MV junior

MORI-FANUC

1985. 1. 300

IM-825301-E

A. SPECIFICATION MANUAL

B. OPERATION MANUAL

C. INSPECTION AND MAINTENANCE MANUAL (MACHINE AND LUBRICATION)

D. INSPECTION AND MAINTENANCE MANUAL (ELECTRICAL SYSTEM)

E. PROGRAMMING MANUAL

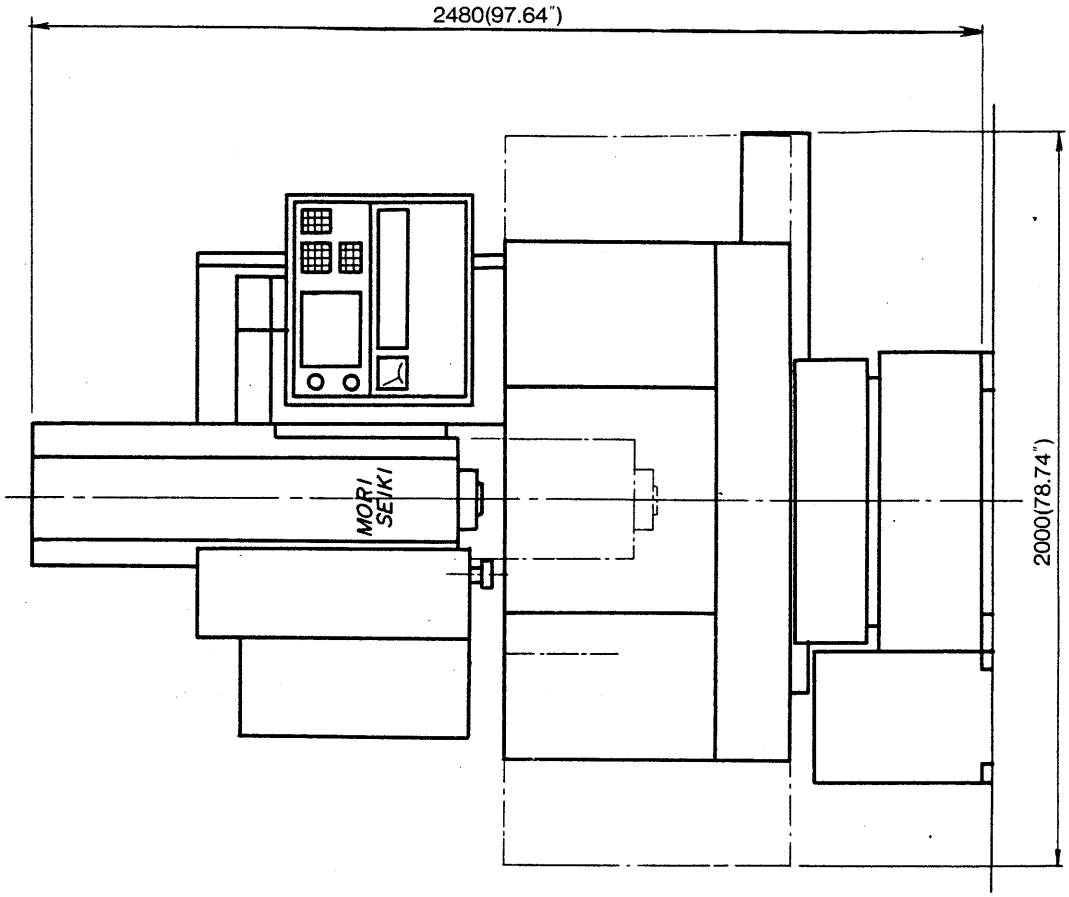
A. SPECIFICATION MANUAL

CONTENTS

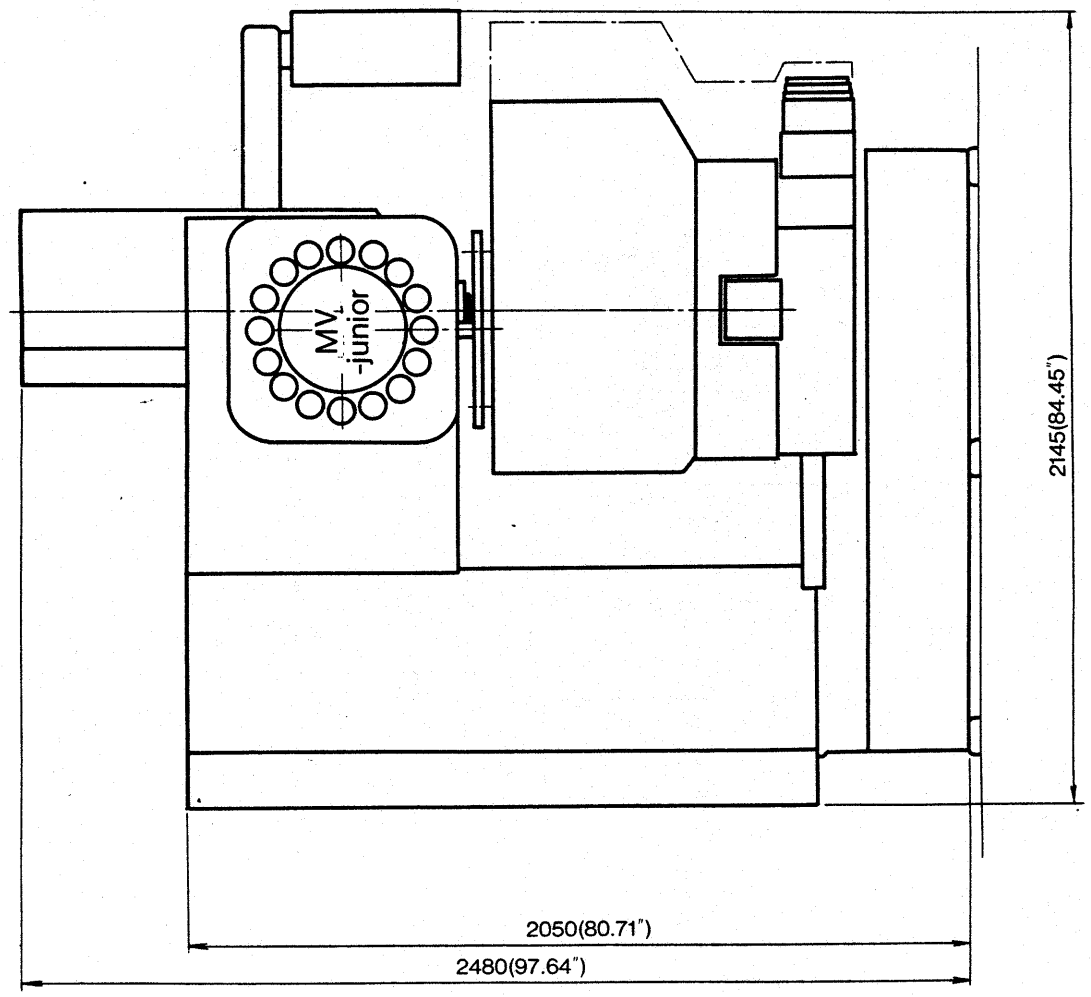
SPECIFICATION MANUAL

1. SPECIFICATIONS

Model	MV-junior
Floor area	2250 mm x 2180 mm (88.6" x 85.8")
Machine height	2480 mm (97.64")
Machine weight	3500 kg



MV-junior Front View



MV-junior Side View

2 FANUC MFNC-V3 (FS-10MA) SPECIFICATIONS

	Item	Specification
Control	Number of axes	Three axes of X, Y and Z
	Number of simultaneously controllable axes	Positioning and linear interpolation.. 3 axes simultaneously Circular interpolation ..... 2 axes simultaneously
	Increment	Minimum input increment ..... 0.001 mm/0.0001 inch Minimum output increment ..... 0.001 mm
Feed function	Rapid feed rate	X and Y axes: 15 m/min (590"/min) Z: 12 m/min (472"/min)
	Cutting feed rate	Constant tangential speed: Max. 5,000 mm/min (197"/min)
	Automatic acceleration and deceleration	Rapid feed: Linear acceleration and deceleration Cutting feed: Exponential acceleration and deceleration
	Rapid feed override	100 mm/min (3.9"/min), 25%, 50%, 100%
	Cutting feed override	0 to 200% (in 10% increments)
	Exact stop check	G09 to prevent corner rounding
	Manual jog feed	0 to 2000 mm/min (0 to 80"/min) for any desired axis, selected in 20 steps by rotary switch
	Incremental feed	0.001 to 10 mm (0.0001 to 1"); variable in 5 steps
	Manual handle feed	100 pulses/rotation by the manual pulse generator Magnification: 1, 10, 100
	Dwell	G04 for dwell: 0.001 to 99999.999 sec. (0.0001 to 9999.9999 sec.)
	Manual absolute ON/OFF	With manual absolute turned using the menu switch, the absolute coordinate value is renewed when a tool is moved manually.
	Backlash offset	Correction of lost motion in the mechanical system

	Item	Specification
	Stored pitch error offset	Correction of ball screw pitch error: 128 points for each axis
	Stored stroke limit	Soft O.T.
Programming function	Fixed cycle	Simplified commands for machining such as drilling, boring and tapping. G73 (peck drilling cycle), G76 (fine boring), G81 (spot drilling), G82 (counter boring), G83 (peck drilling cycle), G84/G74 (tapping cycle), G85/ G86/G87/G88/G89 (boring cycle), G98 (return to initial level point), G99 (return to R-point level)
	Circular arc for radius command	Circular arc commanded by radius value R, instead of I, J, K
	Sub-program	M98 (sub-program call); M99 (return from sub-program); Up to 4 times of nesting
	Mirror image	Reversing the movement to each axis for command, by setting or M function (M73 to M76)
	Return to reference point	G28 (return to reference point); 29 (return from reference point); G30 (return to second reference point); G27 (reference point check)
	Coordinate system setting	G92 to change the coordinate system so as to position the tool as designated
	Work coodinate system	This coordinate system is preset with a certain point on the work piece as the origin; 6 work coodinate systems (G54 to G59) available.
	Local coordinate system	This coordinate system is preset with a point designated by G52 as the origin.
	Single block	The program is executed block by block.
	Feed hold	Temporary stop of automatic operation.
	Optional block skip	The slashed block (/) is ignored.
	Auxiliary function lock	M, S and T signals are ignored (except MO, M1, M2, M30, M98 and M99)
	Program resumption (*2)	If any tool is broken, the sequence number to be restarted is designated, and operation resumes from the number.

Feed function	Follow-up	Retains the actual position in the case of an emergency stop or servo alarm
	Control axis neglect	Ignores the alarm signal regarding the axis which was set by MDI operation. (This function is used to control a rotary table, for example.)
	Dry run	Changes the feed rate to the manual jog feed rate during automatic operation.
	Machine lock	Locks the machine movement so that only the position indication is renewed. Menu switches are used for setting.
	Z axis command ignore	Locks only the Z axis movement of the machine.
Tool function	Tool function	Commanded by a 4-digit T code. (The technical memory random system is used.)
	Tool length compensation	G43: Tool length compensation +; G44: Tool length compensation -; G49: Tool length compensation cancel
	Tool position offset	Extend or contract the amount of tool movement by the offset amount. G45: Extension; G46: Contraction; G47: 2X Extension; G48: 2X Contraction
	Cutter compensation C	G40: Cutter compensation cancel; G41: Cutter compensation (left); G42: Cutter compensation (right)
	Tool offset memory A	32 sets common to all tool offsets
	Programmable data input	Uses G10 to input the tool offset.
Programming function	Decimal point input	Allows input of numbers including decimal point. Can be used in the same way as a pocket calculator ("1" is regarded as "1.").
	Inch/metric selection	G20: Inch input; G21: Metric input
	Absolute/incremental selection	G90: Absolute input; G91: Incremental input
	Positioning	Uses G00 for rapid-feed positioning. Liner/non-liner selection is possible by parameter setting.
	Linear interpolation	G01
	Circular interpolation	G02 (Clockwise),; G03 (Counterclockwise) Capable of interpolating circular arcs extending along many quadrants as well as those used for additional (optional) axes.
	Plane selection	G17: XY plane; G18: ZX plane; G19: YZ plane
	Miscellaneous function	2-digit M code
	Spindle function	Direct command of spindle speed using a 5-digit S code

	Item	Specification
Tape function	Editing	Foreground editing and background editing during automatic operation.
	Program number search	4-digit program numbers, each following address O, are provided. The program name can be written in parentheses.
	Sequence number research	5-digit sequence numbers, each following address N, are provided.
	Tape mode	EIA RS244A/ISO 840 automatic discrimination
	Label skip	At tape information prior to the first EOB is ignored for initial start-up or after resetting.
	Parity check	Tape parity is checked.
	Control in-out	Commentary can be put between the control in and control out.
	Tape memory	CMOS memory; 40 m (130 feet)
	Number of registered programs	50; Program name indication available
	I/O interface	RS232C; 20 mA current loop
Others	Self-diagnosis	NC self-check for abnormality 1) Detection system 2) Position control section 3) Servo system 4) Overheating 5) CPU 6) ROM 7) RAM 8) Data transfer to MDI and CRT 9) Memory 10) Data transfer to PC
	B.M.I. Interface	NC-PC interface allows use of all System 10 functions
	NC state window	The following are possible on the PC side (but impossible on the user side) 1) Reading of the MDI key 2) Display data on CRT 3) Use of CMOS memory 4) Reading of NC data 5) Alteration of NC data 6) Format conversion of NC command programs

	Item	Specification
Others		7) Editing of NC command programs 8) Use of an I/O interface
	Display of ladder diagram	Ladder diagrams can be displayed on the CRT; dynamic display of on-off states of contacts and coils.
	Locker	Closed construction of the integrated NC and power control board
	Emergency stop	Push the emergency button and all commands are withheld to instantly stop the machine.
	MDI/CRT panel	9-inch monochrome CRT
	Menu switch	On-off command for each function can be preset. 1) Single block 2) Machine lock 3) Display lock 4) Auxiliary function lock 5) Dry run 6) Optional block skip 7) Mirror image 8) Z-axis cancel 9) Manual absolute

3 G Code List (FANUC MFNCV3) o: standard Δ : optional

Code	Group	Function	Classification
G00	01	Positioning	o
G01	01	Linear interpolation	o
G02	01	Circular interpolation/helical interpolation CW	o/Δ
G03	01	Circular interpolation/helical interpolation CCW	o/Δ
G04	00	Dwell	o
G09	00	Exact stop check	o
G10	00	Data setting	o
G10.1	00	PC data setting	
G11	00	Data setting mode cancel	o
G17	02	XpYp plane, where Xp: X axis or its parallel axis	o
G18	02	ZpXp plane, where Yp: Y axis or its parallel axis	o
G19	02	YpZp plane, where Zp: Z aixs or its parallel axis	o
G20	06	Inch input	o
G21	06	Metric input	o
G22	04	Stored stroke check function ON	Δ
G23	04	Stored stroke check function OFF	Δ
G27	00	Reference point return check	o
G28	00	Return to reference point	o
G29	00	Return from reference point	o
G30	00	Return to 2nd reference point	o
G31	00	Skip function	Δ
G31.1	00	Multi-skip function 1	Δ
G31.2	00	Multi-skip function 2	Δ

Code	Group	Function	Classification
G31.3	00	Multi-skip function 3	Δ
G38	00	Cutter compensation vector change	o
G39	00	Cutter compensation corner circular arc	o
G40	07	Cutter compensation cancel	o
G41	07	Cutter compensation (left)	o
G42	07	Cutter compensation (right)	o
G43	08	Tool length compensation +	o
G44	08	Tool length compensation -	o
G45	00	Tool position offset extension	o
G46	00	Tool position offset contraction	o
G47	00	Tool position offset extension (x2)	o
G48	00	Tool position offset contraction (x2)	o
G49	08	Tool length compensation cancel	o
G50.1	19	Programmable mirror image cancel	Δ
G51.1	19	Programmable mirror image	Δ
G52	00	Local coordinate system setting	o
G53	00	Machine coordinate system selection	o
G54	12	Work coordinate system 1 selection	o
G55	12	Work coordinate system 2 selection	o
G56	12	Work coordinate system 3 selection	o
G57	12	Work coordinate system 4 selection	o
G58	12	Work coordinate system 5 selection	o
G59	12	Work coordinate system 6 selection	o

Code	Group	Function	Classification
G61	13	Exact stop mode	o
G63	13	Tapping mode	o
G64	13	Cutting mode	o
G65	00	Macro call	Δ
G66	14	Macro modal call A	Δ
G66.1	14	Macro modal call B	Δ
G67	14	Macro modal call A/B cancel	Δ
G73	09	Peck drilling cycle	o
G74	09	Counter tapping cycle	o
G76	09	Fine boring cycle	o
G80	09	Fixed cycle cancel	o
G81	09	Drill cycle, spot boring	o
G82	09	Drill cycle, counter boring cycle	o
G83	09	Peck drilling cycle	o
G84	09	Tapping cycle	o
G85	09	Boring cycle	o
G86	09	Boring cycle	o
G87	09	Back boring cycle	o
G88	09	Boring cycle	o
G89	09	Boring cycle	o
G90	03	Absolute command	o
G91	03	Incremental command	o
G92	00	Work coordinate system change/max. spindle speed setting	o

Code	Group	Function	Classification
G96	17	Constant surface speed control	Δ
G97	17	Constant surface speed control cancel	Δ
G98	10	Fixed cycle initial level return	o
G99	10	Fixed cycle R-point level return	o

Note 1. The G codes of the 00 group are not modal.

Note 2. Multiple G codes belonging different groups can be commanded in the same block.

4 M Function List

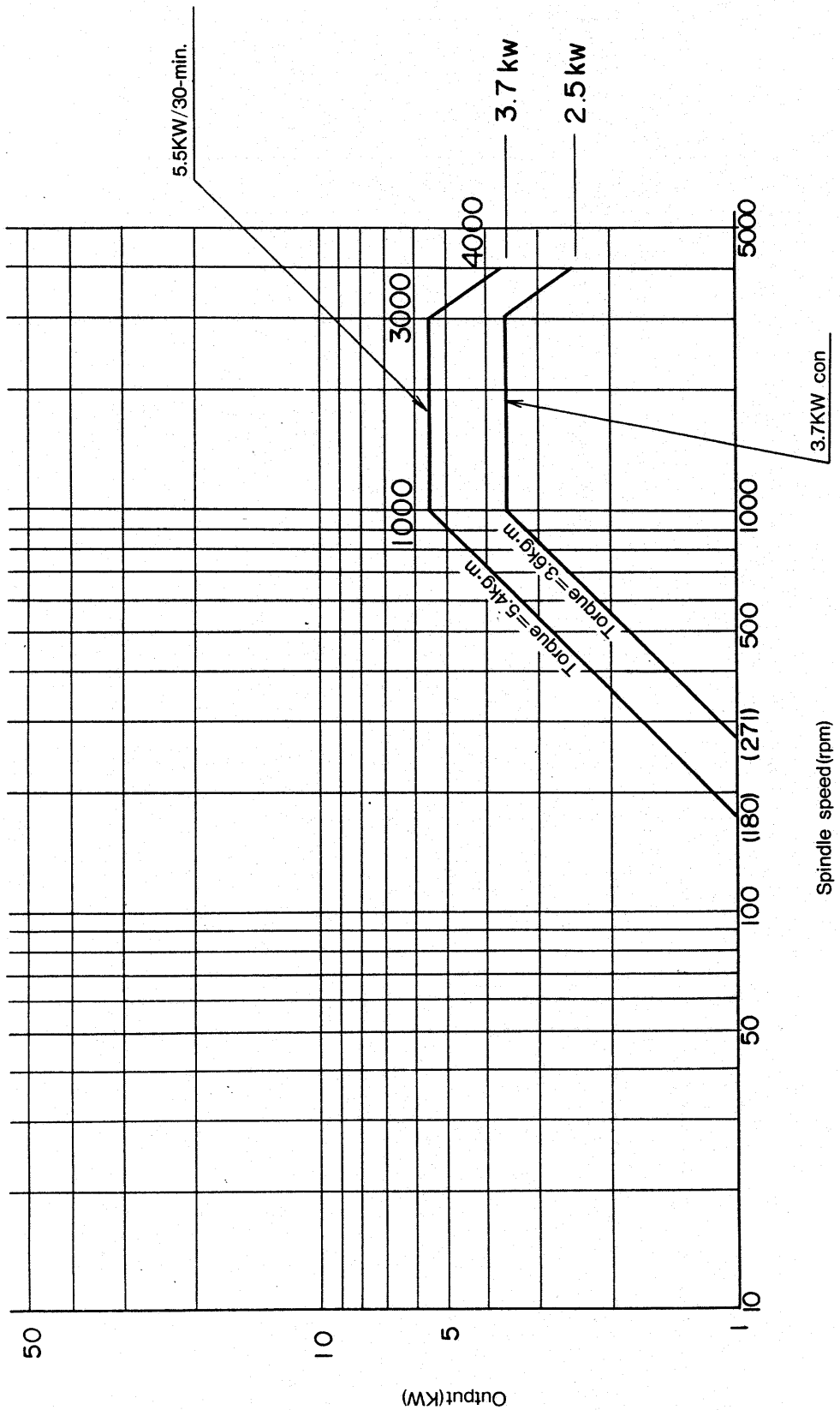
Code	Function	Application
M00	Program stop	Temporary program stop
M01	Optional stop	Temporary program stop (selectable using an external switch)
M02	Program end	Program end and reset
M03	Spindle normal rotation	Normal rotation of spindle
M04	Spindle reverse rotation	Reverse rotation of spindle
M05	Spindle stop	Spindle stop
M06	Tool change	ATC cycle start
M07	Oil shot ON	Oil shot ON (with optional device)
M08	Coolant ON	Coolant discharge
M09	Oil shot, coolant OFF	Oil shot, coolant and oil hole coolant stop
M10	4th axis clamp	Indexing table clamp (with optional device)
M11	4th axis unclamp	Indexing table unclamp (with optional device)
M19	Spindle orientation	Spindle stop at the regular position
M30	Program end	Program end and reset/rewind
M31	Interlock bypass ON	Return cycle and independent operation interlock cancel
M32	Interlock bypass OFF	Cancel of M31 and M35
M33	Tool storage	Return of tool in spindle to the magazine
M35	ATC return preparation	Preparation of return cycle
M48	Override cancel OFF	Override cancel ineffective
M49	Override cancel ON	Override cancel effective
M50	Oil hole coolant ON	Oil hole coolant discharge (with optional device)
M51	Air blow ON	Air blow start (with optional device)
M52	Dust collector air blow ON	Dust collector air blow start (with optional device)
M53	Sensor air blow ON	Sensor air blow start (with optional device)
M54	High pressure coolant ON	High pressure coolant ON (with optional device)
M55	Oil mist ON	Oil mist discharge (with optional device)

Code		Function	Application
M56		High pressure coolant OFF	High pressure coolant OFF
M58		Dust collector air blow/sensor air blow OFF	Stop of dust collector air blow and sensor air blow
M59		Air blow OFF	Stop of air blow
M73		Y-axis mirror image OFF	Y-axis mirror image ineffective
M74		Y-axis mirror image ON	Y-axis mirror image effective
M75		X-axis mirror image OFF	X-axis mirror image ineffective
M76		X-axis mirror image ON	X-axis mirror image effective
External M function	*1 M20	External M function	Unassigned
	M21	"	"
	M22	"	"
	M23	"	"
	M24	"	"
	M25	"	"
	M26	"	"
	M27	"	"
	M28	"	"
	M29	"	"
	M70	Work counter	Work counter count-up
*1 M BCD Code		External M function	M function BCD code transfer

Note *1 M20 - M29 output or M BCD code output can be used, but not both.

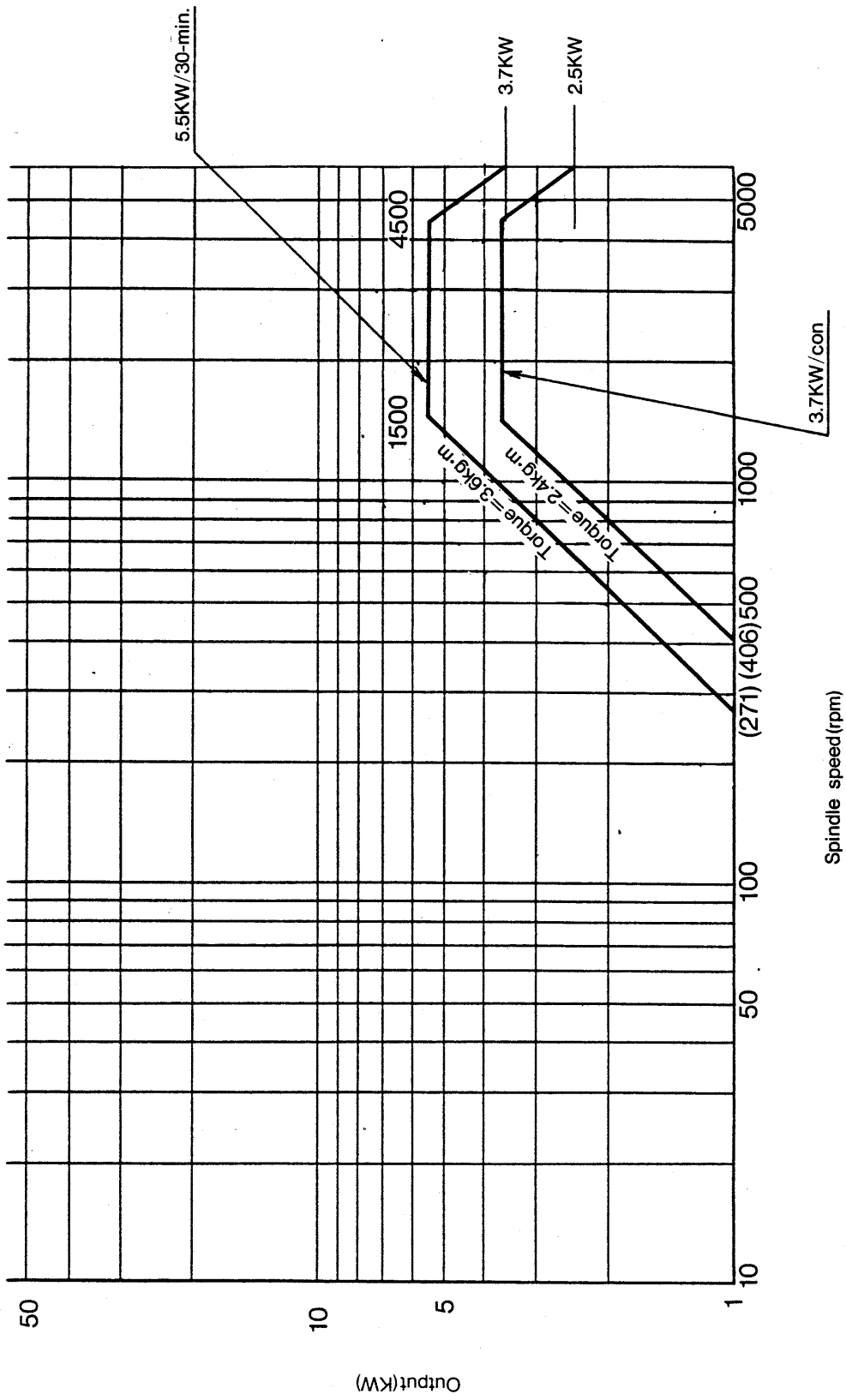
5. Spindle Speed-Output Performance Curve (1)

(4000 RPM Type)



6. Spindle Speed-Output Performance Curve (2)

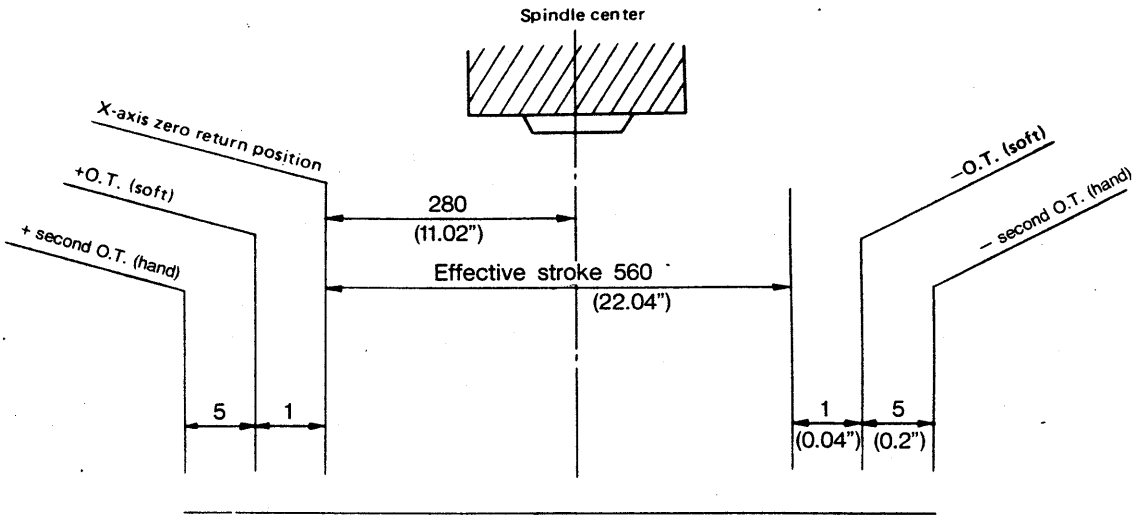
(600 RPM Type)



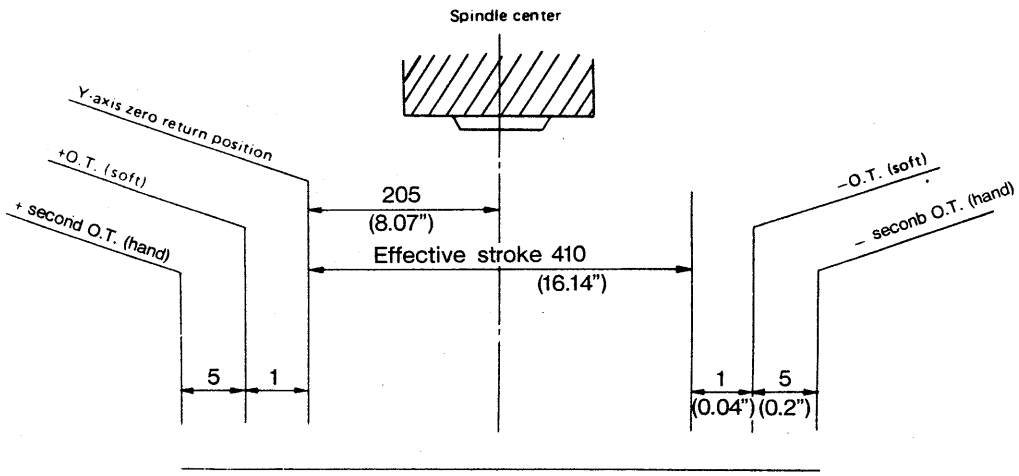
1. X,Y and Z-axis Movement

1.1 X-axis Movement

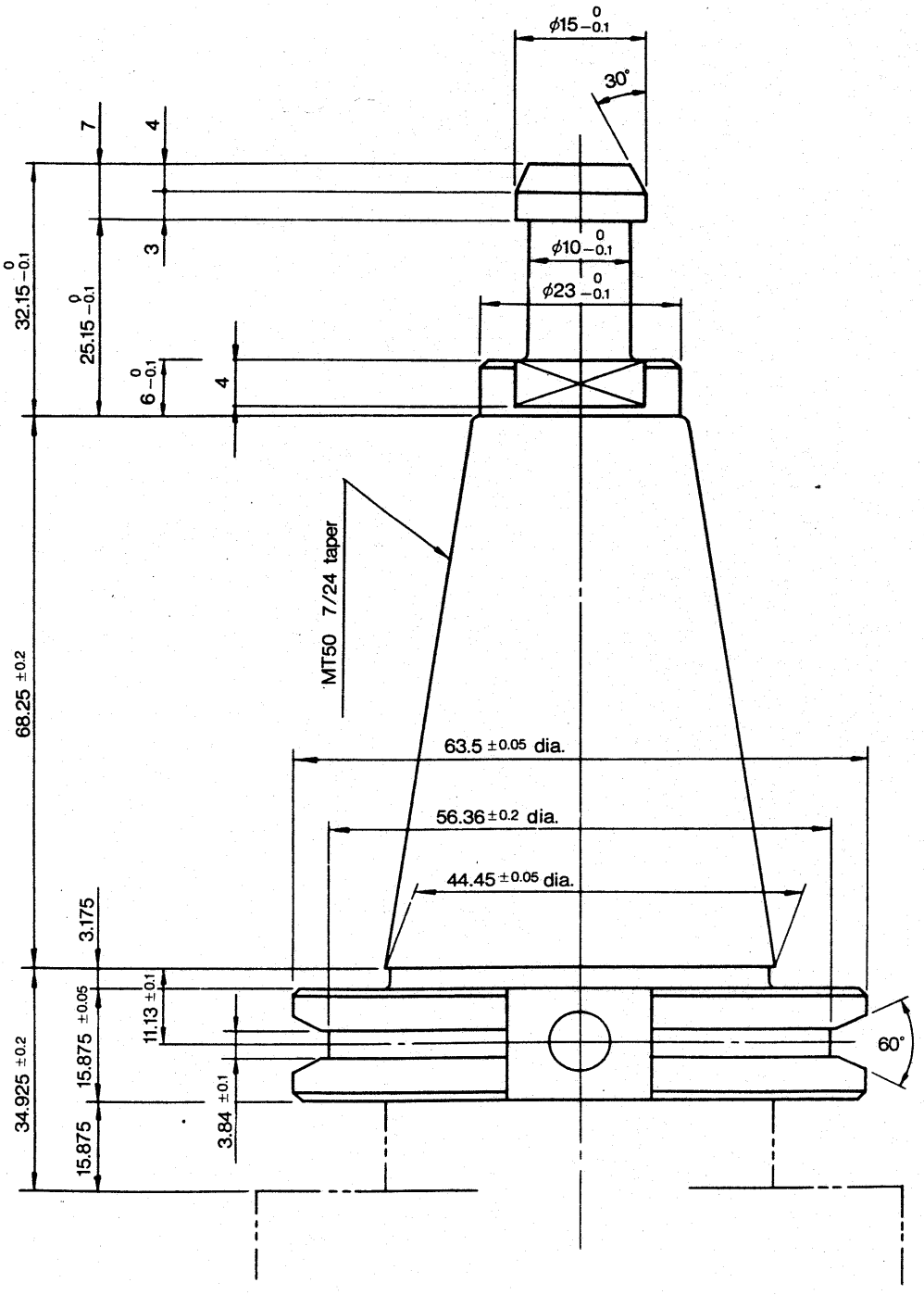
Unit: mm



1.2 Y-axis Movement

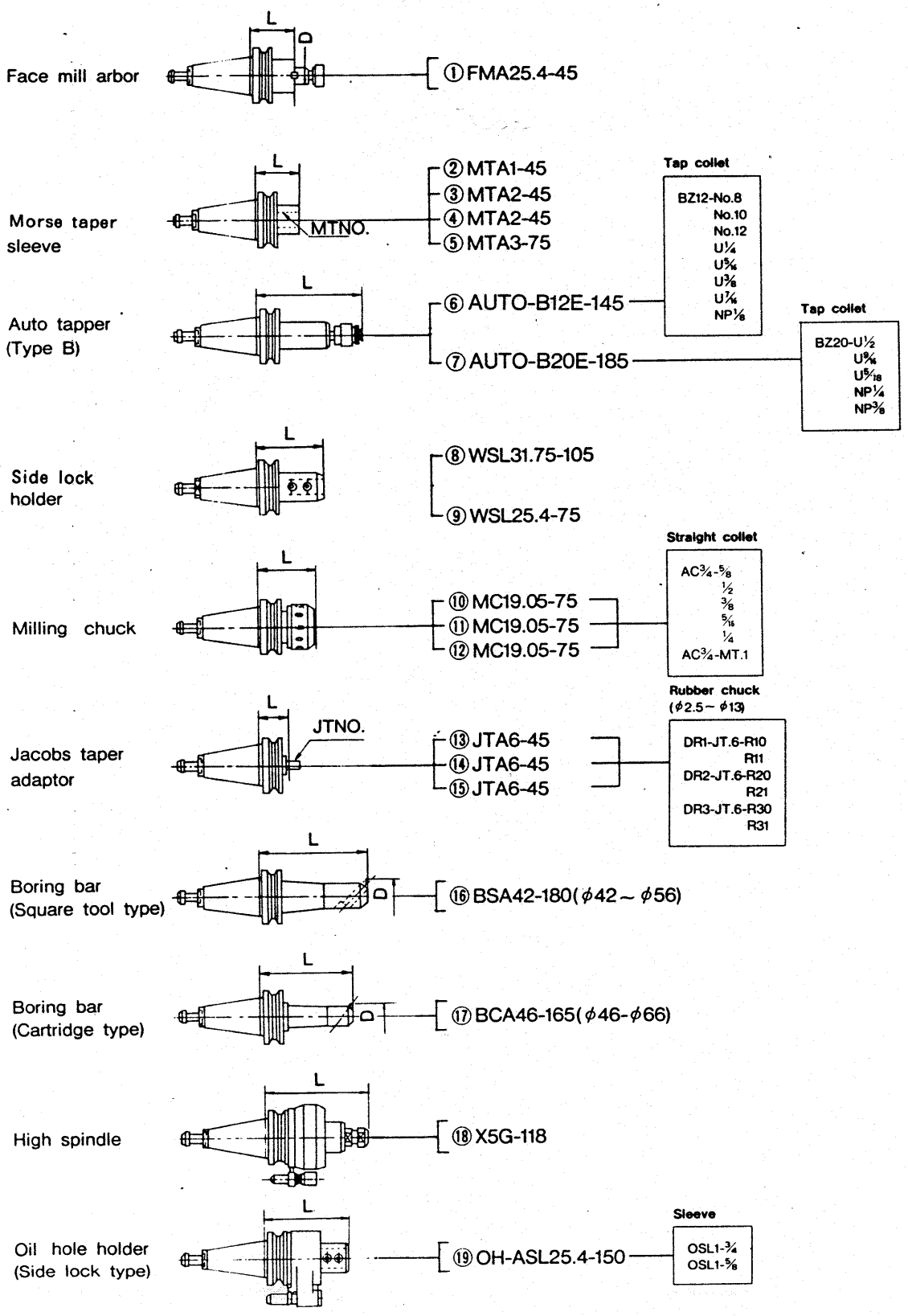


1.1 CAT-40 Tool Shank Drawing



3. TOOLING MANUAL

2.1 BT-40 Tooling System for U.S.A.



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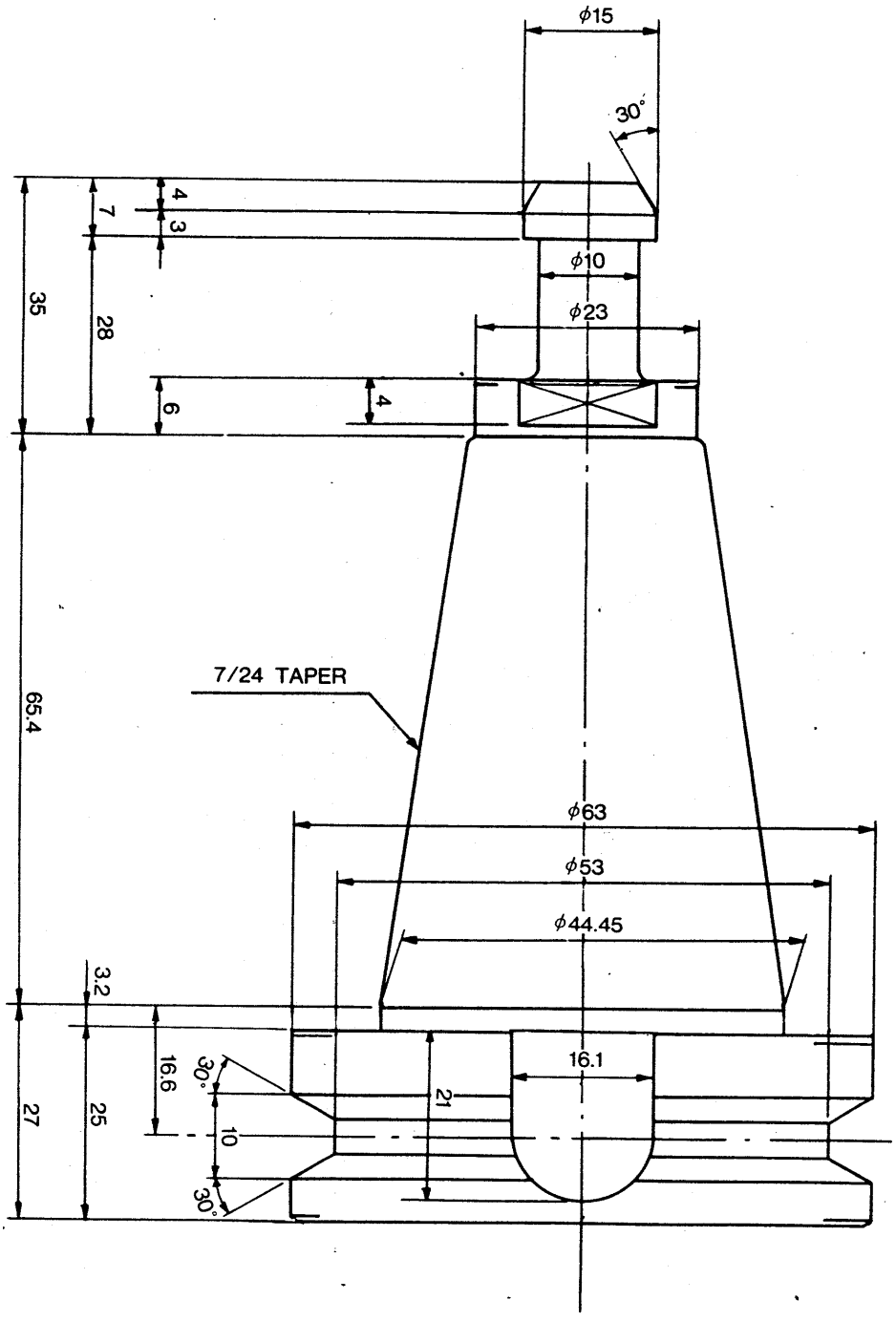
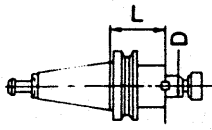
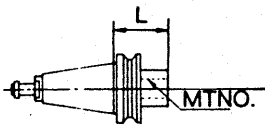


2.1 BT-40 Tooling System for U.S.A.

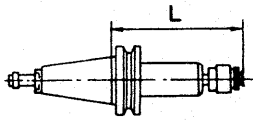


Face mill arbor — ① FMA25.4-45



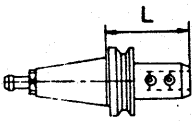
Morse taper sleeve — ② MTA1-45, ③ MTA2-45, ④ MTA2-45, ⑤ MTA3-75

Tap collet: BZ12-No.8, No.10, No.12, U¼, U⁵⁄₁₆, U⅜, U⁷⁄₁₆, NP⅛

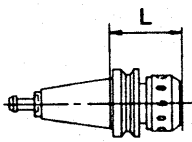


Auto tapper (Type B) — ⑥ AUTO-B12E-145, ⑦ AUTO-B20E-185

Tap collet: BZ20-U½, U⁹⁄₁₆, U⁵⁄₁₆, NP¼, NP⅜

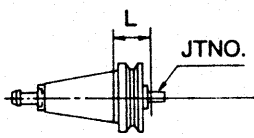


Side lock holder — ⑧ WSL31.75-105, ⑨ WSL25.4-75



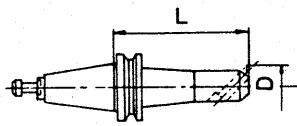
Milling chuck — ⑩ MC19.05-75, ⑪ MC19.05-75, ⑫ MC19.05-75

Straight collet: AC¾-⅝, ½, ⅜, ⁵⁄₁₆, ¼, AC¾-MT.1

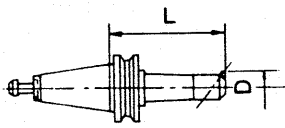


Jacobs taper adaptor — ⑬ JTA6-45, ⑭ JTA6-45, ⑮ JTA6-45

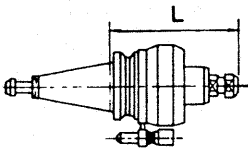
Rubber chuck (φ2.5 ~ φ13): DR1-JT.6-R10, R11, DR2-JT.6-R20, R21, DR3-JT.6-R30, R31



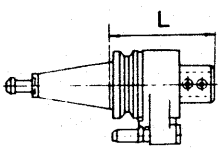
Boring bar (Square tool type) — ⑯ BSA42-180(φ42 ~ φ56)



Boring bar (Cartridge type) — ⑰ BCA46-165(φ46-φ66)



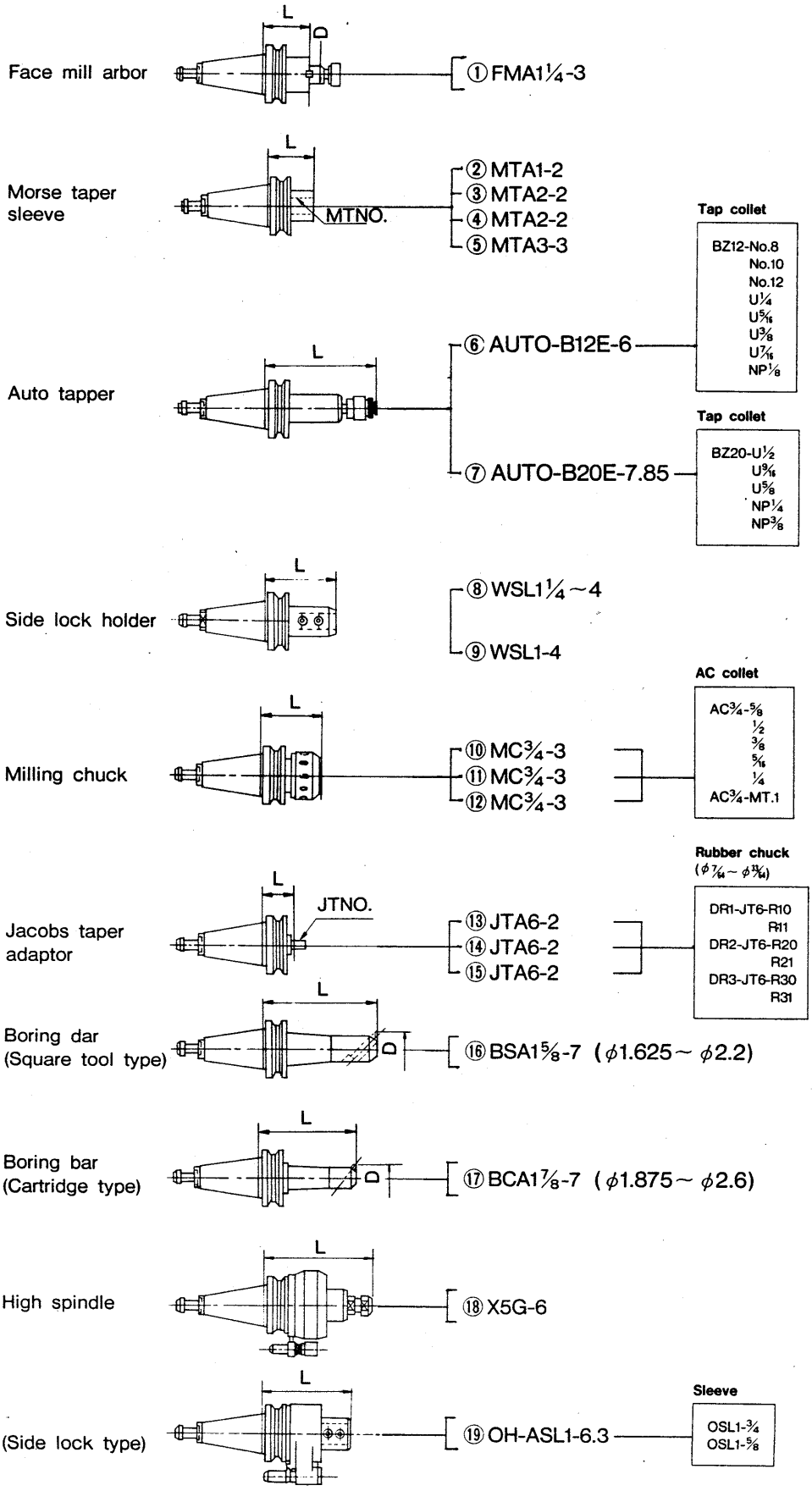
High spindle — ⑱ X5G-118



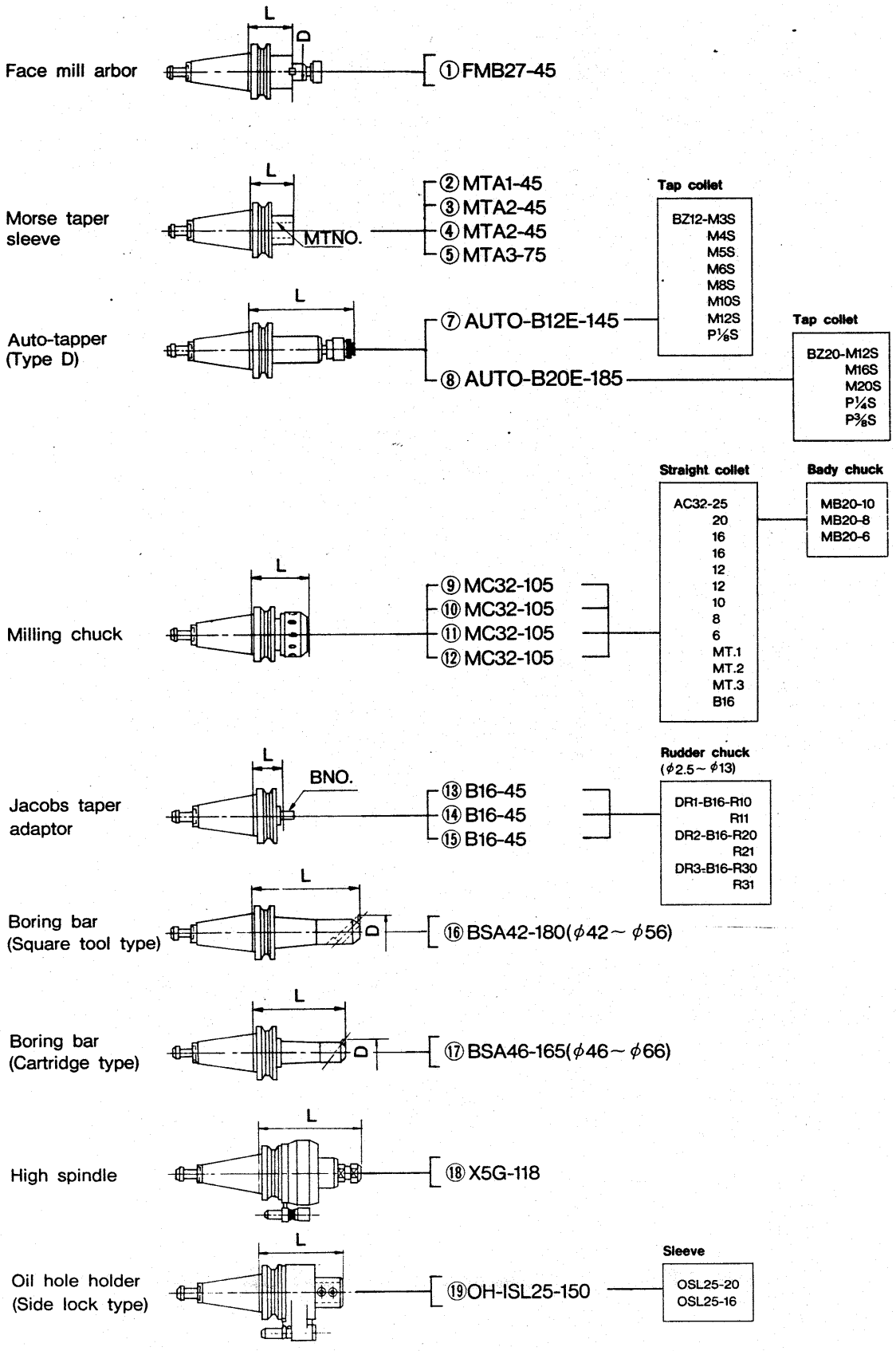
Oil hole holder (Side lock type) — ⑲ OH-ASL25.4-150

Sleeve: OSL1-¾, OSL1-⅝

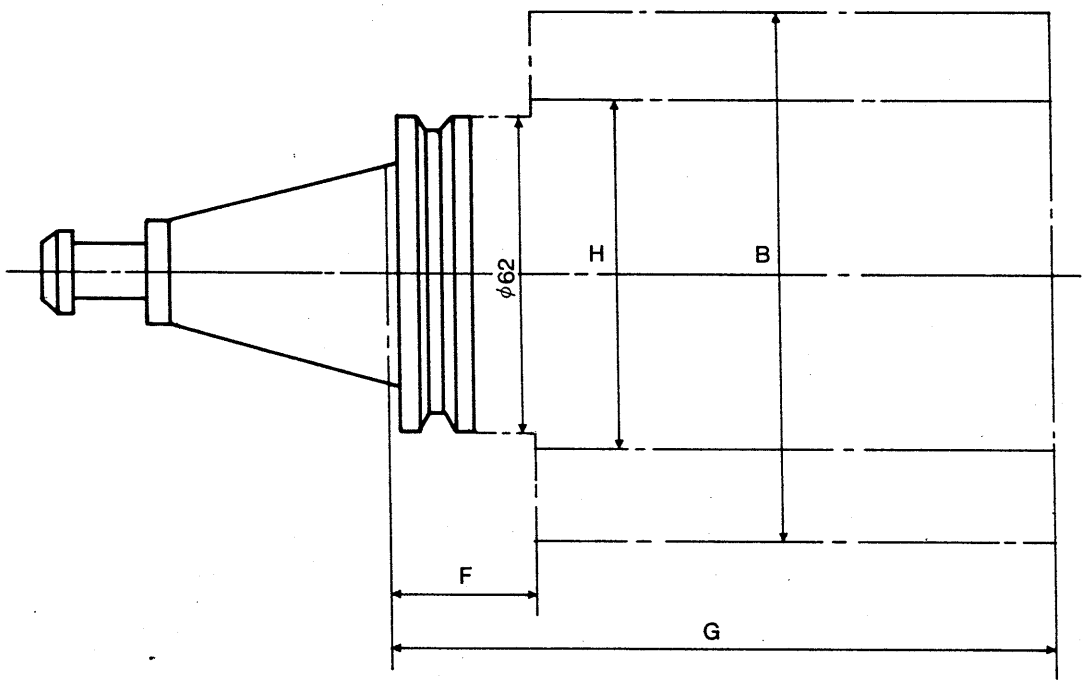
2.2 CAT-40 Tooling System for U.S.A.



2.3 BT-40 Tooling System for EUROPE

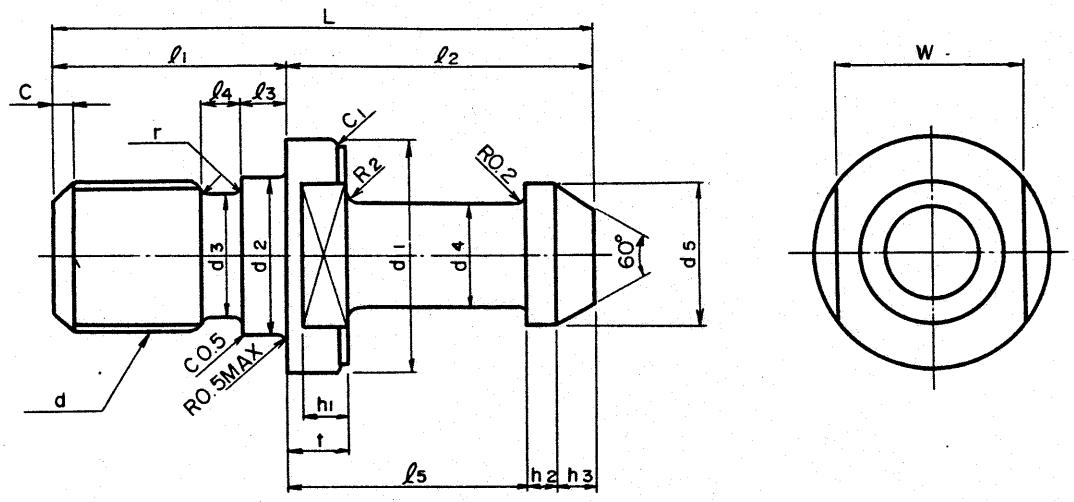


3. Limitation of Tool Length and Weight (MAS-BT)



Model	Shank size	F	G	H	Weight	B
MV-junior	MAS BT-40	32 mm (1.260")	250 mm (9.843")	80 mm (3.150")	8 kg (17.6lbs)	125 mm (4.921")

4. Pullstud (MAS BT-40)

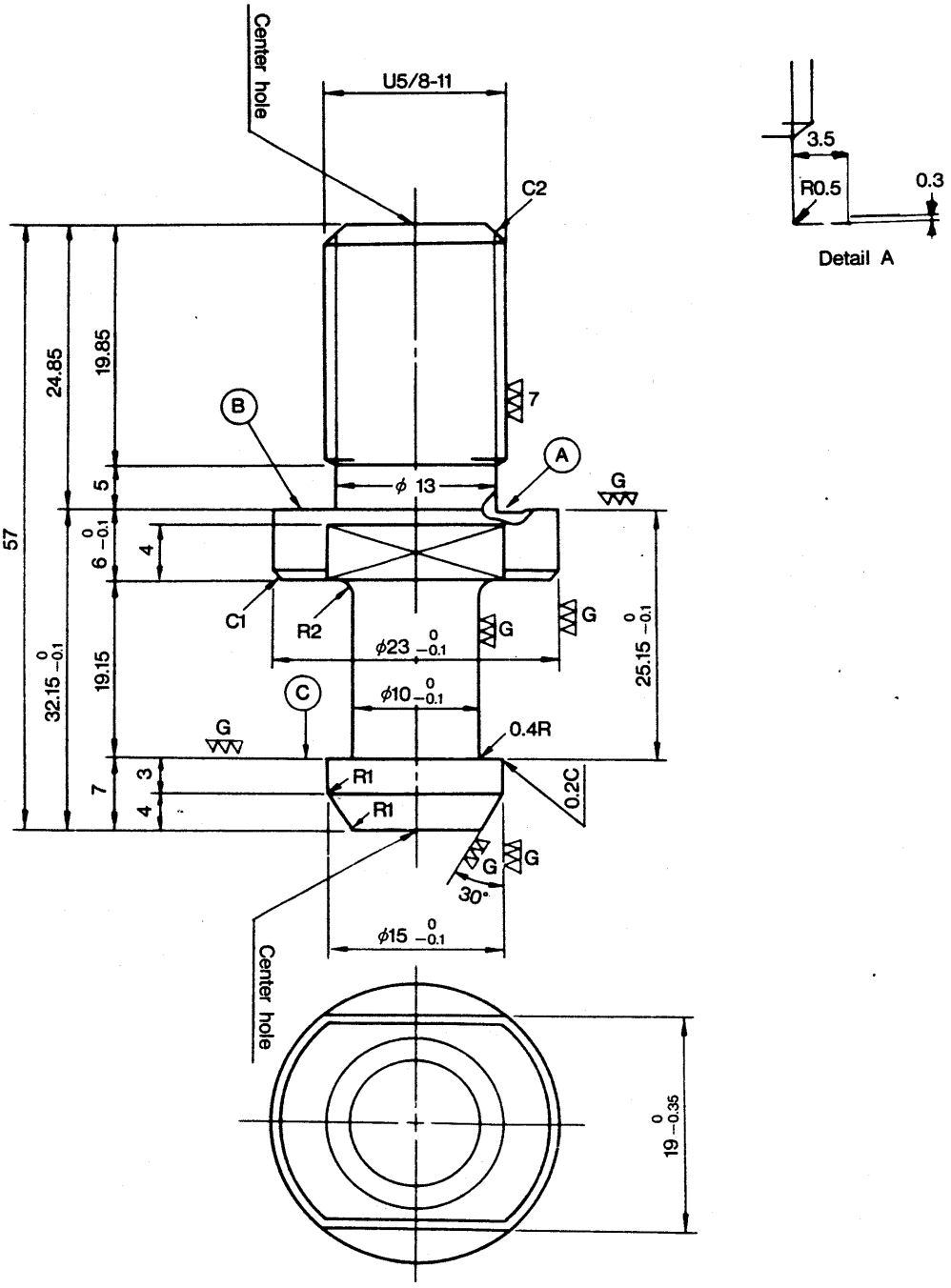


Dimension table

	L	ℓ1	ℓ2		d1	t		h1	d2(h7)		ℓ3	d3	ℓ5
			Dimension	Tolerance		Dimension	Tolerance		Dimension	Tolerance			
BT40	60 (2.36)	25 (0.98)	35 (1.38)	0 -0.1 (0 -0.004)	23 (0.91)	6 (0.24)	0 -0.1 (0 -0.004)	4 (0.16)	17 (0.67)	0 -0.011 (0 -0.005)	5 (0.20)	13 (0.51)	4 (0.16)

	r	d	c	ℓ5		d4		d5		h2	h3	w	
				Dimension	Tolerance	Dimension	Tolerance	Dimension	Tolerance			Dimension	Tolerance
BT40	1 (0.04)	M16 ×2.0	2 (0.08)	28 (1.10)	0 -0.1 (0 -0.004)	10 (0.39)	0 -0.1 (0 -0.004)	15 (0.59)	0 -0.1 (0 -0.004)	3 (0.12)	4 (0.16)	19 (0.75)	0 -0.35 (0 -0.014)

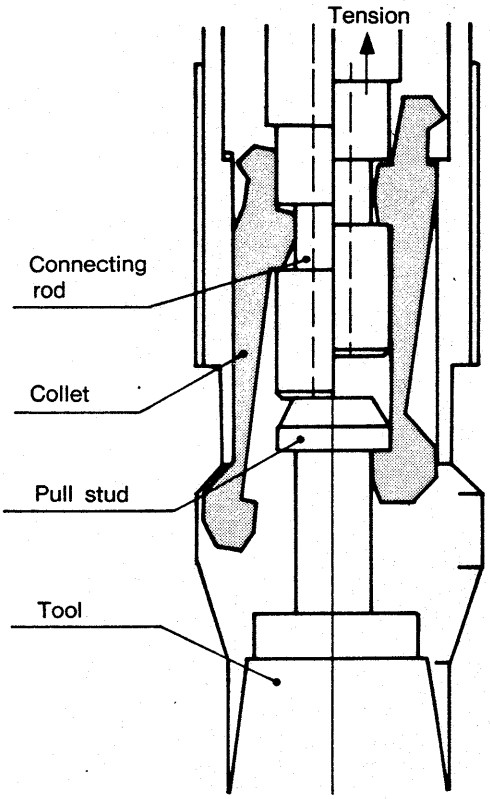
4.1 Pullstud Drawing of CAT-40



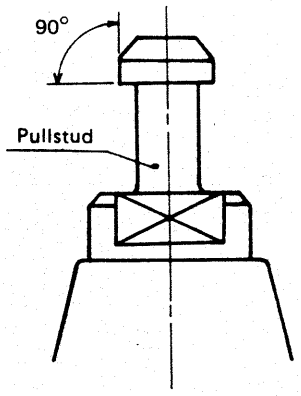
Note: Deviation and off-center of (B) surface agains both center holes (axial center) should be 0.01 or less.

