

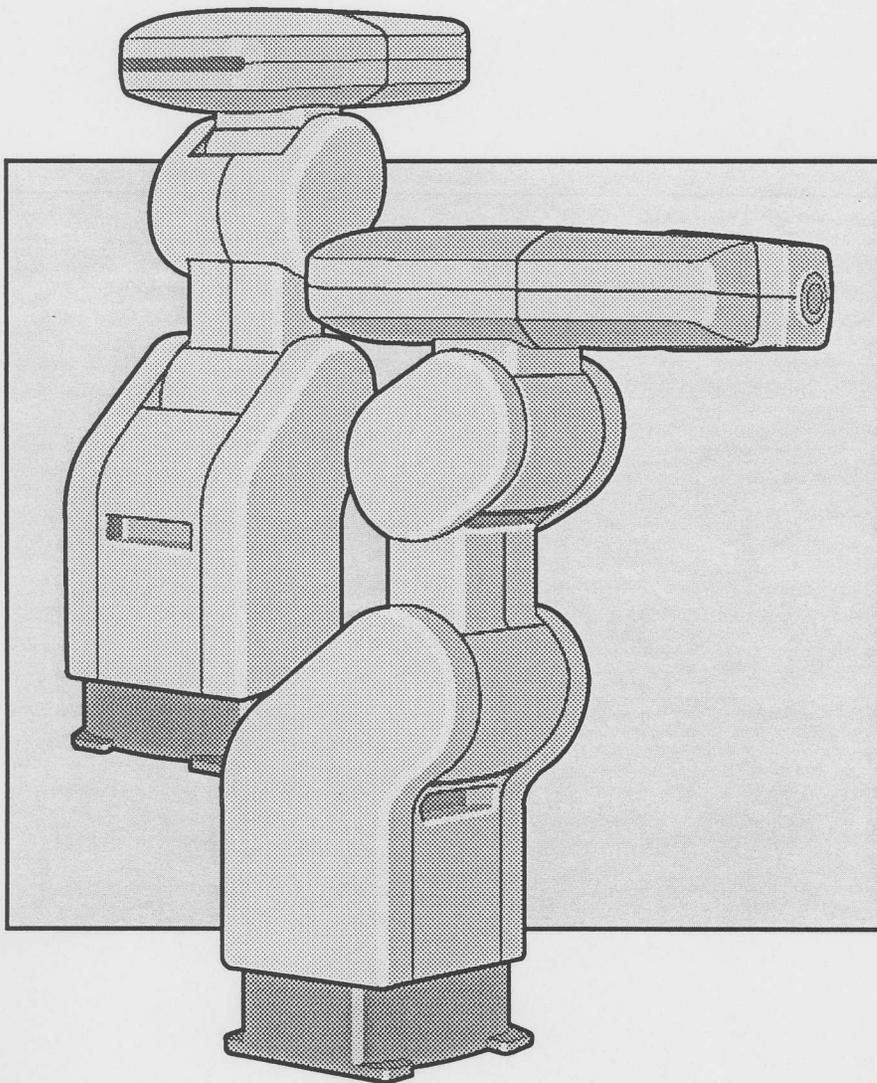
MITSUBISHI

Mitsubishi Industrial Robot

RV-E2

MOVEMASTER SUPER

User's Manual



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 - 2 The important 5 words
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BFP-A5623-A

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1. The first step

This chapter explains about the manuals, a fundamental term, and safety.

The package should contain 3 Documents. This chapter shows how to use them. The specification manual is common for all robot. RV-E2 (E DOP) and RV-E31 (S DOP) has

This is common specification manual for the E series. It explains standard specifications, special specifications, option configuration and maintenance components. It also explains about safety and technique for using the robot.

It explains about safety, setting, unpacking, cabling, installing and fundamental operation. It also explains about the teaching playback method.

