CAK63d SERIES   CNC LATHES

CAK80d SERIES   CNC LATHES

INSTRUCTION BOOK

(For Electrical Unit)

CNC System：FANUC 0i (Mate)-TD

SHENYANG NO.1 LATHE WORKS

SHENYANG MACHINE TOOL CO., LTD

THE PEOPLE′S REPUBLIC OF CHINA

IT IS NECESSARY FOR YOU TO READ THIS BOOK CAREFULLY AND THOROUGHLY BEFORE OPERATING THE MACHINE.

THE CHINESE VERSION OF THIS TECHNICAL DOCUMENT IN ENGLISH IS REGARDED AS FINAL.

Explanations for product models mentioned in this Instruction Book:

CAK63d series: CAK6360d, CAK63135d, CAK63285d, CAK6360di, CAK63135di

CAK80d series: CAK8060d, CAK80135d, CAK80285d, CAK80485d, CAK8060di,
         CAK80135di
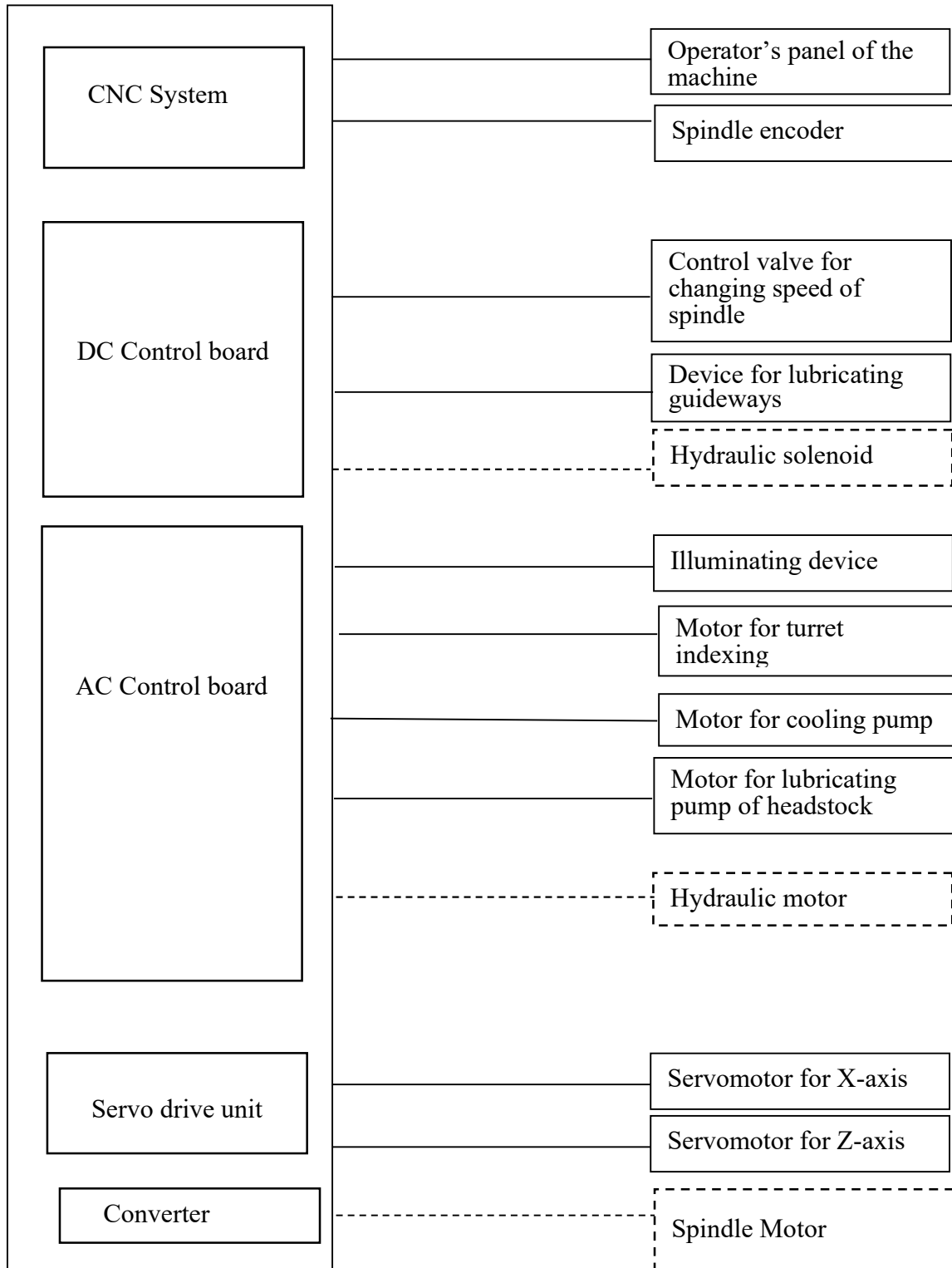
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1.2 Table of Basic Performance of CNC System

| Main Performance	Target
CNC system	FANUC 0i Mate-TD
Min. command unit	0.001mm
Max. programming size	9999.999mm
Capacity of workpiece program	512K
Absolute/Incremental program	X, Z /U, W
Straight/Circular interpolation	●
Metric thread	●
Chamfering at the end of threads	●
Canned cycle	●
Combination cycle	●
Subprogram call (4 steps)	●
Conversion of Metric and Inch	●
Tool compensation	●
Tool tip radius compensation	●
Feed/rev., feed/min.	●
Control of constant linear speed	●
Clearance compensation	●
Compensation of pitch error	●
Parallel shift of work coordinate	●
Return reference point	●
Protection of software over-travel	●
RS232C Communication	●
User's macro-program B	●
Background edit	●
Function of pictures	●
Memory card interface	●
Conversational programming	●
Direction program for dimension of picture	●
Display device	LCD display
Feed drive device	FANUC servo unit

● : Basic function

1.3 List of Motors Used for the Machine

No.	Name	Specification		Remarks
1	Spindle motor	CAK63d（di）	YVP132M3-4-B3	For frequency-changing spindle with change speed
		CAK80d（di）	YPNL-50-15-4-B3	
2	Motor for turret indexing	YLJR9.4-6		
3	Motor for lubricating pump of headstock	Y802-4-B3 750W 1450 r /min		
4	Motor for cooling pump	YWP-18G		
5	Hydraulic motor	Y90L-4-B5 1.5 kW 1500 r/min		Optional
6	Servo motor for X-axis	FANUC β iS12/2000 1.4 kW		Machine spec:750-3000MM
7	Servo motor for Z-axis	FANUC β iS22/2000 2.5 kW		
8	Servo motor for X-axis	FANUC α iF12/3000 3.0 kW		Machine spec:5000MM
9	Servo motor for Z-axis	FANUC α iF30/3000 7.0 kW		

1.4 Operator′s Panel of the Machine

1.4.1 Arrangement Diagram of Operator′s Panel (63d/80d)
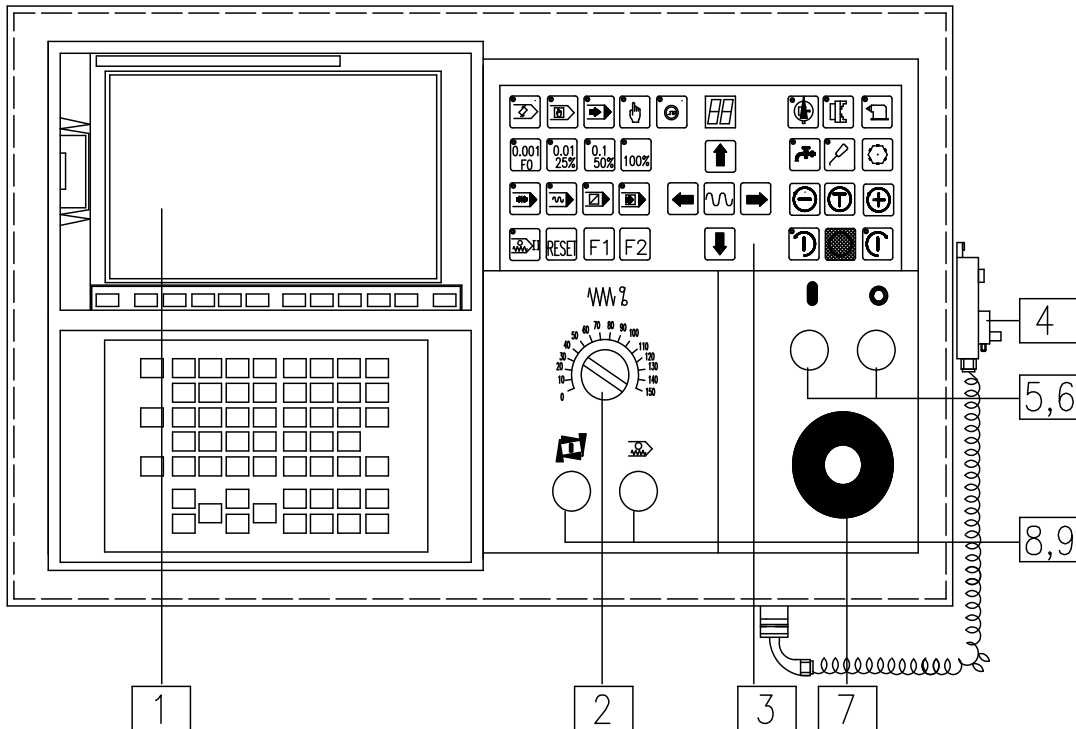
1. Display and keyboard of CNC device

