P PROG LIMIT MC	Software-based P-directional and N-directional travel end limits disclosed to users. Displayed in the machine coordinate system.	Same as above	-99999999 to +99999999
4	N PROG LIMIT MC		Same as above	-99999999 to +99999999
5	G60 OVERRUN AMT	Amount of a jump in uni-directional positioning. The direction is set by the NC optional parameter (bit), No. 19.	300 (0.3 mm) (0.012 in.)	0 to 30000
6	BACKLASH	Backlash compensation amounts for individual axes are set.	10 (0.01 mm) (0.0004 in.)	0 to 1000
7	CLAMP IN-P	Clamp in-position width for each axis. (If the setting is "0", clamp in-position check is not carried out.)	0	0.000 to 1.000

The P PROG LIMIT WRK and P PROG LIMIT MC display the same data as the coordinate values in the work machine and coordinate systems. Both data may be switched either by parameter setting or by program (G22) setting. The same applies to the N PROG LIMIT WRK and N PROG LIMIT MC.

Setting procedure is shown below:

- (1) Press the **PARAMETER** key.
- (2) Press the function key [F6] or [F7] (ITEM) until the USER PARAMETER screen appears.

PARAMETER SET

=USER PARAMETER= 1mm

	X	Y	Z
P PROG LIMIT WPK	2400.000	500.000	-200.000
N PROG LIMIT WPK	-2600.000	-1150.000	-1000.000
P PROG LIMIT MC	2500.000	650.000	0.000
N PROG LIMIT MC	-2500.000	-1000.000	-800.000
G60 OVERRUN AMT	1.000	1.000	1.000
BACKLASH	0.000	0.000	0.000
	0.000	0.000	0.000
	0.000	0.000	0.000
	0.000	0.000	0.000
	0.000	0.000	0.000

	X	Y	Z
ACT POSIT (MC)	-250.000	-100.000	300.000

Entry data

•IF
•IF
•S 500
•

SET	ADD	CAL	SEARCH	ITEM	ITEM	[ENTER]
-----	-----	-----	--------	------	------	---------

F 1 F 2 F 3 F 4 F 5 F 6 F 7 F 8

(5) Press the function key either [F1] (SET), [F2] (ADD) or [F3] (CAL).

(3) Press the function key [F5] (AXIS CHANGE).

(2) Press the function key [F6] or [F7] (ITEM).

- (3) When it is necessary to set data for the additional axes (the 5th and following axes), press the function key [F5] (AXIS CHANGE).
- (4) Using the cursor keys, position the cursor at the setting data.
- (5) Setting
 - (a) When a value is known, press the function key [F1] (SET) and enter that value.
 - (b) When setting any increment as viewed from the previously set position, press the function key [F2] (ADD) and enter that increment on the keyboard.
 - (c) In new setting at any position relative to the active value (position), press the function key [F3] (CAL) and enter the data, which is the relative value of the position to be set as viewed from the active value (position) with numerical keys.

Note that this setting may not be used for the excess travel in one-directional positioning.

- (6) Press the **WRITE** key.

This rewrites the data indicated by the cursor. When the set data is outside the travel end limits set by the system parameter, the corresponding error message appears. In this case, the data is ineffective and is not set.

3-3. G/M Code Macro Setting

The G code macro provides the functions equivalent to MODIN, MODOUT and CALL.

(1) G100

The same code as MODOUT, which cancels MODIN. Its format is as follows:

G100 (no argument setting)

(2) G101 to G110

The same code as MODIN, which executes the specified subprograms after axis movement on a block basis. Its format is:

G101 (argument setting)

(3) G111 to G120

The same as CALL, which is a simple subprogram call. Its format is:

G111 (argument setting)

Thus, the program name used by this G code is set by a parameter.

The M code macro is a function which allows an M code to call a subprogram. It consists of M201 to M210. The program name used by the M code is set by a parameter.

For the details of G and M code macros, see Section 10, 3. "G and M Code Macro Functions" in the "Programming Manual for OSP5020M".

Operating procedure is as follows:

- (1) Press the **PARAMETER** key.
- (2) Press the function key [F6] or [F7] (ITEM) until the G/M CODE MACRO screen appears.

PARAMETER SET			
#G CODE MACRO#		#M CODE MACRO#	
MODIN	CALL	CALL	
G101 01234	G111 0ABCD	M201 ==	
G102 ==	G112 ==	M202 ==	
G103 ==	G113 ==	M203 ==	
G104 ==	G114 ==	M204 ==	
G105 ==	G115 ==	M205 ==	
G106 ==	G116 ==	M206 ==	
G107 ==	G117 ==	M207 ==	
G108 ==	G118 ==	M208 ==	
G109 ==	G119 ==	M209 ==	
G110 ==	G120 ==	M210 ==	
ACT POSIT (WORK) X Y Z			
	-250.320	-250.320	99.680
	A-Mtd		
=IF =S 01234 =S 0ABCD =			
SET	SEARCH	ITEM	ITEM+ [EXTEND]

[F1] [F2] [F3] [F4] [F5] [F6] [F7] [F8]

(4) Press the function key [F1] (SET).

(2) Press the function key [F6] or [F7] (ITEM).

- (3) Using the cursor keys, place the cursor at the desired data.
- (4) Press the function key [F1] (SET) and enter a program name on the keyboard.

To clear the program name, enter " = ".

- (5) Press the **WRITE** key.

This rewrites the data indicated by the cursor.

Display of " == " in the program name column indicates that the corresponding program name has not been registered.

Note: A program name which is set at 00000 to 00999 will result in an alarm. The 00000 and following are intended for use by the maker subprograms only, users are not allowed to use them.

3-4. Machine User Parameter (Long Word)

Parameter No.	CRT Display Name	Contents	Effective Command	Factory Set Initial Value	Setting Range	Setting Unit
1	CROSSRL P LIMIT	Movable range of crossrail (Y-axis) in the positive direction	SET, ADD CAL	Depends on machine specification	-99999999 to 99999999	0.001 mm (0.00004 in.)
2	CROSSRL N LIMIT	Movable range of crossrail (Y-axis) in the negative direction	Same as above	Same as above	Same as above	Same as above
3	AT Y-P	Index allowable range of swivel head or attachment in the positive direction of Y-axis	Same as above	Same as above	Same as above	Same as above
4	AT Y-N	Index allowable range of swivel head or attachment in the negative direction of Y-axis	Same as above	Same as above	Same as above	Same as above
5	ATC P LIMIT	Tool change allowable range in the positive direction of Y-axis	Same as above	Same as above	Same as above	Same as above
6	ATC N LIMIT	Tool change allowable range in the negative direction of Y-axis	Same as above	Same as above	Same as above	Same as above
7	APC Y-P LIMIT	Pallet change allowable range in the positive direction of Y-axis	Same as above	Same as above	Same as above	Same as above
8	APC Y-N LIMIT	Pallet change allowable range in the negative direction of Y-axis	Same as above	Same as above	Same as above	Same as above
9	APC Z-P LIMIT	Pallet change allowable range in the positive direction of Z-axis	Same as above	Same as above	Same as above	Same as above
10	APC Z-N LIMIT	Pallet change allowable range in the negative direction of Z-axis	Same as above	Same as above	Same as above	Same as above
11	APC W-P LIMIT	Pallet change allowable range in the positive direction of W-axis	Same as above	Same as above	Same as above	Same as above
12	APC W-N LIMIT	Pallet change allowable in the negative direction of W-axis	Same as above	Same as above	Same as above	Same as above
13	ATC W-P LIMIT	ATC change allowable range in the positive direction of W-axis	Same as above	0	Same as above	Same as above
14	ATC W-N LIMIT	ATC change allowable range in the negative direction of W-axis	Same as above	0	Same as above	Same as above
15	ATC X-P LIMIT	ATC change allowable range in the positive direction of X-axis	Same as above	0	Same as above	Same as above
16	ATC X-N LIMIT	ATC change allowable range in the negative direction of X-axis	Same as above	0	Same as above	Same as above

Operating procedure is as follows:

- (1) Press the **PARAMETER** key.
- (2) Press the function key [F6] or [F7] (ITEM) until the MC USER PARAMETER (LONG WORD) screen appears.

PARAMETER SET

#MC USER PARAMETER (LONG WORD)=

NO.		NO.	
1	CROSSRL P LIMIT 1234.567	11	APC W-P LIMIT 0.000
2	CROSSRL N LIMIT 0.000	12	APC W-N LIMIT 0.000
3	AT Y-P 0.000	13	
4	AT Y-N 0.000	14	
5	ATC P LIMIT 0.000	15	
6	ATC N LIMIT 0.000	16	
7	APC Y-P LIMIT 0.000	17	
8	APC Y-N LIMIT 0.000	18	
9	APC Z-P LIMIT 0.000	19	
10	APC Z-N LIMIT 0.000	20	

	X	Y	Z
ACT POSIT (MC)	-250.000	-100.000	300.000
	A=fitd		

#S 1234567

SET
ADD
CAL
SEARCH
ITEM
ITEM
[EXTEND]

Entry data

- (4) Press the function key either [F1] (SET), [F2] (ADD) or [F3] (CAL).

- (2) Press the function key [F6] or [F7] (ITEM).

- (3) Using the cursor keys, position the cursor at the desired data.

(4) **Setting**

- (a) When the data to be set is previously known, press the function key [F1] (SET) and enter that data.
- (b) When data has already been set and it is necessary to set the increment relative to that position, press the function key [F2] (ADD) and enter the increment.
- (c) If new data is set at a position relative to the active value (position), press the function key [F3] (CAL) and key in the data, which is the relative value of the position to be set as viewed from the active value (position).

- (5) Press the **WRITE** key.

This rewrites the data at the position indicated by the cursor.

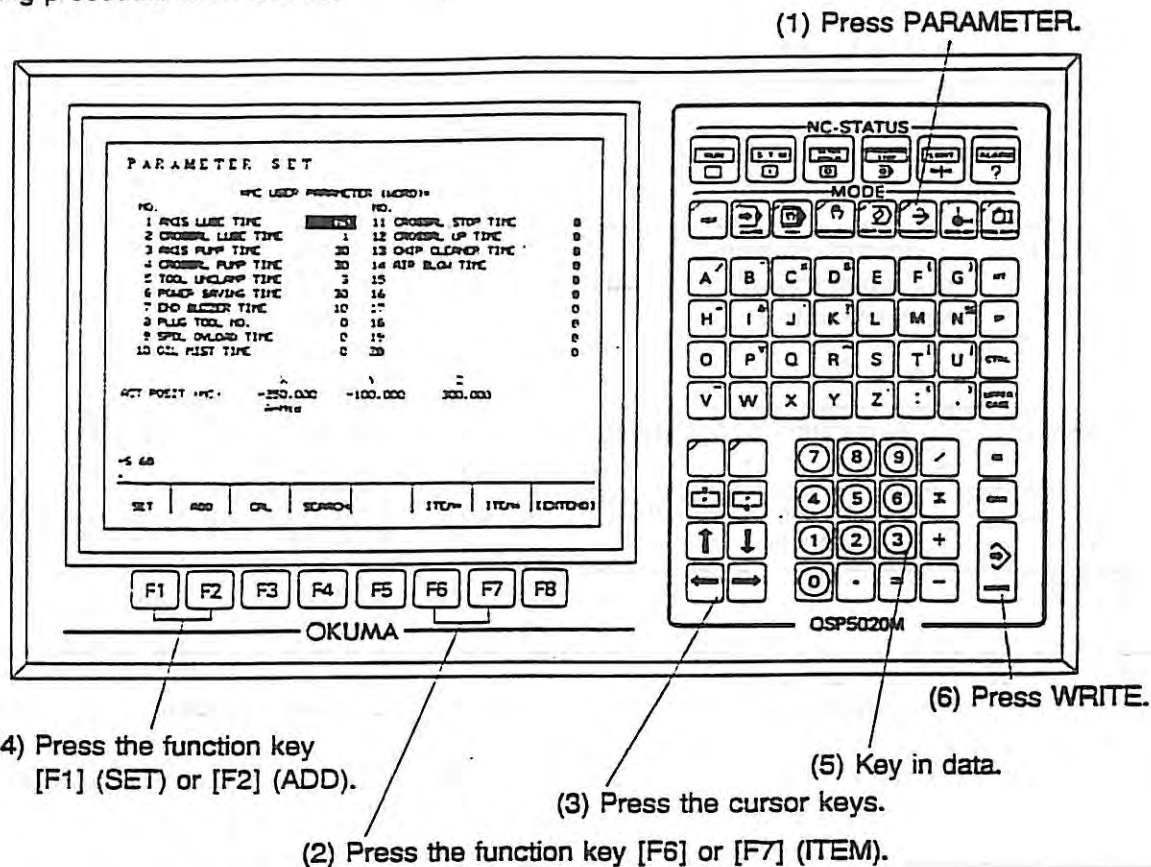
3-5. Machine User Parameter (Word)

The machine user parameter (word) consists of the following elements:

Parameter No.	CRT Display Name	Contents	Effective Command	Factory Set Initial Value	Setting Range	Setting Unit
1	AXIS LUBE TIME	Cycle time for axis lubrication (Interval)	SET, ADD	30 min	0 - 120	1 min
2	CROSSRL LUBE TIME	Cycle time for crossrail lubrication (interval)	Same as above	2 min	0 - 120	1 min
3	AXIS PUMP TIME	Time during which the axis lubrication pump motor is on	Same as above	Depends on machine specification	15 - 60	1 sec
4	CROSSRL PUMP TIME	Time during which the crossrail lubricating pump motor is on	Same as above	Same as above	15 - 60	1 sec
5	TOOL UNCLAMP TIME	Maximum time taken to unclamp the tool after pressing the tool unclamp button	Same as above	3 sec	0 - 30	1 sec
6	POWER SAVING TIME	Time for a power save which is made when a preset time has elapsed the NC comes to a stop	Same as above	30 min	0 - 60	1 min
7	END BUZZER TIME	Time required from the moment the OPERATION END buzzer begins to sound until it stops sounding	Same as above	10 sec	0 - 60	1 sec
8	PLUG TOOL NO.	After the end of operation, if it is necessary to keep the tool mounted on the spindle free of foreign matter, that tool is specified.	SET only	Depends on machine specification	0 to the number of magazine tools	—
9	SPDL OVERLOAD TIME	Time for the control to determine "overload" state after the meter relay has been actuated	SET, ADD	Same as above	0 - 60	1 sec
10	OIL MIST TIME	Mist on time of the oil mist coolant supply system	Same as above	Same as above	0 - 3600	1 sec
11	CROSSRL STOP TIME	Stop time for the crossrail in its upward movements	Same as above	Same as above	0 - 600	0.1 sec

Parameter No.	CRT Display Name	Contents	Effective Command	Factory Set Initial Value	Setting Range	Setting Unit
12	CROSSRL UP TIME	Upward movement time of the crossrail in its upward movements	SET, ADD	Depends on machine specification	0 - 600	0.1 sec
13	CHIP CLEANER TIME	ON duration of chip cleaner	Same as above	Same as above	0 - 60	1 sec
14	AIR BLOW TIME	ON duration of tapped hole chip air blow	Same as above	Same as above	0 - 3600	1 sec
15	RT COUNTER		Same as above	Same as above	0 - 999	
16	SET UP ST. POS.	Pallet carrier position at setup station is set.	SET	Same as above	0 to maximum number of pallets	—
	AXIS LUBE TIME 2	Cycle time for second axis lubrication (Interval)	SET, ADD	Same as above	0 to 120	1 min
18	AXIS PUMP TIME 2	Time during which second axis lubrication pump motor is on	Same as above	Same as above	0 - 180	1 sec
19	WORK CLAMP TIME	Workpiece clamping is assumed to have been completed when a period, set at this timer, has elapsed after the execution of workpiece clamp command.	Same as above	Same as above	0 - 1000	0.01 sec
20	WORK UNCLAMP TIME	Workpiece unclamping is assumed to have been completed when a period, set at this timer, has elapsed after the execution of workpiece unclamp command.	Same as above	Same as above	0 - 1000	0.01 sec
21			Same as above	Same as above	0 - 1000	0.01 sec
22			Same as above	Same as above	0 - 1000	0.01 sec
		System check mode	Same as above	0	0 - 999	—

Setting procedure is as follows:



- (1) Press the **PARAMETER** key.
- (2) Press the function key **[F6]** or **[F7]** (**ITEM**) until the MC USER PARAMETER (WORD) screen appears.
- (3) Using the cursor keys, position the cursor at the desired data.

PARAMETER SET

#MC USER PARAMETER (WORD)#

NO.		NO.	
1	AXIS LUBE TIME	11	CROSSRL STOP TIME
2	CROSSRL LUBE TIME	12	CROSSRL UP TIME
3	AXIS PUMP TIME	13	CHIP CLEANER TIME
4	CROSSRL PUMP TIME	14	AIP BLOW TIME
5	TOOL UNCLAMP TIME	15	
6	POWER SAVING TIME	16	
7	END BLUZZER TIME	17	
8	PLUG TOOL NO.	18	
9	SPTL OVLORD TIME	19	WORK CLAMP TIME
10	OIL MIST TIME	20	

ACT POSIT (MC)

X Y Z

-250.000 -100.000 300.000

P-1111d

#S 60

SET
ADD
CLR
SEARCH
ITEM←
ITEM→
[EXTEND]

[F1]
[F2]
[F3]
[F4]
[F5]
[F6]
[F7]
[F8]

Setting:

If data is previously known:

- (4) Press the function key [F1] (SET).
- (5) Enter data on the keyboard.

If data has already been set and it is necessary to set the increment against the data:

- (4) Press the function key [F2] (ADD).
- (5) Enter the increment.
- (6) Press the **WRITE** key.

This rewrites the data at the cursor position.

3-6. Machine User Parameter (Bit)

The machine user parameter bits available are listed below:

Parameter No.	Bit No.	Contents	SET 1	SET 0	Factory Set Initial Value
1	0	Issuing an M09 command does not turn off the coolant.	Does not turn off	Turns off	0
	1	Issuing an M09 command does not turn off the through-the-tool coolant low pressure.	Does not turn off	Turns off	0
	2	Issuing an M09 command does not turn off the through-the-tool coolant high pressure.	Does not turn off	Turns off	0
	3	Issuing an M09 command does not turn off the air blow (nozzle) type.	Does not turn off.	Turns off	0
	4	Issuing an M09 command does not turn off the air blow (adapter type).	Does not turn off	Turns off	0
	5	Issuing an M09 command does not turn off the oil mist.	Does not turn off	Turns off	0
	6	Issuing an M09 command does not turn off the work shower.	Does not turn off	Turns off	0
	7				0
2	0	An M00/M01 does not turn off the spindle or coolant groups	Does not turn off	Turns off	0
	1	Alarm generation is added as a requirement for automatic power shutdown (OFF).	Adds	Does not add	0
	2	Spindle stops when an alarm of level B occurs.	Stops	Does not stop	0
	3	Spindle speed override is made effective for S2-digit specification.	Effective	Ineffective	0
	4	A level A alarm is made ineffective when APC door open confirmation signal is turned off.	Ineffective	Effective	0
	5				0
	6	Power save function is made ineffective during M00 or M01 mode.	Ineffective	Effective	0
	7	Power save function is made ineffective.	Ineffective	Effective	0
3	0	M181 external M command is made effective after completion of positioning.	Effective	Ineffective	0
	1	M182 external M command is made effective after completion of positioning.	Effective	Ineffective	0
	2	M183 external M command is made effective after completion of positioning.	Effective	Ineffective	0
	3	M184 external M command is made effective after completion of positioning.	Effective	Ineffective	0
	4	M185 external M command is made effective after completion of positioning.	Effective	Ineffective	0
	5	M186 external M command is made effective after completion of positioning.	Effective	Ineffective	0
	6	M187 external M command is made effective after completion of positioning.	Effective	Ineffective	0
	7	M188 external M command is made effective after completion of positioning.	Effective	Ineffective	0

Parameter	Bit No.	Contents	SET 1	SET 0	Factory Set Initial Value
4	0	Attachment joint air blower is ineffective when attachment is installed.	Ineffective	Effective	0
	1	Attachment joint air blower is ineffective when adaptor is installed.	Ineffective	Effective	0
	2	For multi-link magazine, command is executed for the No. 2 magazine.	Executed	Not executed	0
	3	For multi-link magazine, command is executed for the No. 3 magazine.	Executed	Not executed	0
	4	With MC-40H and MC-3VA, standby is carried out at magazine rotation position.	Carried out	Not carried out	0
	5	With MC-40H, tool change arm door open interlock function is made ineffective.	Ineffective	Effective	0
	6	Spindle rotation is continued even when operation door interlock function is activated.	Continued	Not continued	0
	7	Manual intervention mode is made ineffective when magazine door interlock function is activated.	Ineffective	Effective	0
5	0	Specification code of the second timer is ignored.	Ignored	Not ignored	0
	1	The second timer is used for counting spindle rotation period.	Used	Not used	0
	2	The second timer is used for counting NC operation period.	Used	Not used	0
	3	Automatic operation condition is added for the second timer.	Added	Not added	0
	4	Automatic operation and single block off conditions are added to the second timer.	Added	Not added	0
	5				0
	6				0
	7				0
6	0	Specification code of the third timer is ignored.	Ignored	Not ignored	0
	1	The third timer is used for counting spindle rotation period.	Used	Not used	0
	2	The third timer is used for counting NC operation period.	Used	Not used	0
	3	Automatic operation condition is added for the third timer.	Added	Not added	0
	4	Automatic operation and single block off conditions are added to the third timer.	Added	Not added	0
	5				0
	6				0
	7				0