It explains the optional components, programming (teaching playback method and MOVEMASTER command method), external I/O equipment, tooling specification and maintenance. It explains about the commands, parameters, alarm and program examples.



(Contents of each document)

Reference manual	User's manual	Specification manual	Contents
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Command summary, Parameter summary, Alarm
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Specifications Maintenance, Inspection
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Connection with external equipment, Tooling
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Command reference
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Advanced operation
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Detail specification of configuration machinery
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Installation for optional equipments
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Basic operation (Teaching playback method)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Installation
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Safety
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Introduction
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Optional equipments
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1.1 How to use this User's Manual

1.1.1 Introducing the Manuals

The package should contain 3 Documents. This chapter shows how to use them. The specification manual is common for all robot. RV-E2 (6 DOF) and RV-E3J (5 DOF) has

- Specification manual

This is common specification manual for the E series. it explains standard specifications ,special specifications, option configuration and maintenance components. it also explains about safety and technique for using the robot.
- User's manual

It explains about safety, setting, unpacking, cabling, installing and fundamental operation. it also explains about the teaching play back method.
- Reference manual

It explains the optional components, programming (teaching playback method and MOVEMASTER command method), external I/O equipment, tooling specification and maintenance. it explains about the commands, parameters, alarm and program examples.

<Contents of each document>

Contents	specification manual	User's manual	Reference manual
• Specification, Maintenance consumptions	○		
• Optional equipments	○		
• Introduction	○		
• Safety		○	
• Installation		○	
• Basic operation (Teaching playback method)		○	
• Installation for optional equipments			○
• Detail specification of configuration machinery			○
• Advanced operation			○
• Command refernce			○
• Connecton with external equipments, Tooling specifications, Maintenance, Inspection			○
• Command summery, Parameter summery, Alarm summery, Program Examples			○

1.1.2 Symbolic Conventions

Table 1.1 shows the symbols in the Manuals.

Table 1.1 Symbolic Conventions

Symbol	Contents
◆ ◆ ◆ Tips ◆ ◆ ◆	It explains the tips for the robot operation.
☆ ★ ☆ Caution! ☆ ★ ☆	You risk damaging for your equipments if you don not heed the instruction.
[Joint]	The bracketed text indicates a key that you press.
[+ / FORWD] + [+X/+W] (A) (B)	It indicates that you push (A) key with (B) simultaneously. This example means that you press [+ / FORWD] key with [+X/+W] key.
[STEP / MOVE] + (A) ([COND] -> [RPL->]) (B) (C)	It indicates that you push (A) key with (B) key, and alternate (B) key with (C) key. This example means that you push [STEP / MOVE] key with [COND] key, and alternate [COND] key with [RPL->] key.

No	Beep Pattern	Contents
1	Long Beep : —————	HW Alarm
2	Short Beep : — — — — —	Miscellaneous Alarm
3	Shift Beep : — — — — —	Over-run Alarm

1.2 Introducing the important 5 words

This section explains terms used often in the robot operation.

(1) Program

It describes sequences of robot operation. This robot has two programming methods. One is teaching play back method and another is command programming method.

Here, This manual explains teaching play back method. There is "file" for a term relating to "program." "File" is a container stocking program and data.

(2) Teaching play back method

This is one method that allows you to teach your robot the job sequence with a teaching box.

One operation motion has a unit called the a "step" that has motion to a teaching point and requirements' data as hand status.

(3) Alarm

It appears as numbers or messages from a controller at malfunction, false editing or wrong operation.

controller beeps and shows 2 characters to alternating on PRO/ ALM display.

These numbers mean alarm number. Teaching box shows an alarm message on the display.

Table 1.2 shows alarm beeping means.

Table 1.2 Alarm beeps and alarm factors

No	Beep Pattern	Contents
1	Long Beep : <----->	H/W Alarm
2	Short Beep : <----> <----> <----> <---->	Misoperation Alarm
3	Brief Beep : <--> <--> <--> <--> <--> <--> <--> <-->	Over-run Alarm

◆ ◆ ◆ tips ◆ ◆ ◆

Push alarm reset key of teaching box and remove alarm whether it pushes RESET switch of controller front panel when alarm occurred.