2. Feed override switch

3. Operation keyboard of the machine

4. Hand unit

5. Button of power on of CNC device

6. Button of power off of CNC device

7. Emergency stop button

8. Cycle start key

9. Button for feed dwell

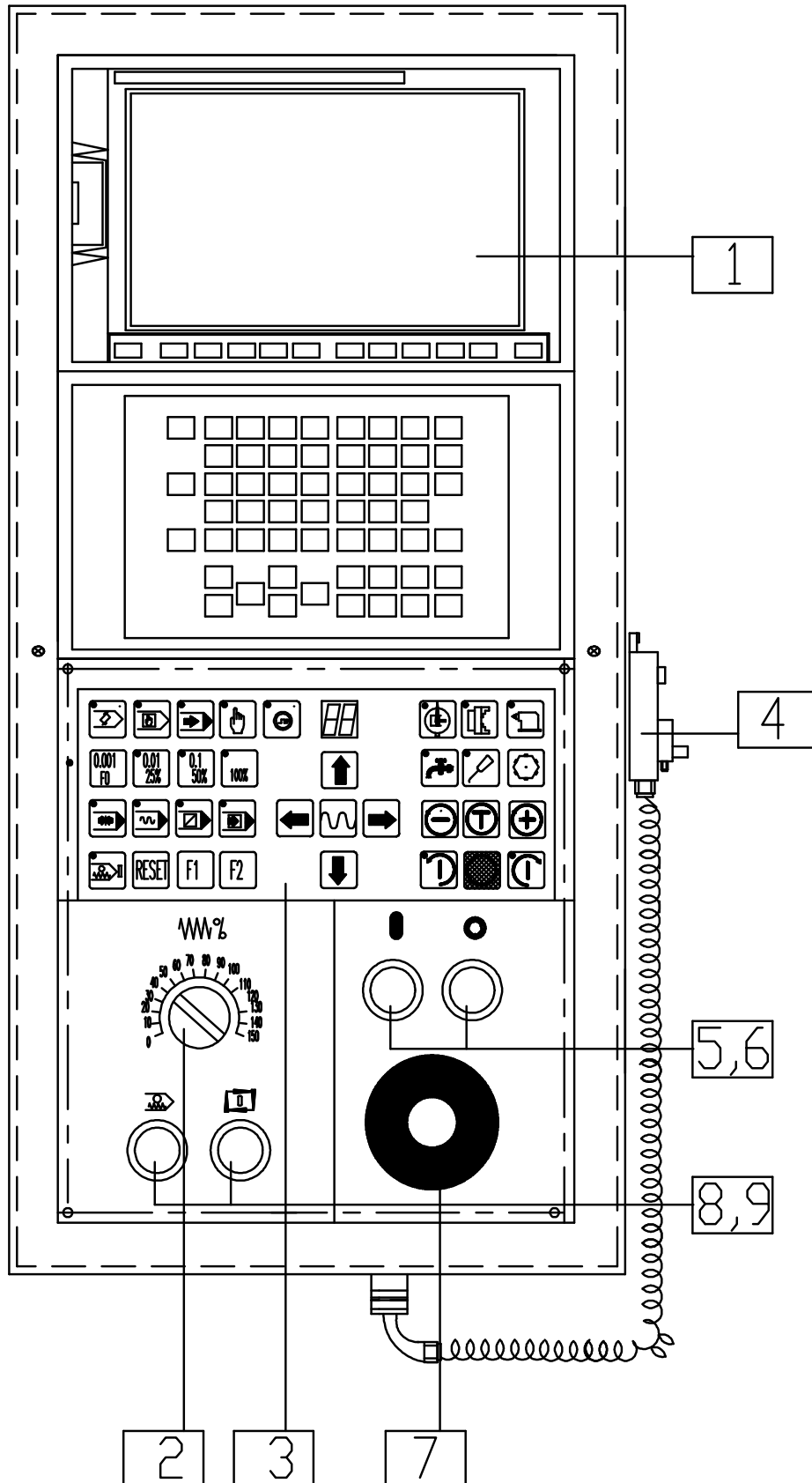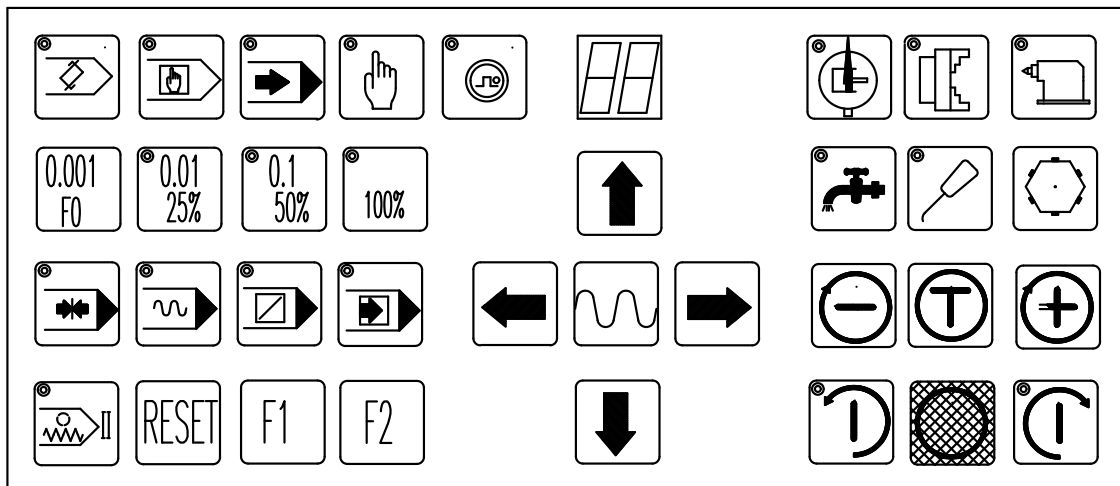## 1.4.2 Arrangement Diagam of Operator's Panel (63di/80di)

1. Display and keyboard of CNC device

2. Feed override switch

3. Operation keyboard of the machine

4. Hand unit

5. Button of power on of CNC device

6. Button of power off of CNC device

7. Emergency stop button

8. Cycle start key

9. Button for feed dwell

1.4.3 Arrangement Diagram of Operation Keyboard
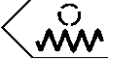
1.4.4 Table of Functions of Operation Keyboard

No.	Symbol	Name	No.	Symbol	Name
1		Edit mode	20		Negative jogging of X-axis
2		MDI mode	21		Positive jogging of X-axis
3		Auto mode of storage program	22		Negative jogging of Z-axis
4		Manual feed mode	23		Positive jogging of Z-axis
5		Handwheel pulse mode	24		Manual rapid speed
6	0.001 1%	Min. unit of Handwheel pulse G00 speed F0	25		Manual selection of tool
7	0.01 25%	Handwheel pulse unit 0.01mm G00 speed override 25%	26		ON/OFF of coolant manually
8	0.1 50%	Handwheel pulse unit 0.1mm G00 speed override 50%	27		ON/OFF of manual lubrication
9	1 100%	G00 speed override 100%	28		Clamping/releasing of chuck
10		Single segment	29		Advancing/withdrawing of tailstock
11		Optional segment skip	30		Start/stop of hydraulic device
12		Dry run	31		Manual spindle reverse
13		Locking of machine	32		Manual spindle forward
14		Feed hold II	33		Manual spindle jog
15	RESET	Outer reset	34		Manual spindle stop
16	F1	Standby	35		Manual speed-up of spindle
17	F2	Door switch	36		Manual retarding of spindle
18			37		(Left) Display of speed step of spindle (Right) Display of current tool No.
19			38		