5. Precautions for Use of Pullstud

.... IMPORTANT

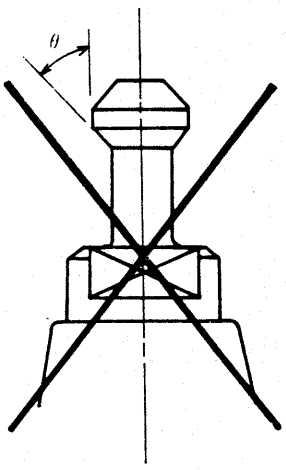


The collet is hydraulically clamped with a tensil force of 2500 kg by the mechanism as shown at the left.



Not allowed to be used

Be sure to use our exclusive pull-stud when tools for BT/CAT are used for our machining centers.
The pullstud shown at the left should not be used since it needs a different pulling mechanism.
If a pullstud (shown at the left) other than that specified by us is used, a greater tensile force is applied and the collet may be damaged.



θ = 45° : MAS I type
θ = 60° : MAS II type

B. OPERATION MANUAL

General Precautions for Safe Use of the Machine

General precautions are described below so that the machine can be used safely. The engineers of our company or our dealers may also explain how the machine works and how it is operated safely in detail when the machine is installed or operation guidance is given. Complete safety features are provided in all sections of the machine. For example, all rotating parts are covered. The machine is completely covered so that the operator's safety is assured even if chips are scattered or if a workpiece bounces out. However, if the machine is used inproperly by mistake, a serious accident may occur.

The following basic safety precautions should be observed before using the machine.

(1) The machine should be operated only by an operator who is well trained and informed of the specifications. Untrained and uninformed operators should be trained sufficiently before operating the machine.

(2) Operators should not come close to or touch the rotating or moving parts of the machine unless absolutely necessary. The machine, especially ATC, may be stopped midway during its stroke due to a defective switch.
It may start moving again when the switch is pressed or is given an inpact.
Do not attempt to repair the machine without cutting off the power supply.
Before shutting down the machine, contact the nearest sales and service office of Mori Seiki Products.

Examples of practical safety precautions are described below.

* Each machine should be operated by only one fully trained operator. If one operator is replacing the workpiece or cutting tool and another operator presses the button on the control panel to operate the spindle, an accident resulting in injury may occur. Before attempting to fix or replace any prats of the machine be sure to push the Emergency Stop Button.
* Do not remove covers unless absolutely necessary.
  Do not retate the spindle when the cylinder cover is removed.
  Do not insert a bar in spindle during spindle rotation.
* Do not open the front cover during spindle rotation unless absolutely necessary.
  Do not open the front cover during spindle rotation to remove chips or to touch the workpiece or cutting tools.
* If the machine is modified by the user, contact us.
* Machines with optional specifications should be operated according to those specifications.

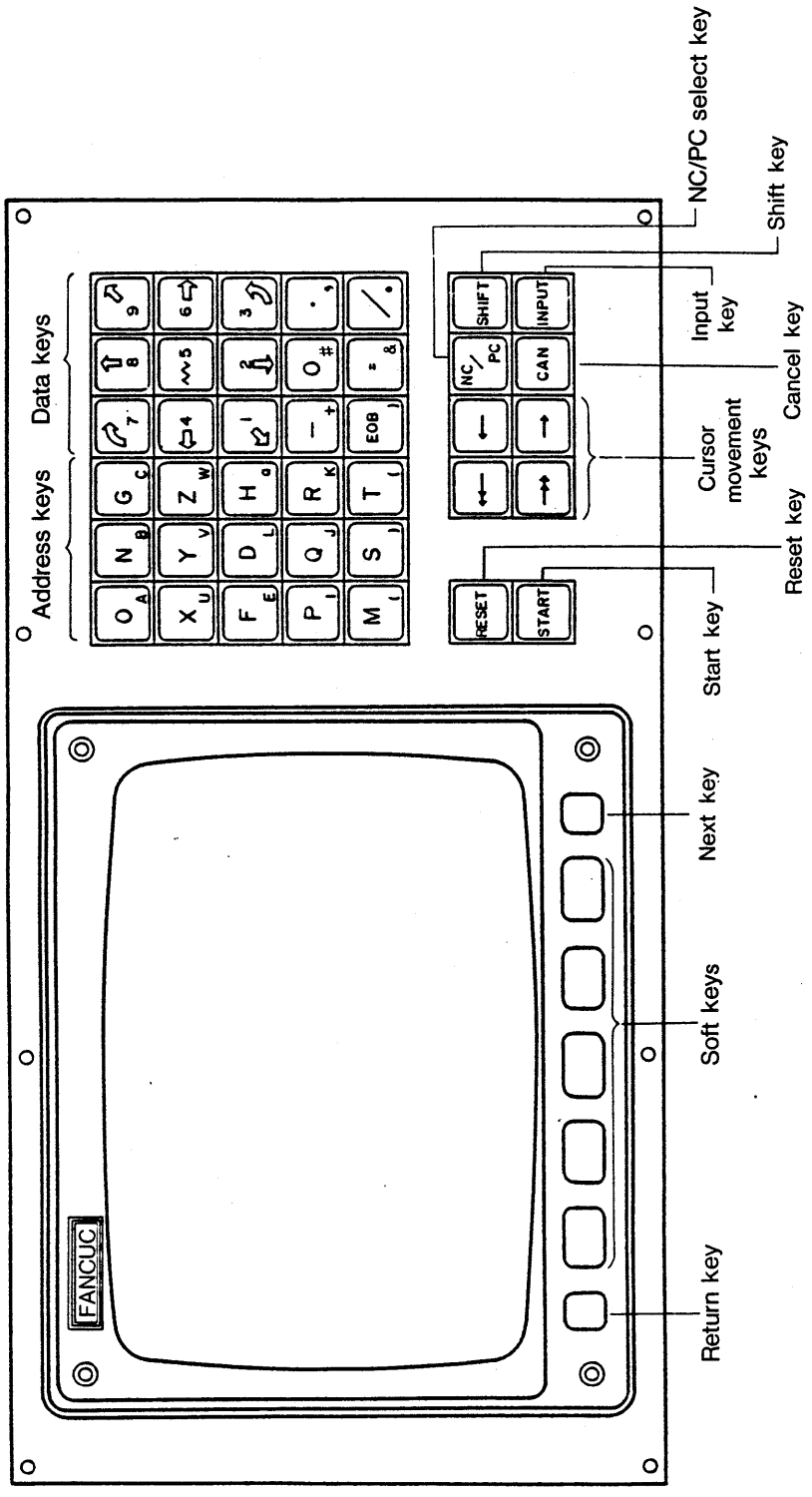
Briefly, these are the most important safety precautions. However, since this model is used by many users, and workpieces and machine applications vary according to the user, it is very difficult for us to explain the proper precautions for every possible situation. Consequently, safety measures should also be initiated by the user himself.

OPERATION MANUAL

1. FUNCTIONAL EXPLANATION

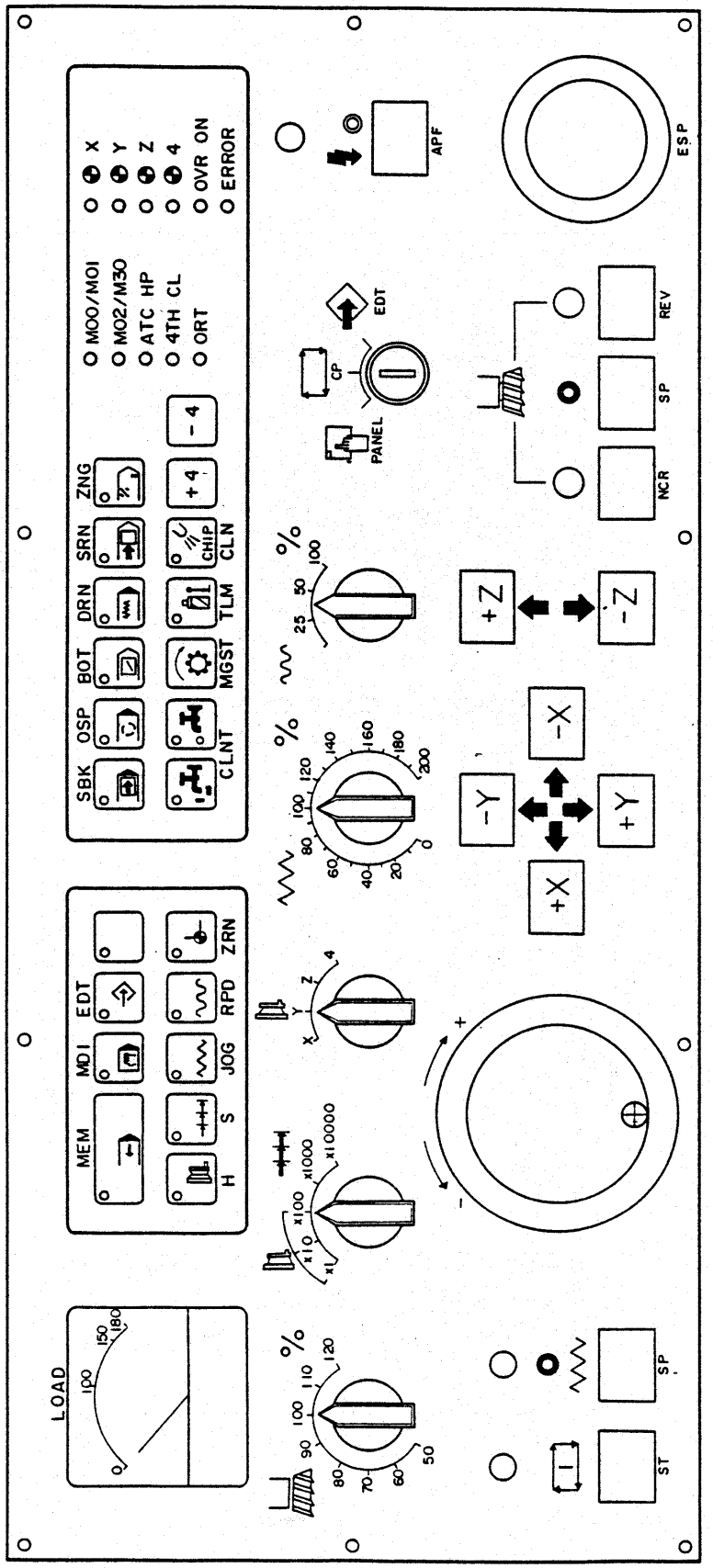
1. FUNCTIONAL EXPLANATION

Carefully read "FANUC SYSTEM 10M-A Operation Manual" issued by FANUC Ltd. for functional explanation and operation procedure of NC control panel (MDI & DPL unit).

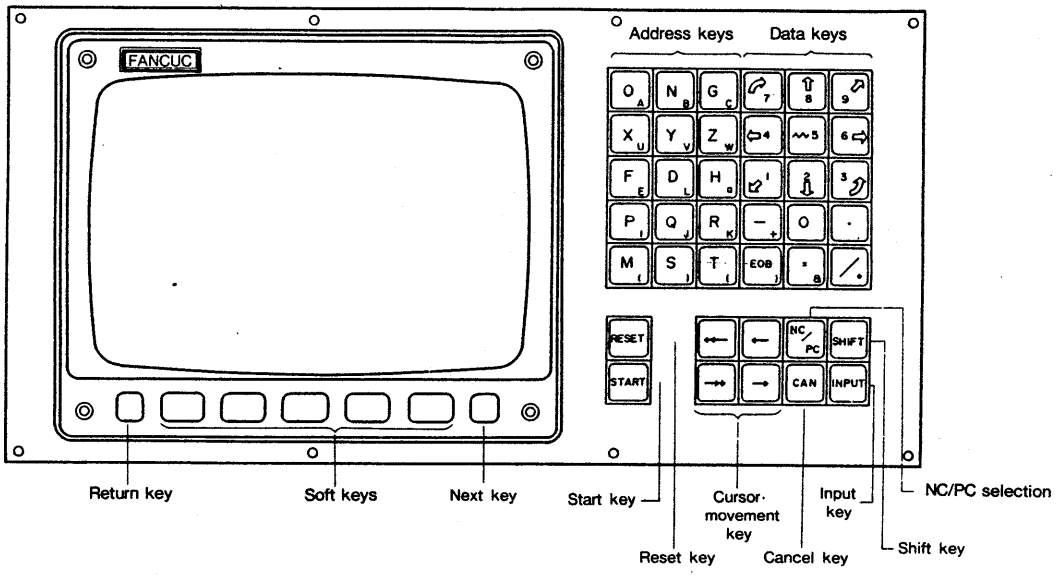


MDI/CRT Panel (FANUC MFNC V3)

Machine Control Panel (FANUC MFNC V3)



1. MDI & DPL Panel



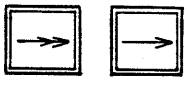
1.1 CRT Character Display

CRT is an abbreviation for cathode ray tube. This CRT is used for character display. In this manual, the character display is called the "CRT".

1.2 PAGE

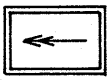
These keys are used to replace a picture displayed on the CRT. Although the MFNC-V3 can display various functions, since each function has too much information to be displayed at a time, the picture should be replaced each time the key is pressed to display entire information.

..... This key is pressed to return to the previous page.

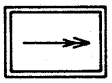


..... This key is pressed to turn to the next page. (If this key is pressed while the final page is displayed, the first page is recalled.)

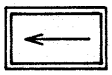
1.3 CURSOR



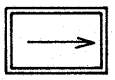
Use this key to move the cursor one line up.



Use this key to move the cursor one line down.



Use this key to move the cursor to the left.



Use this key to move the cursor to the right.

1.4 ADDRESS

This key is used to command the address section (alphabet) of NC data for program editing, tool offset data inputting, MDI commanding, etc.

1.5 DATA

There are 15 keys including 0 - 9, - (minuts), . (decimal point), / (slash), and EOB (end of block). They are used to command data (numerical section of a word).

1.6 RESET

This key is used to reset the NC unit and clear the alarm (after the cause is corrected).

1.7 START

This is the start pushbutton for the MDI mode.

1.8 INPUT

This key is used to input data.

1.9 NC/PC

This key is used to select between NC display or PC display.

1.10 Soft keys

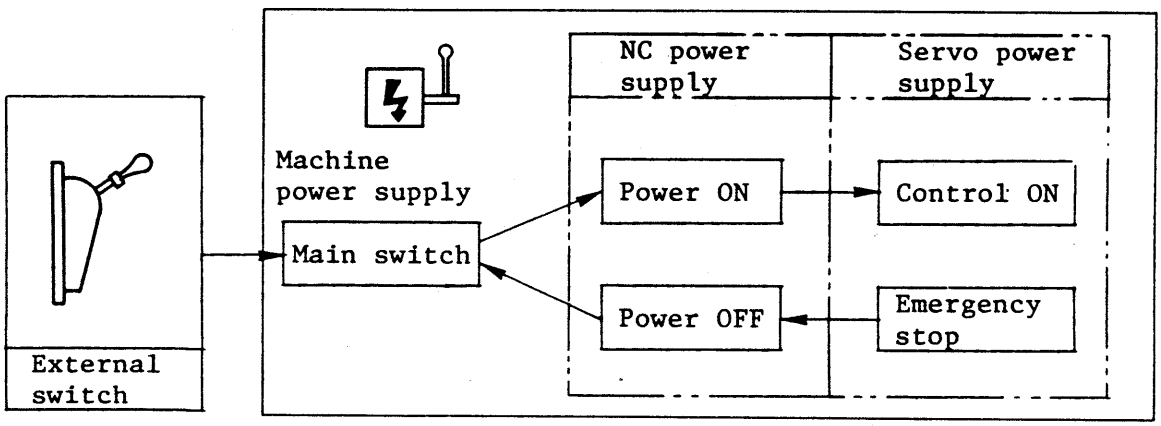
· These keys are located below the CRT.
The functions of the soft keys are displayed on the CRT.

° The key beside the right soft key is called the NEXT key, and is used to display another soft keys for the present fuction.

° The key beside the left soft key is called the RETURN key. Press the RETURN key, and the function selection mode will be displayed for the soft keys.
For details regarding the soft keys, refer to the operation manual published by FANUC.

1.11 POWER ON/OFF Pushbuttons

ON ▮ ..... This pushbutton turns the NC power supply on.
OFF ○ ..... This pushbutton turns the NC power supply off.



a) Turning the Power On

i) Turn on the breaker on the power control board

ii) Press the POWER ON button.

iii) Make sure that something appears on the CRT.

Note: Do not touch any other keys on the MDI and CRT panel when pressing the POWER ON key. These keys can be pressed only after a position display or alarm display has appeared on the CRT. Some keys, if pressed, may cause unexpected action because they are used for maintenance or any other special purposes.

b) Turning the Power Off

i) Confirm that the CYCLE START lamp on the operation panel is off.

ii) Confirm that all movable parts are stopped.

iii) If input/output devices, such as a paper tape punch unit are connected, turn them off.

iv) Press the POWER OFF button and hold it for several seconds.

2 Function selection keys

To select the desired function, press the [RETURN] key and display function selection keys for the soft keys, then press the desired function selection soft key.
Function selection is possible in any mode.
Use the chapter selection keys to select detailed functions.
The following function selection keys (soft keys) are available.

POSITON	PROGRAM	OFFSET	PRG-CHK	CHAPTER	+
SETTING	SERVICE	MESSAGE		CHAPTER	+

(1) [POSITON] key

Press this key to select the actual position display.

(2) [PROGRAM] key

Press this key to select the part program display.

(3) [OFFSET] key

Press this key to select the tool offset display or work origin offset display.

(4) [PRG-CHK] key

Press this key to select the command data display.

(5) [SETTING] key

Press this key to select the setting display.

(6) [SERVICE] key

Press this key to select the parameter display or diagnostic display.

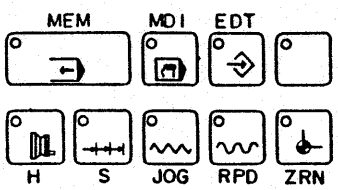
(7) [MESSAGE] key

Press this key to select the alarm message display or operator message display.

3. Machine Operation

3.1 MODE (Mode switch)

This switch is used to select operation mode, and is the basic control switch for all operations.



Mark	Meaning
EDT	EDIT
MEM	MEMORY
MDI	MANUAL DATA INPUT
T	TAPE
H	HANDLE
S	STEP
J	JOG
RPD	RAPID
ZRN	ZERO-RETURN

3.1.1 EDT (Edit)

Set MODE switch to EDT for the following.

i) Registration of program to memory

ii) Alteration, insertion and deletion of program

iii) Punching-out and editing memory program (Foreground editing)

3.1.2 MEM (Memory)

Set MODE switch to MEM for the following.

i) Execution of program registered in the memory

ii) Program editing, punching-out, tape-reading in the background editing mode.

3.1.3 MDI (Manual data input)

Set MODE switch to MDI for the followings.

i) When MDI operation is required

ii) Parameter setting and other settings

3.1.4 T (Tape)

Set MODE switch to [T] for the following.

i) Reading and exection of program from tape reader

ii) Searching sequence number of program on the tape

3.1.5 H (Handle feed)

Set MODE switch to [H] to perform handle feed.

(Fine feed is possible by rotating the manual pulse generator.)

3.1.6 S (Step feed)

Set MODE switch to [S] for step feed.

Step feed is adjustable in a range of 0.001 - 10mm (0.0001 - 1")
at 0 - 2000 (0 - 80")mm/min by controlling jog override.

3.1.7 J (Jog feed)

Set MODE switch to [J] for jog feed.

(Only two axes can be moved simultaneously in manual mode.
Therefore, even when three axes are controlled simultaneously,
only the two axes previously selected can be moved.)

3.1.8 RPD (Rapid feed)

Set MODE switch to [RPD] for rapid feed.

Rapid feed is possible in the direction of the axis selected while the corresponding feed button is pressed.

Override from fine to 100% is possible by operating RAPID FEED RATE OVERRIDE setting switch.

Rapid feed rate (at 100%)

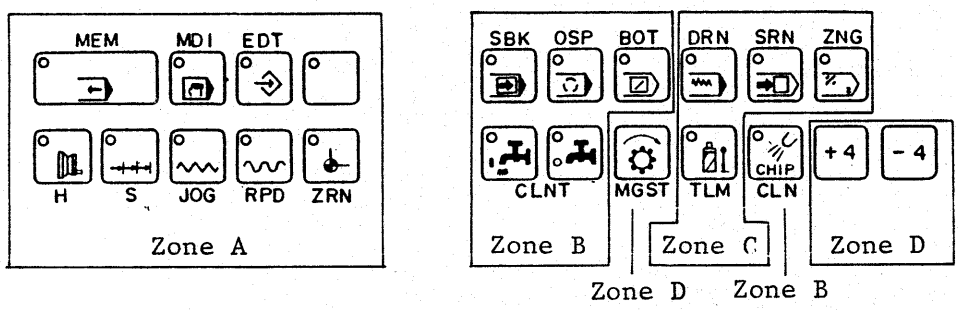
X, Y: 15000 mm/min (590 inch/min)

Z: 12000 mm/min (472 inch/min)

3.1.9 ZRN (Zero return)

Set MODE switch to ZRN to perform manual zero return.
All axes move in the "+" direction during zero return.
The Zero Return mode is automatically selected at the initial start-up. (The Memory Mode can be selected by the parameter setting.) If the coordinates are nearly zero, press the "-" direction button for zero return. If the coordinates are far from zero, press the "+" direction button only one. Zero return is performed automatically.

3.2 Sheet Key Operation

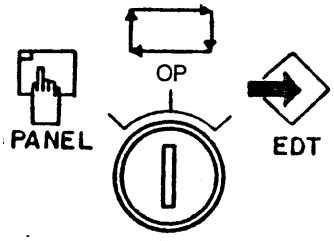


Sheet key operation zone

Zone A: Alteration is possible only when the Automatic Start LED lights.
Zone B: Alteration is always possible when power is supplied.
Zone C: Alteration is possible only when the key switch is set to PANEL.
Zone D: Alteration is possible only in the manual mode.

Key switch

Editing key



° This key switch is used to prevent accidental alteration of the programs in the memory from maloperation.

° Setting the switch to the EDIT position allows rewriting the programs, offset values, absolute coordinates, and setting data.

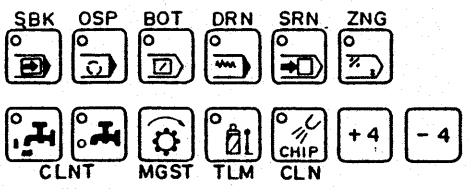
° When the key switch is set to the EDIT position, cycle start cannot be performed.
Changing the sheet keys of zones A and B is possible, however.

Operation

° In the automatic operation mode, only the sheet keys of Zone B can be changed.
When not in the automatic operation mode (including temporary stop), the sheet keys of zones A and B can be changed.

° If the sheet keys of zone C which may cause an accident if are operated improperly by mistake can be changed only in this condition.
Other interlock functions can be used by parameter setting.
The machine stops temporarily during operation.

3.2.1 Panel Switches



When one of these panel switches is pressed, its corresponding function is activated, and the LED housed in the switch lights. When the switch is pressed again, the LED goes off, indicating that the function is inactivated.
The MGST, +4 and -4 panel switches have no LED.

3.2.2 SINGLE BLOCK

- This function is used to temporarily stop the machine at the end of given block, or to read block data on the program one by one.
- When this switch is turned on during the machine running, command are executed and the machine stops.
- When this switch is turned on and the machine is moved by the CYCLE START button, one block data on the program are executed and the machine stops.

3.2.3 OPTIONAL STOP

OSP

With this button pressed, the switch ON/OFF display lamp lights. Pressed again, the lamp goes off. M01 command in the program is effective while the lamp is lit. When a movement command is present in the same block, the movement command is completed before M01 command is executed. In this time, machine feed, spindle rotation, coolant pump, etc. stop and the M01 execution lamp lights.

With this switch OFF M01 command is ignored.

When the program is stoppped by an M01 code, the M00/M01 lamp lights.

3.2.4 BLOCK DELETE

BDT

With this switch at:

OFF ..... Data in slashed (/) blocks on a program are executed.

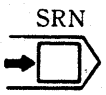
ON ..... Data in slashed (/) blocks are ignored.

3.2.5 DRY RUN

When this switch is turned on, the feed rate commanded on the program is ignored, and the machine operates at the dry run speed.
This switch is valid when the MODE selection switch is set to TAPE, MEMORY or MDI.
This dry run speed can be overriden in the range of 0∿2000 mm/min (0∿80 inch/min) by the FEED RATE OVERRIDE setting switch.

Note: Dry run is invalid in the following cases:
(a) Manual operation
(b) Tapping

3.2.6 SEQUENCE RETURN



This function is used to make cycle start from the middle of the program interrupted or from any portion of the program. G and S functions are memorized and executed. T functions can be offset, but indexing is not executed. So indexing must be executed by MDI.
M functions do not operate at all in the restart condition. Therefore, M03 (M04) must be inputted by MDI.

3.2.7 Z COMMAND NEGLECT

(Z-axis cancel valid/invalid selection switch)
With this switch ON, only commands for Z-axis are ignored in automatic operation (MDI/TAPE/MEMORY) and manual operation (JOG/HANDLE/STEP).

Notes 1: If the Z-axis cancel signal is turned on and off during command execution, block stop occurs when the block subjected to on/off operation is completed.
If this switch is ON when the CYCLE START button is pressed, Z-axis commands are ignored in the subsequent blocks.

3.2.8 Coolant

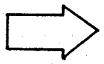
ON OFF

° Pressing the left ON button supplies coolant and pressing the right OFF button stops coolant supply.
° With the OFF lamp lit (by pressing the OFF switch) during the memory, tape or MDI operation, the coolant will not be discharged when an M code for coolant discharge is read, and the ON lamp will light. (Both the ON and OFF lamps are lit.) (The OFF lamp will start blinking when a cycle start is activated with the lamp lit.) To discharge the coolant, press the ON switch. The OFF lamp will turn off, and the coolant will be discharged.

* To turn off the OFF lamp when only the lamp is lit, press the OFF switch again.
* The ON lamp lights when the ON switch is pressed or when an M code for coolant discharge is read.
* The ON lamp turns off when the OFF switch is pressed in the manual operation mode.
* The OFF lamp lights when the OFF switch is pressed during the lighting of both ON and OFF lamps.

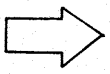
* The OFF lamp turns off when the OFF switch is pressed while the OFF lamp is lit or is blinking.

To discharge coolant
Press the ON switch.



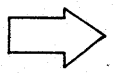
When the ON lamp is lit and the OFF lamp is lit or is blinking

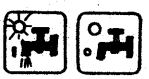
To stop the coolant discharge
Press the OFF switch.



When only the ON lamp is lit.

To discharge the coolant
Press the ON switch.





When only the OFF lamp is lit or is blinking

3.2.9 MAGAZINE START

Press this button to rotate the magazine manually for tool replacement.
This button is operative in the manual operation mode.
This magazine rotates in the normal direction when the button is pressed and stops when the button is repleased.

3.2.10 CHIP CLEAN

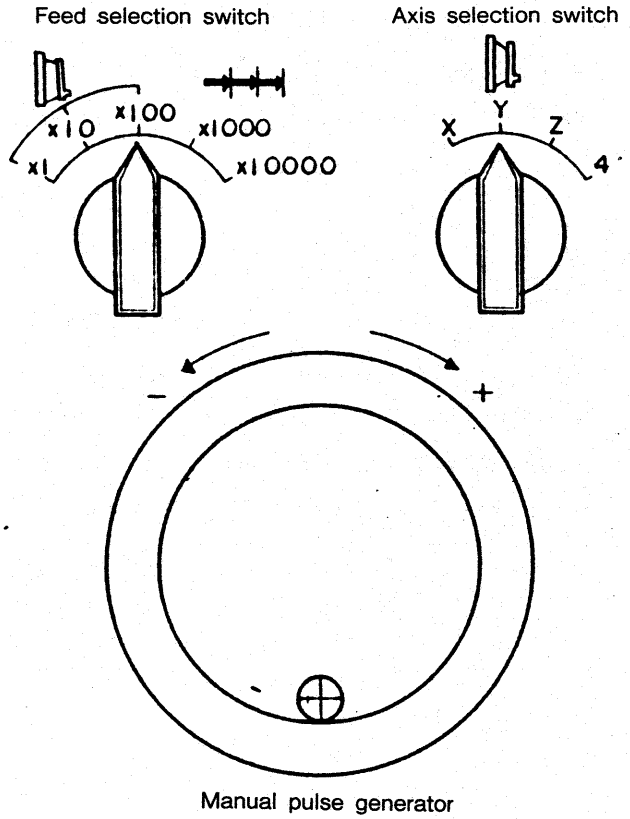
This switch controls on and off operation of the coolant unit for chip removal which is optionally available. Pressing the button once supplies coolant and pressing it on the second time stops coolant discharge.

3.2.11 4TH AXIS FEED BUTTON

+4, -4

This switch is used when an optional 4th axis is added to the machine. Use the switch just as you do with the X, Y and Z axes. Clamping and unclamping the 4th axis is controlled by M10 and M11 codes respectively.

3.3 Manual Pulse Generator



The manual pulse generator is portable.

Rotation of the manual pulse generator dial allows the handle feed of the axis selected with the axis selection switch. When the mode switch is set to H (HANDLE), the handle mode lamp lights.

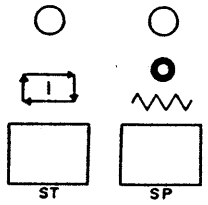
The selected axis is fed in the "+" direction when the pulse generator dial is turned clock wise, and when turned counter clock wise, the axis is fed in the "-" direction.

The feed amount of one graduation (one pulse) of the manual pulse generator is switchable in units of 1/1000, 1/100, and 1/10 (mm) (1/10000", 1/1000", 1/100") by the feed amount selection switch.

3.4 CYCLE START (Cycle start)

This pushbutton is used to start an automatic operation (TAPE/MDI/MEMORY operation). During automatic operation, the lamp over this pushbutton lights.

3.5 FEED HOLD (Feed hold)

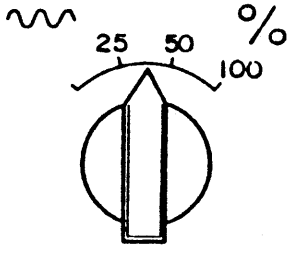


This pushbutton is also called the "temporary stop switch", and it is used to temporarily stop feeding in an automatic operation started with the CYCLE START button.
During temporary stop, the lamp over this pushbutton lights.

Note: If the CYCLE START pushbutton is kept pressed, this functions will not start, i. e. the button must be released.
To resume the operation, press the CYCLE START button again.

The Feed Hold button is used for ATC or SBC return cycles or ATC or SBC independent operations. For details, refer to the descriptions regarding the ATC or SBC return cycles or ATC or SBC independent operations.

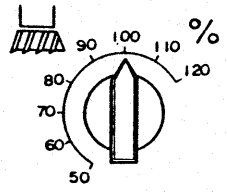
3.6 RAPID FEED RATE OVERRIDE



By this switch setting, rapid feed rate can be overriden from fine feed (10%) to 100%.
The rapid feed rates for the X, Y and Z axes are as follows.

X, Y	15000 mm/min	(590"/min)
Z	12000 mm/min	(472"/min)

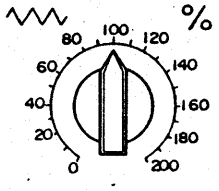
3.7 SPINDLE SPEED OVERRIDE



When the spindle is rotated, spindle speed can be overriden from 50 to 120% with this switch. Command speed of MDI/TAPE/MEMORY operation corresponds to 100%.

3.8 FEED RATE OVERRIDE

JOG FEED RATE



The feed rate (100%), designated in F code of automatic operation mode, can be varied from 0% up to 200% in 10% increments. With this switch at 0%, feed of all axes stops, that is, this switch functions in the same way as the feed hold switch.

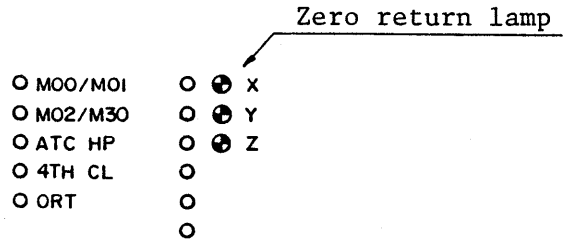
Notes 1: When the tapping mode (G74 and G84) is commanded, feed rate is regarded as 100%.

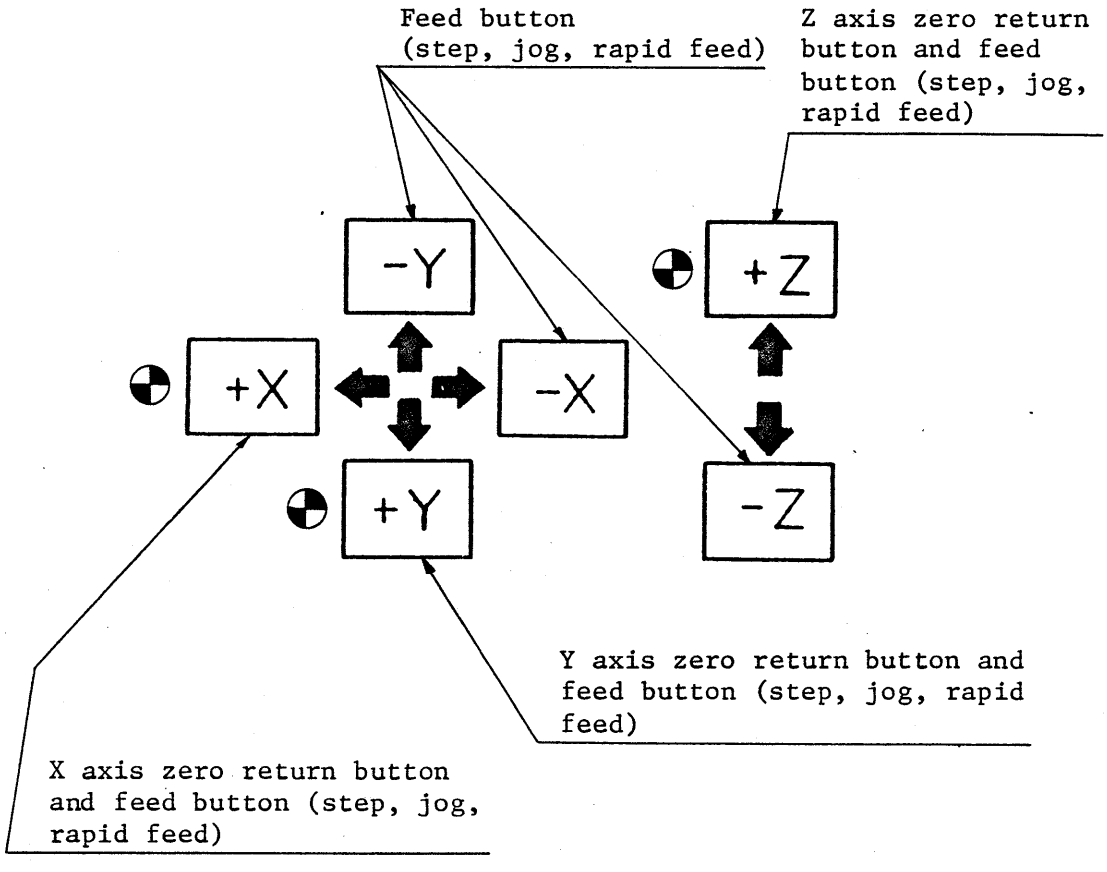
The same switch is used for jog feed. During a jog feed, the 100% on the meter scale represents 1000 mm/min (40"/min). (Setting must be made to NC parameters.)

NC parameter No. 1423: Jog feed rate

NC parameter No. 1410: Dry run speed

3.9 FEED BUTTON



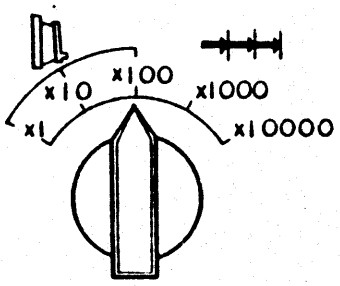


1) By pressing the X, Y or Z axis zero return button in the zero return mode, the corresponding axis moves at the speed specified by the rapid feed rate (from fine feed to 100%). (An automatic zero return will be performed by pressing the zero return button and releasing it once. Parameter setting can be changed to require continuous pressing of the button.)

2) When the zero return is completed by using "G27" or "G28" in the MDI or memory operation, the zero return completion lamp "◔" lights.

3) When the feed switch (step, jog, rapid feed) is pressed, the corresponding axis moves in the plus or minus direction at the speed set by the jog override control.

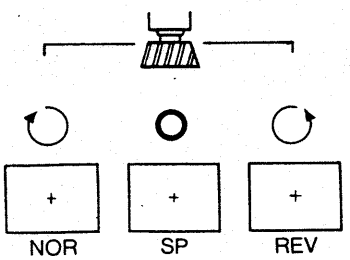
3.10 Step Feed Selection Switch



This switch sets the step feed amount. Set the mode switch to →→→ (STEP). With a single press of a button (see 3.9), the axis moves in the direction designated (with the button) by an amount determined by the jog feed rate.

3.11 SPINDLE (Spindle start)

These switches are used to rotate spindle normally or reversely, or to stop the spindle when automatic operation (MDI/TAPE/MEMORY) is switched to manual operation.



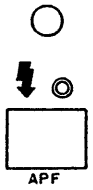
NOR — NORMAL
SP — STOP
REV — REVERSE

Normal ..... Clockwise rotation as viewed from spindle to workpiece.

Reverse ..... Counterclockwise rotation as viewed from spindle to workpiece.

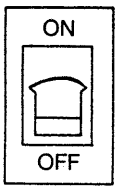
(Functions of these switches will not be actuated if the switches are kept pressed, i.e. the switches must be released.)

3.12 APF (Automatic Power Cutoff)



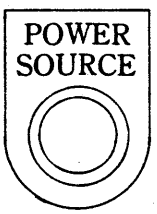
When the button is pressed, the LED above the button lights. When the M02 or M30 code is read during the memory operation with the LED lit, the power supply circuit is automatically cut off. (M00 and M01 can also be used by parameter setting.) The automatic power cutoff does not take place when the LED is not lit. To turn off the LED, press the button once again.

3.13 MAIN SWITCH



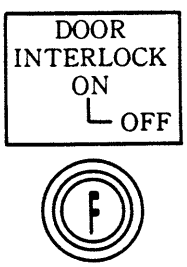
This switch also functions as a no-fuse breaker (NFB) and is automatically turned off when an overcurrent flows in the machine circuit.

3.14 POWER SUPPLY



The lamp lights to indicate that the power has been supplied to the primary of the non-fuse breaker.

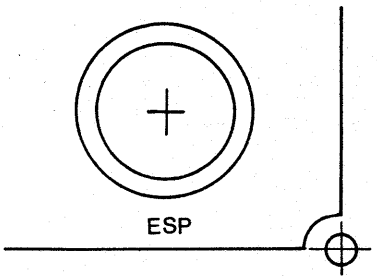
3.15 DOOR INTERLOCK



These key switches are installed on the doors of the power board and the NC unit.
These switches must be set to ON for safety.
At ON setting, when the door is opened with power supply on, the door switch functions to shut off the main switch.

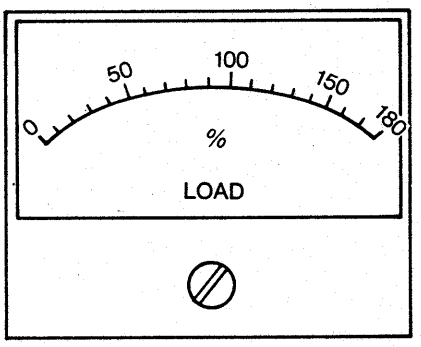
Set these switches to OFF when power supply should be on when the door is opened, such as during servicing.

3.16 EMERGENCY STOP



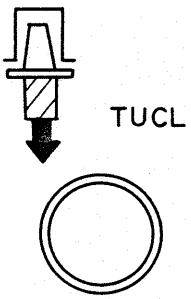
When this button is pressed, the NC servo power supply is turned off, the CONTROL ON (operation ready) switch is turned off, and all motion stops.
When this button is turned clockwise, emergency stop is released. Then, press the CONTROL ON switch to restart the servo power supply.
After power is resumed, be sure to perform zero return operation.
This button is also used to cut power off after operation.

3.17 SPINDLE LOAD



This meter indicates the load applied to the main motor in percent (%).
When the speed is in the rated output range, the 100% on the scale represents 3.7 KW (5.0 HP) and the 150% represents 5.5 KW (7.4 HP).

3.18 TOOL UNCLAMP



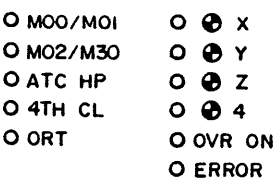
This button is pressed to remove the tool from the spindle. The tool is unclamped when the button is kept pressed.

3.19 DESCRIPTIONS OF THE LAMPS

1) M00/M01 lamp

i) The lamp lights when the M00 code is read.

ii) The lamp lights when the M01 codes is read with the OSP button pressed.



2) M02/M30 lamp

The lamp lihgt when the M02 or M30 code on a program is read.

3) ATCHP lamp

The lamp lights when the double arm is at the home position. The lamp is off during the ATC cycle.

4) 4THCL lamp

With a 4th axis option, the lamp lights when the 4th axis is clamped.

5) ORT lamp

The lamp lights when the spindle orientation is completed.

6) X, Y, Z, and 4 lamps

When the X, Y, Z and 4th axes have completed their zero return to their first origin, the corresponding lamps light. The 4 lamp lights only when a 4th axis option is equipped.

7) OVRON lamp

The lamp lights when the feed override is other than 100%. By changing the parameter, the lamp can light to indicate that the rapid feed override or the spindle override is other than 100%.

8) ERROR lamp

The lamp lights when a program error, machine error or data error occurs.

2. MANUAL OPERATION

1. Before Supplying Power

Make sure that doors on the power board and on the NC control board are closed.

The power unit and the NC unit has an enclosed construction to seal internal parts form ambient air. Do not leave doors, open for extended periods.

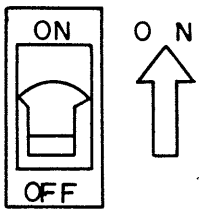
2. Power Supply

Make sure that the power lamp lights.
The POWER lamp **lights when the input power supply is turned on.**

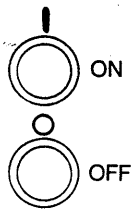
Power source lamp

Turn the main switch on.

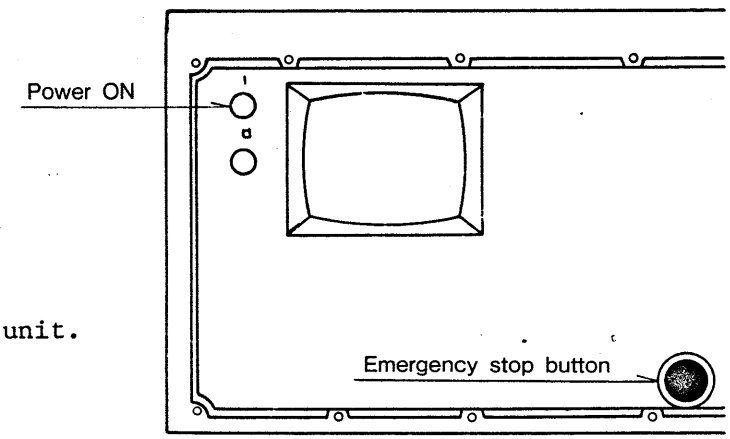
Press POWER ON button.



Main switch



POWER ON/OFF buttons are located on the front control panel.



Pressing the POWER ON button supplies the power to the control unit.

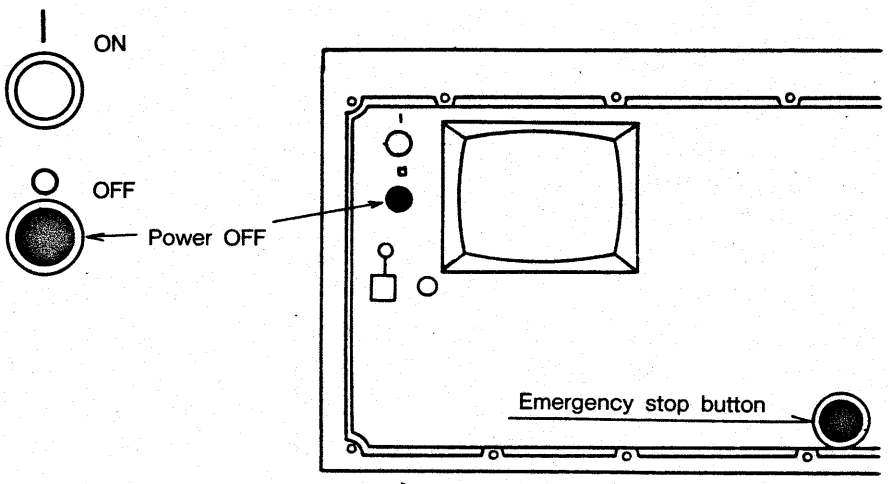
Note: When the EMERGENCY STOP button is pressed, the inverted display "EMG" appears on the CRT screen, and power is not supplied to the control unit even if the POWER ON button is pressed. In this case, turn the EMERGENCY STOP button clockwise to reset, and press the POWER ON button again. The power is then supplied to the control unit.

3. Turning Power Supply Off

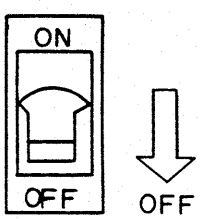
Press EMERGENCY STOP button.

Once this button is pressed, emergency stop function continues until the button is reset by turning clockwise.

Press POWER OFF button.



Turn the main switch (no-fuse breaker) off.

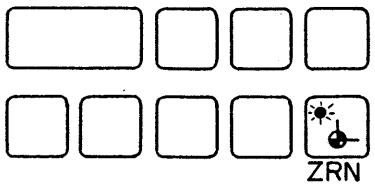


4. Zero Return (ZRN)

Perform zero return operation in the following cases.

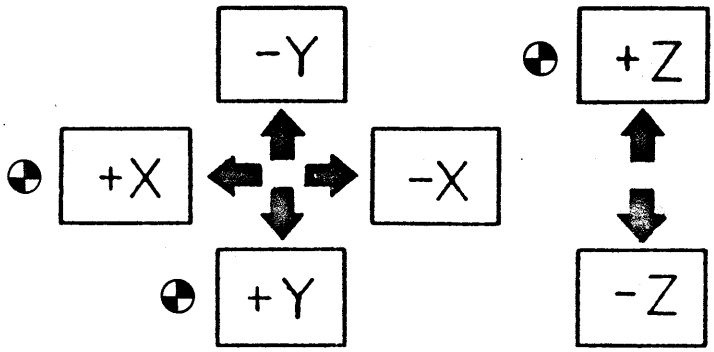
1. When power is supplied at the start of daily work. (Zero return is automatically selected by parameter setting.)
2. Before obtaining tool offset amount after tool setting.
3. When an operator makes an error.

Set MODE switch to ZRN (ZERO RETURN).



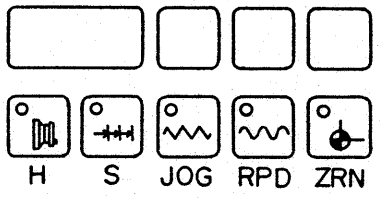
Press the FEED pushbutton corresponding to the desired axis for zero return.

° The table travels to approximate machine origin in rapid feed, and then automatically decelerates to complete return.

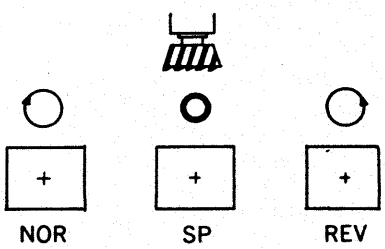


5. Spindle Start

Set MODE switch to a manual position (H/S/J/RPD/ZRN).



Press SPINDLE start button.



NOR (NORMAL) ..... Normal rotation

SP (STOP) ..... Stop

REV (REVERSE) ..... Reverse rotation

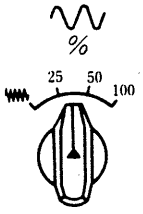
Normal ..... Clockwise rotation as viewed from spindle to workpiece.

Reverse ..... Counterclockwise as viewed from spindle to workpiece.

Notes:
- Functions of these switches will not be actuated if the switches are kept pressed, i.e. the switches must be released.
- Rotating direction can be changed between NORMAL and REVERSE without stopping the spindle.
- Spindle speed must be previously commanded by MDI.

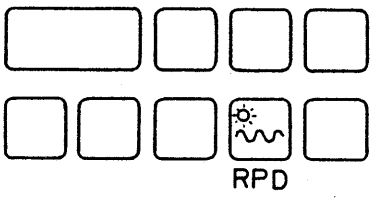
6. Rapid Feed (RAP)

Rapid feed is used for rough positioning.
The rapid feed rate is 15,000 mm/min (590"/min) for the X and Y axes, and 12,000 mm/min (472"/min) for the Z axis.

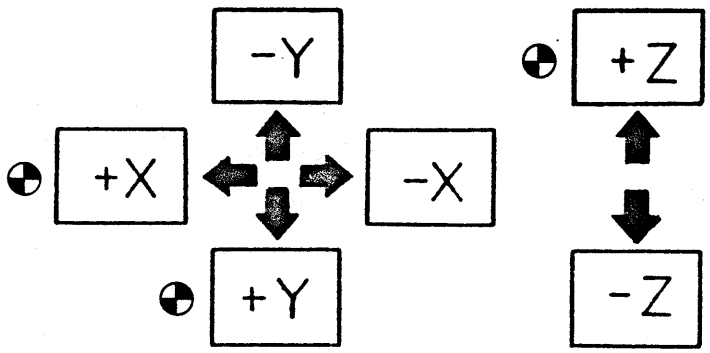


The feed rates can be reduced by turning the rapid feed rate override control.

Set MODE switch to RPD.



Press the FEED pushbutton corresponding to the axis and direction to be fed.

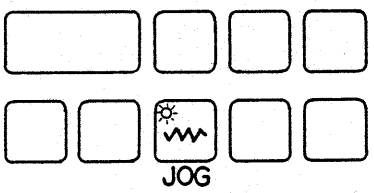


° Rapid feed functions while the FEED button is pressed, and stops when it is released.

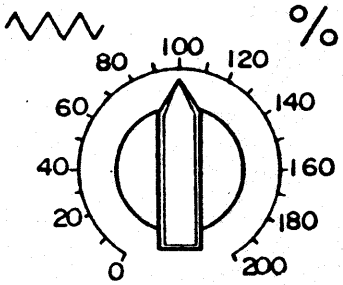
7. JOG Feed

JOG feed (manual continuous feed) is used for cutting over relatively long distances and positioning.

Set MODE switch to JOG.

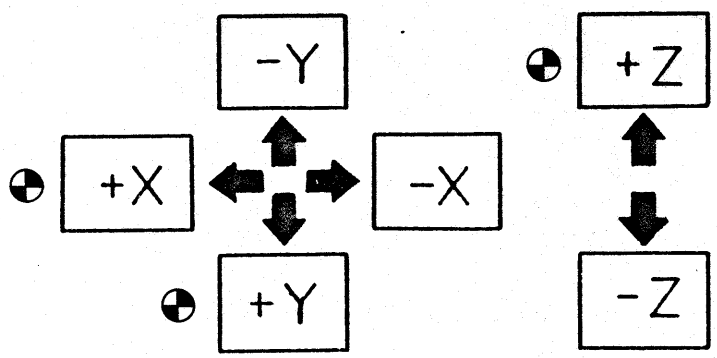


Set the desired feed rate.



Set the feed rate (for the 100% setting of the feed override) to NC parameter No. 1423.

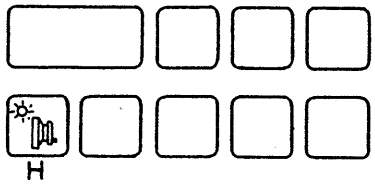
Press the FEED pushbutton corresponding to the axis and direction to be fed.



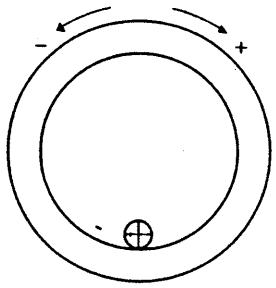
8. HANDLE FEED

Also called a manual pulse generator, the HANDLE is used to skin-cut the workpiece during setup or to make final fine-adjustment during positioning.

Set the MODE switch to the HANDLE position

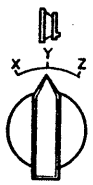


The lamp on top of the manual pulse box also lights.

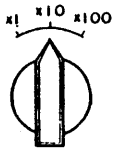


Manual pulse generator

Determine the axis to feed and the feed amount.

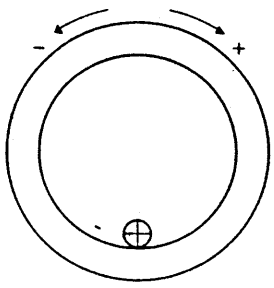


Select the axis to feed.



Select the feed amount.
The numbers above the switch represent magnifications of the minimum output.

Turn the manual pulse generator knob.



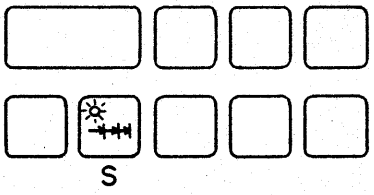
Turn the knob clockwise to move the axis in the plus (+) direction.

Turn the knob counterclockwise to move the axis in the minus (-) direction.

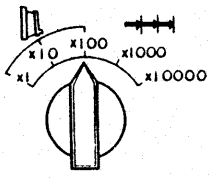
9. Step Feed

By pressing a FEED pushbutton, the corresponding axis(table/spindle) is moved over the preset constant distance at the JOG feed (manual continuous feed) rate.

Set MODE switch to S (STEP).

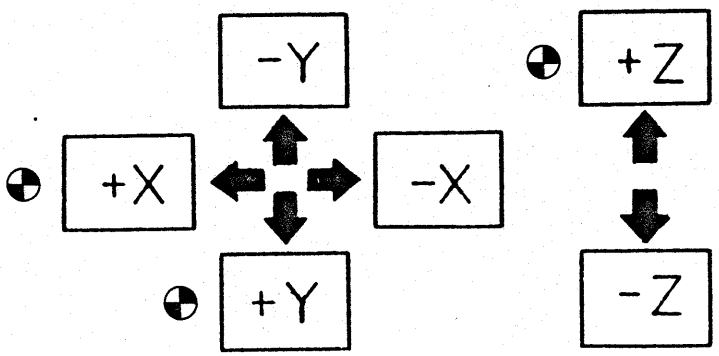


Set STEP setting switch to the desired step feed amount.



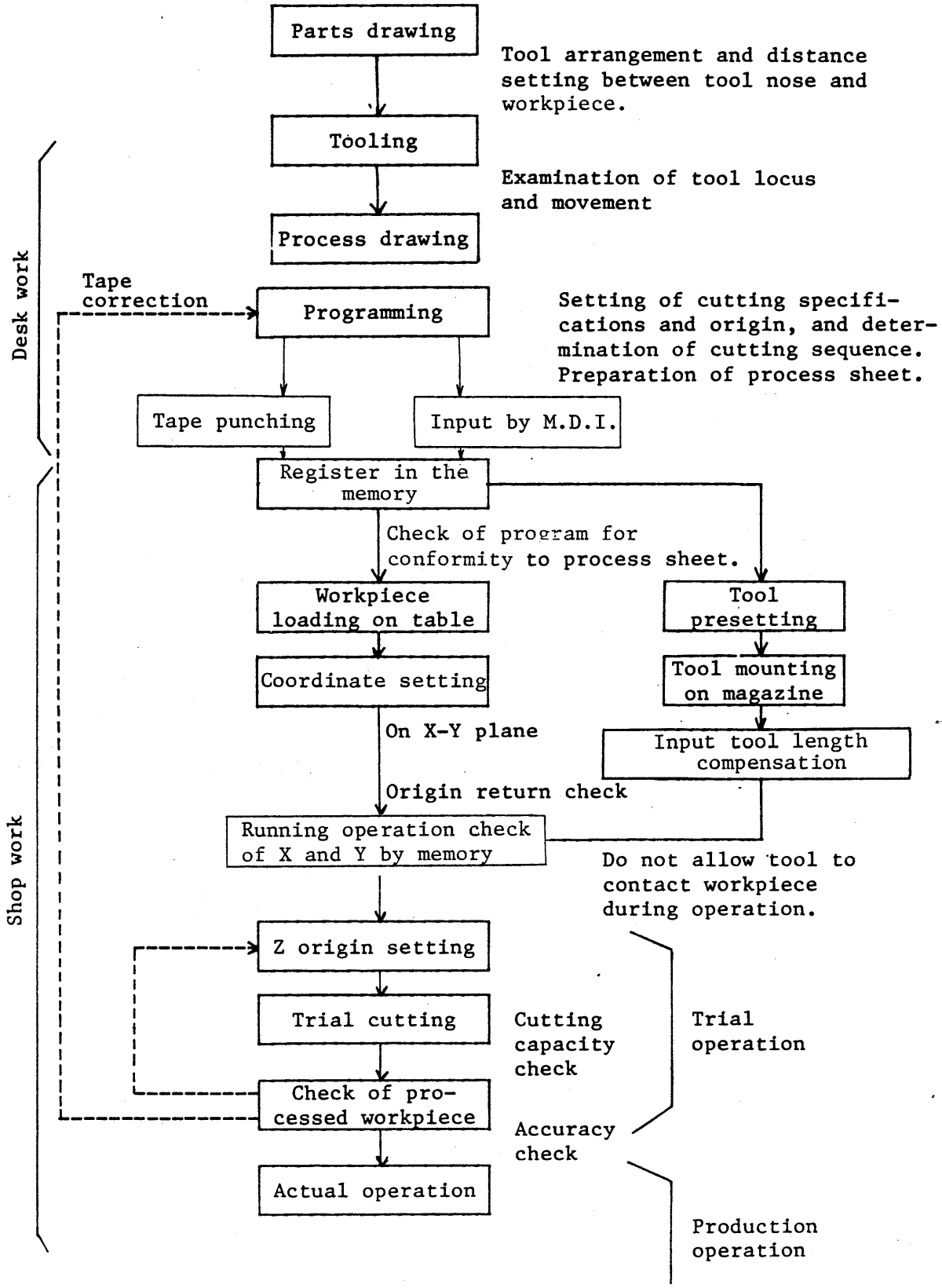
° Select the step feed amount as required.
° Dial settings are for amount to be fed by one pressing of the selected FEED button.

Press the FEED pushbutton corresponding to the axis and direction to be fed.



3. AUTOMATIC OPERATION

1. Automatic Operation Procedure



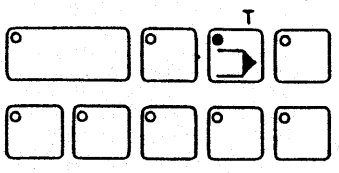
2. Tape Operation

When all items illustrated in the previous page are satisfied, the following operations can be performed.

Load an NC tape on the tape reader.

See next page for tape setting.
Operator's hand must be clean and dry.
The tape reader is a optional equipment.

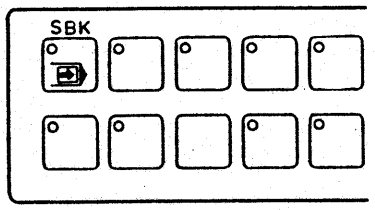
Set MODE to TAPE.



Depress RESET button on the control panel.

RESET button is red.

Turn on SINGLE BLOCK if necessary.



Depress CYCLE START button on the control panel.

The lamp lights.

Depress FEED HOLD. Only feed is halted.

The lamp lights.

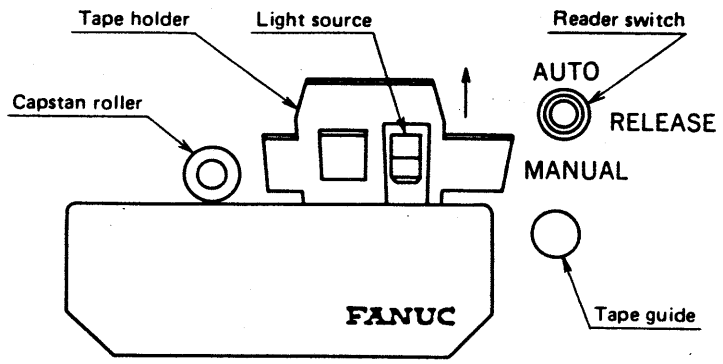
Note: Depress EMERGENCY STOP button if any trouble occurs.

2.1 NC Tape Setting

Set the tape reader switch to RELEASE. (The tape reader is a optional equipment.)

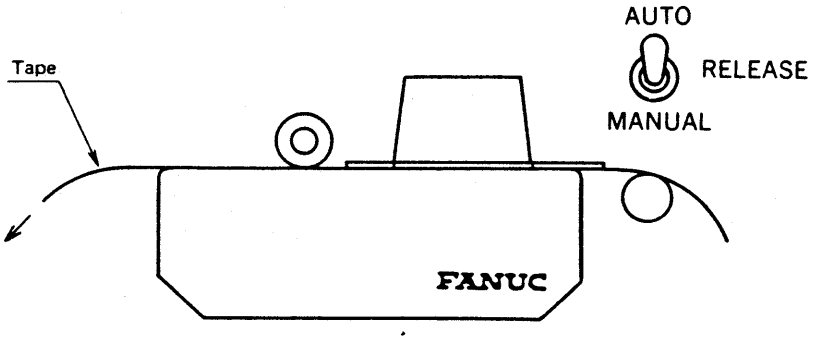
(This de-energizes the absorption magnet of tape holder.)

Lift the tape holder and thread the tape underneath the holder.



Lower the tape holder and check for smooth tape run.

Set the tape reader switch to AUTO to finish tape setting.



Note: Do not attempt to set the tape reader switch to MANUAL. MANUAL setting should be used only by service personnel. After reading the tape, the switch must be returned to the RELEASE position.

3. Memory Operation

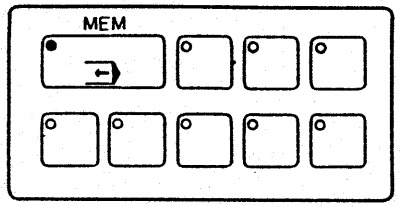
Store NC tape data in memory.

Refer to "Deletion" and "Storing" in the following pages.

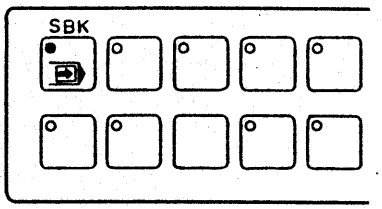
Search program number according to work.