Reference manual /6 chapters explains about alarm.

(4) Step feeding

You can forward the program sequence step by step.

Conform Check your program with this step feeding operation before automatic operation.

(5) JOG

You can move the robot arm manually with the teaching box in jog operation.

This section explains joint jog operation and XYZ jog.

«Joint Jog Operation»

The robot moves each joint independently in this operation. the robot can turn each joint in each direction. Figure 1.1 shows the joint jog operation.

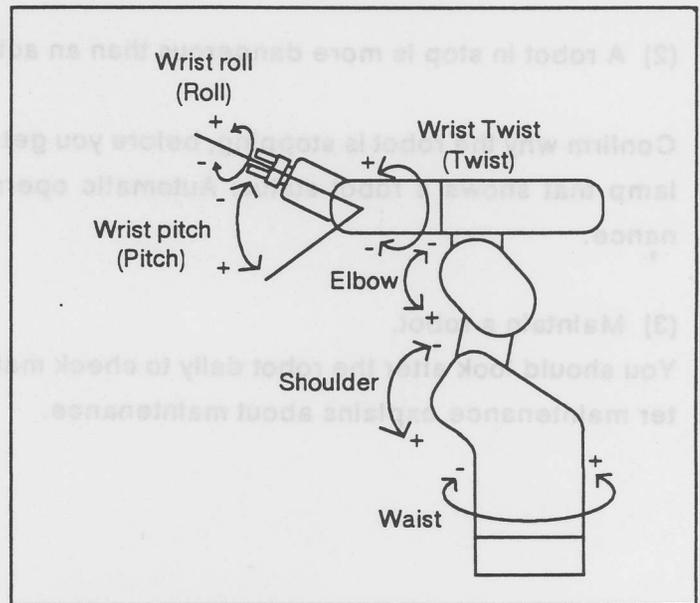


Fig. 1.1 Joint Jog control

«XYZ jog Operation»

The robot moves its tip along XYZ axes.

+X is the front side.

+Y is the right side.

+Z is the up side

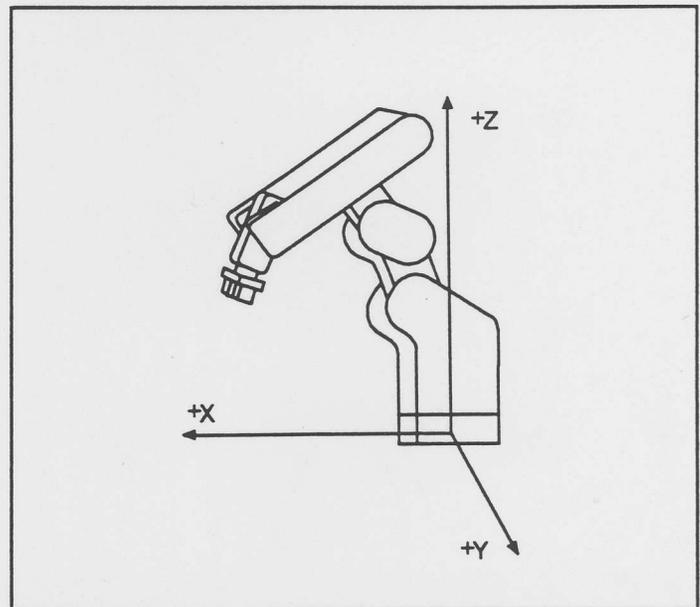


Fig. 1.2 XYZ Jog control

1.3 Safety

Robot is the powerful friend with correct operation.

Keep the following instruction for safe and efficient operation.

(1) Keep away from the moving robot

It is very dangerous to get near a robot in action. you are better to make a safety fence or wall for anyone to keep away the robot operation range.