1.4.5 Buttons on the Operator's Panel

Number	Symbol		Name	Number	Symbol	Name
5	NC	▮	Power-on of CNC system	2		Feed override switch
6		○	Power-off of CNC system	7	●	Emergency stop button
8		▮	Cycle start			
9		⌇	Feed hold			

1.5 Soft Keys

1.5.1 Screen of Soft Keys

KEYON	OFF	ON		Program Protection
HION	OFF	ON		Handwheel interruption
CHUKIN	OFF	ON		Internal/external clamp of chuck
TLPULL	OFF	ON		Tightening of tailstock
M01	OFF	ON		Selective-stop valid
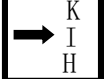
Screen of soft keys   **Name of soft keys**

1.5.2 Operation of Soft Keys

❶ Press `OFFSET SETTING` key, then `▷` on the LCD screen to select screen `[OPR]`,

following, press `PAGE ↓` key, coming into soft key screen.

❷ Press `CURSOR ↓` key，to select some switch.

❸ Pressing `→ K I H` key can right move the mark "■" to the front of ON, showing

this switch has been switched on.

❹ Pressing $\boxed{\leftarrow\begin{array}{c}B\\C\end{array}}$ key can left move the mark " ■ " to the front of OFF, showing this switch has been switched off.

1.5.3 Functions of Soft Keys

No.	Ab.	Name	Functions
1	KEYON	Program protection	Program edit and parameter setting can be done at the position ON.
3	HION	Handwheel interruption	Under Auto. mode, handwheel pulse generator is also valid when at the position ON; at this moment, there is prompt information displayed on the screen.
4			
5	CHUKIN	Selection of chuck	When at the position OFF, hydraulic chuck is under status of internal clamp and at the position ON, the hydraulic chuck under status of external clamp.
6	TLPULL	Selection of tailstock	When at the position OFF, the center of hydraulic tailstock advances to be tightening, and at the position ON, the center of hydraulic tailstock withdraws.
7	M01	Selective stop	When at the position ON, selective stop is valid; When at the position OFF, selective stop is invalid.

1.6 Coordinate Axes and Setting of Coordinate System

● The machine has two feed axes and adopts transmitting structure for AC servomotor to drive ball leadscrew to obtain plane continuous path movement.

Longitudinal feed axis is in parallel with spindle and it is called Z-axis (feed), and

the direction pointing at tailstock is positive direction.

Traverse feed axis is perpendicular with X-axis and it is called X-axis (feed), direction of away from workpiece is positive direction.
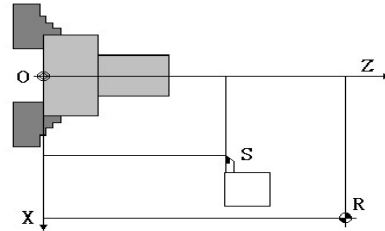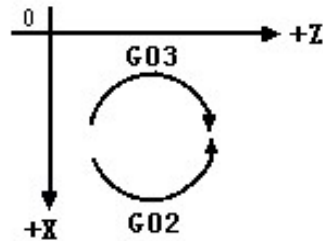
- In order to describe moving position and moving path of tool tip, first, it is necessary to establish a coordinate system on a certain point on workpiece which is chucked on the machine, then, edit program workpiece to be turned according to certain rules and on the basis of some points of tool movement path. The two axes of workpiece coordinate system are separately parallel with two feed axes of the machine. The axis parallel with longitudinal feed axis is called Z (coordinate) axis, and that parallel with traverse axis is called X (coordinate) axis. Direction of coordinate axis is always in keeping with that of feed axis.

Point coordinate (X、Z) is referred to as absolute coordinate.Using absolute coordinate to program is called absolute programming. To use absolute programming, first, it is necessary to set coordinate system, that is, set the origin of coordinate system to a specified position.In normal case, z-axis is set on the rotary center of spindle and x-axis is set to position on chuck endface, workpiece endface,etc..

Point S shown in the right figure on last page is a original position for turning. Coordinate value set by G50 is the coordinate value of the point S. Point R is reference point of the machine.

- Programming mode of not using absolute coordinate and displacement amount of using new position to present position is called incremental programming. In general, there are two methods to obtain incremental programming. The standard method of the machine is (U, W) address mode, U is increment of X-direction, and W is increment of Z-direction.

- For this machine, both the absolute programming and the incremental programming can be used, and combination programming is also used.

- Diameter programming is used in the direction of X-axis of the machine, therefore, programmed value X (U) is two times of practical coordinate value, coordinate value of X-axis displayed on screen is also two times of practical value, but movement amount of tool is only half of programmed value.

- Direction commanded by circular interpolation G02, G03 is shown by the above figure.

Setting method of mechanical coordinate system:

Owing to the machine′s servo systems of two axes use absolute position encoders, these encoders possesses memory function, the reference point return had been completed before delivery of the machine and the mechanical coordinate system had been also established, the coordinate system is kept by memory function of the encoder. User needn′t to perform the job of reference point return after power-on every time when using the machine. If the reference point is lost due to mal-voltage of the batteries or the relative position of the servo motor shaft to X/Z leadscrews is changed to result in the position of the reference point of the machine is also changed when the machine is maintained, although the system does not give alarm, it is still necessary to return reference point.

Under the manual mode, move the carriage of the machine to the starting point of the reference-point return to lose the reference point (refer to 3.1.6 in this Instruction Book), and set the parameter 1815.4 to 0.

Select the reference-point return mode and the movement direction of axis, and then annually return to reference point.

The specific setting method and position is shown as follows:
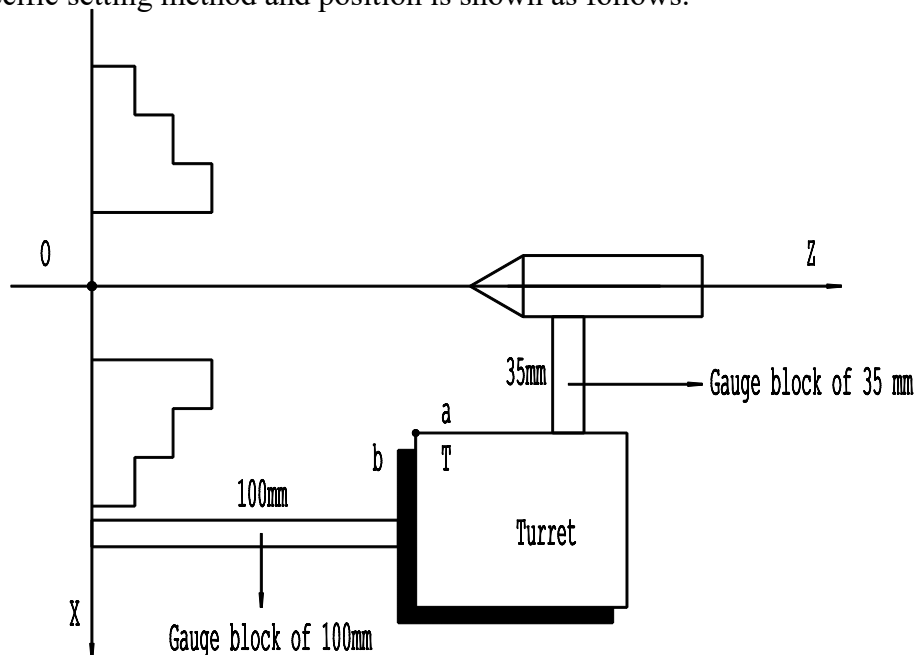
Setting method of reference point Z-axis:

❶ Move the carriage of the machine manually to the position shown in the figure to make the one end of gauging block of 100mm fully touch with the endface of chuck and the other end touch with the endface "B" of tool post, the filler gauge of 0.04mm is not inserted into.