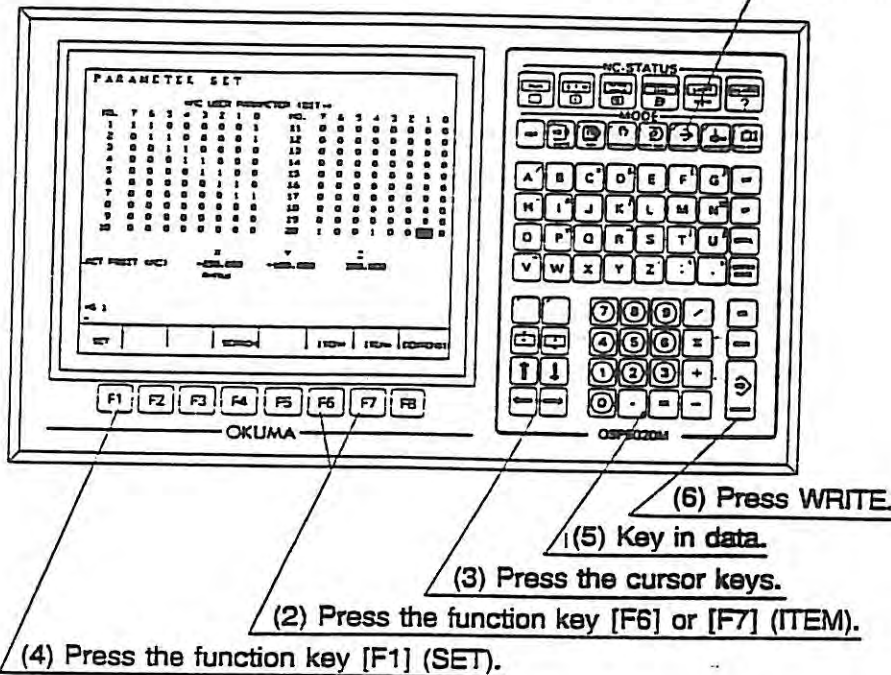
Parameter No.	Bit No.	Contents	SET 1	SET 0	Factory Set Initial Value
7	0	Single block off condition is made ineffective for the third indicating lamp (NC running).	Ineffective	Effective	0
	1	Automatic operation and single block off conditions are made ineffective for the third indicating lamp (NC running).	Ineffective	Effective	0
	2	The third indicating lamp (NC running) is turned off when an alarm occurs.	Turned off	Not turned off	0
	3				0
	4				0
	5				0
	6				0
	7				0
8	0	Single block off condition for alarm lamp is made ineffective	Ineffective	Effective	0
	1	Automatic operation and single block off conditions for alarm lamp are made ineffective.	Ineffective	Effective	0
	2				0
	3				0
	4	Single block off condition for operation end indicating lamp is made ineffective.	Ineffective	Effective	0
	5	Automatic operation and single block off conditions for operation end indicating lamp are made ineffective.	Ineffective	Effective	0
	6				0
	7				0
9	0	Single block off condition for operation end warning buzzer is made ineffective.	Ineffective	Effective	0
	1	Automatic operation and single block off conditions for operation end warning buzzer are made ineffective	Ineffective	Effective	0
	2	Operation end warning buzzer is not turned off by timer.	Not turned off	Turned off	0
	3	Operation end warning buzzer is not turned on when alarm occurs.	Not turned on	Turned on	0
	4	Operation end warning buzzer is not turned on when completing the program.	Not turned on	Turned on	0
	5				0
	6				0
	7				0

Parameter No.	Bit No.	Contents	SET 1	SET 0	Factory Set Initial Value
10	0	ATC cycle in progress for APC start conditions is made ineffective.	Ineffective	Effective	0
	1	The S command entered through the pendant operation panel is made ineffective during manual intervention.	Ineffective	Effective	0
	2	WRITE and READ are made ineffective for the ATC sequence, TD, and S data.	Ineffective	Effective	0
	3	The VAC gain is increased during synchronized tapping.	Does	Does not	0
	4	The operation logic of the APC for the FMS specification is made effective.	Effective	Ineffective	0
	5	The value of S command can be minimized up to the minimum value for the motor speed.	Can	Can not	0
	6	A level A alarm is generated when the X-, Y-, or Z-axis overload is detected.	Alarm A	Alarm C	0
	7	Chuck grips the ID of the workpiece.	ID	OD	0
11	0	Enter "Automatic operation mode" to output conditions of external hour meter.	Enter	Not enter	1
	1	Enter "RUN lamp on" to output conditions of external hour meter.	Enter	Not enter	1
	2	Enter "Spindle in rotating" to output conditions of external hour meter.	Enter	Not enter	0
	3	Enter "Axis moving" to output conditions of external hour meter.	Enter	Not enter	0
	4	Enter "Spindle speed override 100%" to output conditions of external hour meter.	Enter	Not enter	1
	5	Enter "Feedrate override 100%" to output conditions of external hour meter.	Enter	Not enter	1
	6	Enter "Single block off" to output conditions of external hour meter.	Enter	Not enter	1
	7				
13	0	Interface TYPE-B for the robot/loader is made effective.	Effective	Ineffective	0
	1	Interface TYPE-C for the robot/loader is made effective.	Effective	Ineffective	0
	2	The "tool exist in magazine pot confirmation" interlock is made ineffective.	Ineffective	Effective	0
	3	Manual tool change is enabled nearby the tool orientation position. (MC-500H/600H)	Enabled	Not enabled	0
	4	Pin IN/OUT command from the stacker crane and APC for the FMS specification are made ineffective.	Ineffective	Effective	0
	5				0
	6	The "no tool in spindle" interlock is made ineffective.	Ineffective	Effective	0
	7				0

Parameter No.	Bit No.	Contents	SET 1	SET 0	Factory Set Initial Value
14	0	Automatic power shutoff is made effective.	Effective	Ineffective	0
	1	Operation completion indicating lamp is made effective.	Effective	Ineffective	0
	2	Alarm indicating lamp is made effective.	Effective	Ineffective	0
	3	Operation end warning buzzer is made effective.	Effective	Ineffective	0
	4	The third indicating lamp is made effective.	Effective	Ineffective	0
	5				0
	6				0
	7				0
21	0				0
	1				0
	2				0
	3	Selection of the magnification for magnetic pulse generator from $\times 4$ or $\times 1$	$\times 4$	$\times 1$	0
	4				0
	5				0
	6				0
	7				0
39	0	This makes setting of the attachment swivel range ineffective.	Ineffective	Effective	0
	1				0
	2				0
	3				0
	4				0
	5				0
	6				0
	7				0
40	0	This makes crossrail automatic offset mode effective.	Effective	Ineffective	0
	1	This makes input from the crossrail automatic positioning sensor ineffective.	Ineffective	Effective	0
	2				0
	3				0
	4				0
	5				0
	6				0
	7				0

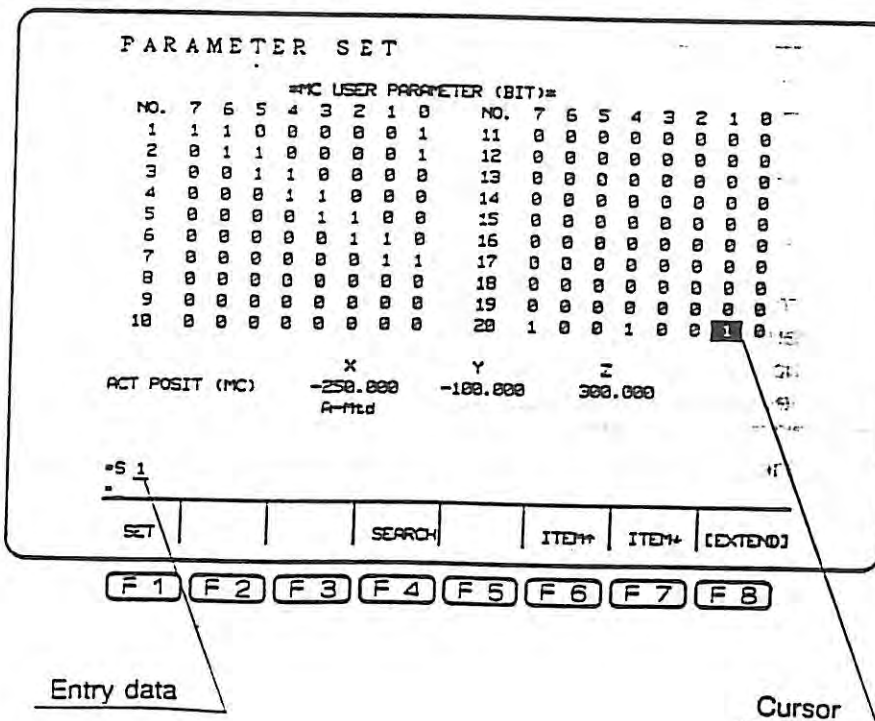
Setting procedure is as follows:

(1) press **PARAMETER**.



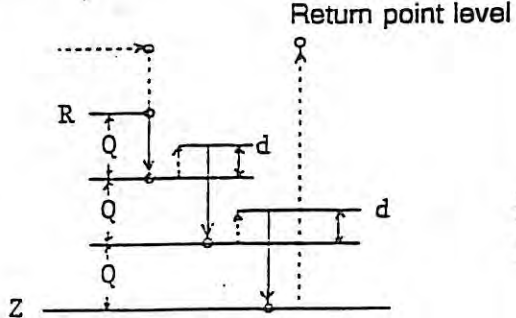
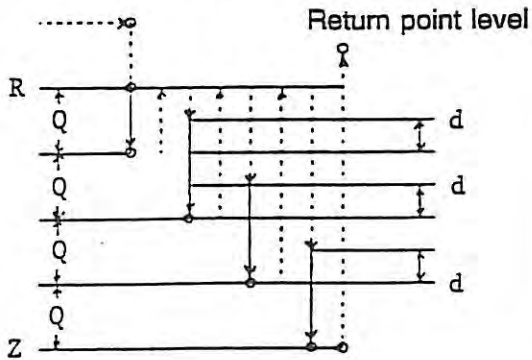
- (1) Press the **PARAMETER** key.
- (2) Press the function key [F6] or [F7] (ITEM) until the MC USER PARAMETER (BIT) screen appears.
- (3) Using the cursor keys, position the cursor at the desired data.
- (4) Press the function key [F1] (SET).
- (5) Enter the data.
The entry data is only 0 or 1.
- (6) Press the **WRITE** key.

This rewrites data indicated by the cursor.

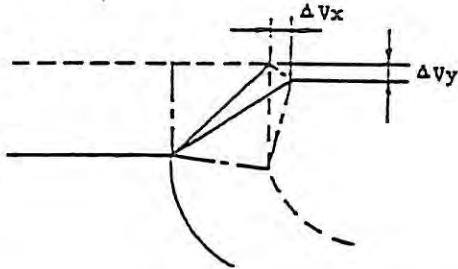
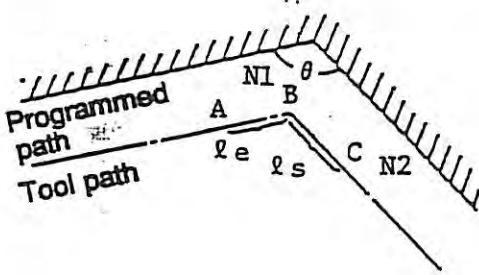


3-7. NC Optional Parameter (Long Word)

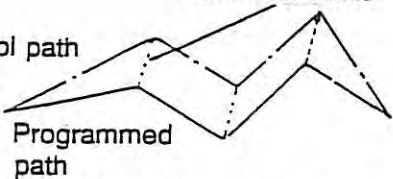
The optional parameter (long words) that follow are available. The parameter numbers are keyed to the numbers on the CRT screen.

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
1※	Retraction in G73 cycle (high-speed deep hole)	In G73 cycle, Z-axis is infeed by "Q", retracted to level "d" and then infeed by "Q + d". "d" is the retraction amount. 	300 (0.3 mm) (0.012 in.)	0 to 10000
2※	Retraction in G83 cycle (deep hole)	In G83 cycle, Z-axis is infeed by "Q", retracted to level "R" in a rapid feedrate, and then positioned to the level "d" higher than the previously infeed level. Infeed by "Q + d" is made after that. "d" is the retraction amount. 	1000 (1 mm) (0.04 in.)	0 to 1000
3※	Arc check data	An alarm will occur if, in an arc command, the difference in radius between the starting point and the end point is greater than the preset level, set by the check data.	10 (0.01 mm) (0.0004 in.)	2 to 200

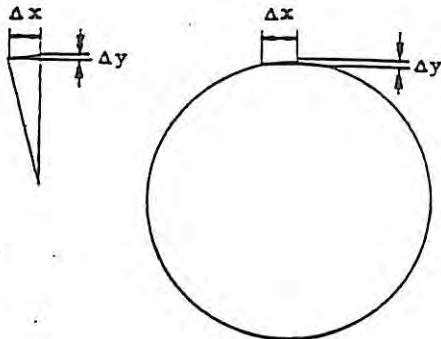
※ In μm unit specification, the factory set initial value and the setting range are ten times those in mm unit specification.

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
4※	Cutter radius compensation vector check data	For an extremely small corner movement, if $\Delta V_x \leq \Delta V$ and $\Delta V_y \leq \Delta V$, then ignores the rear moving point for movement. The ΔV is set by the check data. 	50 (0.05 mm) (0.002 in.)	2 to 5000
5	Decelerating distance at end point for cutter radius compensation corner override		0	0 to 99999999
6	Decelerating distance at starting point for cutter radius compensation corner override	A : Override ON point B : N1 positioning point C : Override OFF point N1 X_ Y_ F1 N2 X_ Y_ F2 le: Decelerating distance at corner's end point ls: Decelerating distance at corner's starting point		

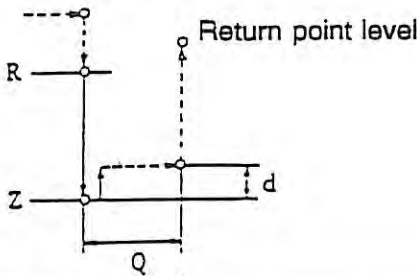
※ In μm unit specification, the factory set initial value and the setting range are ten times those in mm unit specification.

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
7	Three-dimensional tool offset vector size	Three-dimensional tool offset vector  G41 tool path Programmed path Vector component in Xp-axis direction: $\Delta V_x = ir/p$ Vector component in Yp-axis direction: $\Delta V_y = jr/p$ Vector component in Zp-axis direction: $\Delta V_z = kr/p$ where i, j & k: Values specified by I, J and K, respectively r : Tool offset value corresponding to the tool offset number specified by D p : Parameter-set Value; for 0, the following equation applies. $P = \sqrt{i^2 + j^2 + k^2}$	0	-99999999 to +99999999
8※	G31 (skip function) feedrate	Sets the feedrate for G31 (skip function)	0	1 to 20000

※ In μm unit specification, the factory set initial value and the setting range are ten times those in mm unit specification.

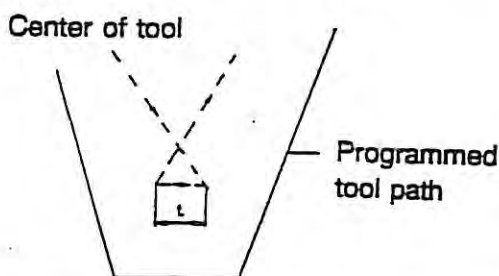
Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
9※	Error data resulting from cutter radius compensation calculation for minute circular arcs and quasi-full circles in cutter radius compensation mode	 Minute arc Quasi-full circle $(\Delta X \leq \Delta V, \Delta Y \leq \Delta V)$ (a) Minute arc The horizontal and vertical distances between the starting point and the end point of a circular arc are smaller than the setting. (b) Quasi-full circle A circular arc which is almost a full circle. The horizontal and vertical distances of the gap of the arc are smaller than the setting. The setting ΔV is given by the error data. The endpoint of a minute circular arc is ignored and no arc movement takes place. The endpoint of a quasi-full circle is ignored and the arc is handled as a full circle which begins at the starting point.	10 (0.01 mm) (0.0004 in.)	2 to 200
10	Maximum feedrate clamp value	When an attempt is made to feed an axis at a rate exceeding the preset value, the axis feedrate is clamped at this value and the alarm indication setting unit is mm/min.	Rapid feedrate of machine	0 to 20000

※ In μm unit specification, the factory set initial value and the setting range are ten times those in mm unit specification.

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
11※	Retraction amount in G76 (fine boring) and G87 (back boring) cycles	In the G76 and G87 cycle, the cutting tool is infed to level "Z" where a dwell of "P" seconds is carried out and then it is retracted upwards by "d". At this retracted level, the cutting tool is shifted by "Q" in the direction opposite to the tool bit. This sets the amount "d". 	500 (0.05 mm) (0.02 in.)	0 to 10000
12※	Positioning point for RMIL (inner round milling)	Sets the distance between the first positioning point for RMIL (inner round milling) and the workpiece endface.	500 (0.05 mm) (0.02 in.)	0 to 10000
13	Number of bytes for the program data transmission until the DNC-B cycle start.	Sets the number of bytes for the program data transmission until the cycle start in the DNC-B remote buffer operation mode with communication control protocol is started.	0	0 to 99999999
14	Feedrate change value in the fixed cycle when the coordinate system conversion	Sets the feedrate value when the rapid feedrate is changed to a cutting feedrate in the fixed cycle during 3-D coordinate system conversion.	20000 (20m/min)	1 to 20000
15	Spindle index zero	Spindle index zero position (Spindle index machine zero for E command)	Depends on machine specification	0 to 359.999 or 0 to 359.9999
16	Spindle IN-P check value	Spindle (C-axis) IN-P check value is set.	Depends on machine specification	0 to 359.999 or 0 to 359.9999
17	Spindle index angle at rapid feedrate	Rapid feedrate (angle) of spindle indexing is set.	Depends on machine specification	0 to 359.999 or 0 to 359.9999

* Setting unit: VAC control unit (1/1000° or 1/10000°)

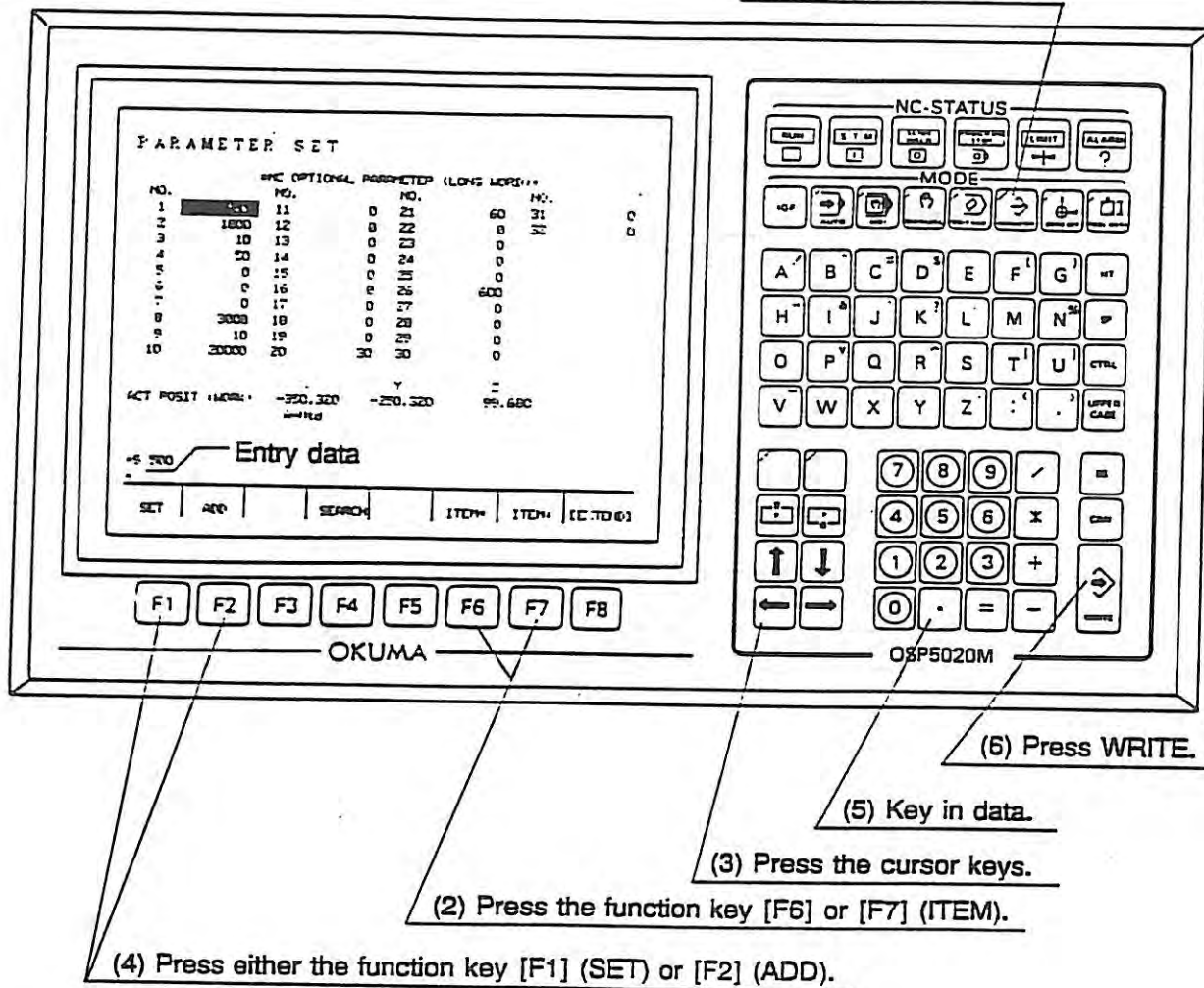
※ In μm unit specification, the factory set initial value and the setting range are ten times those in mm unit specification.