(2) A robot in stop is more dangerous than an activate one.

Confirm why the robot is stopping, before you get near it. you are better to put on the pilot lamp that shows a robot status: Automatic operation, Teaching operation and Maintenance.

(3) Maintain a robot.

You should look after the robot daily to check malfunction. Reference Manual/ 5th chapter maintenance explains about maintenance.

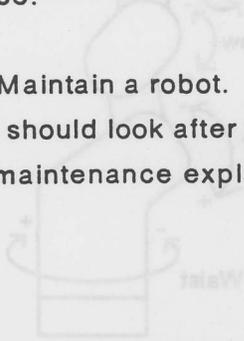


Fig. 1.1 Joint Jog control

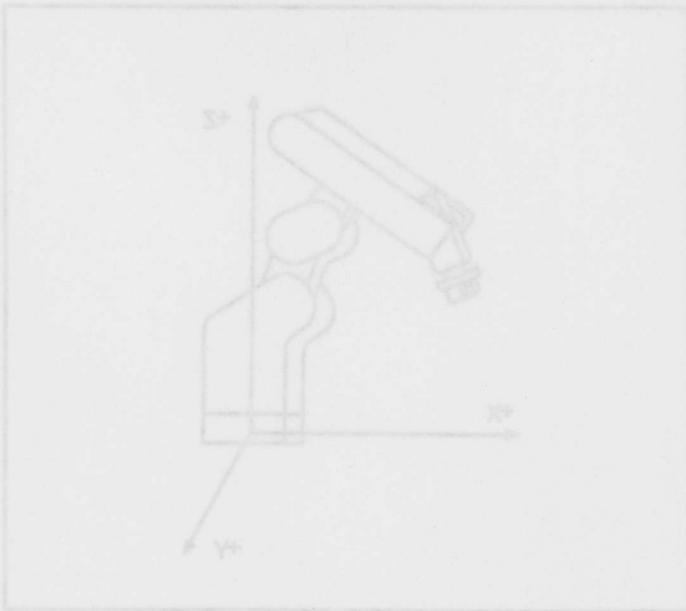


Fig. 1.2 XYZ Jog control

1.4 Introducing the programming method

The Move Master Super has two programming methods. this User's manual explains the basic operations in the teaching play back method. Reference manual explains about the MOVE MASTER command method.

Nc	Method	Equipment	Feature	Note
1	Teaching playback method	Teaching box	<p>You create your task program with the teaching box.</p> <p>It allows you to set the the condition data : interpolation mode, speed, timer and I/O to each step.</p> <p>It is suitable method for a simple task.</p> <p>It is adaptable with the computer.</p>	<ul style="list-style-type: none"> • The task with conditiona branches requires an external controller or commnad method • programming. <p>There are no function to caricurate positions, digit values; interruption from external signals nor palletaizing.</p>
2	MOVEMASTER command method	Personal computer & Teaching box	<p>«Program mode»</p> <p>You teach positions with the teaching box, and create programs wiht the computer. (Line number + command)</p> <p>MOVEMASTER commands allows to create complex task program.</p> <p>It is suitable for tasks that require conditional branches, interruption, palletaizing, calicuration.</p>	<ul style="list-style-type: none"> • This method needs the BASIC language or the ROBT PROGRAMMING • SUPPORTER. <p>The program is adaptable with the teaching box.</p>
			<p>«Direct mode»</p> <ul style="list-style-type: none"> • The robot executes the MOVEMASTER commands from the computer one by one. • It is free from the memory limitation so that the computer manages the program. 	<p>The robo to shall connect</p> <ul style="list-style-type: none"> • with the computer always. <p>You can not stop the robot, while it executes the</p> <ul style="list-style-type: none"> • command.

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1.4 Introducing the programming method

The Move Master Super has two programming methods. The User's manual explains the basic operations in the teaching play back method. Reference manual explains about the MOVE MASTER command method.