❷ Take out the filler gauge, then move the carriage of the machine along +Z direction for 400mm, entry 500000 into the set position of Prm.1240 Z-axis.

❸ Set the set value of Z-axis in Prm.1815.4 to 1. Thus, after power-off, then power-on of NC till this, setting of the reference point of Z-axis is completed.

Setting method of referent point for X-axis:

❶ Move the carriage of the machine manually to the position shown in the figure to make the one end of gauging block of 35mm fully touch with the endface of chuck and the other end touch with the endface "a" of tool post, the filler gauge of 0.04mm is not inserted into.

❷ Take out the filler gauge, then, move the carriage of the machine along +X direction for 305mm (diameter value), entry 450000 into the set position of Prm.1240 X-axis.

❸ Set the set value of X-axis in Prm. 1815.4 to 1, thus, after power-off, then power-on of NC till this setting of the reference point of X-axis is completed.

■ Coordinate system is not set by command G50 after it is established by help of this method. Only without accompanying or trouble, the position anywhere the tool moves tallies with the position displayed by absolute coordinate, thereby, as long as without interference, the tool can start program to turn workpiece at any position.

■ If set coordinate system by G50 after it is automatically set through returning reference point, the coordinate system set by G50 is priority.

Setting method of coordinate system of workpiece:

Edit command G50 in program.

Format: G50 X α Z γ .

❶ Select reference tool (Ex. Tool No.1)

❷ Move the tool No.1 to nearby workpiece manually to cut endface of workpiece, then move it away from the workpiece along X-axis direction. Reset (clear) the position coordinate W.

❸ Turn O.D. of workpiece manually. Then, move the tool away from the workpiece along Z-axis direction. Reset the position coordinate U and measure value D of 0. D. of   workpiece.

❹ Move the carriage manually until U= α -D, W= γ -L are displayed.("L" is a distance from coordinate′s origin to trial-turning endface of workpiece.)

1.7 Code Table of G Commands

Code	Group	Function	Remark
G00		Positioning of rapid travel	
G01	01	Linear interpolation	
G02		Circular interpolation (CW)	
G03		Circular interpolation (CCW)	
G04	00	Dwell	
G18	16	Selection of ZX plane	
G20	06	Inch input	
G21		Metric input	
G27		Check of reference point return	
G28	00	Reference point return	
G30		Second reference point return	
G32	01	Thread cutting	
G40		Cancel compensation of tool tip radius	
G41	07	Left compensation of tool tip radius	
G42		Right compensation of tool tip radius	
G50	00	Coordinate system setting/setting of spindle speed limitation	
G70		Finishing cycle	
G71		Roughing cycle of external cylinder surface	
G72		Cycle of roughing end face	
G73	00	Canned turning cycle	
G74		Cycle of drilling deep-hole on end-face	
G75		Grooving cycle of on OD, I D.	
G76		Combination cycle for cutting thread	
G90		Canned cycle for traverse cutting	
G92	01	Canned cycle for cutting threads	
G94		Canned cycle for cutting end-face	
G96	02	Constant linear speed control	
G97		Cancel of constant linear speed	
G98	05	Feed/min.	
G99		Feed/rev.	

Notes: 1. G codes in Group 00 are non-model and they are effective only segments in which they are specified.

2. Alarm occurs if G codes which are not listed in the table mentioned above are specified.

3. Codes in a few different groups can be specified in the same block. The last code is valid if codes in many different groups are specified.

4. The system is under this G code state when symbol "▼" shows switch-on.

1.8 Code Table of M Commands

Code	Function	Remarks
M00	Unconditional stop of program	
M01	Conditional stop of program	
M02	End of program	
M03	Spindle forward	
M04	Spindle reverse	
M05	Spindle stop	
M08	Coolant ON	
M09	Coolant OFF	
M30	End of program and return to program beginning	
M40	Spindle neutral step	
M41	Spindle step Ⅰ	
M42	Spindle step Ⅱ	
M43	Spindle step Ⅲ	
M44	Spindle step Ⅳ	
M50	Valid of chamfering at the end of threads	During the square-angle transition, the turning process will pause for a while.
M51	Invalid of chamfering at the end of threads	
M52	Valid of error test	Only valid while executing G92 and G76
M53	Invalid of error test	
M98	Subprogram call	
M99	Subprogram return	

1.9 Code Table of T Commands

T commands are comprehensive commands of tool selection and tool compensation, and they consist of T+4 digits.

Format：**T▲▲●●**

▲▲: Tool No., from 01 to max. tool number of turret, more than this max. number is not allowed.

●●: Unit No. of tool compensation, from 01 to 32. 00 can be specified, which presents cancel of tool compensation. Tool No. and tool compensation No. can be freely combined. Each tool can use tool compensation unit of many groups.

Code	Function	Remarks
T0100	Selection of tool No.1	
T0200	Selection of tool No.2	
T0300	Selection of tool No.3	
T0400	Selection of tool No.4	
T0500	Selection of tool No.5	Only for 6,8-station turret
T0600	Selection of tool No.6	
T0700	Selection of tool No.7	Only for 8-station turret
T0800	Selection of tool No.8	

For example, select No.2 tool and ready for using tool compensation unit of group 3 to compensate No.2 tool, it is necessary to edit statement T0203 at proper position of program.

2   FEEDING (POWER-ON) OF THE MACHINE

2.1 Major Technical Requirements of Electrical Unit of the Machine

No.	Name of Equipment		Specification	Remarks
1	General power of the machine		30kW	
2	General current of the machine	Power supply of 380V	60A	For more than 380V the electrified wire netting is the same as that of 380V
	General fuse of user's power supply	Power supply of 380V	120A	
3	General current of the machine	Power supply of 220V	100A	For 220V
	General fuse of user's power supply	Power supply of 220V	200A	
4	Wire system		3-phase 4-wire	
5	Voltage of electrified wire netting		Basic 3-phase; 380V	
6	Allowed fluctuating range of voltage of electrified wire netting		±10%	
7	Frequency of electrified wire netting		50Hz	Optional: 60Hz
8	Allowed fluctuating range of frequency of electrified wire netting		±1%	
9	Temperature of working environment		0°C~45°C	
10	Relative humidity		Less than 75%	
11	Vibration（when operating）		Less than 0.5G	
12	Control voltage	AC	AC 110V	
		DC	DC 24V	
13	Illuminating voltage/capacity		AC 220V	
14	Voltage and capacity of CNC system		DC 24V/100VA	
15	Voltage and capacity of servo amplifier		AC 210V/4.2KVA	Machine spec:750-3000MM
			AC 210V/6.0KVA	Machine spec:5000MM

2.2 Basic Requirements before Power-on of the Machines

● Feeding (power-on) of electrical system of the machine must employ 3-phase, 4-wire

(3 phase wires and 1 PE wire) AC power supply. Section of feeder shall not be less than recommended section, the end must be connected pressingly and firmly by cold pressing terminal whose capacity is specified.

● The special earthing bolt set on the bed body of the machine must be connected firmly and reliably with earthing wire.

● In order to prevent CNC system from interfering normal working high frequency equipment, such as welding machine, etc, is not allowed to be connected nearby the machine.

2.3 Check before Power-on of the Machines

First switch-on：

● It is necessary to confirm if the power supply of feeding of the machine conforms with requirements of "section 2.1" and "section 2.2".

● It is necessary to confirm if protection ground wire is connected with earth bolt, firmly and reliably, specified by the machine. And earthing resistor shall be less than 10 ohms.

● Check whether any of contactors, relays and connectors on the AC board and the DC board is loose or flick off.

● Check whether any of modules, insertion connectors of CNC system is loose or flick off.

● Check whether the breakers on the AC distribution board in the electrical cabinet are all closed.

● Check whether all electrical devices, cables and control pendant are loose, flick away or damaged.

● Check whether the belt cover door is well closed otherwise, the breaker QF0 of the general power supply of the machine cannot be well closed.

2.4 Power-on of the Machine

The machine has been provided with feeding conditions after all checking jobs mentioned above are completed and are confirmed no any trouble. Feeding procedures are as follows:

Switch on the breaker of general power supply. After the motor for headstock lubricating pump of headstock starts, the working lamp lights on.