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
18	Tolerance for the interference with cutter radius compensation	When the programmed tool path is different from the actual tool path as shown in the figure below, a tool interference error is generated while the tool does not interfere with the workpiece. To avoid this, set the tolerance range ("t" in the figure below) for interference. Interference error will not be generated when the gap between the programmed tool path and the actual tool path is within the tolerance range. 	0 (μm)	0 to 99999999
19	Spindle orientation offset value	Sets the offset amount during spindle orientation with the high-precision VAC.	0 (deg)	0 to 359.9999
22※	Acceleration/deceleration speed constant for F1-digit feed	Sets the acceleration/deceleration speed constant for F1-digit feed (both rotary switch and parameter).	0	0 to 4000000
23	Motor continuous rating	Sets the spindle motor cont. rating for the synchronized tapping torque monitor. Refer to the final specifications of the machine when setting data.	0 (W)	110 to 99999999
33	Synchronization position shift amount (μm)	If the setting is "0" when power is turned on, the difference between the master and slave axis command values (SRSCON) is automatically set as the synchronization shift amount.	0	Automatic setting
34	Cutting start point for RMILO (outer round milling)	Sets the distance between the cutting start point for RMILO (outer round milling) and the workpiece endface.	0 (μm)	-99999999 to +99999999
35	Cutting start point for RMILI (inner round milling)	Sets the distance between the cutting start point for RMILI (inner round milling) and the workpiece endface.	0 (μm)	-99999999 to +99999999

※ In μm unit specification, the factory set initial value and the setting range are ten times those in mm unit specification.

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
44	Maximum tool length	Sets the maximum length of tool to be used. This setting is necessary to shorten the operation time by using the automatic tool length offset/broken tool detection function.	0 (μm)	0 to 999

Data setting procedure is as follows:



- (1) Press the **PARAMETER** key.
- (2) Press the function key [F6] or [F7] (ITEM) until the NC OPTIONAL PARAMETER (LONG WORD) screen appears.
- (3) Using the cursor keys, position the cursor at desired data.

Cursor

PARAMETER SET

NO.		=NC OPTIONAL PARAMETER (LONG WORD)=			
1	500	11	0	21	60
2	1000	12	0	22	0
3	10	13	0	23	0
4	50	14	0	24	0
5	0	15	0	25	0
6	0	16	0	26	600
7	0	17	0	27	0
8	3000	18	0	28	0
9	10	19	0	29	0
10	20000	20	30	30	0

ACT POSIT (WORK)	X -350.320 A-Mtd	Y -250.320	Z 99.680
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Entry data

=S 500

SET	ADD	SEARCH	ITEM+	ITEM-	END/ITEM
-----	-----	--------	-------	-------	----------

Parameter No.

F1
F2
F3
F4
F5
F6
F7
F8

Setting:

When data is previously known:

- (4) Press the function key [F1] (SET).
- (5) Enter the data on the keyboard.
- (6) Press the **WRITE** key.

This rewrites the data indicated by the cursor.

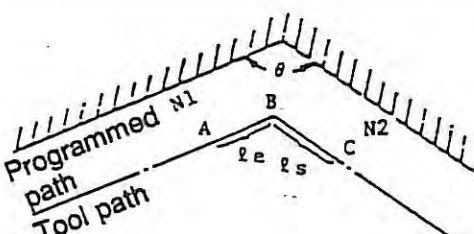
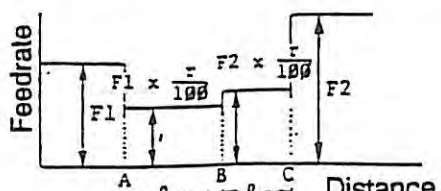
When data has already been set and it is necessary to set the increment from the data:

- (4) Press the function key [F2] (ADD).
- (5) Enter the increment on the keyboard.
- (6) Press the **WRITE** key.

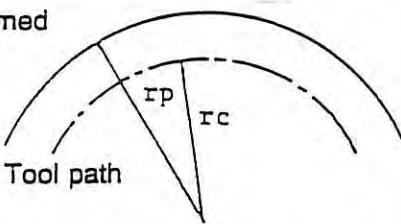
This rewrites the data indicated by the cursor.

3. NC Optional Parameter (Word)

The optional parameter (words) that follow are available

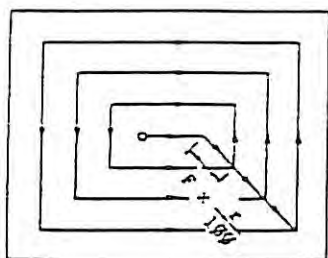
Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
1	Tape feed holes in punching	For a punchout in the PIP (transfer) mode, there is a tape feed before the program is punched out, which is followed by tape feed. The number of feed holes is set by this parameter.	600	1 to 10000
2	Defaults of tape lengths in divided punching	A file of part programs which is too long to be stored in a roll of paper tape is divided into smaller files to be punched out. The lengths of the divisions are closed at the breaks of each block, so that the setting is slightly different from the actual tape length. A divided punchout gives the beginning of each tape part a file name. Note that the setting does not include the lengths corresponding to the file name and feed holes.	180 m (590 feet)	1 to 300 m (3 - 984 feet.)
3	Decelerating ratio of cutter radius compensation corner override	 N1 X_Y_ F1 N2 X_Y_ F2	100%	1 to 100%
4	Internal identification angle of cutter radius compensation corner override	A : Override ON point B : N1 positioning C : Override OFF point r : Decelerating ratio θ : Corner's internal identification angle 	90 deg	1 to 179 deg

NC optional parameter (word)

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range										
5	Decelerating ratio of cutter radius compensation arc's internal override	Programmed path  Generally, the feedrate during cutter radius compensation is controlled so that the tool center path gets the specified speed. Parameter setting, however, provides an override which permits the feedrate on the programmed path to get the specified speed although it is limited to circular arc's inside cutting. (a) When $rc/rp \times 100 \geq$ Parameter setting Actual feedrate = Specified speed $\times rc/rp$ (b) When $rc/rp \times 100 <$ Parameter setting Actual feedrate = Specified speed $\times$ (Parameter setting/100)	100%	1 to 100%										
6	NC baud rate for RS232C Channel 0	This parameter sets the baud rate of the RS232C interface when used for the puncher. <table border="1"><thead><tr><th>Baud rate</th></tr></thead><tbody><tr><td>110</td></tr><tr><td>150</td></tr><tr><td>300</td></tr><tr><td>600</td></tr><tr><td>1200</td></tr><tr><td>2400</td></tr><tr><td>4800</td></tr><tr><td>9600</td></tr><tr><td>19200</td></tr></tbody></table> If a baud rate other than the value indicated above is set, the baud rate closest to and smaller than the setting is selected.	Baud rate	110	150	300	600	1200	2400	4800	9600	19200	600 (0.6 K baud)	110 to 19200 (baud)
Baud rate														
110														
150														
300														
600														
1200														
2400														
4800														
9600														
19200														

Parameters indicated by an asterisk (*) require turning off the power supply once after setting new data, then turn it on again.

NC optional parameter (word)

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range										
7	Override in pocket milling (spiral type) corner cutting	Pocket milling (spiral type) PMILR  In the movement illustrated above, this parameter specifies the override of the feedrate of the 45-degree cut. Actual feedrate = Specified speed × (r/100) This value of r is set by the parameter.	100%	1 to 100%										
8	Magazine pot number for touch probe	This parameter specifies the magazine pot number for storing the touch probe.	0	0 to Number of magazine pots										
9	Imaginary spindle rpm for machine lock	This parameter specifies the imaginary spindle speed for the machine lock mode operation.	2000 rpm (min ⁻¹)	1 to 8000 rpm (min ⁻¹)										
10	Servo processor monitor function	This parameter specifies the number of DSVVAR1 (leftmost 2 digits) and RSVVAR2 (rightmost 2 digits) display on the CHECK page.	0	0 to 9999										
11	Designation of operation method	This specifies the operation method to be selected when option designation is not given at the time program selection is made. <table><tr><th>Setting</th><th>Operation Method</th></tr><tr><td>0</td><td>Normal operation (method A)</td></tr><tr><td>1</td><td>Large volume operation (method B)</td></tr><tr><td>2</td><td>Operation without branching and subprograms (method S)</td></tr><tr><td>3</td><td>Multi-volume operation (method M)</td></tr></table>	Setting	Operation Method	0	Normal operation (method A)	1	Large volume operation (method B)	2	Operation without branching and subprograms (method S)	3	Multi-volume operation (method M)	1	0 to 3
Setting	Operation Method													
0	Normal operation (method A)													
1	Large volume operation (method B)													
2	Operation without branching and subprograms (method S)													
3	Multi-volume operation (method M)													

NC optional parameter (word)

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
12	Rapid feedrate override in traveling to home position	This specifies the override value for rapid feedrate when traveling rapidly to home position.	0	0 to 100%
13	Schedule program auto update	Automatic updating of schedule program 0 : Ineffective 1 : Effective	0	0 to 1
15	Machine number for DNC link	This parameter specifies the machine number for DNC link.	0	0 to 9999
16	Number of bytes in one block for batch output in DNC-B mode	This specifies the number of bytes in one block when NC program is reverse-transmitted in protocol A.	0	0 to 4000
17	Baud rate for RS422 channel	This specifies the baud rate for RS422 channels (MAIN CARD 7)	200 (baud)	111 to 19200 (baud)
18	STM answer back time over check period	When S, T and M commands are executed, if the completion of the command is not confirmed within the period set at this parameter, an alarm occurs.	120 (min)	0 to 120 (min)
19	In-position time over check period	If all axes do not arrive within in-position zone within the preset duration after the completion of calculation, an alarm occurs.	6000 (600 sec)	0 to 6000 (× 0.1 sec)
20	Spindle load max. %	Set the percent value which corresponds to full scale (torque command \$FF) indication of the spindle load to be displayed on the load display screen.	180	1 to 500
21	Allowable number (n) of torque low for synchronized tapping	An alarm occurs when the spindle load torque exceeds the allowable value for the duration of $6.4 \times n$ (msec) continuously while the synchronized tapping torque is monitored. Sets the allowable number (n) of low torque for the synchronized tapping	0	0 to 32
23	File read waiting time for channel 0 in DNC-B mode	Sets the duration from filename designation (DC4 output) to the file read (DC1 output) for channel 0 with DC code control. If "0" is set, the parameter No. 34 will be used automatically.	0 sec	0 to 9999
24	File read waiting time for channel 1 in DNC-B mode	Sets the duration from filename designation (DC4 output) to file read (DC1 output) for channel 1 with DC code control. If "0" is set, the parameter No. 35 will be used automatically.	0 sec	0 to 9999

NC optional parameter (word)

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
25	File read waiting time for channel 2 in DNC-B mode	Sets the duration from filename designation (DC4 output) to file read (DC1 output) for channel 2 with DC code control. If "0" is set, the parameter No. 36 will be used automatically.	0 sec	0 to 9999
26	File read waiting time for channel 3 in DNC-B mode	Sets the duration from filename designation (DC4 output) to file read (DC1 output) for channel 3 with DC code control. If "0" is set, the parameter No. 37 will be used automatically.	0 sec	0 to 9999
27	File read waiting time for channel 4 in DNC-B mode	Sets the duration from filename designation (DC4 output) to file read (DC1 output) for channel 4 with DC code control. If "0" is set, the parameter No. 38 will be used automatically.	0 sec	0 to 9999
28	Answer waiting period in DNC-C mode	In the DNC-C specification, limit of answer waiting period after sending [C,NCP] (NC program transmission request) for input and verify operations.	30	1 to 9999
29	Home position number of the first sequence point	This specifies the home position number for the first reference point return command - tape conversion specification (FANUC).	0	1 to 8
30	Home position number of the second reference point	This specifies the home position number for the second reference point return command - tape conversion specification (FANUC).	0	1 to 8
31	Home position number of the third reference point	This specifies the home position number for the third reference point return command - tape conversion specification (FANUC).	0	1 to 8
32	Home position number of the fourth reference point	This specifies the home position number for the fourth reference point return command - tape conversion specification (FANUC).	0	1 to 8
33	Maximum allowable sets of screw pitch error compensation	This parameter specifies the total number of sets of pitch error compensation data of all axes.	2304	0 to 2304

NC optional parameter (word)

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
*34	Ready completion waiting time for RS232C channel 0	This specifies the duration in which the RS232C channel 0 must be set ready. If it is not set ready within the time specified, an alarm occurs.	10 (sec)	1 to 9999 (sec)
*35	Ready completion waiting time for RS232C channel 1	This specifies the duration in which the RS232C channel 1 must be set ready. If it is not set ready within the time specified, an alarm occurs.	10 (sec)	1 to 9999 (sec)
*36	Ready completion waiting time for RS232C channel 2	This specifies the duration in which the RS232C channel 2 must be set ready. If it is not set ready within the time specified, an alarm occurs.	10 (sec)	1 to 9999 (sec)
*37	Ready completion waiting time for RS232C channel 3	This specifies the duration in which the RS232C channel 3 must be set ready. If it is not set ready within the time specified, an alarm occurs.	10 (sec)	1 to 9999 (sec)
*38	Ready completion waiting time for RS232C channel 4	This specifies the duration in which the RS232C channel 4 must be set ready. If it is not set ready within the time specified, an alarm occurs.	10 (sec)	1 to 9999 (sec)
*39	Baud rate of RS232C channel 1	This parameter specifies the baud rate for RS232C channel 1.	600 (0.6K baud)	110 to 19200 (baud)
*40	Baud rate of RS232C channel 2	This parameter specifies the baud rate for RS232C channel 2.	600 (0.6 K baud)	110 to 19200 (baud)
*41	Baud rate of RS232C channel 3	This parameter specifies the baud rate for RS232C channel 3.	600 (0.6 K baud)	110 to 19200 (baud)
*42	Baud rate of RS232C channel 4	This parameter specifies the baud rate for RS232C channel 4.	600 (0.6 K baud)	110 to 19200 (baud)

Parameters indicated by an asterisk (*) require turning off the power supply once after setting new data, then turn it on again.

NC optional parameter (word)

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range														
43	RS232C channel used for DNC-A channel	<table><tr><th>Setting</th><th>Device Name</th></tr><tr><td>0</td><td>TT : (CN0) [RS232C]</td></tr><tr><td>1</td><td>CN1 : [RS232C]</td></tr><tr><td>2</td><td>CN2 : [RS232C]</td></tr><tr><td>3</td><td>CN3 : [RS232C]</td></tr><tr><td>4</td><td>CN4 : [RS232C]</td></tr></table>	Setting	Device Name	0	TT : (CN0) [RS232C]	1	CN1 : [RS232C]	2	CN2 : [RS232C]	3	CN3 : [RS232C]	4	CN4 : [RS232C]	0 (channel)	0 to 4 (channel)		
Setting	Device Name																	
0	TT : (CN0) [RS232C]																	
1	CN1 : [RS232C]																	
2	CN2 : [RS232C]																	
3	CN3 : [RS232C]																	
4	CN4 : [RS232C]																	
44	Channel No. for DC code control	Sets the channel No. for DC code control in the infinite buffer operation mode. <table><tr><td>CN0 :</td><td>0</td></tr><tr><td>CN1 :</td><td>1</td></tr><tr><td>CN2 :</td><td>2</td></tr><tr><td>CN3 :</td><td>3</td></tr><tr><td>CN4 :</td><td>4</td></tr></table>	CN0 :	0	CN1 :	1	CN2 :	2	CN3 :	3	CN4 :	4	0	0 to 4				
CN0 :	0																	
CN1 :	1																	
CN2 :	2																	
CN3 :	3																	
CN4 :	4																	
*45	Designation of punch device	<table><tr><th>Setting</th><th>Device Name</th></tr><tr><td>0</td><td>TT : (CN0) [RS232C]</td></tr><tr><td>1</td><td>CN1 : [RS232C]</td></tr><tr><td>2</td><td>CN2 : [RS232C]</td></tr><tr><td>3</td><td>CN3 : [RS232C]</td></tr><tr><td>4</td><td>CN4 : [RS232C]</td></tr><tr><td>5</td><td>PP : [Parallel]</td></tr></table>	Setting	Device Name	0	TT : (CN0) [RS232C]	1	CN1 : [RS232C]	2	CN2 : [RS232C]	3	CN3 : [RS232C]	4	CN4 : [RS232C]	5	PP : [Parallel]	0	0 to 5
Setting	Device Name																	
0	TT : (CN0) [RS232C]																	
1	CN1 : [RS232C]																	
2	CN2 : [RS232C]																	
3	CN3 : [RS232C]																	
4	CN4 : [RS232C]																	
5	PP : [Parallel]																	

Parameters indicated by an asterisk (*) require turning off the power supply once after setting new data, then turn it on again.

NC optional parameter (word)

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range														
46	Designation of print data output external device name	<table><tr><th>Setting</th><th>Device Name</th></tr><tr><td>0</td><td>TT : (CN0) [RS232C]</td></tr><tr><td>1</td><td>CN1 : [RS232C]</td></tr><tr><td>2</td><td>CN2 : [RS232C]</td></tr><tr><td>3</td><td>CN3 : [RS232C]</td></tr><tr><td>4</td><td>CN4 : [RS232C]</td></tr><tr><td>5</td><td>PR : [Centronics]</td></tr></table>	Setting	Device Name	0	TT : (CN0) [RS232C]	1	CN1 : [RS232C]	2	CN2 : [RS232C]	3	CN3 : [RS232C]	4	CN4 : [RS232C]	5	PR : [Centronics]	0	0 to 5
Setting	Device Name																	
0	TT : (CN0) [RS232C]																	
1	CN1 : [RS232C]																	
2	CN2 : [RS232C]																	
3	CN3 : [RS232C]																	
4	CN4 : [RS232C]																	
5	PR : [Centronics]																	
48	Average number of sampling data sets for load display	This specifies the number (n) of load data sets to be sampled; spindle and axis load data is the average value of these sampled data sets.	16	4 to 80														
*49	Time constant for linear acceleration/deceleration	This specifies the time constant for linear acceleration/deceleration for synchronized control. (N × 12.8 ms)	20	0 to 30														
50	Synchronization error allowance A	If a synchronization error between the master and slave axes exceeds this value during normal machine operation conditions, an alarm occurs.	200 (μm) (0.008 in.)	0 to 1000														
51	Synchronization error allowance B	If a synchronization error between the master and slave axes exceeds this value when power is turned on, an alarm occurs.	1000 (μm) (0.04 in.)	0 to 5000														
*57	Designation of read device (no DC code control)	<table><tr><th>Setting</th><th>Device Name</th></tr><tr><td>0</td><td>TR : Standard tape reader</td></tr><tr><td>1</td><td>CN0: RS232C channel 0 tape reader</td></tr><tr><td>2</td><td>CN1: RS232C channel 1 tape reader</td></tr><tr><td>3</td><td>CN2: RS232C channel 2 tape reader</td></tr><tr><td>4</td><td>CN3: RS232C channel 3 tape reader</td></tr><tr><td>5</td><td>CN4: RS232C channel 4 tape reader</td></tr></table>	Setting	Device Name	0	TR : Standard tape reader	1	CN0: RS232C channel 0 tape reader	2	CN1: RS232C channel 1 tape reader	3	CN2: RS232C channel 2 tape reader	4	CN3: RS232C channel 3 tape reader	5	CN4: RS232C channel 4 tape reader	0	0 to 5
Setting	Device Name																	
0	TR : Standard tape reader																	
1	CN0: RS232C channel 0 tape reader																	
2	CN1: RS232C channel 1 tape reader																	
3	CN2: RS232C channel 2 tape reader																	
4	CN3: RS232C channel 3 tape reader																	
5	CN4: RS232C channel 4 tape reader																	
59	3-D arc projection path judgment tolerance amount	The tolerance amount used to determine whether the path obtained by projecting the 3-D arc on a plane is a line or not.	0	0 to 32767														

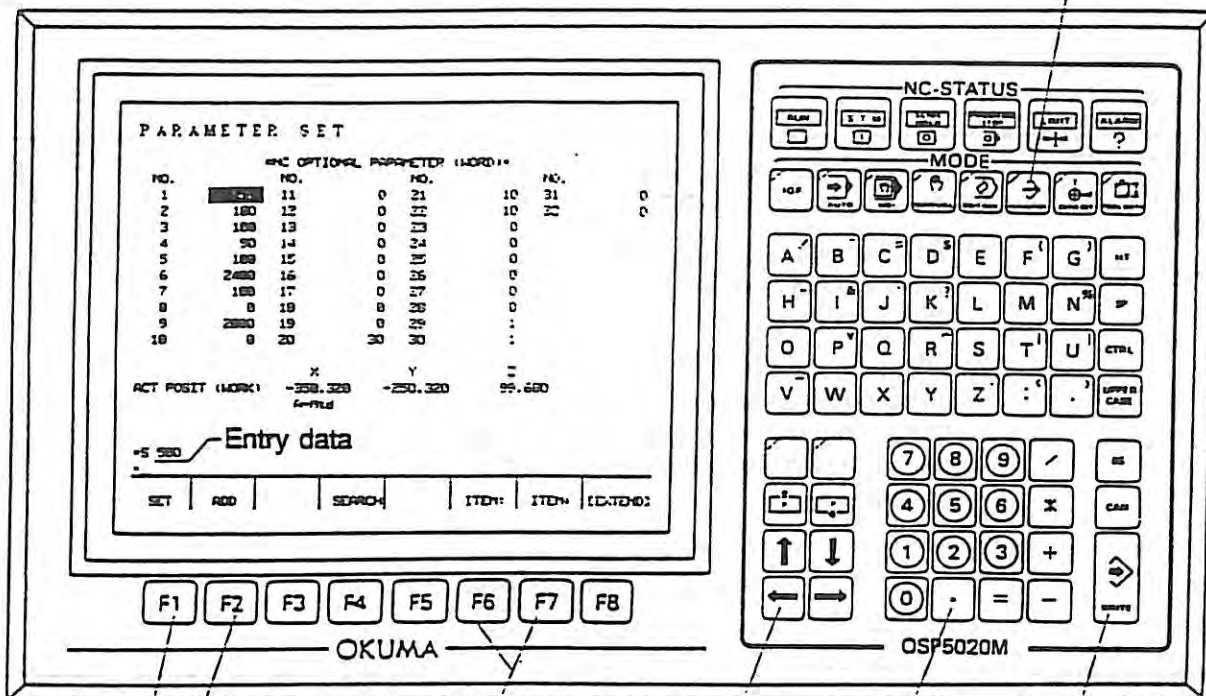
Parameters indicated by an asterisk (*) require turning off the power supply once after setting new data, then turn it on again.