No	Method	Equipment	Feature	Note
1	Teaching playback method	Teaching box	<p>You create your task program with the teaching box.</p> <p>It allows you to set the condition data: initialization mode, speed, time and VO to each step.</p> <p>It is suitable method for a simple task.</p> <p>It is adaptable with the computer.</p>	<ul style="list-style-type: none"> The task with conditions branches requires an external controller or command method programming. There are no function of coordinate position, digit values, interruption from external signals or pausing.
2	MOVE MASTER command method	Teaching box Personal computer &	<p>allows to create complex task program.</p> <p>It is suitable for tasks that require conditional branches, interruption, pausing, calculator.</p> <p>MOVE MASTER commands (Line number + command) program with the computer, teaching box, and create program mode.</p> <p>You teach position with the</p>	<ul style="list-style-type: none"> The method needs the BASIC language or the ROBOT PROGRAMMING SUPPORTER. The program is adaptable with the teaching box.
			<ul style="list-style-type: none"> It is free from the memory limitation so that the computer manages the program. The robot executes the MOVE MASTER commands from the computer one by one. Direct mode. 	<ul style="list-style-type: none"> You can not stop the robot while it executes the command. The robot will connect with the computer always.

2. Equipments

This chapter explains standard configuration ; robot arm, controller and teaching box .

Table 2.1 Standard Items

No	Items	Type	Qty	Note
1	Robot Arm	RV-E2	1	
2	Controller	CR-E110	1	
3	Machine Cable set	TE-SCBL	1	signal & power
4	User's Manual	BFP-A5823	1	
5	Reference Manual	BFP-A5824	1	
6	Specification Manual	BFP-A5818	1	
7	Installation Guide	MS-30	4	
8	Spring washers for installation bolts	For MS	4	
9	Flat washers for installation bolts	For MS	4	
10	Extra fuse	MF20R-15A-05	1	
11	Making Gears		1	

Specification manual V4.2:option explains the option products. The robot contains no power supply cable and grounding cable.

2.1 Confirmation of equipments

Tabel 2.1 shows a standard items. Make sure them.

Table 2.1 Standard Items

No.	Items	Type	Qunt.	Note
1	Robot Arm	RV-E2	1	
2	Controller	CR-E116	1	
3	Machine Cable set	1E-5CBL	1	signal & power
4	User's Manual	BFP-A5623	1	
5	Reference Manual	BFP-A5624	1	
6	Specification Manual	BFP-A5618	1	
7	Installation Bolts	M8 * 30	4	
8	Spring washers for installation bolts	For M8	4	
9	Flat washers for installation bolts	For M8	4	
10	Extra fuse	MF60NR-15A-05	1	
11	Marking Seals		1	

Specification manual /4.2:option explains the option products. The robot contains no power supply cable and grounding cable.

2.2 Connecting the equipments

Figure 2.1 shows basic connection.