Refer to 8.

Set MODE to MEMORY.



Turn on SINGLE BLOCK if necessary.



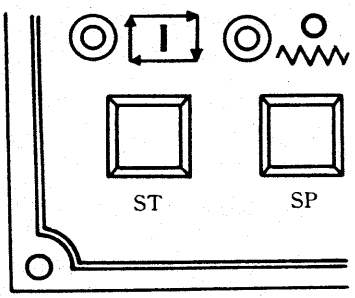
Press CYCLE START on the control panel.

The lamp lights.

Pressing FEED HOLD, only feed is halted.

The cycle start lamp goes off and the temporary stop lamp lights.

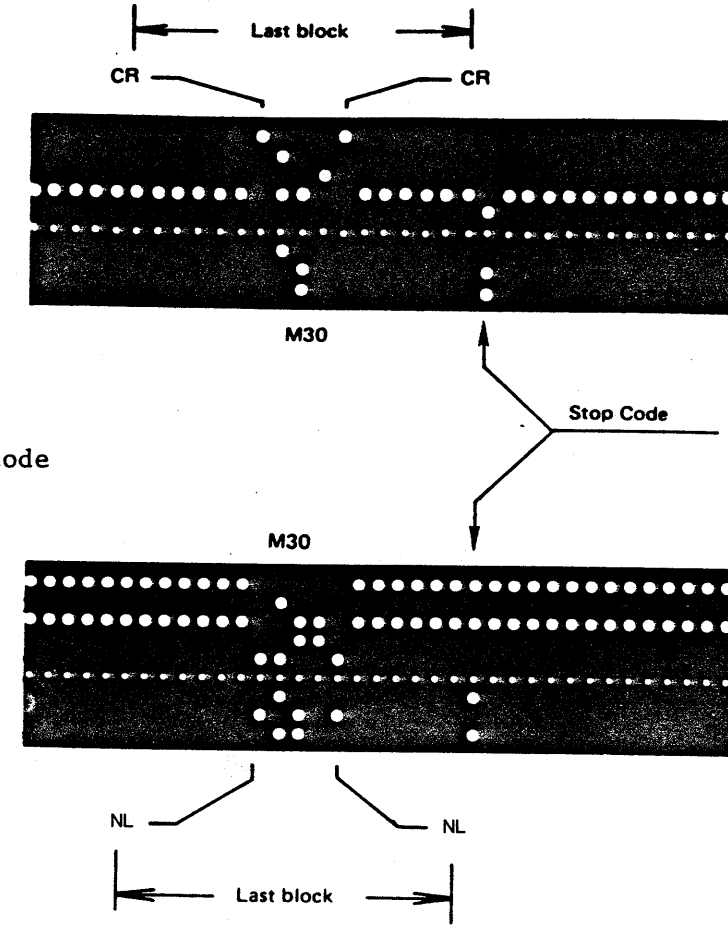
Note: Depress EMERGENCY STOP button if any trouble occurs.



3.1 Before Storing NC Tape Data in Memory

1) Check that M30 is commanded in the last block of the tape program.
2) Check that stop code is perforated at the end of the tape program.

∘ EIA code



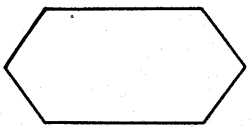
∘ ISO code

3) Check that memory has been deleted. (After the machine is delivered, delete all programs for correct operation. When adding new programs to the existing program, there is no need for clearing.)

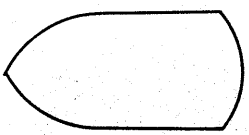
4. CRT Function and Operation

See "Function Indicaion item 3" in Functional Explanation for functions.

4.1 Flow chart symbols

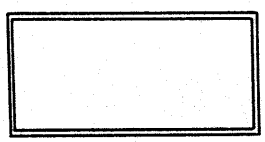


..... Represents a preparation by setting mode switches.

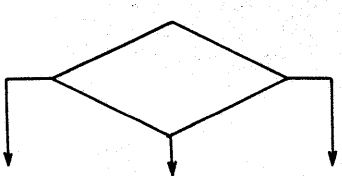


..... **Represents a display on the CRT.**

..... **Represents pressing of a button on the control panel.**

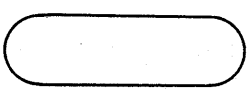


..... **Represents commanding a figure by operating data keys.**



..... **Represents a selection that determines which of a number of alternative operation procedures is to be followed.**

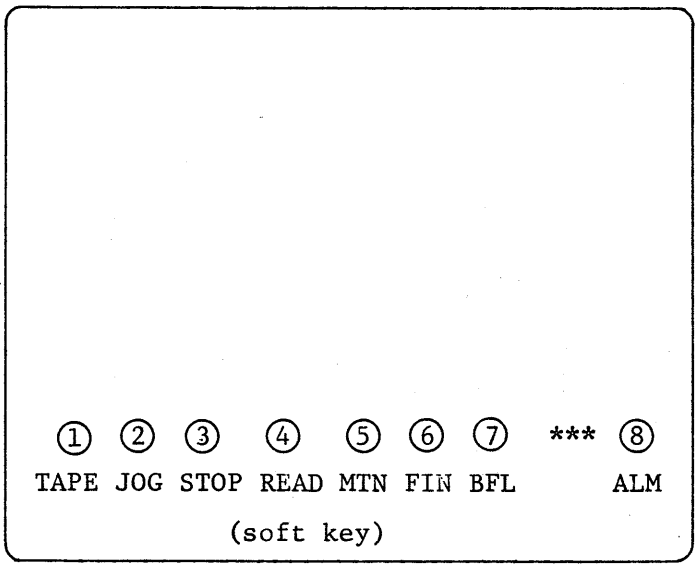
..... Represents paper tape.



..... Represents a terminal point.

4.2 Status Display

Status display appears on the second to the last line (the line above the soft key display) of the CRT screen.



This display is divided into 8 fields (1 to 8) providing the following information common to all NC displays.

1) Mode selection in automatic operation
   (MEM, MDI, TAPE, EDIT, or ****)
   The automatic operation mode selected at the time is displayed.
   Unless automatic operation is selected, "****" is displayed.

2) Mode selection in manual operation
   (JOG, HND, INC, AGJ, J+H, REF, or ***)
   The manual operation mode selected at the time is displayed.
   Unless manual operation is selected, "***" is displayed.

3) Status of automatic operation
   (RSET, STOP, HOLD, STRT, MSTR, or SRCH)
   The status of automatic operation is displayed.
   RSET: Resetting
   STOP: Automatic operation is stopped.
   HOLD: Automatic operation is held.
   STRT: Automatic operation is started.
   MSTR: Manual numerical command is started.
   SRCH: Sequence number is being searched.

4) Status of program editing
(READ, PNCH, VRFY, SRCH, COND, EDIT or ****)
The status of program editing is displayed.
READ: Program is being registered.
PNCH: Program is being punch out.
VRFY: Program is being verified.
SRCH: Program is being searched.
COND: Memory is being conditioned.
EDIT: Other editing operations (INSERT, ALTER, etc.)
****: No editing operation is performed.

5) Axis movement and dwell (MTN, DWL or ***)
"MTN" is displayed when the axis is moved, "DWL" is displayed when dwell is performed, and "***" is displayed when neither is performed.

6) Status of M.S.T.B. function (FIN or ***)
"FIN" is displayed while auxiliary functions, such as M, S, T, and B, are being executed while wating a completion signal from the PC. "***" is displayed in all other cases.

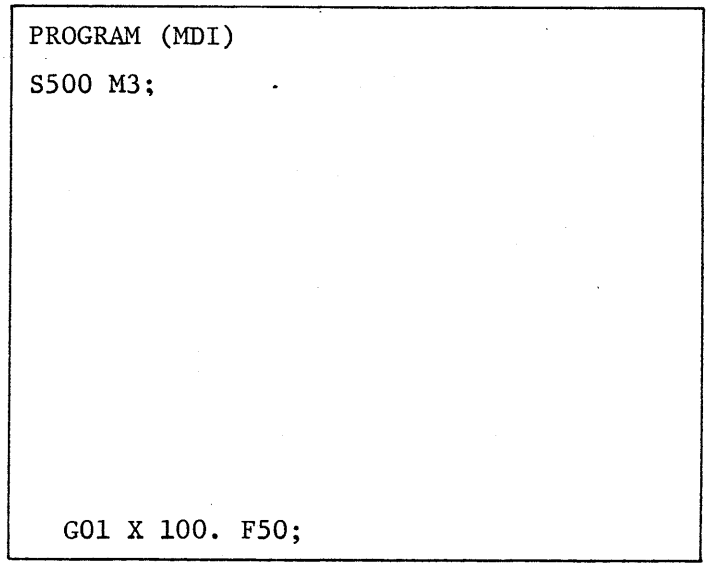
5')6') Emergency stop (EMG)
When an emergency stop is activated, displays 5 and 6 are replaced with an inverted "--EMG--" display.

7) Automatic operation buffer (BEL or ***)
"BFL" is displayed when the buffer for automatic operation is not empty. "***" is displayed when empty.

8) Alarm (ALM, BAT or ***)
"ALM" (inversed blinking) is displayed while the alarm is issued. "***" is displayed otherwise.
In FS10, when no alarm is isssued, the status of the battery alarm is displayed. If a signal warning of battery failure is sent, "BAT" is displayed. After replacement of the battery, "***" is dispalyed by pressing the RESET button.

4.3 Key Inputs

Addresses and numerals input through the corresponding keys are displayed at the bottom of the CRT screen. Symbol ">" leads the data to indicate that the data has keyed-in. Some keys have two inscriptions placed up and down. To input the letter at the down position of such a key, press the SHIFT key first and then press the key.



Up to 78 letters can be keyed-in for a single word, or for a block or multiple blocks at one time.

(1) Insertion of letters

Move the cursor"__" using the [→→] and/or [←←] keys to where letters must be inserted and then enter the letters.

Example: Display of key input buffer >N001X100.0Y200.0F100.0:_

To insert G90 after N001:

- Press the [←←] cursor shift key and move the cursor to the position as shown below:
  >N001_X100.0Y200.0F100.0;
- Key-in G90.
  >N001G90_X100.0Y200.0F100.0;
- Press the [→→] cursor shift key and move the cursor to the position as shown below:
  >N001G90X100.0Y200.0F100.0;_

(2) Deletion of letters

Move the cursor to the right of the letter to be deleted, and press the CAN key.

Example: Display of key input buffer >N001X100.0Y200.0F100.0;_

To delete Y200.0

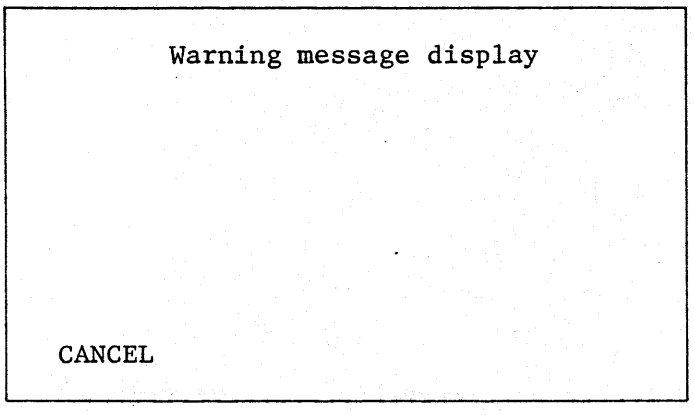
- Press the [←←] cursor shift key to move the cursor to the position as shown below:
  >N001X100.0Y200.0_F100.0;
- Press the CAN key five times.
  >N001X100.0_F100.0;
- Press the [→→] cursor shift key to move the cursor to the position as shown below:
  >N001X100.0F100.0;_

Note: Pressing the [SHIFT] and [CAN] keys delete all characters in the key input buffer.

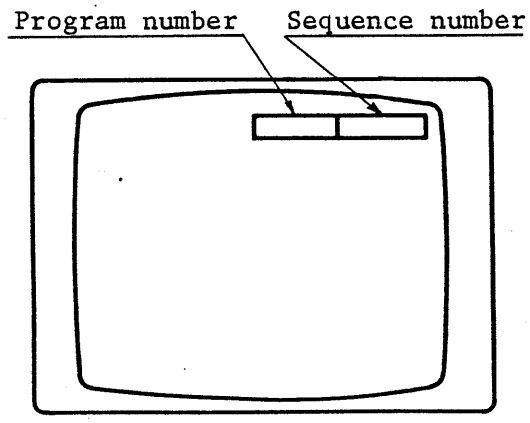
4.4 Warning Message

Data must be input according to a specified form. If any data contrary in form has been erroneously entered into the key input buffer and an attempt was made to execute operation, a warning message will be displayed.

When the warning message is displayed, the soft key is changed to the CANCEL key. Press this soft key to cancel the warning message. Then correct the data in the key input buffer as the specified. Operation can then be executed.



4.5 Display of Program Number and Sequence Number



The program number and sequence number are displayed in the top right corner of the screen.

4.6 Present Position Display and Setting

4.6.1 Display of Present Position

The following four displays are available to indicate present position.

a) Overall position display screen
b) Present position in a relative coordinate system
c) Present position in a work coordinate system
d) Present position in a machine coordinate system

(1) Press [RETURN] key and set the soft keys for function selection.

POSITION	PROGRAM	OFFSET	PRG-CHK	CHAPTER	+

(2) Press the [POSITION] key to cause the present position display to appear.

(3) Press the [POSITION] key repeatedly, and the above four displays will appear in sequence.
Or press the [CHAPTER] key to set the soft key displays for chaper selection.

OVERALL	RELATIVE	ABSOLUT	MACHINE		

a) Press [OVERALL] for overall position display.
b) Press [RELATIV] for the present position display in a relative coordinate system.
c) Press [ABSOLUT] for the present position display in a work coordinate system.
d) Press [MACHINE] for the present position display in a machine coordinate system.

I. Overall Position Display

The following present positions are displayed at the same time.

a) Present postion in a relative coordinate system. (RELATIVE)
b) Present position in a work coordinate system. (ABSOLUTE)
c) Present position in a machine coordinate system. (MACHINE)
d) Remaining distance to be moved. (DISTANCE TO GO)

```
ACTUAL POSITION                O1000 N00000
   (RELATIVE)                  (ABSOLUTE)
   X    0.000                  X    0.000
   Y    0.000                  Y    0.000
   X    0.000                  Z    0.000
   (MACHINE)                   (DIST TO GO)
   X    0.000                  X    0.000
   Y    0.000                  Y    0.000
   Z    0.000                  Z    0.000
```

Remaining distance to be moved by one-block commands.

II. Present Position Display in a Relative Coordinate System (RELATIVE)

The relative position at which a point preset by the operator is 0 is displayed.

```
ACTUAL POSITION          01000 N00000
                    (RELATIVE)
                 X    0.000
                 Y    0.000
                 Z    0.000
```

III. Present Position Display in a Work Coordinate System (ABSOLUTE)

The present position is displayed in the program coordinate system preset by G92 and G54 - G59 (codes for the work coordinate system).

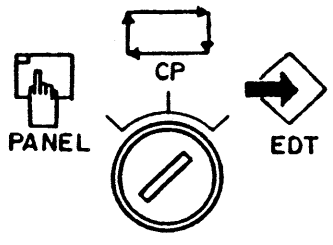
```
ACTUAL POSITION                01000 N00000
                    (ABSOLUTE)
                 X    0.000
                 Y    0.000
                 Z    0.000
```

4.6.2 Setting of the Present Position

I. To Set the Present Position at Zero

1) Select the present position display for setting. (Refer to 4.6.1)

2) Set the key switch at the "EDIT" position. The above operation is necessary for the preset of absolute position but not necessary for the preset of relative position.



3) Press the [NEXT] key to change the soft key displays for operation selection.

ORIGIN	PRESET				

4) Pressing the [ORIGINE] key causes the soft key displays to change for operation guide.

ALL-AXS	(AXIS)				

5-1) To set the coordinate values of all axes at zero press the [ALL-AXS] key.

5-2) To set the coordinate value of a desired axis at zero, key-in the axis name (X, Y, Z). Then, following soft key display will appear.

EXEC					

To set the coordinate values of more than one axis at zero, input the axis names succeedingly.
ex, XYZ
Push the [EXEC] key and the coordinate value of the designated axes is set at zero.

Note 1. Underlines on some keys indicate that their operation is executed immediately after they are pressed. The 9-inch monochrome CRT displays them with high brightness.

Note 2. Parentheses around a key indicate that data corresponding to the display between the parentheses must be input. Press this key. When the address of the data to be input is fixed, the address is displayed in the key input buffer to wait for data input. When it is necessary for an operator to decide the data to be input, a message is displayed that requests data input.

Note 3. When the overall position display is selected, only RELATIVE coordinate system is preset to zero.

4.7 Program Display

In the MEMORY or EDIT mode, the program selected at present can be displayed.

Set the soft keys for function selection.

POSITION	PROGRAM	OFFSET	PRG-CHK	CHAPTER	+

Pressing the PROGRAM key causes the program display or the directory display of programs stored in the program memory to appear on the screen.

When a directory display appears, press the CHAPTER key to change the soft key displays for chapter selection.

TEXT	DIR.MEM				

Then press the TEXT key.

Or press the PROGRAM key repeatedly until a program display appears.

```
O  0001
G54G90GO..
G43Z50HI
  :
  :
  :
  :
  :
```

To display other programs, refer to the section of the program number search.

4.8 Display of Program Command Value

There are six different displays that indicate program command values.

a) Command value and modal value in the last executed block
b) Command value and modal value in the block which is being executed at the present
c) Command value and modal value in the block to be executed next
d) Command value and modal value in the second block after the block which is being executed at the present (This display may not appear depending on the command program)
e) Command value and modal value in the third block after the block which is being executed at the present (This display may not appear depending on the command program)
f) Command value and modal value in the fourth block after the block which is being executed at the present (This display may also not appear depending on the command program)

(1) Set the soft keys for function selection.

POSITION	PROGRAM	OFFSET	PRG-CHK	CHAPTER	+

(2) Press the [PRG-CHK] key to cause a display indicating command value.

(3) If no desired display appears, press the [CHAPTER] key to change the soft key displays for chapter selection.

CHECK	LAST	ACTVE			+

Then press the key of the desired program display

[CHECK] - Check the progress state of the program being executed.
[LAST] - Command value in the last executed block.
[ACTIVE] - Command value in the block being executed

Or press the PRG-CHK key repeatedly until the desired display appears.

(I) Check the progress state of the program being executed.

```
PROGRAM                          01000 N00000
 01000;
 N1 T2;
 G54 G90 G0 X200, Y-75, S800 M3;
 G43 Z50. H1;
 ABSOLUTE       DIST TO GO      G/D/H     (M)
  X 0.000        X 0.000        G91 G54
  Y 0.000        Y 0.000        G01 G80
  Z 0.000        Z 0.000        G17 G64
                                G40 G49
                                D0  H0
  F  (ACT. F)
  S  (ACT. S)
  T
```

(II) Command value in the last executed block

```
COMMAND (LAST)                        01000 N00000
   G01   G97        X        F
   G17   G54        Y        S
   G91   G64        Z        T
   G22   G69        A        M
   G94   G15        B        B
   G21   G50.1      C        D
   G40              U        H
   G49              W        Q
   G80              I        R
   G98              J        L
   G50              K
   G67
```

(III) Command value in the block being executed

COMMAND (ACTIVE)	O1000 N00000
X	F
Y	S
Z	T
A	M
B	B
C	D
U	H
V	P
W	Q
I	R
J	L
K	

4.9 Setting

4.9.1 Input/Output Display and Setting

I. Display

(1) Set the soft keys for function selection.

SETTING	SERVICE	MESSAGE		CHAPTER	+

(2) Press the [SETTING] key to obtain the setting display.

(3) When the input/output setting display does not appear, press the [CHAPTER] key to change the soft key displays for chapter selection.

HANDY	GENERAL	OP.PANL	MACRO		

Then, press the [HANDY] key.
Or press the [SETTING] key repeatedly until the input/output display appears.

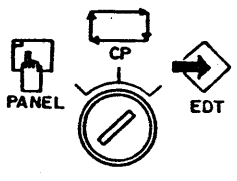
```
SETTING (HANDY)          -
  TV CHECK          = 0 (0:OFF 1:ON)
  PUNCH CODE        = 1 (0:ISO 1:EIA)
  INPUT UNIT        = 0 (0:MM 1:INCH)
  INPUT DEVICE      = 2 (2-3: RS232C
                         11: ASR 13:RS422)
  OUTPUT DEVICE     = 2 (2-3: RS232C
                         11:ASR 13:RS422)
  INPUT DEVICE      = 2 -BG.EDIT-
  OUTPUT DEVICE     = 2 -BG.EDIT-
```

II. Setting

(1) Set the key switch to the EDIT position.

(2) Set the MDI mode.

(3) Obtain the input/output display.
(Refer to the descriptions in "I. Display" above.)



(4) Use the cursor shift key to move the cursor to the position of the item where setting must be made.

(5) Press the [NEXT] key to change the soft key displays for function selection.

INPUT		ON : 1	OFF : 0		+

(6) Set the input/output data in accordance with the following table.

Display	Setting	
TV CHECK	0 : OFF	1 : ON
PUNCH CODE	0 : EIA code	1 : ISO code
INPUT UNIT	0 : mm input	1 : inch input
INPUT DEVICE OUTPUT DEVICE INPUT DEVICE OUTPUT DEVICE	For foreground For foreground For background For background (Setting of I/O devices)	0 : PTR 1: No.1 RS232C interface 2: No.2 RS232C interface 11: 20 mA current loop 13: RS422
MIRROR IMAGE	0: OFF	1: ON

(6-1) Setting 1 or 0

Press the [ON: 1] key to set "1" and the [OFF: 0] key to set "0". Pressing these keys does not affect the soft key displays.

(6-2) Setting data other than 1 and 0

i) Pressing the [INPUT] key changes the soft key displays for operation guide.

ii)

(VALUE)					

ii) Key-in the data that must be set.

The following soft key display will appear after keying-in.

EXEC					

iii) Pressing the [EXEC] key sets the data, and the soft key display will return to the one for operation selection.

Note: In steps 5 and 6, the numerical keys (0 to 9) and the [INPUT] key can be used to input the data instead of the soft key.

4.9.2 Display and Setting of Settable Parameters

The types of settable parameters are described in the section "Parameters".

I. Display

(1) Select the MDI mode.

(2) Set the soft key for function selection.

SETTING	SERVICE	MESSAGE		CHAPTER	+

(3) Pressing the [SETTING] key causes a setting display to appear.

(4) If the setting display is the one having no settable parameters, press the [CHAPTER] key to change the soft key displays for chapter selection.

HANDY	GENERAL	OP.PANEL	MACRO		+

Then, press the [GENERAL] key. The settable parameters will be displayed.

Or press the [SETTING] key repeatedly until the settable parameters appear.

(5) When the display does not have the desired parameters:

(5-1) Change the page by pressing the cursor shift key or the page change key.

(5-2) Use of the soft key

i) Press the [NEXT] key to change the soft key displays for operation selection.

INPUT		ON : 1	OFF : 0	INP-NO.	+

ii) Pressing the [INP-NO.] soft key causes the soft key displays to change for operation guide.

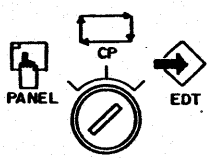
(VALUE)					

iii) Key-in the data number of the parameter that must be displayed. The following soft key display will appear after keying-in.

EXEC					

iv) Pressing the [EXEC] key causes the display indicating the parameter of the keyed-in data number to appear. And the soft key display will return to the one for operation selection.

II. Setting



(1) Set the key switch to the EDIT position.

(2) Select the MDI mode.

(3) Obtain the parameter display for setting. (Refer to the descriptions in "I. Display" above.

(4) Move the cursor by using the cursor shift key to the parameter where setting must be made.

(5) Change the soft key displays for operation selection.

INPUT		ON : 1	OFF : 0	INP-NO.	+

(6-1) Setting 1 or 0

Press the [ON : 1] key to set "1" and the [OFF : 0] key to set "0".

(6-2) Setting data other than 1 and 0

i) Pressing the [INPUT] key changes the soft key displays to the one for operation guide.

(VALUE)					

ii) Key-in the data to be set.

To input data for a series of parameters, punctuate each data using the "EOB" (end of block) key.

Example 100 ; 200 ; 300

When ";" is entered, the cursor automatically advances by one step.

The following soft key display will appear after keying-in.

EXEC					

iii) Pressing the [EXEC] key sets the keyed-in data, and the soft key display will return to the one for operation selection.

4.9.3 Display and Setting of Menu Switch

I. Display

1) Set the soft keys for function selection.

SETTING	SERVICE	MESSAGE		CHAPTER	+

2) Pressing the [SETTING] key causes a setting display to appear.

3) When the setting display is not the menu switch display, press the [CHAPTER] key to change the soft key displays, for chapter selection.

HANDY	GENERAL	OP.PANL	MACRO		

Then, press the [OP.PANL] soft key.

Or press thee [SETTING] key repeatedly until the menu switch display appears.

II. Setting

1) Obtain the menu switch display. (Refer to the descriptions in "I. Display" above.)
2) Use the cursor shift key to move the cursor to the position of the item where setting must be made.
3) Push the [NEXT] key to change the soft key displays for function selection.

INPUT		ON : 1	OFF : 0		+

4) Set the menu switches in accordance with the following table.

Display	Function	Setting
MACHINE LOCK	Machine lock	1: Switch ON 0: Switch OFF Setting the ON-OFF operation of the switches
DISPLAY LOCK	Display lock	
AUX. FUNC. LOCK	Auxiliary function lock	
MANUAL ABSOLUTE	Manual absolute	
Z AXIS NEGLECT	Z axis command ignor	
DRY RUN	Dry run	
BLOCK DELETE 1 BLOCK DELETE 9	Optional block skip 1 to 9	

Note 1. ON-OFF operation of the mirror image switch can be controlled through the input/output setting display.
Note 2. "Z AXIS NEGLECT" and "DRY RUN" can be turned on and off by the switches on the control panel.

5) Press the [ON: 1] key to set "1" and the [OFF: 0] key to set "0". (Pressing these keys does not affect the soft key displays.)

4.10 Display and Setting of Custom Macro Variables

The variables that can be displayed are local variables, common variables 1, and common variables 2. Those which can be set are common variables 1 and 2.

#1 to #32: Local variables
#100 to #199: Common variables 1 (not held when the power is cut off)
#500 to #699: Common variables 2 (held when the power is cut off)

I. Display

(1) Set the MDI mode.

(2) Set the soft keys for function selection.

SETTING	SERVICE	MESSAGE		CHAPTER	+

(3) Pressing the [SETTING] key causes a setting display to appear.

(4) If the setting display is the one having no custom macro variable, press the [CHAPTER] key to change the soft key displays for chapter selection.

HANDY	GENERAL	OP.PANL	MACRO		

Then, press the [MACRO] key. The custom macro variables will be displayed. Or press the [SETTING] key repeatedly until custom macro variables appear.

(5) When the display does not have the desired custom macro variables:

(5-1) Change the page by pressing the cursor shift key or the page change key.

(5-2) Use of the soft key

Press the [NEXT] key to change the soft key displays for operation selection.

INPUT	+INPUT	ALL-CLR	EMPTY	INP-NO.	+

Pressing the [INP-NO] soft key causes the soft key displays to change for operation guide.

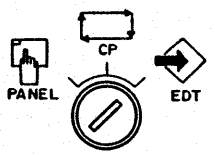
(VALUE)					

Key-in the number of the custom macro variable that must be displayed. The following soft key display will appear after keying-in.

EXEC					

Pressing the [EXEC] key causes the display indicating the macro variable of keyed-in number to appear. And the soft key will return to the one for operation selection.

II. Setting



(1) Set the key switch to the EDI position.

(2) Set the MDI mode.

(3) Obtain the custom macro variable display for setting. (Refer to the descriptions in "I. Display" above.)

(4) Move the cursor by using the cursor shift key to the variable where setting must be made.

(5) Press the [NEXT] key to change the solft key displays for operation selection.

INPUT	+INPUT	ALL-CLR	EMPTY	INP-NO.	+

(6-1) To set an empty as the variable

By pressing the [EMPTY] key only, "empty" (no setting) is set. The soft key display remains to be the one for operation selection.

When an "empty" is set as the variable, steps (7) and after are not required.

(6-2) To set the keyed-in value as variable (absolute input):

Press the [INPUT] key.

(6-3) To add the keyed-in value to the variable already set (incremental input);

Press the [+INPUT] key.

(7) Pressing the [INPUT] or [+INPUT] key causes the soft key display to change to the one for operation guide.

(VALUE)					

(8) Key-in the variable or the increment.
To continuously set values for consecutive variables, punctuate each item using the [EOB] (end of block) key.

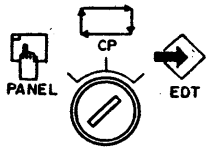
Example 100.0 ;200.0 ;300.0 ;400.0

When a ";" mark is entered, the cursor is automatically advanced by one step.
The following soft key display will appear.

EXEC					

(9) Pressing the [EXEC] key sets the keyed-in data and the soft key display will return to the one for operation selection.

III. Clear



(1) Set the the switch to the EDIT position.
(2) Select the MDI mode.
(3) Obtain a custom macro variable display. (Refer to the descriptions in "I. Display" above.)
(4) Press the [NEXT] key to change the solft key displays for operation selection.

INPUT	+INPUT	ALL-CLR	EMPTY	INP-NO.	+

(5) Push the [ALL-CLR] key.
The soft key displays will change to the operation guide.

ALL	PRG-CHK1	PRG-CHK2			

(6-1) To clear both common variables 1 and 2 to 0 (zero), push the [ALL] key.

(6-2) To clear only common variable 1, push the [PRG-CHK1] key.

(6-3) To clear only common variable 2, push the [PRG-CHK2] key.

The soft display will return to the one for operation selection

5. [MDI Operation]

Commands for more than one block can be input in the MDI memory and executed. The memory capacity is 200 characters.

(1) Select the MDI mode.

(2) Press the [RETURN] key to set the soft key displays for function selection.

POSITION	PROGRAM	OFFSET	PRG-CHK	CHAPTER	+

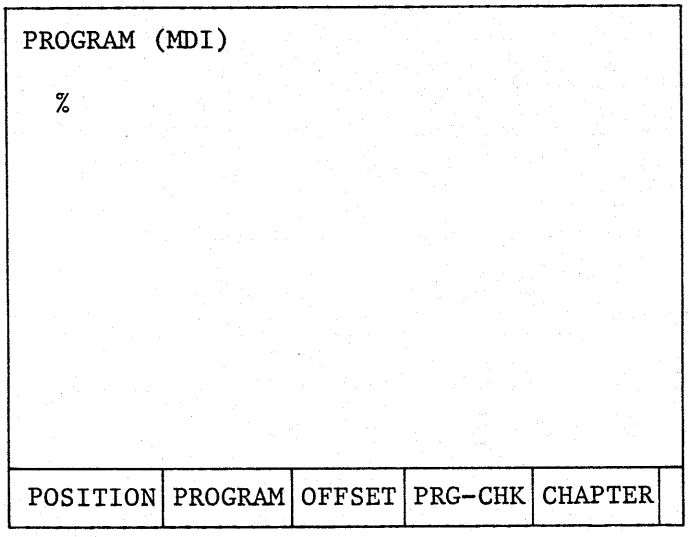
(3) Pressing the [PROGRAM] key causes the program display to appear.

(4) If the program display does not show a program text, press the [CHAPTER] key to change the soft key display for chapter selection.

TEST	DIR.MEM				

Then press the [TEXT] key.

Or press the [PROGRAM] key until the program text appears.



(5) Press the switch key (for the right key) to change the soft key display for operation selection.

ALTER	INSERT	DELETE	DLT-WRD	BG-EDIT	+

(6) Key-in the program to be input (see Section 4.3).
Be sure to press the "EOB" key at the end of each block.

(7) Press the [INSERT] key to input the program in the memory.

(8) To input more programs, repeat steps (6) and (7).

(9) Press the [START] key to perform MDI operation. (It is unnecessary to return the cursor to the beginning.)

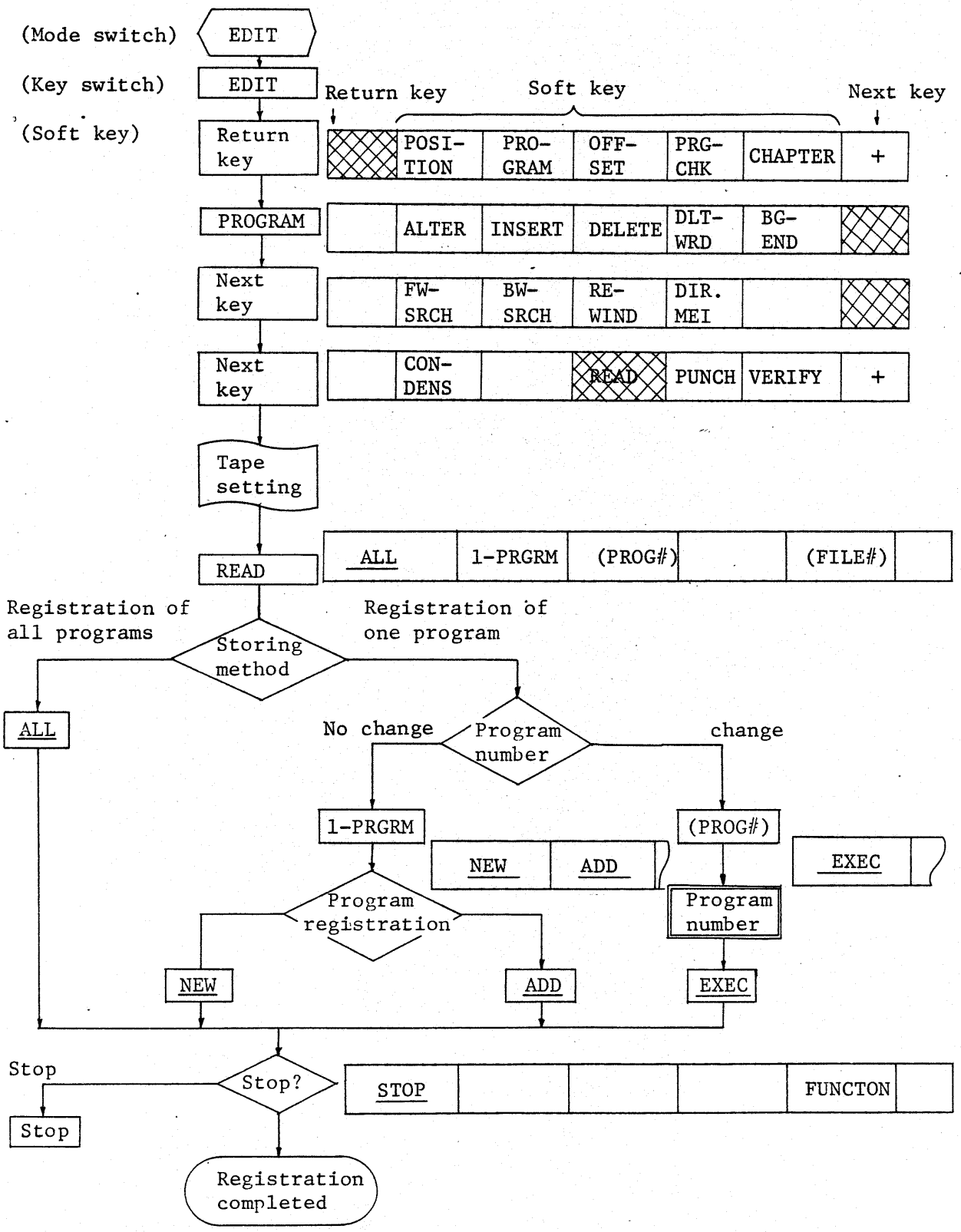
(10) When the single block switch is ON, press the [START] key each time one block operation is completed.

```
PROGRAM (MDI)
S500 M03;
G91 G1X-500.F100;
```

ALTER	INSERT	DELETE			

Note: Programs in the MDI memory can be edited using the same procedure used to edid programs stored in the memory.

6. Procedure for Storing NC Tape Data in the Memory



7 Program Registration Using the MDI Key

(1) Set the mode switch to the EDIT position.

(2) Set the key switch to the EDIT position.

(3) Press the [RETURN] key to set the soft key displays for function selection.

POSITION	PROGRAM	OFFSET	PRG-CHK	CHAPTER	+

(4) Press the [PROGRAM] key once or twice to obtain the PROGRAM (MEMORY) display.

(5) Press the [NEXT] key to set the soft key display for operation selection.

ALTER	INSERT	DELETE	DLT-WRD	BG-EDIT	+

(6) Key-in the program that must be registered.

(7) Press the [INSERT] key to enter the program in the memory.

(8) To enter program data, repeat steps (6) and (7).

```
PROGRAM (MEMORY)
O 0001
N1  T2
G54G90G0X0Y0
G43Z50.H1
S2000M3
     :
     :
     :
     :
     :
```

ALTER	INSERT	DELETE			

8 Program Number Search

When several programs are stored in the memory, one can be searched.

(I) Method 1

(1) Set the mode switch to the MEMORY or EDIT position.

(2) Push the [RETURN] key to set the soft key display for function selection.

POSITION	PROGRAM	OFFSET	PRG-CHK	CHAPTER	+

(3) Press the [PROGRAM] key once or twice to obtain the program display.

(4) Press the [NEXT] key to set the soft key display for operation selection.

(5) In the EDIT mode, press the [NEXT] key . (This is not required in the MEMORY mode.)

FW-SRCH	BW-SRCH	REWIND	DIR.MEM		+

(6) Input the program number to be searched by following the address $\bar{O}$. Example >$\bar{O}$ 1234

(7) Pressing the [FW-SRCH] initiates the search for the program number.

(II) Method 2

Steps (1) to (5): Same as Method 1 above. .

(6) Pressing the [FW-SRCH] key causes the soft key display to change to the one for operation guide.

BOTTOM	(WORD)	(PROG#)	NEX-PRG		

(7) Pressing the (PROG#) key inputs O to the key input buffer, prompting an input of a program number. The following soft key will appear.

EXEC					

(8) When the [EXEC] key is pressed after the program number is keyed in the program number is searched. The program of the number is then selected and displayed.

(III) Method 3

In the directory display of the programs stored in the memory, the program next to the one being currently selected can be selected.

Steps (1) to (5): Same as in Method 1 above.

FW-SRCH	BW-SRCH	REWIND	DIR.MEM		+

(6) Pressing the [FW-SRCH] key causes the soft key to display to change the one for operation guide.

BOTTOM	(WORD)	(PROG#)	NEX-PRG		

(7) Pressing the [NEX-PRG] key selects the next program. And the soft key display will return to the one for operation selection.

(IV) Method 4

In the directory display of the programs stored in the memory, the program preceding to the one being currently selected can be selected.

Steps (1) to (5): Same as in Method 1 above.

FW-SRCH	BW-SRCH	REWIND	DIR.MEM		+

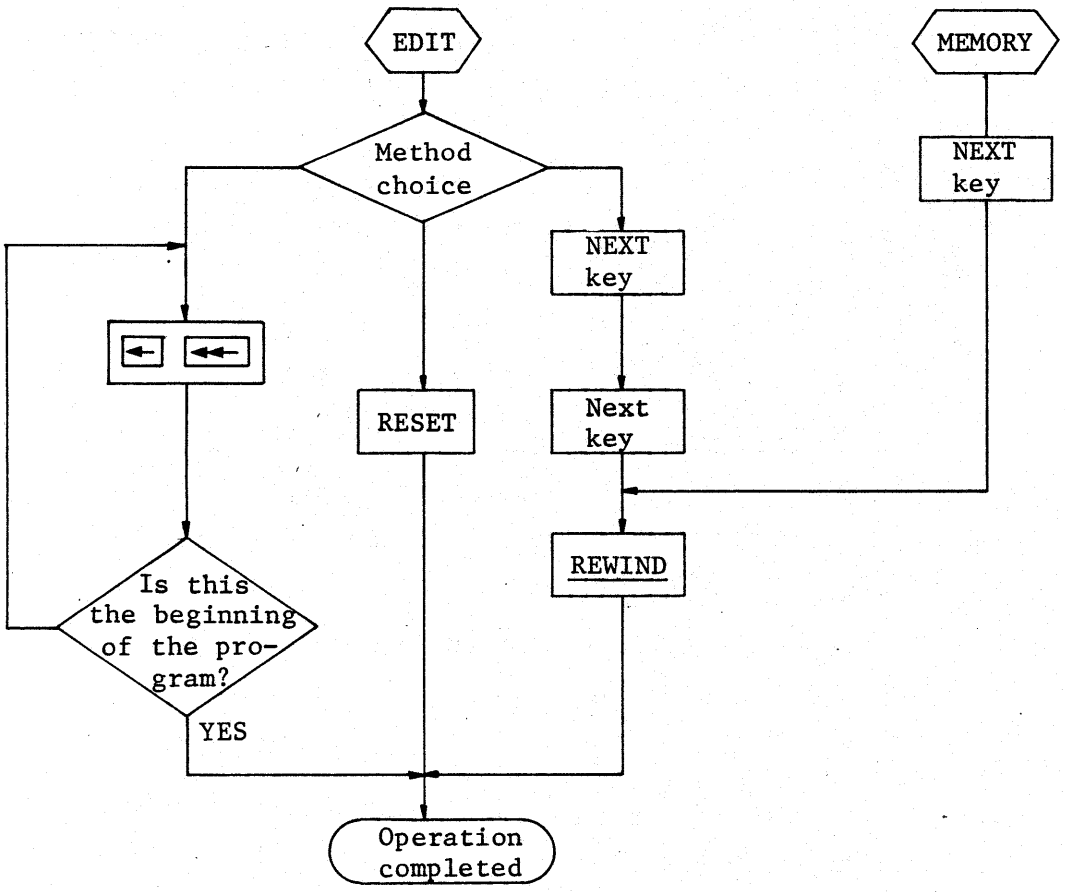
(6) Pressing the [BW-SRCH] key causes the soft key display to the one for operation guide.

TOP	(WORD)	(PROG#)	PRV-PRG		

(7) Pressing the [PRV-PRG] key selects the previous program.

9 Procedure for Returning the Program to Its Beginning

(1) Obtain a program display (see Section 4.7) and follow the steps described below



10. Program Editing

10.1 Foreground and Background Modes

(I) Program memory and eiditing in the foreground mode

(1) Select the EDIT mode.

(2) Set the soft key display for function selection.

POSITION	PROGRAM	OFFSET	PRG-CHK	CHAPTER	

(3) Pressing the [PROGRAM] key causes a program display to appear.
"PROGRAM (MEMORY)" is then displayed in the top right corner of the CRT, allowing foreground program memory and editing.

(4) Set the key switch to the EDIT position. Program memory and editing is now available.

* For details regarding program memory and editing operation, refer to the relative sections.

(II) Program memory and editing in the background mode

a) Background program memory/editing can be performed any time unless the mode is set in the EDIT position.
Any alarm or warning generated during background program memory/editing operation will have no effect on foreground operation and vice versa.
Background program memory/editing is prepared for by the following procedure.

(1) Set the soft key display for function selection.

POSITION	PROGRAM	OFFSET	PRG-CHK	CHAPTER	+

(2) Pressing the [PROGRAM] key causes a program display to appear.

(3) Press the [NEXT] key to change the soft key display to the one for operation selection.

ALTER	INSERT	DELETE	DLT-WRD	BG-EDIT	+

(4) Pressing the [BG-EDIT] key causes the soft key display to the one for operation guide.

			(PROG#)	PRV-PRG	

(5-1) To choose the previously background-edited program, push the [PRV-PRG] key. The program is then displayed and the soft key display will return to the one for operation selection.
In this case, step (6) is not required.

ALTER	INSERT	DELETE	DLT-WRD	BG-EDIT	+

(5-2) To choose the program of a certain number, push the (PROG#) key. "O" is then entered in the key input buffer to wait for program number input. The following soft key display will appear.

EXEC					

(6) Pressing the [EXEC] key after keying-in the desired program number cause the program display to appear. The soft key display will return to the one for operation selection.
"PROGRAM (BG-EDIT)" is then displayed in the top right corner of the CRT, allowing background editing.

(7) Set the key switch to the EDIT position.
For details regarding program memory/editing operation, refer to the sections related to each item.

b) Background editing finishing procedure

(1) Set the soft keys for operation selection.

ALTER	INSERT	DELETE	DLT-WRD	BG-END	+

(2) Pressing the [BG-END] key completes background editing.

10.2 Program Editing

The data of programs stored in the memory can be altered using the procedure below.

(1) Make preparations for program memory/editing. (Refer to 10.1.)

(2) Select (search) the program to be edited. (Refer to Section 8.)

(If it has already been selected, this operation is not required.)

(3) Move the cursor to the place to be edited.

i) Use the cursor shift key and the page change key to move the cursor to the position where editing is required. The small cursor shift key [→] [←] moves the cursor word by word. The large cursor shift key [⇒] [⇐] moves the cursor block by block. Note that when letters have been entered in the key input buffer, the large cursor shift key serves as a cursor movement key.

ii) Method with search

Refer to Section 10.3 "Forward Search" or 10.4 "Backward Search".

(4) Perform editing such as alteration, insertion, and deletion.

10.3 Forward Search

(1) Make preparations for editing. (Refer to 10.1.)

(2) Press the [NEXT] key to set the soft key displays for operation selection.

FW-SRCH	BW-SRCH	REWIND	DIR.MEM		+

(3) Pressing the [FW-SRCH] key causes the soft key display to change the one for operation guide.

BOTTOM	(WORD)	(PROG#)	NEXT-PRG		

(4-1) To search a word or an address

Pressing the (WORD) key causes the message to display, prompting the input of the word or the address that must be searched. The following soft key display will appear.

EXEC					

i) To search a word

When the [EXEC] key is pressed after keying-in the word to be searched (N100 for example), the word is searched in the forward direction from the point where the cursor is currently located. When the word is searched, the cursor moves to the word from the current point. The soft key display will return to the one for operation selection.

ii) To search an address

When the [EXEC] key is pressed after keying-in the address to be searched (N for example), the address is searched in the forward direction from the point where the cursor is currently located. When the address is searched, the cursor moves to the address from the current point. The soft key display will return to the current operation selection.

(4-2) To move the cursor to the end of a program

Pressing the [BOTTOM] key moves the cursor to the end of the program. The soft key display will return to the one for operation selection.

10.4 Backward Search

(1) Make preparations for editing. (Refer to 10.1.)

(2) Press the [NEXT] key to set the soft key displays for operation selection.

FW-SRCH	BW-SRCH	REWIND	DIR.MEM		+

(3) Pressing the [BW-SRCH] key causes the soft key display to change to the one for operation guide.

TOP	(WORD)	(PROG#)	PRV-PRG		

(4-1) To search a word or an address

Pressing the (WORD) key causes the message to display, prompting the input of the word or the address that must be searched. The following soft key display will appear.

EXEC					

i) To search a word

When the [EXEC] key is pressed after keying-in the word to be searched (N100 for example), the word is searched in the backward direction from the point where the cursor is currently located. When the word is searched, the cursor moves to the word from the current point. The soft key display will return to the one for operation selection.

ii) To search an address

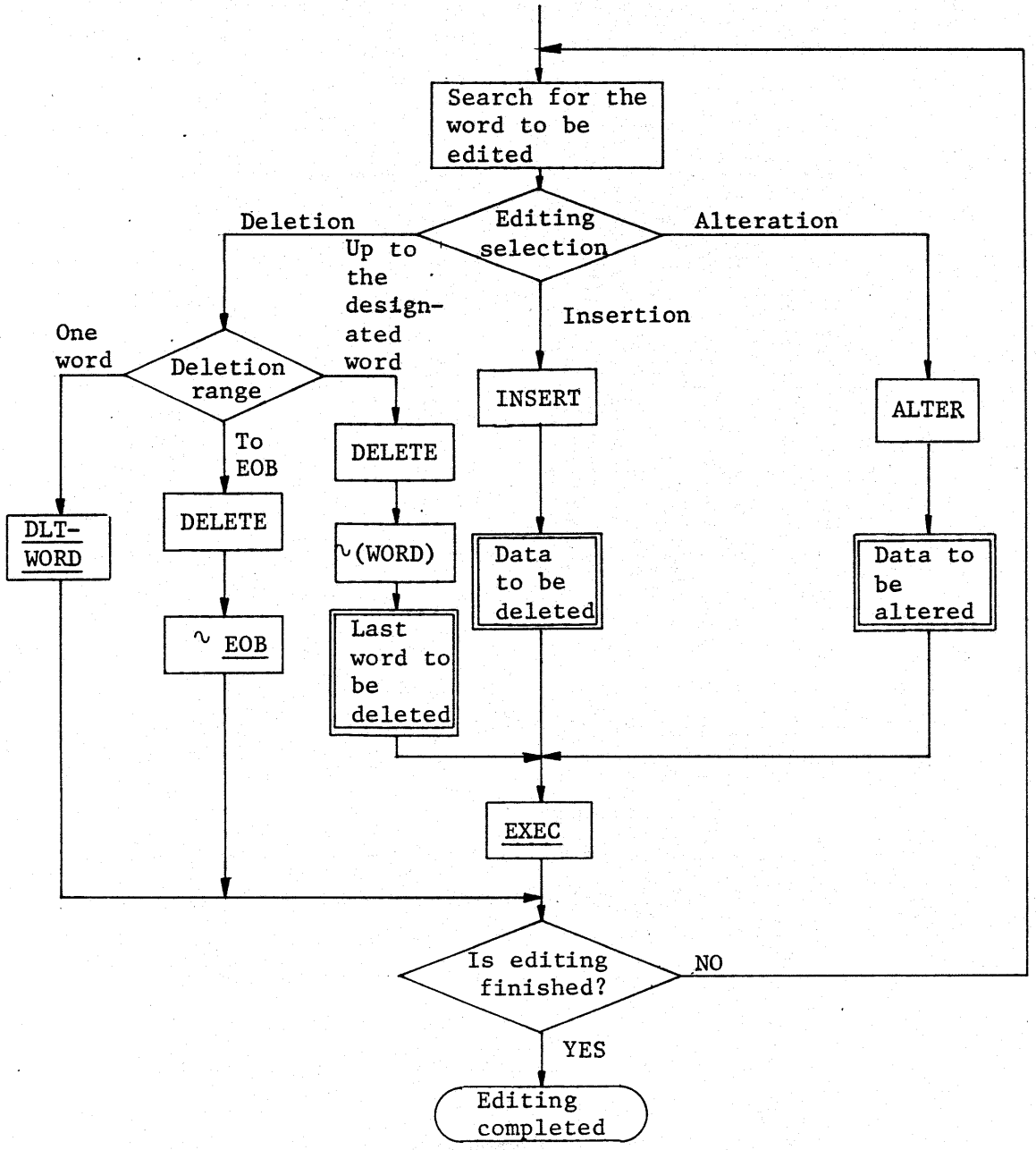
When the [eXEC] key is pressed after keying-in the address to be searched (N for example), the address is searched in the backward direction from the point where the cursor is currently located. When the address is searched, the cursor moves to the address from the current point. The soft key display will return to the one for operation selection.

(4-2) To move the cursor to the beginning of a program

Pressing the TOP key moves the cursor to the beginning of the program. The soft key display will return to the one for operation selection.

10.5 Alteration, Insertion and Deletion

Make preparations for editing (refer to 10.1.), and follow the steps described below.



10.6 Condensing the Memory

Repetitive program editing may use memory ineffectively, resulting in inability of the memory to hold the maximum tape memory capacity.

Condensing the memory can solve this situation.

(1) Make preparations for tape editing. (Refer to 10.1.)

(2) Press the [NEXT] key to set the soft key displays for operation selection.

CONDENS		READ	PUNCH	VERYFY	+

(3) Pressing the [CONDENS] key causes the soft key display to change to the one for operation guide.

ALL	THIS	(PROG#)			

(4-1) To condense memories for all programs, press the ALL key.

(4-2) To condense memory for the currently selected program, press the [THIS] key.

(4-3) To condense the memory of the specified program number, press the (PROG#) key.
"0" is then input in the key input buffer, prompting the keying-in of the program number. The following soft key display will appear.

EXEC					

Pressing the [EXEC] key causes the program memory of the keyed-in program number to be condensed. The soft key display will return to the operation selection.

10.7 Program Deletion

Make preparations for program memory/edit. (Refer to 10.1.)

(1) Press the [NEXT] key to set the soft key displays for operation selection.

ALTER	INSERT	DELETE	DLT-WRD	BG-END	+

(2) Pressing the [DELETE] key causes the following soft key display to appear.

WORD	∿EOB	∿(WORD)		PROGRAM	

(3) Pressing the [PROGRAM] key causes the soft key display to change to the operation guide.

ALL	THIS	(PROG#)			

(a) To delete all programs
Pressing the [ALL] key deletes all the registered programs except those of which tape editing is prohibited.

(b) To delete the currently selected program
Pressing the [THIS] key deletes the currently selected program.

(c) To delete the program of the keyed-in program number

i) When the [(PROG#)] is pressed, "O" is entered in the key input buffer, prompting the keying-in of the pro-program number. The following soft key display will appear.

EXEC		(,PRG#)			

ii) Pressing the [EXEC] key after keying-in the program number causes the program to be deleted. To delete programs of a certain range all at once, input the first and last program numbers using a mark "," as follows.

Example

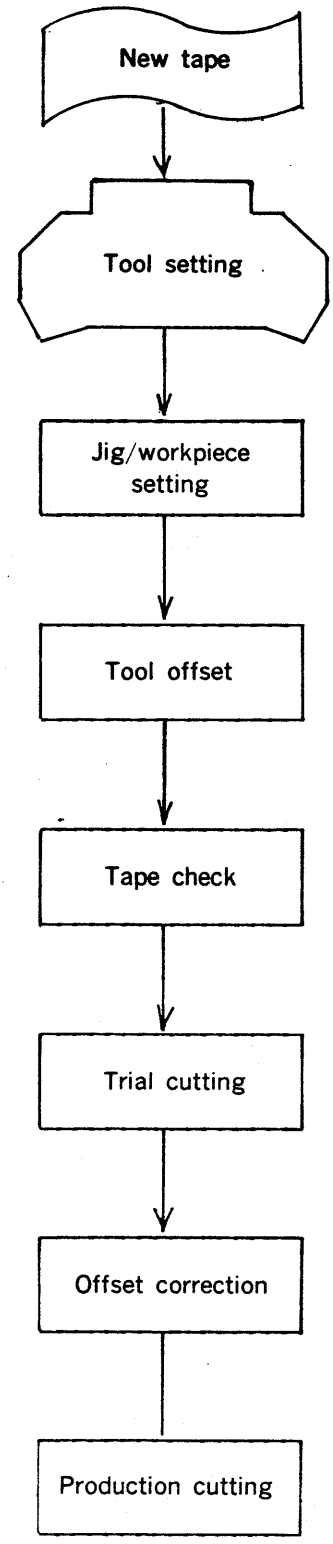
0100, 0200

When these numbers are entered, and the [EXEC] key is pressed, programs between 0100 and 0200 are deleted.

4. PREPARATION FOR PROCESSING

This chapter describes general preparations for processing. Methods and figures described may sometimes be inappropriate for some jobs. Read this chapter of general procedures and then adapt them for your own particular requirements.

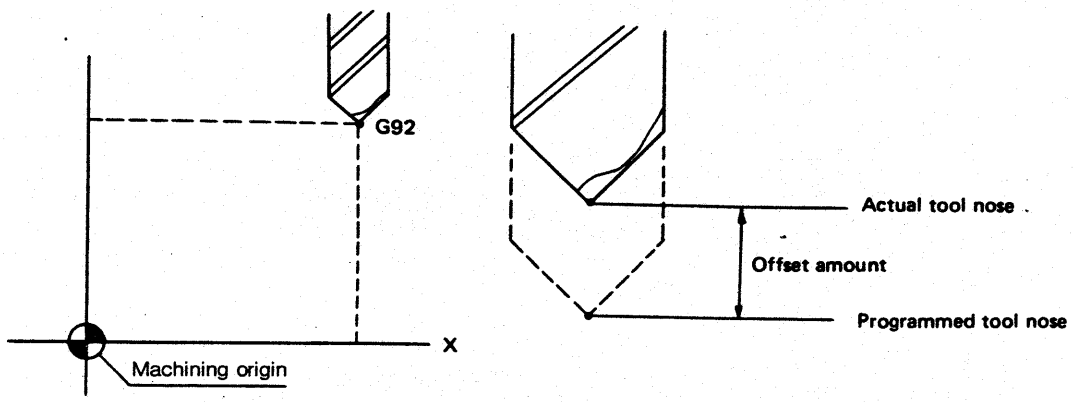
Machining Center Operation Procedure



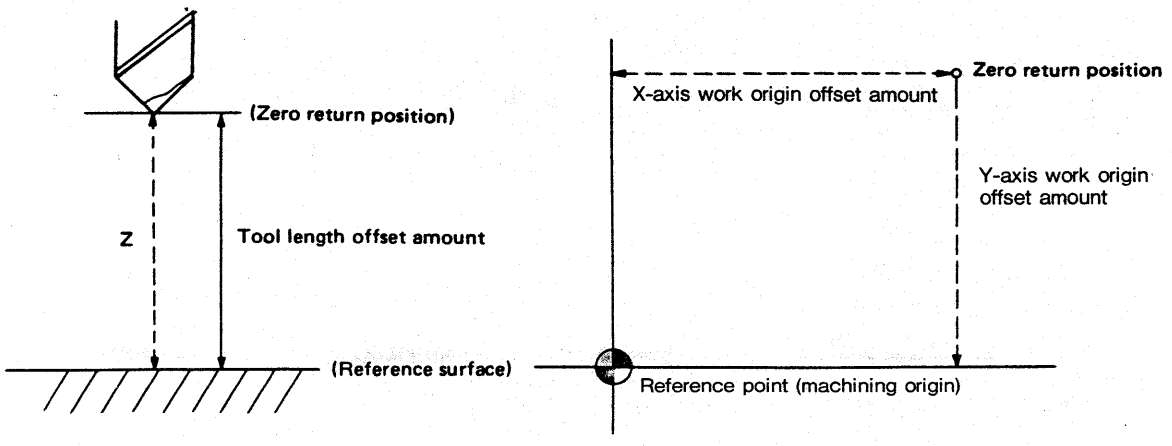
- Programmer checks the process sheet.
- Set tools according to the tooling diagram.
- Register tool numbers to parameters.
- Install a subtable or jig on the table and set a workpiece.
- Register tool length offset, tool position offset, tool diameter offset, etc. to the specified offset numbers.
- Check movement by single block function (or auxiliary function lock, Z-axis command ignore function when required) and correct as required.
- Cut the workpiece while slightly relieving the tool from the workpiece.
- Correct dynamic offset considering cutting load.
- After the workpiece is processed within the tolerance, production can be started.

1. Offset Function

The offset function is used to compensate the difference between the actual tool position and the coordinates of each tool established by G92, or G54 to G59.
In a general practice, the distance of the tool nose from the machining origin is established by G92 and the difference between that position and the position specified on the program is taken as an offset amount.

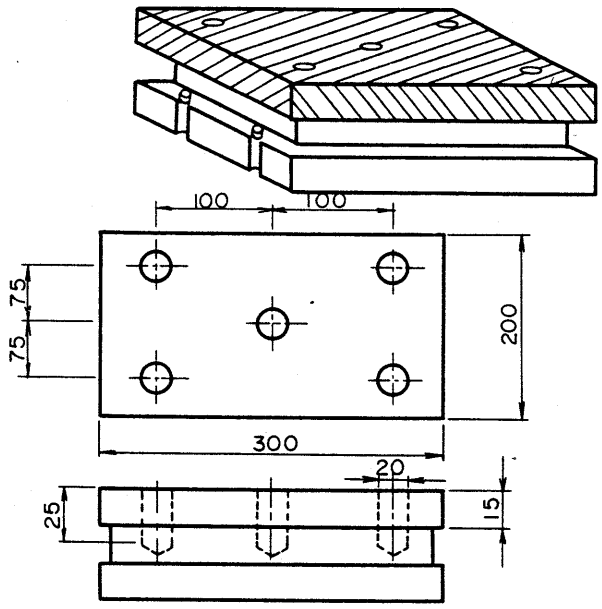


Programming in the procedure above requires the exact tool lengths and the distance between the machining origin and the zero return position. This makes programming more complicated as the number of tools used increases.
To simplify programming, a work coordinate system (G54 to G59) is used. The work coordinate system is determined by setting the distance of each axis (X and Y) (the work origin offset amount) from the machine origin to the machining origin. "0" must be set for the Z axis in advance, and a tool length compensation must be then made.



2. Program Example

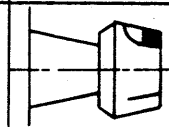
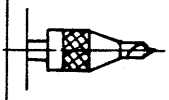
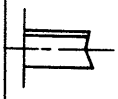
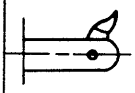
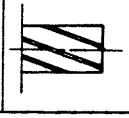
I. The test piece shown below is used as an example.



Surfaces to be cut are shaped in the figure at left.

Material Aℓ

2.1 Tool Used

Cutting sequence	Tool	Type of cutting
1	 ϕ80 face mill T 9001	Plane cutting (milling)
2	 Center drill T 0002	Centering
3	 ϕ19 drill T 0003	Drilling
4	 ϕ19.8 end mill T 0004	Preliminary boring
5	 ϕ20 boring T 0005	ϕ20 finishing
6	 ϕ20 end mill T 0006	Circumferential cutting

3. Test Piece Program

```
O1 (TEST PIECE)
N1 T2 (80 DIA. FACE MILL)
G54 G90 G0 X200. Y-75. S800 M3
G43 Z50. H1
Z0
G1 X-200. F400
G0 Y-10.
G1 X200.
G0 Y55.
G1 X-200.
G0 Z50.
G91 G28 Z0
G30 Y0 M6
M1

N2 T3 (CENTER DRILL)
G54 G90 G0 X0 Y0 S3000 M3
G43 Z50. H2 M8
G99 G81 Z-5. R2. F200
X100. Y75.
X-100.
Y-75.
X100.
G0 Z50. M9
G91 G28 Z0
G30 Y0 M6
M1

N3 T4 (19 DIA. DRILL)
G54 G90 G0 X0 Y0 S800 M3
G43 Z50. H3 M8
G99 G73 Z-35. R2. Q3. F120
X100. Y75.
X-100.
Y-75.
X100.
G0 Z50. M9
G91 G28 Z0
G30 Y0 M6
M1

N4 T5 (19.8 DIA. END MILL)
G54 G90 G0 X0 Y0 S800 M3
G43 Z50. H4 M8
G99 G73 Z-28. R2. Q3. F120
X100. Y75.
X-100.
Y-75.
X100.
G0 Z50. M9
G91 G28 Z0
G30 Y0 M6
M1

N5 T6 (20 DIA. BORING)
G54 G90 G0 X0 Y0 S3000 M3
G43 Z50. H5 M8
G99 G76 Z-25. R2. I.5 J.2 F150
X100. Y75.
X-100.
Y-75.
X100.
G0 Z50. M9
G91 G28 Z0
G30 Y0 M6
M1

N6 T9001 (20 DIA. END MILL)
G54 G90 G0 X170. Y-120. S800. M3
G43 Z50. H6 M8
G1. Z-20. F2000
G41 Y-100. D26
X-150. F120
Y100.
X150.
Y-105.
G40 G0 Z50. M9
G91 G28 Z0
G30 Y0 M6
M30
```

4. Example of Cutting Preparation

4.1 Set tools.

Load tools in the magazine pots as specified by the programmer.
Pay attention to type, diameter, length, etc. of tools.