NC optional parameter (word)

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
61	Synchronized tapping torque monitor Spindle speed (A)	Synchronized tapping torque monitoring starts in the following manner (1) Spindle overload is ignored until the spindle speed reaches A% of the S command value. (2) When the spindle speed reaches A% of the S command value, torque monitoring starts after duration "t" (100 msec) to wait the spindle speed to be constant.	0%	1 to 100
62	Synchronized tapping torque monitor Waiting time (t)	T: Spindle overload is ignored before the spindle speed does not become constant. t: Duration "t" (set by the parameter), the spindle overload is ignored. Monitoring torque value Spindle constant speed Time Spindle speed Spindle is recognized at the constant speed. S command value A% 100% Time	0 (×0.1sec)	1 to 1000

Data setting procedure is as follows:

(1) Press PARAMETER.



(6) Press WRITE.

(5) Key in data.

(3) Press the cursor keys.

(2) Press the function key [F6] or [F7] (ITEM).

(4) Press the function key either [F1] (SET) or [F2] (ADD).

- (1) Press the **PARAMETER** key.
- (2) Press the function key [F6] or [F7] (ITEM) more than once until the NC OPTIONAL PARAMETER (WORD) screen appears.
- (3) Using the cursor keys, position the cursor at the desired data.

Cursor

PARAMETER SET

NO.		#INC OPTIONAL PARAMETER (WORD)=		NO.		NO.	
1	500	11	0	21	10	31	0
2	100	12	0	22	10	32	0
3	100	13	0	23	0		
4	90	14	0	24	0		
5	100	15	0	25	0		
6	2400	16	0	26	0		
7	100	17	0	27	0		
8	0	18	0	28	0		
9	2000	19	0	29	1		
10	0	20	30	30	1		

ACT POSIT (WORK)	X	Y	Z
	-350.320	-250.320	99.600
	A-Mtd		

Entry data

*S 500

SET	ADD	SEARCH	ITEM+	ITEM+	[EXTEND]
-----	-----	--------	-------	-------	----------

F1 F2 F3 F4 F5 F6 F7 F8

Parameter No.

Setting:

When data is previously known:

- (4) Press the function key [F1] (SET).
- (5) Enter the data with key board.
- (6) Press the **WRITE** key.

This rewrites the data indicated by the cursor.

When data has already been set and it is necessary to set the increment from the data:

- (4) Press the function key [F2] (ADD).
- (5) Enter the increment with key board.
- (6) Press the **WRITE** key.

This rewrites the data indicated by the cursor.

3-9. NC Optional Parameter (Bit)

The NC optional parameter (bits) that follow are available.

Parameter No.	Bit No.	Contents			Set 1	Set 0	Factory Set Initial Value																
1	0	Sets Tape code	<table><tr><th>Tape Code Setting</th><th>Automatic Tape Code Recognition</th><th>Operating Conditions</th></tr><tr><td>1</td><td>1</td><td>In "READ" and "VERIFY", tape code is automatically recognized irrespective of ISO/EIA. In "PUNCH", ISO is used.</td></tr><tr><td>0</td><td>1</td><td>In "READ" and "VERIFY", tape code is automatically discriminated irrespective of ISO/EIA. In "PUNCH", EIA is used.</td></tr><tr><td>1</td><td>0</td><td>In "READ" and "VERIFY", ISO code is used, and wrong tape code results in an error. In "PUNCH", ISO is used.</td></tr><tr><td>0</td><td>0</td><td>In "READ" and "VERIFY", EIA code is used, and wrong tape code results in an error. In "PUNCH", EIA is used.</td></tr></table>			Tape Code Setting	Automatic Tape Code Recognition	Operating Conditions	1	1	In "READ" and "VERIFY", tape code is automatically recognized irrespective of ISO/EIA. In "PUNCH", ISO is used.	0	1	In "READ" and "VERIFY", tape code is automatically discriminated irrespective of ISO/EIA. In "PUNCH", EIA is used.	1	0	In "READ" and "VERIFY", ISO code is used, and wrong tape code results in an error. In "PUNCH", ISO is used.	0	0	In "READ" and "VERIFY", EIA code is used, and wrong tape code results in an error. In "PUNCH", EIA is used.	ISO	EIA	1
	Tape Code Setting	Automatic Tape Code Recognition				Operating Conditions																	
	1	1				In "READ" and "VERIFY", tape code is automatically recognized irrespective of ISO/EIA. In "PUNCH", ISO is used.																	
	0	1				In "READ" and "VERIFY", tape code is automatically discriminated irrespective of ISO/EIA. In "PUNCH", EIA is used.																	
	1	0				In "READ" and "VERIFY", ISO code is used, and wrong tape code results in an error. In "PUNCH", ISO is used.																	
	0	0				In "READ" and "VERIFY", EIA code is used, and wrong tape code results in an error. In "PUNCH", EIA is used.																	
	1	Recognition tape code automatically				Does	Does not	1															
	2	Carries out a tape TV check				Does	Does not	0															
3	There is a tape delimiting code.	ISO % EIA ER	Feed holes	0																			
4	Verifies tape during reading	Does	Does not	0																			
5	Rewinds tape without verifying after tape reading	Does	Does not	0																			
6	Handles special code (other than \$20-\$5F, HT) as an alarm.	Does	Does not	1																			
7	Does not store special code	Does	Does not	0																			

NC optional parameter (bit)

m- No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
2	0	During automatic operation with the single block ON, a block of a control statement such as IF, GOTO or CALL usually does not come to a stop until the next block is executed. This bit is intended to select a stop or a non-stop in the particular control statement block.	Stop	Non-Stop	0
	1	In multiple rotary table rotation control, rounding processing of the actual value on the work coordinate system is carried out when the control is reset.	Does	Does not	0
	2	Makes the dry run effective even at rapid feed, and operates by the manually selected feedrate.	Effective	Ineffective	0
	3				
	4	Output of print function to external device is made effective.	Effective	Ineffective	0
	5	Cycle start after the mode has been switched from the automatic to setting is possible.	Possible	Impossible	0
	6	Makes fraction processing. Always set at "1".	Does	Does not	1
	7	During automatic operation with the single block OFF, does not carry out reading or arithmetic operations for any of the blocks that follow the block in process until the operation is completed. Note, however, that during cutter radius compensation, reading and arithmetic operations are carried out until the intersecting point is found (for up to three blocks).	No buffering	Buffering	0
3	0	Selects inches or mm for length unit system. "1	Inch	mm	0
	1	Selects 1 mm, 1 inch, 1 deg. and 1 sec for the input unit system.	Yes	As set by bit 2 to bit 5 and bit 7	1
	2	Selects 0.01 mm or 0.001 mm for length unit system.	0.01 mm	0.001 mm	0
	3	Selects either 0.1 mm/min and 0.01 inch/min or 1 mm/min and 0.1 inch/min for the speed input system.	0.1 mm/min 0.01 inch/min	1 mm/min 0.1 inch/min	0
	4	Selects either 0.001 mm/rev and 0.0001 inch/rev or 0.01 mm/rev and 0.001 inch/rev for the speed input system.	0.001 mm/rev 0.0001 inch/rev	0.01 mm/rev 0.001 inch/rev	0
	5	Selects 0.01 sec or 0.1 sec for the time input unit.	0.01 sec	0.1 sec	0
	6	Selects 1 mm, 1 inch, 1 deg. and 1 sec for the unit of the data with decimal point.	Yes	As set by bit 1 - bit 5 and bit 7	0
	7	Selects 0.001 sec or 0.1 sec for the time input system. "2	0.001 sec	0.1 sec	0

Setting of bit 0 is effective only when the optional inch/metric switchable function is selected.
Unit of input time always 0.01 sec when setting of bit 5 is "1".

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
4	0	Selects 0.001 deg or 0.0001 deg for angle unit system.	0.0001 deg	0.001 deg	0
	1	A system reset is followed by bubble memory loading and it takes 80 seconds or so for the NC to be normal. Then, the automatic operation mode is established. This bit is intended to make an automatic selection of the program selected before the system reset. (The same applies also when the power supply is turned on.)	Does	Does not	1
	2	In an NC reset, zeros the manual shift in manual interruption and the shift in pulse handle interruption (MANUAL SHIFT ACTUL/MANUAL SHIFT TOTAL).	Does	Does not, but as it is.	1
	3	Enables the program sequence number search after NC start.	Possible	Impossible	1
	4	Does not display the system subprogram (SSC, LIB) in automatic operation mode.	Does not	Does	0
	5				0
	6	Selects 4 × 4 as the character size for the enlarged display of the actual position data.	Does (4 × 4)	Does not (2 × 2 is selected)	0
	7	Displays position data on the remote position display unit in incremental values in reference to the position	Does	Does not	0
5	0	Input/output bit screen	Does not display	Displays	0
	1	Specification bit screen	Does not display	Displays	0
	2	Axis data screen	Does not display	Displays	0
	3	NC/spindle diagnostic data screen	Does not display	Displays	0
	4	System & I/O variable screen	Does not display	Displays	0
	5	Index of diagnosis page is displayed by \$4000.	Display by \$4000	Display by \$20	0
	6	Actual position data (extended characters) is displayed in reference to the origin of local coordinate system.	From local coordinate system origin	From work coordinate system origin	0
	7	To produce the current value and graphic to be displayed, adds the shift in the manual intervention or pulse handle overlap.	Does	Does not	1

NC optional parameter (bit)

Parameter No.	Bit No.	Contents		Set 1	Set 0	Factory Set Initial Value
6	0	Enlarges/reduces the graph for the X-axis.		Does	Does not	0
	1	Enlarges/reduces the graph for the Y-axis.		Does	Does not	0
	2	Enlarges/reduces the graph for the Z-axis.		Does	Does not	0
	3	Enlarges/reduces the graph for the 4th-axis.		Does	Does not	0
	4	Enlarges/reduces the graph for the 5th-axis.		Does	Does not	0
	5	Enlarges/reduces the graph for the 6th-axis.		Does	Does not	0
	6	Displays the current position (enlarged) on the slanted coordinate system.		Does	Does not	0
	7	External simultaneous axis position display		There is	There is not	0
7	0	When the AXIS COM. CANCEL switch is turned ON, the axis commands whose bit is "1" are canceled and neither arithmetic operation nor ordinary operation is carried out.	Cancels the X-axis command	Does	Does not	0
	1		Cancels the Y-axis command	Does	Does not	0
	2		Cancels the Z-axis command	Does	Does not	1
	3		Cancels the 4th-axis command	Does	Does not	0
	4		Cancels the 5th-axis command	Does	Does not	0
	5		Cancels the 6th-axis command	Does	Does not	0
	6	Axis lock	All axis locked	Does	Does not all	0
	7		Axis lock ON/OFF	ON	OFF	0
8	*0	Stop bit of CN0: (RS232C)		1 bit	2 bit	0
	*1	Ready signal of CN0: (RS232C)		Internal READY	External READY	1
	*2	Parity check of CN0: (RS232C)		Checked	Not checked	0
	*3	Parity of CN0: (RS232C)		Even	Odd	0
	*4	8-bit JIS of CN0: (RS232C)		There is	There is not	0
	*5	DC code of CN0: (RSC232C)		There is	There is not	0
	*6	DC code control type 2 of CN0: (RS232C)		Executed	Not executed	0
	*7	File name present in reading operation at CN0: (RS232C) in DNC-A mode		Present	Not present	0

Parameters indicated by an asterisk (*) require turning off of power supply once after setting new data. Turn it back on.

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
9	0	In data setting, unit system of length is either "inch" or "mm".	Inch	mm	0
	1	In data setting, setting unit is either minimum setting unit or 1 mm, 1 inch, 1 deg. and 1 sec.	1 mm, 1 inch, 1 deg, 1 sec	Minimum setting unit	1
	2	In data setting, unit system of length is either 0.1 μ m or 0.00001 inch.	Does	Does not	0
	3	In data setting, unit system of angle is either 0.001 deg. or 0.0001 deg.	0.0001 deg.	0.001 deg.	0
	4				0
	5	Operation mode(s) inoperative for edit lock specification when the EDIT LOCK (partly restricted) mode is selected.	Program edit, parameter setting	Program edit	0
	6	In the data setting, the decimal point indicates 1 mm, 1 inch, 1 deg. and 1 sec.	Basic unit	Bit 1 setting.	0
	7	In the EDIT LOCK mode, the maximum increment for tool length upset and cutter radius compensation is 1 mm/0.1 inch.			0
10	0	Default of EBCDIC, for floppy disk of IBM format	Does	Does not	0
	1	Default of ASCII, for floppy disk of IBM format	Does	Does not	0
	2	End code (%) is available for floppy disk of IBM format.	Yes	No	0
	3	NC file name is not output at DNC punch output.	Not output	Output	0
	4	Verify output is made at DNC punch output.	Output	Not output	0
	*5	Selection of IBM format (standard IBM format and JIS specified IBM format)	JIS specified IBM format	Standard IBM format	0
	*6	Extension is used for file name in data input/output using floppy disk of IBM format	Not used (blank)	Used	0
	7	Tool length and tool radius compensation can be added maximum 1 mm/0.1 inch when PL mode is selected.	Can	Can not	0

Parameters indicated by an asterisk (*) require turning off of power supply once after setting new data. Turn it back on.

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
11	0	Tape conversion function is executed. (OSP3000M level I, FS-9M level I/II)	Yes	No	0
	1				0
	2				0
	3	End of record code for NC program transmission (DNC-B, C)	LF	CR, LF	0
	4				0
	5	Designation of the parameter setting screen for coordinate system conversion	2nd screen	1st screen	0
	6	Gives a command for transmitting the coordinate system conversion value when the operation mode is switched to MANUAL.	Dose	Dose not	0
	7	Ignores the minimum value for the 0.1 μ m external position display.	Dose	Dose not (displays)	0
12	0	Spindle speed is programmed in S2-digit when tape conversion function is on.	2-digit command	4-digit command	0
	1	Spindle speed is programmed in S2-digit when tape conversion function is off.	2-digit command	4-digit command	0
	2	File name output for tape punch out	Not punched	Punched	0
	3	End of record code for tape punch operation in ISO code	LF	CR, LF	0
	4	Code used for tape feed for tape punch operation	Space	NULL	0
	5	Specifies whether tape feed portion is punched.	Punched	Not punched	0
	6	Communication link is reset by pressing NC reset button (DNC-C).	Reset	Not reset	0
	7				0

Parameters indicated by an asterisk (*) require turning off of power supply once after setting new data. Turn it back on.

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
13	*0	Stop bit of CN1: (RS232C)	1 bit	2 bit	0
	*1	Ready signal of CN1: (RS232C)	Internal READY	External READY	0
	*2	Parity check of CN1: (RS232C)	Checked	Not checked	0
	*3	Parity of CN1: (RS232C)	Even	Odd	0
	*4	8-bit JIS of CN1: (RS232C)	There is	There is not	0
	*5	DC code of CN1: (RS232C)	There is	There is not	0
	*6	DC code control type 2 of CN1: (RS232C)	Executed	Not executed	0
	*7	File name present in reading operation at CN1: (RS232C) in DNC-A mode	Present	Not present	0
14	*0	Stop bit of CN2: (RS232C)	1 bit	2 bit	0
	*1	Ready signal of CN2: (RS232C)	Internal READY	External READY	0
	*2	Parity check of CN2: (RS232C)	Checked	Not checked	0
	*3	Parity of CN2: (RS232C)	Even	Odd	0
	*4	8-bit JIS of CN2: (RS232C)	There is	There is not	0
	*5	DC code of CN2: (RS232C)	There is	There is not	0
	*6	DC code control type 2 of CN2: (RS232C)	Executed	Not executed	0
	*7	File name present in reading operation at CN2: (RS232C) in DNC-A mode	Present	Not present	0

Parameters indicated by an asterisk (*) require turning off of power supply once after setting new data. Turn it back on.

NC optional parameter (bit)

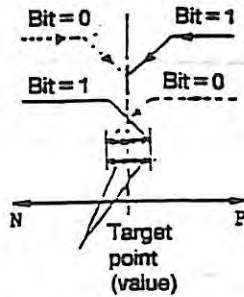
Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
15	0				0
	1				0
	2				0
	3				0
	4				0
	5	STM answer time over check function is made effective. Alarm 615 STM time over Optional parameter (word) No. 18	Effective	Ineffective	0
	6	In-position time over check function is made effective. Alarm 616 In-position monitoring time over Optional parameter (word) No. 19	Effective	Ineffective	0
	7	In the inch system, the unit system for an F command used for a rotary axis can be selected.	25.4 deg/min	1 deg/min	0
16	0				0
	1				0
	2				0
	3				0
	4				0
	5	Type A buffer operation in the DNC-B mode	Type A	Type B (large capacity)	0
	6	Displays the common variable setting screen with the comment.	Does	Does not	0
	7	Displays and enables the setting of: system parameter, pitch error compensation, machine system parameter (word), machine system parameter (long word) and No. 33 and following Nos. in the NC optional parameter (word); and No. 17 and trailing Nos. in the NC optional parameter (bit).	Setting OK	Setting NG	0

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value														
17	0	Fixes the cycle axis for a fixed cycle, which may be any axis other than plane designation, at the Z-axis.	Does	Does not	0														
	1	<table><tr><td>Bit 1</td><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td>Bit 2</td><td>0</td><td>1</td><td>0</td><td>1</td></tr><tr><td>Shift direction</td><td>P-X</td><td>N-X</td><td>P-Y</td><td>N-Y</td></tr></table> Specifies the shift direction and axis in a fixed cycle (G76, G87). This is effective only when bit 0 is "1".	Bit 1	0	0	1	1	Bit 2	0	1	0	1	Shift direction	P-X	N-X	P-Y	N-Y	} See the table at the left.	0
	Bit 1		0	0	1	1													
	Bit 2		0	1	0	1													
	Shift direction	P-X	N-X	P-Y	N-Y														
	2	0																	
	3	At a reset, clears the mirror images for all axes, providing normal conditions.	Does	Does not	0														
	4				0														
	5	External program selection is executed for main program or schedule program.	Schedule program	Main program	0														
	6	In external program selection operation, the selection of the same file name is not executed.	Does not	Does	0														
	7	Specifies which tapping cycle the G codes (G74, G84) call, conventional tapping cycle or synchronized	Synchronized tapping cycle	Conventional tapping cycle	0														
18	0	Specifies the G code to be set automatically when the power supply is turned on.	G00	G01	1														
	1		G18	G17	0														
	2		G19	G17	0														
	3		G56	G53	0														
	4		G91	G90	0														
	5		G95	G94	0														
	6		G22	G23	0														
		7				0													

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
19	0	X-axis	N direction	P direction	0
	1	Y-axis	Same as above	Same as above	0
	2	Z-axis	Same as above	Same as above	1
	3	4th axis	Same as above	Same as above	0
	4	5th axis	Same as above	Same as above	0
	5	6th axis	Same as above	Same as above	0
	6	DNC communication ON/OFF	ON	OFF	0
	7	DNC buffer operation ON/OFF	ON	OFF	0



(This excess travel is set by a user parameter.)

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
20	0	Gives D.STA transmission request in the simple DNC (DNC-C) mode	Does	Does not	0
	1	For single-axis command, actual position or a point on the arc is taken as the command value for the axis not programmed.	Any point on arc	Actual position	0
	2	Z-axis moves to the upward limit position when alarm B occurs.	Yes	No	0
	3	Message code in the simple DNC (DNC-C) mode	ASCII	ISO	0
	4	End code in the simple DNC (DNC-C) mode	ETX	CR	0
	5	Delimiter code in the simple DNC (DNC-C) mode	NUL	%	0
	6	Designates the file extension in host computer in the simple DNC (DNC-C) mode	Does	Does not	0
21	7	Protocol selection in the DNC-B mode	Protocol B	Protocol A	0
	*0	Stop bit of CN3: (RS232C)	1 bit	2 bit	0
	*1	Ready signal of CN3: (RS232C)	Internal READY	External READY	0
	*2	Parity check of CN3: (RS232C)	Checked	Not checked	0
	*3	Parity of CN3: (RS232C)	Even	Odd	0
	*4	8-bit JIS of CN3: (RS232C)	There is	There is not	0
	*5	DC code of CN3: (RS232C)	There is	There is not	0
	*6	DC control type 2 of CN3: (RS232C)	Executed	Not executed	0
	*7	File name present in reading operation at CN3: (RS232C) in DNC-A mode	Present	Not present	0

Parameters indicated by an asterisk (*) require turning off of power supply once after setting new data. Turn it back on.

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value	
22	*0	Stop bit of CN4: (RS232C)	1 bit	2 bit	0	
	*1	Ready signal of CN4: (RS232C)	Internal READY	External READY	0	
	*2	Parity check of CN4: (RS232C)	Checked	Not checked	0	
	*3	Parity of CN4: (RS232C)	Even	Odd	0	
	*4	8-bit JIS of CN4: (RS232C)	There is	There is not	0	
	*5	DC code of CN4: (RS232C)	There is	There is not	0	
	*6	DC control type 2 of CN4: (RS232C)	Executed	Not executed	0	
	*7	File name present in reading operation at CN4: (RS232C) in DNC-A mode	Present	Not present	0	
23	0	No. 1	In the positioning at the home position, its rapid feedrate is controlled either by setting of override switch or setting value for NC optional parameter (word) No. 12. Setting is possible from No. 1 to No. 32. No. 1 corresponds to home position number 1.	Parameter	Override switch	0
	1	No. 2		Parameter	Override switch	0
	2	No. 3		Parameter	Override switch	0
	3	No. 4		Parameter	Override switch	0
	4	No. 5		Parameter	Override switch	0
	5	No. 6		Parameter	Override switch	0
	6	No. 7		Parameter	Override switch	0
	7	No. 8		Parameter	Override switch	0

Parameters indicated by an asterisk (*) require turning off of power supply once after setting new data. Turn it back on.