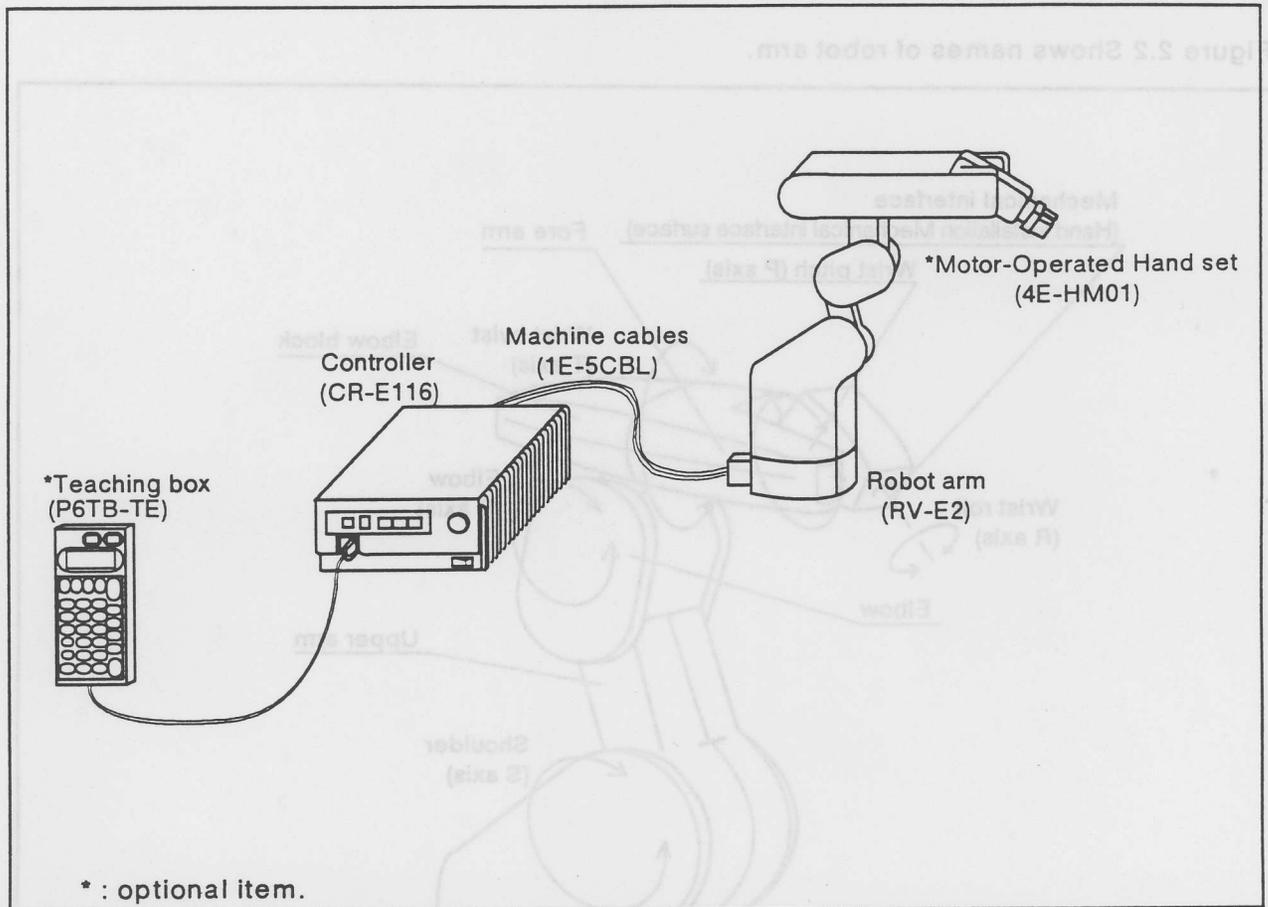


Fig. 2.1 Configuration

- Teaching box is optional product. but it is necessary for basic robot operation.
- user's manual does not explain about a personal computer .Read the refernce REference manual explains the PC connection and the programming method.
- figure 2.1 shows only basic equipments.

2.3 Understanding the robot

2.3.1 Robot arm

Figure 2.2 Shows names of robot arm.