4.2 Register tool numbers.

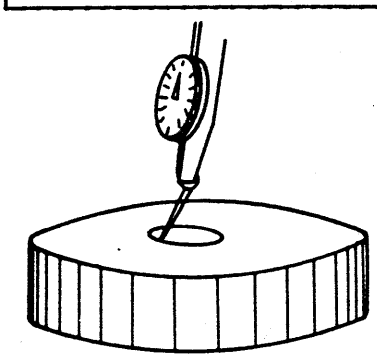
Tool numbers must be registered in PC parameters since a memory random system is used for tool selection.
See "Tool Number Registration" for registration procedure.

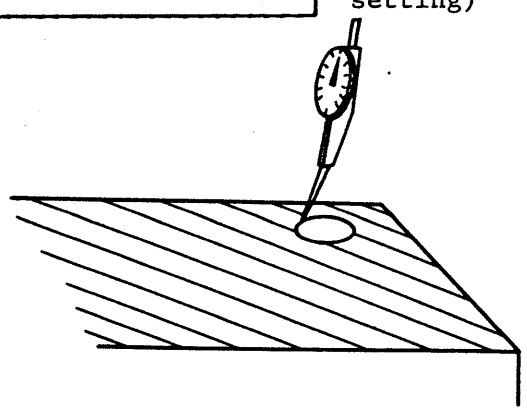
4.3 Set jig and workpiece on the table.

4.4 Return all axes to machine origin.

4.5 Obtain the reference point of the jig or workpiece.

(Coordinate system setting)





Attach a pick test to the spindle and find the machining origin (XO.YO) on the program.
Record the distances (X and Y axes) from the machine origin and enter the work origin offset amounts. Reset the present position display to "0."

4.6 Setting the Work Origin Offset Amount

(1) Display

a) Set the soft key display for function selection.

POSITION	PROGRAM	OFFSET	PRG-CHK	CHAPTER	+

b) Pressing the [OFFSET] key causes a tool offset or work origin offset display to appear.

c) When no work origin offset display appears

Press the [CHAPTER] key to change the soft key display to the one for chapter selection.

TOOL	WRK.ZER				

Pressing the [WRK.ZER] key causes a work origin offset display to appear.

Or, press the [OFFSET] key repeatedly until a work origin offset display appears.

d) When the offset display of the desired work coordinate system is not shown.

d-1) Change the page by pressing the cursor shift key or the page change key.

d-2) Use of the soft key

i) Change the soft key displays to the one for function selection.

INPUT	+INPUT		PUNCH	INP-NO.	+

ii) Pressing the INP-No. soft key causes the soft key display to change to the one for operation guide.

(VALUE)					

iii) Key-in the number of the work coordinate system that must be displayed.

0: External work origin offset

1 to 6: Work coordinate system numbers (corresponding to G54 to G59)

After keying-in the number, the following soft key display will appear.

EXEC					

iv) Pressing the [EXEC] key causing the display showing the keyed-in work coordinate system number to appear. The soft key display will return to the one for operation selection.

INPUT	+INPUT		PUNCH	INP.NO.	+

(2) Setting

a) Obtain the work origin offset display in which the offset amount must be set.
(Refer to the description in (1) above.)

b) Move the cursor using the cursor shift key to the position where the work origin offset amount must be set.

c) Press the [NEXT] key to change the soft key displays to the one for operation selection.

INPUT	+INPUT	MEASURE	PUNCH	INP-NO.	+

d-1) To set the keyed-in number as the offset amount, press the [INPUT] soft key. (Absolute input)

d-2) To add the keyed-in number to the already set offset amount, press the [+INPUT] soft key. (Incremental input)

e) The soft key display will change to the one for operation guide.

(VALUE)					

f) Key-in the offset amount.

Offset amounts can be consecutively input. The [EOB] key must be pressed after each data, however.

The pressing of the [EOB] (end of block) key is indicated by the ";" mark of the CRT screen.

Example: 100.0 ; 200.0 ; 300.0

When ";" is entered, the cursor automatically advances by one step (just as when the cursor shift key [→] is pressed).

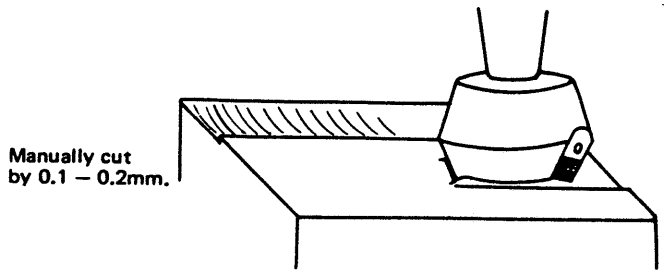
EXEC					

g) Pressing the [EXEC] key sets the keyed-in offset amount to the offset memory. The soft key display will then return to the one for operation selection.

INPUT	+INPUT	MEASURE	PUNCH	INP-NO.	+

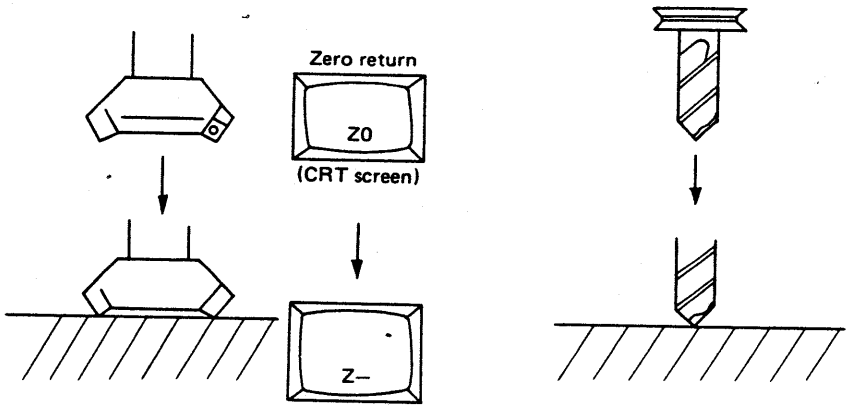
4.7 Obtain tool length offset and input it.

Before obtaining tool length offset:
Skin-cut the surface to obtain the reference plane (tentative finishing surface Z0) for offset making.



(1) Gently contact each tool on the skin-cut plane, and take a note of the corresponding present position value displayed in Z-axis.

(Example)



(2) Input the noted value in the specified offset No. on the program for each tool (input procedure is the same as for tool position offset).
Note that G43 and G44 have opposite directions from each other in terms of +/- directions.

Since G43 is commanded in the program example in this section, + (plus) offset amount is inputted.
If - (minus) offset amount is inputted, the spindle head is raised.

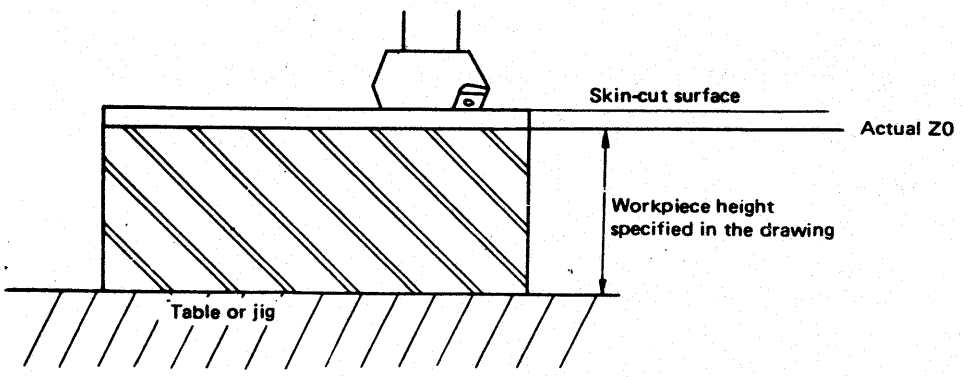
* See "Offset Function" of FANUC Operation Manual for work coordinate system and tool length offset.

4.8 Input tool diameter offset.

Input tool radius in the specified offset number on the program.

4.9 Correct tool length offset.

The tool length offset obtained as described above is based on the skin-cut plane (temporary Z0) and differs from the offset based on the actual Z0.
Measure the workpiece height and input offset amount again so that the height is within the allowable dimension.



5. Tool Data Entry

(a) Press the NC/PC key to select the PC display.
The basic PC menu will appear.

PCMDI	PCLAD	PCDGN	PCPRM	

(b) Press the PCMDI soft key to select the selection display.

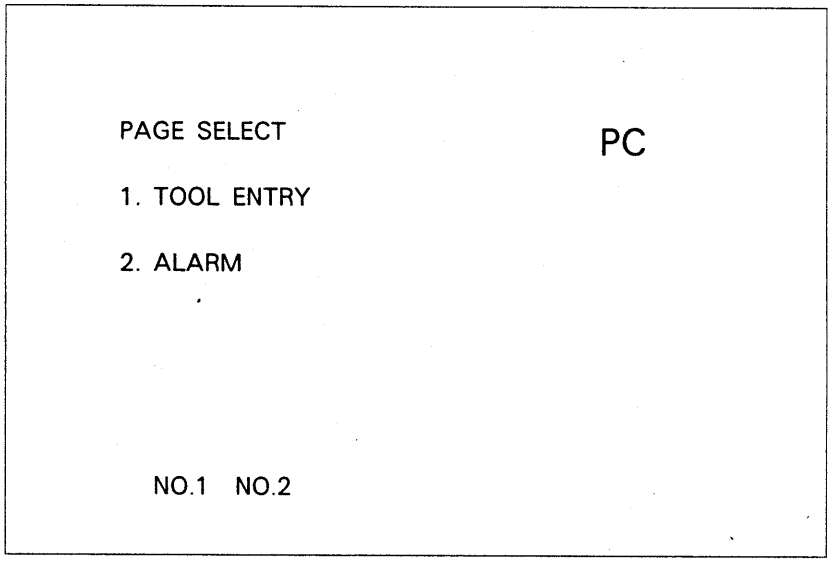


Fig. 1 Selection display

(c) Press the No. 1 soft key to select the tool registration display.

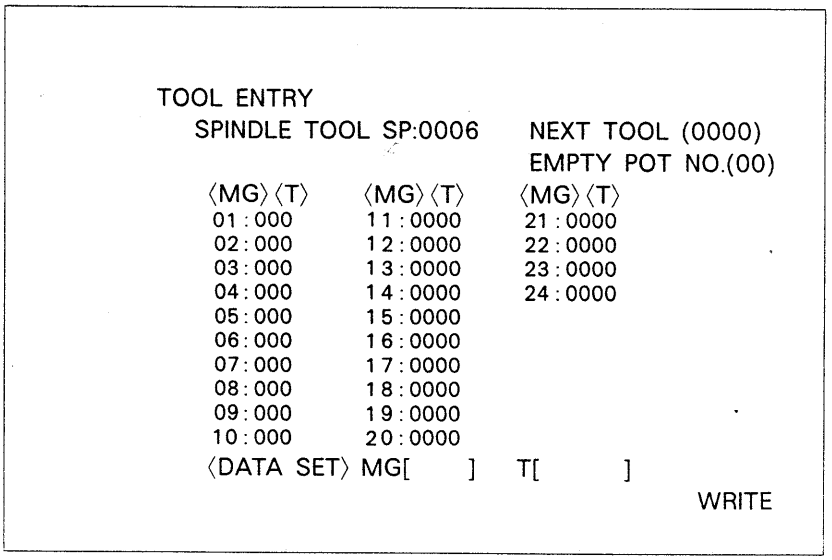


Fig. 2 Tool entry display

(d) Tool data entry procedure

1) Use the data set section [DATA SET MG ( ) T( )] to input data.
Enter data using the number keys on the keyboard and press the INPUT key. The input data will be displayed at the position on the data set section where the cursor is located.

2) After checking the input data on the set section, press the WRITE soft key. The data is set and the data indication on the set section will disappear.

3) i) Tool data cannot be registered during the ATC cycle or magazine rotation.

ii) DAta setting is possible only for the entry of the tools in the mágazines and the tool to be loaded in the spindle. Data for empty pot and for next tool are only indicated.

iii) To register a tool data to the spindle tool, input 0 to MG. To register tools to magazines, input the corresponding numbers to MG.

iv) If a tool number which has been registered is input, "*TOOL ALREADY USED*" appears.
If an unusual value is input, "*MISS SETTING*" appears. Thus, input data is not set. The error indication will disappear when new data is input.
Repeat the above steps to set the tool data.
Remember that the most significant digit of each 4-digit number must be set as follows.

Large diameter tools : 9
Medium diameter tools : 1 to 8
Small diameter tools : 0

To return to the NC display after entry, press the NC/PC key once.
To return to another PC display, press the NC/PC key twice.

(e) Setting spindle tool data

Change the spindle tool as described below.

i) Select the manual mode (handle, step, jog, rapid or zero return).

ii) Press the tool unclamp button and change the tool. If the spindle tool number is the same as the number of the previous tool, setting is complete. If not, advance to step iii).

iii) Select the MCI mode. Set the key switch on the control panel to EDT OK.

iv) Register tool numbers in the same manner as described in steps (a) to (c).

v) Check whether it is possible to return the spindle tool to an empty pot whose number is shown in the tool entry display. display.

A pot which is indicated as empty must not be loaded with a tool.

vi) Press the NC/PC key twice. Then press the PCPRM and KEEPRL keys in that order.

vii) Move the cursor to K11 and set the number of the pot to which the spindle tool is returned using a binary code(*1). When the spindle tool is returned to the No. 13 pot, for example, set 00001101.

viii) Set the spindle tool diameter to K13.

Small diameter tools : 00000001

Medium diameter tools : 00000000

Large diameter tools : 00000010

(*1) Binary code (binary notation)

Bit	7 Bit	6 Bit	5 Bit	4 Bit	3 Bit	2 Bit	1 Bit	0 Bit
Data	$128(2^7)$	$64(2^6)$	$32(2^5)$	$16(2^4)$	$8(2^3)$	$4(2^2)$	$2(2^1)$	$1(2^0)$

"15" for example is 8 + 4 + 2 + 1. "1" is given at bit 4, bit 3, bit 2 and bit 1. Thus "15" is represented by "00001111" in binary notation.

C. INSPECTION AND MAINTENANCE MANUAL (MACHINE AND LUBRICATION)

INSPECTION AND MAINTENANCE MANUAL
(MACHINE AND LUBRICATION)

1. INSTALLATION

2. GREASING AND LUBRICATION

1. INSTALLATION

1. Installation Site

Do not install the machine where they are exposed to direct sunlight, chips or their refuse, water, oil, etc. from other equipment, or vibrations.

Ambient temperature: 0 - 45°C

Humidity: 10 - 90% RH

2. Input Power

Electrical systems should be shielded against noises caused by electric welders, electrospark machining equipment, etc.
Excessive voltage drops resulting from insufficient capacity of plant power lines can cause malfunctioning of the NC unit. As a general rule, the machine should be wired independently from the main plant power source.

* Input power source capacity: 16 KVA

* Current capacity: $A = \frac{KVA \times 1000}{V \times \sqrt{3}}$

  (with 200 V input voltage) A = 42 ampere

* Permissible input voltage fluctuation: AC 200/220 V ±10%, 50/60 Hz

* Electric wire for input power source: 220 V 8∿14 mm^2 (in case of metal piping)

3. Grounding

Ground the machine singularily as much as possible. When grounding wire of electric welding machine, electrospark machining equipment, etc. is connected to plant's frame, never connect grounding wire of this machine to plant's frame. Use as short and thick (8 mm^2) grounding wire as possible.
Class 3 grounding with grounding resistance of 100Ω or less

4. Machine power Capacity List

Spindle motor:	9.00 KVA
CNC control unit and servo motor:	5.00 KVA
Electric control board:	1.00 KVA
Auxiliary devices :	0.73 KVA
Cutting oil pump motor:	0.18 KW
ATC motor:	0.40 KW

(Power factor 80%: Total of auxiliary devices (KVA) = Total of motors/0.8)

Total:	16	KVA

5. Installation Procedure

° Precautions in installation

1) Maintenance area

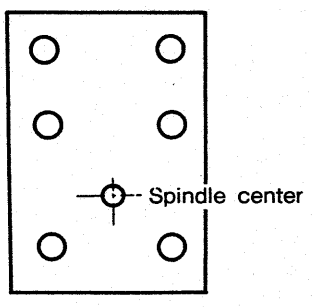
There must be no obstacles impeding opening/closing of the electric control board door and removal of the Y axis motor.

2) Check for obstacles within the table travel range.

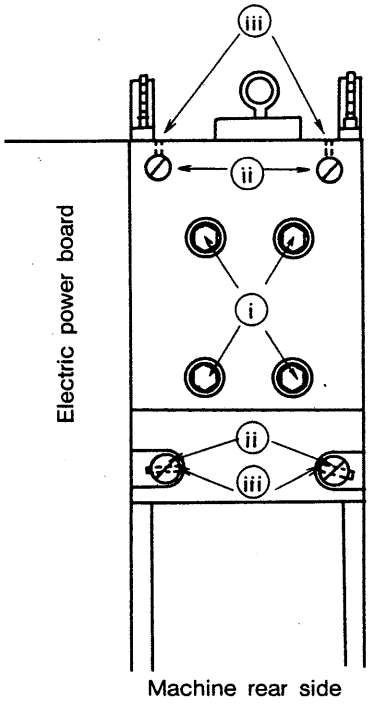
3) Open space for chip conveyor removal.

1. Leveling

Place a level at the center of the table and level the machine with jack bolts.



2. Mounting the Counterbalance



1) Remove the four hex bolts (i).
2) Turn the eccentric shaft (ii) to press the pulley (located between the counterbalance and the column) against the race.
3) Tighten the hex socket set screw (iii) to secure the eccentric shaft.

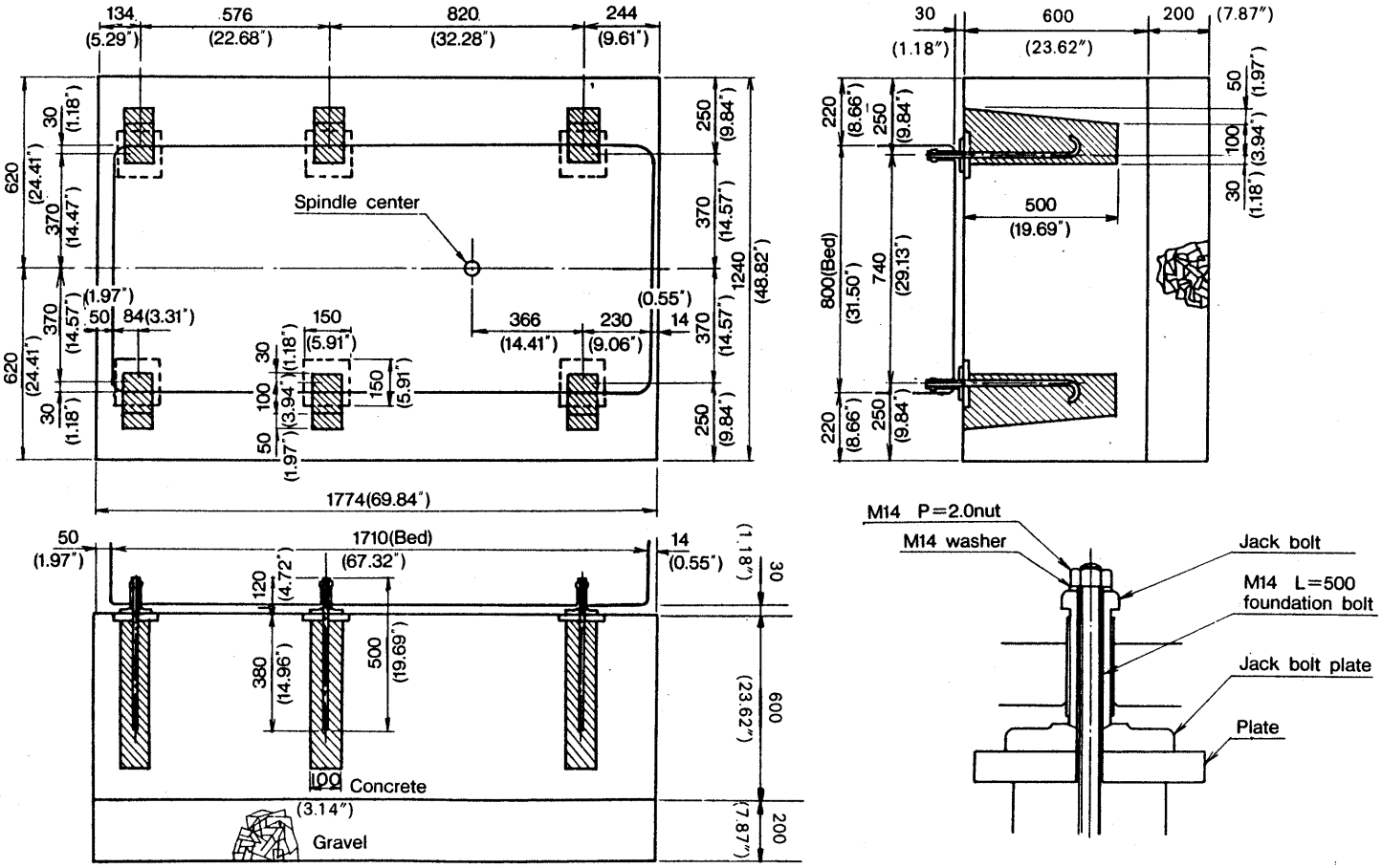
6. Check points before turning power on

° Check bolts for tighteness.
° Check Cannon connectors for tighteness.
° Make sure that hydraulic hoses and pipes are completely connected.
° Input power supply.
Voltage, R/S/T phases
Check the above items and then turn power supply on.
After bleeding air from the counterbalance, remove all brackets.
Make sure that there are no interfering object.

7. Checks after the Initial Start-up

* Check the oil level.
* Warm up the spindle as follows.
  At 1,000 rpm for 30 minutes
  At 2,000 rpm for 30 minutes
  (Also warm up the spindle when the machine has not been used for a long period of time.)
* Operate the X, Y and Z axes at a low speed for 30 minutes so that the grease fits well with their slideways.
* Check that all functions work properly using the running tape provided with the machine.

8. Foundation Diagram



Note1) The standard foundation is shown in this drawing. Concrete thickness can be modified according to ground conditions.

2) Prepare the following items before installation.

1. Anchor bolt	M14×500	6
2. Washer and not for anchor bolt	M14	6 for each
3. Face plate	150×150×20	6

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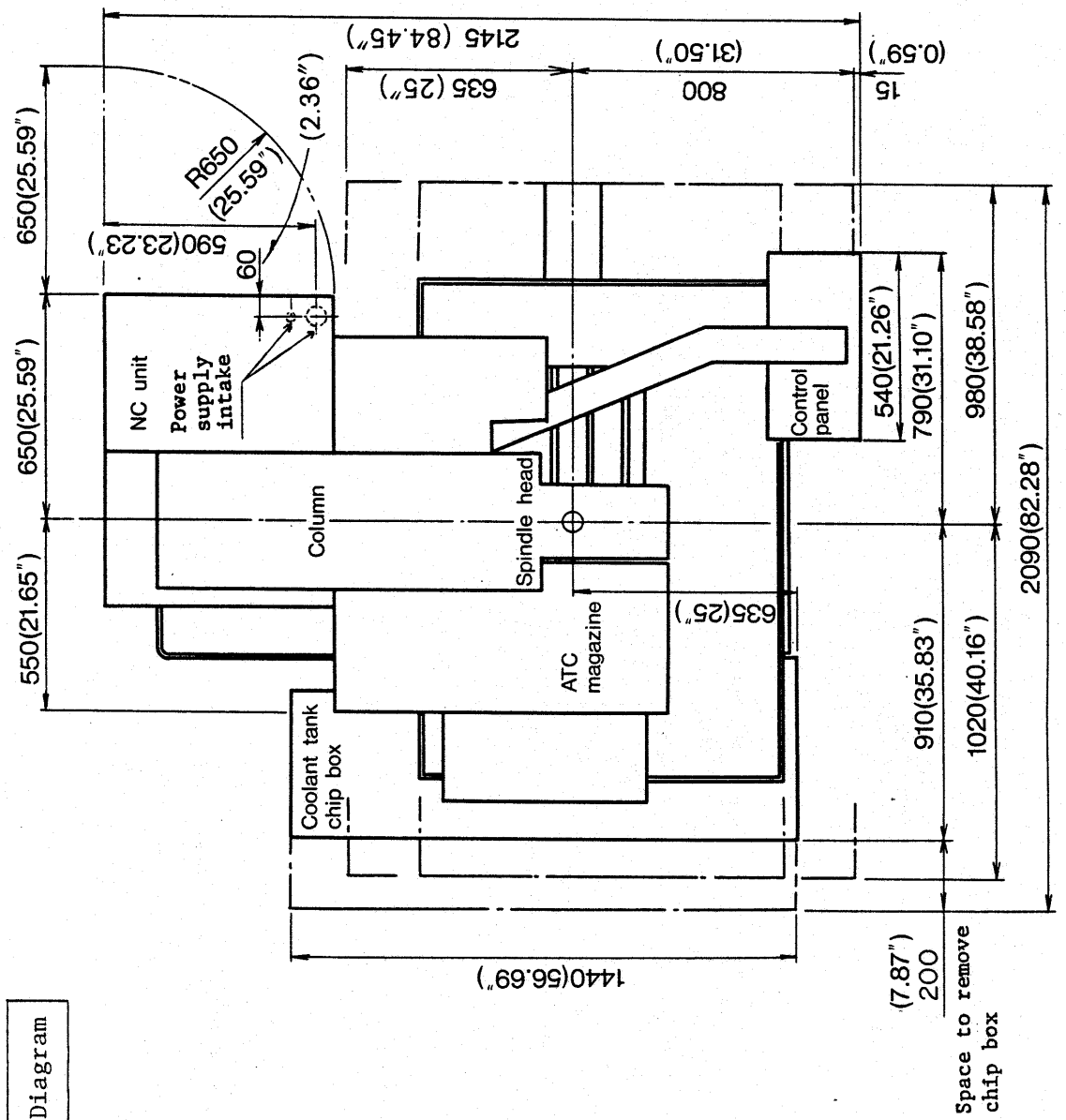


9. Installation Diagram

2. GREASING AND LUBRICATION

Lubrication is vital for machine tool and greatly influences machine life. Accordingly, be sure to use recommended lubricating oils which are completely free of foreign matter. Periodically clean the tank and filter for each lubricating system and check equipment and piping for damage so that the machine can be operated under the optimum conditions.

1. Greasing

Grease lubrication is used for all linear guides and ball nuts of the X, Y and Z axes.

To supply grease, pressure-inject grease once using a grease gun, and move respective axes.

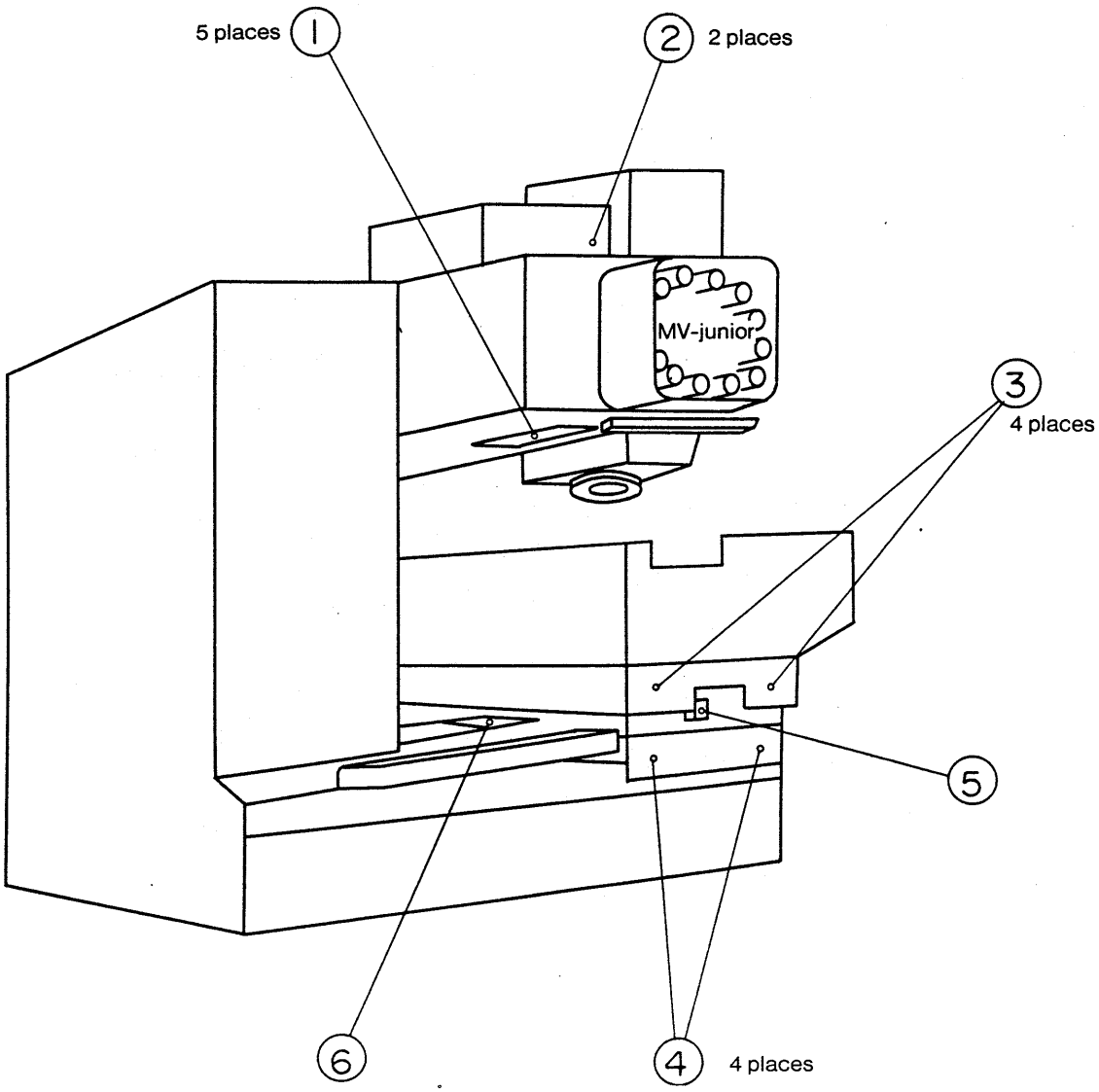
Then, pressure-inject grease again.

Use Maltemp LRL3 produced by Kyodo Yushi or similar grade of grease.

Add grease every 3 months.

Greasing points are illustrated below.

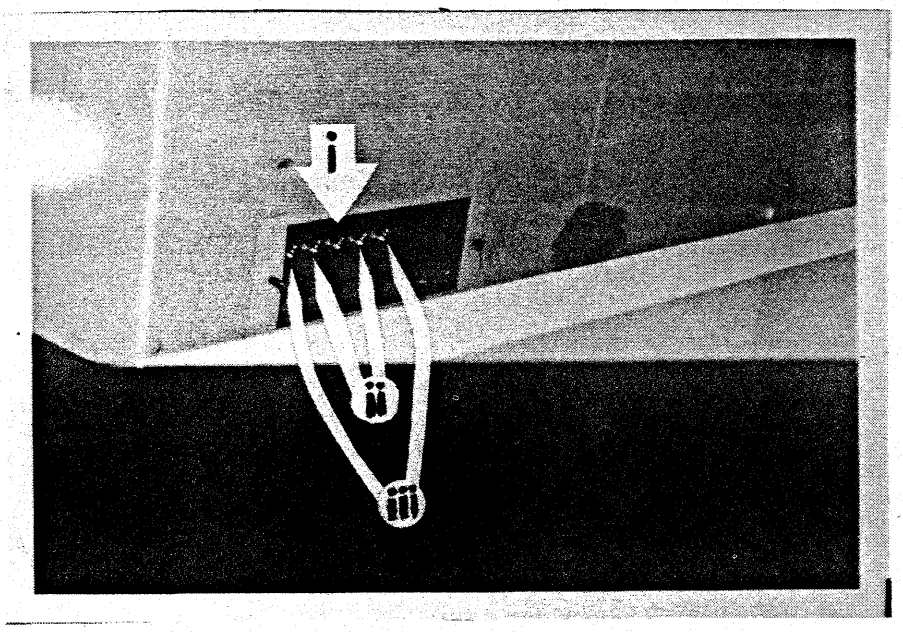
1.1 Greasing point



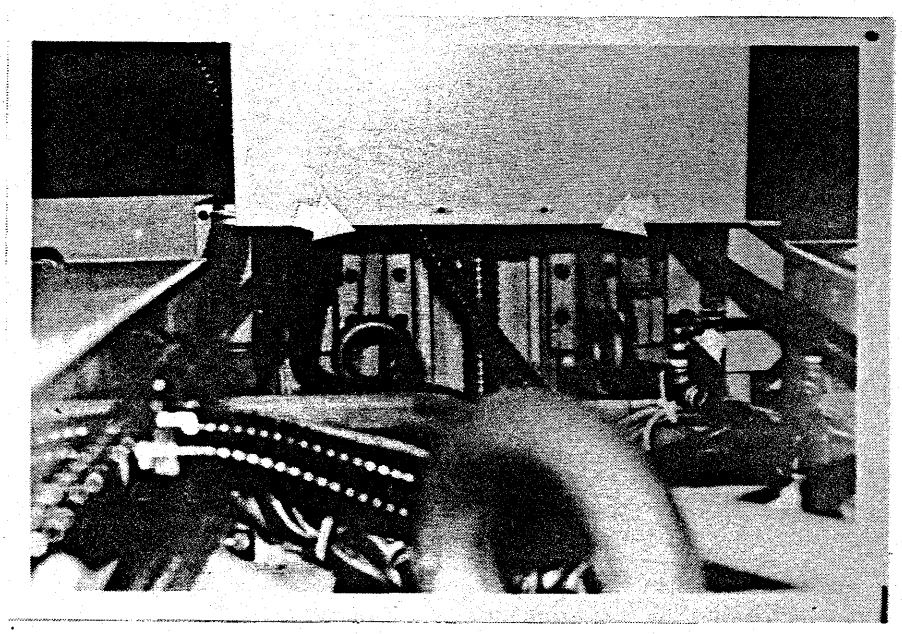
1 i) Z axis ball nut

ii) Z axis linear guide (two points in the middle portion)

iii) Z axis linear guide (two points in the lower portion)

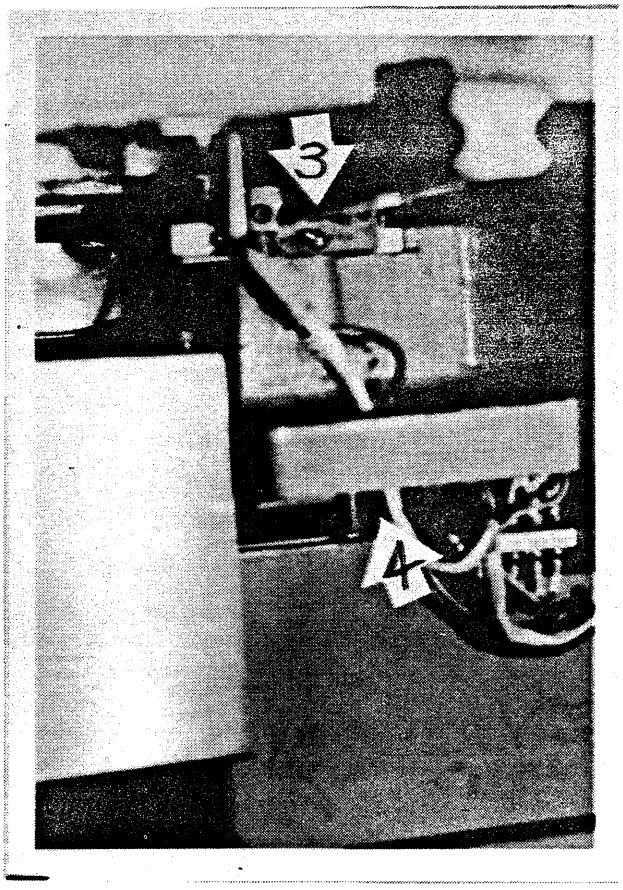


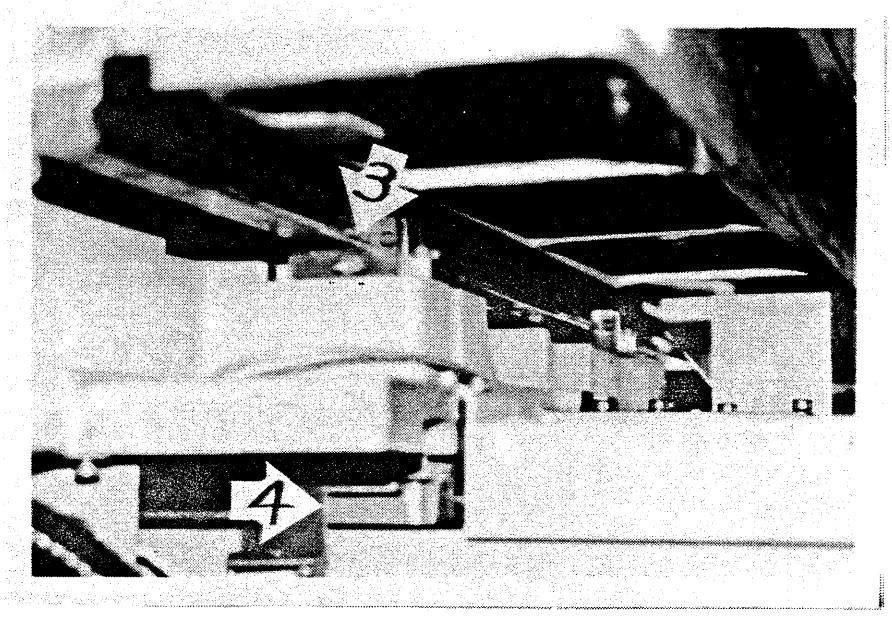
2 Z axis linear guide (two points in the upper portion)



3 X axis linear guide

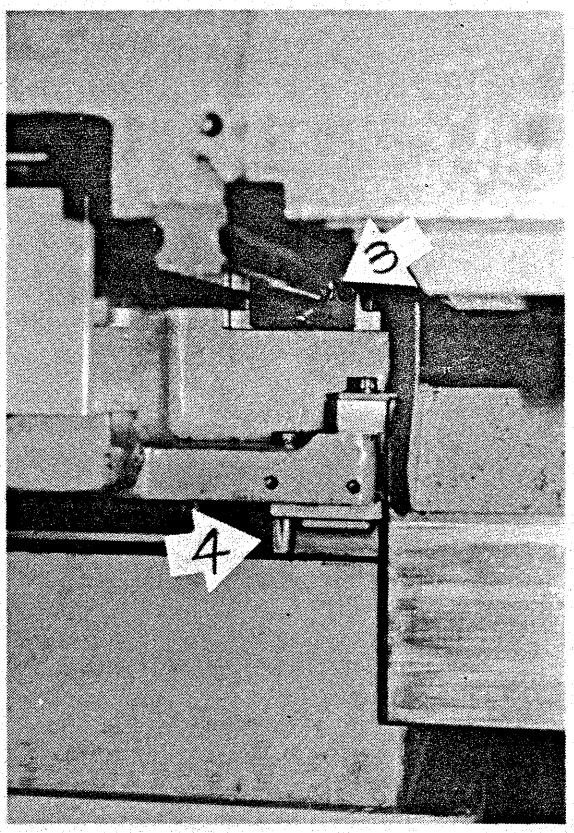
4 Y axis linear guide

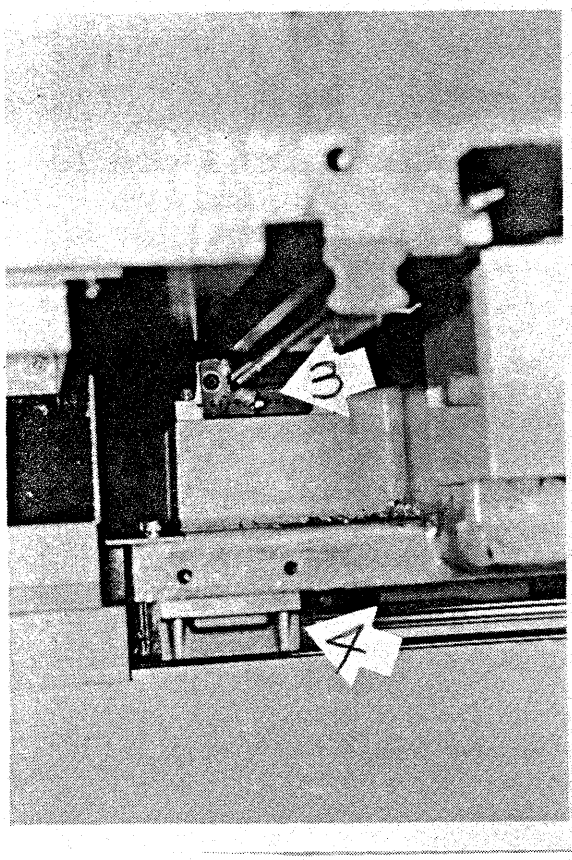




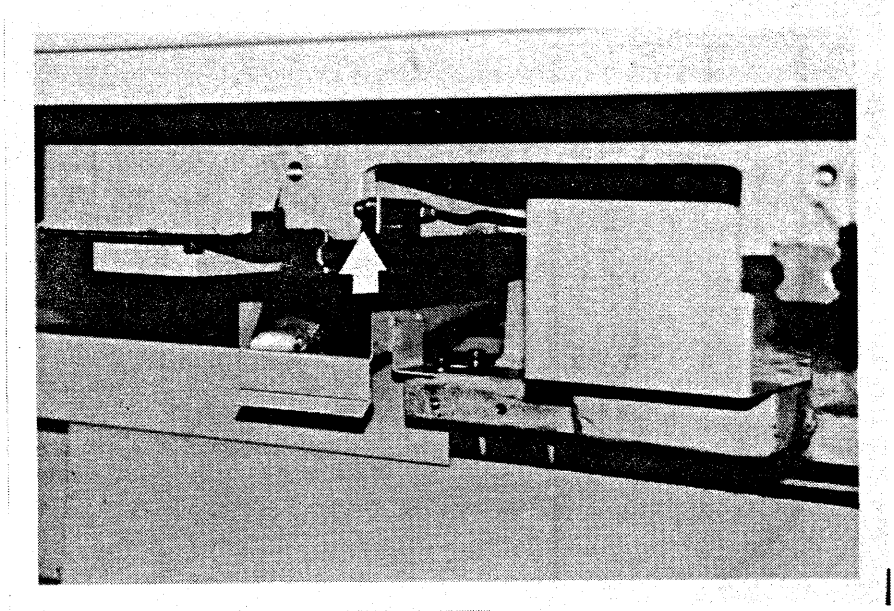
3 X axis linear guide

4 Y axis linear guide

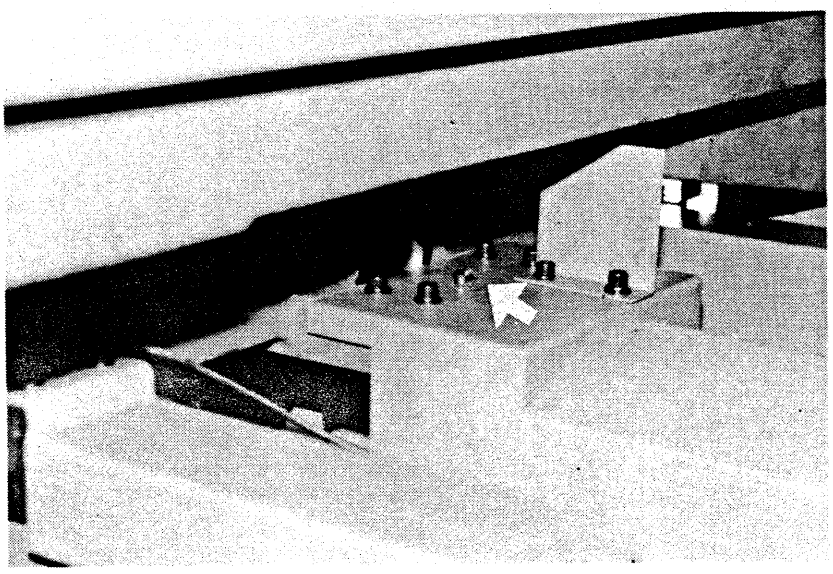




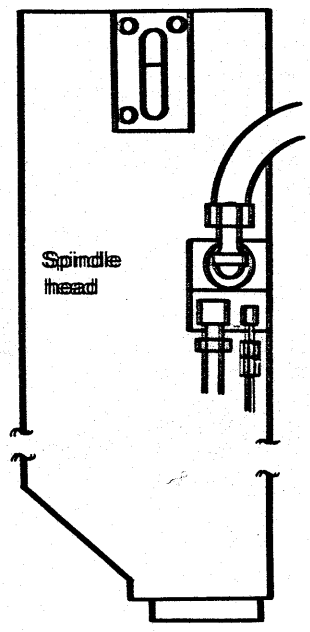
5 X axis ball nut



6 Y axis ball nut



2. Lubrication

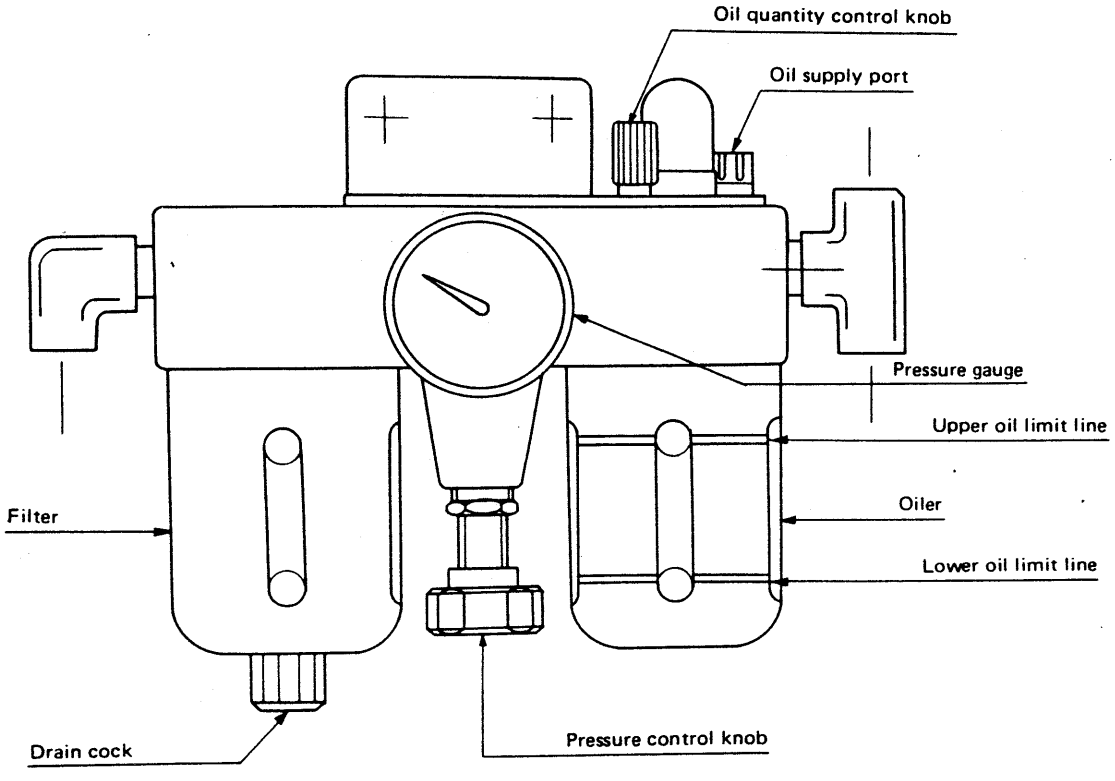


An oil tank that supplies oil to the cylinder is located in the spindle head. When the oil level falls below the red line, add oil. Use Daphne Hydraulic 32.

3. Air Unit (3-component air kit)

Compressed air is used for the following. (Pneumatic supply: 100 Nℓ/min)

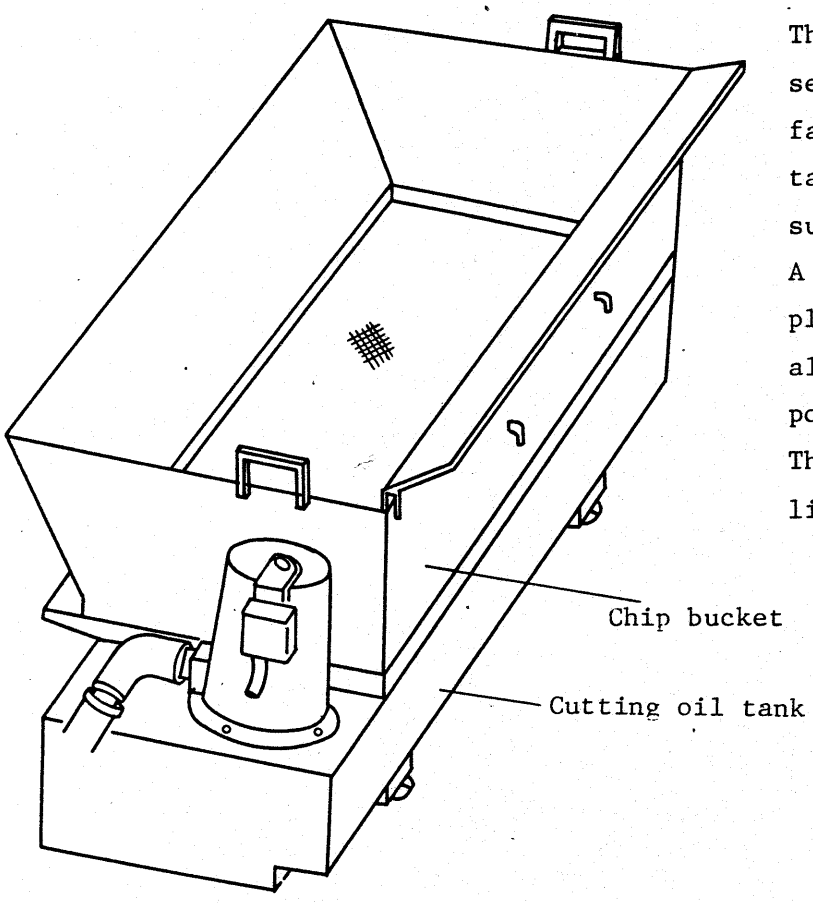
* Air blow: Air is blown from the inside the spindle to the tool shank to remove dust when tools are automatically replaced.
* Tool/clamp/unclamp: Use for the cylinder to clamp and unclamp tools in the manual mode.
* Pot up/down: Used for the pot up/down cylinder.
* Engagement/disengagement of the pin for pot lowering prevention: A pin is used to prevent the pot from lowering when the power is turned off. Air is used to operate the pin cylinder.



Supply turbine oil from the oil supply port to the upper oil limit line.

When water accumulates in the filter, use the drain cock to drain.

4. Coolant



The coolant tank is separately installed to facilitate cleaning the tank interior and supplying coolant.
A chip bucket can be placed on the tank, allowing easy chip disposal.
The tank can contain 85 liters of coolant.

5. Oil Guide Table

Lubrication point	Lubrication system	Frequency	Recommended oil	Q'ty
Linear guides and ball nuts	Grease lubrication	once in three month	Multemp CRL NO.3 (Kyodo yushi)	As required
Cylinder in the headstock		As required	Daphne Hydraulic32 (Idemitsu)	0.1 ℓ
Pneumatic unit		As required	Daphne Hydraulic32 (Idemitsu)	0.1 ℓ
Coolant		As required	Water-soluble base or oil base	85 ℓ

6. Specified Oils and Their Corresponding Oils

Manufacturer	Grease
Kyodo yushi	Multemp CRL NO.3
Caltex	Caltex prm grease SRI
NOK Kluber	Isoflex LDS special 18
Mobil	Mobil 22
Esso	Temprex

Manufacturer	Oil
Idemitsu	Daphne Hydraulic 32
Nippon Sekiyu	Supper Hi-land 32
Maruzen Sekiyu	Swa-fluid 32
Mobil	Hydraulic Oil 28
Shell	Shell Tellus Oil 32

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D. INSPECTION AND MAINTENANCE MANUAL (ELECTRICAL SYSTEM)

INSPECTION AND MAINTENANCE MANUAL
(ELECTRICAL SYSTEM)

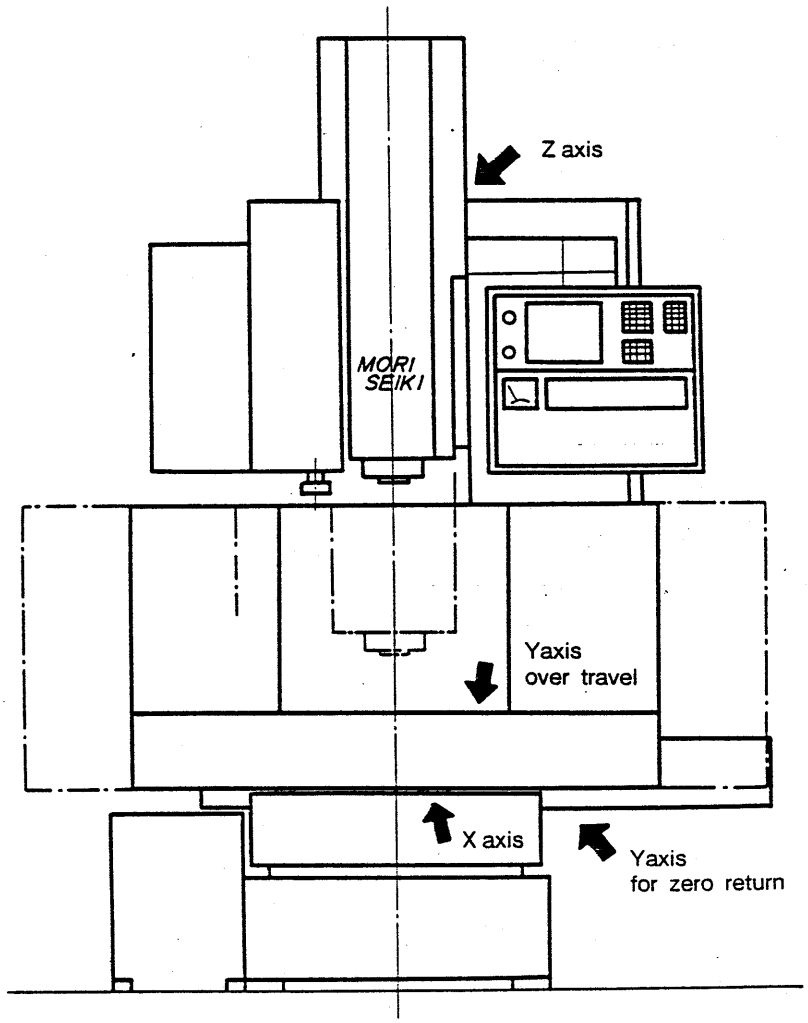
1. MAINTENANCE AND INSPECTION

2. SELF DIAGNOSIS FUNCTION (LADDER DIAGRAM EXPLANATION)

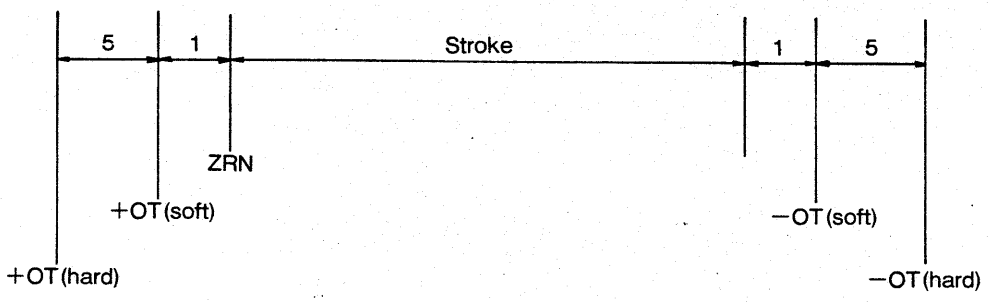
1. MAINTENANCE AND INSPECTION

1. X, Y and Z Axis Relations

1.1 X, Y and Z Axis Overtravel and Zero Return Limit Switch



1.2 Stroke of axes



Strokes

X axis: 560 mm

Y axis: 410 mm

Z axis: 460 mm

Parameter Numbers for Stroke Adjustment

° Backlash amount (setting values: -9999∿+9999, unit: 1/1000 mm)

No. 1851

° Reference (zero return) point (setting values:
-32768∿+32767, unit: 1/1000 mm)

No. 1850

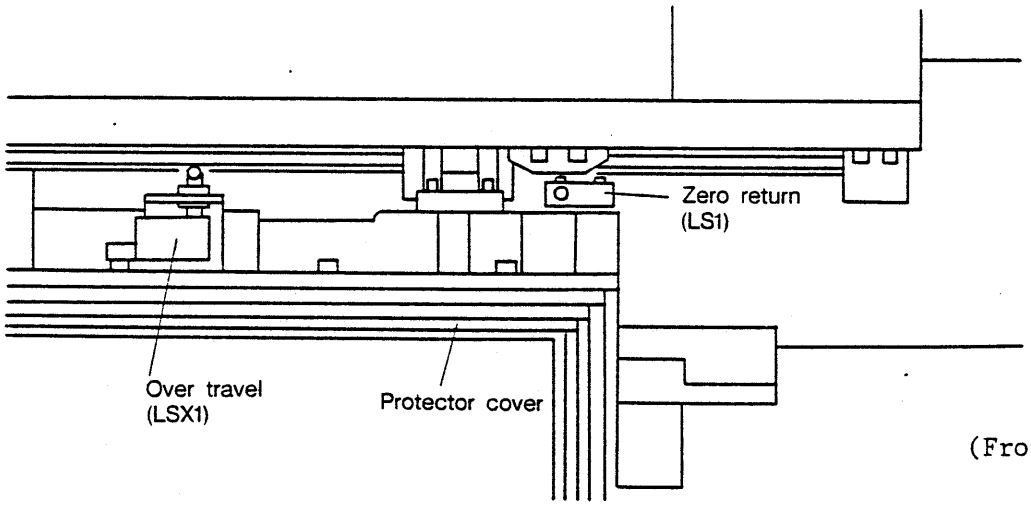
° SoftO.T. (setting values: -99999999∿+99999999, unit: 1/1000 mm)

No. 5220 + direction soft limit

No. 5221 - direction soft limit

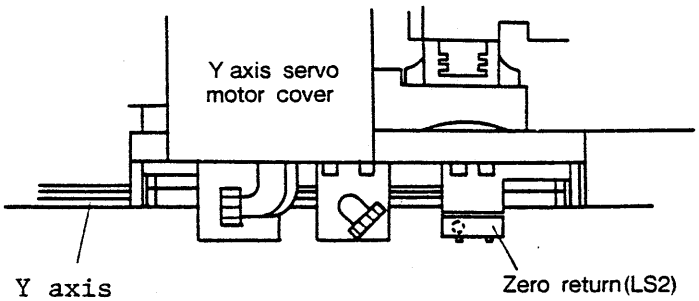
Parameters must be set for each axis; for example, No. 1851 of X stands for X axis backlash.

X axis

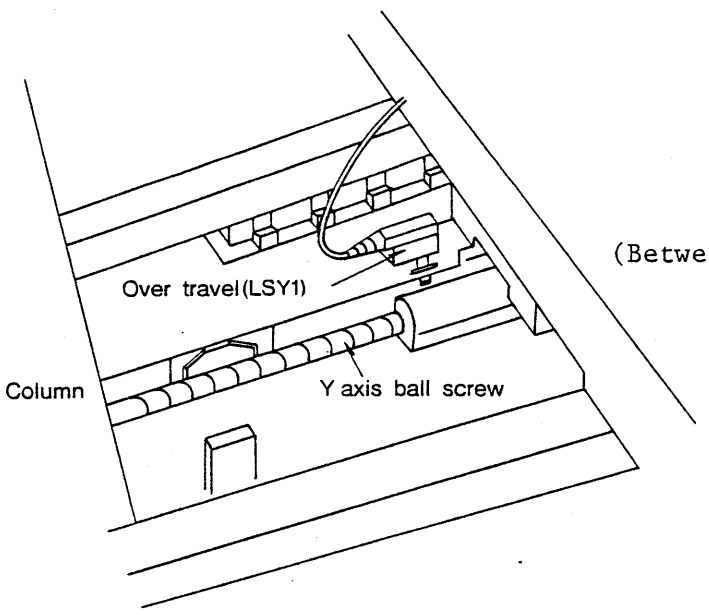


(Front)

Y axis

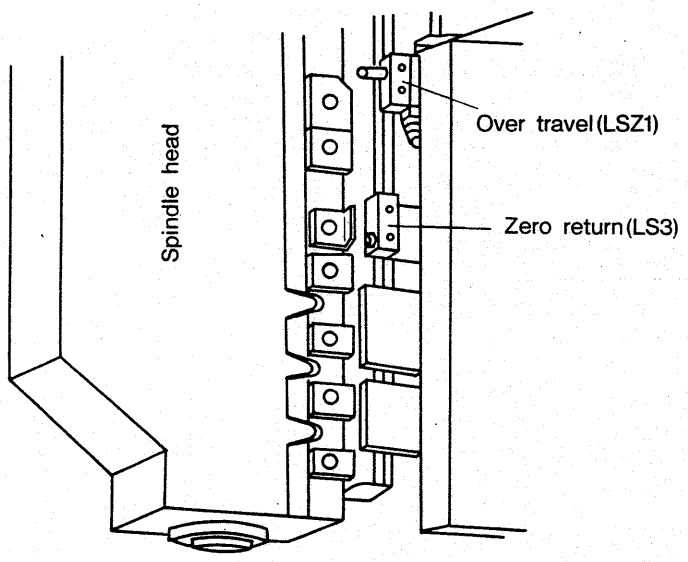


(Right side)



(Between column and table)

Z axis



2. Zero Return Adjustment

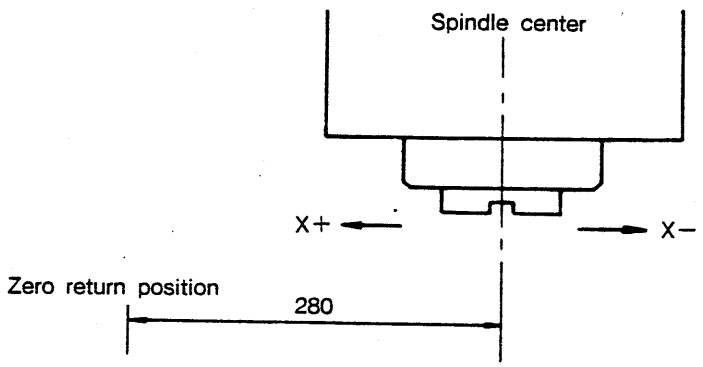
° Properly input backlash (parameter No. (1851) for all axes before

° Set zero return point setting parameters (No. 1850) of all axes to 0.