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
24	0	No. 9	Parameter	Override switch	0
	1	No. 10	Parameter	Override switch	0
	2	No. 11	Parameter	Override switch	0
	3	No. 12	Parameter	Override switch	0
	4	No. 13	Parameter	Override switch	0
	5	No. 14	Parameter	Override switch	0
	6	No. 15	Parameter	Override switch	0
	7	No. 16	Parameter	Override switch	0
25	0	No. 17	Parameter	Override switch	0
	1	No. 18	Parameter	Override switch	0
	2	No. 19	Parameter	Override switch	0
	3	No. 20	Parameter	Override switch	0
	4	No. 21	Parameter	Override switch	0
	5	No. 22	Parameter	Override switch	0
	6	No. 23	Parameter	Override switch	0
	7	No. 24	Parameter	Override switch	0

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
26	0	No. 25	Parameter	Override switch	0
	1	No. 26	Parameter	Override switch	0
	2	No. 27	Parameter	Override switch	0
	3	No. 28	Parameter	Override switch	0
	4	No. 29	Parameter	Override switch	0
	5	No. 30	Parameter	Override switch	0
	6	No. 31	Parameter	Override switch	0
	7	No. 32	Parameter	Override switch	0
In the positioning at the home position, its rapid feedrate is controlled either by setting of override switch or setting value for NC optional parameter (word) No. 12. Setting is possible from No. 1 to No. 32. No. 1 corresponds to home position number 1.					
27	0	Specifies the EIA code which represents "=". Conditions of the hole, punched or not punched, when the key to be used for punching the symbol "=" is pressed are set in terms of the bit data. Same for following setting.	Punched	Not punched	0
	1		Punched	Not punched	0
	2		Punched	Not punched	0
	3		Punched	Not punched	0
	4		Punched	Not punched	0
	5		Punched	Not punched	0
	6		Punched	Not punched	0
	7		Punched	Not punched	0

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
28	0	Specifies the EIA code which represents " * ".	Punched	Not punched	0
	1		Punched	Not punched	0
	2		Punched	Not punched	0
	3		Punched	Not punched	0
	4		Punched	Not punched	0
	5		Punched	Not punched	0
	6		Punched	Not punched	0
	7		Punched	Not punched	0
29	0	Specifies the EIA code which represents "[".	Punched	Not punched	0
	1		Punched	Not punched	0
	2		Punched	Not punched	0
	3		Punched	Not punched	0
	4		Punched	Not punched	0
	5		Punched	Not punched	0
	6		Punched	Not punched	0
	7		Punched	Not punched	0

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
30	0	Specifies the EIA code which represents "J".	Punched	Not punched	0
	1		Punched	Not punched	0
	2		Punched	Not punched	0
	3		Punched	Not punched	0
	4		Punched	Not punched	0
	5		Punched	Not punched	0
	6		Punched	Not punched	0
	7		Punched	Not punched	0
31	0	Specifies the EIA code which represents "\$".	Punched	Not punched	0
	1		Punched	Not punched	0
	2		Punched	Not punched	0
	3		Punched	Not punched	0
	4		Punched	Not punched	0
	5		Punched	Not punched	0
	6		Punched	Not punched	0
	7		Punched	Not punched	0

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
32	0	Setting of machine parameter data is enabled when debugging	Enabled	Not enabled	0
	1				0
	2				0
	3				0
	4				0
	5				0
	6	NC output is performed during box check.	Output	Not output	0
	7	Carries out box check.	Does	Does not	0
	0	Graphic coordinate system is made effective when NC is reset.	Effective	Ineffective	0
33	1	Backup function is effective when M02 or M30 is executed.	Effective	Ineffective	0
	2	The mirror image function is effective in the slanted coordinate system ("0" is set at No. 34, bit 2)	Effective	Follow No. 34, bit 2	0
	3	Counting of counters (work counter, NC running counter, spindle rotation counter, cutting time counter) occurs only in auto mode.	Only AUTO mode	All modes	0
	4				0
	5				0
	6	The Z-axis automatic retract function is effective when a B-axis rotation command is given	Effective	Ineffective	0
	7	Gathering minute blocks when interpreting a program	Effective	Ineffective	0

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
34	0	Single block stop at point R level in the fixed cycle is effective.	Effective	Ineffective	0
	*1	Communication with MOP	Not made	Made	0
	*2	Mirror image effective in	Work coordinate system	Local coordinate system or slanted coordinate system	0
	3	System G code macros 300 - 349 are MODIN type.	MODIN	CALL	0
	*4	System variable VINCH is made write enabled.	READ/WR ITE enabled	Only READ enabled	0
	5	Splash guard interlock is effective.	Effective	Ineffective	0
	*6	To set whether the calculation results of the function (ROUND, FIX, FUP) are to convert numerical data into an integer with or without a decimal point when setting it for an address character.	With decimal point	Integer	0
	7	Space for attachment rotation offset	U-/V-/W-axis	X-/Y-/Z-axis	0
35	0	EC-P check on diagnosis screen	Effective	Ineffective	0
	1				0
	2				0
	3				0
	4				0
	5				0
	6				0
	7				0

Parameters indicated by an asterisk (*) require turning off the power supply once after setting new data. Turn it back on.

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
36	0	The unit of variables assigned to MSB is set at 0.001 mm (0.0001 inches) when bit 0 and bit 6 of NC optional parameter (bit) No. 3 are "0" and "1", respectively.	0.001 mm (0.0001 in.)	1 mm (1 in.)	0
	1	Uni-direction automatic gauging with touch probe	Does	Does not	0
	2	Automatic gauging and automatic tool length offset/broken tool detection with ring sensor	Does	Does not	0
	3	Default of the maximum tool length for automatic tool length offset/broken tool detection	Effective	Ineffective	0
	4				0
	5				0
	6				0
	7				0
37	0	Synchronized operation; synchronized error compensation mode input	ON	OFF	0
	1	Synchronized operation; synchronized position shift amount setting	Possible	Impossible	0
	2	Semi-synchronized operation in the DNC-B mode	Effective	Ineffective	0
	3	Plane on which 3-D arc is projected is fixed using G17, G18, or G19.	Effective	Ineffective	0
	4	In the rapid feed mode operation, the command causing overtravel causes an alarm	Yes	No	0
	5	Selection of PQR command method for 3-D arc	Normal vector	Position	0
	6	With PPC P selection, the workpiece number is taken as the file name.	Yes	No	0
	7	Pitch error compensation ineffective (laser measurement mode) (in 0.1 μ m control specification)	Ineffective	Effective	0

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
38	0	Stop bit of MOP-TOOL	1 bit	2 bit	0
	1	Read signal of MOP-TOOL	Internal READY	External READY	0
	2	Parity check of MOP-TOOL	Checked	Not checked	0
	3	Parity of MOP-TOOL	Even	Odd	0
	4				0
	5				0
	6				0
	7	Communication device of MOP-TOOL (RS232L)			0
39	0	Interruption effective command (EIN)	Ineffective	Effective	0
	1	Interruption signal	Status trigger	Edge trigger	0
	2	Execution of the interruption program	End of block	Interrupting block	0
	*3	A-axis multi-turn function is made effective.	Effective	Ineffective	0
	*4	B-axis multi-turn function is made effective.	Effective	Ineffective	0
	*5	C-axis multi-turn function is made effective.	Effective	Ineffective	0
	6	Animated graphic display	Not supported	Supported	0
	7				0
40	0	Designation of master or slave station for CN0: RS232C 1F channel	Slave station	Master station	0
	1	Designation of master or slave station for CN1: RS232C 1F channel	Slave station	Master station	0
	2	Designation of master or slave station for CN2: RS232C 1F channel	Slave station	Master station	0
	3	Designation of master or slave station for CN3: RS232C 1F channel	Slave station	Master station	0
	4	Designation of master or slave station for CN4: RS232C 1F channel	Slave station	Master	0
	5				0
	6				0
	7				0

Parameters indicated by an asterisk (*) require turning off the power supply once after setting new data. Turn it back on.

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
43	0	↑ DNC-B method, protocol A Data at 41st to 44th byte of SAT and SET command bit 0			0
	1	Data at 41st to 44th byte of SAT and SET command bit 1			0
	2	Data at 41st to 44th byte of SAT and SET command bit 2			0
	3	Data at 41st to 44th byte of SAT and SET command bit 3			0
	4	Data at 41st to 44th byte of SAT and SET command bit 4			0
	5	Data at 41st to 44th byte of SAT and SET command bit 5			0
	6	Data at 41st to 44th byte of SAT and SET command bit 6			0
	7	Data at 41st to 44th byte of SAT and SET command bit 7			0
44	0	Data at 41st to 44th byte of SAT and SET command bit 8			0
	1	Data at 41st to 44th byte of SAT and SET command bit 9			0
	2	Data at 41st to 44th byte of SAT and SET command bit 10			0
	3	Data at 41st to 44th byte of SAT and SET command bit 11			0
	4	Data at 41st to 44th byte of SAT and SET command bit 12			0
	5	Data at 41st to 44th byte of SAT and SET command bit 13			0
	6	Data at 41st to 44th byte of SAT and SET command bit 14			0
	7	↓ Data at 41st to 44th byte of SAT and SET command bit 15			0
46	0	G00 linear interpolation positioning is carried out.	Yes	No	0
	1	G60 linear interpolation positioning is carried out.	Yes	No	0
	2	G30 linear interpolation positioning is carried out.	Yes	No	0
	3	M6, M60 linear interpolation positioning is carried out.	Yes	No	0
	4	Level B alarm occurs if a positioning point exceeds the travel limit.	Effective	Ineffective	0
	5	The centers of ID and OD are gauged at three points in manual gauging operation.	Yes	No	0
	6	Auto-cycle/single is effective at the start of interactive work gauging operation.	Auto/single effective	Auto effective	0
	7	Automatic zero point setting is carried out in interactive work gauging operation.	Carried out	Not carried out	0

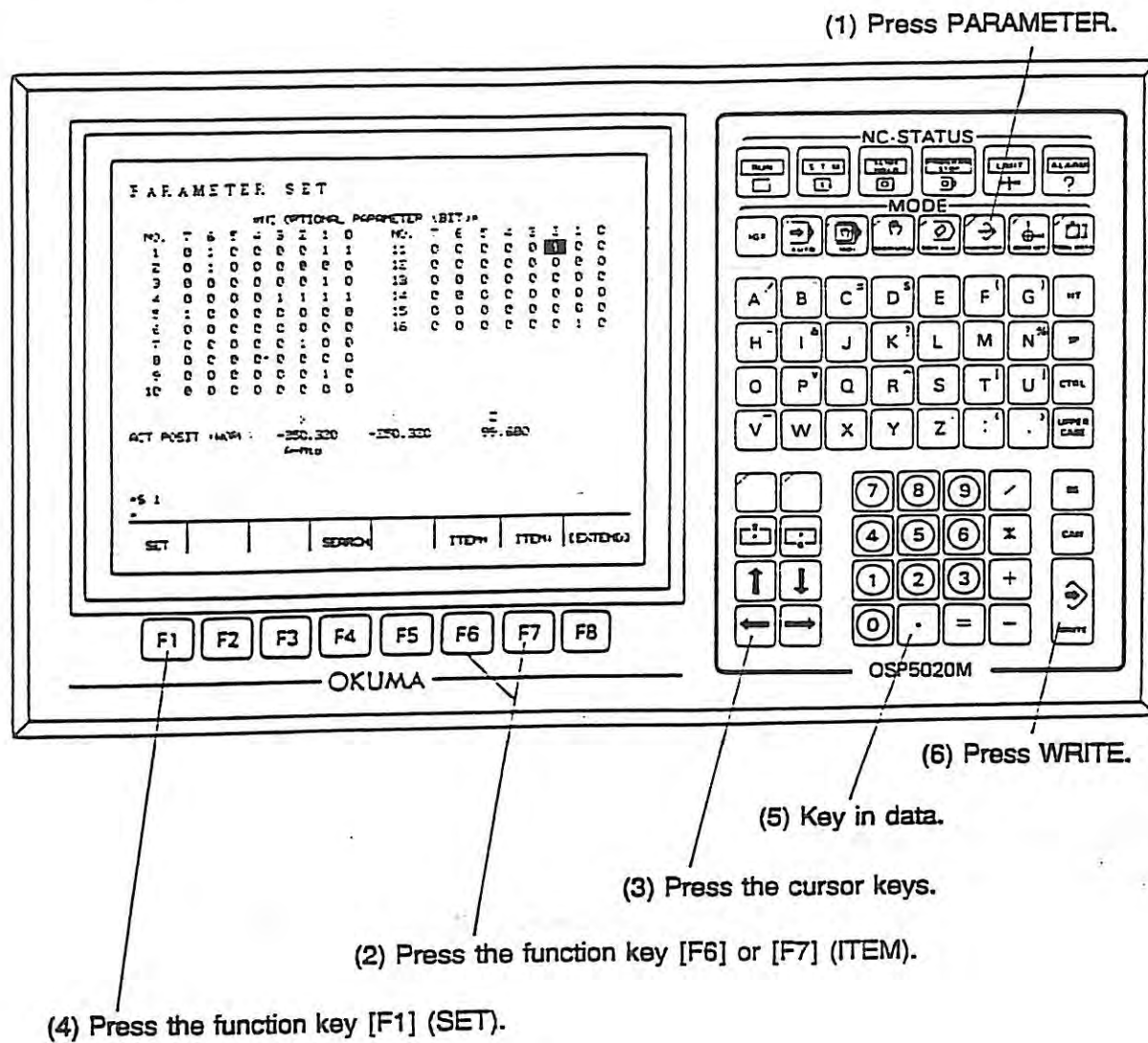
NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
47	0				0
	1				0
	2				0
	3				0
	4				0
	5				0
	6				0
	7	Executes FS-9M tape conversion operation	Does	Does not	0
48	0				0
	1	Coordinate system in which tool length offset is carried out in 3-D coordinate system conversion	Slanted coordinate system	Work coordinate system	0
	2				0
	3				0
	4				0
	5				0
	6	Selection of method for synchronized tapping torque monitoring			0
	7				0
49	0	Specifies the EIA code which represents "#".			0
	1				0
	2				0
	3				0
	4				0
	5				0
	6				0
	7				0

NC optional parameter (bit)

Parameter No.	Bit No.	Contents	Set 1	Set 0	Factory Set Initial Value
50	0	Specifies an irregular code.			0
	1				0
	2				0
	3				0
	4				0
	5				0
	6				0
	7				0
51	0	Specifies a regular code (ISO code).			0
	1				0
	2				0
	3				0
	4				0
	5				0
	6				0
	7				0
54	0	Additional axis selection in the upper surface detection mode for fixed cycle LE command	Additional axis	Basic axis	0
	1	Shifts by the manual interruption shift amount in the broken tool detection mode for fixed cycle LP command	Does	Does not	0
	2				0
	3				0
	4				0
	5				0
	6	Multiplying factor of the pulse generator multiplied by 10 when the 0.0001° rotary axis specification is selected. X1→X10 X10→X100 X50→X500	Does	Does not	0
	7	Selects axis configuration for the multi-turn rotary table from the rotary axis parameter or from the settings at NC optional parameter (bit) No. 39, bits 3, 4, and 5.	Rotary axis parameter	No. 39, bit 3, 4, or 5	0

Data setting procedure is as follows:



(1) Press the **PARAMETER** key.

(2) Press the function key [F6] or [F7] (ITEM) until the NC OPTIONAL PARAMETER (BIT) screen appears.

(3) Position the cursor at the desired data.

PARAMETER SET

#NO. OPTIONAL PARAMETER (BIT)#									
NO.	7	6	5	4	3	2	1	0	
1	0	1	0	0	0	0	1	1	
2	0	1	0	0	0	0	0	0	
3	0	0	0	0	0	0	1	0	
4	0	0	0	0	1	1	1	1	
5	1	0	0	0	0	0	0	0	
6	0	0	0	0	0	0	0	0	
7	0	0	0	0	0	1	0	0	
8	0	0	0	0	0	0	0	0	
9	0	0	0	0	0	0	1	0	
10	0	0	0	0	0	0	0	0	

ACT POSIT (WORK) X -250.320 Y -250.320 Z 99.680
A-Mtd

#S 1

SET			SEARCH		ITEM	ITEM	[EXTEND]
-----	--	--	--------	--	------	------	----------

F1 F2 F3 F4 F5 F6 F7 F8

Cursor

Parameter No.

Entry data

(4) Press the function key [F1] (SET).

(5) Enter the data with keyboard.

The entry of any number other than 0 and 1 or any character will result in an error.

(6) Press the WRITE key.

This rewrites the data indicated by the cursor.

0. Unit Systems for Programming

The unit systems set by NC optional parameter (bit) No. 3, bit 0 through bit 7, and No. 9, bit 0 and bit 1, can be confirmed on the display.

From this page, it is possible to set the unit system.

Note that the unit systems of length, angle, feedrate (mm/min), feedrate (mm/rev) and time are determined by the combination of bit data, changing the unit systems from this page might unexpectedly change other unit systems.

The setting for REAL NUMBER (Y/N) is related with the setting for bit 6 of NC optional parameter (bit) No. 3 and No. 9.

If the change of the unit systems is required, change them using the NC optional parameter (bit) No.3.

PARAMETER SET

= INPUT UNIT SYSTEM =

PART PROGRAM UNIT	DATA SET UNIT
METRIC/INCH (M/I) = ☒ M	METRIC/INCH (M/I) = M
REAL NUMBER (Y/N) = N	REAL NUMBER (Y/N) = N
LENGTH (mm) = 1.000	LENGTH (mm) = 1.000
ANGLE (°) = 1.000	ANGLE (°) = 1.0000
FEEDRATE (mm/min) = 1.000	
FEEDRATE (mm/rev) = 1.000	
DWELL TIME (sec) = 1.000	

X

ACT POSIT (WORK) -350.320

A-Mtd

Y

-250.320

Z

99.600

#S I

SET			SEARCH		ITEM#	ITEM#	[EXTEND]
-----	--	--	--------	--	-------	-------	----------

[F1]
[F2]
[F3]
[F4]
[F5]
[F6]
[F7]
[F8]

Optional parameter (bit)

No. 4	No. 3								Length (mm)	Angle (°)	Speed (mm/min)	Speed (mm/rev)	Time (sec)
	7	6	5	4	3	2	1	0					
0	*	*	*	*	*	*	1	0	1	1	1	1	1
0	0	*	0	0	0	0	0	0	0.001	0.001	1	0.01	0.1
0	0	*	0	0	0	1	0	0	0.01	0.001	1	0.01	0.1
0	0	*	0	0	1	0	0	0	0.001	0.001	0.1	0.01	0.1
0	0	*	0	1	0	0	0	0	0.001	0.001	1	0.001	0.1
1	*	*	1	0	0	0	0	0	0.001	0.001	1	0.01	0.01
1	1	*	0	0	0	0	0	0	0.001	0.001	1	0.01	0.001
1	0	*	0	0	0	0	0	0	0.001	0.0001	1	0.01	0.1

3-11. Machine System Paramter (Long Word)

The machine system parameter (long word) consists of the setting items that follow.

Parameter No.	CRT Display Name	Contents	Effective Command	Factory Set Initial Value	Setting Range	Setting Unit
1	CARRIER OFFST CA	Output value of the absolute position encoder at the carrier's CA position	SET ADD CAL	Depends on machine specification.	0 to 99999999	0.001 mm (0.00004 in.)
2	CARRIER OFFST CH	Output value of the absolute position encoder at the carrier's CH position	Same as above	Same as above	-99999999 to 99999999	0.001 mm (0.00004 in.)
3	CARRIER OFFST CV	Output value of the absolute position encoder at the carrier's CV position	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
4	CARRIER OFFST CS	Output value of the absolute position encoder at the carrier's CS position	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
5	CARRIER OFFST CD	Output value of the absolute position encoder at the carrier's CD position	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
7	CARRIER P LIMIT	Carrier's P-directional travel end limit	Same as above	Depends on machine specification	-99999999 to 99999999	0.001 mm (0.00004 in.)
8	CARRIER N LIMIT	Carrier's N-directional travel end limit	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
9	MAGAZINE OFFST 1	Output value of the absolute position encoder in the T1 which serves as the origin of the 1st magazine	Same as above	Same as above	Depends on machine specification.	1 part
10	MAGAZINE OFFST 2		Same as above	0	Same as above	1 part
11	MAGAZINE OFFST 3		Same as above	0	Same as above	1 part

Machine system parameter (long word)

Parameter No.	CRT Display Name	Contents	Effective Command	Factory Set Initial Value	Setting Range	Setting Unit
12	AAC MAG OFFST	Output value of the absolute position encoder at the AAC magazine's zero position	SET ADD CAL	Depends on machine specification.	Depends on machine specification	1 part
13	SWIVEL HEAD OFFST	Output value of the absolute position encoder at the attachment's forward position	Same as above	Same as above	Same as above	1 part
14						
15	AT AIR Z-P LIMIT	Z-axis position in the positive direction for air blow range of attachment joint	SET ADD CAL	Depends on machine specification.	-99999999 to 99999999	0.001 mm (0.00004 in.)
16	AT AIR Z-N LIMIT	Z-axis position in the negative direction for air blow range of attachment joint	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
17	AT SWIVEL Z-P LIMIT	Z-axis position in the positive direction for attachment swivel range	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
18	AT SWIVEL Z-N LIMIT	Z-axis position in the negative direction for attachment swivel range	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
19	AT IN POSITION	In position width for manual attachment indexing	SET ADD	Same as above	0 to 999	1 part
20	AT BACKLASH	Backlash compensation amount for attachment indexing	Same as above	Same as above	-999 to 999	1 part
21	CROSSRAIL ZERO	Numeric value from absolute position encoder at zero for automatic crossrail positioning	SET ADD CAL	Same as above	0 to 99999999	0.001 mm (0.00004 in.)