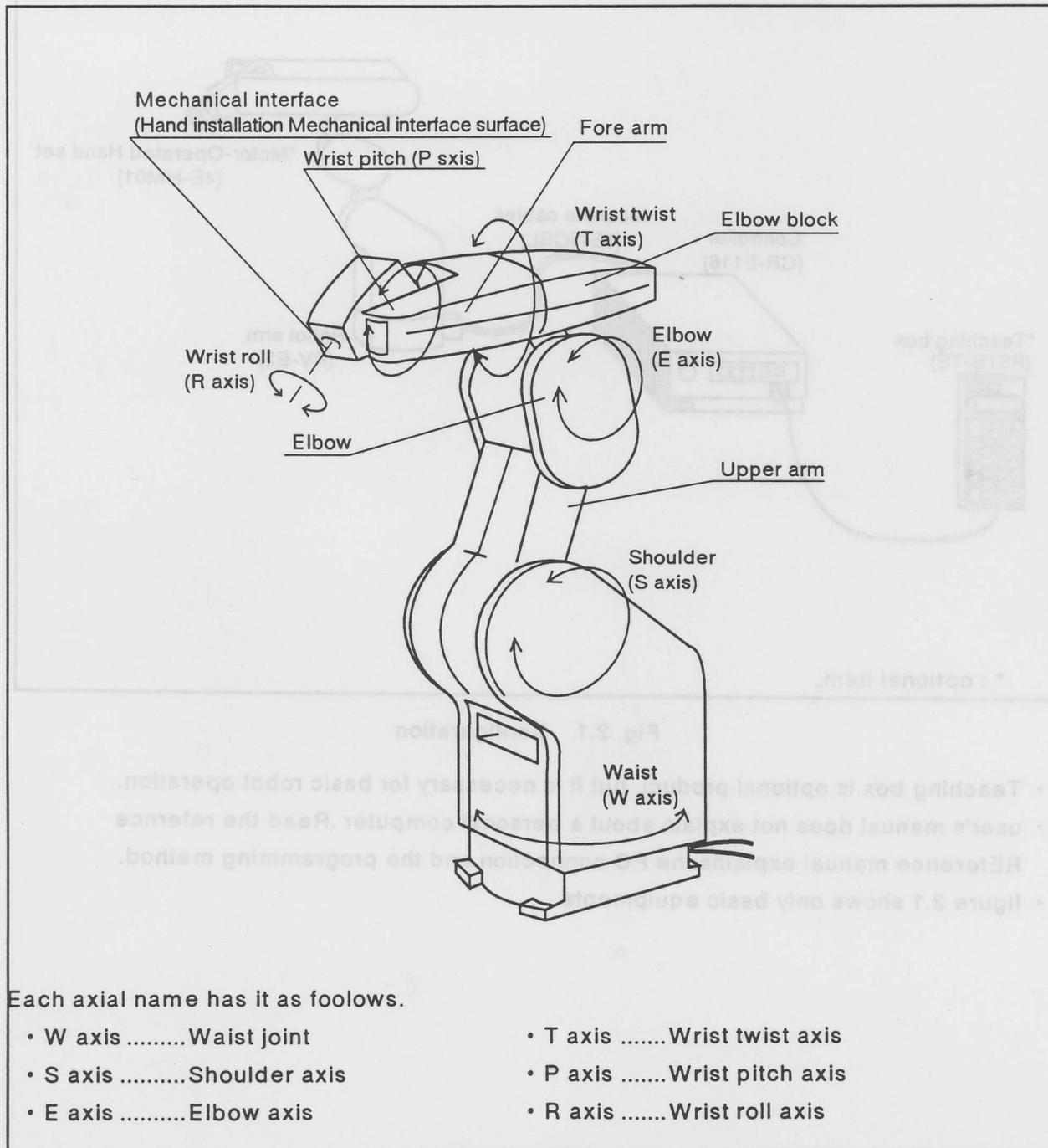


Fig. 2.2 Robot arm

2.3.2 Controller

Check the controller frontview. Figure 2.3 shows names and functions of each items.