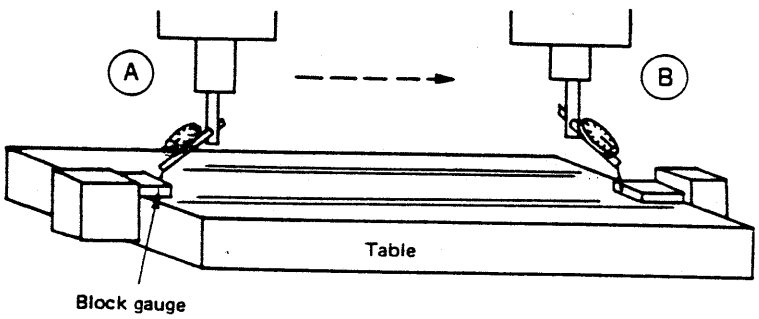
2.1 Zero return position (reference point is obtained)

Set the zero return position as shown below.

2.1.1 X-axis



X-axis reference point is at the center of the table.



(1) Set a block gauge on the table end using a magnet or other means as shown at (A).

(2) Set the dial gauge (or lever type dial test indicator) on the spindle to 0. Also set the present position counter to 0. Press [X] and [ORIGIN] buttons on the RELATIVE display.

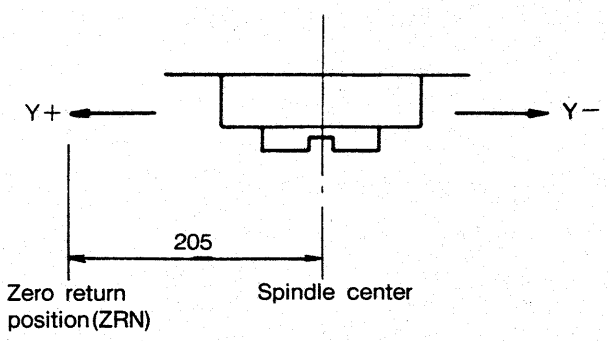
(3) Move the block gauge to the other end as shown at (B).

(4) Move the table until the reading of the dial gauge (or lever type dial test indicator) coincides with that

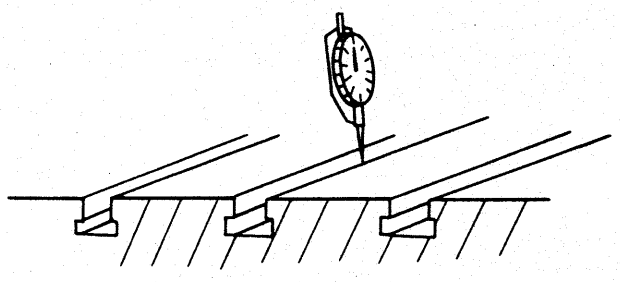
obtained at (A).
Note the present position display.
(The table center is half of the displayed value.)

(5) After the table is moved to the center reset the present position display to 0.

2.1.2 Y-axis



The Y-axis reference point is located at the midpoint between the two central grooves.



(1) Set a lever type dial test indicator on the spindle, and locate the midpoint between the two central grooves.

(2) Set the Y-axis present position display of the table center point to 0.

2.1.3 Z-axis

Z-axis reference point is determined by the relationship between the ATC and the spindle head.

- Zero return adjustment (from reference point determination to parameter setting) should be done for one axis each time.

2.2 Adjustment of zero return dog

(1) Perform zero reuturn operation.

(2) Adjustment the dog position so that the readings of the present position display are as follows.

X axis 270.000 280.000 mm

Y axis 195.000 205.000 mm

Z axis According to the ATC adjustment.

2.3 Calculation of positioning error

(1) After dog position adjustment, perform zero return operation again.

(2) Note the present position display.

(3) Calculate the difference between the position to be returned and the actual zero return position (when not adjusted).

2.4 Input data in parameters

Setting value: -32768 ∿ +32767 (unit: 1/1000 mm)

Parameter No. 1850 X X axis

1850 Y Y axis

1850 Z Z axis

When the reference point (zero return point) is shifted to the + (-) position, set + (-) value.

2.5 Adjustment of Soft O.T.

Input values determined for parameters (unit: 1/1000 mm)

Parameter No.		Setting value
5220 X	X + direction soft limit	1000
5220 Y	Y + direction soft limit	1000
5220 Z	Z + direction soft limit	1000
5221 X	X - direction soft limit	-561000
5221 Y	Y - direction soft limit	-411000
5221 Z	Z - direction soft limit	-461000

2.6 Adjustment of hard O.T.

(1) Perform zero return.

(2) At this time, make the soft O.T. on and adjust the dog position so that a movement of 5mm results in hard O.T.

2.7 O.T. Clear

a) Soft O.T. clear

If any axis travels to the stroke end due to misoperation or mulfunction, the O.T. alarm is issued. This alarm can be cleared by returning the misoperated axis and pressing the reset button.

This machine retains the memory of the machine coordinates even when the power is turned off. If the axis is moved when the power is off, therefore, the machine coordiantes will change, which in turn may cause an O.T. alarm even if the axis is located in the stroke.

This alarm is cleared by the following procedures:

i) Turn off the power to the NC unit.

ii) While pressing the [.] and [-] data keys at the same time, press the POWER ON button.

iii) In several seconds, the IPL menu display will appear as shown below.

```
procedure:
1  ---
2  ---
3  ---
4  SETTING
5  ---
6  END IPL
```

iv) Press the [4] and [INPUT] keys.
The message "CHECK SOFT OT AT POWER POWER ON" will appear.

v) Push the [N] key.

vi) Push the [6] and [INPUT] keys.

vii) NC is restored to its normal display.

viii) Perform zero return for all axes.
Note that the machine coordinates are cleared to "0" only when zero return of all axes is completed.

b) Hard O.T. clear

If the soft O.T. does not work, this machine activates the hard O.T. to stop machine travel.

When the hard O.T. switch is turned on, the alarm message "V READY OFF" is displayed. When the hard O.T. switch is turned on, the power supply to the velocity control unit is cut off, inabling the machine to move in all axes.

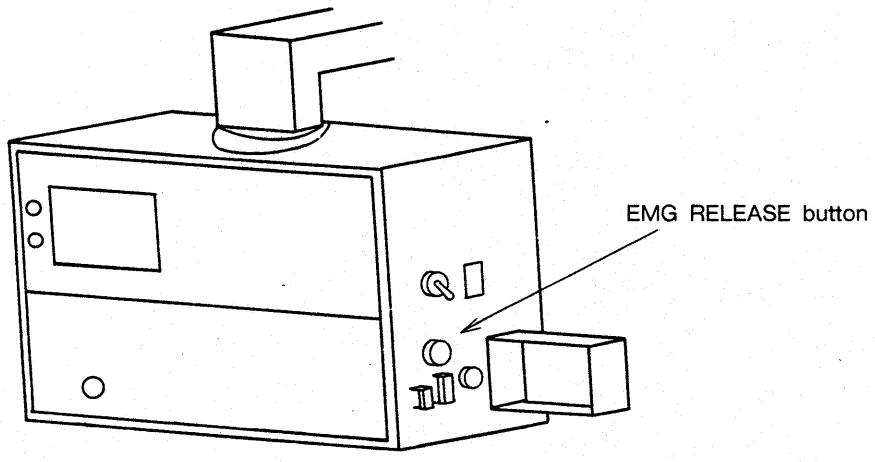
This hard O.T. is cleared by the following procedure.

i) While pressing the EMG RELEASE button located on the right side of the control panel, press the reset button to clear the alarm message "V READY OFF".
Do not release the EMG RELEASE button until the axis is returned to its normal zone.

ii) Press the POWER ON button to activate control on, then manually return the axis from the hard O.T. zone to the normal zone.

Note that all O.T. switches are inoperative when the EMG RELEASE button is pressed. Pay careful attention when moving the axis.

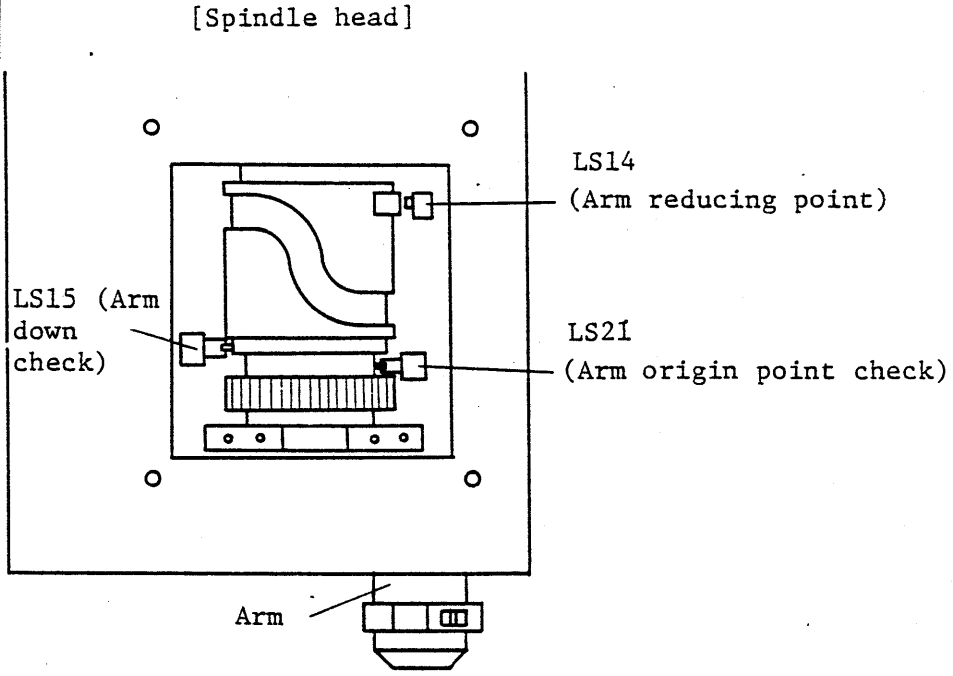
The EMG RELEASE button is located on the right side of the control panel.



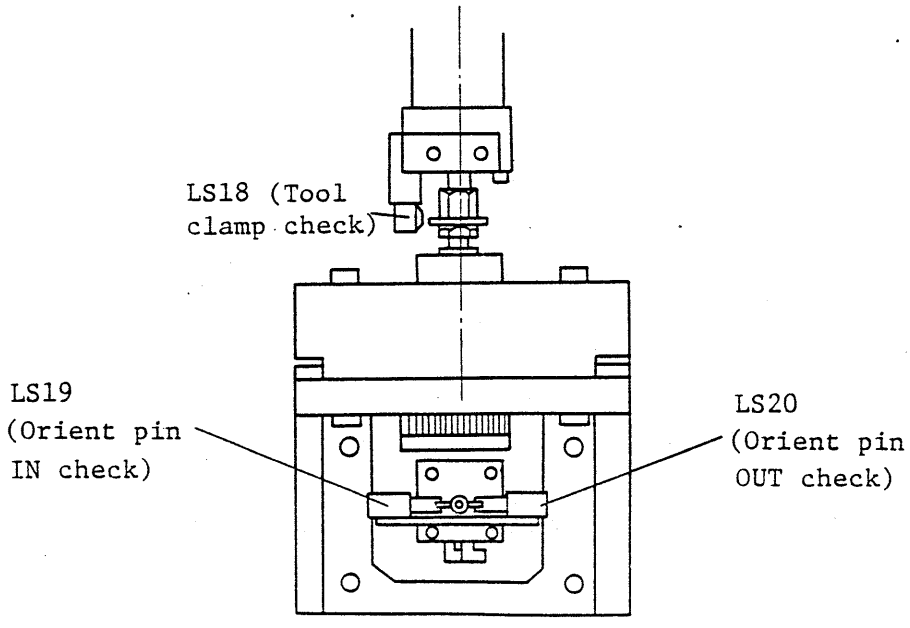
3. ATC Relations

3.1 ATC Relation Limit Switch

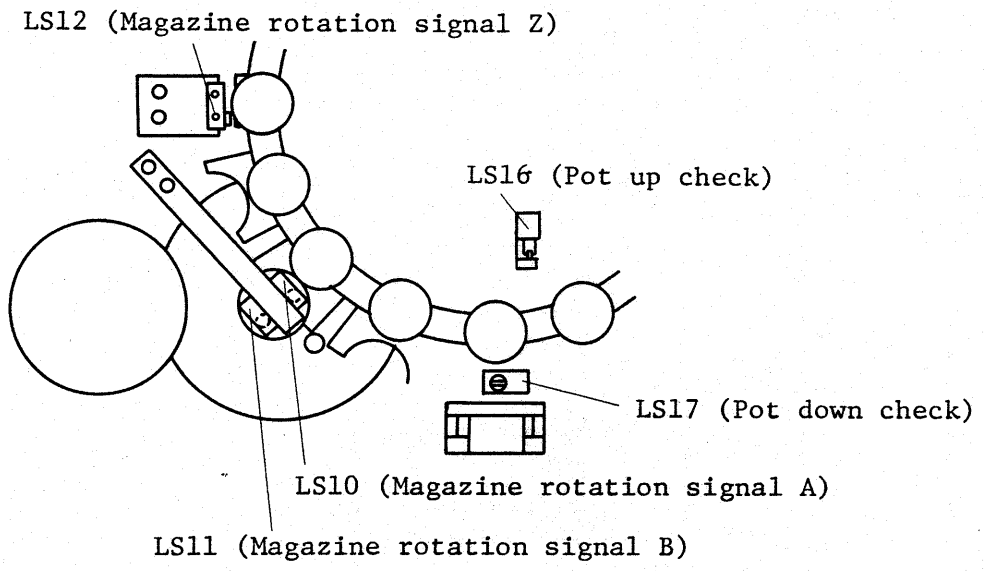
Arm



Spindle



Magazine


LS12 (Magazine rotation signal Z)
LS16 (Pot up check)
LS17 (Pot down check)
LS10 (Magazine rotation signal A)
LS11 (Magazine rotation signal B)

3.2 ATC System Adjustment

3.2.1 ATC parameters (Refer to Section 4 for the setting procedure.)

Data table control parmeters

NO.	ADDRESS	PARAMETERS	NO. OF DATA	OFFSET	SPECIAL	TABLE NO. 0
000	D0000		10			
001	D0002	00000010	10	0		
002	D0010	00000010	1	0		
003	D0018	00000010	Number of pots + 1			
004	D0026					
005	D0034					
006	D0042					
007	D0050					
008	D0058					
009	D0066					
010	D0074					

Be sure to set the data table control parameters as specified in this table. Set the number of pots + 1 (17 or 31) to the "No. of DATA" column of NO. 003.

Timer

No.	Specification	Set value (msec)
T7	Determines the effective braking time for the arm and magazine motors.	400
T11	Determines the pot up/down movement monitoring time	5000
T12	Determines the arm lowering monitoring time	2000
T13	Determines the arm deceleration monitoring time.	2000
T16	Determines the arm forward rotation time when the arm operation is restored from the arm deceleration signal activation state.	496
T17	Determines the allowable time limit of an ATC return cycle.	15000

No.	Specification	Set value (msec)
T19	Determines the time between the activation of the magazine coincidence count signal and the deactivation of the rotation output. This timer is effective only when bit 7 of PC parameter K6 is 1.	

Keep relays

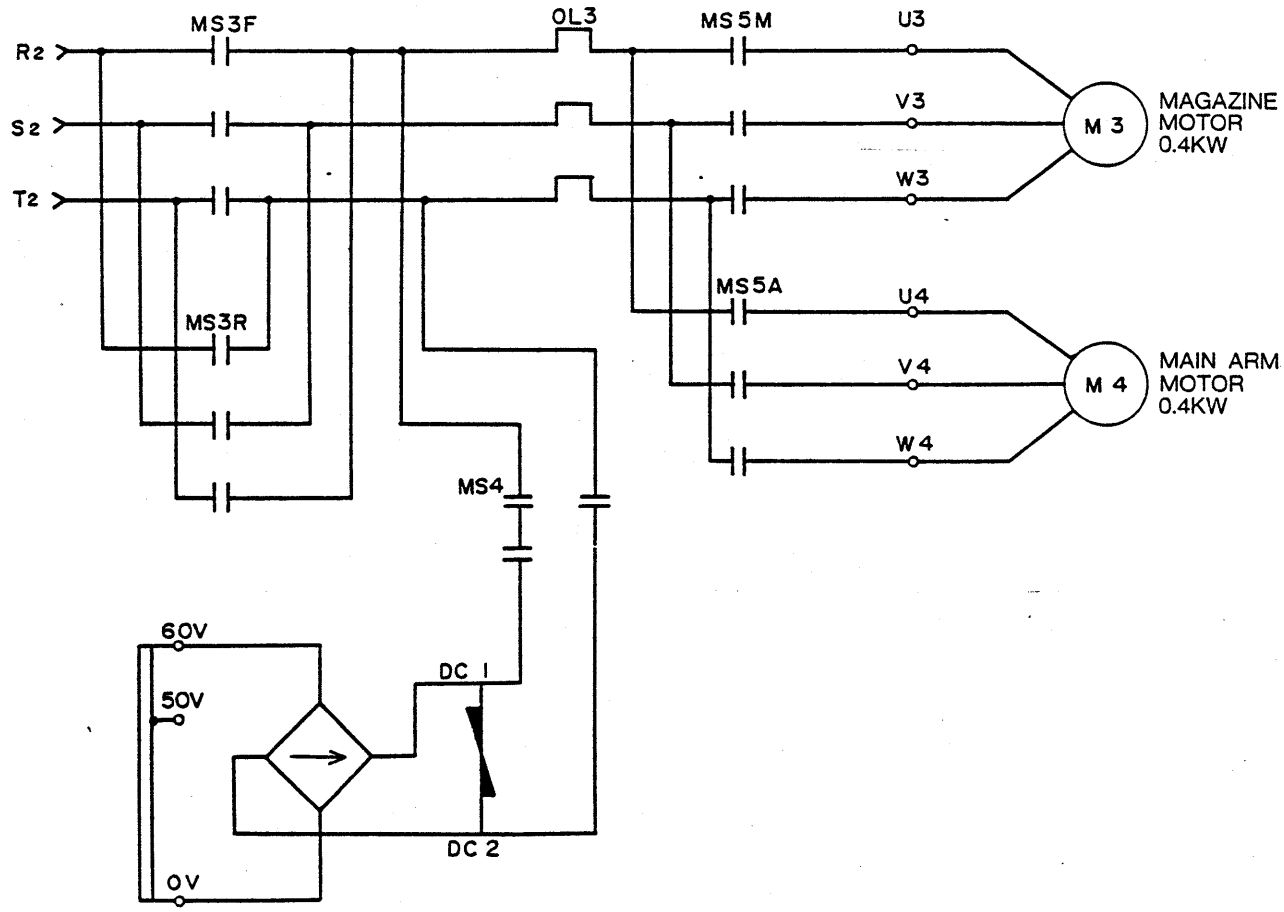
No.	Specification	Standard setting
Bit 1 of K0	1: Presence of a tool in a pot is not checked. 0: Presence of a tool in a pot is checked. This parameter is not used after Serial No. 83.	0
Bit 2 of K4	1: Magazine stopping is possible by resetting. 0: Magazine stopping is not possible by resetting.	1
Bit 5 of K4	1: Tool diameter discrimination is executed. 0: Tool diameter discrimination is not executed.	1
Bit 6 of K5	1: M02 and M30 are output immediately. 0: M02 and M30 are not output immediately during magazine indexing.	0
Bit 2 of K6	1: K15 is not automatically compensated for when an abnormal stop has occurred during a return cycle. 0: K15 is automatically compensated for when an abnormal stop has occurred even during a return cycle.	0
Bit 3 of K6	1: The brake is activated immediately when the magazine coincidence detection signal (LS11) is turned on. 0: The brake is activated after the magazine rotation output is deactivated and when the time set to K14 (forward rotation) or K16 (reverse rotation) elapses.	0
Bit 6 of K6	1: The magazine and arm brake timings (K14 to K16) are automatically compensated for when an abnormal stop has occurred. 0: The brake timings K14 to K16 are not automatically compensated for.	

Counter

No.	ADDRESS	PRESET	CURRENT
5	C16	Number of pots: 16 or 30	Current position of magazine

3.2.2 ATC Motor Adjustment

Both ATC double arm and magazine are driven by an AC motor.
A DC type brake is used.



The MS3 and MS5 are reversible contactors and MS4 is a standard contactor.

No.	Specifications	PCDGN
MS3F	ATC normal rotation	Y1.0
MS3R	ATC reverse rotation	Y1.1
MS4	ATC braking	Y1.3
MS5M	Magazine motor drive	Y1.4
MS5A	Arm motor drive	Y1.5

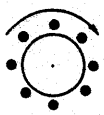
(Example) Magazine reverse rotation ..... MS3R, MS5M ON
Magazine braking ..... MS4, MS5M ON
Arm normal rotation ..... MS3F, MS5A ON
Arm braking ..... MS4, MS5A ON

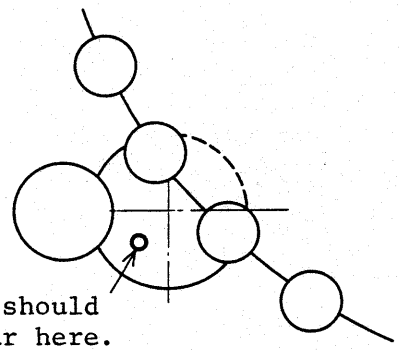
* Procedure for adjusting the double arm brake

1) Remove the tool loaded in the spindle.
2) Command "M31; M35;" in the MDI mode.
(The field hold lamp and ATCHP lamp blink.)
3) Push the [+x] button. (Continue to press it until the arm stops.) Removing the front cover from the magazine reveals the limit switch (LS21) for checking the arm original position in the lower right corner. If this switch is located in the center of the dog, it indicates that adjustment is completed.
4) When the LS21 is off the center of the dog, adjust the brake by varying the value of PC parameter timer K15.

Note) If bit 6 of PC parameter K6 is 1, K15 is automatically compensated for when the arm causes an improper stop.

3.2.3 Magazine Brake Adjustment

1) Select the MANUAL mode.
2) Press the magazine start button  and release it at the appropriate time.
3) At this time check the position of the magazine. If the pin wheel is at the 45° position (center of positioning), this adjustment is completed.



4) When it deviates from the center of positioning, adjust the PC parameter keep relay K14 for normal rotation or K16 for reverse rotation.

5) After adjusting the magazine brake in the normal rotation, adjust the brake in the same way for the reverse rotation. (The magazine can rotate reversely only in the automatic mode. Since a tenchnical random memory is used, use a T code that calls a tool which will cause a reverse magazine rotation.)

Note 1: Only up to 72 msec can be set to K14 and K16. If the magazine is stopped too quickly even when 72 msec (all zero) is given, set 1 to bit 7 of K6 and set 20 to 39 msec to T19.

Note 2: If bit 6 of PC parameter K6 is 1, the values for K14 and K16 are automatically compensated for when an abnormal stop has occurred during magazine indexing in the automatic mode. Therefore, brake adjustment is possible even when the break-in operation by T codes is performed for 30 minutes in the automatic mode.

The following parameters are used to set the braking timings for the arm and magazine drive motors.
If bit 6 of K6 is 1, the parameter values will automatically change when an abnormal stop has occurred.
The table below indicates the parameter-time relationship.

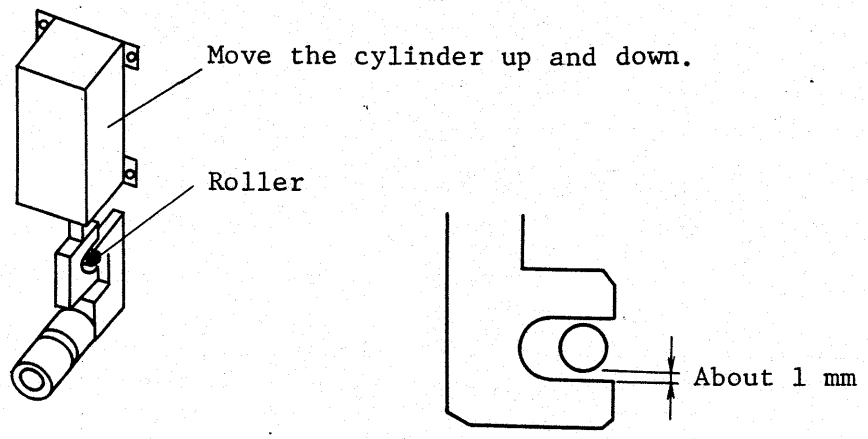
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Time
0	0	0	0	0	0	0	0	72 msec
0	0	0	0	0	0	0	1	8 msec
0	0	0	0	0	0	1	0	16 msec
0	0	0	0	0	1	0	0	24 msec
0	0	0	0	1	0	0	0	32 msec
0	0	0	1	0	0	0	0	40 msec
0	0	1	0	0	0	0	0	48 msec
0	1	0	0	0	0	0	0	56 msec
1	0	0	0	0	0	0	0	64 msec

K14	Determines the time from the deactivaiton of the magazine rotation output during magazine forward rotation to the activation of the brake
K15	Determines the time from the deactivation of the arm rotation output to the activation of the brake
K16	Determines the time from the deactivation of the magazine rotation output during magazine reverse rotation to the activation of the brake

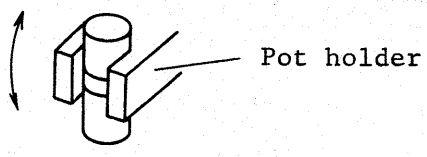
Note: If 1 is set at two or more bits, that used at the lowest bit (shortest time) has priority.

3.2.4 ATC Adjustment

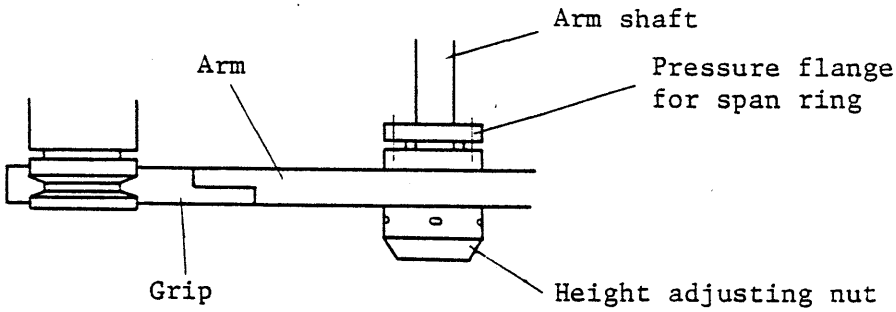
1) Move the pot up-down cylinder vertically and adjust the gap between it and the roller to about 1 mm in the up position.



2) After confirming the action of limit for pot up-down operation, check that all pots can move smoothly into the pot holder.

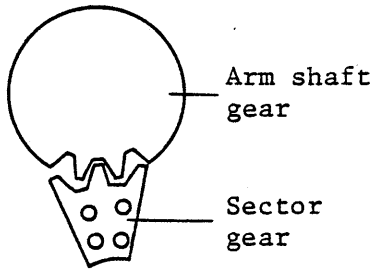


3) Load a tool into the pot and move the pot down.
Mount the arm and adjust the grip height using the height adjusting nut.



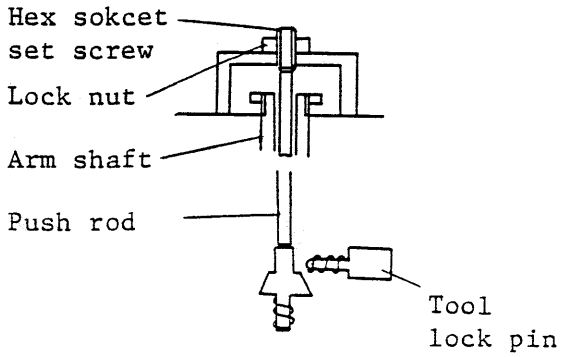
4) Raise the pot to load a tool into the spindle.
   - Adjust the Z-axis zero return so that the height on the main spindle side is the same as that on the pot side (3).
   - Secure the grip to the arm while aligning it to the tool. In this state, adjust the orientation position using the hex socket set screw located on the side of the spindle head.

5) Replace the ATC drive motor with the adjusting handle.
   - Reduce the backlash between the sector gear and the arm shaft gear as much as possible.
   - Rotate the sector gear fully clockwise using the handle. In this state, align the grip to the tool in the spindle, tighten the span ring and secure the arm to the arm shaft.



   Note: When tightening this span ring, use three hexagonal bolts only temporarily since there is no sufficient space to use a hexagonal wrench. Replace them with a cap bolt as the arm is lowered.

6) Drive a tool lock pin into the arm.
   Allow the hex socket set screw to push the push rod so that the lock pin slips in completely without applying force when the arm is raised, then secure it with the lock nut.



7) Rotate the handle to activate the ATC and check the following points.

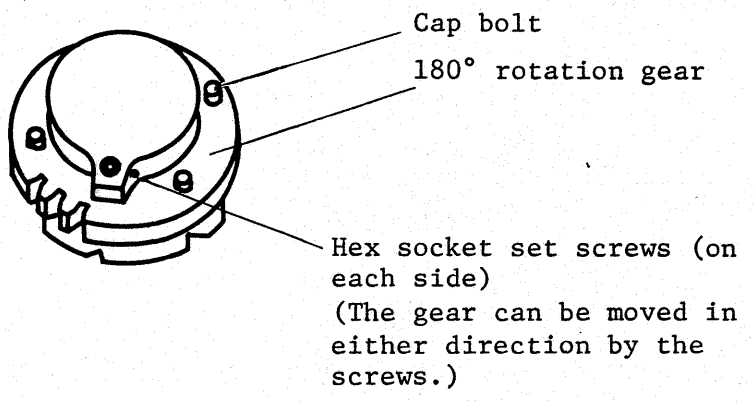
1 That the grip slips in smoothly without the tool lock pin interfering with the tool,

2 That the tool is not clamped when the arm is lowered,

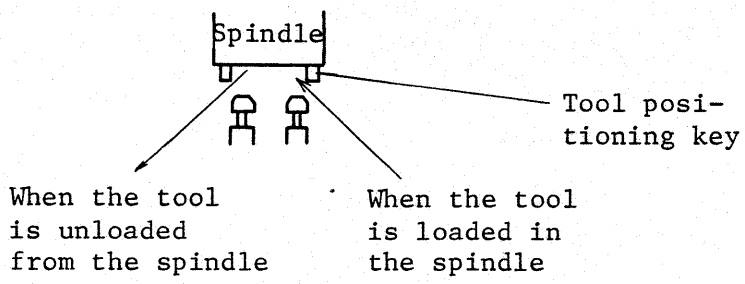
3 That the tool is completely gripped when the arm is lowered,

4 That the tooth trace of the sector gear matches that of the 180° rotation gear,

Note: If not, adjust the 180° rotation gear using the hex socket set screw.



5 That the pull stud bolt does not contact the tool positioning keys on the both side when the tool is loaded on unloaded.



8) Mount the ATC drive motor and perform the ATC operation.
Perform the same check as in step 7.
In addition, repeatedly check to see that the ATC returns to its home position.

3.3 ATC Operation

3.3.1 Tool Data Entry

(a) Press the NC/PC key to select the PC display.
The basic PC menu will appear.

PCMDI	PCLAD	PCDGN	PCPRM	

(b) Press the PCMDI soft key to select the selection display.

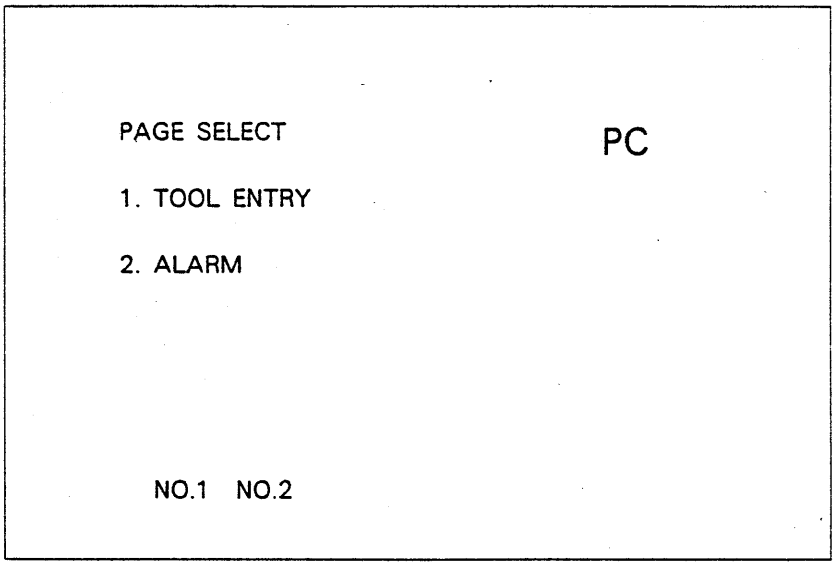


Fig. 1 Selection display

(c) Press the No. 1 soft key to select the tool registration display.

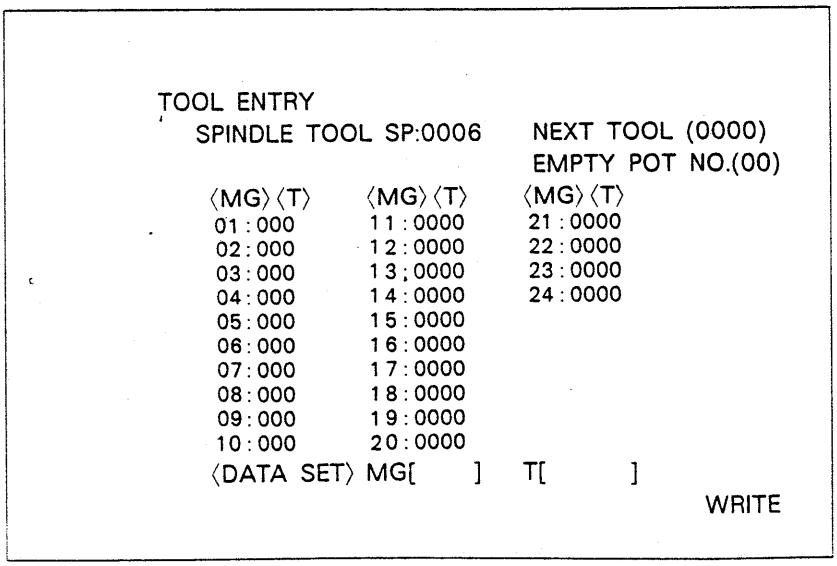


Fig. 2 Tool entry diaplay

(d) Tool data entry procedure

1) Use the data set section [DATA SET MG( ) T( )] to input data.

Enter data using the number keys on the keyboard and press the [INPUT] key. The input data will be displayed at the position on the data set section where the cursor is located. located.

2) After checking the input data on the set section, press the WRITE soft key. The data is set and the data indication on the setting section will disappear.

3) i) Tool data cannot be registered during the ATC cycle or magazine rotation.

ii) Data setting is possible only for the entry of the tools in the magazines and the tool to be loaded in the spindle. Data for empty pot and for next tool are only indicated.

iii) To register a tool data to the spindle tool, input 0 to MG. To register tools to magazines, input the corresponding numbers to MG.

iv) If a tool number which has been registered is input, "*ALREADY USED*" appears.

If an unusual value is input, "*MISS SETTING*" appears. appears.

Thus, input data is not set. The error indication will disappear when new data is input.

Repeat the above steps to set the tool data.

Remember that the most significant digit of each 4-digit number must be set as follows.

Large diameter tools : 9

Medium diameter tools : 1 to 8

Small diameter tools : 0

To return to the NC display after entry, press the [NC/PC] key once.

To return to another PC display, press the [NC/PC] key twice.

(e) Setting spindle tool data

Change the spindle tool as described below.

i) Select the manual mode (handle, step, jog, rapid or zero return).

ii) Press the tool unclamp button and change the tool. If the spindle tool number is the same as the number of the previous tool, setting is complete. If not, advance to step iii).

iii) Select the MDI mode. Set the key switch on the control panel to EDT OK.

iv) Register tool numbers in the same manner as described in steps (a) to (c).

v) Check whether it is possible to return the spindle tool to an empty pot whose number is shown in the tool entry display.
A pot which is indicated as empty must not be loaded with a tool.

vi) Press the NC/PC key twice. Then press the PCPRM and KEEPRL keys in that order.

vii) Move the cursor to K11 and set the number of the pot to which the spindle tool is returned using a binary code (*1). When the spindle tool is returned to the No. 13 pot, for example, set 00001101.

viii) Set the spindle tool diameter to K13.
Small diameter tools : 00000001
Medium diameter tools : 00000000
Large diameter tools : 00000010

(*1) Binary code (binary notation)

Bit	7 Bit	6 Bit	5 Bit	4 Bit	3 Bit	2 Bit	1 Bit	0 Bit
Data	$128(2^7)$	$64(2^6)$	$32(2^5)$	$16(2^4)$	$8(2^3)$	$4(2^2)$	$2(2^1)$	$1(2^0)$

"15" for example is 8 + 4 + 2 + 1. "1" is given at bit 4, bit 3, bit 2 and bit 1. Thus "15" is represented by "00001111" in binary notation.

3.3.2 Empty Pot

The empty pot is defined as a pot to which a tool located in the spindle is to be returned.
When a tool change is made under the condition that there is a tool in the waiting pot but no tool in the spindle, the pot number is registered as the empty pot number.
After that, as far as tools of the same diameter are changed, the empty pot number is not changed. When a tool change of different diameters is commanded, the tool located in the spindle returns to the empty pot and the waiting pot is designated as the new empty pot.
(For details regarding tools of the same diameter or different in diameter, refer to the Programming Manual.)
Empty pots can be indexed by a T0 command. An M33 command, identical to a T0;M6 command in function, indexes the empty pot to replace tools and allows the tool located in the spindle to return to the magazine.
The empty pot is designated whether the tool diameter discrimination is effective or not.

3.3.3 Magazine Indexing

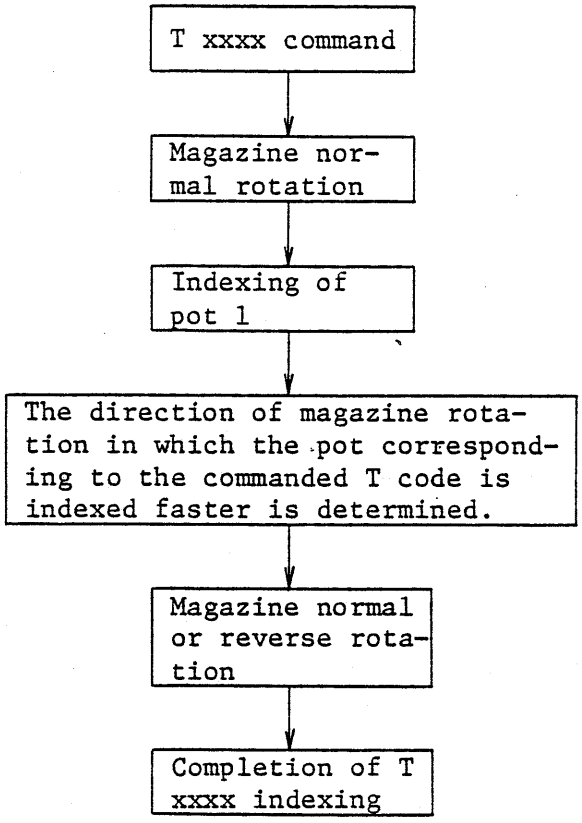
The magazine indexing position is detected by the ring counter using the origin (pot 1) as the standard. After the initial start-up or when the magazine indexing was interrupted, the counter is initialized. In this case, the zero return of the magazine must be performed. Otherwise, counting will not start.

i) Procedure for magazine zero return

(a) T command

The zero return of the magazine is automatically performed by commanding a T code, and the desired tool is indexed.

The sequence is described below.



When a T command calling pot 9 is given, for example, with pot 1 indexed after the initial start-up, the magazine rotates a full turn in the normal direction and a half turn in the reverse direction to complete the indexing.

(b) Manual indexing

In the manual mode, pressing the MAGAZINE ROTATION button located on the control panel causes the magazine to turn in the normal direction. Releasing it stops the magazine.

In this case, even if zero return is not completed as mentioned above, it can be automatically performed by allowing the magazine to pass from pot 16 to pot 1.

As described above, zero return of the magazine is automatically performed in all cases and does not require any special operation. Note that tool replacement is impossible without completion of the magazine zero return. (Even if a command is given, it is treated as an error.) Therefore, be sure to give a T command prior to tool replacement.

ii) Confirmation of current magazine position

The current magazine position can be confirmed on the PC display, which is obtained by following the procedure below.

1) Press the NC/PC key to obtain the PC display.
2) Press the PCPRM soft key to cause the PCPRM menu display to appear.
3) Press the COUNTER soft key.

The CURRENT value of ADDRESS 16 on the counter stands for the current position of the magazine.

NO	ADDRESS	PRESET	CURRENT
05	C.18	16(*)	(Current magazine position)

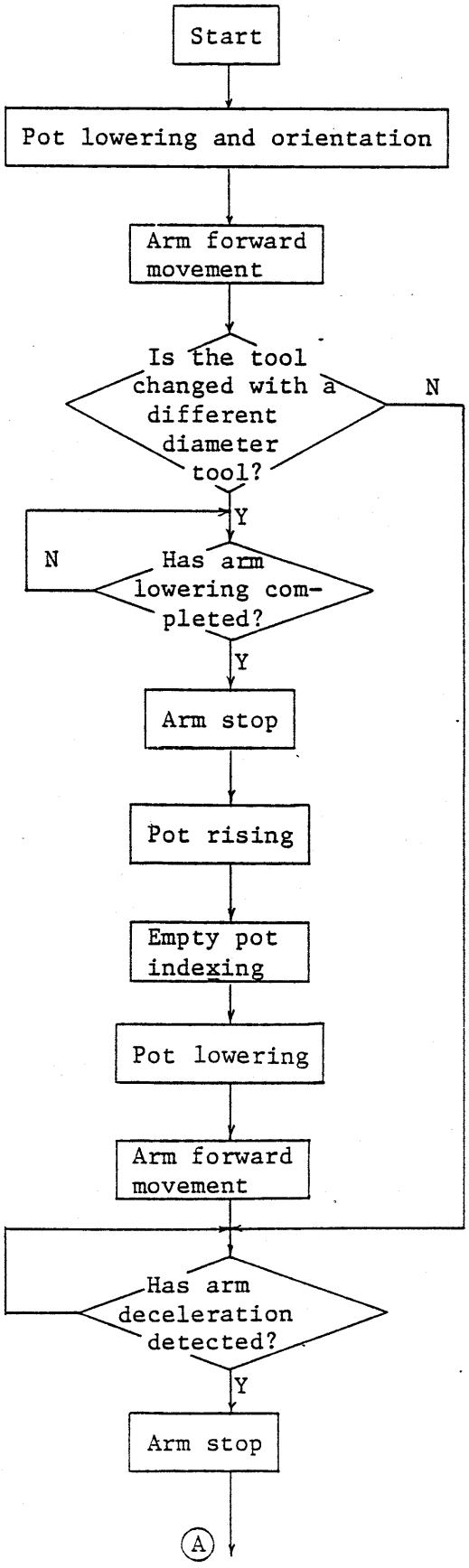
* "30" is preset when 30 tools are used.

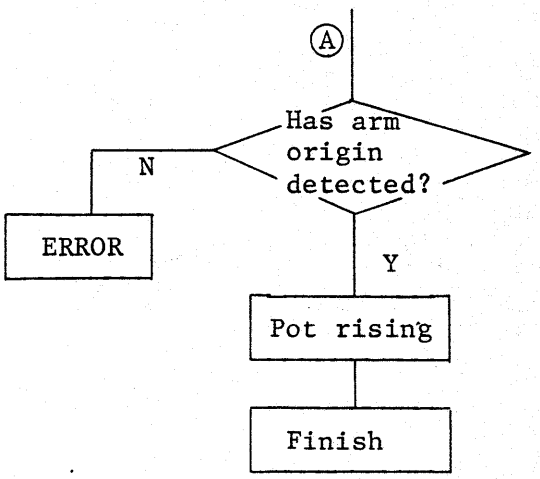
3.3.4 M6 Command

The M6 (tool change) command has the following interlocks.

i) The Z axis must be in the zero return position.
ii) The Y axis must be in the minus side from -100 mm in the machine coordinate system, or it must be more than 100 mm from the zero return position in the minus direction.
iii) Magazine indexing must have been completed.
(An M6 code cannot be commanded when no magazine indexing has been done after the initial start-up or when magazine indexing has stopped midway.)
iv) The arm must be at the origin (with the ATCHP lamp lit) and the pot must have risen.
v) KEEPRL K8 of PC must be "0."
vi) The return operation or the independent operation must not be being carried (with the temporary stop lamp blinking).

M6 Flow Chart





3.3.5 ATC Return Cycle

If the double arm stops halfway during the ATC cycle, perform the return operation as described below.

1) Press the reset button.
2) Input "M31; M35;" in the MDI mode and press the start button on the MDI/CRT panel. The temporary stop lamp and the ATCHP lamp will blink alternately.
3) Make sure that the Z axis is at the origin and that the Y axis is in the minus side from -100 mm in the machine coordinate. Also, make certain that the double arm is not interfered with the work when the arm rotates. If there is a possibility of interference, change the mode to HANDLE, and move the arm to a safety area.
   (When the mode is changed to HANDLE, command M35 once again.)
4) Press the temporary stop button.
5) The arm rotates in the reverse direction and the tool is returned its state prior to the M6 command.
6) To ensure safety, check the PC data table display to make sure the tool data is correct.

3.3.6 When Return Operation Cannot be Used

When return operation cannot be used, return the ATC to the original position in the following manner.

1) Press the RESET button.
2) Input "M31;" and press the START button on the MDI/CRT panel. The temporary stop lamp will blink.
3) If the pot has lowered, proceed to step 9.
   If the pot has not lowered, proceed to step 4.
4) Change the mode to HANDLE.
   Index a pot which will not cause interference using the magazine index button.
5) Confirm that the Z axis is at the origin and that the Y axis is in the minus side from -100 mm in the machine coordinate. Also confirm that the double arm is not interfered with the work when the arm rotates. If there is a possibility of interference, move the arm to a safe position.
6) Return the mode to MDI.
7) Lower the pot by referring to "7. ATC Independent Operation." Enter "1" for PRESET of counter C0 in the PC display, and press the temporary stop button.
   The pot is then lowered and the PRESET value will change from "1" to "0."
8) Press the [NC/PC] button.
9) Command "M35;." The ATCHP lamp will blink.
10) Press the [+x] button for normal rotation of the arm or press the [-x] button for reverse rotation of the arm. When the button is pressed continuously, the arm reaches the original position and stops.
11) Once the arm has returned to the original position, press the RESET button. Make sure that the ATCHP lamp is lit while the temporary stop lamp continues to blink.
12) Press the [NC/PC] button to obtain the PC display.
13) Input "2" for PRESET of counter C0 in the PC display and press the temporary stop button. (For details, refer to 3.3.7.)
    The pot is then raised and the PRESET value will change from "2" to "0."

14) Remove the spindle tool in the manual mode, and return it to the magazine pot.
15) Return the mode to MDI.
16) By referring to the tool data registration, set the tool which is being replaced. (See the display of data table #3.)
17) Press the KEEPRL soft key.
18) Set all K8, K11 and K13 data to "0."
19) Press the RESET button.
20) Command "M32."

3.3.7 ATC Independent Operation

i) Pot up/down and orientation pin out/in

Pot up and down and orientation are independently operated in the following manner.

1) Input "M31." The temporary stop lamp will blink.
2) Press the NC/PC key to obtain the PC display.
The basic PC menu will be displayed.

PCMDI	PCLAD	PCDGN	PCPRM	

Press the PCPRM soft key to cause the next menu to appear.

TIMER	COUNTR	KEEPRL	DATA	POS

3) Press the COUNTR soft key. The counter display will appear.

```
COUNTER
NO.   ADDRESS     PRESET      CURRENT
01      C00
02
03
 .
 .
 .
 .
 .
 .
 .
 .
 .

15
```

Fig. 3 Counter display

4) Input the desired code in table 3.1 to PRESET of C00, and press the temporary stop button. The operation corresponding to the code will then be performed.

Code	Operation
1	Pot down
2	Pot up
3	Orientation pin in
4	Orientation pin out

Table 3-1 Independent operation code table

ii) Double arm independent operation

For independent operation of the double arm, turn the double arm motor according to the procedure below. In this case, take special care because no interlock is provided.

1) Input "M31; M35;" in the MDI mode. The temporary stop lamp and the ATC origin lamp will blink alternately.
2) Press the [+x] button for normal rotation of the double arm or press the [-x] button for reverse rotation of the double arm.
When the button is released, the brake stops the arm. If it is pressed continuously, the ATC stops at the original position.

3.3.8 ATC Data Display and Rewriting

i) Display

Parameters K9 and K8 are used to store machine states. Parameters K10, K11 and K12 are stored as binary codes. Parameter K13 is used to store the spindle tool diameter. The following description in each bit is effective when the bit is 1.

	7	6	5	4	3	2	1	0
K9	ATC8M	ATC7M	ATC6M	ATC5M	ATC4M	ATC3M	ATC2M	ATC1M

ATC1M: ATC start was commanded and pot down and orientation command signals were transmitted.

ATC2M: Pot down and orientation were completed and arm normal rotation command signal was transmitted.

ATC3M: The arm down was completed and the pot up command signal was transmitted for replacement of a different-diameter tool. The current magazine value at the time of ATC cycle.

ATC4M: The pot up eas completed and the empty pot indexing started. (Only for replacement of a different-diameter tool)

The pot up was completed and the empty pot indexing began.

ATC5M: (Only for replacement of a different-diameter tool)
The pot up was completed and the empty pot indexing began.
command signal eas transmitted.

ATC6M: (Only for replacement of a different-diameter tool)
The pot down was completed and the arm normal rotation command signal was transmitted.

ATC7M: The arm reached the deceleration point and the arm stop command signal was transmitted.

ATC8M: The arm stop was completed and the pot up command signal was transmitted.

	7	6	5	4	3	2	1	0
K8							OPCM	MWF

NWF: The ATC cycle is being executed.

OPCM: Tools of different diameters are being changed.

	7	6	5	4	3	2	1	0
K10	128	64	32	16	8	4	2	1

The current magazine value at the time of ATC cycle start is stored in memory in the Binary code.
This data is used for the return cycle and does not required rewriting in normal cases.

	7	6	5	4	3	2	1	0
K11	128	64	32	16	8	4	2	1

The empty pot number is stored in memory in the B.C.D. code.

	7	6	5	4	3	2	1	0
K12	128	64	32	16	8	4	2	1

The previous empty pot number is stored in memory in the B.C.D. code.

This data is used for the return cycle and does not require rewriting in normal cases.

	7	6	5	4	3	2	1	0
K13			LGP2	SMP2			LGP1	SMP1

SMP1: The empty pot is for small diameter tools.

LGP1: The empty pot is for large diameter tools.

SMP2: The previous empty pot is for small diameter tools.

LGP2: The previous empty pot is for large diameter tools.

SMP2 and LGP21 are data for the return cycle and do not require rewriting in normal cases.

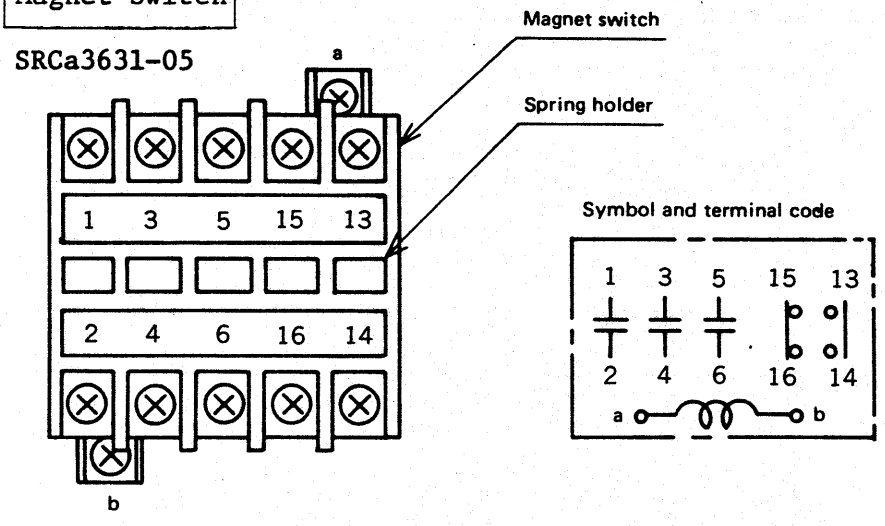
ii) Rewriting

All the data described above are retained even after power interruptions and used for ATC and return cycles. Even the ATC cycle is interrupted for some reasons, these data will restore normal values by performing the ATC return cycle. However, if the mechanical state is forced to return to the ATC original position as described in 3.3.6 these data must be corrected to the normal values by the operator.

1) Press the NC/PC key to obtain the PC display.
2) Press the PCPRM soft key.
3) Press the KEEPRL soft key.
4) Move the cursor to the address requiring alteration, and enter the data.

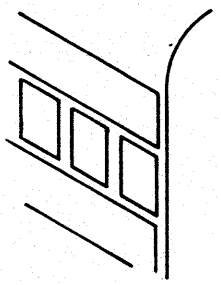
4. Functional tests of Major Electrical Components

4.1 Magnet switch

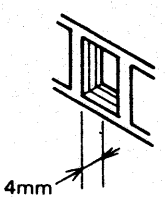


The magnet switch is used to start and stop the induction motor.

a) When the magnet switch is not functioning (energized): The movable contact spring holder is flush with the switch body.



b) When the magnet switch is functioning (energized): The spring holder retracts approx. 4mm from the switch body.

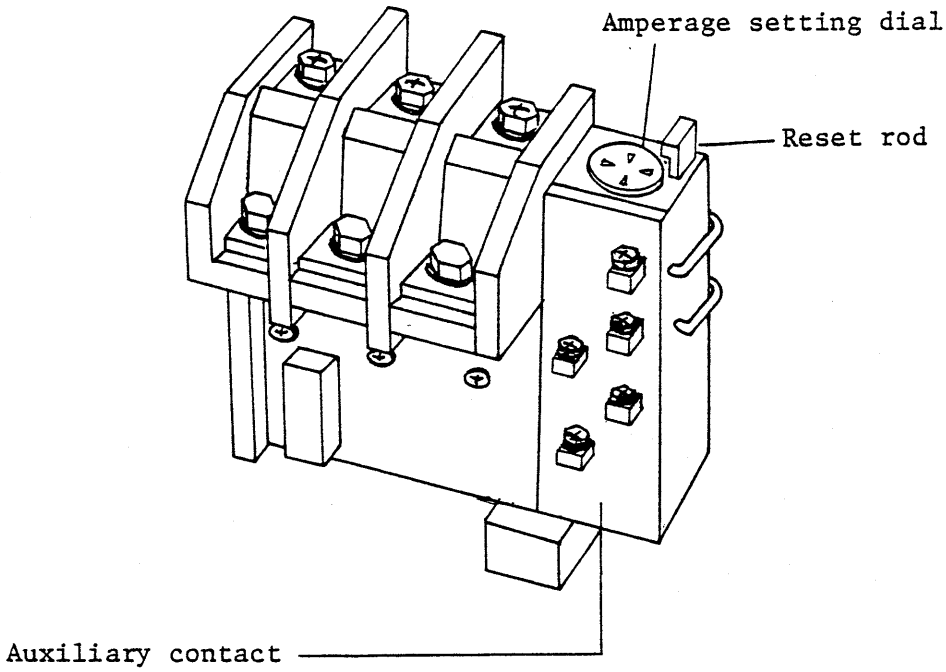


Notes:

1) The spring holder is sometimes kept retracted even though the magnet switch is not functioning (even though the coil is not energized), due to contact fusing, or other faulty contacts may be caused by the presence of dust or other foreign matter on the contact and movable portion.

2) For some troubles, check if the voltage is applied to the magnet switch coil by connecting a multi-tester (V.A. Ohm meter) between terminals a and b.

4.2 Thermal Relay



This thermal relay is used to prevent overcurrent from flowing into the motor and burning it.

a) Amperage setting dial

Do not touch this dial since it has been appropriately adjusted in accordance with the motor used.

b) Reset rod

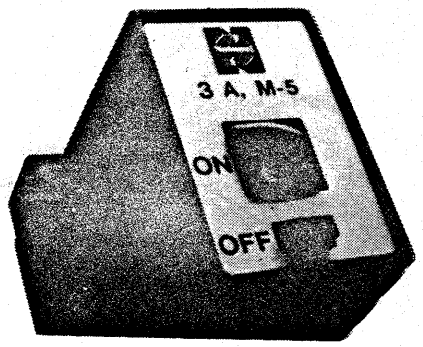
When overcurrent flows to actuate the thermal relay, this rod pops out. After two or three minutes, push this rod to reset it.

Note 1. Frequent activation of the thermal relay can be caused by defects in the motor or by mechanical parts being too tight and causing an overload.

4.3 Circuit protector (breaker)

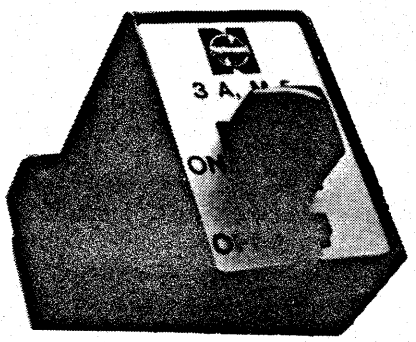
The circuit protector (NF) functions similarly to a fuse. A fuse must be replaced once it has been blown. A circuit protector, however, can be reused repeatedly by just pressing the ON button.

a) Normal state



ON button is press in, indicating no abnormalities is the electric circuit.

b) Abnormal state

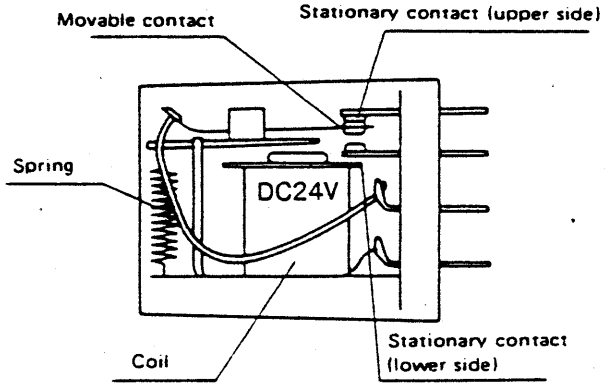


When an abnormality, such as short occurs in a circuit after the circuit protector, the ON button pops out to cut off current flow, protecting the circuit.
After correcting the trouble, press ON button.

4.4 Control relay

Control relay (OMRON-MY2/MY4) can be checked for operation by observing the contact.

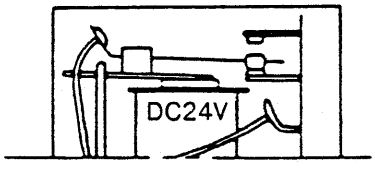
a) When the relay is not functioning (energized):



The relay functions when the relay coil is energized to attract the movable contact to the coil. When the relay is not functioning, the movable contact is in contact with the upper stationary contact due to a spring pressure.
The contact that closes to allow current to flow when the relay is not functioning is called the "B-contact".

Symbol: —|/|—

b) When the relay is functioning (energized):



The movable contact is attracted to the lower stationary contact by the energized coil, which means that the current flows into the other circuit.
The contact that closes when the relay functions is called the "A-contact" or "Make contact".
When the A contact closes, the B contact opens and current does not flow.

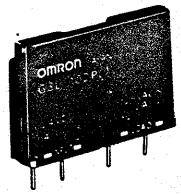
Symbol: —| |—

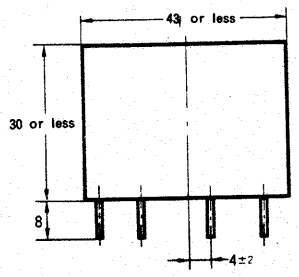
4.5 Solid State Relay

The solid state relay, abbreviated as S.S.R., is a semiconductor switch for controlling DC input and AC output.

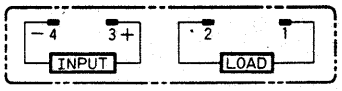
The state of this relay can be checked by viewing an LED. The LED side to the solid state relay lights when the relay is turned on and goes off when the relay is turned off.

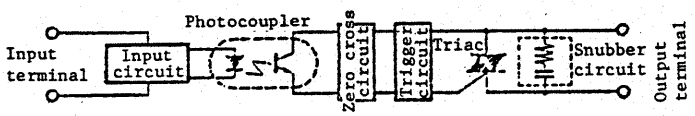
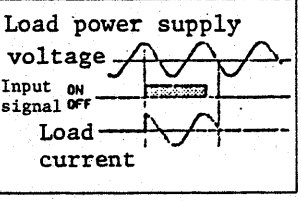
MODEL G3L-102PL1
MODEL G3L-202PL1





Terminal layout
(BOTTOM VIEW)



Insulation method	Circuit diagram	I/O waveform (with resistance load)
Photo-coupler		

Limit switch number	Operation	Model	PCDGN	Remarks
LS10	Magazine rotation signal A	2FS-5895-901	X4.0	See the chart below.
LS11	Magazine rotation signal B	2FS-5895-901	X4.1	See the chart below.
LS12	Magazine rotation signal Z	2FS-5895-901	X4.2	See the chart below.
LS14	Arm deceleration point	2FS-5895-901	X4.3	"1" when reaching to the arm deceleration point.
LS15	Arm down check	SL1-A	X3.2	"1" is when arm down is completed.
LS16	Pot up check	SL1-H	X3.0	"1" when pot up is completed.
LS17	Pot down check	SL1-H	X3.1	"1" when pot down is completed.
LS21	Arm origin check	SL1-A	X0.0	"1" at the arm origin.