⚠ **It is necessary to confirm the phase sequence of the power supply at the first time feeding, wrong sequence of the power supply may result in a series of troubles which should not occur, for example, turret does not index, cooling pump does not pump water, headstock is not lubricated, hydraulic system has no pressure, etc. , even component(s) may be damaged.**

**Simple method to judge the phase order：**

Observe whether in the oil window on the front of headstock lubricating oil flows on. If there is oil flow, it shows the phase order is correct, if there is no oil flow and the lubricating motor runs on normally, it shows the phase order is often not correct in the first time feeding. In this case you should switch off user's switch of power supply (Attention: Not the general switch of the machine) Correcting method is to change positions of two phases at the terminal of leading wires of external power supply.

2.5 Power-on of CNC System

Press the NC start key on the Operator′s Panel of the machine, a few seconds later, the screen will be lighting and display concerned positions and command information; All of the indicating lamps on the Operator′s Panel of the machine are lighting, five seconds later, the display of tool No. and the display of step position will be alternatively displaying, the indicating lights of the other keys change to normal displaying, the lubricating pump for lubricating guideways comes into work and starts to timing, power-on of CNC system is completed and the CNC system comes into operable status. Wherever as long as the button for power-off NC is pressed, the system will immediately be power-off.

3   BASIC OPERATION OF THE MACHINE

3.1   Selection of Operation Mode
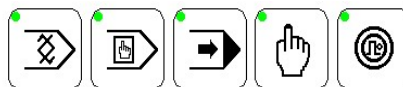
Five keys shown in above figure are selection keys of operation mode and they are used to select five operation modes of the machine, in any case, only one mode can be selected, the indicating lamp of the selected operation mode will be lighting on. In any case, only one indicating lamp lights on, and the other statuses are all abnormal.

3.1.1 Edit Mode

This mode is an operation mode to input, modify, cancel, inquiry and call turning program of workpiece. Switch on the switch of program protection before inputting, modification, cancel of work turning program. In this mode, work program does not run.

For the operating procedures in detail of edit mode, refer to the 《BEIJING FANUC 0i-MATE OPERATION MANUAL 》, please. For command codes used for programming, please refer to "section 1.7, 1.8 and 1.9" of this Instruction Book.

3.1.2 Manual Data Input (MDI) Mode

Under this mode, entry the segment of program by the keyboard of CNC system, then, pressing the cycle start key to execute it. In general case, this mode is used to execute operation of simple test.

Operating steps are as follows:

① Press ⬚ key, with indicating lamp lighting, and coming into MDI operation mode.

② Press 《 PRGRM 》 key on the CNC key board.

③ Press 《 PAGE 》 displaying page with MDI on the left upper on screen.

④ Press the 《 INRUT 》 key through word character keyboard of CNC, displaying input command words on the right half part of screen.

⑤ Press the Cycle Start key ⬚ after all command words are input, the indicating lamp of this key will light on. Programs come into executing status. The indicating lamp goes out after the programs are completely executed, program commands are canceled with them.

⑥ It is necessary to reentry the commands in the same if they need to be executed again. Only one program segment block can be executed one time.

⑦ During executing, it is necessary first to return reference point if there is displacement command.

⚠️ **It is necessary to set and modify parameters of the system under this operation mode!!**

3.1.3 Auto Operation Mode ➡️

Auto. operation mode is a mode which controls the machine to perform continuous and automatic turning according to commands of programs.

● This operation mode is also referred as stored program operation mode because the programs executed by automatic operation (that is, work programs) are stored in the storage of CNC system before cycle start.

● It is necessary to measure compensation value of each tool accurately by help of correct correcting tool method before starting automatic operation cycle, and then, set the measured compensation value in tool compensation unit which is specified by program.

● It is necessary to move the turret exactly to the original position specified by workpiece program before starting automatic operation cycle.

Basic operating precedures are as follows:

① Press ➡️ key to select Auto. operation mode.

② Select program to be executed.

③ Press the Cycle Start key 🔲 ,with the indicating lamp of this key lighting on, automatic turning cycle starts.

④ After programs are executed to complete, the indicating lamp of cycle start key goes out, turning cycle ends, programs return to the beginning to prepare next execution.

● If there is alarm information display of "PS000" on screen during operation, it shows there is any mistake in the programs or set data. Refer to the 《BEIJING FANUC 0i-MATE OPERATION MANUAL》 please.

● Automatic running of programs may stop under following cases：

① Executing command M02 and M30（normal stop）;

② Reset key on the CNC keys board is pressed; Emergency stop button has been pressed.

③ Wrong alarm of program.

④ Servo alarms.

● Automatic running of programs may dwell under following cases：

① Feed Dwell key 〔⬦〕 has been pressed, the indicating lamp of the feed dwell key lights on. In this time, as long as the Cycle Start key 〔▣〕 is pressed, program recovers to automatic running.

② Operation mode is out of automatic operation mode.

In this case, the machine returns to automatic operation mode as soon as press the key of automatic operation mode, then, press the Cycle Start key 〔▣〕 , program recovers to automatic running immediately.

● Program executed command M00；

① Press the Cycle Start key 〔▣〕 , program recovers to automatic running immediately.

② Program executed command M01(Selection stop button of program is under ON status)

③ Press the Cycle Start key 〔▣〕 , program recovers to automatic running immediately.

● Single-segment switch has been switched on.

Press the Cycle Start key 〔▣〕 , program runs continuously, but, only one segment is executed by pressing the Cycle Start key as long as single-segment switch is not switched off.

3.1.4 Manual Operation Mode 〔✋〕

Press the key 〔✋〕 , with the indicating lamp of this key lights on, the machine comes into manual operation mode. Under this operation mode, all the operations of manual functions can all be executed.

3.1.4.1 Jog and Jog Rate of X-axis and Z-axis
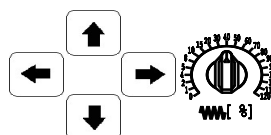
● Keep pressing the key 〔⬆〕 , the carriage is moving to negative direction of X-axis, as long as the key is released , the carriage stops moving.

Keep pressing the key 〔⬇〕 , the carriage is moving to positive direction of X-axis, as long as the key is released, the carriage stops moving.

Keep pressing the key 〔⬅〕 , the carriage is moving to negative direction of Z-axis, as long as the key is release, the carriage stops moving.

Keep pressing the key 〔➡〕 , the carriage is moving to positive direction of z-axis, as long as the key is released, the carriage stops moving.

● Moving rate of feed axis is determined by the position of feed-override switch 🎛 , 10％ corresponds to the lowest rate of 50 mm/min and 150% to the highest rate of
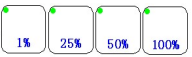
750 mm/min. Please refer to the 《BEIJING FANUC 0i-MATE OPERATION MANUAL》for details.

⚠ The feed override switch is not set to the zero position in normal case, otherwise, the feed axis does not move.

3.1.4.2 Rapid Jog [∿]   and Rapid Override [1%] [25%] [50%] [100%]

While the rapid Jog key and rapid Selecting key [∿] of a certain direction are together being pressed at the same time, the feeding axis will move rapidly with the indicating lamp of the key [∿] lighting on. Release the rapid Selecting key, the indicating lamp of the key goes out, and the movement of feeding shaft recovers to jog speed.

Rapid moving rate = rapid-override ×rapid moving rate set by Prm 1422.

There are four kinds of selections of rapid override: 1%, 25%, 50% and 100%, which are selected by the four keys [1%] [25%] [50%] [100%]   . Press any one of the four,   the indicating lamp of the pressed key will light on and the other three indicating lamps will be off. The pertenctage of the pressed key is the current rapid override.

Rapid override is also effective for rapid instruction of programs (G00, G27, G28, G30 and rapid-movement segment of canned cycle). Besides, it is also effective for rapid travel of manual-return reference point.

3.1.4.3 Change Speed of Spindle : [⊖] [⊕]

Basic form: 4-step frequency, stepless changing speed

Unit：r/min

Spindle step	Numerical Display	M Commands	Speed Range
0	0	M40	Neutral step
1	1	M41	15～115
2	2	M42	34～250
3	3	M43	75～570
4	4	M44	170～1000

● That under Manual Mode (the spindle is running), spindle speed can be increased by pressing the key [⊕], and reduced by pressing the key [⊖], is available with the range of current step.