Machine system parameter (long word)

Parameter No.	CRT Display Name	Contents	Effective Command	Factory Set Initial Value	Setting Range	Setting Unit
22	CROSS OFFST1	Relative position of M85 (M199) from zero of automatic crossrail positioning	SET ADD CAL	Depends on machine specification.	-99999999 to 99999999	0.001 mm (0.00004 in.)
23	CROSS OFFST 2	Relative position of M84 (M198) from zero of automatic crossrail positioning	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
24	CROSS OFFST 3	Relative position of M83 (M197) from zero of automatic crossrail positioning	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
25	CROSS OFFST 4	Relative position of M82 (M196) from zero of automatic crossrail positioning	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
26	CROSS OFFST 5	Relative position of M81 (M195) from zero of automatic crossrail positioning	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
27	CROSS OFFST 6	Relative position of M194 from zero of automatic crossrail positioning	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
28	CROSS OFFST 7	Relative position of M193 from zero of automatic crossrail positioning	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
29	CROSS OFFST 8	Relative position of M192 from zero of automatic crossrail positioning	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
30	CROSS OFFST 9	Relative position of M191 from zero of automatic crossrail positioning	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
31	CROSS OFFST 10	Relative position of M190 from zero of automatic crossrail positioning	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)

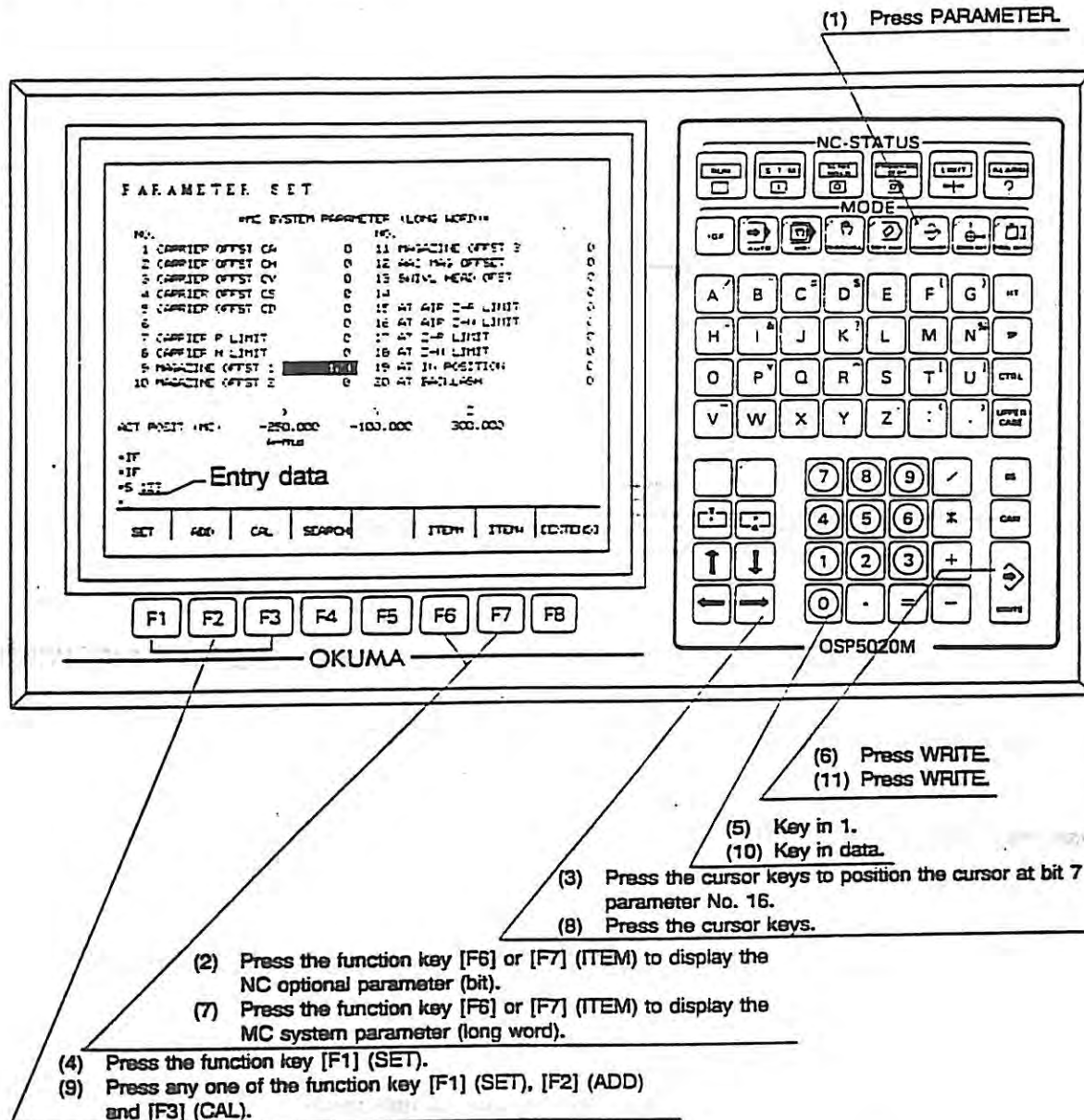
Machine system parameter (long word)

Parameter No.	CRT Display Name	Contents	Effective Command	Factory Set Initial Value	Setting Range	Setting Unit
32	CROSS SEC.LIMIT P		SET ADD CAL	Depends on machine specification	Depends on machine specification	0.001 mm (0.00004 in.)
33	CROSS SEC.LIMIT N		Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
34						
35						
36	PALLET MAGAZINE OFFSET	Output value of the absolute position encoder at the APC pallet magazine's zero position	SET ADD CAL	Depends on machine specification	Depends on machine specification	1 part
37						
38						
39						
40						
41	SHIFTER ORIGIN	Standby position of APC shifter	SET ADD CAL	Depends on machine specification	0 to shifter APAMAX	0.001 mm (0.00004 in.)
42	SHIFTER P LIMIT	Travel end limit of APC shifter in the positive direction	Same as above	Same as above	- shifter APAMAX to + shifter APAMAX	0.001 mm (0.00004 in.)
43	SHIFTER N LIMIT	Travel end limit of APC shifter in the negative direction	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)

Machine system parameter (long word)

Parameter No.	CRT Display Name	Contents	Effective Command	Factory Set Initial Value	Setting Range	Setting Unit
44	APC LIMIT	APC shifter position which allows axis movement of X and B axes.	SET ADD CAL	Depends on machine Specification	- Shifter APAMAX to + Shifter APAMAX	0.001 mm (0.00004 in.)
45	SHIFTER HP CHECK	Mid-stop position of APC shifter advancing motion when X, Z and B axes are not at APC position	Same as above	Same as above	Same as above	0.001 mm (0.00004 in.)
48	SPINDL INDEX POS	Spindle index offset (high-precision VAC)	Same as above	Same as above	-359.999 to +359.999	0.001 deg.

Setting procedure is as follows:



- (1) Press the **PARAMETER** key.
- (2) Press the function key [F6] or [F7] (ITEM) until the NC OPTIONAL PARAMETER (BIT) screen appears.
- (3) Press the cursor keys to position the cursor at bit 7 of parameter No. 16.
- (4) Press the function key [F1] (set) and key in 1.
- (5) Press the **WRITE** key.

Parameter No. 17 and following data are displayed on the CRT.

This enables the setting of the MC system parameter (long word).

PARAMETER SET			
MC SYSTEM PARAMETER (LONG WORD)			
NO.		NO.	
1	CARRIER OFFST CA	0	11 MAGAZINE OFFST 3
2	CARRIER OFFST CH	0	12 AAC MAG OFFSET
3	CARRIER OFFST CV	0	13 SHIV. HEAD OFST
4	CARRIER OFFST CS	0	14
5	CARRIER OFFST CD	0	15 AT AIP Z-P LIMIT
6		0	16 AT AIP Z-N LIMIT
7	CARRIER P LIMIT	0	17 AT Z-P LIMIT
8	CARRIER N LIMIT	0	18 AT Z-N LIMIT
9	MAGAZINE OFFST 1	122	19 AT IN POSITION
10	MAGAZINE OFFST 2	0	20 AT BACKLASH

ACT POSIT (MC)	X	Y	Z
	-250.000	-100.000	300.000
	6-Min		

*IF
*IF
*S 122

Entry data

SET	ADD	CAL	SEARCH	ITEM+	ITEM+	[EXTEND]
-----	-----	-----	--------	-------	-------	----------

F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
-----	-----	-----	-----	-----	-----	-----	-----

(6) Press the function key [F6] or [F7] (ITEM) until the MC SYSTEM PARAMETER (LONG WORD) screen appears.

(7) Using the cursor keys, position the cursor at the desired position.

Setting:

(a) When data is previously known

(8) Press the function key [F1] (SET).

(9) Enter the data with keyboard.

(b) When data has already been set and it is necessary to set the increment against the data

(8) Press the function key [F2] (ADD)

(9) Enter the increment with keyboard.

(c) When new setting is made at the position relative to the current value

(8) Press the function key [F3] (CAL).

(9) Enter the relative value with keyboard.

(10) Press the WRITE key.

This rewrites the data indicated by the cursor.

12. Machine System Parameter (Word)

The MC system parameter (word) includes the setting items that follow.

Parameter No.	CRT Display Name	Contents	Effective Command	Factory Set Initial Value	Setting Range	Setting Unit
1	ATC SEQUENCE NO.	Operation sequence number of the ATC	SET	Depends on machine specification.	The range of ATC operation Sequence number	
2	APC SEQUENCE NO.	Operation sequence number of the APC	Same as above	Same as above	The range of APC operation sequence number	
3	AAC(F) SEQUENCE NO.	Operation sequence number of the AAC (floor type)	Same as above	Same as above	The range of AAC operation sequence number	
4	AAC(T) SEQUENCE NO.	Operation sequence number of the AAC (table type)	Same as above	Same as above	Same as above	
5	TA ARM A,B MODE	The ATC change arm, because of its mechanism, does not rotate only in one direction, but alternately changes its direction between right and left. Either mode is specified by this parameter.	Same as above	Same as above	1 or 2	
6	PALLET A,B MODE	APC pallet operation mode A, B (A = 1 B = 2)	Same as above	Same as above	Same as above	
7	PLUG TOOL (AAC-F)	Set the T number of the plug tool (floor type).	Same as above	Same as above	0 to 999	
8	PLUG TOOL (AAC-T)	Set the T number of the plug tool (table type).	Same as above	Same as above	Same as above	
9	LTC SEQ NO.	Operation sequence number of the LTC (long tool change unit)	Same as above	Same as above	The range of LTC operation sequence number	

Machine system parameter (word)

Parameter No.	CRT Display Name	Contents	Effective Command	Factory Set Initial Value	Setting Range	Setting Unit
10	AT SEQ NO.	Operation sequence number for swivel head or attachment	SET	Depends on machine specification.	0 to 10	
11	AAC(C) SEQ NO.	Operation sequence number for AAC operations (column type)	Same as above	Same as above	The range of AAC operation sequence number	
12						
13						
21	SPDL ORIENT OFST	In the execution of M06 or M19 which orients the spindle, this parameter specifies how many pulses there are from the orientation position to the spindle pulse's marker position.	SET ADD CAL	Depends on machine specification.	-4095 to 4095	1 pulse
22	ORIENT V2 SPEED	This parameter specifies spindle speed for beginning spindle orientation.	SET ADD	Same as above	0 to 200	1 rpm
23	ORIENT DECEL POS	This parameter specifies the point at which deceleration begins in spindle orientation in terms of the number of parts prior to the spindle orientation position.	Same as above	Same as above	0 to 4095	1 part
24	ORIENT V3 DA	This parameter specifies the creep speed (speed after deceleration) for spindle orientation.	Same as above	Same as above	0 to 100	1 bit
25	ORIENT INP VAL	This parameter specifies the in-position confirmation position for spindle orientation in terms of the number of parts prior to the spindle orientation position.	Same as above	Same as above	0 to 100	1 part
26						

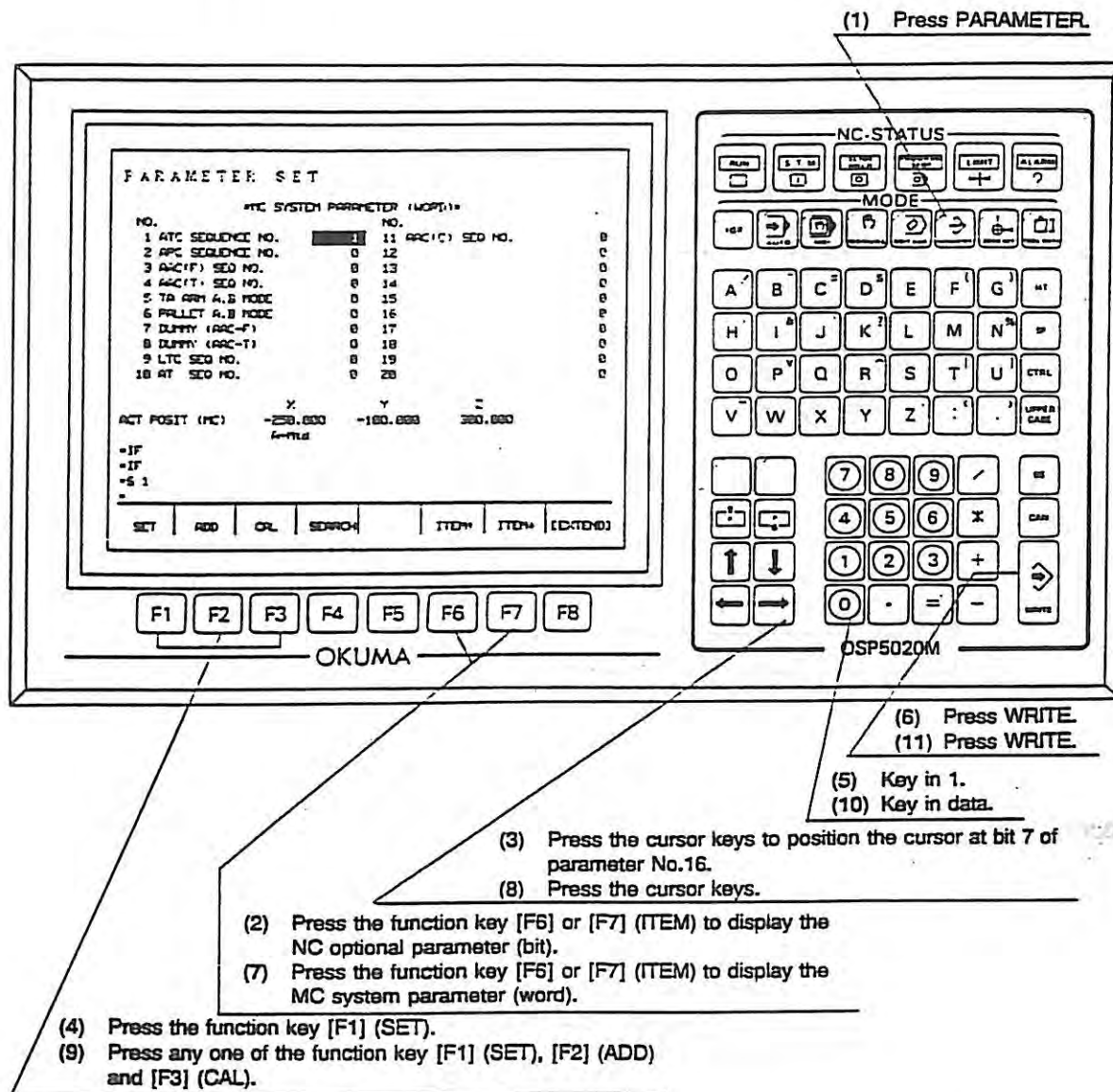
Machine system parameter (word)

Parameter No.	CRT Display Name	Contents	Effective Command	Factory Set Initial Value	Setting Range	Setting Unit
27	SPINDLE OSCIL DA	This spindle will oscillate in gear change. DA output in this oscillation is set by this parameter. DA voltage = [(parameter setting)/16383]*10V	SET	100	0 to 16383	—
28	OSCILLATE FREQCY	In spindle oscillation, there is an output to the gear shifting solenoid and the motor is oscillated after a period of time, which is set by this parameter.	SET ADD	100	0 to 500	10 sec
29	OSCILLATE PERIOD	In spindle oscillation, the motor repeats CW and CCW movements, the time for which is set by this parameter.	Same as above	500	0 to 500	Same as above
30	AAC COUNTER		Same as above	Depends on machine specification.	1 to 4	—
31	ACCEL/DECEL 1G	This parameter specifies the acceleration/deceleration constant for the first spindle speed range.	SET ADD	Same as above	0 to 16383	—
32	ACCEL/DECEL 2G	This parameter specifies the acceleration/deceleration constant for the second spindle speed range.	Same as above	Same as above	Same as above	—
33	ACCEL/DECEL 3G	This parameter specifies the acceleration/deceleration constant for the third spindle speed range.	Same as above	Same as above	Same as above	—
34	ACCEL/DECEL 4G	This parameter specifies the acceleration/deceleration constant for the fourth spindle speed range.	Same as above	Same as above	Same as above	—

Machine system parameter (word)

Parameter No.	CRT Display Name	Contents	Effective Command	Factory Set Initial Value	Setting Range	Setting Unit
35	ACCEL/DECEL COEFF	This parameter specifies the spindle rotation acceleration/deceleration factor.	SET ADD	Depends on machine specification.	0 to 65535	—
36						
37						
38						
39						
40	BOX CHECK MODE		SET	0	0 to 15	—
41	ORIENT V2 SPEED	The ORIENT V2 SPEED for second range speed is set.	SET ADD	Varies depending on machine model	0 to 200	
42	ORIENT DECEL POS 2G	The ORIENT DECEL POS for the second range speed is set.	Same as above	Same as above	0 to 4095	
43	ORIENT V3DA 2G	The ORIENT V3DA for second range speed is set.	Same as above	Same as above	0 to 100	
44	ORIENT INP VAL 2G	The ORIENT INP VAL for second range speed is set.	Same as above	Same as above	0 to 100	
45	ORIENT V2 SPEED 3G	The ORIENT V2 SPEED for third range speed is set.	Same as above	Same as above	0 to 200	
46	ORIENT DECEL POS 3G	The ORIENT DECEL POS for third range speed is set.	Same as above	Same as above	0 to 4095	
47	ORIENT V3DA 3G	The ORIENT V3DA for third range speed is set.	Same as above	Same as above	0 to 100	
48	ORIENT INP VAL 3G	The ORIENT INP VAL for third range speed is set.	Same as above	Same as above	0 to 100	
49	CHANGE ARM OFFSET	The CHANGE ARM OFFSET is set.	SET ADD CAL	Same as above	0 to 1023	

Setting procedure is as follows:



- (1) Press the **PARAMETER** key.
 - (2) Press the function key [F6] or [F7] (ITEM) until the NC OPTIONAL PARAMETER (BIT) screen appears.
 - (3) Press the cursor keys to position the cursor at bit 7 of parameter No. 16.
 - (4) Press the function key [F1] (SET) and key in 1.
 - (5) Press the **WRITE** key.
- Parameter No. 17 and following data are displayed on the CRT. This enables the setting of the MC system parameter (word).
- (6) Press the function key [F6] or [F7] (ITEM) until the MC SYSTEM PARAMETER (WORD) appears.

- (7) If no setting data is on the screen, press the page key [P ↓] to advance the screen to page 2.
Page 1 looks like:

PARAMETER SET			
#MC SYSTEM PARAMETER (WORD)=			
NO.		NO.	
1	ATC SEQUENCE NO.	1	11 ARC(C) SEQ NO.
2	APC SEQUENCE NO.	0	12
3	ARC(F) SEQ NO.	0	13
4	ARC(T) SEQ NO.	0	14
5	TA ARM A.B MODE	0	15
6	PALLET A.B MODE	0	16
7	DUMMY (ARC-F)	0	17
8	DUMMY (ARC-T)	0	18
9	LTC SEQ NO.	0	19
10	AT SEQ NO.	0	20

	X	Y	Z
ACT POSIT (MC)	-250.000	-100.000	300.000
	A-Mtd		

•IF
•IF
•S 1
•

SET	ADD	CLR	SEARCH	ITEM+	ITEM+	[EXTEND]
-----	-----	-----	--------	-------	-------	----------

F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
-----	-----	-----	-----	-----	-----	-----	-----

Page 2 looks like:

PARAMETER SET			
#MC SYSTEM PARAMETER (WORD)=			
NO.		NO.	
21	SPDL ORIENT OFST.	0	31 ACCEL/DECEL 1G
22	ORIENT V2 SPEED	0	32 ACCEL/DECEL 2G
23	ORIENT DECEL POS	0	33 ACCEL/DECEL 3G
24	ORIENT V3 DA	0	34 ACCEL/DECEL 4G
25	ORIENT INP VRL	0	35 ACCEL/DECEL COEFF
26		0	36
27	SPINDLE OSCIL DA	100	37
28	OSCILLATE FREQCY	100	38
29	OSCILLATE PERIOD	200	39
30	ARC DIRECTION	1	40

	X	Y	Z
ACT POSIT (MC)	899.999	999.999	-1100.000

•IF
•IF
•IF
•

SET	ADD	CLR	SEARCH	ITEM+	ITEM+	[EXTEND]
-----	-----	-----	--------	-------	-------	----------

F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
-----	-----	-----	-----	-----	-----	-----	-----

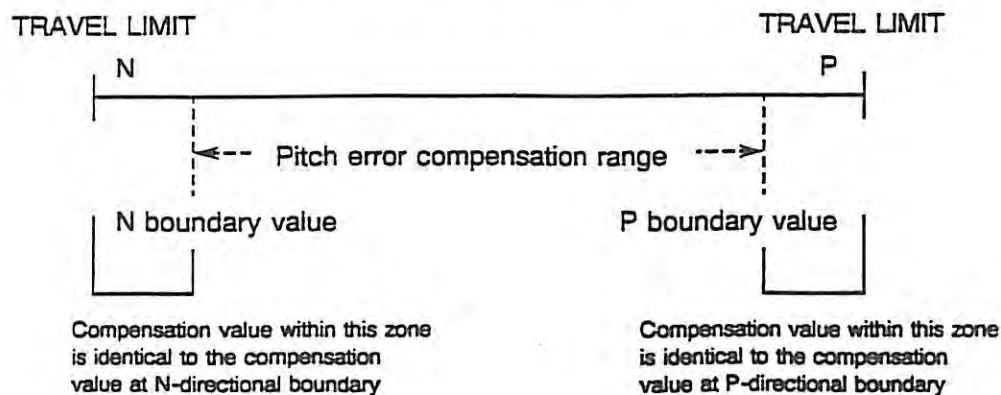
3-13. System Parameter

On the "SYSTEM PARAMETER" display screen, page 1 includes the following items are displayed:
This display screen is not provided depending on the machine model.