Magazine signal A, B, and Z timing

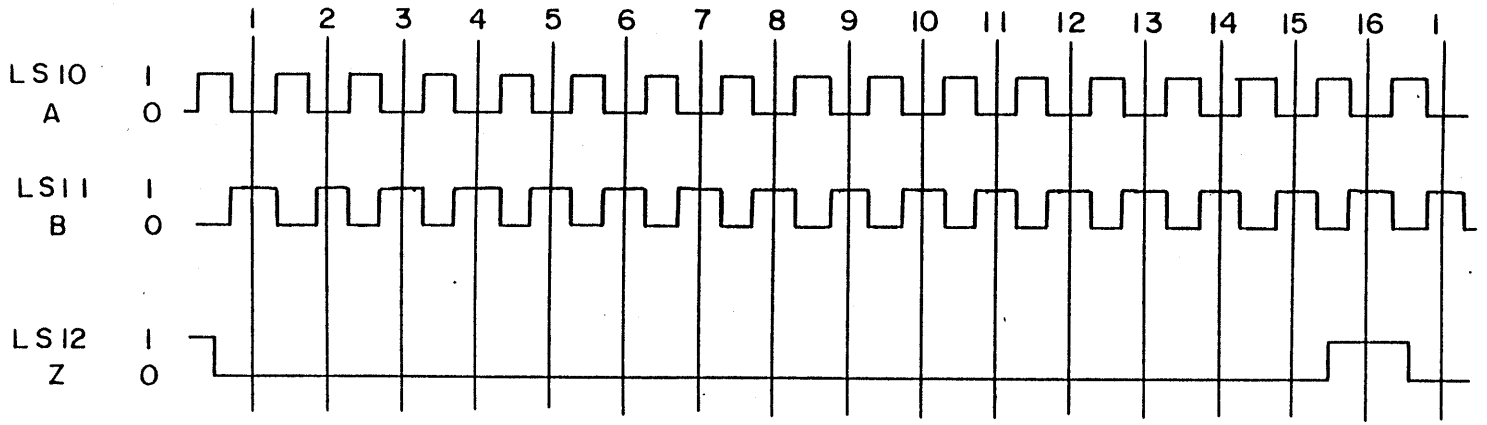


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Table of Limit Switches (All products made by Yamatake-Honeywell)

O.T. and zero return

Limit switch number	Operation	Model	PCDGN	Remarks
LSX1	X axis O.T.	SL1-A	-	Input to terminals No. 3 and No. 4 of the servo unit (B contact)
LSY1	Y axis O.T.	SL1-A	-	Same as above
LSZ1	Z axis O.T.	SL1-A	-	Same as above
LS1	Zero return X	2FS-5895-901	X4.5	"1" around X axis origin.
LS2	Zero return Y	2FS-5895-901	X4.6	"1" around Y axis origin.
LS3	Zero return Z	2FS-5895-901	X4.4	"1" around Z axis origin.

Spindle

LS18	Tool clamp check	2FS-5895-901	X3.5	"1" when tool clamping is completed.
LS19	Orientation pin in check	SL1-A	X3.3	"0" when the orientation pin in is completed.
LS20	Orientation pin out check	SL1-A	X3.4	"1" when the orientation pin out is completed.

MORI SEIKI CO., LTD.

4.7 List of Air Solenoid (Made by Shoketsu)

Solenoid number	Operation	Model	PCDGN
SOL	Pot up/down		Y1.6, Y1.7
SOL	Orientation		Y2.0
SOL	Tool unclamp		Y2.1

2. SELF DIAGNOSIS FUNCTION

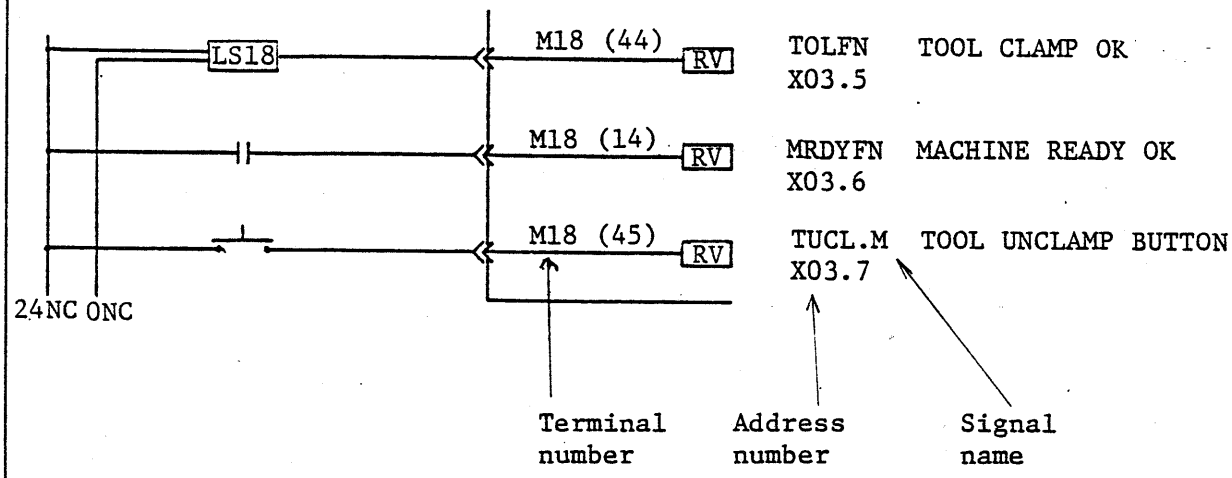
(LADDER DIAGRAM EXPLANATION)

1. Ladder Diagram

Machine operation is controlled by a Programmable Controller (PC). The PC program is represented by a ladder diagram which is composed of an I/O interface, ladder diagram and address table.

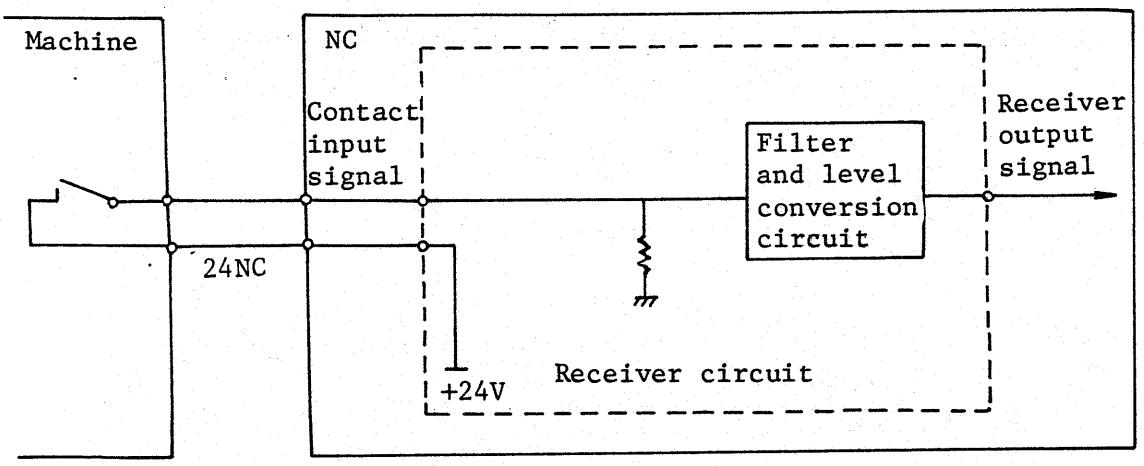
2. I/O Interface

2.1 Input Interface (DI)



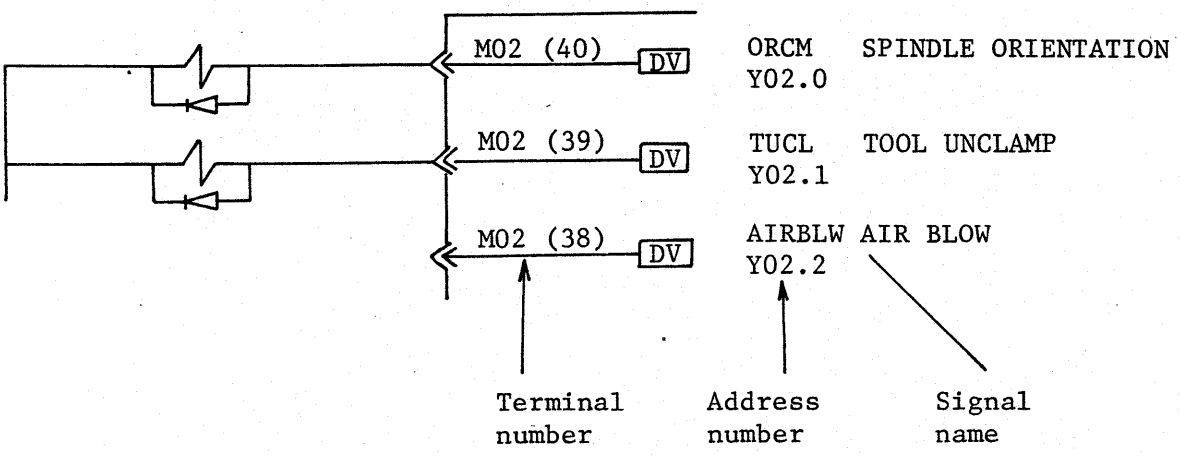
The input interface is the part which controls signals entering the PC from the machine side.

RV stands for receivers which have the following circuit.



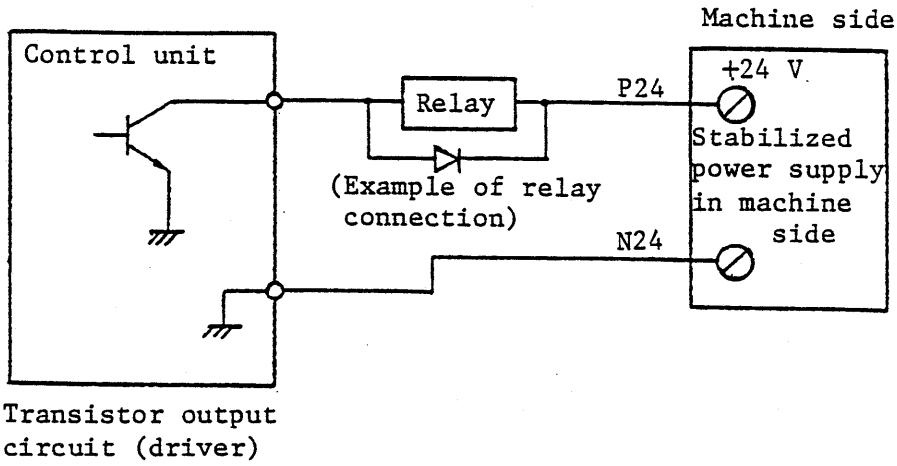
When one address is "1," 24 volts is input to the receiver corresponding to the address.

2.2 Output Interface (DO)



The output interface is the part which controls output signals to the machine side from the PC.

DV stands for drivers which have the following circuit.



When an address is "1," the transistor of the driver corresponding to the address is turned on.

2.3 Reading the Interface Diagram

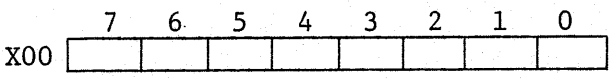
2.3.1 Address Numbers

Address numbers, each consisting of a letter and number are displayed on PCDGN display. Letters used and their descriptions are as follows.

- X : Input
- Y : Output
- F : Signal from NC to PC
- G : Signal from PC to NC
- R : Internal coil of PC
- C : Counter
- K : Keep relay
- D : Data table

Numbers following the decimal point represent the bit numbers.

(Example) X00.7 represents bit 7 of X00.



When input X is "1," the input signal is turned on.

When output Y is "1," the output signal is turned on.

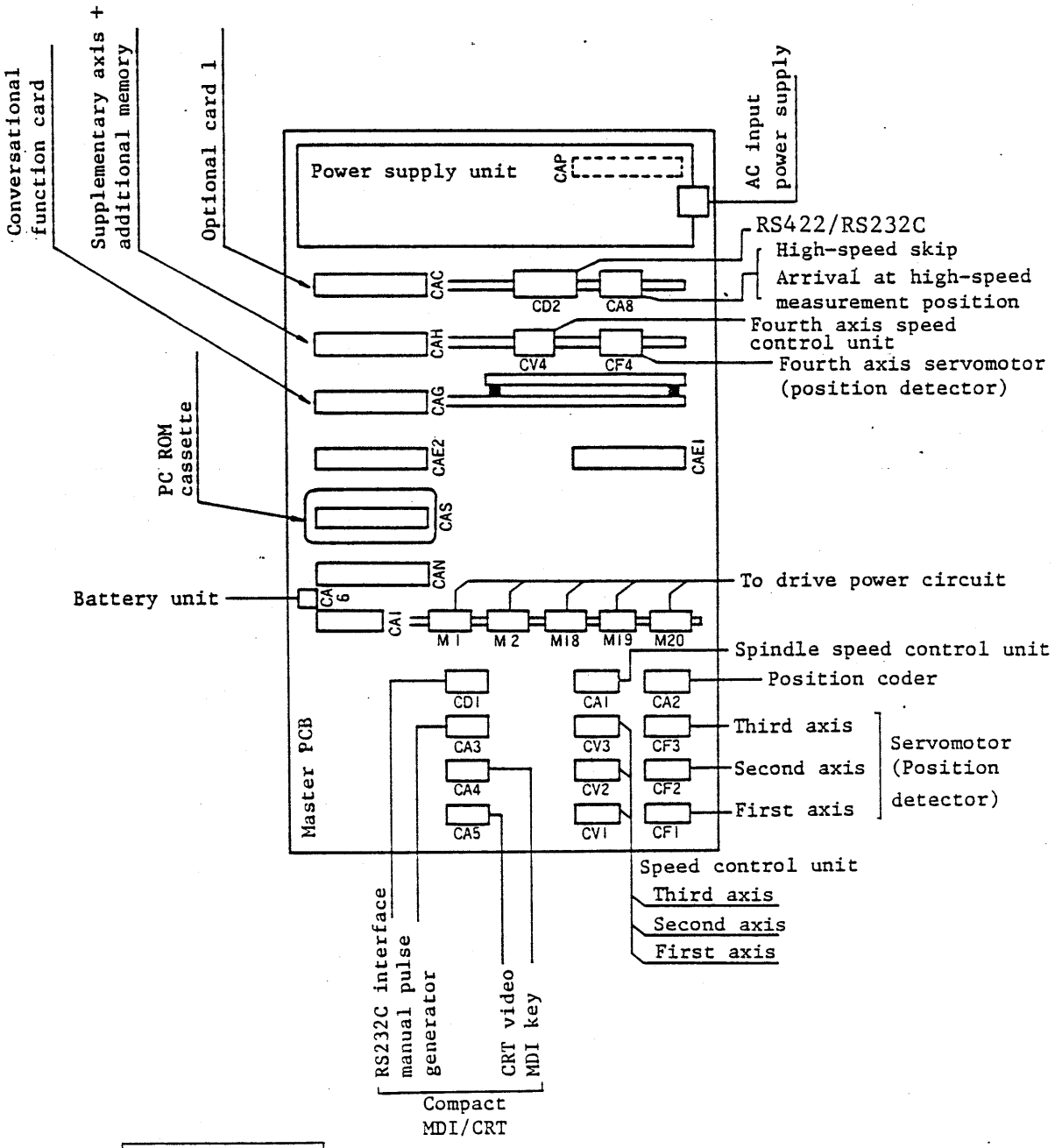
2.3.2 Terminal Numbers

Terminal numbers are composed of a connector number and pin number on the NC's DI/DO PC board.

M18 (44)

Connector number Pin number

The DI/DO PC board is located at the extreme left of the NC unit.



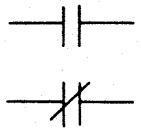
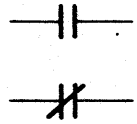
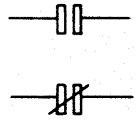
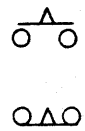
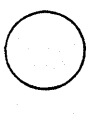
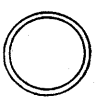
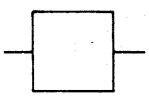
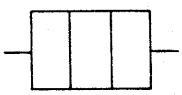
2.3.3 Signal Names

Signal names are used in the ladder diagram.

3. Ladder Diagram

Symbols described below are used in ladder diagrams.

PC: Programmable controller

Symbol	Description
	Represents a contact of a relay on the PC. These symbols are used except for signals inputted from the machine and the NC unit.
	Represents an input signal from the NC unit.
	Represents an input signal from the machine (including the control panel).
	Represents a contact of a timer in the PC.
	Represents a relay coil whose contact signal is used in the PC only.
	Represents a relay coil whose contact signal is outputted to the NC unit.
	Represents a relay coil whose contact signal is outputted to the machine.
	Represents a coil of a timer in the PC.
	Represents a function command. Symbol format differs according to function command.

Note: ° Contacts of the relay coils ◯ and ◎ are represented by ⊣⊢ or ⊣/⊢ since the coils are installed on the PC.

° The signal symbol B.○○○ generally represents a B-contact input/output signal.

B.○○○ ⊣⊢ Closes when a DGN input status is "0" and B.○○○ ⊣/⊢ closes when the status is "1".

3.1 Subroutine

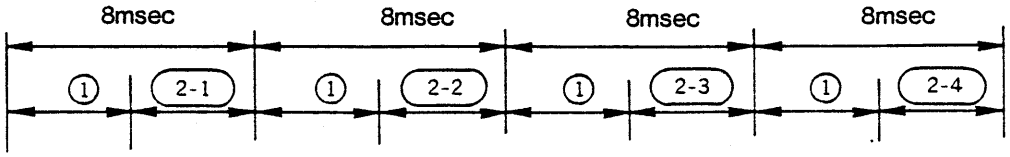
END	1

This represents the end of a rapid sequence.

END	2

This represents the end of a slow sequence.
The PC scanning time of this machine is n x 8 msec in case of n divisions (one division = 8 msec).

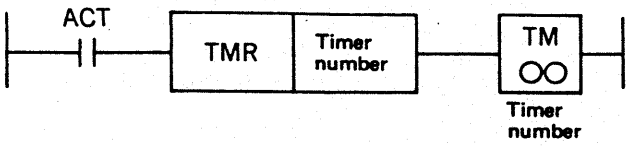
When n = 4:



① Rapid sequence processing

(2-1) + (2-2) + (2-3) + (2-4) = Slow sequence processing

Data from the start to [END | 1] is processed once for each division, and data from [END | 1] to [END | 2] is divided by four and processed as shown above. As a result, rapid sequence data is processed once every 8 msec, and slow sequence data is processed once every 32 msec.

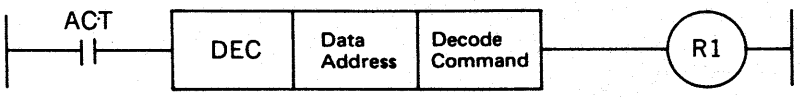


A timer is represented as shown above.

ACT = 0 Timer coil OFF

ACT = 1 Timer coil ON

TM ○○ Becomes ON ("1") after a timer coil is turned on and a preset time is reached.

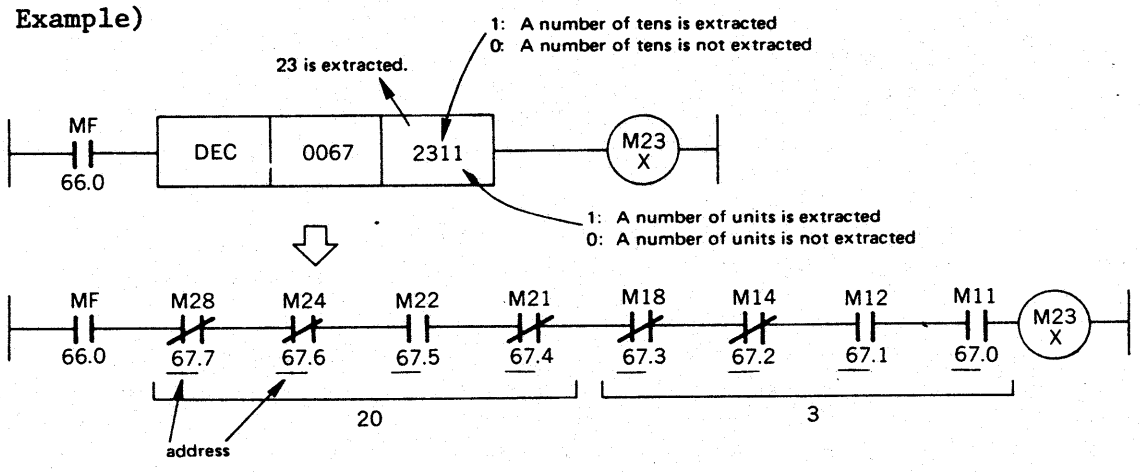


These symbols are used as examples to convert a binary coded decimal number into a decimal number.

Data address represents an address number in the PC or DGN.

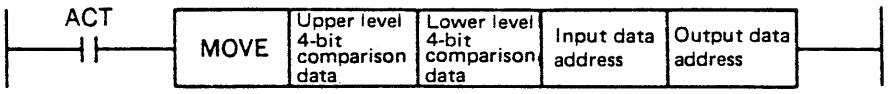
Decode command uses four digits of ○○○○. The first two digits specify the number to be extracted. The next digit determines whether a number of tens is extracted or not, and the last digit determines whether a number of units is extracted or not.

Example)



tens↔units

When MF is "1" and the status of the address 67 is "0010 | 0011", M23X is ON ("1").



These symbols are used to transfer a logical product of a status of an input data address and a comparison data to an output data address.

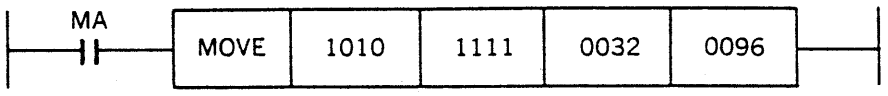
ACT = 0 Transfer is not performed.

ACT = 1 Transfer is performed.

Comparison data 1 An input data status is transferred to an output data.

Comparison data 0 "0" is transferred to an output data ragardless of input data status.

(Example)



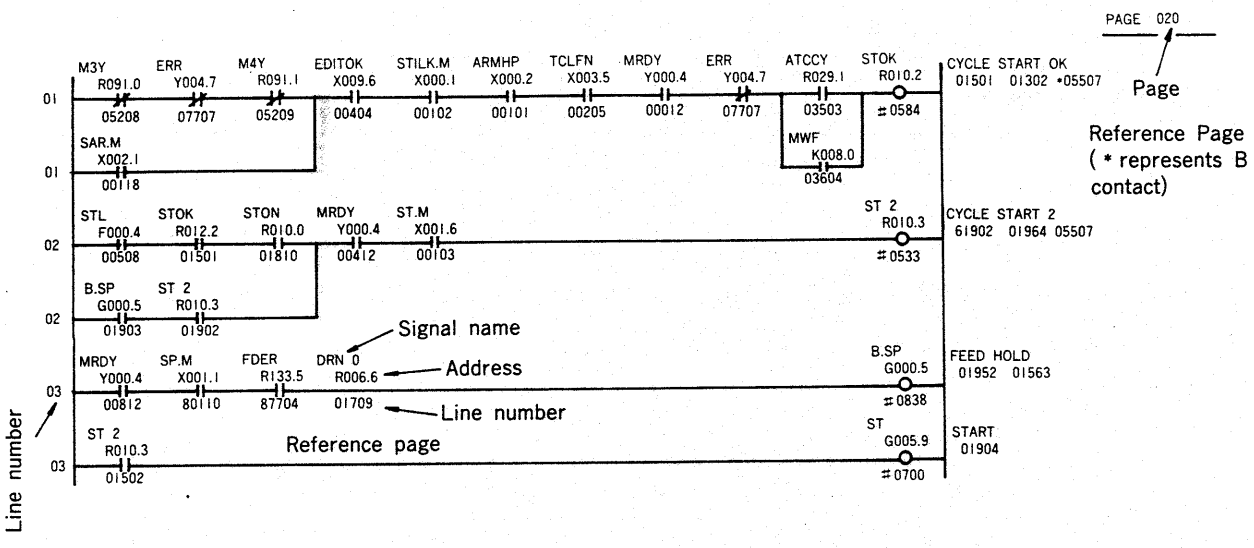
When MA is "1" and the status of address 32 is 0110 1010, 0010 1010 is transferred to address 96.

	Upper 4 bits	Lower 4 bits	
	1 0 1 0	1 1 1 1	Comparison data
This represents "multiplication". →	× × × ×	× × × ×	
	0 1 1 0	1 0 1 0	Input data
This represents "equal". →	‖ ‖ ‖ ‖	‖ ‖ ‖ ‖	
	0 0 1 0	1 0 1 0	Output data

3.2 Ladder Diagram

The term "ladder diagram" comes from the fact that this diagram is drawn like a ladder.

This diagram is described below.



A ladder diagram has line numbers on its left end and a page number in the top right. The address is shown under the signal name. The reference page and line number of the signal are also indicated by the five figures under the contact. The first three figures indicate the page and the remaining two figures indicate the line number. In the address, figures above the decimal point indicate the address number and those below the decimal point indicate the bit number.

Example)

MRDY
Y000.4
—| |—
00812

ADDRESS	7	6	5	4	3	2	1	0
Y000	0	0	0	1	0	1	0	1

To check the MRDY signal, display the page that indicates Y000 by following the procedure described in the next section, and check the state of bit 4 of the address whether it is "0" or "1."

"0" ... MRDY is OFF.

"1" ... MRDY is ON.

To check the conditions of MRDY, refer to line number 12 on page 8. Ladder diagrams can also be displayed on the CRT. For details, refer to Section 5.

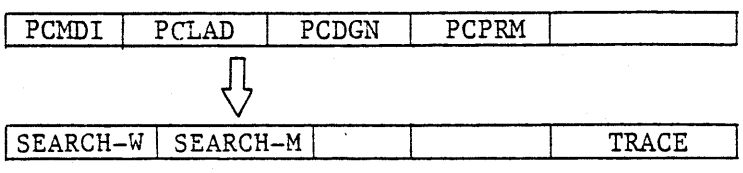
4. PC I/O Signal Display and Internal Relay Display (PCDGN)

Press the [PCDGN] soft key in the basic PC menu to obtain the status display containing PC I/O signals and internal relays. All addresses (X, Y, F, G, R, A, C, K and D) specified in the program can be displayed. The display format used is a bit pattern of "0" and "1."

1) Press the [NC/PC] button to cause the basic PC menu to appear.
2) Push the [PCDGN] soft key. Another CRT display will appear and the soft key menu will also change to [SEARCH].
3) Key-in the address to be displayed and then press the [SEARCH] soft key.
4) Consecutive 10-byte data from the designated address is displayed in bit pattern in the upper part of the CRT.
5) To display data for other addresses, repeat steps 3 and 4.
6) When the display is completed, press the [RETURN] key to return the initial basic PC menu.

5. PC Ladder Diagram Display

The PC ladder diagram is displayed on the MDI and CRT panel. For this operation, press the [PCLAD] soft key of the basic PC menu and obtain the following menu.



Basic PC menu

After pressing the PCLAD soft key in the basic PC menu to change the menu, the ladder diagram appears while the menu changes.

In this diagram, each horizontal line of a 9-inch CRT can display up to 9 relay contacts or relay coils.

When this line has more relay contacts, they are displayed using the lower line, i.e. with two lines.

Signal name (6 letters or less)

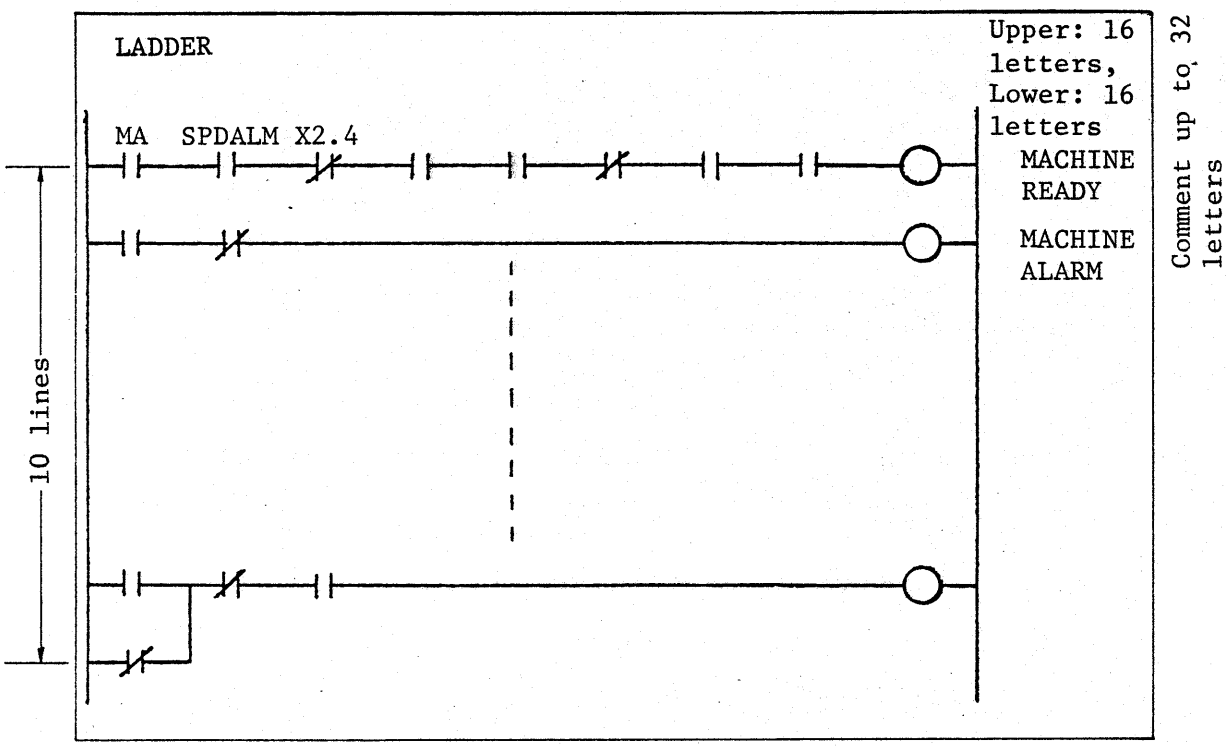
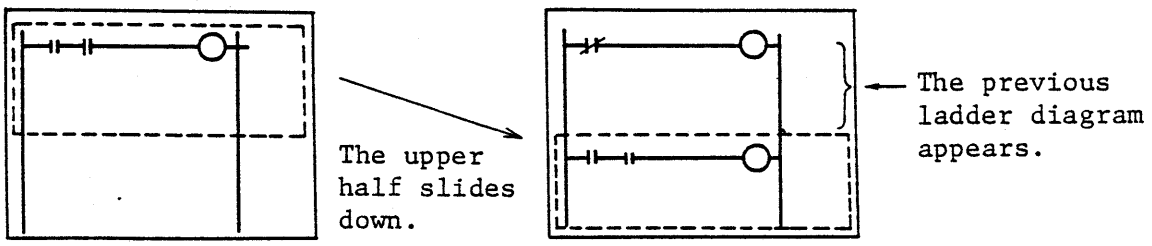


Fig. 5.1 Ladder diagram display

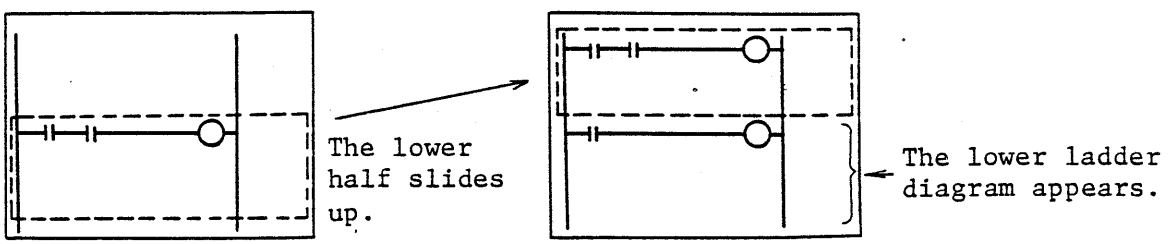
Key operation on the MDI and CRT panel changes the ladder diagram display as follows.

a) Page key:

[↑] key: Page backward key. By pressing it once, only half the screen changes. The screen currently displayed slides down and shifts the top column to the middle of the screen.
The upper half of the screen shows the previous ladder diagram which was not displayed before.
While this key is pressed, the screen continuously changes.

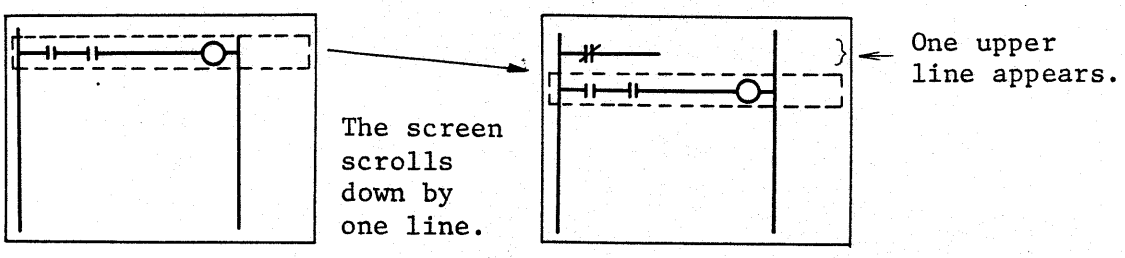


[↓] key: Page advance key. By pressing it once, only half the screen changes. The screen currently displayed slides up and shifts the middle column to the top of the screen. The lower half of the screen shows the next ladder diagram.
While this key is pressed, the screen continuously changes.



b) Cursor key

[↞] key: Cursor up shift key. When that key is held down, the cursor leaves the top column. If any ladder diagram exists in that direction, the screen scrolls down, allowing one line of the ladder diagram to appear on the screen.
When this key is kept pressed, the ladder diagram is fed out line by line.



[↠] key: Cursor down shift key. This key is used to scroll up the screen so that one subsequent line of the ladder diagram will appear at the bottom of the screen. The feed direction is opposite to that of the above cursor key.

c) [SEARCH-W] soft key

This soft key is pressed to search relay coils. After pressing the address number of the coil, press the [SEARCH-W] soft key.

3. PARAMETER SETTING

NOTES: 1) Once the parameter has been set, no further adjustment is required. If some modification is necessary, conatact MORI SEIKI.

2) In this operation manual, only parameter settings which can be easily modified by the customer are described. For more details, refer to "FANUC SYSTEM 10MA Operation Manual".

1. PC Data Setting and Display

Timer, counter, keep relay, data table and positioning module parameters can be set and displayed on the MDI anc CRT panel. For this operation, press the [PCPRM] soft key in the basic PC menu to obtain the following menu.

TIMER	COUNTR	KEEPRL	DATA	POS

Note that the NC must be set in the MDI mode to set data.

1.1 Timer Setting and Display

Set the time for each variable timer and display it.
When no timer display is shown, press the [TIMER] soft key.

Timer number (1 - 40)

TIMER

NO	DATA	NO	DATA
001	2000	016	1000
002	1000	.	.
.	.	.	.
.	.	.	.
.	.	.	.
015	0	030	0

Fig 4.1 Timer display

Specification Timer number	Minimum setting time	Maximum setting time
1 ∿ 8	50 ms	1638.3 sec
9 ∿40	8 ms	262.136 sec

(1) Setting and display through the MDI and CRT panel

(a) For timer setting, set the NC to the MDI mode, and turn on the NC parameter for parameter writing.
This operation is unnecessary for timer setting display.

(b) Press the [PCPRM] soft key in the basic PC menu to obtain the timer display (see Fig. 4.1).

(c) Press the [↓] page key as required to display the desired timer number.
Follow the steps described below to set the timer.

(d) Move the cursor to the desired location by using the cursor keys.

(e) After keying-in the timer data using numeral keys, press the [INPUT] key to set the data.
To set subsequent data, repeat steps (c to e).

(f) After timer data setting, turn off the NC parameter for parameter writing.
Then, press the [RETURN] key to return the basic PC menu.

(2) Description of timers

Described below are the functions of respective timers. Timer settings are closely related to the machine movements. Please consult us before attempting to alter the setting.
The time unit used for timer setting is msec (1/1000 seconds).

Soft Timer Table

No.	Setting location	Description
1	T 1	Adjusts the time to turn on the control power supply after pressing the power on button for the initial start-up.
2	T 2	Adjust the time for the machine and servo to get ready after the CONTROL power supply is turned on.
3	T 3	Adjusts the time to start the automatic power cut-off sequence after completing the program.
4	T 4	Adjusts the lag time of the M function read signal to be output outside the machine.
5	T 5	
6	T 6	
7	T 7	Adjusts the effective time of the arm and magazine motor braking.

No.	Setting location	Description
8	T 8	
9	T 9	
10	T10	Adjusts the flickering time of the lamp during the return cycle.
11	T11	Adjusts the time to monitor the pot up/down movements.
12	T12	Adjusts the time to monitor the arm down movement.
13	T13	Adjusts the time to monitor the arm deceleration.
14	T14	
15	T15	
16	T16	Adjusts the time when reverse arm rotation begins from turning off the deceleration signal provided the arm turning on the deceleration signal has rotated forward and returned.
17	T17	Adjusts the time limit for completion of the ATC return cycle.
18	T18	
19	T19	Adjusts the time to cut off the rotation output after the detection of the correspondence check signal (MGLSA) during magazine indexing. This timer is effective only when bit 7 of PC parameter K6 is 1.
20	T20	Adjusts the time to cut off the reverse rotation output after the detection of the correspondence check signal (MGLSA) during magazine indexing.
21	T21	Adjusts the time to convert the analog voltage output to low speed rotation during spindle orientation and spindle jog.
22	T22	Adjusts the time to overlook the spindle stop check signal during spindle orientation from the reverse rotation of the spindle.
23	T23	Adjusts the time to monitor the spindle orientation pin disengagement.
24	T24	Adjusts the time to monitor the signal during torque limitation.

No.	Setting location	Description
25	T25	Adjusts the time to monitor the spindle stop check signal.
26	T26	Adjusts the time to monitor the spindle reach and speed detection signals.
27	T27	Adjusts the time to complete the operation of the spindle rotation command. (When the tapping cycle is not selected.)
28	T28	Adjusts the time to complete the operation of the spindle rotation command. (When the tapping cycle is selected.)
29	T29	
30	T30	Adjusts the flickering time of the COOLANT OFF lamp.
31	T31	Adjusts the time to check the speed reach signal during spindle orientation.
32	T32	
33	T33	
34	T34	Adjusts the oil shot time.
35	T35	
36	T36	
37	T37	Adjusts the time to issue an error when the air pressure falls below the specified level.
38	T38	Adjusts the time to monitor the spindle orientation pin engagement.
39	T39	Adjusts the time limit for magazine indexing.
40	T40	Adjusts the time to monitor the 4th axis clamping and unclamping.

Keep relay parameters are described below. (For details, refer to the section dealing with the maintenance of the ATC system.)

K14	Determines the time from the deactivation of the magazine rotation output during magazine forward rotation to the activation of the brake.
K15	Determines the time from the deactivation of the arm rotation output to the activation of the brake..
K16	Determines the time from the deactivation of the magazine rotation output during magazine reverse rotation to the activation of the brake.

1.2 Counter Setting and Display

This function allows setting and display of the preset values and current values for the counters.
When the counter display is not shown, press the [COUNTR] soft key.

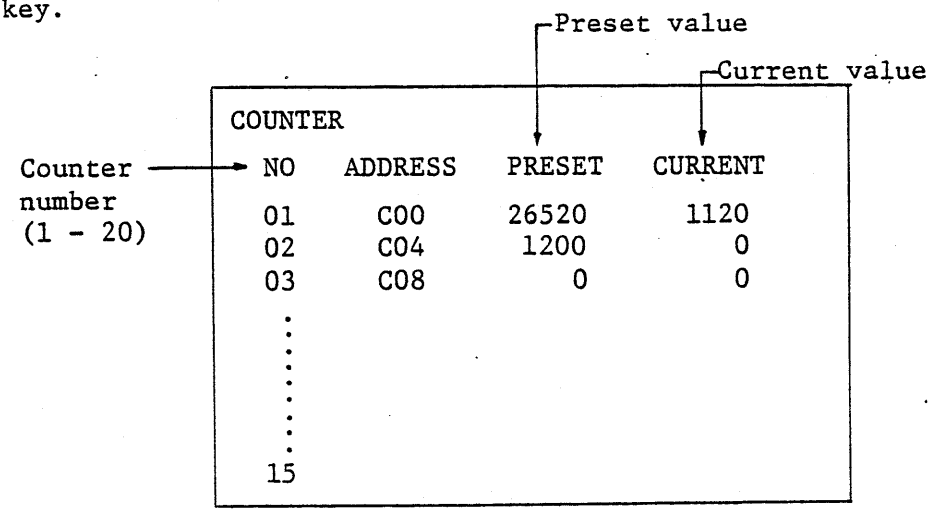


Fig. 4.2 Counter display

1) Setting and display through the MDI and CRT panel
   (a) Press the [PCPRM] soft key in the basic PC menu to change the menu display, and then press the [COUNTR] soft key to obtain the counter display (see Fig. 4.2).
   (b) Press the [↓] key as required to cause the desired counter number to appear.
   To set the counter data, follow the steps described below.

(c) Set the NC in the MDI mode, and set KEY 4 = 1 for the BMI interface.
For FS3 and FS6 interfaces, set KEY = 1.

(d) Using the cursor keys, move the cursor to the setting location.

(e) After keying-in the counter data with the numeral keys, press the [INPUT] key for setting the data.
To set subsequent data, repeat steps (d and e).

(f) After setting the counter data, press the [RETURN] key to return the basic PC menu.

1.3 Setting and Display of Keep Relay and Holding Memory Control Data

This function allows the setting and display of the keep relay and holding memory control data.
When the keep relay display is not shown, press the [KEEPRL] soft key.

```
KEEP RELAY
 NO    ADDRESS        DATA
 01      K00        10100011
 02      K01        00011100
 .       .             .
 .       .             .
 .       .             .
 .       .             .
 .       .             .
 15      K14        11000101
```

Fig. 4.3 Keep relay display

1) Keep relay setting and display

(a) For data setting, set the NC in the MDI mode, and turn on the NC parameter for parameter writing.
This operation is not required for display.

(b) Press the [PCPRM] soft key in the basic PC menu to change the menu display, and then press the [KEEPRL] soft key to obtain the keep relay display (see Fig. 4.3).

(c) Press the [↓] key as required to cause the desired keep relay data to appear.
To set the keep relay and holding memory control data, follow the steps described below.

(d) Move the cursor to the data setting poisition on the display using the cursor key.

(e) Enter the keep relay data (bit pattern) using the number keys and press the [INPUT] key to set the data.
(To continue setting data, repeat steps (d) and (e).)

(f) After setting the keep relay data, press the [RETURN] key to return the display to the PC basic menu display.

(2) Setting and display of holding memory control data
The holding memory control data is set and displayed just as the keep relay data is set and displayed.
The holding memory control data coresponds to the No. 17 ADDRESS k16 of the keep relay data display. Only the sixth and seventh bits are used for data.

(3) PC parameter table
The seven bytes, K0 to K6, are used for PC parameters. When you desire to change the PC parmeters, contact us for details since some PC parameters are related to model selection.
The contents of the PC parameters are described below.

PC Parameter Content

	7	6	5	4	3	2	1	0
KO	K1.20K	CLTLK	BDTLK	OSPLK	STLK	ORRST	PTTL	ZRHD

Name	State	Description
K.1.20K	1	The key switch need not be turned to alter data of tool offset, and work coordinate.
	0	The key switch must be turned on to alter such data.
CLTLK	1	The "CLNT" button is operative only when the key switch is thrown to the PANEL position.
	0	The "CLNT" button is operative at any key switch position.
BDTLK	1	The "BDT" button is operative only when the key switch is turned to the PANEL position.
	0	The "BDT" button is operative at any key switch position.
OSPLK	1	The "OSP" button is operative only when the key switch is turned to the PANEL posision.
	0	The "OSP" button is operative at any key switch position.
STLK	1	The cycle start can be effective even when the key switch is turned.
	0	The cycle start cannot be effective when the key switch is turned.
ORRST	1	The spindle orientation cannot be reset.
	0	The spindle orientation can be reset.
PTTL	1	Presence of a tool in the magazine pot is checked with the T code.
	0	Presence of a tool in the magazine pot is not checked with the T code.
ZRHD	1	The push of the zero return button is memorized.
	0	The push of the zero return button is not memorized.

	7	6	5	4	3	2	1	0
K1	MBCD	WNBCD	MCRIN	MIAPF	MOAPF	NYZRN	NXZRN	SBKLK

Name	State	Description
MBCD	1	The external M code is output in the B.C.D. format.
	0	The external M code is output in the binary format.
WNBCD	1	The work number search (WN1-16) is input in the B.C.D. format.
	0	The work number search (WN1-16) is input in the binary format.
MCRIN	1	T code of the tool in the spindle is not read in UI300 to UI331.
	0	T code of the tool in the spindle is read in UI300 to UI331.
MIAPF	1	The automatic power cutoff is activated by M01.
	0	The automatic power cutoff is not activated by M01.
MOAPF	1	The automatic power cutoff is activated by M00.
	0	The automatic power cutoff is not activated by M00.
NYZRN	1	The Y axis zero return direction is minus (-).
	0	The Y axis zero return direction is plus (+)
NXZRN	1	The X axis zero return direction is minus (-).
	0	The X axis zero return direction is plus (+).
SBKLK	1	The "SBK" button is operative only when the key switch is turned to the PANEL position.
	0	The "SBK" button is operative at any key switch position.

	7	6	5	4	3	2	1	0
K2	HINT	STL/OP	ROVC	OVONSP	OVONRT	MDLK	LPCHEK	IMODE

Name	State	Description
HINT	1	The handle operation can be simultaneously performed with jog or step operation.
	0	The handle operation cannot be simultaneously performed with jog or step operation.
STL/OP	1	OP.M signal is output during the cycle start only.
	0	OP.M signal is output in the automatic operation.
ROVC	1	The rapid feed rate override is fixed at 100%.
	0	The rapid feed rate overrise switch is effective at all times.
OVONSP	1	The "OVR ON" lamp lights when the spindle override is other than 100%.
	0	The "OVR ON" lamp is not related to the spindle override.
OVONRT	1	The "OVR ON" lamp lights when the rapid feed rate override is other than 100%.
	0	The "OVR ON" lamp is not related to the rapid feed rate override.
MDLK	1	Mode change cannot be made when the key switch is set to the OP position.
	0	Mode change can be made at any key switch position provided that the CYCLE START lamp is not lit.
LPCHEK	1	All lamps on the control panel light at the initial start-up as lamp check.
	0	Lamp check is not performed at the initial start-up.
IMODE	1	The memory mode is selected after the initial start-up.
	0	The zero return mode is selected after the initial start-up, and after the zero return, the memory mode is selected.

	7	6	5	4	3	2	1	0
K3	THOV	TAPOV	SOVC	SPCL	M1DEL	MODEL	SARWH	MDCSP

Name	State	Description
THOV	1	Spindle override is effective during threading.
	0	Spindle override is ineffective during threading.
TAPOV	1	Spindle override is effective during tapping.
	0	Spindle override is ineffective during tapping.
SOVC	1	The spindle override is fixed at 100%.
	0	The spindle override is effective.
SPCL	1	The maximum speed is clamped at all times. (The commanded value is clamped if so commanded.)
	0	The maximum speed is clamped only during the constant surface speed control.
M1DEL	1	The spindle rotation and coolant supply are not stopped by M01.
	0	The spindle rotation and coolant supply are stopped by M01.
MODEL	1	The spindle rotation and coolant supply are not stopped by M00.
	0	The spindle rotation and coolant supply are stopped M00.
SARWH	1	The cutting block starts upon receipt of the spindle speed reach signal.
	0	The cutting block starts without waiting for the spindle speed reach signal.
MDCSP	1	The spindle stops when the mode is changed.
	0	The spindle does not stop even when the mode is changed.

	7	6	5	4	3	2	1	0
K4	PL/T	MCHK	STCON	F1DOK	ILKOK	MGRST	CLHD	TPCL

Name	State	Description
PL/T	1	The playback mode is used.
	0	The tape mode is used.
MCHK	1	The M00/M01, M02/M30 and ERROR lamps light during lamp check.
	0	The M00/M01, M02/M30 and ERROR lamps do not light during lamp check.
STCON	1	Tool diameter discrimination is performed. (T0xxx, small diameter; T1xxx to T8xxx, medium diameter; T9xxx, large diameter)
	0	Tool diameter discrimination is not performed.
F1DOK	1	With an F1-digit feed option, the feed rate can be varied by the manual pulse generator.
	0	With an F1-digit feed option, the feed rate cannot be varied by the manual pulse generator.
ILKOK	1	The external interlock signal is used.
	0	The external interlock signal is not used.
MGRST	1	The magazine rotation is not stopped when the RESET button is pressed.
	0	The magazine rotation is stopped when the RESET button is pressed.
CLHD	1	The coolant supply signal is automatically output after the ATC cycle if the output had been commanded before the cycle.
	0	The coolant supply signal is automatically cut off when the ATC cycle is activated.
TPCL	1	The oil shot/oil mist signal is automatically output only in the tapping unitl M9 is commanded in the tapping cycle.
	0	The oil shot/oil mist signal is not output in the tapping cycle.

	7	6	5	4	3	2	1	0
K5	30/16	PRGEND	M70/21	M1/SO	MISTOF		BCD/DEC	SPJOK

Name	State	Description
30/16	1	30 tools are used for the magazine.
	0	16 tools are used for the magazine.
PRGEND	1	The M02 and M30 signals are output immediately.
	0	The M02 and M30 signals are not output during magazine indexing.
M70/21	1	M70 is decoded for output.
	0	M21 is decoded for output.
M1/SO	1	Oil mist is provided.
	0	Oil shot is provided
MISTOF	1	Oil mist is supplied for the period set by the timer.
	0	Oil mist supply is cut when M9 is read.
BCD/DEC	1	The external M code is output in the unit of two digits.
	0	M21 to M29 are decoded for output.
SPJOK	1	Spindle jog is effected when the spindle normal rotation button is pressed in the automatic mode.
	0	Spindle jog is not used.

	7	6	5	4	3	2	1	0
K6	SPTM	DRT		CL/UCL				EROF

Name	State	Description
SPTM	1	1: The magazine rotation output is deactivated after the magazine coincidence count signal is deactivated and the time set in T19 elapses.
	0	0: The magazine rotation output is deactivated immediately when the magazine coincidence count signal is deactivated.
DRT		1: The magazine and arm brake timing parameters (K14, K15 and K16) are automatically compensated for when an abnormal stop has occurred.
		0: K14, K15 and K16 are not automatically compensated for.
CLP/UCLP	1	The "4UCLP" output is used as the 4th axis clamp output.
	0	The "4UCLP" output is used as the 4th axis unclamp output.
EROF	1	The automatic power cutoff is activated by an error output.
	0	The automatic power cutoff is not activated by an error output.

	7	6	5	4	3	2	1	0
K7	SBK2	OSP2	BDT1.2	DRN2	ZNG2			4UCLM

These parameters are used to store the states of the machine in the memory.

Name	State	Description
SBK2	1	The single block mode is selected.
	0	The single block mode is not selected.
OSP2	1	The optional stop mode is selected.
	0	The optional stop mode is not selected.
BDT1.2	1	The block delete mode is selected.
	0	The block delete mode is not selected.
DRN2	1	The dry run mode is selected.
	0	The dry run mode is not selected.
ZNG2	1	Z axis is ignored.
	0	Z axis is not ignored.
4UCLM	1	The 4th axis unclamp is commanded.
	0	The 4th axis unclamp is not commanded.

For parameters K8 to K13, refer to the descriptions "(8) ATC Data Display and Rewriting" in the ATC operation.

	7	6	5	4	3	2	1	0
K15				32	24	16	8	0

For this parameter, set the time to output the dynamic brake after the confirmation of completing the deceleration (LS14) for stopping the arm.

Bit 0: 0 msec
Bit 1: 8 msec
Bit 2: 16 msec
Bit 3: 24 msec
Bit 4: 32 msec

1.4 Data Table Setting and Display

When the data table display is not shown, press the [DATA] soft key in the PC parameter menu. The data table control data display (see Fig. 4.4 (a)) will appear.

When the correct data is set to the data table control data, pressing the [DATA] soft key again causes the data contents of data table group #1 (Fig. 4.4 (b) and (c)) to appear. Data table groups #2, #3, and #n are then displayed by pressing the [→] and [→→] keys.

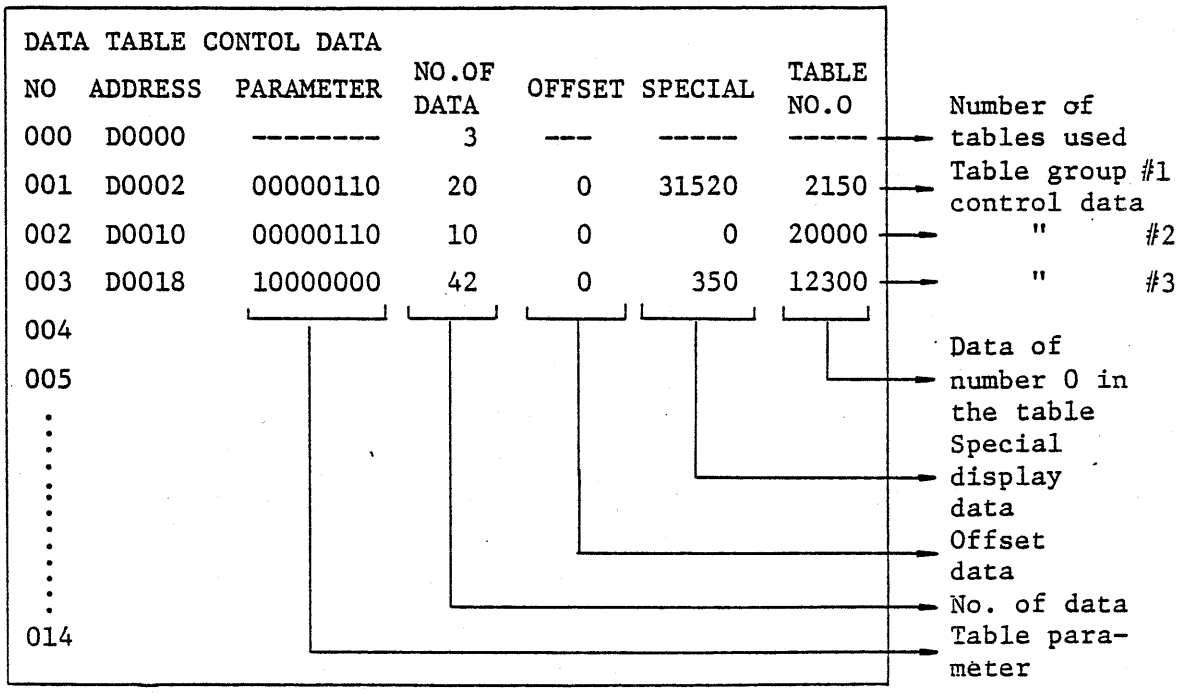


Fig. 4-4 (a) Data table control data display

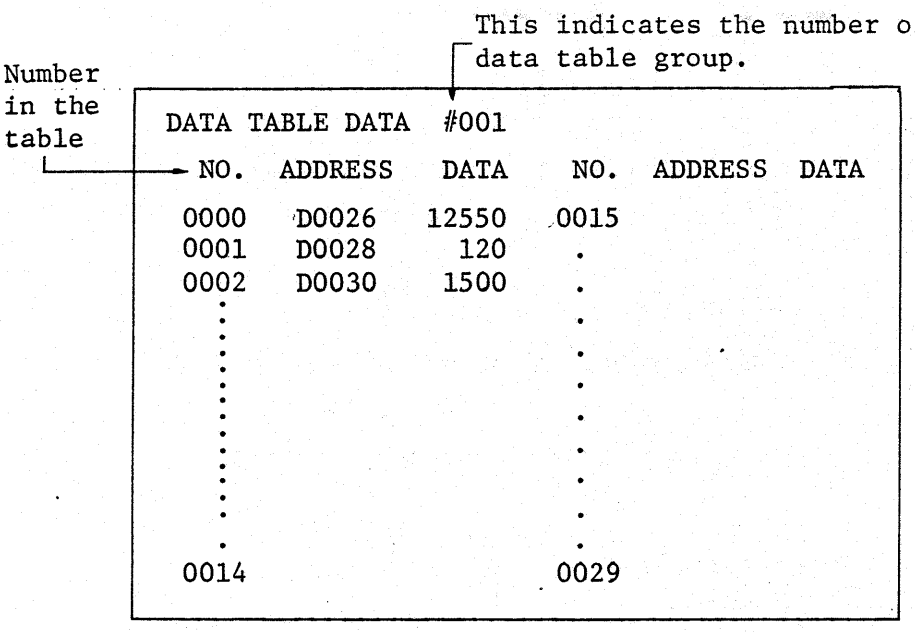


Fig. 4-4 (b) Data table data display

(1) Data table control data setting and display

Only control data in each data table group are displayed in the form shown in Fig. 4.4 (a).

The data numbered 0 are those for the number of data table group, and used for the column "NO. OF DATA."

Data numbered 2 and after are data table control data in each data table group. Data used to set and display on the MDI and CRT are as follows.

PARAMETER:	Table parameter
NO. OF DATA:	Number of data (The number of table groups used is set in the line numbered 0.)
OFFSET:	Offset data
SPECIAL:	Special display data
TABLE NO. 0:	Data numbered 0 in the table

(a) For setting the data, set the NC in the MDI mode, and set KEY 4 = 1 for the BMI interface. For FS3 and FS6 interfaces, set KEY = 1.
This operation is not required for display.

(b) Press the [PCPRM] soft key in the basic PC menu to change the menu, and then press the [DATA] soft key.

(c) Data table control data display (Fig. 4.4 (a)) will appear. To display the table control data display numbered 15 and after, press the [↓] page key as required. For data setting, the steps described below must be followed.

(d) Move the cursor to the desired location using the cursor keys on the MDI and CRT cursor keys.

(e) After keying-in the data using the numeral keys, pressing the [INPUT] key.

(f) The data at the specified location will be altered.

(g) To set subsequent data, repeat steps (d, e, and f).

(h) To set the data table data after setting the control data, press the [DATA] soft key and obtain the data table display. For details, refer to the following section.
Pressing the [RETURN] key to return to the basic PC menu.

(2) Data table setting and display

(a) For setting the data, set the NC in the MDI mode, and set KEY 4 = 1 for the BMI interface. For FS3 and FS6 interfaces, set KEY = 1.
This operation is not required for display.

(b) Press the [PCPRM] soft key in the basic PC menu to change the menu, and then press the [DATA] soft key.

(c) The data table control data display (Fig. 4.4 (a)) will appear first, and the soft key menu will change as follows. Then, press the [DATA] soft key to cause the data table display. Refer to Fig. 4.4 (b).

TIMER	COUNTER	KEEPRL	DATA	POS

The data table display of table group #1 will first appear. The data table display is replaced by the one of table group #2 when the [DATA] soft key is pressed. Displays of table groups #3, #4 and so forth will successively appear each time the [DATA] soft key is pressed.

(d) If there are more than 30 pieces of data table data, use the [↓] page key.
For data setting, the steps described below must be followed.

(e) Move the cursor to the desired location using the cursor keys on the MDI and CRT cursor keys.

(f) After keying-in the data using the numeral keys, pressing the [INPUT] key.

(g) The data at the specified location will be altered.

(h) To set subsequent data, repeat steps (e, f, and g).

(i) After setting the data table data, press the [RETURN] key to return to the basic PC menu.

1.5 PC Data All Clear

This operation clears all timer, counter, keep relay, data table, positioning module parameters.

Use this operation only when initializing the PC system.

(a) Set the NC in the MDI mode, and turn on the NC parameter for parameter writing.

(b) Press the [PCPRM] soft key in the basic PC menu to change the menu, and then press the [NEXT] soft key to obtain the following menu.

CLEAR		READ	VERIFY	OUT

(c) Press the [CLEAR] soft key. The menu will change as follows. To discontinue clearing, press the [CANCEL] soft key or the [RETURN] key to return the original menu.

EXEC	CANCEL			

(d) Press the [EXEC] soft key.
The PC data all clear will be initiated, and when the clearing is completed the message "PC DATA ALL CLEAR END" appears on the down right corner of the CRT.

(e) After the completion of the clearing, press the [RETURN] key to return to the basic PC menu.

2. NC Parameter Display and Setting

2.1 Parameter Display

2.1.1 Display of parameters other than pitch error correction data

(1) Press the [SERVICE] soft key and then the [PARAM] soft key to obtain the parameter display.

(2) Key-in the data number of the parameter which must be displayed, and press the [INP-NO.] soft key.
The cursor key or the page key may be used instead of keying-in the data number to change the display.

2.1.2 Display of pitch error correction data

(1) Press the [SERVICE] soft key and then the [PITCH] soft key to obtain the parameter display.

(2) Key-in the data number of the parameter which must be displayed, and press the [INP-NO.] soft key.
The cursor key or the page key may be used instead of keying-in the data number to change the display.

2.2 Paramter Setting

Parameter setting through the MDI mode.

(1) Select the MDI mode, or press the EMERGENCY STOP button.

(2) Press the [SETTING] soft key to obtain the setting display.

(3) Key-in 8000.

(4) Pressing the [INP-NO.] soft key causes the data number 8000 to appear.

(5) Key-in 1 and press the [INPUT] soft key.
Parameter PWE = 1 is set, enabling parameter setting. The NC is now in the alarm condition.

(6) Pressing the [RETURN] soft key causes the soft key display to change to the one for function selection.

(7) Press the [SERVICE] soft key and then the [PARAM] soft key to obtain the parameter display.

(8) Key-in the data number of the parameter which must be set and press the [INP-NO]. soft key.
The display on which parameter setting is to be made will appear.

(9) Key-in the data to be set, and press the [INPUT] soft key to set the data.
To input the data in succession to the parameter of the selected data number, insert mark ";" between data.
For example, key-in 10;20;30;40 and press the [INPUT] soft key. 10, 20, 30 and 40 will be successively set starting from the parameter where the cursor is currently located.

(10) Repeat steps (7, 8, and 9).

(11) After parameter setting, set 0 to parameter PWE of data number 8000 to prohibit further parameter setting.

(12) Reset the NC to clear the alarm "POSSIBLE TO SET PARAMETERS." If the alarm reads "A PARAMETER HAS BEEN SET THAT REQUIRES THE TURNING OFF OF THE NC POWER SUPPLY," turn off the NC power supply.

2.3 Paper Tape Punch and Registration from Paper Tape

2.3.1 Punching all parameters

(1) Connect a punch unit to the I/O interface.

(2) Select the EDIT mode.

(3) Press the [SERVICE] soft key and then the [PARAM] soft key to obtain the parameter display.

(4) Press the [PUNCH] soft key and then the [ALL] soft key. All the parameters will be then punched out.

2.3.2 Punching all parameters except pitch error correction data

(1) Connect a punch unit to the I/O interface.

(2) Select the EDIT mode.

(3) Press the [SERVICE] soft key and then the [PARAM] soft key to obtain the parameter display.

(4) Press the [PUNCH] soft key and then the [PARAM] soft key. All the parameters except pitch error correction will be then punched out.

2.3.3 Punching pitch error correction data

(1) Connect a punch unit to the I/O interface.

(2) Select the EDIT mode.

(3) Press the [SERVICE] soft key and then the [PITCH] soft key to obtain the parameter display.

(4) Press the [PUNCH] soft key and then the [PITCH] soft key. Pitch error correction data will be then punched out.

2.3.4 Setting by using parameter tape

(1) Select the MDI mode or press the EMERGENCY STOP button.

(2) Press the [SETTING] soft key to obtain the setting display.

(3) Key-in 8000.

(4) Press the [INP. NO] soft key to display the parameter of data number 8000.

(5) Key-in 1 and press the [INPUT] soft key.
Parameter PWE = 1 is set, enabling parameter setting. The NC is now in the alarm condition.

(6) Pressing the [RETURN] soft key causes the soft key display to change to the one for function section.