● Under Auto. Mode or MDI Mode (the spindle is stopped), spindle step can be directly specified by commands M41, M42, M43 and M44.

● The left digit of numerical display [吕] displays current class of change speed.

⚠ That the spindle is directly started by the universal three-phase AC asynchronous motor and motor possess special original features makes that frequent start of the machine many cause overheat to the motor for the spindle, resulting overheat-protection. Therefore, while operating the machine, the min. interval for star and stop of the machine shall not be less than 30 seconds.

● Speed in every step is commanded by command Snnnn, and "nnnn" represents speed value of spindle. The system will automatically limit it to max. speed specified by this step when speed given exceeds the max. speed of spindle of this step.

● Under Manual Mode to use the increasing key ⊕ or the decreasing key ⊖ of spindle can increase or decrease speed of spindle in range of the step, jogging once changes one △S(set by K3+K4),if the pressing time exceeds five seconds, the changing is continuous. The upper limitation and the lower limitation of speed can be set by k5+k6, k7+k8.The speed is still kept no change until new S command comes out after the speed under manual made changes into the speed under Auto. mode. And for the spindle speed commanded under Auto. mode to be switched into the speed under manual mode, the result is as the same, too.

● Too large load inertia on spindle (with larger fixture) may make the converter alarm when retarding or stop of the machine, in this case, it is necessary properly to prolong retarding time of the converter, refer to the Table of Parameters for converter, please.

3.1.4.4 FWD, REV and Stop of Spindle
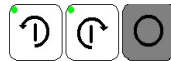
● Select changing step and required speed of spindle by M Command according to Change-speed Chart of the Spindle.

● Press the Spindle FWD key ,its indicating lamp lights on, having spindle forward.

● Press the Spindle REV key , its indicating lamp lights on, having spindle reverse.

● Press the Spindle Stop key , indicating lamps which indicate spindle forward and reverse light off, spindle stops rotating.

● Every time, when the spindle executes the operation of stop running, the spindle braking will be executed simultaneously. The braking of the frequency-changing spindle with changing speed is realized by energy consumption of resistor connected outside the converter. The braking time is determined by the converter. Refer to the chapter Table for Parameters of Converter

Under Auto mode or MDI mode:

● After command （M03）of spindle forward is executed, the indicating lamp of

spindle forward lights on just as manual operation.

● After command（M04）of spindle reverse is executed, the indicating lamp of spindle reverse lights on just as manual operation.

● If spindle stop command（M05）is executed, the indicating lamps for forward and reverse are all off.

⚠ **No starting Spindle at neutral step!**

⚠ **It is necessary to close the protection door well before start of spindle!**

⚠ **Do not start spindle at high speed in case workpiece is not clamped for the machine equipped with non-hydraulic chuck!**

3.1.4.5 Jog of Spindle

Keep pressing the Spindle Jog key, spindle will jog, and as soon as the pressed key is released, the jog of the spindle will stop.

3.1.4.6 ON/OFF of Coolant

● Press the "ON/OFF of coolant" key , with its indicating lamp lights on, the cooling pump is working. Open the cock of coolant, coolant is gushing. If press the key again, the lamp will be off, and the cooling pump is off and coolant stops gushing.

● Under Auto. Mode or MDI mode, if command (M08) of coolant ON is executed, its indicating lamp also lights on. Command（M09）of coolant OFF is executed, or press this key again, its indicating lamp is off，coolant is off.

3.1.4.7 Manual Tool Selection

● Pressing the Manual Tool Section key , turret is automatically releasing, then, it is counterclockwise indexing and searching required tool station. After the Tool Selection key is released, the turret counter leans against the seat automatically, then, it is locked on the target position. The numerical display will displays current tool-station number.

● Lightly to press the Tool Selection key can realize pressing one time to select one tool station.

⚠ Insufficient delay of turret locking can affect locking rigidity of turret, but overlong delay of turret locking can make the turret motor overheat, resulting in damage. Delay time of turret locking is set by parameter T7 that has been well set before delivery, and it should not be changed at will. If you find that locking of turret is not enough and affecting machining accuracy, properly increase the setting value for the time is allowed. Pay attention to temperature of turret motor when increasing the value. Record the time data in the Parameter Table after adjustment.

Manual tool setting

X-axis

1. Under the manual mode, cut the outer diameter "B"
   as shown by Figure below.
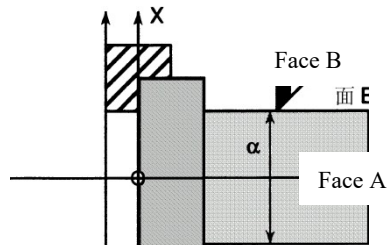
2. Stop the spindle, do not move the X-axis, and shift out the tool along the direction of Z-axis.

3. Press the key OFFSET SETTING , then the key [GEOM][OPERATION] to display the page of compensation for tool length. And move the cursor to the current compensation No.

4. Press the key X, and input the dia. value "α" of the workpiece to be turned.

5. At last, press the key [MEASURMENT], the value of tool compensation will be automatically input into the compensation No. indicated by the cursor.
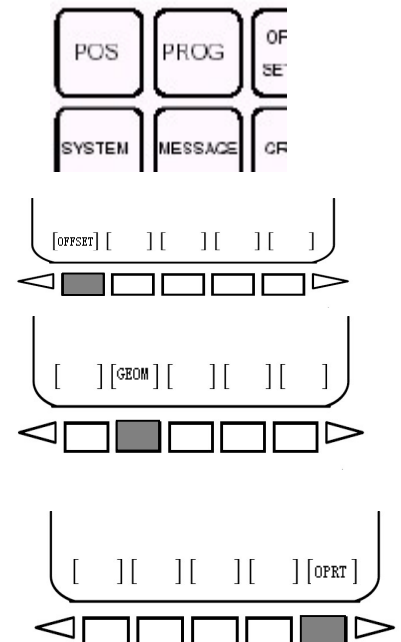
Z-axis

1. Under the manual mode, cut the endface "A" shown in the above fig.

2. Stop the spindle as well as the Z-axis, and shift out the tool along the direction of X-axis.

3. Press the key OFFSET SETTING ,then the key [GEOM][OPERATION] to display the page of compensation for tool length. And move the cursor to the current compensation No.

4. Press the key X, and input the dia value α of the workpiece to be turned.

5. At last, press the key [MEASURMENT], the value of tool compensation will be automatically input into the compensation No. indicated by the cursor.

3.1.5 Feed Mode of Manual Pulse Generator

Press the key , with the indicating lamp of the key lighting, the machine will be under feed mode of handwheel pulse generator. Operator can turn the handwheel of handwheel pulse generator to make turret moving in directions of all sides (forwards, backwards, left and right). Its speed can be adjusted at will. It is very available for

tool-setting operation in short distance, etc.

Operating procedures are as follows:

① Select the handwheel Pulse Overrid ⬚ .

② Handwheel pulse overrides have three: 0.001/0.01/0.1mm. You can select any kind of them according to rapid, slow, finishing and roughing. The indicating lamp of selected override lights on, thus, equivalent value per scale on the handwheel can be determined.

③ Selection of manual feed axis:

Press ⬚ key to select X-axis;

Press ⬚ key to select Z-axis.

④ Turn the handwheel clockwise or counter-clockwise.

■ Manual feed mode can execute manual spindle change speed, manual spindle start and stop, manual coolant ON and OFF, manual tool selection.

3.1.6 Mode of Return Reference Point ⬚

In normal case, it is not necessary to return reference point owing to that the machine uses absolute encoder. If the position of mechanical coordinate of the machine has been changed in relative position, it is necessary to set the reference point again. For the practical method, refer to the chapter 1.6 coordinate Axes and setting of coordinate system.

3.2 Cycle Start and Feed Hold ⬚ ⬚

● Cycle start key ⬚ :

Both auto mod and MDI mode employ the Cycle Start key to start the program. And during the program being performed, the indicating lamp on the left-upper corner of the key lights on.

● Feed hold key ⬚ :

During program being performed under auto mode or MDI mode, press the key, having the indicating lamp on the left-upper corner of the key lighting and the program being performed is held. Repress the feed hold key; its indicating lamp is off and the program is continuously performed.