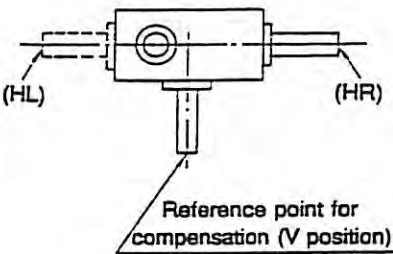
< Screen 1 >

CRT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
P TRAVEL LIMIT	P-directional travel end limit in the machine coordinate system	Depends on machine specification	-99999999 to +99999999	Selected unit system
N TRAVEL LIMIT	N-directional travel end limit in the machine coordinate system	Same as above	Same as above	Same as above
P PITCH ERR COMP	Specifies the range for pitch error compensation in the machine coordinate system. Sets the P- and N-directional boundaries. Normally, sets the value equivalent to the travel end limit. (Note 1)	Same as above	Same as above	Same as above
N NPITCH ERROR COMP		Same as above	Same as above	Same as above
IN POSITION	Sets the check data to be used in executing exact stop checks.	3	0 to 1000	Same as above
ZERO OFFSET (MACHINE)	Sets the zero offset of the machine coordinate system for each axis.	Depends on machine specification.	0 to 99999999	Same as above
IN POSITION (H)	Sets the in-position width used in positioning at the home position of each axis at the execution of ATC, APC, etc.	20	0 to 1000	Same as above

Note 1: If P and/or N boundary value is set inside the TRAVEL LIMIT (P, N), compensation within the zone outside the boundary to TRAVEL END is carried out using the compensation value effective at the boundary.



< Screen 2 >

RT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
SWL HD POS FRONT	 These parameters set the positions (front, left, rear and right) of the horizontal spindle in reference to the spindle vertical position.	X = 400 (15.75) Y = -150 (-5.91) Z = -330 (-12.99)	-99999999 to 99999999	Selected unit system
SWL HD POS LEFT		X = -150 (-5.91) Y = -400 (-15.75) Z = -330 (-12.99)	Same as above	Same as above
SWL HD POS REAR		X = -400 (-15.75) Y = 150 (5.91) Z = -330 (-12.99)	Same as above	Same as above
SWL HD POS RIGHT		X = 150 (5.91) Y = 400 (15.75) Z = -330 (-12.99)	Same as above	Same as above

< Screen 3 >

CRT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
BARRIER (Y, Z)	On MC-H series machining center, if both of Y- and Z-axis enter a certain area at the same time, they will interfere with each other. To prevent this, a barrier is set so that an alarm is triggered with axis motion halted if both of these two axes exist in the barrier zone at the same time. The setting is effective only for Y- and Z-axis. This function is not effective for models other than MC-H.	0	-99999999 to 99999999	Selected unit system
ENCODER OFFSET*	This parameter offsets the zero-cross point of the position encoder.	0	Same as above	Same as above

Parameter indicated by an asterisk (*) requires turning off the power supply once after setting new data. Turn it back on.

< Screen 4 >

CRT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
HOME POSITION 1	Sets the home position for the ATC. Setting should be carried out in the machine coordinate system.	Depends on machine specification	-99999999 to +99999999	Selected unit system
HOME POSITION 2		Same as above	Same as above	Same as above
HOME POSITION 3	Sets the home position for a left pallet change in the rotary type 2-pallet APC. This is also employed as the home position for the parallel type 2-pallet APC and rotary type multi-pallet APC. Setting should be carried out in the machine coordinate system.	Same as above	Same as above	Same as above
HOME POSITION 4	Sets the home position for a right pallet change in the rotary type 2-pallet APC. This is also employed as the home position for the parallel type 2-pallet APC. Setting should be carried out in the machine coordinate system.	Same as above	Same as above	Same as above
HOME POSITION 5		Same as above	Same as above	Same as above
HOME POSITION 6		Same as above	Same as above	Same as above
HOME POSITION 7		Same as above	Same as above	Same as above
HOME POSITION 8		Same as above	Same as above	Same as above

< Screen 5 >

CRT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
HOME POSITION 9		Depends on machine specification	- 99999999 to + 99999999	Selected unit system
HOME POSITION 10		Same as above	Same as above	Same as above
HOME POSITION 11		Same as above	Same as above	Same as above
HOME POSITION 12		Same as above	Same as above	Same as above
HOME POSITION 13		Same as above	Same as above	Same as above
HOME POSITION 14		Same as above	Same as above	Same as above
HOME POSITION 15		Same as above	Same as above	Same as above
HOME POSITION 16		Same as above	Same as above	Same as above

< Screen 6 >

CRT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
HOME POSITION 17		Depends on machine specification	- 99999999 to + 99999999	Selected unit system
HOME POSITION 18		Same as above	Same as above	Same as above
HOME POSITION 19		Same as above	Same as above	Same as above
HOME POSITION 20		Same as above	Same as above	Same as above
HOME POSITION 21		Same as above	Same as above	Same as above
HOME POSITION 22		Same as above	Same as above	Same as above
HOME POSITION 23		Same as above	Same as above	Same as above
HOME POSITION 24		Same as above	Same as above	Same as above

< Screen 7 >

CRT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
HOME POSITION 25		Depends on machine specification	- 99999999 to + 99999999	Selected unit system
HOME POSITION 26		Same as above	Same as above	Same as above
HOME POSITION 27		Same as above	Same as above	Same as above
HOME POSITION 28		Same as above	Same as above	Same as above
HOME POSITION 29		Same as above	Same as above	Same as above
HOME POSITION 30		Same as above	Same as above	Same as above
HOME POSITION 31		Same as above	Same as above	Same as above
HOME POSITION 32		Same as above	Same as above	Same as above

< Screen 8 > *HOME POSITION MOVEMENT ORDER*

CRT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
HOME POSITION 1	Sets the axis moving sequence in the home position 1	Depends on machine specification.	0 to 3	—
HOME POSITION 2	Sets the axis moving sequence in the home position 2	Same as above	Same as above	—
HOME POSITION 3	Sets the axis moving sequence in the home position 3	Same as above	Same as above	—
HOME POSITION 4	Sets the axis moving sequence in the home position 4	Same as above	Same as above	—
HOME POSITION 5	Sets the axis moving sequence in the home position 5	Same as above	Same as above	—
HOME POSITION 6	Sets the axis moving sequence in the home position 6	Same as above	Same as above	—
HOME POSITION 7	Sets the axis moving sequence in the home position 7	Same as above	Same as above	—
HOME POSITION 8	Sets the axis moving sequence in the home position 8	Same as above	Same as above	—

0: No axis movement

1: 1st

2: 2nd

3: 3rd

Note: For the same home position number, the operation sequence should be set so that the axes are moved sequentially. Assigning numbers which are not consecutive causes the operation to be interrupted.

Example: HOME POSITION 1 X Y Z
 1 0 3

Z-axis does not move.

<Screen 9> *HOME POSITION MOVEMENT ORDER*

CRT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
HOME POSITION 9	Sets the axis moving sequence in the home position 9	Depends on machine specification	0 to 3	—
HOME POSITION 10	Sets the axis moving sequence in the home position 10	Same as above	Same as above	—
HOME POSITION 11	Sets the axis moving sequence in the home position 11	Same as above	Same as above	—
HOME POSITION 12	Sets the axis moving sequence in the home position 12	Same as above	Same as above	—
HOME POSITION 13	Sets the axis moving sequence in the home position 13	Same as above	Same as above	—
HOME POSITION 14	Sets the axis moving sequence in the home position 14	Same as above	Same as above	—
HOME POSITION 15	Sets the axis moving sequence in the home position 15	Same as above	Same as above	—
HOME POSITION 16	Sets the axis moving sequence in the home position 16	Same as above	Same as above	—

<Screen 10> *HOME POSITION MOVEMENT ORDER*

CRT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
HOME POSITION 17	Sets the axis moving sequence in the home position 17	Depends on machine specification	0 to 3	—
HOME POSITION 18	Sets the axis moving sequence in the home position 18	Same as above	Same as above	—
HOME POSITION 19	Sets the axis moving sequence in the home position 19	Same as above	Same as above	—
HOME POSITION 20	Sets the axis moving sequence in the home position 20	Same as above	Same as above	—
HOME POSITION 21	Sets the axis moving sequence in the home position 21	Same as above	Same as above	—
HOME POSITION 22	Sets the axis moving sequence in the home position 22	Same as above	Same as above	—
HOME POSITION 23	Sets the axis moving sequence in the home position 23	Same as above	Same as above	—
HOME POSITION 24	Sets the axis moving sequence in the home position 24	Same as above	Same as above	—

< Screen 11 > *HOME POSITION MOVEMENT ORDER*

CRT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
HOME POSITION 25	Sets the axis moving sequence in the home position 25	Depends on machine specification	0 to 3	—
HOME POSITION 26	Sets the axis moving sequence in the home position 26	Same as above	Same as above	—
HOME POSITION 27	Sets the axis moving sequence in the home position 27	Same as above	Same as above	—
HOME POSITION 28	Sets the axis moving sequence in the home position 28	Same as above	Same as above	—
HOME POSITION 29	Sets the axis moving sequence in the home position 29	Same as above	Same as above	—
HOME POSITION 30	Sets the axis moving sequence in the home position 30	Same as above	Same as above	—
HOME POSITION 31	Sets the axis moving sequence in the home position 31	Same as above	Same as above	—
HOME POSITION 32	Sets the axis moving sequence in the home position 32	Same as above	Same as above	—

< Screen 12 > *HOME POSITION MOVEMENT ORDER*

CRT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
INDUCTOSYN OFFSET*	This parameter data is used for matching the phase of the Inductosyn and type E position sensor, and it is not effective for models not equipped with Inductosyn scale.	Depends on machine and axis	-81920 to 49152	—

Parameters indicated by an asterisk (*) require turning off the power supply once after setting new data. Turn it back on.

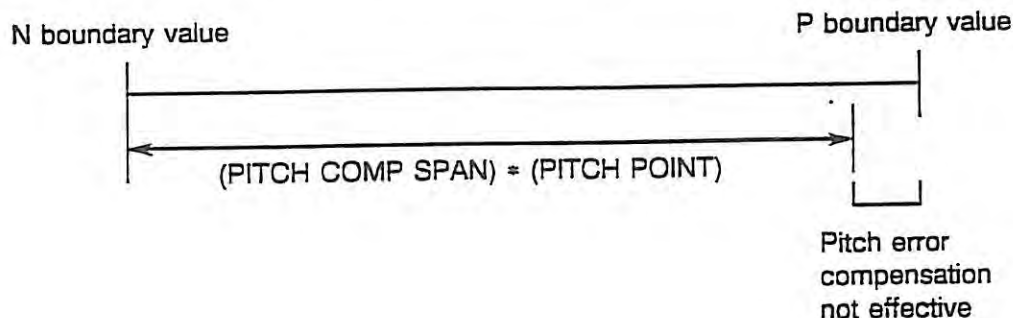
<Screen 13> *HOME POSITION MOVEMENT ORDER*

CRT Display Name	Contents	Factory Set Initial Value mm (in.)	Setting Range	Setting Unit
PITCH COMP SPAN*	Specifies the interval between sets of points for setting pitch error compensation data	Depends on machine and axis	1 to 65535	Selected unit system
PITCH POINT*	Sets the total number of pitch points for each axis (Note 2)	Same as above	0 to 384	—
HARD SERVO COEFF	Sets the two servo processor coefficient: Setting = Hard servo ratio (%) $\times 163.84$	Same as above	0 to 16384	—
KV VALUE	Sets the KV value: Setting = KV $\times 52$	Same as above	52 to 5200	—
SLOW UP/DOWN COEFF	Sets the accel/decel coefficient: Setting = Kcv[1/sec] $\times 105$	Same as above	105 to 21000	—

Parameters indicated by an asterisk (*) require turning off the power supply once after setting new data. Turn it back on.

Note: If the product of the PITCH COMP SPAN and PITCH POINT is smaller than the pitch compensation range, the pitch error compensation is not effective within the area beyond the point calculated as the product of them up to the P boundary point, which will cause pitch error alarm. Therefore, pitch error compensation parameter data must be set to meet the following inequality.

$$(P\text{-direction boundary}) - (N\text{-direction boundary}) \leq (\text{Pitch comp span}) * (\text{Pitch point})$$



NUMBER SYSTEMS AND CONVERSIONS

NUMERICAL EQUIVALENTS

DECIMAL	BINARY	HEXADECIMAL	OCTAL
0	0	0	0
1	1	1	1
2	10	2	2
3	11	3	3
4	100	4	4
5	101	5	5
6	110	6	6
7	111	7	7
8	1000	8	10
9	1001	9	11
10	1010	A	12
11	1011	B	13
12	1100	C	14
13	1101	D	15
14	1110	E	16
15	1111	F	17
16	10000	10	20
17	10001	11	21
18	10010	12	22
19	10011	13	23
20	10100	14	24
21	10101	15	25
22	10110	16	26
23	10111	17	27
24	11000	18	30
25	11001	19	31
26	11010	1A	32
27	11011	1B	33
28	11100	1C	34
29	11101	1D	35
30	11110	1E	36
31	11111	1F	37
32	100000	20	40
33	100001	21	41
34	100010	22	42
35	100011	23	43
36	100100	24	44
37	100101	25	45
38	100110	26	46
39	100111	27	47
40	101000	28	50
41	101001	29	51
42	101010	2A	52
43	101011	2B	53
44	101100	2C	54

POWERS OF THE BASE

XXXXXXXXXXXXX	DECIMAL	BINARY	HEX	OCTAL
	1	1	1	1
	10	2	16	8
	100	4	256	64
	1000	8	4096	512
	10000	16	65536	4096
	100000	32	1048576	32768
	1000000	64	16777216	262144
	10000000	128	268435456	2097152
	100000000	256	4294967296	16777216
	1000000000	512	68719476736	134217728
	10000000000	1024	1099511627776	1073741824
	100000000000	2048	17592186044416	8589934592

When using any conventional numbering system, the value of the number is based on the "weight," or value, of the digits in each column.

Example:

$$\begin{array}{rcl}
 1101_{10} & & \\
 \begin{array}{l} \text{1 unit in the} \\ \text{0 unit in the} \\ \text{1 unit in the} \\ \text{1 unit in the} \end{array} & \begin{array}{l} \text{1 column} = \\ \text{10 column} = \\ \text{100 column} = \\ \text{1000 column} = \end{array} & \begin{array}{r} 1 \\ 0 \\ 100 \\ 1000 \end{array} \\
 & & \underline{1101} \text{ decimal} = 1101_{10}
 \end{array}$$

Example:

$$\begin{array}{rcl}
 1101_2 & & \\
 \begin{array}{l} \text{1 unit in the} \\ \text{0 unit in the} \\ \text{1 unit in the} \\ \text{1 unit in the} \end{array} & \begin{array}{l} \text{1 column} = \\ \text{2 column} = \\ \text{4 column} = \\ \text{8 column} = \end{array} & \begin{array}{r} 1 \\ 0 \\ 4 \\ 8 \end{array} \\
 & & \underline{13} \text{ decimal} = 1101_2
 \end{array}$$

Example:

$$\begin{array}{rcl}
 1101_8 & & \\
 \begin{array}{l} \text{1 unit in the} \\ \text{0 unit in the} \\ \text{1 unit in the} \\ \text{1 unit in the} \end{array} & \begin{array}{l} \text{1 column} = \\ \text{8 column} = \\ \text{64 column} = \\ \text{512 column} = \end{array} & \begin{array}{r} 1 \\ 0 \\ 64 \\ 512 \end{array} \\
 & & \underline{577} \text{ decimal} = 1101_8
 \end{array}$$

CONVERTING BETWEEN NUMBERING SYSTEMS

CONVERTING DECIMAL TO BINARY

To find the binary equivalent of a decimal number, determine the binary components.

Example: To convert 1130_{10} to binary.

<u>Arithmetic</u>	<u>Binary Component</u>	<u>Number of Components</u>
1130	1024	1
<u>1024</u>	512	0
106	256	0
<u>64</u>	128	0
42	64	1
<u>32</u>	32	1
10	16	0
<u>8</u>	8	1
2	4	0
<u>2</u>	2	1
0	1	0

$$1130_{10} = 10001101010_2$$

Proof: See the following section, dealing with conversion of binary to decimal.

CONVERTING BINARY TO DECIMAL

To find the decimal equivalent of a binary number, multiply the number of components by the component value (for each component) and add the results.

Example: To convert 10001101010_2 to decimal.

1 X	2 =	2
1 X	8 =	8
1 X	32 =	32
1 X	64 =	64
1 X	1024 =	<u>1024</u>
		1130 ₁₀

$$10001101010_2 = 1130_{10}$$

Proof: See the preceding section, dealing with conversion of decimal to binary.

CONVERTING DECIMAL TO OCTAL

To find the octal equivalent of a decimal number, determine the octal components.

Example: To convert 1130_{10} to octal.

<u>Arithmetic</u>	<u>Binary Component</u>	<u>Number of Components</u>
1130		
<u>1024</u>	512	2
106		
<u>64</u>	64	1
42		
<u>40</u>	8	5
2		
<u>2</u>	1	2
0		

$$1130_{10} = 2152_8$$

Proof: See the following section, dealing with conversion of octal to decimal.

CONVERTING OCTAL TO DECIMAL

To find the decimal equivalent of an octal number, multiply the number of components by the component (for each component) value and add the results.

Example: To convert 2152_8 to decimal.

$$\begin{array}{rcl} 2 \times 1 & = & 2 \\ 5 \times 8 & = & 40 \\ 1 \times 64 & = & 64 \\ 2 \times 512 & = & 1024 \\ & & \hline & & 1130_{10} \end{array}$$

$$2152_8 = 1130_{10}$$

Proof: See the preceding section, dealing with conversion of decimal to octal.

CONVERTING DECIMAL TO HEXADECIMAL

To find the hexadecimal equivalent of a decimal number, determine the hexadecimal components.

Example: To convert 1130_{10} to hexadecimal.

<u>Arithmetic</u>	<u>Binary Component</u>	<u>Number of Components</u>
1130		
<u>1024</u>	256	4
106		
<u>96</u>	16	6
10		
<u>10</u>	1	A
0		

$$1130_{10} = 46A_{16}$$

Proof: See the following section, dealing with conversion of hexadecimal to decimal.

CONVERTING HEXADECIMAL TO DECIMAL

To find the decimal equivalent of an hexadecimal number, multiply the number of components by the component (for each component) value and add the results.

Example: To convert $46A_{16}$ to decimal.

$$\begin{array}{rcl} A \times 1 & = & 10 \\ 6 \times 16 & = & 96 \\ 4 \times 256 & = & \underline{1024} \\ & & 1130_{10} \end{array}$$

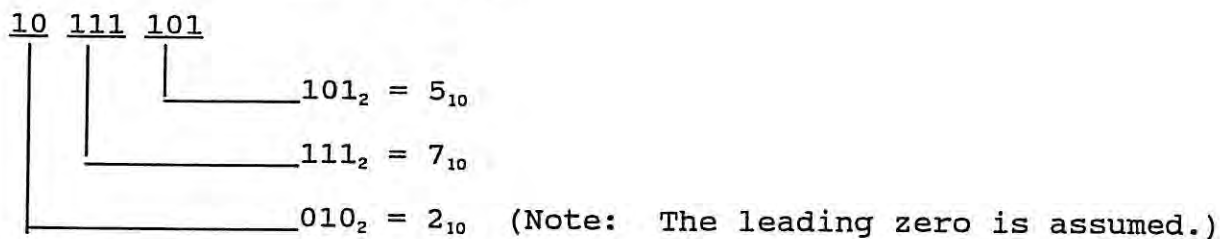
$$46A_{16} = 1130_{10}$$

Proof: See the preceding section, dealing with conversion of decimal to octal.

CONVERTING BINARY TO OCTAL

To find the octal equivalent of a binary number, divide the binary number into groups of three bits (binary digits), beginning at the right, and determine the octal value of each group.

Example: To convert 1011101_2 to octal.



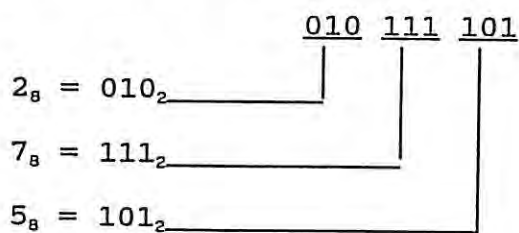
$$1011101_2 = 275_8$$

Proof: See the following section, dealing with conversion of octal to binary.

CONVERTING OCTAL TO BINARY

To find the binary equivalent of an octal number, determine the binary equivalent of each octal digit. The resulting binary value is the binary equivalent.

Example: To convert 275_8 to binary.



$$275_8 = 1011101_2$$

Proof: See the preceding section dealing with conversion of binary to octal.

CONVERTING BINARY TO HEXADECIMAL

To find the hexadecimal equivalent of a binary number, divide the binary number into groups of four bits (binary digits), beginning at the right, and determine the hexadecimal value of each group.

Example: To convert 1011101₂ to hexadecimal.

1 0 1 1 1 1 0 1

$$\begin{array}{l} \text{_____} 1101_2 = D_{16} \\ \text{_____} 1011_2 = B_{16} \end{array}$$
$$10111101_2 = BD_{16}$$

Proof: See the following section, dealing with conversion of hexadecimal to binary.