(7) Press the [SERVICE] soft key and then the [PARAM] soft key to obtain the parameter display.

(8) Load the parameter tape on the tape reader.

(9) Press the [READ] soft key.

(10) Then press the desired soft key among the three below.

[ALL]:	All parameters
[PARAM]:	All parameters except pitch error correction data
[PITCH]:	Pitch error correction data

3. Parameter Table

3.1 NC Parateter

NO		DATA							
		7	6	5	4	3	2	1	0
0						1		1	
10									
11									
12	X								
	Y								
	Z								
	4								
20									2
21									2
22									2
23									2
100									
101									
102									
103									
104									
105									
106									
1000									
1002									
1004	X								
	Y								
	Z								
	4								
1005	X					1			
	Y					1			
	Z		1			1			
	4	1				1			
1006	X								
	Y								
	Z								
	4						1	1	1
1020	X							8	8
	Y							8	9
	Z							9	0
	4							6	5

NO		DATA							
		7	6	5	4	3	2	1	0
1021	X								
	Y								
	Z								
	4								
1022	X								1
	Y								2
	Z								3
	4								
1023	X								1
	Y								2
	Z								3
	4								4
1030								6	6
1031									1
1220	X								
	Y								
	Z								
	4								
1221	X								
	Y								
	Z								
	4								
1222	X								
	Y								
	Z								
	4								
1223	X								
	Y								
	Z								
	4								
1224	X								
	Y								
	Z								
	4								

NO		DATA							
		7	6	5	4	3	2	1	0
1225	X								
	Y								
	Z								
	4								
1226	X								
	Y								
	Z								
	4								
1240	X								
	Y								
	Z								
	4								
1241	X								
	Y		−	1	0	0	1	0	0
	Z								
	4								
1242	X								
	Y								
	Z								
	4								
1243	X								
	Y								
	Z								
	4								
1260	X								
	Y								
	Z								
	4								
1400									
1401									
1410						1	0	0	0
1412								2	5
1413									
1414							1	0	0

NO		DATA							
		7	6	5	4	3	2	1	0
1420	X					1	5	0	0
	Y					1	5	0	0
	Z					1	2	0	0
	4								
1421	X						1	0	0
	Y						1	0	0
	Z						1	0	0
	4								
1422	X						5	0	0
	Y						5	0	0
	Z						5	0	0
	4								
1423	X					1	0	0	0
	Y					1	0	0	0
	Z					1	0	0	0
	4								
1424	X								
	Y								
	Z								
	4								
1425	X						4	0	0
	Y						4	0	0
	Z						4	0	0
	4								
1426									
1427	X								
	Y								
	Z								
	4								
1428									
1450									
1451									
1452									
1453									
1454									

NO		DATA							
		7	6	5	4	3	2	1	0
1455									
1456									
1457									
1458									
1459									
1460									
1461									
1600	X								
	Y								
	Z								
	4								
1620	X						1	0	0
	Y						1	0	0
	Z						1	0	0
	4								
1621	X							1	0
	Y							1	0
	Z							1	0
	4								
1622	X							2	0
	Y							2	0
	Z							2	0
	4							2	0
1623	X								
	Y								
	Z								
	4								
1624	X							5	0
	Y							5	0
	Z							5	0
	4							5	0
1625	X								
	Y								
	Z								
	4								
	5								

NO		DATA							
		7	6	5	4	3	2	1	0
1626	X								
	Y								
	Z								
	4								
1627	X								
	Y								
	Z								
	4								
1628	X								
	Y								
	Z								
	4								
1629	X								
	Y								
	Z								
	4								
1630							4	0	0
1631								5	0
1800									1
1802	X								
	Y								
	Z								
	4							1	
1810				1		1	1		
1815	X								
	Y								
	Z								
	4								
1816	X		1	1	1	1			1
	Y		1	1	1	1			1
	Z			1	1		1		1
	4								
1820	X								2
	Y								2
	Z								2

NO		DATA							
		7	6	5	4	3	2	1	0
	4								
1825	X					3	0	0	0
	Y					3	0	0	0
	Z					3	0	0	0
	4					3	0	0	0
1826	X					1	4	3	4
	Y					1	4	3	4
	Z					1	1	9	5
	4								
1827	X							1	0
	Y							1	0
	Z							1	0
	4								
1828	X				1	0	0	0	0
	Y				1	0	0	0	0
	Z					8	0	0	0
	4								
1829	X						5	0	0
	Y						5	0	0
	Z						5	0	0
	4								
1830	X						5	0	0
	Y						5	0	0
	Z						5	0	0
	4								
1831	X								
	Y								
	Z								
	4								
1832	X					9	1	6	6
	Y					9	1	6	6
	Z					7	3	3	3
	4								
1833	X								
	Y								

NO		DATA							
		7	6	5	4	3	2	1	0
	Z								
	4								
1834	X								
	Y								
	Z								
	4								
1835	X					2	5	0	0
	Y					2	5	0	0
	Z					3	0	0	0
	4								
1850	X	G	R	D					
	Y	G	R	D					
	Z	G	R	D					
	4	G	R	D					
1851	X	B	K	L					
	Y	B	K	L					
	Z	B	K	L					
	4	B	K	L					
1890	X								
	Y								
	Z								
	4								
2000			1				1	1	
2001						1		1	
2002									
2003									
2010									
2011									
2014						1	0	0	0
2015						1	0	0	0
2016					2	0	0	0	0

NO		DATA							
		7	6	5	4	3	2	1	0
2020	X								
	Y								
	Z								
	4								
2021	X								
	Y								
	Z								
	4								
2030									4
2031									5
2032									4
2033									
2049									
2200					1				
2201									
2202									
2203							1	1	
2400									
2401		1							1
2402					1			1	
2410								1	0
2411									
2412									
2413									
2414									
2415									
2416									
2417									
2418									
2900									
5001									
5002									1
5003									

NO		DATA							
		7	6	5	4	3	2	1	0
5011									1
5013									
5110									1
5111									2
5112								1	0
5120									
5121									
5122									
5130									
5131									
5132									
5140									
5141									
5142									
5150									
5151									
5152									
5160									
5161									
5162									
5200									
5210	X								
	Y								
	Z								
	4								
5220	X						1	0	0
	Y						1	0	0
	Z						1	0	0
	4		9	9	9	9	9	9	9
5221	X		−	5	6	1	0	0	0
	Y		−	4	1	1	0	0	0
	Z		−	4	6	1	0	0	0
	4	−	9	9	9	9	9	9	9
5222	X								
	Y								
	Z								
	4								
5223	X								

NO		DATA							
		7	6	5	4	3	2	1	0
	Y								
	Z								
	4								
	5								
5224	X								
	Y								
	Z								
	4								
	5								
5225	X								
	Y								
	Z								
	4								
	5								
5420	X								
	Y								
	Z								
	4								
5421	X								
	Y								
	Z								
	4								
5422	X								
	Y								
	Z								
	4								
5423	X								
	Y								
	Z								
	4								
5424	X								
	Y								
	Z								
	4								
5425	X								
	Y								
	Z								
	4			3	6	0	0	0	0

NO	DATA							
	7	6	5	4	3	2	1	0
5600								
5601								
5602								
5603								
5610								
5611								
5612								
5613								
5614								
5615								
5616								
5617								
5618								
5619								
5620								
5621								
5622								
5623								
5624								
5625								
5626								
5627								
5628								
5631								
5632								
5633								
5634								
5635								
5636								
5637								
5640								3
5641								
5642								
5643								
5644								
5645								
5646								
5647								
5648								

NO		DATA							
		7	6	5	4	3	2	1	0
5680									
5681									
5682									
5683									
5691									
5692									
5693									
5694									
5695									
5696									
5697									
5698									
6000				1			1		
6001									1
6002									
6010								5	0
6011									
6200							1	1	
6201								1	1
6202									
6210							1	0	0
6211						1	0	0	0
6212									
6213									
6214									
6215									
6216									
6217									
6218									
6219									
6220									
6240	X								
	Y								
	Z								
	4								
	5								

NO		DATA							
		7	6	5	4	3	2	1	0
6400									
6410									
6411									
6820									
7000					1				
7001									1
7010									
7011									
7012									
7013									
7014									
7050									
7051									
7052									
7053									
7054									
7055									
7056									
7057									
7058									
7059									
7071									
7072									
7073									
7074									
7075									
7076									
7077									
7078									
7079									
7110	X								1
	Y								2
	Z								3
	4								
7200									
7201				1					1
7202		1					1		
7211									
7212									

NO	DATA							
	7	6	5	4	3	2	1	0
7213								
7214								
7300								
4311								
7312								
7313								
7321								
7322								
7323								
7331								
7332								
7333								
7600			1					1
7601						1		
8000								
8010								

NO	DATA							
	7	6	5	4	3	2	1	0
9000								3
9001								3
9002							1	6
9020								
9100							1	1
9101								
9102			1		1	1	1	1
9103								
9104								
9105		1				1		
9106	1	1						
9107								1
9108			1		1			
9109								
9110								
9111								
9112								
9113				1				
9114								
9115				1				
9116								
9117								
9118								
9119								
9120								
9121								
9122								
9123								
9124								
9125								
9126								
9127								
9128								
9129								
9130								
9131								

3.2 PC Parameter

NO.	DATA
T01	1000
T02	4000
T03	5000
T04	0500
T05	
T06	
T07	0300
T08	
T09	
T10	1000
T11	5000
T12	2000
T13	2000
T14	
T15	
T16	0496
T17	2500
T18	
T19	
T20	
T21	0096
T22	0496
T23	1496
T24	1496
T25	7000
T26	7000
T27	0600
T28	0296
T29	
T30	1000
T31	0496
T32	
T33	
T34	
T35	
T36	
T37	1000
T38	5000
T39	3000
T40	5000

TIMERS

*4

NO.	ADDRESS	PRESET	CURRENT
01	C00		
02	C04		
03	C08		
04	C12		
05	C16	*4	Magazine present value
06	C20		
07	C24		
08	C28		
09	C32		
10	C36		
11	C40		
12	C44		
13	C48		
14	C52		

COUNTERS

NO.	DATA	Remarks
K00	10010*	During field adjustment
K00	10010* 1	When shipment
K01	0100	
K02	0000	
K03	0000	
K04	0101	
K05	0001	
K06	0100	
K07	0000	
K08	0000	
K09	0000	
K10	0000	
K11	0000	
K12	0000	
K13	0000	
K14	0000	Standard setting — * 1
K14	0000	After adjustment * 1
K15	0000	Standard setting — * 3
K15	0000	After adjustment * 3
K16	0000	Standard setting — * 2
K16	0000	After adjustment * 2

*: Setting during field adjustment

*1: Brake adjustment when magazine forward rotating

*2: Brake adjustment when magazine reversing

*3: Arm brake adjustment

0 bit...8msec 1 bit...16msec
2 bit...24msec 3 bit...32msec
4 bit...40msec 5 bit...48msec
6 bit...56msec 7 bit...64msec

(Set 0 to all bits: 72 msec)

* Set 1st bit of K0 to "1" for the machine (No.43 to No. 82)

*4 6000 : for 30 tools

NO.	ADDRESS	PARAMETER	NO. OF DATA	OFFSET	SPECIAL	TABLE NO. 0
000	D0000		10			
001	D0002	00000010	10			
002	D0010	00000010	1			
003	D0018	00000010	*1			
004	D0026					
005	D0034					
006	D0042					
007	D0050					
008	D0058					
009	D0066					
010	D0074					

NO.	ADDRESS	DATA
000	D0082	82
001	D0084	8191
002	D0086	*2
003	D0088	
004	D0090	
005	D0092	
006	D0094	
007	D0096	
008	D0098	*3
009	D0100	*4

*1: Number of pot +1 (17/31)
*2: Maximum spindle speed (4000/60000/10000)
*3: Spindle jog speed (rpm) (75/ 50/ 30)
*4: Orientation speed (rpm) (75/ 50/ 30)

4. TROUBLESHOOTING

If the error lamp lights, find the cause as described below.

1. Press the [NC/PC] key to select the PC display.
2. Press the [PCMDI] soft key to select the selection display.
3. Press the [No. 2] soft key.
4. The alarm display will appear and the alarm number corresponding to the error is indicated at the ALARM NO. section on the upper section of the display.
5. Press the [CONTENT] soft key. The alarm number and the corresponding content are indicated at the ALARM CONTENT section on the lower section of the display. If many errors have occurred, their alarm numbers are indicated individually each time the [CONTENT] soft key is pressed.
6. (i) To select the selection display, press the [RETURN] soft key (the far left key).
   (ii) To select the NC display, press the [NC/PC] key.
   (iii) To select the PC display, press the [NC/PC] key after the NC display is selected.
7. When no PC alarm is generated, press the [CONTENT] key. "(NO ALARM)" will be indicated.

```
PAGE SELECT
1. TOOL ENTRY          PC
2. ALARM

   No.1  No.2
```

```
   ALARM

   ALARM NO.
   CONTENT

              NO.

                   CONTENT
```

ERROR LIST

Error code	Message	Coil name	Address	Content
1	WORK NO. CODE ERROR	PER1	R130.1	A binary code is input for work number search in the B.C.D. code (when bit 6 of K6 is 1). The addresses for work number search in the B.C.D. code are as follows. WN01 .. X10.0 WN10 .. X10.4 WN02 .. X10.1 WN20 .. X10.5 WN04 .. X10.2 WN08 .. X10.3 Verify whether or not this is a B.C.D. code.
2	ARM NOT AT ORIGIN	PER50	R135.0	M3, M4 or M19 was commanded when the arm was not at its original position. The arm original position signal (LS21) can be monitored by PCDGN X0.0. Tool clamp sometimes fails when the main arm is not at its original position. If the command was given in the middle of an ATC cycle, return the arm to its original position by ATC return operation. If the command was given out of an ATC cycle, return the arm by the independent arm operation. If it is impossible for the arm original position signal to become "1" (in the high state), the brake or LS21 is maladjusted or defective.
3	TOOL UNCLAMP	PER52	R135.2	M3, M4 or M19 was commanded before completion of tool clamp. The tool clamp detection signal (LS18) can be monitored by PCDGN X3.5. Tool clamp sometimes fails when the main arm is not at its original position. Return the arm in the manner described for PER50 above. If the main arm is at its original position, LS18 may be maladjusted or defective.

Error code	Message	Coil name	Address	Content
4	S CODE NOT COMMANDED	PER53	R135.3	M3 or M4 was commanded with an S code ("0") unspecified. Press the RESET button and specify an S code.
5	DURING SP INCHING	PER54	R135.4	M3 or M19 was commanded during spindle jog.
6	M31 NOT CANCELLED	PER55	R135.5	M3, M4 or M19 was commanded during an interlock bypass. Press the RESET button and cancel the interlock bypass by commanding M32.
7	SPINDLE DIRECTION CHANGED	PER57	R135.7	The operation mode was changed to manual during spindle rotation in the automatic mode, the spindle rotation direction was then switched, and the automatic mode was returned again.
8	NOT EQUAL TOOL DIA. SP & EM. POT	PER100	R140.0	The diameter of the tool in the spindle does not correspond with that of the tool in the empty pot when M6 is commanded to change tools of different diameters. The diameter of the tool in the empty pot is stored in PC parameter K13. Empty pot numbers are stored in the B.C.D. code in PC parameter K11. Confirm that there is no danger of interference even when the tool in the spindle returns to the empty pot, then set K13 as follows. For a large diameter tool in the spindle (T code 9xxx): 00000010 For a standard diameter tool in the spindle (T code 1xxx to 8xxx):00000000 For a small diameter tool in the spindle (T code 0xxx): 00000001

Error code	Message	Coil name	Address	Content
9	NOT EQUAL TOOL & LS-13	PER101	R140.1	The state of the change tool detection signal does not correspond to the data. To perform a dry run (with no tool), set "1" at bit 1 of PC parameter K0. The tool detection signal (LS13) can be monitored by PCDGN X4.4. When the signal is "1" (the high state), there is a tool at the tool change position. When it is "0" (the low state), there is no tool.
10	ARM NOT AT ORIGIN	PER104	R140.4	M6 or M33 was commanded when the arm was not at its original position. The arm original position detection signal (LS21) can be monitored by PCDGN X0.0. If the command was given during an ATC cycle, return the arm to its original position by ATC return operation. If the command was not given during an ATC cycle, return the arm to its original position by independent arm operation.
11	POT NOT UP	PER105	R140.5	M6 or M33 was commanded before the pot had risen. The pot up detection signal (LS16) can be monitored by PCDGN X3.0. Move the pot up by independent ATC operation. If the X3.0 does not become "1," even though the pot has risen, LS16 is mal-adjusted or defective.
12	MAGAZINE NOT ZERO RETURN	PER106	R140.6	M6 was commanded even though no T code was commanded after initial start-up or before completion of magazine indexing. Press the RESET button and command a T code to call the tool that must be loaded into the spindle.

Error code	Message	Coil name	Address	Content
13	M31 NOT CANCELLED	PER107	R140.7	M6 or M33 was commanded during the interlock bypass. Press the [RESET] button and release the interlock bypass by commanding M32.
14	Y & Z AXIS NOT AT ATC POSITION	PER110	R140.0	M6 or M33 was commanded without accompanying a movement command in the same block when the Y or Z axis was in the tool change prohibition area. Move the Z axis to the machine origin and move the Y axis to a position between -100mm and -410mm along the machine coordinate, then perform an ATC change.
15	TOOL UNCLAMP	PER111	R140.1	M6 or M33 was commanded during the off state of the tool clamp detection signal. The tool clamp detection signal (LS18) can be monitored by PCDGN X3.5. Tool clamp sometimes fails if the main arm is not at its original position. If the main arm is at its original position, LS18 may be maladjusted or defective.
16	SEQUENCE ERROR		R190.3	Sequence operation error Check R155 to R158 to determine which bit is "1" and inform Mori Seiki of the result.
17	ATC NOT END	PER113	R141.3	M6 of M33 was commanded when MWF (ATC incomplete, K8.0) was "1" (in the high state). Return the main arm to the original position by the ATC return cycle.

Error code	Message	Coil name	Address	Content
18	EMPTY POT DATA ERROR	PER114	R141.4	A value exceeding the number of magazine tools is stored in the empty pot data. The empty pot data is stored in a B.C.D. code in PC parameter K11. Set the correct empty pot data.
19	EMPTY POT NOT FOUND	PER115	R141.5	The value of the data table that corresponds to the empty pot data is not "0." The empty pot data is stored in a B.C.D. code in PC parameter K11. For example, when K11 is 00000011, the empty pot data is pot 3. At this time, the data for pot 3 must be "0." Set the correct data.
20	NOT IN M.D.I. MODE	PER116	R141.6	M31 or M35 was commanded in a mode other than the MDI mode.
21	DURING SP. ROTATION	PER117	R141.7	M31 or M35 was commanded during spindle rotation.
22	M31 NOT COMMANDED	PER120	R142.0	M35 was commanded without commanding M31.
23	STEPPING COMMAND CODE ERROR	PER130	R143.0	A numeral of 5 or more was entered to the preset value of counter 0 during the independent ATC operation.

Error code	Message	Coil name	Address	Content
24	POT NOT UP	PER150	R145.0	A T code was commanded before the rising of the pot. The pot rising detection signal (LS16) can be monitored by PCDGN X3.0. Move the pot up by independent operation. If X3.0 does not become 1 (the high state) even if the pot has risen, LS16 is maladjusted or defective.
25	EMPTY POT NOT FOUND	PER151	R145.0	T0 was commanded with no empty pot data. The T0 command is effective only when there is empty pot, that is when there is a tool in the spindle.
26	ATC NOT END	PER153	R145.3	A T code was commanded when MWF (ATC incomplete, K8.0) was "1." Return the main arm by ATC return cycle.
27	TOOL IN EMPTY POT	PER157	R145.7	The change tool presence signal is on after completion of empty pot indexing. No tool must be loaded in the empty pot. This error can develop only on the 1st to 42nd machines.
28	SP. TOOL COMMANDED	PER160	R146.0	A T code was used to command the spindle tool. A T code cannot be used to command the spindle tool.

Error code	Message	Coil name	Address	Content
29	T & M33 IN SAME BLOCK	PER161	R146.1	M33 and T codes were commanded in the same block. M33 and T codes cannot be commanded in the same block.
30	AIR PRESSURE DOWN	MER1	R160.1	The air pressure dropped. Set the air pressure to 4 to 5 kg/cm^2. Set the pressure switch to the 3 kg/cm^2 position. The pressure switch on/off can be monitored by PCDGN X2.7. The pressure is normal when X.27. is "1." An alarm is issued when the time preset at T37 elapses following a reduction in air pressure. (Standard setting: 10000)
31	MAGAZINE OVER LOAD	MER2	R160.2	Thermal relay (OL3) of the arm motor and the magazine motor was tripped. OL3 can be monitored by PCDGN X2.5. When the X2.5 is "1," it indicates that the thermal relay was tripped. The trip can be reset by pressing the reset bar of OL3.
32	CHIPCONV & COOLANT OVER LOAD	MER3	R160.3	Thermal relay OL2 for the coolant motor was tripped. OL2 can be monitored by PCDGN X2.6. When X2.6 is "1," it indicates that the thermal relay was tripped. The trip can be reset by pressing the reset bar of OL2. This error is also indicated when the optional chip conveyor or spindle coolant unit malfunctions.

Error code	Message	Coil name	Address	Content
33	4 AXIS NOT CLAMP. UNCLAMP	MER5	R160.5	The 4th axis clamp detection signal or the 4th axis unclamp detection signal did not turn on within the predetermined time limit. The 4th axis clamp detection can be monitored by PCDGN X12.5, and the 4th axis unclamp detection can be monitored by PCDGN X12.4. The time is set at T40 (standard setting: 5000).
34	CYCLE ST. SWITCH BROKEN	MER6	R160.6	The CYCLE START button is defective. The error occurs if the start condition switches from on to off when the status of the CYCLE START button (PCDGN X1.0) is "1." This condition may be the same as when the START button is kept pressed.
35	POWER OF DURING ATC CYCLE	MER7	R160.7	The power was cut off when MWF (ATC incomplete, PC parameter K8.0) was "1." Return the ATC by ATC return cycle.
36	MACHINE READY OFF	MER10	R161.0	The machine ready signal disappeared. The machine ready signal (relay CR1 contact) can be monitored by PCDGN X3.6. This signal became "0" for some reasons. This error is indicated when the oil air lubrication unit malfunction in the case of 100,000 rpm. spindle speed specifications.

Error code	Message	Coil name	Address	Content
37	LS19 NOT ON	MER50	R165.0	The orientation pin disengagement detection signal did not turn on within the predetermined time limit after the turning off of the orientation command. The orientation pin disengagement detection signal (LS20) can be monitored by PCDGN X3.4. The orientation pin may be caught somewhere in the middle of its stroke or LS20 may be maladjusted or defective. The time must be set at T23 (standard setting: 1496).
38	LS20 NOT ON	MER51	R165.1	The orientation pin engagement detection signal did not turn on within the predetermined time limit after the turning off of the orientation command. The orientation pin engagement detection signal (LS19) can be monitored by PCDGN X3.3. This signal becomes "0" in the negative logic when the pin is engaged. LS19 may be maladjusted or defective. The time must be set at T23 (standard setting: 1496).
39	ORIENT-PIN NOT OUT	MER52	R165.2	The orientation pin did not disengage within the predetermined time limit after the turning off of the orientation command. This error is caused when both LS19 (PCDGN X3.3) and LS20 (PCDGN X3.4) are "1" after the turning off of the orientation command. The solenoid or NC driver may be defective or the pin may be damaged. The time must be set at T23 (standard setting: 1496).

Error code	Message	Coil name	Address	Content
40	LS19 NOT OFF	MER53	R165.3	The orientation pin engagement detection signal did not turn off within the predetermined time limit after the turning on of the orientation command. The orientation pin engagement detection signal (LS19) can be monitored by PCDGN X3.3. This signal becomes "0" in the negative logic when the pin is engaged. The orientation pin may be caught somewhere in the middle of the stroke, or LS19 may be maladjusted or defective. The time must be set at T38 (standard setting: 5000).
41	LS20 NOT OFF	MER54	R165.4	The orientation pin disengagement detection signal did not turn off within the predetermined time limit after the turning on of the orientation command. The orientation pin disengagement detection signal (LS20) can be monitored by PCDGN X3.4. LS20 may be defective. The time must be set at T38 (standard setting: 5000).
42	ORIENT PIN NOT IN	MER55	R165.5	The orientation pin did not engage within the predetermined time limit after the turning on of the orientation command. This error is caused when both LS19 (PCDGN X3.3) and LS20 (PCDGN X3.4) are "0" after the turning on of the orientation command. The solenoid or NC driver may be defective or the pin may be damaged. The time must be set at T38 (standard setting: 5000).

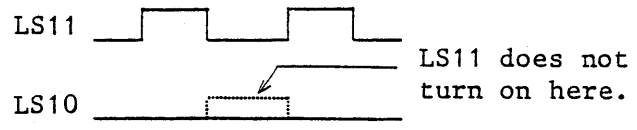
Error code	Message	Coil name	Address	Content
43	TOOL CLAMP CONDITION LOST	MER56	R165.6	The tool was unclamped during spindle rotation. The tool clamp detection signal (LS18) can be monitored by PCDGN X3.5. When this signal is "1," it indicates that the tool clamp has completed. The proximity switch may be maladjusted or defective, or the tool clamp mechanism may be damaged.
44	ATC NOT AT ORIGIN	MER57	R165.7	The arm was dislocated from the original position during spindle rotation. The arm original position detection signal (LS21) can be monitored by PCDGN X0.0. When this signal is "1," it indicates that the arm is at the original position. The limit switch may be maladjusted or defective.
45	NOT CONFIRMED TOOL CLAMP	MER60	R166.0	The orientation pin disengagement completion signal disappeared during spindle rotation. This error is caused if either LS19 (PCDGN X3.3) or LS20 (PCDGN X3.4) becomes "0" during spindle rotation. Either LS19 or LS20 may be maladjusted or defective.
46	LIMITED TORQUE SIGNAL OFF	MER61	R166.1	The limited torque signal did not turn on within the predetermined time limit after the output of the torque limit signal during orientation. The limited torque signal which is sent from the spindle servo unit can be monitored by PCDGN X2.4. The wiring or the servo unit may be in trouble. The time must be set at T24 (standard setting: 1496).

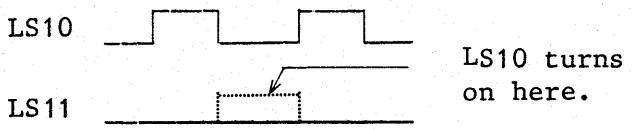
Error code	Message	Coil name	Address	Content
47	SP. STOP SIGNAL OFF	MER62	R166.2	The spindle stop detection signal did not turn on within the predetermined time limit although no spindle rotation command was given. The spindle stop detection signal can be monitored by PCDGN X2.0. If this signal does not become "1" even though the spindle is stopped, the wiring or the servo unit may get in trouble. The time must be set at T25 (standard setting: 7000).
48	SP. SPEED DETECT SIGNAL OFF	MER63	R166.3	The speed detection signal did not turn on within the predetermined time limit after the start of orientation. The speed detection signal can be monitored by PCDGN X2.0. If the signal does not become "1" even the spindle rotates at a low speed (approx. 30 rpm), the wirng or the servo unit may be in trouble. The time must be set at T26 (standard setting: 7000).
49	SP. SPEED ARRIVAL SIGNAL OFF	MER64	R166.4	The speed reach signal did not turn on within the predetermined time limit after the start of orientation. The speed reach signal can be monitored by PCDGN X2.1. If the signal does not turn on even the spindle rotates at a low speed (approx. 30 rpm), the wiring or the servo unit may be in trouble. The time must be set at T26 (standard setting: 7000).

Error code	Message	Coil name	Address	Content
50	LS16 NOT ON	MER100	R170.0	The pot up detection signal did not turn on within the predetermined time limit after the output of the pot up command. The pot up detection signal (LS16)can be monitored by PCDGN X3.0. LS16 may be maladjusted or defective. The time must be set at T11 (standard setting: 5000).
51	LS17 NOT OFF	MER101	R170.1	The pot down detection signal did not turn off within the predetermined time limit after the output of the pot up command. The pot down detection signal (LS17) can be monitored by PCDGN X3.1. LS17 may be maladjusted or defective. The time must be set at T11 (standard setting: 5000).
52	LS17 NOT ON	MER102	R170.2	The pot down detection signal did not turn off within the predetermined time limit after the output of the pot down command. The pot down detection signal (LS16) can be monitored by PCDGN X3.0. LS16 may be maladjusted or defective. The time must be set at T11 (standard setting: 5000).
53	LS16 NOT OFF	MER103	R170.3	The pot up detection signal did not turn off within the predetermined time limit after the output of the pot down command. The pot up detection signal can be monitored by PCDGN X3.1. LS17 may be maladjusted or defective. The time must be set at T11 (standard setting: 5000).

Error code	Message	Coil name	Address	Content
54	POT NOT UP	MER104	R170.4	The pot did not rise within the predetermined time limit after the output of the pot up command. The NC driver or the solenoid may be in trouble. The time must be set at T11 (standard setting: 5000).
55	POT NOT DOWN	MER105	R170.5	The pot did not lower within the predetermined time after the output of the pot down command. The NC driver or the solenoid may be in trouble. The time must be set at T11 (standard setting: 5000).
56	LS15 NOT ON	MER106	R170.6	The arm down detection signal was not sent back within the predetermined time limit after the beginning of the ATC cycle. The arm down detection signal (LS15) can be monitored by PCDGN X3.2. LS15 may be maladjusted or defective. The time must be set at T12 (standard setting: 2000).
57	LS14 NOT ON	MER107	R170.7	The arm deceleration signal was not sent back within the predetermined time limit after the completion of the arm lowering. The arm deceleration detection signal (LS14) can be monitored by PCDGN X4.3. LS14 may be maladjusted or defective. The time must be set at T13 (standard setting: 2000).

Error code	Message	Coil name	Address	Content
58	LS21 NOT ON	MER110	R171.0	The arm was not at original position when the arm stop was completed. The arm original position detection signal (LS21) can be monitored by PCDGN X0.0. LS21 may be maladjusted or defective or the brake may be maladjusted.
59	LS15 NOT ON	MER111	R171.1	The arm down detection signal disappeared during empty pot indexing. The arm down detection signal (LS15) can be monitored by PCDGN X3.2. LS15 may be maladjusted or defective, or the brake may be maladjusted.
60	ATC CYCLE TIME OVER	MER112	R171.2	The ATC return cycle was not completed within the predetermined time limit. The arm has not lowered although the arm is in the lowest position according to the ATC memory. Or, I/O conditions for the ATC may be improper or maladjusted.

Error code	Message	Coil name	Address	Content
61	MAGAZINE COUNTER ERROR	MER150	R175.0	The magazine origin signal does not turn on even though a tool is loaded in pot 16. Or, the magazine origin signal turns on even though a tool is not loaded in pot 16. (Pot 30 in case of 30-tool specification) The magazine origin signal (LS12) can be monitored by PCDGN X4.2. If the signal does not turn on even though a tool is loaded in pot 16, LS12 may be maladjusted or defective. If the signal turns on even though a tool is not loaded in pot 16, number counting may be improper. The current magazine number recognized by the PC is indicated on the "CURRENT" value on PC parameter counter C18, and the number of pots is indicated on the "PRESET" number.
62	LS11 NOT ON	MER151	R175.1	The magazine rotation signal B does not turn on. The magazine rotation signal B (LS11) can be monitored by PCDGN X4.1. This error develops if magazine rotation signal A (LS10: PCDGN X4.0) turns on twice in succession. (Refer to the note *2.)  LS10 may be maladjusted or defective.

Error code	Message	Coil name	Address	Content
63	LS10 NOT ON	MER152	R175.2	The magazine rotation signal does not turn on. Magazine rotation signal A (LS10) can be monitored by PCDGN X4.0. This error develops if magazine rotation signal B (LS11: PCDGN X4.1) turns on twice in succession.  LS11 may be maladjusted or defective.
64	MAGAZINE INDEX TIME OVER	MER153	R175.3	The magazine indexing exceeded the cycle time. This error is caused if the magazine indexing was not completed within the predetermined time limit. The motor may be disconnected, or both proximity switches LS10 and LS11 are defective.
65	POT UP CONDITION LOST	MER154	R175.4	The pot up detection signal disappeared during magazine indexing. The pot up detection signal (LS16) can be monitored by PCDGN X3.0. The LS16 may be maladjusted or defective.
66.	MAGAZINE INDEX POSITION ERROR	MER155	R175.5	Magazine rotation signal B does not turn on after the completion of the magazine stop. The magazine brake may be maladjusted.

Error code	Message	Coil name	Address	Content
67	T-CODE MISS SETTING	PER155	R145.5	A T-code was used to call an unregistered tool.

*1 B.C.D. Code and Binary Code

The B.C.D. (short for binary coded decimal) code uses binary digits to represent decimal numbers, with each digit position of a decimal number is allocated four bits of a binary number.

7	6	5	4	3	2	1	0	Bit
80	40	20	10	8	4	2	1	Signal content

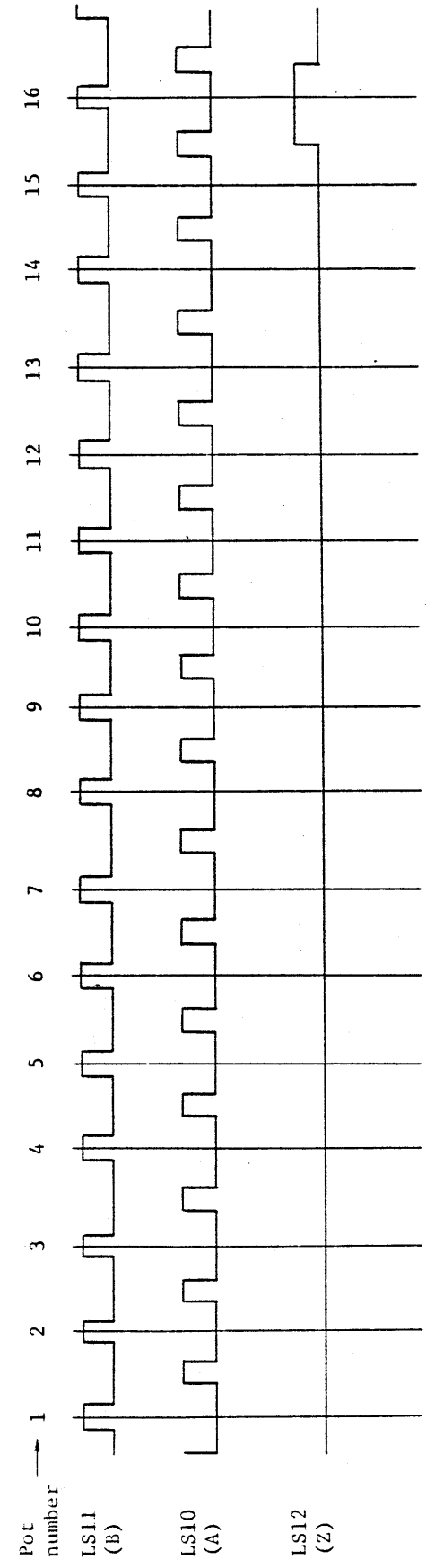
B.C.D. code

Whereas, the binary code uses the ordinary binary digits.

7	6	5	4	3	2	1	0	Bit
128	64	32	16	8	4	2	1	Signal content

For example, the number "17" is represented by "00010111" in the B.C.D. code, while, it is represented by "00010001" in the binary code.

* 2 Timing Chart of Magazine Rotation Signals A, B, and Z



In the case of a 30-tool specification model, LS12 turns on at pot 30.

PC parameter setting procedure for systems 10 and 11

(1) Set the NC to the emergency stop state or select the MDI mode. Set the editing key switch on the control panel to EDIT or the NC parameter writing switch to 1 according to the requirments of the corresponding PC parameters.

PC parameter / Switches	Timer	Counter	Keep relay	Data table	Positioning module
Editing key switch on the control panel	-	0	-	0	-
NC parameter writing switch	0	-	0	-	0

0: Setting to EDIT (or 1)

-: Either setting is possible.

Note 1: Data table for the 11T lathe can be set only in the emergency stop state. (This is because data is being written on the data table according to the sequence to prevent accidents when the control is on.)

Note 2: The above procedure may differ if a different system floppy disk is used when data is written on the PC cassette sequence ROM.

(2) Press the [NC/PC] key to select the PC display. The basic PC menu will appear.

Fig.

PCMDI	PCLAD	PCDGN	PCPRM	

Press the [PCPRM] soft key to call the next menu.

Fig.

TIMER	COUNTR	KEEPRL	DATA	POS

(3) Set data for the parameters of the timer, counter, keep relay, data table and positioning module.

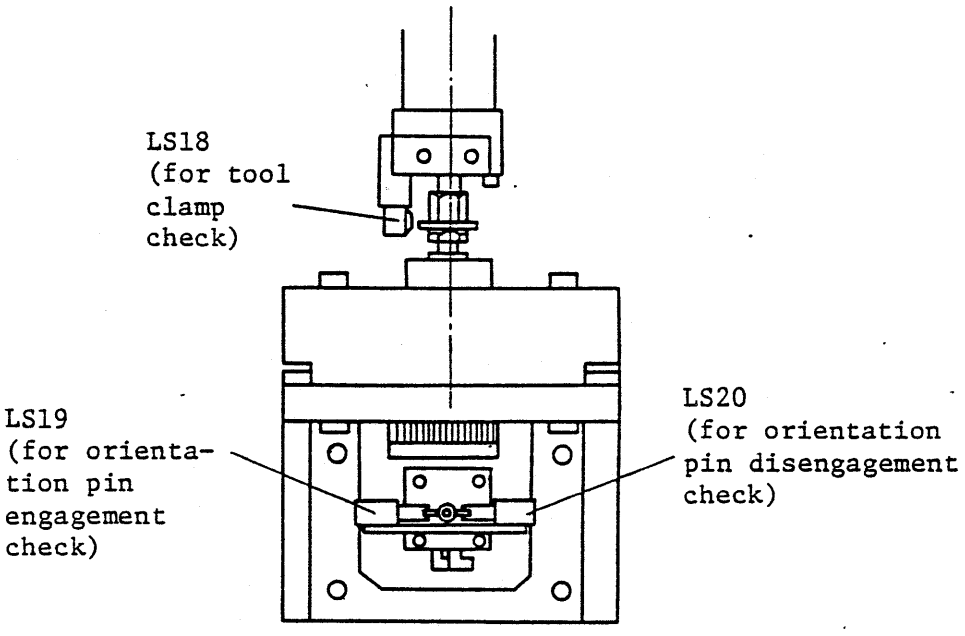
Note: Timer .....

Timer No.	Minimum setting unit	Maximum setting unit
T1 - T8	50 ms	1638.3 sec
T9 - T40	8 ms	262.136 sec

5. MAIN MOTOR DRIVE UNIT

1. Spindle

1.1 Spindle Head Limit Switches



1.2 Spindle Speed Adjustment

1.2.1 Spindle speed parameters

NC parameter No.	Specifications
5613	Compensation value of offset voltage for spindle speed analog output. (Setting range: -1024 to +1024) Set value: -8191 x (Offset voltage/12.5)
5614	Gain adjustment data for spindle speed analog output (Setting range: 700 to 1250)

PC parameter No.	Specifications
D82	Minimum spindle motor clamp speed (Setting range: 0 to 8191) Set value = $\frac{\text{Minimum spindle motor clamp speed}}{\text{Maximum spindle motor speed}}$ x 8191
D84	Maximum spindle motor clamp speed (Setting range; 0 to 8191) Set value = $\frac{\text{Maximum spindle motor clamp speed}}{\text{Maximum spindle motor speed}}$ x 8191
D86	Maximum spindle speed

1.2.2 Command voltage adjustment

1) Set the parameters as follows

NC (Refer to item 2.2 in section 6 for the setting procedure.)

5613	0
5614	1000

PC (Refer to item 1.4 in section 6 for the setting procedure.)

D82	0
D84	8191
D86	Maximum speed (6000 for 6000 rpm)

2) Offset voltage adjustment

(1) Command SO in the MDI mode.

(2) Measure the voltage between CH1 ⊕ and CH16 ⊖ of the spindle servo unit.

(3) Set "measured voltage x (-8191)/12.5" to NC parameter No. 5613.

(4) Command S1, then command M3 and M4 alternately.

(5) Adjust RV2 so that the voltage between CH13 ⊕ and CH16 ⊖ of the spindle servo unit is the same with M3 and M4.

3) Adjustment of speed command voltage

(1) Command the maximum speed in the MDI mode.
The spindle override must be set at 100% at this time.

(2) Measure the voltage between CH1 and CH16 of the spindle servo unit.

(3) Set the measured voltage multiplied by 100 to NC parameter No. 5614.

(4) With an M3 command, adjust RV1 so that the voltage between CH13 ⊕ and CH16 ⊖ is 10 V $\pm$ 0.05 V.

(5) After adjustment, change the value of PC parameter D82 to 82.

4) Speed adjustment

Using a speed meter, adjust RV9 for the normal rotation speed and RV11 for the reverse rotation speed.

1.3 Orientation Adjustment

A mechanical orientation system is used for this machine. Adjustment is easier than with an all electric orientation system.

1.3.1 Orientation parameters (PC parameters)

Data table

No.	Specification	Set value
D100	Speed during spindle orientation (Setting range: 0 to 127) Set value = Spindle speed x 8191/6000	50

Timer

No.	Specification	Set (msec) value
T21	Adjusts the time required to convert the analog voltage to low speed for spindle orientation.	100
T22	Adjusts the time to overlook the spindle stop signal for orientation from the reverse spindle rotation.	500
T23	Adjusts the time to monitor the spindle orientation pin disengagement.	2000
T24	Adjusts the time to monitor the limited torque signal.	1500
T31	Adjusts the time from the change of analog voltage to check the rated spindle speed arrival.	1000
T38	Adjusts the time to monitor the spindle orientation pin engagement.	5000

Keep relay

No.	Specifications	Standard setting
Bit 2 of K0 1: 0:	Orientation is reset when the RESET button is pressed. Orientation is not reset when the RESET button is pressed.	

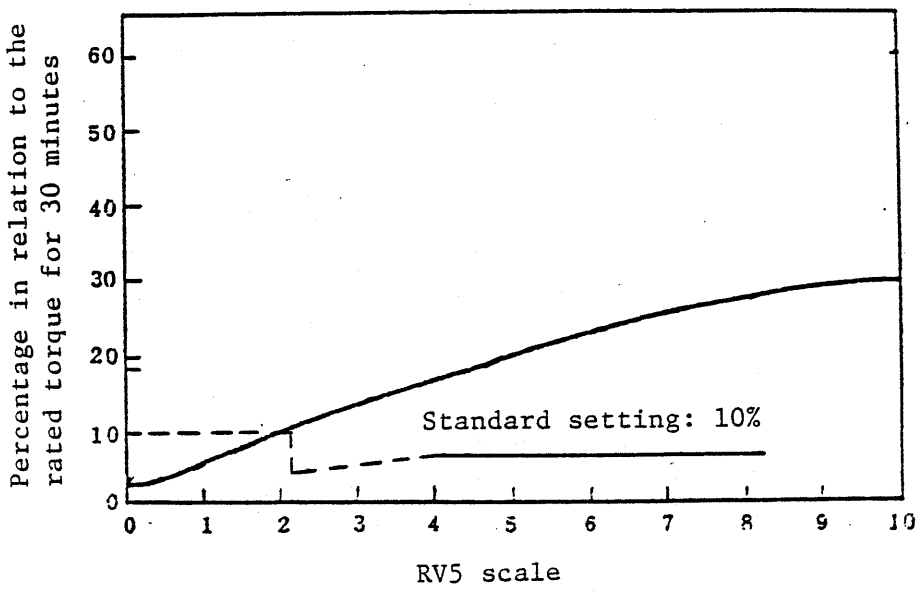
1.3.2 Speed adjustment

Set the value obtained by multiplying the spindle speed during orientation by 1.37 to the PC parameter's data table D100.
(Standard value: 50)
Value of 127 or over is ignored.

1.3.3 Torque adjustment at orientation rotation

This torque is adjusted by variable resistor RV-5 on the spindle unit. Adjustable range is 5 to 25% of the maximum torque.

Limited torque level (RV5)
The figures on the ordinate are represented by the percentage in relation to the rated torque for 30 minutes.



1.3.4 Checking orientation pin engagement and disengagement

The engagement and disengagement of the pin can be checked by the procedure described below.

1) Command M31 in the MDI mode.
2) Press the [NC/PC] button.
3) Press the [PCPRM] soft key.
4) Press the [COUNTER] soft key.

5) Move the cursor to [PRESET] of C00.

6) Roughly position the spindle key at the place of orientation.

7) Press the [3] and [INPUT] keys, and press the feed hold button. The pin will be engaged. Press the [4] and [INPUT] keys, and press the feed hold button. The pin will be disengaged. If the operation is correctly completed, the input data will be rest to "0."

   Operation of the limit switches can be checked by PCDGN X3.3 (Engagement check) and X3.4 (Disengagement check).

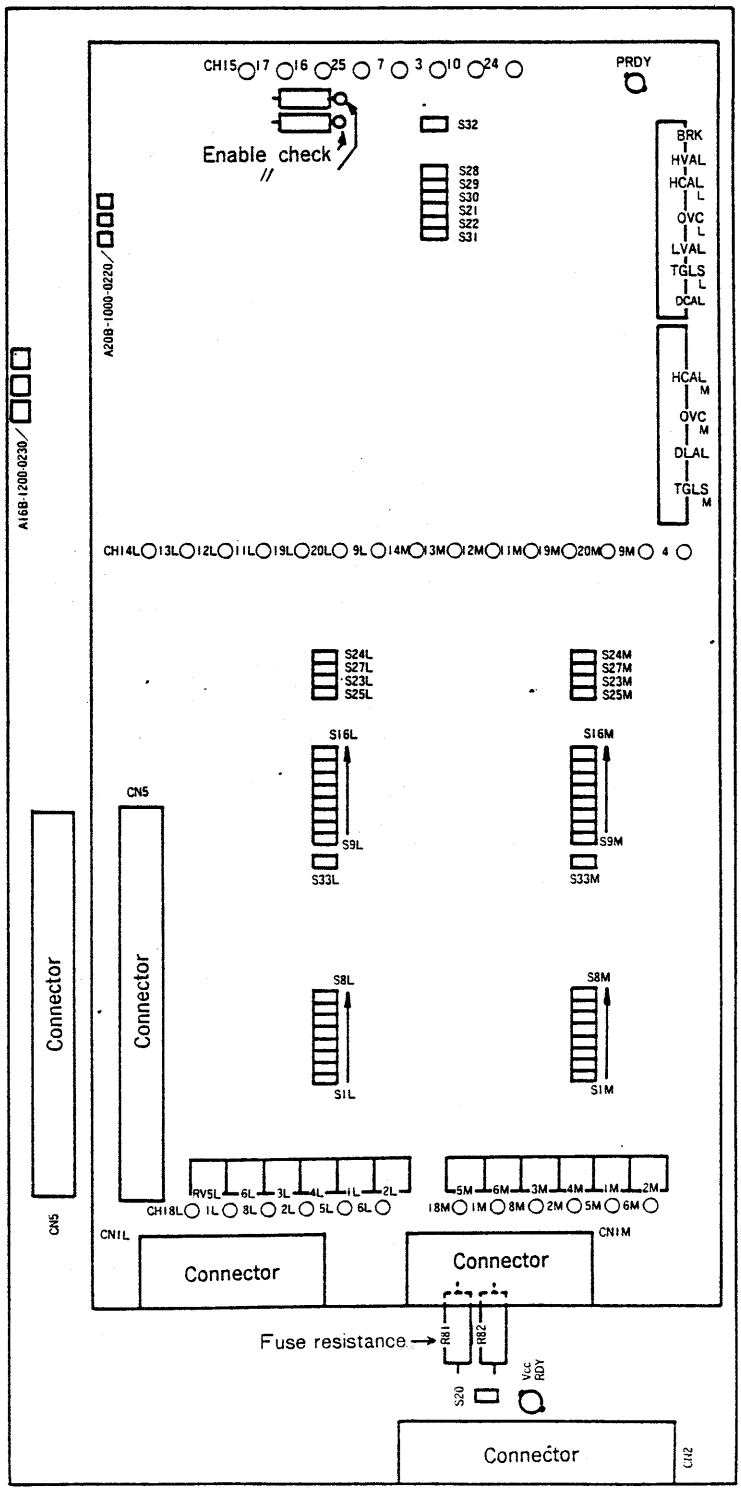
   The X3.3 and X3.4 data are "0" when the pin is engaged (when the positioning has been completed), and "1" when the pin is disengaged.

8) After checking, command M32.

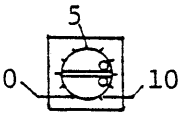
2. Setting the Servo Unit

A 2-axis servo unit is iused for X and Y axes, and a one-axis servo unit is used for Z axis.

2.1 Adjustment of X/Y Axis Verocity Control Unit



Short bar setting table (Mark o indicates short)		
Short bar	Setting	Remarks
S1L, M	o	Tachogenerator voltage
2, "	o	
3, "		No connection
4, "	o	Gain selection
5, "		
6, "	o	
7, "		
8, "		
9, "		
10, "		
11, "	o	
12, "		
13, "	o	
14, "	o	
15, "		
16, "		
23, "		TGLS alarm enable
24, "	o	OVC alarm duration setting
25, "		TGLS alarm sensitivity setting
27, "		OVC alarm enable
33, "	o	Current loop gain selection
S20		TOH setting
S21		BRK alarm enable
22		DCAL alarm enable
28	o	Discharge regenerative unit
29	o	
30		
31		DLAL alarm enable
32		Chopping frequency selection

Variable resistor setting						Variable resistor scale
Variable resistor	Motor 00M	Motor 0M	Motor 5M	Remarks		 The example above shows the setting of 8.
RV1L. M	4	4	4	Gain setting		
RV2L, M	5	5	5	Offset (1) pulse corder is set at 5 on the scale. (2) When a pancake type tacho-generator is used, short CH1-3 and CH2-3, and adjust the voltage between CH6 and CH3 at less than ±0.5 V.		
RV3L, M	10	10	10	OVC alarm level setting	00M: 0.6 + 1.1 x scale (A)	
					0M, 5M: 2 + 3.8 x scale (A)	
RV4L, M	5	5	5	Tachogenerator voltage correction (1) Standard: scale 5 (2) For the strict adjustment of position loop gain, refer to the the service manual of NC.		
RV5L, M	9	9	9	Current limiter	00M: 6.15 + 0.77 x scale (A)	
					0M, 5M: 20.3 + 2.54 x scale (A)	
RV6L, M	0	7.5	7.5	Current loop gain		

	Check Terminals	
Terminal	Code	Description
CH1L, M		3/4 x speed command voltage (VCMD)
CH2L, M	TSAL, M	Tachogenerator signal
CH3	0V	0V
CH4	0V	
CH5L, M		Compensation circuit
CH6L, M		
CH7	Triangle wave. Refer to Fig. 1.9.1 (c).	
CH8L, M	Current	00M 0.66 V/A
		0M - 5M 0.2 V/A
CH9L, M	ERL, M	Input for width modulation circuit
CH10	DISCHARGE	Discharge monitor. Refer to Fig. 1.9.1 (d).
CH11L, M	PWA, F	Width modulation output, (A-phase) (F-phase)
CH12L, M	PWB, G	" (B-phase) (G-phase)
CH13L, M	PWC, H	" (C-phase) (H-phase)
CH14L, M	PWD, J	" (D-phase) (J-phase)
CH15	+24V	+24V
CH16	+15V	+15V
CH17	-15V	-15V
CH18L, M	VCMDL, M	Speed command voltage
CH19L, M	VFB1L, M	Armature voltage feedback signal
CH20L M	VFB2L, M	
CH24		No use
CH25		Discharge regenerative alarm monitor

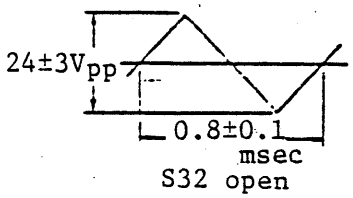


Fig. 1.9.1 (c)

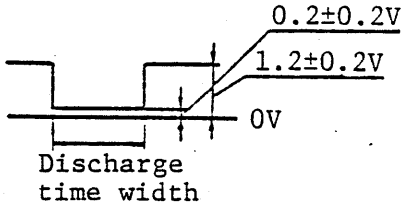


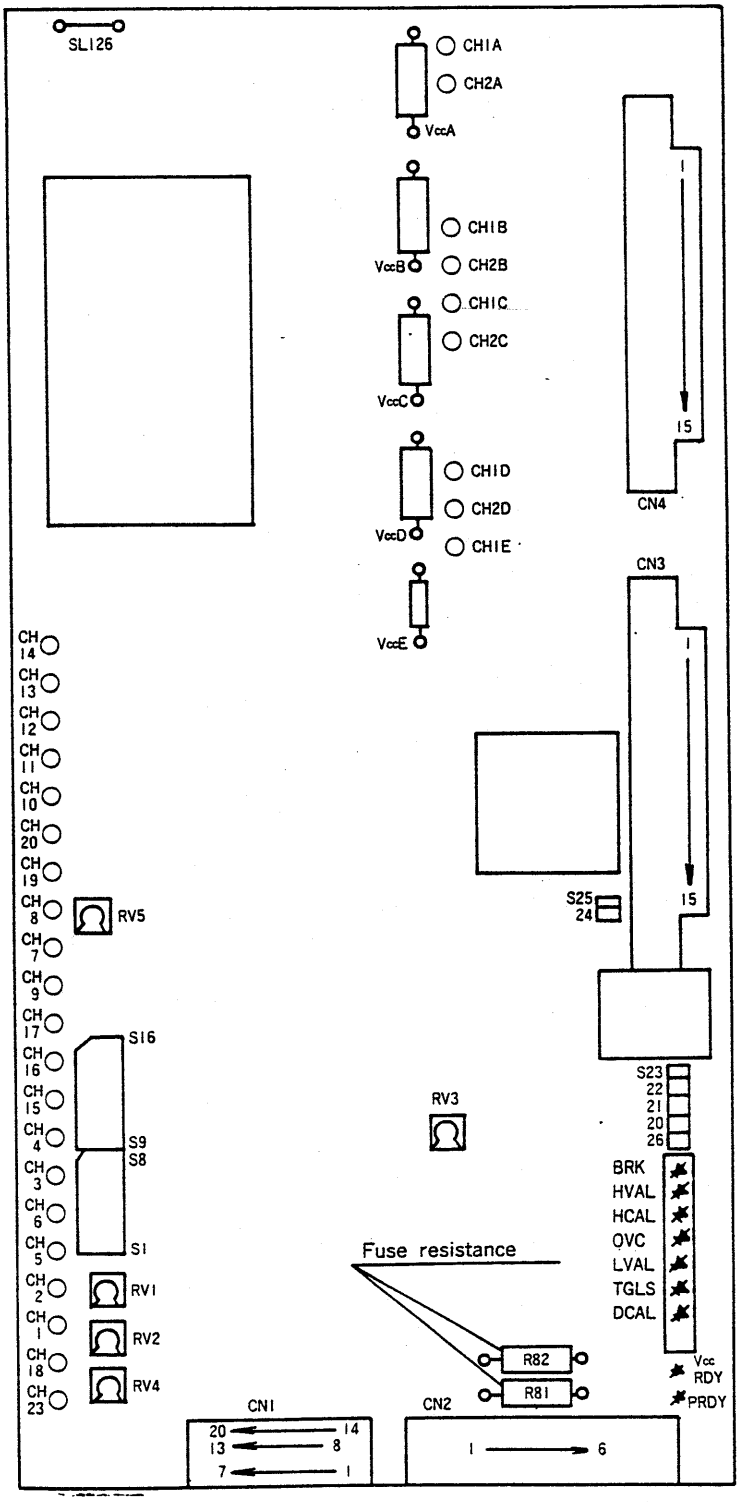
Fig. 1.9.1 (d)

Light Emitting Diodoe Indication

LED	Description
PRDY (Green)	Position control ready signal
VccRDY (Green)	Monitor for disconnection of fuse resistors (R81 and R82).(Lower PCB) ON: No trouble OFF: Items to be checked 1) Conduction of R81 and R82 2) Conduction between PCB (CN2) and power transformer.
BRK (Red)	Indicates the operation of non-fuse breaker.
HVAL (Red)	Overvoltage alarm Power supply voltage is too high. Trouble in discharge circuit Load inertia is too high.
HCALL.M (Red)	High current alarm Short between Tl (5L) and Tl (7L): short between Tl (5M) and Tl (7M) Trouble in transistor modules Trouble in PCB
OVCL.M (Red)	Over-load alarm (Adjusted by RV3L,M) Load of motor is too high.
TGLSL,M (Red)	Detection of the disconnection of the speed feed back circuit. Disconnection of tachogenerator signal or pulse-recorder signal Disconnection between the armature of the motor and verocity control unit Tl (5L, 7L, 5M, 7M)

DCAL (Red)	Discharge alarm Too frequent acceleration/reduction of the speed Regenerative energy caused by the machine weight is too high at gravity axis. Trouble in discharge transistor
LVAL (Red)	Low supply voltage alarm Supply voltage is too low. Trouble in PCB.
DLAL (Red)	Alarm for low supply voltage for reverse bias of drive circuit Abnormal supply voltage circuit for reverse bias

2.2 Setting and Adjustment of A Axis Verocity Control Unit



The diagram above applies to the verocity control units of versions 05B to 09D.

Short bar setting (Mark o indicates short)

Short bar		Description	
S 1	o	Tachogenerator voltage setting	
2			
3		Kinked line circuit enable	
4		Gain selection	
5	o	High-frequency gain	
6	o		
7	o	Ripple filter	
8	o	High-gain circuit enable	
9		Selection of compensation circuit capacity	
10	o		
11			
12	o	A.C. gain selection	
13			
14		Connection of high-gain circuit capacity	
15		01A	Current limiter setting
		02B	No connection
		07C	High-frequency gain
16	o	Chopping frequency selection	
20		Setting when a transformer and regenerative discharge unit are used.	
21		BRK alarm enable	
22		DCAL alarm enable	
23		TGLS alarm enable	
24	o	OVC alarm duration setting	
25		TGLS alarm sensitivity setting	
26	o	Regenerative discharge unit setting	
126		Voltage feedback motor setting	

Adjustment and Check of Variable Resistors

No.	Item	Setting conditions						Remarks
		Variable resistor	Check terminal	Short	Setting			
1	Short bar setting				Check the setting according to the table above.			
2	Power supply voltage		CH15-3 CH16-3 CH17-3		CH15-3	CH16-3	CH17-3	
					22 - 27V	14.5-15.5V	-145-155V	
3	Gain	RV1			Scale 5			
4	Offset	RV2	CH16-3	CH1-3 CH2-3	Within ±0.5V			When a pancake tacho-generator is used.
					Scale 5			When a pulse corder is used.
5	Overload alarm setting	RV3			Scale 10		00M	0.6 + 1.1 x Scale (A)
							0M-20M	2 + 3.8 x Scale (A)
							30M	4 + 7.5 x Scale (A)
6	Tachogenerator voltage compensation	RV4			1) Standard: Sclae 5 2) For the strict adjustment of position loop gain, refer to the service manual of NC.			
** 7	Current limiter	RV5			Scale 9	00M	564/(93 - 5 x scale) (A)	
						0M-20M	1880/(93 - 5 x scale) (A)	
						30M (H)	3760/(93 - 5 x scale) (A)	

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Check Terminals		
Termianl	Code	Description
CH1		3/4 x Speed command voltage (VCMD)
2	TSA	Tachogenerator signal
3	0V	0V
4	0V	
5		Compensation circuit
6		
7	TRIANGLE WAVE	Triangle wave. Refer to Fig. 2.
8	CURRENT	00M 0.66 V/A
		0M-20M 0.2 V/A
		30M (H) 0.1 V/A
9	ER	Input for width modulation circuit
10	DISCHARGE	Discharge monitor. Refer to Fig. 3.
11	PWA	Width modulation output, (A-phase)
12	PWB	" (B-phase)
13	PWC	" (C-phase)
14	PWD	" (D-phase)
15	+24V	+24V
16	+15V	+15V
17	-15V	-15V
18	VCMD	Speed command voltage
19	VFB1	Armature voltage feedback signal
20	VFB2	
23	ENBL	Enable

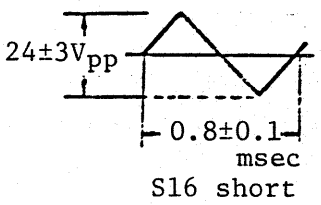


Fig. 2

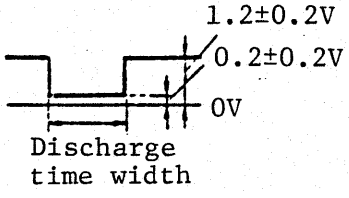


Fig. 3

Light Emitting Diode

LED	Description
PRDY (Green)	Position control ready signal
VccP.DY (Green)	Monitor for disconnection of fuse resistors (R81 and R82). (Lower PCB) ON: No trouble OFF: Items to be checked 1) Conduction of R81 and R82 2) Conduction between PCB (CN2) and power transformer.
BRK (Red)	Indicates the operation of non-fuse breaker
HVAL (Red)	Overvoltage alarm Power supply voltage is too high. Trouble in discharge circuit Load inertia is too high.
HCAL (Red)	High current alarm Short between T1 (5)(6) and (7)(8): Trouble in transistor modules Trouble in PCB
OVC (Red)	Over-load alarm (Adjusted by RV3) Load of motor is too high.
TGLS (Red)	Runaway detection Disconnection of tachogenerator signal or pulse-recorder signal Disconnection between the armature of the motor and verocity control unit T1 (5) - (8)
DCAL (Red)	Discharge alarm Too frequent acceleration/reduction of the speed Regenerative energy caused by the machine weight is too high at gravity axis. Trouble in discharge transistor.
LVAL (Red)	Low supply voltage alarm Supply voltage is too low. Trouble in PCB

E. PROGRAMMING MANUAL

PROGRAMMING MANUAL

1. BEFORE PROGRAMMING

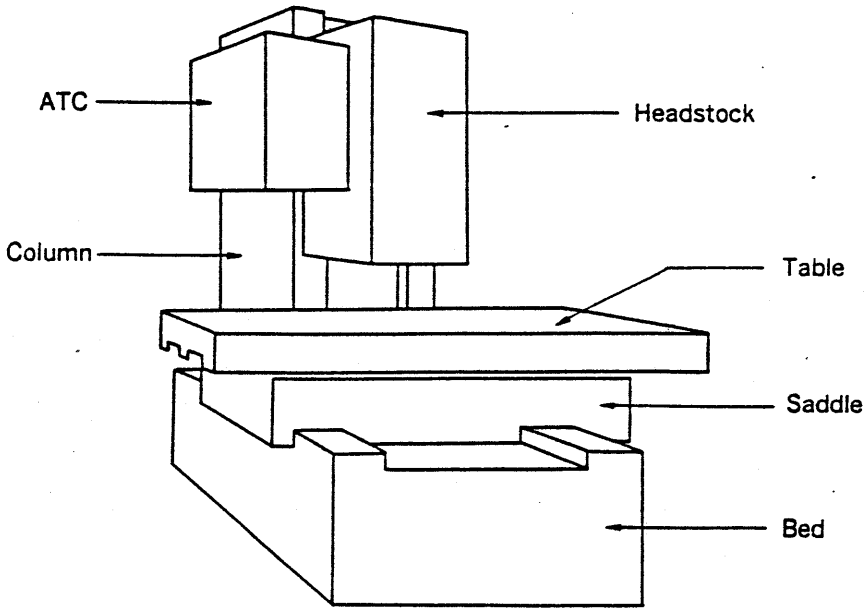
2. PROGRAMMING

1. BEFORE PROGRAMMING

1. Definition of Machining Center

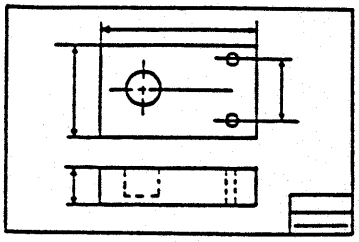
- NC (numerical control) machine tool
- Equipped with ATC (automatic tool changer)
- Capable of automatic control of machine cycle and auxilialy functions.
- Capable of various operations such as milling, drilling, tapping, etc., once a workpiece is set up.