3.3 Feed Override Switch ⬚
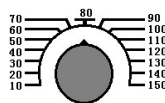
During the program being performed, you can use this switch to adjust feed speed specified in the program at any time to obtain optimum turning result. Actual feed speed

after adjustment can be observed through display screen. Adjusting range：$10\% \sim 150\%$.

3.4 Trial-run (Dry Run)

Trial- run is also referred as dry-run, it is a operation which is to test, check the newly input programs of turning workpiece under non-turning condition. In order to shorten debugging time, feed rate is forced to max. value by the system during trial - running.

Operating procedures are as follows:

① Select Auto. mode to call out program to be tested.

② Press the Trial-running key with its indicating lamp "ON" lighting, showing that trial-running status is valid.

③ Press the Cycle Start key with its indicating lamp lighting, trial - running operation begins.

For the operation of trial run of the machine, it is not allowed to chuck a workpiece on the machine, and attention must be paid to that the two axes are running at a high speed.

3.5 Lock Operation of the Machine ：

● Press the key with its indicating lamp lighting on, lock of the machine is valid. Press the key again, having the indicating light off, lock status of the machine is released.

● Under locking status of the machine, moving operation (jog, handwheel feed) of each axis under manual mode can only change displayed values of position and not move every axis of the machine, but, spindle, coolant and turret work normally.

Under locking status of the machine, under the manual mode, the motion operation of (jog, handwheel feed) of each axis under manual mode can only change-displayed values of position but not move every axis of the machine. However, spindle, coolant and turret work normally.

3.6 Operation of Optional Skip of Segment

● Press the key with its indicating lamp lighting, block skip function is valid. Press the key again with indicating lamp off, segment skip function invalid.

● Under Auto. mode, during valid period of segment skip function, all segments which are preceded by symbol "/" （erase character）in front of block number all skip over not to be executed. During invalid period of segment function, all of segments are all executed normally.

● Functional application：Edit some special segments, such as trial-turning,

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measurement and tool setting in program. Precede segment numbers "N" with symbol "/" .To use this kind of segment skip function can control the machine to execute these segments selectively.

3.7 Operation of Single Segment

- Press the key   under Auto. mode with the indicating lamp of the key lighting, single-segment function is valid. Press the key again, the indicating lamp goes off, single segment function is canceled. The Single-segment Function key is allowed to be switched over while program is continuously running.

- During valid period of single-segment function under Auto. mode, pressing the Cycle Start key once, only one segment will be executed; Press the key again, the next segment will be executed.

- Functional application：Mainly, it is used to test programs, and according to the practical requirements, it can also be combined with the functions of trial-run, lock of the machine and segment-skip.

3.8 Limitation and Release of Over travel of the Machine

Limitation of store travel (Software limitation)：

During operation, the carriage of the machine may move out of safe area set by Prm1320, 1321 in some direction due to some reasons (operation fault, programming data error, etc.), CNC system will alarm, and the carriage will stop moving. Move the carriage out of forbidden area in opposite direction, then, you can do normal operation.

3.9 E-stop Operation

- A red mushroom emergency stop button is on the right- upper corner on the Operator's panel. If any emergency case occurs, all actions of the machine stop immediately as soon as the emergency stop button is pressed and the button will be self-locked automatically. Turning the button for a certain angle clockwise can make it be recovered after emergency-shooting or trouble-shooting.

- After the emergency stop button is pressed, spindle may run for 3-5 seconds due to inertia. The carriage can slide a little.

3.10 Operation of Lubricating Guideways
The machine has automatic intermittent lubricating function of guideways.

- The machine comes automatically into travel lubricating state of guideways after power-on. The travel lubricating controls "stop" and "start" (ON and OFF) of the lubricating pump of guideways through calculating the moved distance of the servo axis. Start time (Filling oil time) is set by T10 (ms), and upper limit of travel is set by D152

(cm). Operator may adjust them by himself according to practical requirement.

● If you keep pressing the button for lubricating the guideways, the lubricating pump will be continuously working.

4   OPERATION OF HYDRAULIC SYSTEM ⏚ , HYDRAULIC CHUCK ⏚   AND HYDRAULIC TAILSTOCK ⏚

4.1 Start of Hydraulic System ⏚

① Press the auto. air-switch "QF5" on in the electrical cabinet.

② Press the button of Hydraulic Star/Stop ⏚   with its indicating lamp lighting, hydraulic pump starts. Press the key again with the indicating lamp off, hydraulic pump stops. After there is emergency stop operation, the hydraulic pump stops, and hydraulic pump should be restarted.

Adjust the pressure of hydraulic system and the pressure relay to the pressure required by chucking workpiece.

4.2 Operation of Hydraulic Chuck ⏚

● Using either the key ⏚ or the foot-pedal switch SQ50 of hydraulic chuck can complete clamping and releasing of chuck. Press the key or step the foot-pedal switch one time, chuck will be clamping, with the indicating lamp of the key lighting. Repressing the key or stepping the pedal switch again can make the chuck release, and the indicating lamp of the key goes out.

● Clamping pressure of hydraulic chuck can be indicated by pressure relay, and clamping force may be adjusted by user according to practical condition; it is also available for user to indicate the clamping pressure by selecting a travel switch.

When spindle does not rotate, the chuck can be operated in any mode.

In order to avoid accidents, to operate the chuck is not allowed when the spindle is under running status. It is only available for you to operate the hydraulic chuck while the spindle speed is retarded to zero.

4.3 Operation of Hydraulic tailstock ⏚

Using either the key ⏚ or the foot-pedal brake can complete advancing and withdrawing of the sleeve of hydraulic tailstock. Press the key (or step the foot-pedal switch) once, the sleeve of tailstock is advancing with the indicating lamp lighting; and press the key (or step the foot-pedal brake again, the sleeve is withdrawing, the indicating lamp goes out. The lowest tightening up pressure of advancing of the hydraulic tailstock sleeve is indicated by the pressure relay and the tightening up pressure may be adjusted by user according to the practical situation; it is also available for user to indicate the tightening pressure by selecting a travel switch.

● When spindle does not run, the tailstock can be operated under any mode.

● In order to avoid accidents, to operate the tailstock is not allowed when the spindle is running. It is only available for you to operate the tailstock when the spindle speed has been retards to zero.

5 OPERATING FLOW DIAGRAM AND USER'S PARAMETERS

5.1 Operating Flow Diagram

Close the general power supply breaker, and then the machine gets normal power-on

Switch on the push-button, CNC system gets power.

Input turning programs, check and confirm their correctness.

Lock the machine and do dry-run to verify rightness of the programs, especially, carefully observe whether the coordinate sizes of every segment are correct. After complete those, it is necessary to cancel dry-run operation.

Release the machine and load the workpiece for trial-run, and select every tool manually, and then measure the tool compensation of every tool in method of trial-running and input the tool compensation unit specified by the program. At last, pay attention to the positive and negative sign and decimal point.

Taking the trial-turning workpiece as reference, move the carriage manually to coordinate position set by command G50. Unload the trial-turning workpiece.

Call out program of current turning workpiece, and select Auto. operation mode and proper feed overridde as well as rapid override. Press the Cycle Start key to start the automatic cycle turning. For turning first workpiece, it is better to select lower rapid override and using single block function can reduce troubles resulting from program and error from tool setting.

After first workpiece is completed, measure sizes of each turning position and modify tool compensation value of each tool. Then, turn the second workpiece. Recover rapid override of 100% to turn all of workpieces after confirming all sizes are correct.

6 ELECTRICAL MAINTENANCE AND ADJUSTMENT

When alarm information is displayed on the display screen during the electric maintenance, please do trouble-shooting according to remedy of relative alarm given by 《BEIJING FANUC 0i-MATE OPERATION MANUAL》.

While the machine is power-off, the parameters and turning programs of CNC system are protected by the battery. The screen displays alarm warn when energy of the batteries is not enough, in this case, it is necessary for user to change them immediately under status of power-on of CNC system, otherwise, the parameters and the programs may be lost.

It is necessary for you to carefully and thoroughly read this INSTRUCTION BOOK and 《BEIJING FANUC 0i-MATE OPERATION MANUAL》, before operating the machine to avoid operation failure resulting in accidents.