CONVERTING BINARY TO HEXADECIMAL

To find the binary equivalent of a hexadecimal number, determine the binary equivalent of each hexadecimal digit. The resulting binary value is the binary equivalent.

Example: To convert BD_{16} to binary.

$$\underline{1011} \quad \underline{1101}$$
$$B_{16} = 1011_2 \underline{\hspace{1cm}}$$

$$D_{16} = 1101_2 \underline{\hspace{1cm}}$$
$$\text{BD}_{16} = 10111101_2$$

Proof: See the preceding section, dealing with conversion of binary to hexadecimal.

CONVERTING OCTAL TO HEXADECIMAL

To find the hexadecimal equivalent of an octal number, use the following procedure:

- 1) Convert the octal number to binary.
- 2) Convert the binary number to hexadecimal.

Refer to the preceding sections for instructions for making these conversions.

CONVERTING HEXADECIMAL TO OCTAL

To find the octal equivalent of a hexadecimal number, use the following procedure:

- 1) Convert the hexadecimal number to binary.
- 2) Convert the binary number to octal.

Refer to the preceding sections for instructions for making these conversions.

11. Inverter Motor (Tool Change Arm Motor)

11-1. Outline

An inverter motor is used for ATC tool change arm drive. The motor rotation direction, forward or reverse, and the motor speed are controlled by the inverter. The maintenance of the inverter motor is described in this paragraph.

11-2. Inspection and Maintenance

The inverter motor does not require daily inspections. However, to make the most of its outstanding performance over a long period of time, check the following inspection items periodically.

Before starting inspection, turn off the power supply. Then, remove the terminal cover in ten seconds after the power has been turned off. (Do not attempt an inspection immediately after the power has been turned off. Voltage remains in the capacitor inside the inverter motor.)

- (1) Check the inside of the inverter motor. If dust accumulates, clean it.
- (2) Check the screws used in the terminals and parts for looseness. If they are loose, tighten them securely.
- (3) Check the wiring accessories and parts. If they are faulty, contact your local Okuma representative.
- (4) Checks the following using a multimeter.
 - a) When checking the external circuit using a multimeter, disconnect all terminals from the inverter so that the test voltage is not applied to the inverter.
 - b) When checking the inverter using a multimeter, check only the main circuit as illustrated below. Do not check the control circuit. Use a 500 VDC multimeter.
 - c) Do not conduct a continuity test for the control circuit.

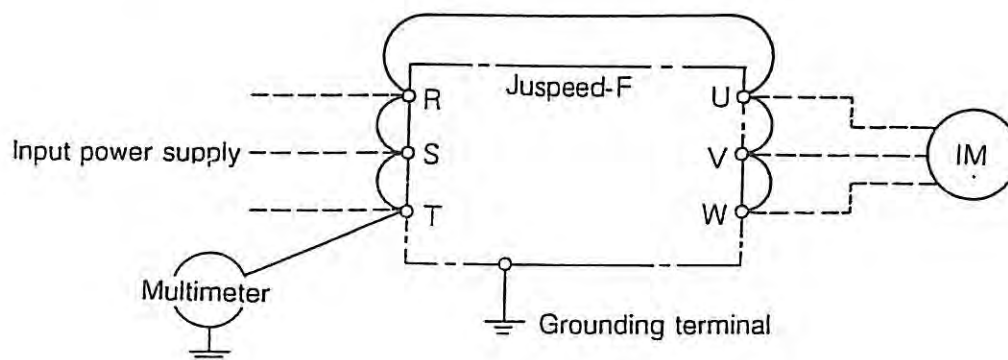


Fig. 3-24

11-3. Switch Setting

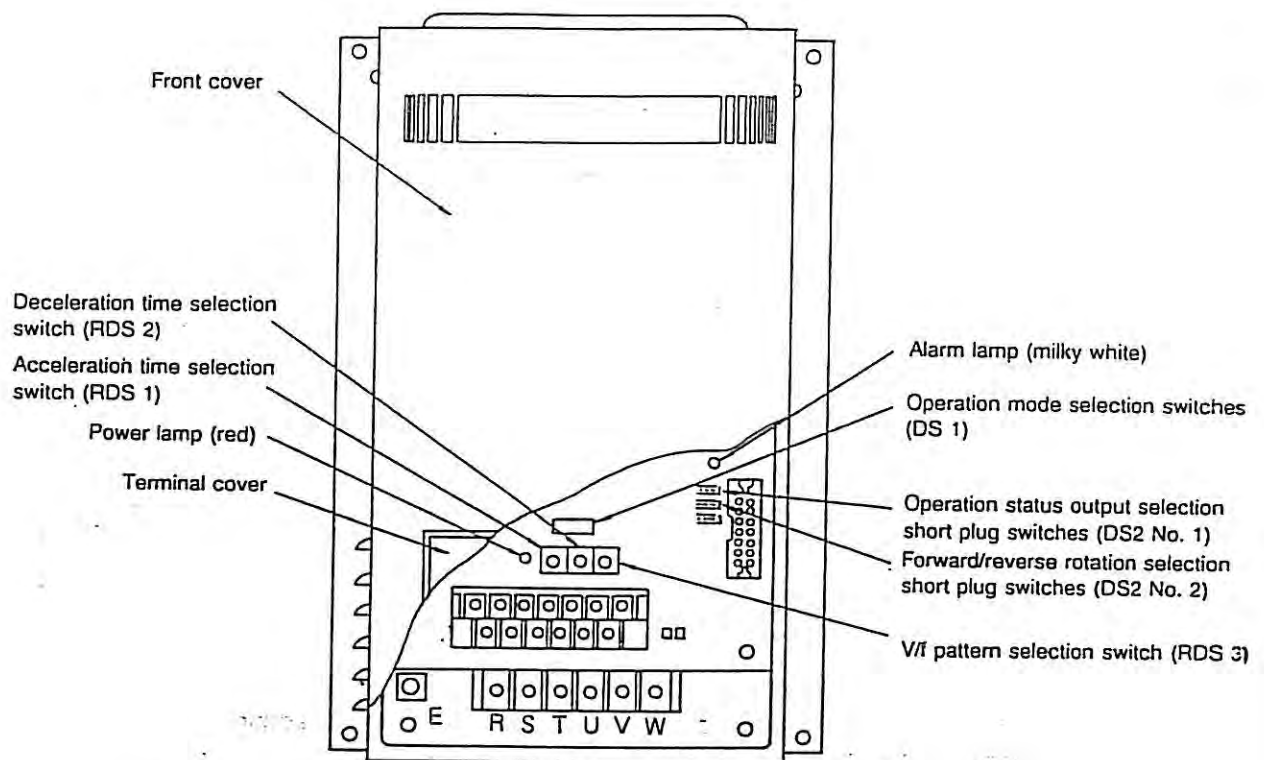


Fig. 3-25 Switch Setting in the Inverter

(1) Operation Mode Selection Switches (DS 1)

A total of six switches are arranged on the base plate. Switches 3 and 4 are set at the "ON" position and the others are set at the "OFF" position prior to shipment from the factory. To change the setting, use a tool which has a thin top, for example, a ball-point pen.

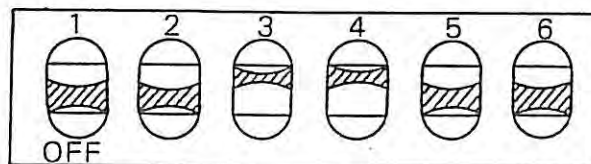


Fig. 3-26 Operation Mode Selection Switch Setting

(2) Forward/reverse Rotation Selection Short Plug Switches (DS No. 2)

As illustrated in Fig. 3-27, three short plugs are arranged. The plug is set to the left for switches 1 and 3, and it is set to the right for switch 2.

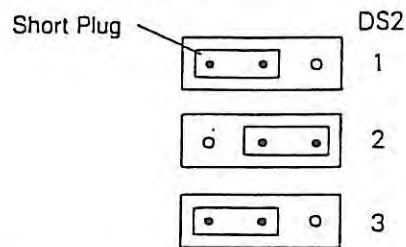


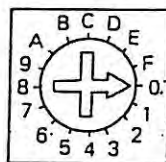
Fig. 3-27 Forward/reverse Rotation Selection Short Plug Switches (DS 2)

(3) Deceleration Time Selection Switch (RDS 2)

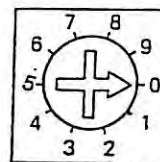
Acceleration Time Selection Switch (RDS 1)

V/f Pattern Selection Switch (RDS 3)

As illustrated in Fig. 3-28, these switches are set at "0" prior to shipment.



RDS1, RDS2



RDS3

Fig. 3-28 Deceleration Time Selection Switch Setting

Acceleration Time Selection Switch Setting

V/f Pattern Selection Switch Setting

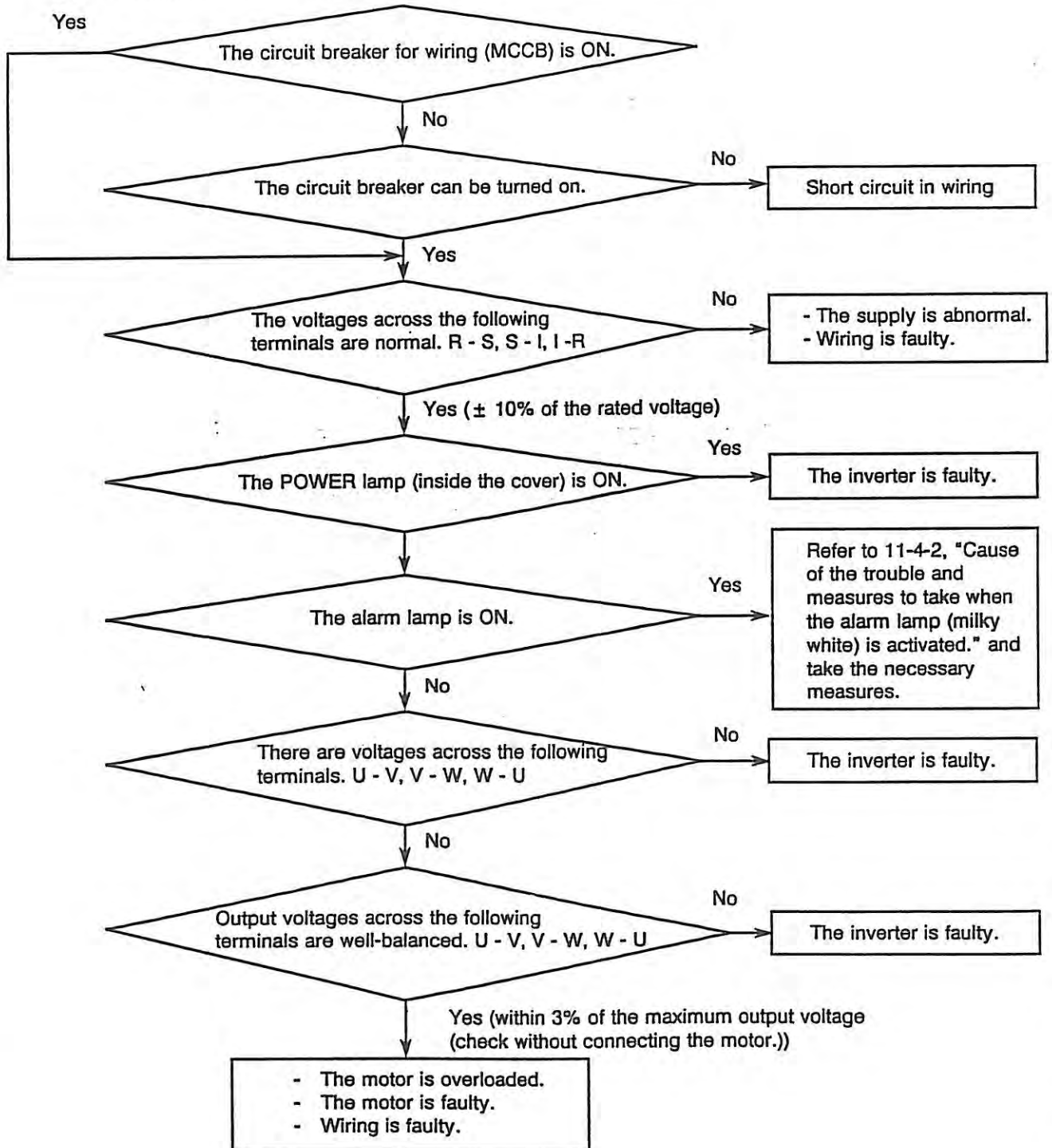
11-4. Troubles and Measures to Take

When a trouble has occurred and the inverter does not function, refer to the chart below to locate the cause of the trouble and to take the necessary measures.

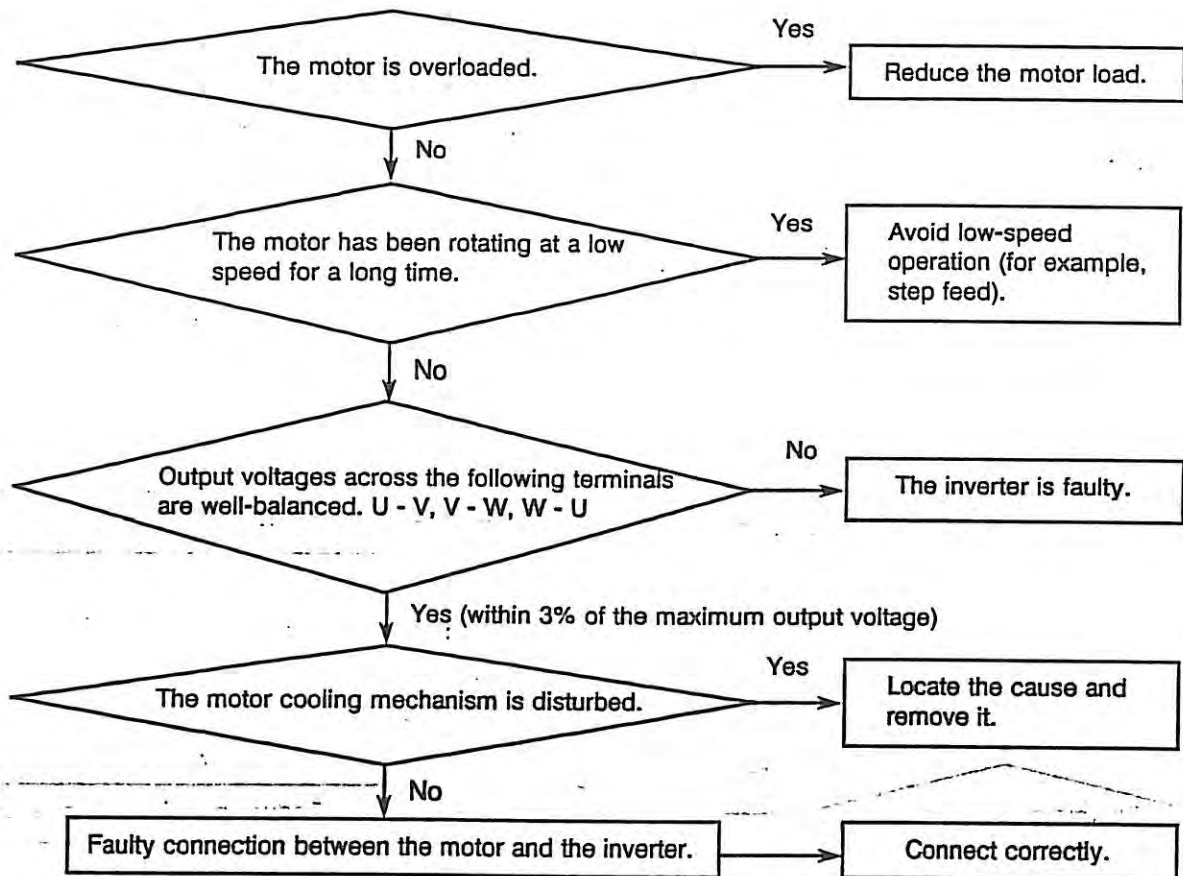
When the cause of the trouble cannot be found, contact your local Okuma representative.

11-4-1. Possible Cause of the Trouble

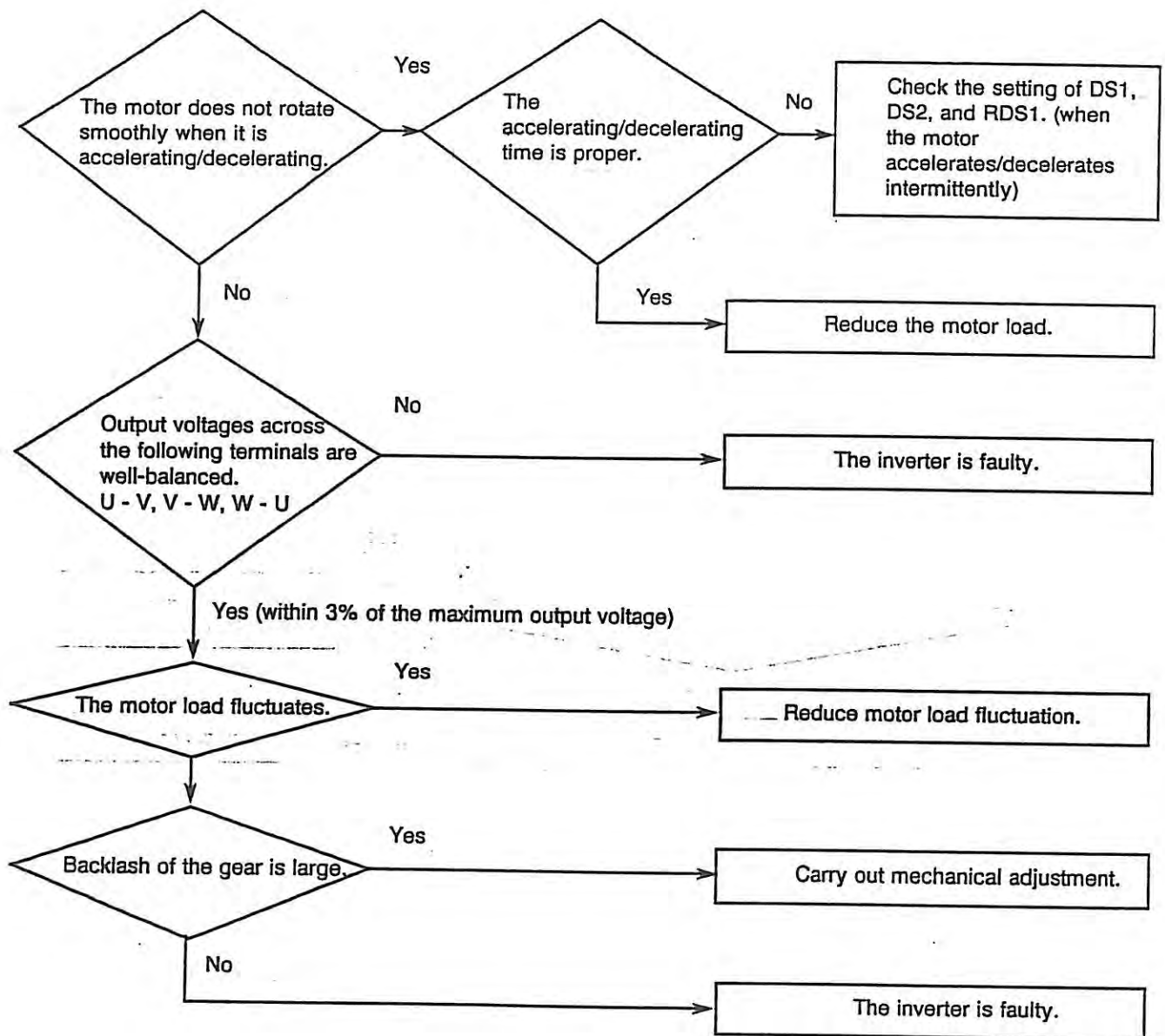
(1) The motor does not rotate.



(2) Overheat of motor



(3) The motor does not rotate smoothly.



11-4-2. Cause of the Trouble and Measures to Take When the Alarm Lamp (milky white) is Activated

When the inverter is faulty, the alarm lamp (milky white) is activated as listed below. When the alarm lamp is activated, locate the cause of the trouble from the flickering state of the alarm lamp, and take the necessary measures.

Cause of the Trouble and Measures to Take

Alarm lamp activation state	Possible causes		Procedure to check	Measures to take
	Instantaneous overcurrent protection	Short circuit or grounding in the output circuit of the inverter	Disconnect all terminals in the output circuit of the inverter, and measure the resistance of the motor.	Remove the short-circuited or ground portion.
		The switch setting is wrong.	Check the switch setting.	Correct the switch setting.
		Overload	- Run the motor without applying load. - Check the inverter while running the motor with load.	Reduce the motor load.
		A phase advancing capacitor is incorporated in the output circuit of the inverter.	—	Remove the phase advancing capacitor.
n = three times 	Regenerative overvoltage protection	The switch setting is wrong.	Check the switch setting.	Correct the switch setting.
n = four times 	Insufficient voltage protection	- The power supply voltage is low. - Instantaneous power failure (15 msec or more)	Measure the power supply voltage and re-start.	Remove the cause of low power supply voltage.

Alarm lamp activation state	Possible causes	Procedure to check	Measures to take
n = five times 	- Grounding - The transistor module is broken	Disconnect all terminals and conduct a continuity test between the motor and the ground.	Remove the ground portion.
n = six times 	- Grounding - The transistor module is broken	Check the output circuit of the inverter for noise sources.	Prevent noise from being generated. Or set a noise filter at the primary or secondary circuit of the inverter.

Note 1: When the alarm lamp has been activated, stop the operation and locate the cause of the trouble. Then, turn off the circuit breaker for wiring (MCCB) and the electromagnetic contactor.

Note 2: When the cause of the trouble cannot be located, disconnect the wiring between the inverter and the motor.

Note 3: Contact your local Okuma representative if the cause of the trouble cannot be located with all your attempts.