Major Machine Sections (construction)

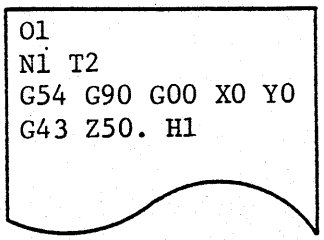


Bed:	Functions as a base for all machine components, including the column, saddle, table, etc.
Column:	Installed on the bed and carries the spindle head.
Saddle:	Installed on the slideways on the bed and traverses back and forth.
Table:	Travels left and right on the saddle slideways.
Spindle head:	Composed of the spindle, spindle drive motor etc. and vertically moves along the column slideway.
ATC system:	Composed of the tool magazine, tool change arm, etc. and changes tools.

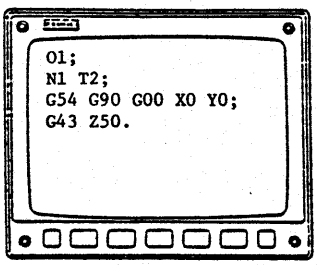
2. From Drawing to Product Completion



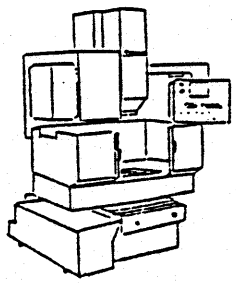
1. Drawing
   Determine processing method, procedure, tooling, etc. according to the drawing.



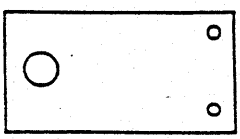
2. Programming
   Prepare a program according to the rule, considering cutting conditions such as rpm, depth of cut, and feed rates.



3. Input of the program
   Store the program into the memory.



4. Tool offset
   Set the tools, and make tool offsets.

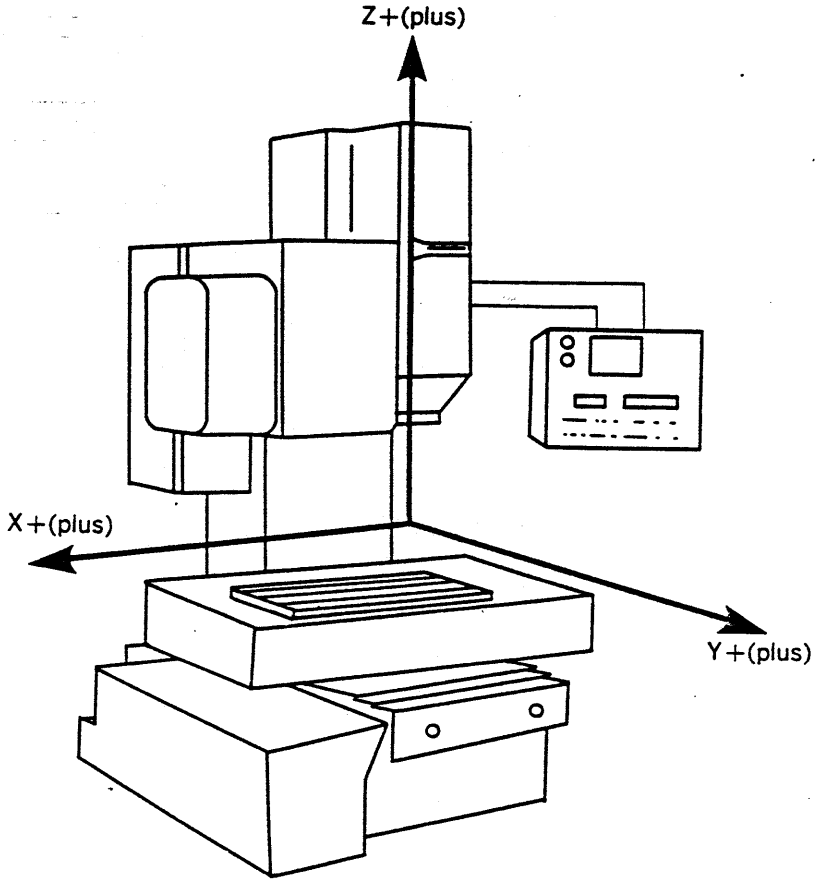


5. Production
   Machine the workpiece while checking with the program.

3. X/Y/Z Axes

This vertical machining center has the following axes.

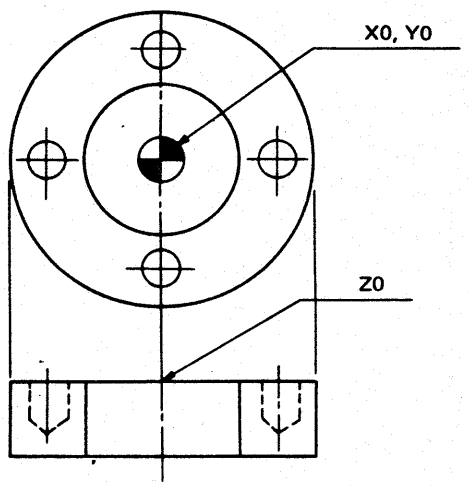
Control axes and directions		
Axis	Movement direction	+ (plus), - (minus)
X-axis	Table, left and right	Left movement: + (as viewed from machine front)
Y-axis	Saddle, back and forth	Forward movement: +
Z-axis	Spindle head, up and down	Up movement: +

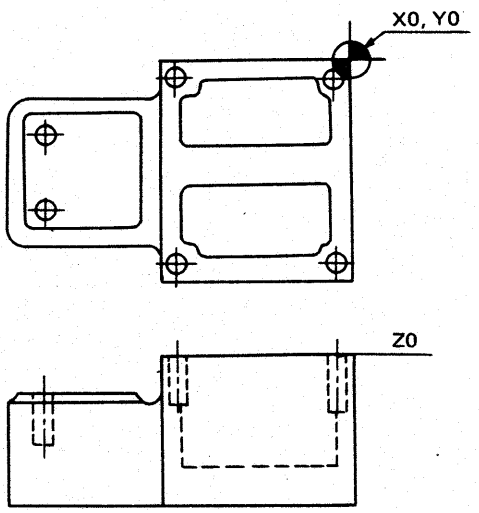


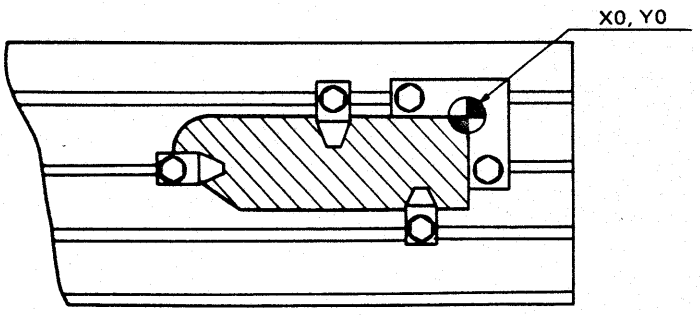
4. Origin (absolute programming)

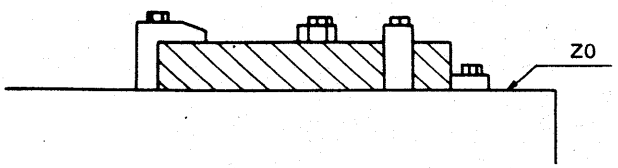
Before preparing a program, the origin on the program (cutting origin) must be determined.
This cutting origin (X0, Y0, Z0) is the reference point for programming and cutting.
The cutting origin differs according to various conditions, such as workpiece shape (cylinder, cube, etc.), use/non-use of jigs and others.
The origin should be set by the user considering convenience of programming and preparation for processing, and important items regarding accuracy.

(Example)



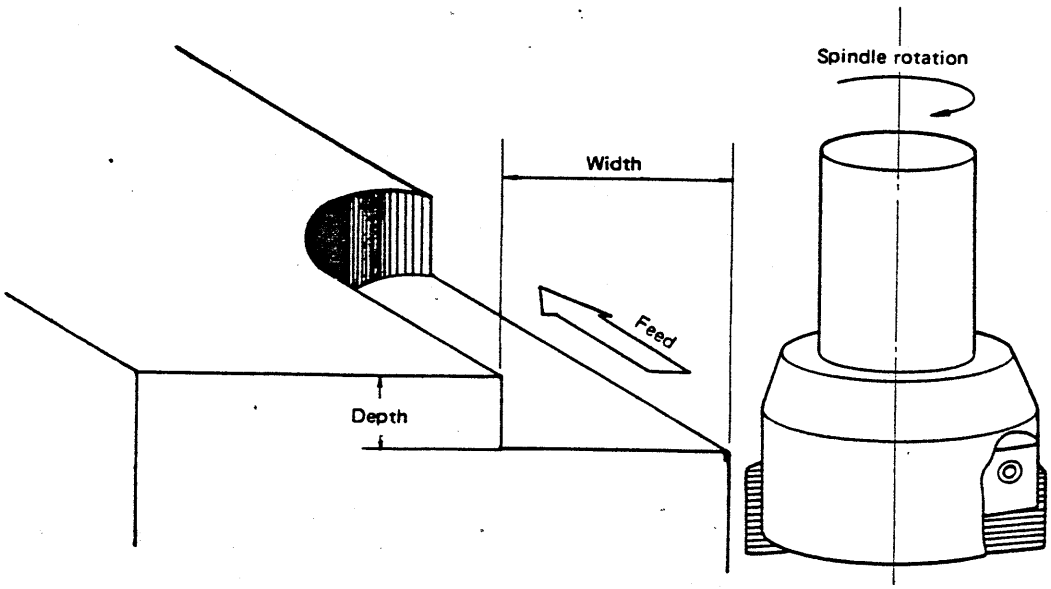






5. Cutting Condition Commanding Method

Cutting conditions should be carefully examined when preparing programs, since these conditions greatly influence cutting efficiency and accuracy.
There are four cutting conditions required for the machining center.



a. Spindle speed (rpm) ..... Directly command rpm after alphabet S.
400 rpm S400

b. Feed rate for cutting (mm/min)
..... Directly command feed rate for cutting after alphabet F.
100 mm/min F100

c. Depth for cutting ..... Command position in Z direction.

d. Width for cutting ..... Command position in X or Y direction.

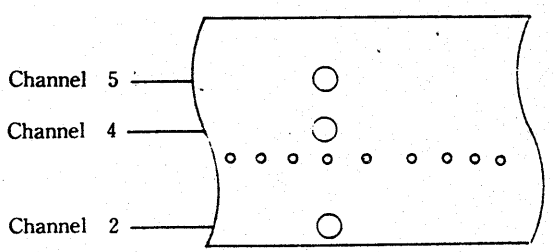
6. Comment Section

Data punched between the control-out and control-in codes, as shown below, are all regarded as comments and cannot be read. TH checks of these comment sections cannot be done. Therefore, indexes, comments, instructions to operators, etc. can be punched in these comment sections according to the desired punch hole arrangement.

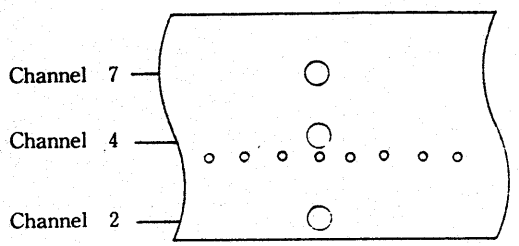
Note that TV Checks in the comment sections can be done.

EIA	ISO	Meaning
2-4-5 *)	(	Control out (start of comment section)
2-4-7 *)	)	Control in (end of comment section)

*) This is punch hole arrangement of EIA code.



Control out

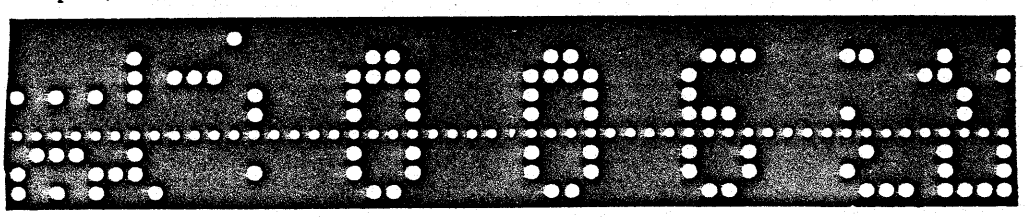


Control in

(Example) Comment in ISO code

```
.............          LF
N1000G00X .....        LF
(MEASURE WORK ....)    LF
N1001G01X .....        LF
.............          LF
```

(Example) Comment used as an index



F1000CR( )N110

Significant data — Tape name, etc. — Significant data

Note 1: Do not use any rewind stop code (% or ER) in comment sections. If used and read, the NC unit is reset.

Note 2: If a long comment section is included in the middle of a program, axis movement may be interrupted for an extended period by the comment section. To prevent this, comment sections must be included at positions where axis movement interruption is permissible or where there is no movement.

Note 3: There is no limit on the length of a comment section.

Note 4: If only a control-in code is read and when there is no preceding control-out code, the control-in code is neglected.

Note 5: There is a parameter (TVC) which cancels TV check for comment sections.

2. PROGRAMMING

1. Tool Function

T functions are used to select tools using the memory random ATC system of this machine.
When a T command is inputted, the magazine automatically turns taking the shorter route, and the specified tool is indexed at the ATC standby position in the magazine.

1.1 Command Method

T functions are commanded using address T and 4-digit number.

Large diameter tool T 9 □□□
Small diameter tool T 0 □□□
Standard diameter tool T 1 □□□ ∿ T 8 □□□
(T functions are classified as T 1 □□□ — T 8 □□□ .)

* Tool diameter

T 0 □□□
T 1 □□□
⋮
T 9 □□□

* Tool number

T □ 0 0 1
T □ 0 0 2
⋮
T □ 0 1 6

o The tool change command (M6) cannot be used together with any other command in one block.

T □□□□CR
M6 CR

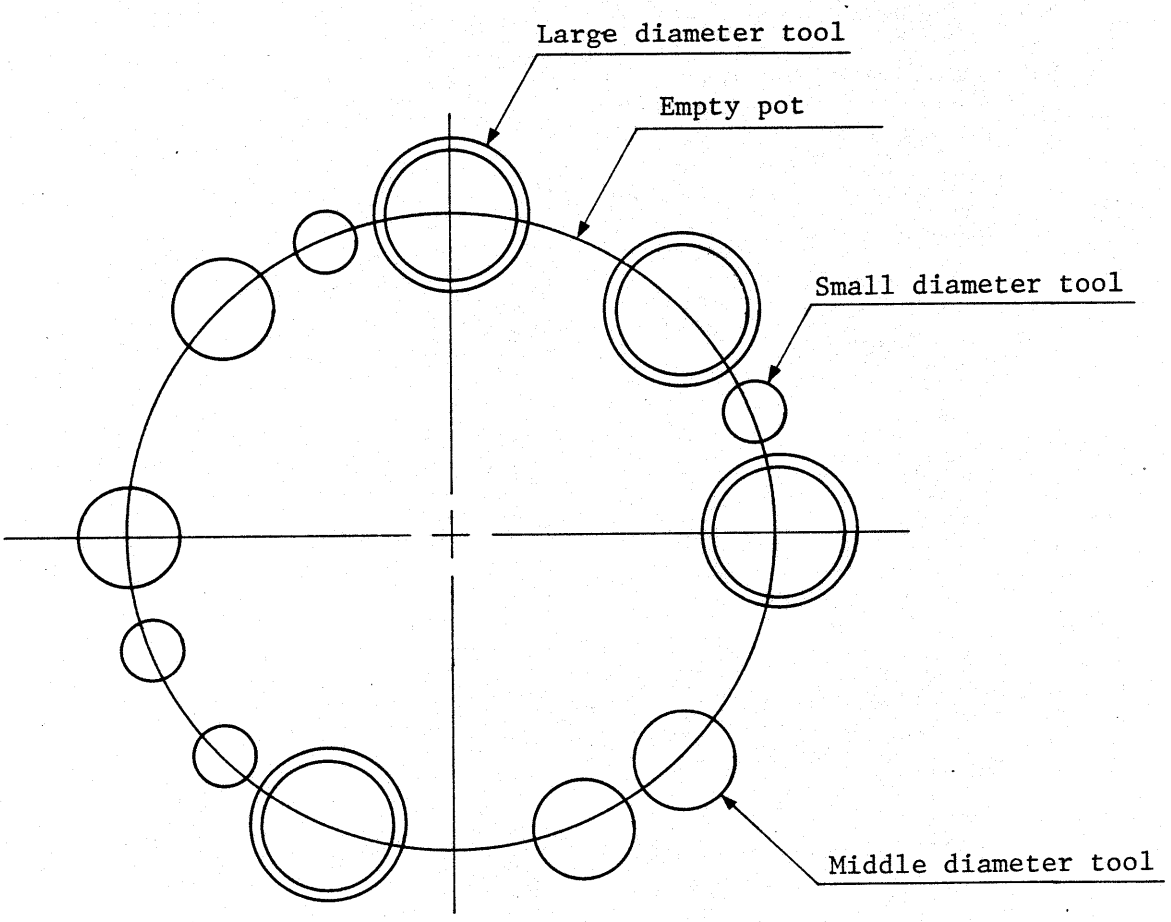
Instead of magazine numbers, tool numbers registered on the tool data display (No. 000 to NO. 0016) for PC parameters are used for tool selection.

1.2 Arrangement of various tools

Tools are not generally returned to their original tool pots since the random memory system is used for tool selection. Therefore, when a large diameter tool whose diameter exceeds the maximum tool pot pitch of 80 mm is used, both tool pots adjacent to the tool must be emptied or loaded with small diameter tools.

When many large diameter tools are used, the tool pots adjacent to the large diameter tools must be loaded with small diameter tools or emptied as shown below.

(Example 1)



1.3 Tool Limit Conditions

The following limit conditions exist regarding tool length, diameter and weight, due mainly to magazine restrictions.

Weight ---------- 7kg
Length ---------- 250mm
Tool pot pitch ---------- 80mm

$$\frac{\text{Dia. of large diameter tool} + \text{dia. of small diameter tool}}{2} < \phi 80$$

* Dia. of large diameter tool is the dia. of the largest diameter of large tool.
  Dia. of small diameter tool is the dia. of the largest diameter of small tool.

2. S Function

° "S" indicates the spindle speed (rpm).
  e.g. 1000 rpm S1000
° Speed command is given at memory operation or M.D.I. operation.
° Standard specification: speed command: 160 to 6,000 rpm
  Optional specification: speed command: 100 to 4,000 rpm or 160 to 10,000 rpm
° Spindle speed: 1 rpm, no change gear

3. M Function

3.1 M00 (temporary program stop)

Command M00 to temporarily stop program.
When the NC unit has read M00, the machine and the NC unit are set to the following conditions.

Machine	NC unit
° The spindle stops rotation ° Coolant supply stops. ° The cycle start lamp remains lighting	M03, M04 and M08 are canceled. G, F and S codes are not affected.

a) The machine can be restarted by pressing the cycle start button.
b) M00 must be commanded using a single block.

3.1.1 Example of use

a) Dimension check

b) Tool check

3.1.2 Program example

```
G01 X200, Y100. Z50.  CR
    M00   CR
G00 S500  M03  CR
```

3.2 M01 Optional Stop

M01 has almost the same function as M00. However, when M00 is commanded, the machine is stopped. When M01 is commanded, machine stop/nonstop can be selected by the operator with an optional switch on the control panel.

- Optional stop switch
  - ON — Stop (valid)
  - OFF — Ignored

a. The machine can be restarted by pressing the CYCLE START button.

b. M01 must be commanded using a single block.

3.2.1 Examples of use

a. Dimension check

b. Tool check

3.2.2 Program example

```
    ⋮
G80  G00  X0 Y0  CR
G91  G28  Z0  M06  CR
     M01
```

3.3 M02 Program End

M02 must be commanded using a single block.

The NC unit is reset, and the program stops.

3.4 M30 Reset & Rewind

a. M30 must be commanded at the end of the program using a single block.

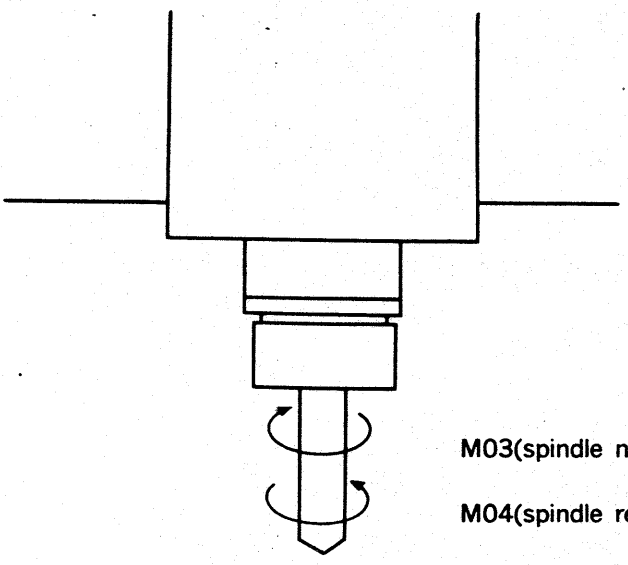
b. The program is completely stopped. All operations stop, and the NC unit is reset.

c. Calls the beginning of the memory. Capable of operation using endless tape.

3.4.1 Program example

```
N0021
G80  M08  T0002  CR
G92  X0  Z0  CR
G90  G43  Z30.  H01  S2000  M03  CR
                    :
                    :        Processing program
                    :
G91  G28  Z0  M06
     M30
```

3.5 M03, M04, M05 Spindle Start/Stop



M03(spindle normal rotation)

M04(spindle reverse rotation)

M05(spindle stop)

a. M03 cancelling command

M00, M01, M02, M04, M05, M06, M19, M30

b. M04 cancelling command

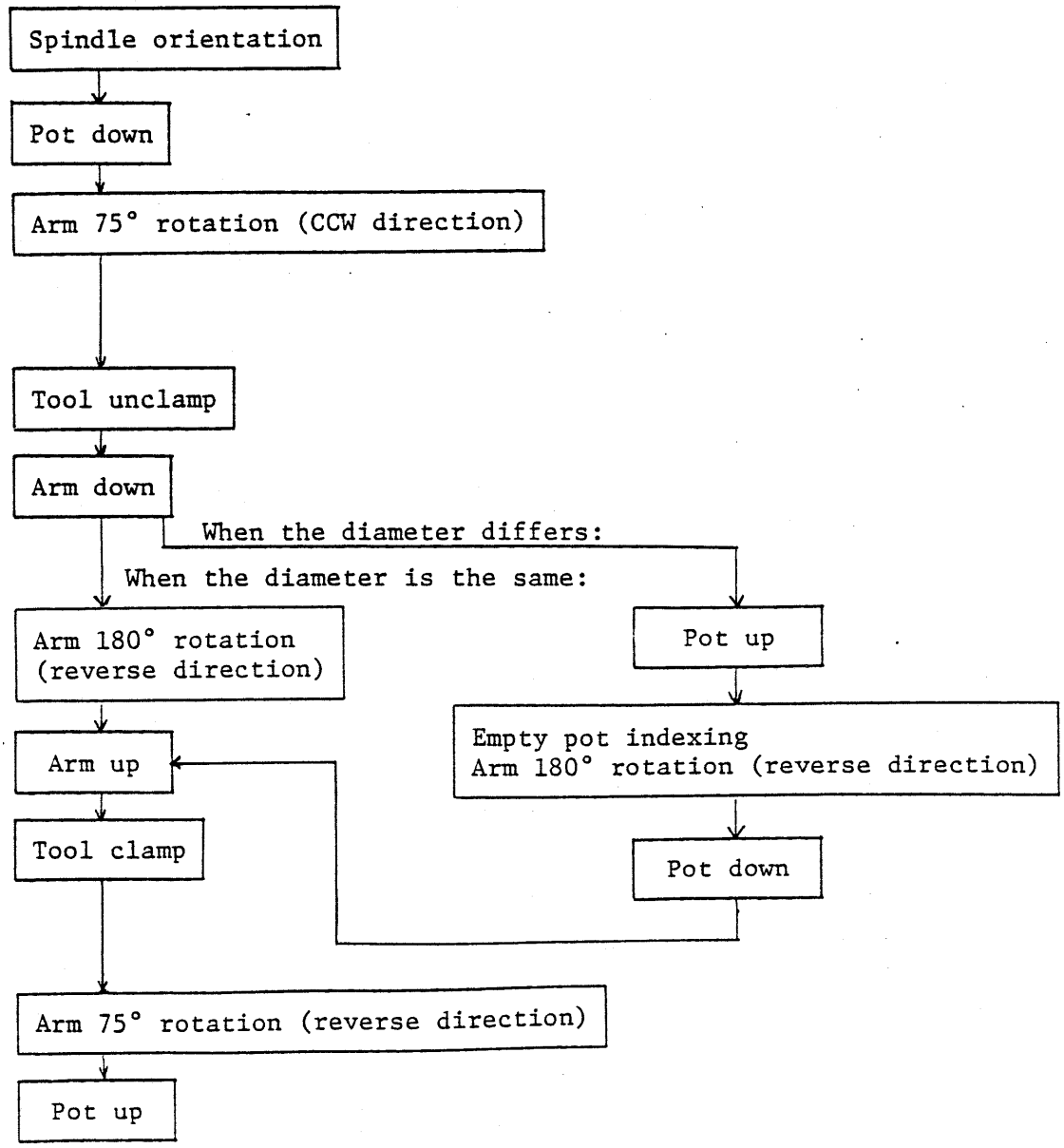
M00, M01, M02, M03, M05, M06, M19, M30

3.6 M06 Tool Change

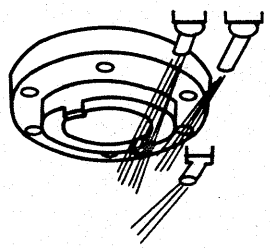
By this command, a series of tool change operation including spindle orientation and tool clamp/unclamp is executed.

Command format G91 G28 Z0 M06 CR

When Z-axis is not at the zero return position as described above, tool change cannot be performed (the ALARM lamp lights).
When M06 is commanded during spindle rotation, the spindle stops automatically, and tool change is executed.
Tools can be changed only when the Y axis is more than 100 mm from the zero return position in the minus side.



3.7 M08, M09 (Coolant Discharge, Stop)



° M08 coolant discharge
Coolant is discharged through 3 ports positioned around the spindle.

° M09 coolant stop

Note: If the coolant OFF button on the control panel is pressed (coolant off lamp ON) during the memory, tape, or MDI operation, coolant will not be discharged even if the machine reads the M08 code but the coolant ON lamp will light.

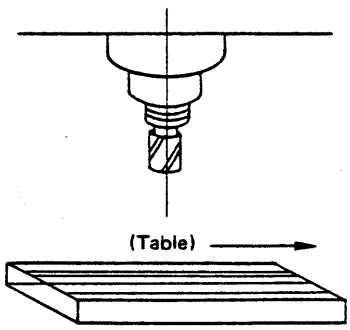
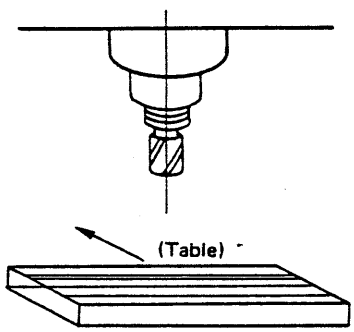
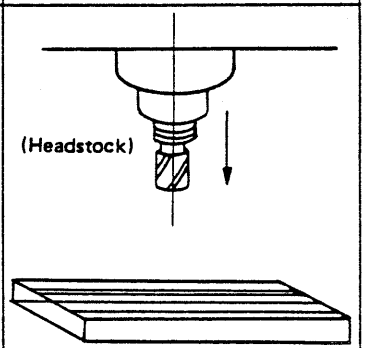
4. G Function

4.1 G00 Positioning

X/Y/Z axes are moved in rapid feed rate to the specified position as commanded by G90/G91.

Command format G00 X_ Y_ Z_ (CR)

- Rapid feed rate: X, Y axis 15000mm/min Z axis 12000mm/min
  Movement passage is not necessarily linear.
- G90 is the absolute command.
  G91 is the incremental command.
- The three axes moves simultaneously.

Command direction	G00 X-__ (direction)	G00 Y-__ (direction)	G00 Z-__ (direction)
Movement of table and spindle head			

(Program example)

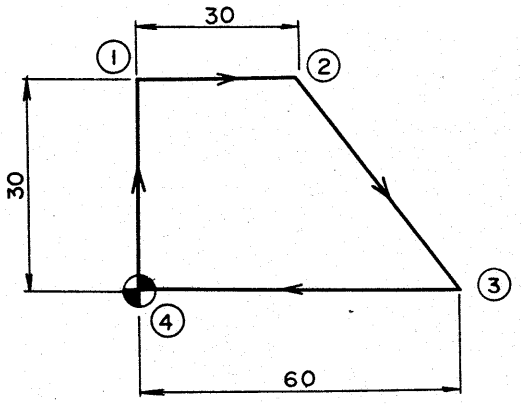
```
N1 ..... Sequence No.
G54 G90 G00 X0 Y0 Z0 ..... Rapid feed to work coordinate
                           system (G54 X0 Y0 Z0) position
X-100. ..... Rapid feed to X-100 position
Y 50. ..... Rapid feed to Y-50 position
G91 Z-30. ..... Incremental command, movement
                command of -30mm in Z direction
X-100. ..... Rapid feed to 100mm in X
             (-) direction
Y 50. ..... Rapid feed to 50mm in Y
            (+) direction
G90 X0 Y0 Z0 ..... Returning to work coordinate
                   system (G54 X0 Y0 Z0)
M30 ..... Program end
```

4.2 G01 (Liner Interporation)

This programming is used for straight cutting. Tool moves in a straight line from the current position to the command position at the rate specified by the F (feed) function.

Programming method	G01	X	Y	Z	F	(CR)

(Programming example)



(Incremental programming)

```
    N1
    G92 X0 Y0 Z0
  1 G91 G01 Y50. F100
  2         X30.
  3         X30. Y-50.
  4         X-60.

    M30
```

(Absolute programming)

```
    N2
    G92 X0 Y0 Z0
  1 G90 G01 Y50. F100
  2         X30.
  3         X60. Y0
  4         X0

    M30
```

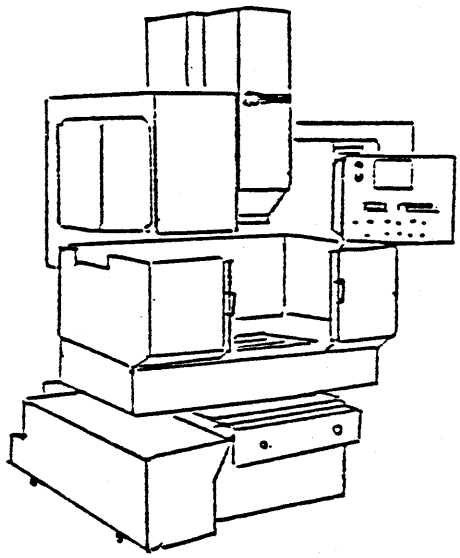
4.3 G17, G18, G19 Plane Selection

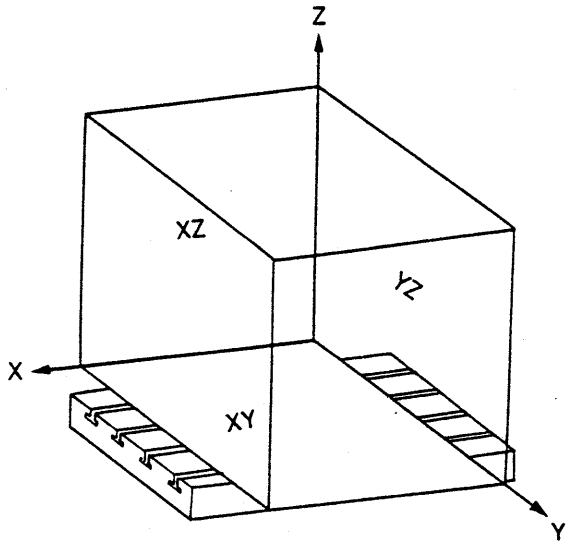
Planes for circular interpolation and tool diameter offset are selected by these commands.

G17 ----- XY plane

G18 ----- ZX plane

G19 ----- YZ plane





Movement commands have no relation to plane selection.

When G17 Z_____ (CR) is commanded, Z-axis is moved.

4.4 G02, G03 Circular Interpolation

The tool moves along a circular passage according to the commanded plane, cutting direction, coordinate system, circular arc size and rapid rate.

Command format

Circular arc on XY plane

$$G17 \left\{ \begin{matrix} G02 \\ G03 \end{matrix} \right\} X\_\_\_\_ \; Y\_\_\_\_ \left\{ \begin{matrix} R\_\_\_\_ \\ I\_\_\_\_ \; J\_\_\_\_ \end{matrix} \right\} F\_\_\_\_ ; \; (CR)$$

Circular arc on ZX plane

$$G18 \left\{ \begin{matrix} G02 \\ G03 \end{matrix} \right\} X\_\_\_\_ \; Z\_\_\_\_ \left\{ \begin{matrix} R\_\_\_\_ \\ I\_\_\_\_ \; K\_\_\_\_ \end{matrix} \right\} F\_\_\_\_ ; \; (CR)$$

Circular arc on YZ plane

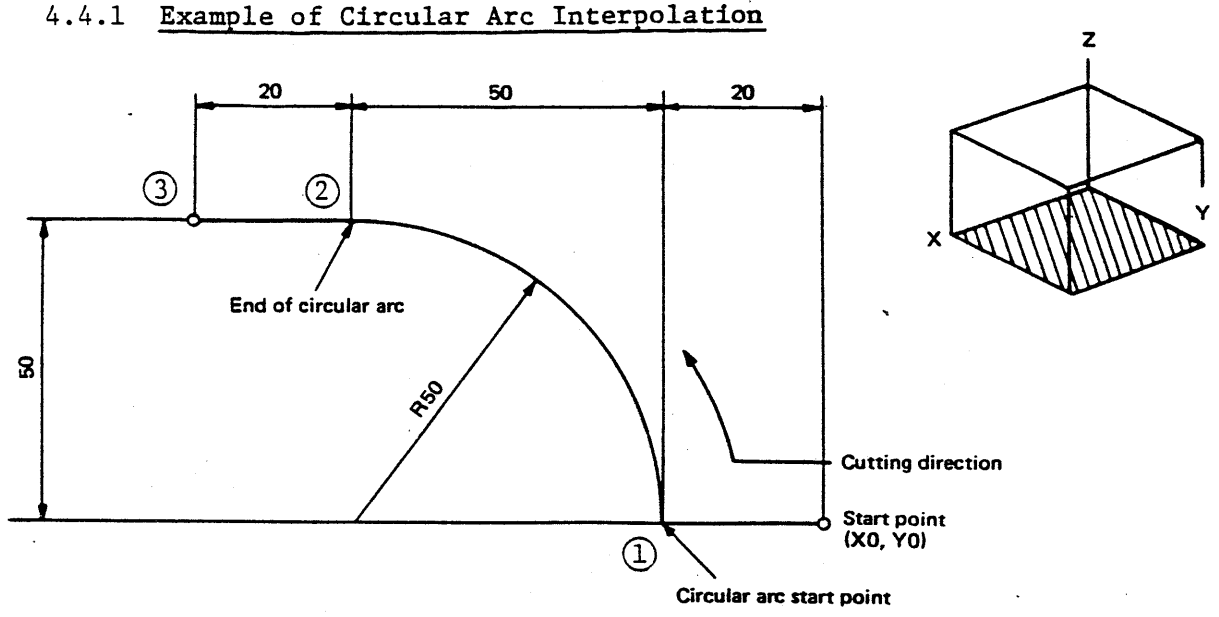
$$G19 \left\{ \begin{matrix} G02 \\ G03 \end{matrix} \right\} Y\_\_\_\_ \; Z\_\_\_\_ \left\{ \begin{matrix} R\_\_\_\_ \\ J\_\_\_\_ \; K\_\_\_\_ \end{matrix} \right\} F\_\_\_\_ ; \; (CR)$$

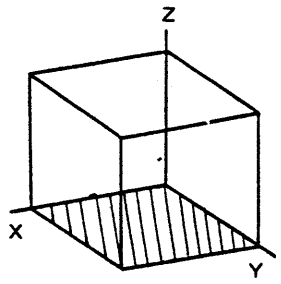
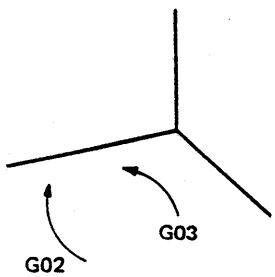
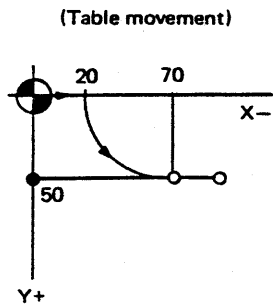
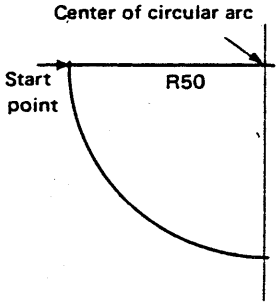
Meaning of code

Designation item			Command	Meaning of Code
1	Plane		G17	Designation of circular arc on XY plane
			G18	Designation of circular arc on ZX plane
			G19	Designation of circular arc on YZ plane
2	Rotating direction		G02	Clockwise (CW)
			G03	Counterclockwise (CCW)
3	End point position	G90 mode	Two of X/Y/Z axes	End point position in work coordinate system
		G91 mode	Two of X/Y/Z axes	Distance from start to end points
4	Distance from start point to center		Two of I/J/K axes	Distance (with +/- sign) from start point to center
	Circular arc radius		R	Circular arc radius

When power is turned on, G17 (XY plane) is designated.

4.4.1 Example of Circular Arc Interpolation



1. Plane designation	2. Rotating direction	3. End point position	4. I/J/K or R
 G17 (XY plane)	 G03 (CCW)	 X-70. Y50.	 I-50 R50

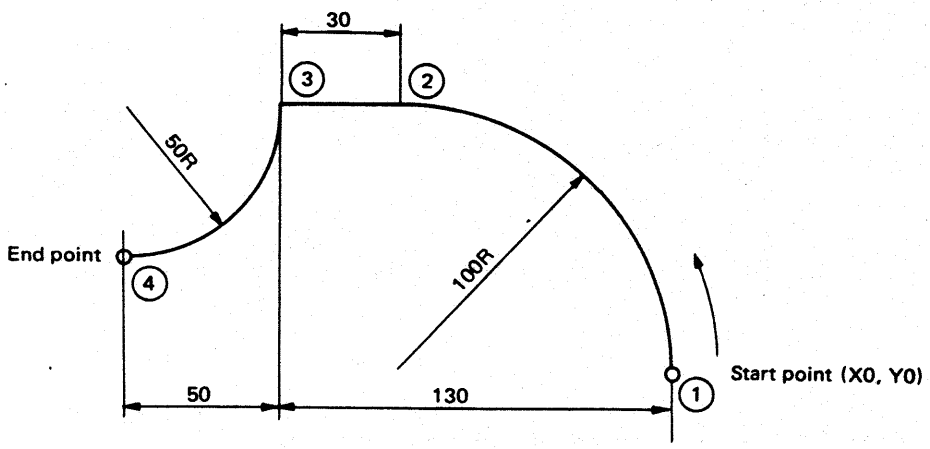
(Incremental command)

```
    N1
    G92 X0 Y0 Z0
①   G91 G01 X-20. F100
②   G17 G03 X-50. Y50. I-50.
③   G01 X-20.
    M02
```

(Absolute command)

```
    N2
    G92 X0 Y0 Z0
①   G90 G01 X-20. F100
②   G17 G03 X-70. Y50. I-50.
③   G01 X-90.
    M02
```

4.4.2 Example of Circular Arc Cutting



(Incremental command)

```
  N1
① G92 X0 Y0 Z0 ---------------- (1) Coordinate system setting
                                    (tool start point)
② G17 G91 G03 X-100. Y100. I-100. F100 --- (2) XY plane, incremental,
                                               circular arc (CCW)
                                               feed command
③ G01 X-30. ------------------- (3) Linear cutting in X direction
④ G02 X-50. Y-50. I-50. ------ (4) Circular cutting (CW)
  M02
```

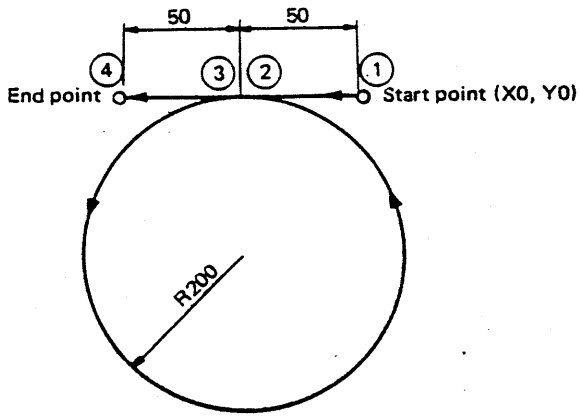
(Incremental R command)

```
  N2
① G92 X0 Y0 Z0
② G17 G91 G03 X-100. Y100. R100. F100
③ G01 X-30.
④ G02 X-50. Y-50. R50.
  M02
```

(Absolute command)

```
  N3
① G92 X0 Y0 Z0
② G17 G90 G03 X-100. Y100. R100. F100
③ G01 X-130.
④ G02 X-180. Y50. R50.
  M02
```

4.4.3 Example of 360° circular Cutting



When X/Y/Z are omitted and I/J/K are used, 360° circular arc (entire circle) cutting is commanded.

$$\left.\begin{matrix}G03\\G02\end{matrix}\right\} \begin{matrix}I\_\_\_\_\\J\_\_\_\_\\K\_\_\_\_\end{matrix} \text{ (CR)}$$

(Incremental command)

```
N1
G92 X0 Y0 Z0 ---------- (1) Coordinate system setting
G91 G01 X-50. F100  ---- (2) Incremental, linear cutting
                             (X direction), feed rate command
G17 G03 J-200. --------- (3) XY plane, CCW circular arc cutting,
                             R200
G01 X-50. ------------- (4) Linear cutting
M02
```

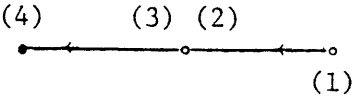
(Absolute command)

```
N2
G92 X0 Y0 Z0 ---------- (1)
G90 G01 X-50. F100  ---- (2)
G17 G03 J-200. --------- (3)
G01 X-100. ------------ (4)
M02
```

(R command)

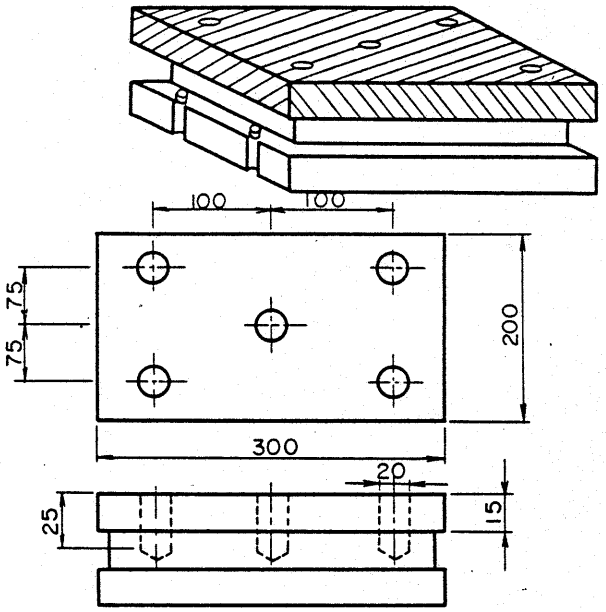
```
N3
G92 X0 Y0 Z0 ---------- (1)
G91 G01 X-50. F100  ---- (2)
G17 G03 R200.---------- (3)
G01 X-50. ------------- (4)
M02
```

- When X/Y/Z are omitted and R is commanded, a circular arc of 0° is commanded, and circular arc passage cannot be obtained.



5. Program Example

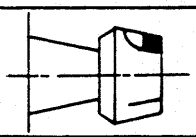
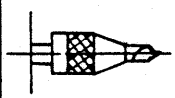
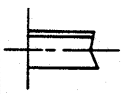
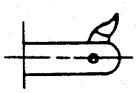
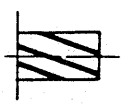
I. Size and shape of cutting, and mounting procedures



Surface to be cut are shaded in the figure at left.

Material Aℓ

5.1 Tool Used

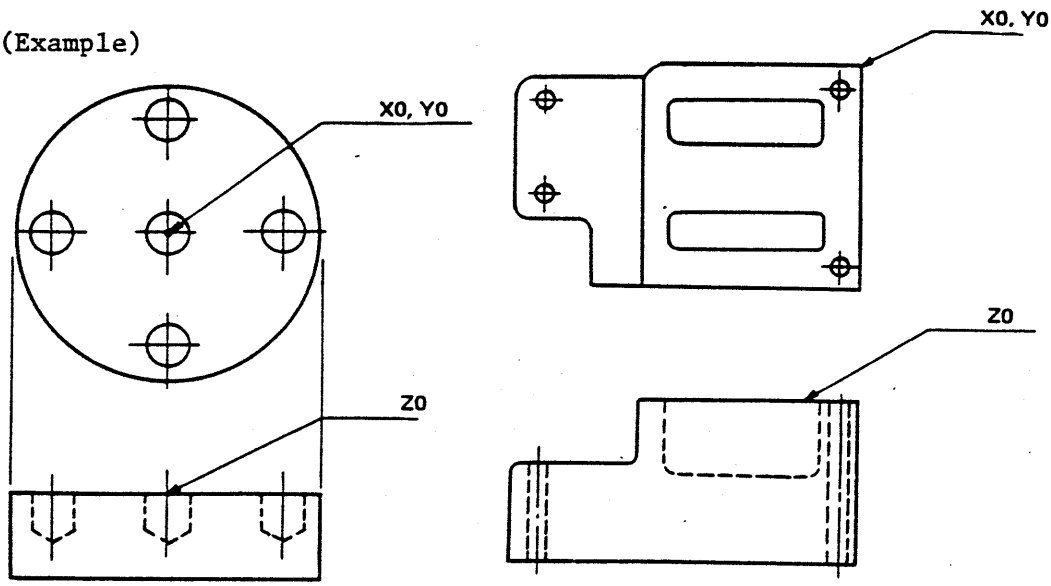
Tool number	Tool	Type of cutting
1	 ϕ80 face mill T 9001	Plane cutting (milling)
2	 Center drill T 0002	Centering
3	 ϕ19 drill T 0003	Drilling
4	 ϕ19.8 end mill T 0004	Preliminary boring
5	 ϕ20 boring T 0005	ϕ20 finishing
6	 ϕ20 end mill T 0006	Circumferential cutting

5.2 Determination of Origin (Cutting Origin) on Program

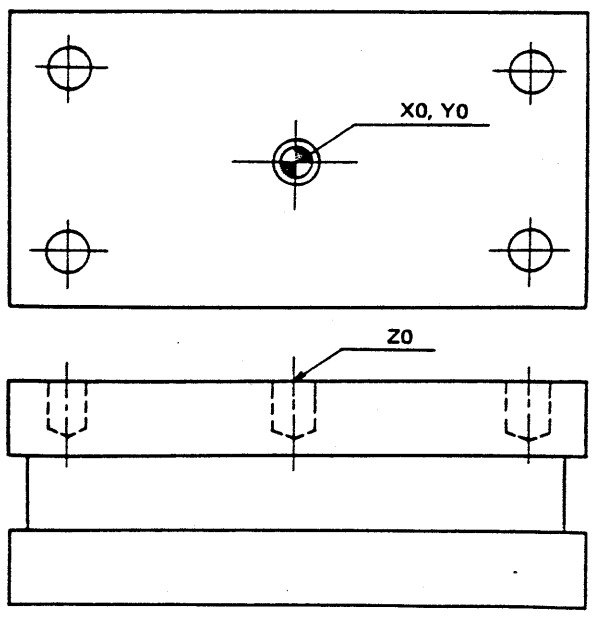
The point of X0, Y0, Z0 is called the origin (cutting origin) and used as the reference point for programming and preparation of processing.

- The cutting origin (X0, Y0, Z0) differs according to various conditions, such as workpiece shape (cylinder, cube, etc.), use/nonuse of jigs and others.
  The origin should be set by the user considering ease of programming and preparation for processing.

(Example)



* The test piece is programmed using the point shown below as the cutting origin.



5.3 Test Piece Program

```
O1 (TEST PIECE)
N1 T2 (80 DIA. FACE MILL)
G54 G90 G0 X200. Y-75. S800 M3
G43 Z50. H1
Z0
G1 X-200. F400
G0 Y-10.
G1 X200.
G0 Y55.
G1 X-200.
G0 Z50.
G91 G28 Z0
G30 Y0 M6
M1

N2 T3 (CENTER DRILL)
G54 G90 G0 X0 Y0 S3000 M3
G43 Z50. H2 M8
G99 G81 Z-5. R2. F200
X100. Y75.
X-100.
Y-75.
X100.
G0 Z50. M9
G91 G28 Z0
G30 Y0 M6
M1

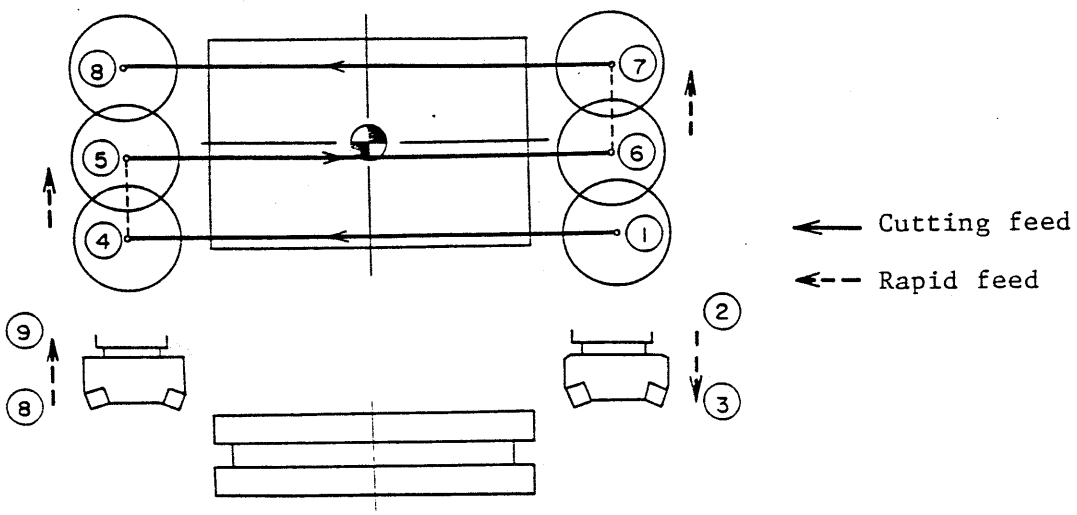
N3 T4 (19 DIA. DRILL)
G54 G90 G0 X0 Y0 S800 M3
G43 Z50. H3 M8
G99 G73 Z-35. R2. Q3. F120
X100. Y75.
X-100.
Y-75.
X100.
G0 Z50. M9
G91 G28 Z0
G30 Y0 M6
M1

N4 T5 (19.8 DIA. END MILL)
G54 G90 G0 X0 Y0 S800 M3
G43 Z50. H4 M8
G99 G73 Z-28. R2. Q3. F120
X100. Y75.
X-100.
Y-75.
X100.
G0 Z50. M9
G91 G28 Z0
G30 Y0 M6
M1

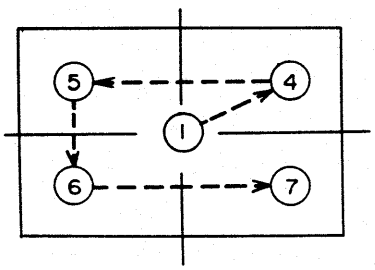
N5 T6 (20 DIA. BORING)
G54 G90 G0 X0 Y0 S3000 M3
G43 Z50. H5 M8
G99 G76 Z-25. R2. I.5 J.2 F150
X100. Y75.
X-100.
Y-75.
X100.
G0 Z50. M9
G91 G28 Z0
G30 Y0 M6
M1

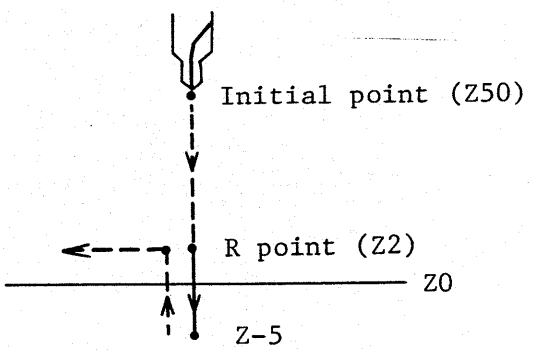
N6 T9001 (20 DIA. END MILL)
G54 G90 G0 X170. Y-120. S800. M3
G43 Z50. H6 M8
G1 Z-20. F2000
G41 Y-100. D26
X-150. F120
Y100.
X150.
Y-105.
G40 G0 Z50. M9
G91 G28 Z0
G30 Y0 M6
M30
```

	O1 (TEST PIECE)	Program number, (title)
	N1 T2 (80 DIA. FACE MILL)	Sequence number; magazine indexing for the next tool T2 (machining with ϕ80 face mill)
1	G54G90GOX200.Y-75.S800M3	Positioning to the X and Y coordinates in the work coordinate system (G54); normal spindle rotation at 800 rpm.
2	G43 Z50. H1	Tool length compensation; offset No. 1; Z axis travel
3	Z0	Lowering to the machining position
4	G1 X-200. F400	Machining to X200 mm at a cutting feed rate of 400 mm/min
5	G0 Y-10.	Rapid feed to the next cutting position
6	G1 X200.	Machining to X 200 mm at a cutting feed rate of 400 mm/min
7	G0 Y55.	Rapid feed to the next cutting position
8	G1 X-200.	Machining to X-200 mm at a cutting feed rate of 400 mm/min
9	G0 Z50.	Rising to Z50 mm in a rapid feed
10	G91 G28 Z0	Z axis zero return by incremental programming
	G30 YO M6	Tool change after reaching the tool change position (This command is not required when the Y coordinate of the tool change position is 100 mm or more away from the zero return position in the minus (-) direction. Command an M6 code independently or command it in the same block for (10).)
	M1	Optional stop



	N2 T3 (CENTER DRILL)	Sequence number; magazine indexing for the next tool T3 (machining with center drill)
1	G54G90G0X0Y0S3000 M3	Positioning to the X and Y coordinates in the work coordinate system (G54); normal spindle rotation at 3,000 rpm.
2	G43 Z50. H2 M8	Tool length compensation; offset No. 2; coolant supply
3	G99 G81 Z-5. R2. F200	R point level return; drill cycle command; feed rate of 200 mm/min
4	X100. Y75.	Execution of the drill cycle after positioning in the X and Y axes
5	X-100.	
6	Y-75.	
7	X100.	
8	G0 Z50. M9	Fixed cycle cancel; rising to Z50 mm in rapid feed; coolant supply stop
9	G91 G28 Z0	Z axis zero return by incremental programming
	G30 Y0 M6	Tool change after reaching the tool change position (This command is not required when the Y coordinate is in the tool change position. Command an M6 code independently or command it in the same block for (9).)
	M1	Optional stop

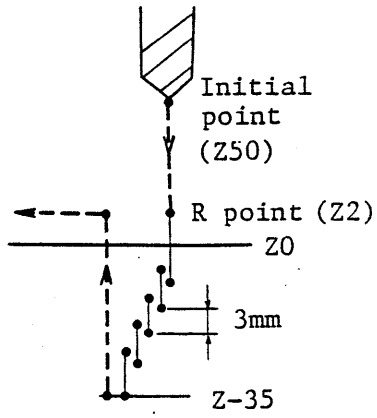




N3 T4 (19 DIA. DRILL)	Sequence number; magazine indexing for the next tool T4 (machining with ϕ19 drill)
G54G90G0X0Y0S800 M3	Positioning to the X and Y coordinates in the work coordiante system (G54); normal spindle rotation at 800 rpm.
G43 Z50. H3 M8	Tool length compensatipn; offset No. 3; coolant supply
G99 G73 X-35. R2. Q3. F120	R point level return; high speed deep hole drilling cycle; feed rate of 120 mm/min

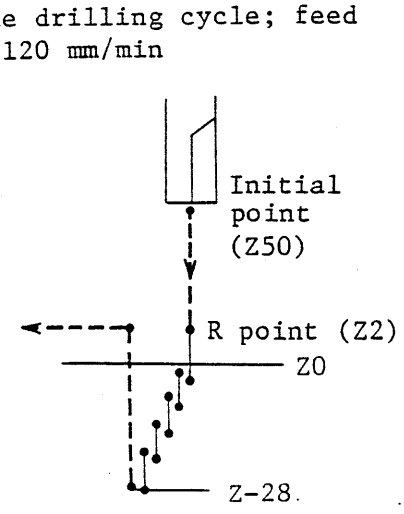
X100. Y75. .....
X-100. .....
Y-75. .....
X100. .....
G0 Z50. M9 .....
G91 G28 Z0 .....
G30 Y0 M6 .....
M1 .....

The same as for machining with a center drill



N4 T5 (19.8 DIA. END MILL)	Sequence number; magazine indexing for the next tool T5 (machining with ϕ19.8 end mill)
G54G90G0X0Y0S800M3	Positioning to the X and Y coordinates in the work coordinate system (G54); normal spindle rotation at 800 rpm.
G43 Z50. H4 M8	Tool length compensation; offset No. 4; coolant supply
G99 G73 Z-28. R2. Q3. F120	R point level return; high speed deep hole drilling cycle; feed rate of 120 mm/min

X100. Y75.
X-100.
Y-75
X 100.
G0 Z50. M9
G91 G28 Z0
G30 Y0 M6
M1



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N5 T6 (20 DIA. BORING) ..... Sequence number; magazine indexing
                             for the next tool T6 (machining
                             with ϕ20 boring drill)
G54G90G0X0Y0S3000 M3 ..... Positioning to the X and Y coordi-
                           nates in the work coordinate sys-
                           tem (G54); normal spindle rotation
                           at 3,000 rpm.
G43 Z50. H5 M8 ..... Tool length compensation; offset
                     No. 5; coolant supply
G99 G76 Z-25. R2. J. 1 F150 ... R point level return; fine boring;
                                feed rate of 150 mm/min
X100. Y75.
X-100..
Y-75.
X100.
G0 Z50. M9
G91 G28 Z0
G30 Y0 M6
M1
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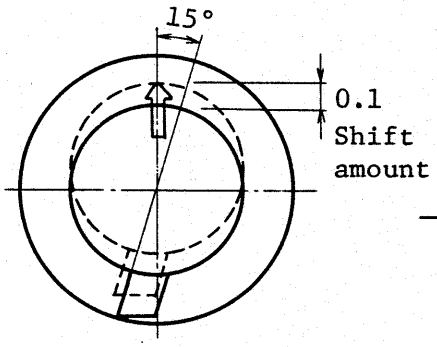
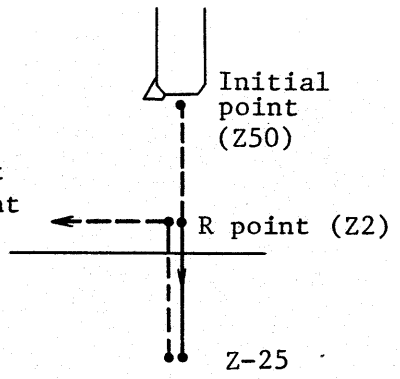


Orientation position

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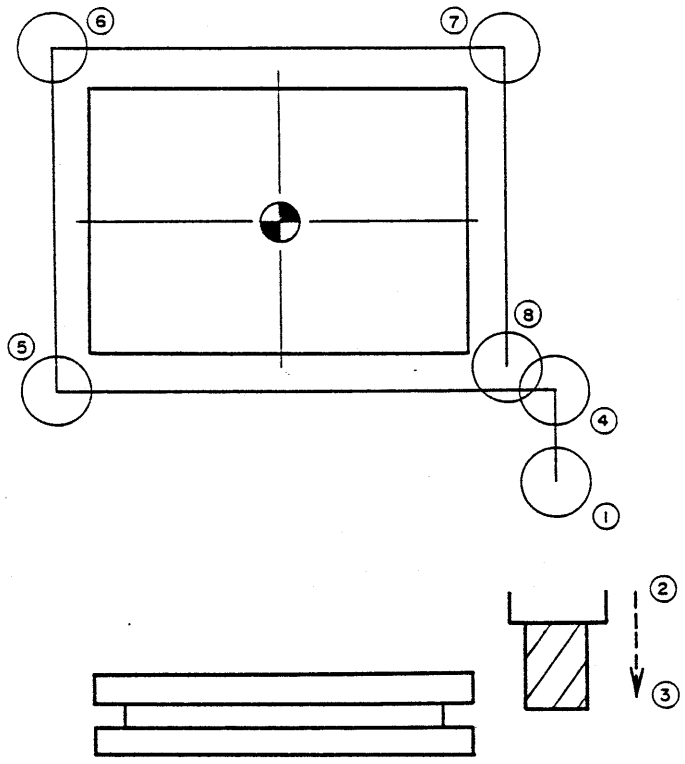
N6 T9001 (20 DIA. END MILL) ... Indexing for the first tool (ϕ20
                                end mill)
 1 G54 G90 G0 X170. Y-120. S800 M3
 2 G43 Z50. H6 M8 ..... Tool length compensation; offset
                        No. 6
 3 G1 Z-20. F2000
 4 G41 Y-100. D26 ..... Tool diameter compensation (left
                        side); offset No. 26
 5 X-150. F120
 6 Y100.
 7 X150.
 8 Y-105.
 9 G40 G0 Z50. M9 ..... Tool diameter compensation cancel;
                        rising of Z axis
10 G91 G28 Z0
   G30 Y0 M6
   M30 ..... Program end
```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