Appendix: Alarm Information and Remedy Method

Alarm Code	Displayed Information	Meaning of Alarm Information	Alarm Condition or Cause	Consequence Resulted from Alarm or Triggered Action	Remedy Method Alarm
#2004	EMG OFF	Emergency stop; switch switched off	Emergency stop button is pressed or circuit is off.	The machine is under emergency stop status. All actions are forbidden.	Shoot the trouble and press the outer reset key F1.
#2005	MAIN MOTOR OVERHEAT	Thermal-protection switch of main motor is off	The sunk-overheat protection switch of the main motor is off.	Intermittent stop, spindle has stopped.	
#2006	BED-HEAD LUBRICATE OFF	Switch for lubricating headstock is off	The air-switch for lubricating headstock is off.	Restarting the turning programs is forbidden.	
#2010	HYDRAULIC NOT RUN	Hydraulic device is not started.	Hydraulic device is not started after the machine is started.	Restarting the turning programs is forbidden.	
#2012	HYDRAULIC CHUCK PRESS LOW	Pressure of the hydraulic chuck is tool low.	Pressure of the hydraulic chuck is too low	Intermittent stop, the spindle has stopped.	
#2013	HYDRAULIC TAIL PRESS LOW	Pressure of the hydraulic tailstock is too low.	Pressure of the hydraulic tailstock is too low.		

Alarm Code	Displayed Information	Meaning of Alarm Information	Alarm Condition or Cause	Consequence Resulted from Alarm or Triggered Action	Remedy Method Alarm
#2020	TURRET CODE ERROR	Turret code is in error	More than practical tool No. or tool No. 0 has been instructed.	The programs have stopped and the system does not response.	Shoot the trouble and press the outer reset key F1
#2021	TURRET RUN OVERTIME	Indexing of the turret is overtime.	Time of arriving at the instructed tool station is over the specified time.		
#2022	TURRET LOCK OVERTIME	Locking of the turret is overtime.	Back-leaning and locking time of the turret is over the specified time		Start the hydraulic device and press the outer reset key F1.
#2023	TURRET NOT LOCK	The turret has not been locked.	Signal is not sent out when back-leaning and locking the turret.		Shoot the trouble and press the outer reset key F1.
#2041	TRY TO RUN SPINDLE WHILE CHUCK NOT LOCK	Try to start the spindle while the chuck is not firmly clamped.	Try to start the spindle while the chuck is not firmly clamped.	Starting the spindle is Forbidden	Tighten up the tailstock and press the outer reset key F1.
#2042	TRY TO RUN SPINDLE WHILE TAIL NOT LOCK	Try to start the spindle while the tailstock is not tightened up.	Try to start while the tailstock is not tightening up		Shoot the trouble and pres the reset key f1.

Alarm Code	Displayed Information	Meaning of Alarm Information	Alarm Condition or Cause	Consequence Resulted from Alarm or Triggered Action	Remedy Method Alarm
#2043	SPINDLE	The spindle step is abnormal.	The switch of spindle step has erroneous action.	Restarting the turning program is forbidden	Shoot the trouble and press the outer reset key F1
#2044	ELECTRO MOTION BECOME M40 OVERTIME	When electronic-changing step, M40 step is overtime.	M40 of the spindle step had error action.		
#2045	BECOME RESPONSION OVERTIME	Responding time of changing step is overtime.	There is error action while changing step of the spindle.		
#2046	BECOME START-UP OVERTIME	Time of starting changing step is overtime.			
#2047	M41 BECOME PROTECT1 OVERTIME	Changing step protection 1 is overtime.	There is error action in the spindle step		
#2050	M4X ARRIVE OVERTIME	Time of arriving at M4x is overtime.			Shoot the trouble and press the outer reset key F1.
#2051	PRINCIPAL AXIS BECOME ITHERING OVERTIME	Whipping time of changing step of the spindle is overtime.	There is error action on the spindle step station M40.		
#2053	SAFETY DOOR BE OPENED	The safety door has been opened.	The safety door has been opened during normal turning.	Intermittent stop; the spindle stops.	Close the safety door and pres the outer reset key F1.
#2054	SAFETY DOOR NOT CLOSE	The safety door is not closed.	The spindle or the turning programs are attempted to be start when the safety door is closed.	Starting the spindle or the turning programs is forbidden.	

Alarm Code	Displayed Information	Meaning of Alarm Information	Alarm Condition or Cause	Consequence Resulted from Alarm or Triggered Action	Remedy Method Alarm
#2056	CONVERTER ALARM	Convert alarms.	Convert alarms.	Starting the spindle or the turning programs is forbidden.	Check the converter and shoot the trouble, and press the outer reset key F1.
#2060	MANUAL HANDLE INTERRUPT	Handhweel interrupt is valid.	Handhweel interrupt is valid.		Check soft switch.
#2061	MANUAL ABSOLUTE ENABLE	Manual absolute is valid.	Manual absolute is valid.		Check soft switch.
#2062	SPINDLE NEUTRAL GEAR	Spindle is set at neutral step.	Spindle is set at neutral step.	Starting the spindle or the turning programs is forbidden.	Set the spindle to the proper step.

Other matters needing attention:

If actions of the machine can not be realized due to voltage fluctuation or overload making the air breaker OFF, please check if overload occurs to circuits and electric elements or short circuit exists, after trouble shooting, reset the corresponding air breakers, and for correspondence of the motors and each air breaker is shown below:

Name	Air Breaker	Portion Cause or Phenomenon
General switch	QF0	Door of electric cabinet is not closed, short circuit occurs to electric elements.
Lubricating motor	QF2	Overload or short circuit of motor, or short circuit of cables occurs.
Cooling motor	QF3	
Motor for turret	QF4	
Hydraulic motor	QF5	

Reliable work of travel switch is essential for machine, and therefore, periodically check if there is foreign matters blocked on its contact, and if there is, clear it in time. If alarm occurs when the machine has not been over travel, and it is unable to carry out the operation of return zero point, check if there are foreign matters blocked on the contactor.

If over-travel switch of the machine is pressed or it is needed to change cables of motor encoder, etc., it is necessary for you to reset the reference point of the machine (refer to the method described above).

Modification of parameters of the machine.

FANUC control system: press key "OFS/SET", and then soft key "SETTING", selecting MDI mode. Set "Parameter Read-in" to 1, No. 100 alarm will occur to the system, press key "SYSTEM" and input the parameter No. to be modified. After pressing the horizontal soft key "SEARCH", the system will skip automatically to the parameter to be modified to carry out the modification. Set "Parameter Read-in" to 0, the alarm of the system will disappear. If No. 000 alarm occurs after modification of the parameter, it is necessary to re-power on the system.

Parameters of the machine can influence the accuracy and actions of the machine greatly, so the modification of parameters of the machine shall be carried out by professional. Erroneous input of parameters will bring great damage to the machine and injury to operation personnel.

Adjustment of electro brake: braking and stopping speed of spindle differs because the loading of spindle is different, and the braking force and braking time (left of the brake shows the braking force and right shows the braking time) can be regulated according to actual loading status. In addition, it is available to observe the status of brake through the four indicating lights "TROUBLE" "POWER SUPPLY" "BRAKING" AND "ALLOWANCE" on the brake.

While short circuit occurs to the machine, it is necessary to check if the cable is broken by protection or other components, and normally, there is standby cable to take the place of the broken cable, and if there is not, you should change the cable.

Matters needing attention to use of air conditioner:

Filter net of air conditioner of electric cabinet shall be cleaned periodically, and otherwise, the

normal work of the system will be influenced because the temperature in the electric cabinet is too high. The cleaning of filter net shall be carried out according to working environment, and normally, twice for every month. For light dirt, clear it by dust collector or flapping, if the dirt is too much, clear it out by neutral detergent or wash it by clean water. After complete cleaning, dry it and then re-install it.

The temperature inside the cabinet has been well set, and un-profession is forbidden to do any regulation.

For maintenance, when it is necessary to open air conditioner, it is necessary to cut off the power.

The temperature shall be properly regulated higher in baiu seasons and wet seasons.

Every day, you should check if the drainpipes are blocked or the water in water receiver overflows. Every day, at least, the water receiver shall be poured once, and once for every 4 hours during plum rain season and wet season.