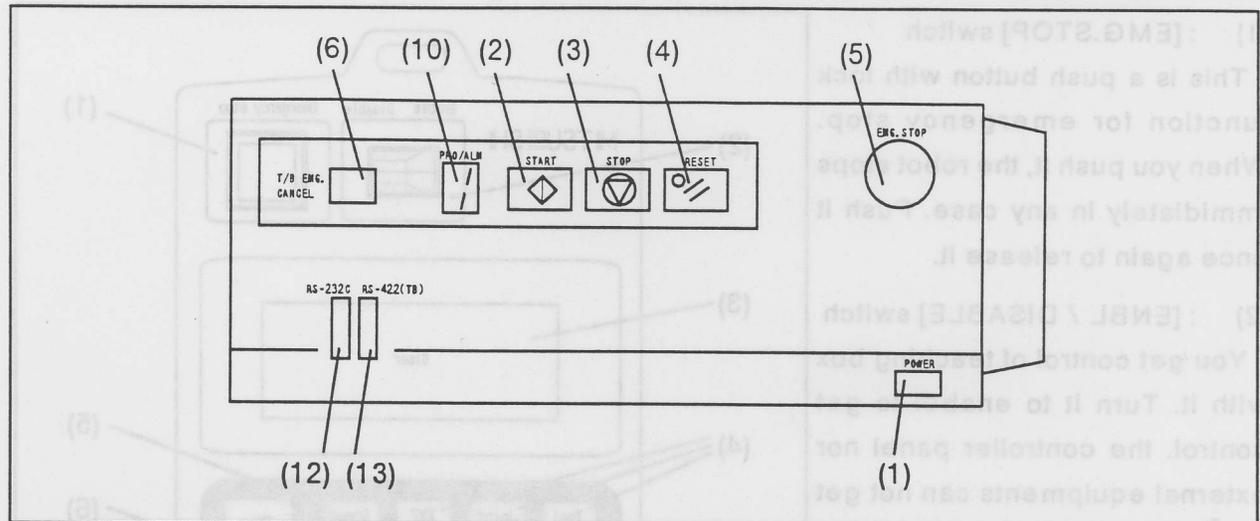


Fig. 2.3 Controller (Front view)

- | | |
|-----------------------------|--|
| (1) : POWER switch | : It is a power supply switch. |
| (2) : START switch | : It starts a program or restarts the stoping robot. |
| (3) : STOP switch | : It stops the robot. |
| (4) : RESET switch | : It resets a stopping program and sets the program at the beginning.
It removes alarm. |
| (5) : EMG.STOP switch | : It is a locking switch for emergency stop. When you push this switch, the contoller cuts off servo power and the robot in action stops immediately.
Turn it right and return it front side to reset it. |
| (6) : T/B EMG.CANCEL switch | (Emergency stop disable) : It disables emergency stop from teaching box. push it, When you do not connect a teaching box.Take off teaching box during automatic mode, after push this switch. |
| (10) : PRO/ALM display | : It Indicates program number and alarm number. it indicate " ." to show that the controller is effective. |
| (11) : RS422 receptacle: | : It Is a receptacle for the teaching box. |
| (12) : RS232C receptacle: | : It Is a receptacle for the personal computer. |

(2)(3)(4) switches have Indicating lamps.

See Reference manual /2.2.1: controller operation.

2.3.3 Teaching box

This chapter explains about teaching box and each keys.

(1) : [EMG.STOP] switch

This is a push button with lock function for emergency stop. When you push it, the robot stops immediately in any case. Push it once again to release it.

(2) : [ENBL / DISABLE] switch

You get control of teaching box with it. Turn it to enable to get control. the controller panel nor external equipments can not get control while the teaching box keeps control.

(3) : LCD

This LCD indicates a program or status of the robot. it has 4 rows and 16 columns.

(4) : [JOINT]key

It selects joint jog mode.

(4) : [XYZ] key

Push it to select XYZ JOG mode.

(5) : [SPD] key

Push it to set speed at JOG, step forward / backward or step jump operation.

(6) : [STOP] key

Push it to interrupt a program in active and decelerate a robot. it is equal to [STOP] switch on the controller front. it is effective, whenever [Enable/Disable] switch is enable or disable.

(7) : [STEP/MOVE] key

Push it with [INP / EXE] key to jumps steps.

(8) : [+ / FOWRD] key

Push it with [INP / EXE] key to feed steps forward.

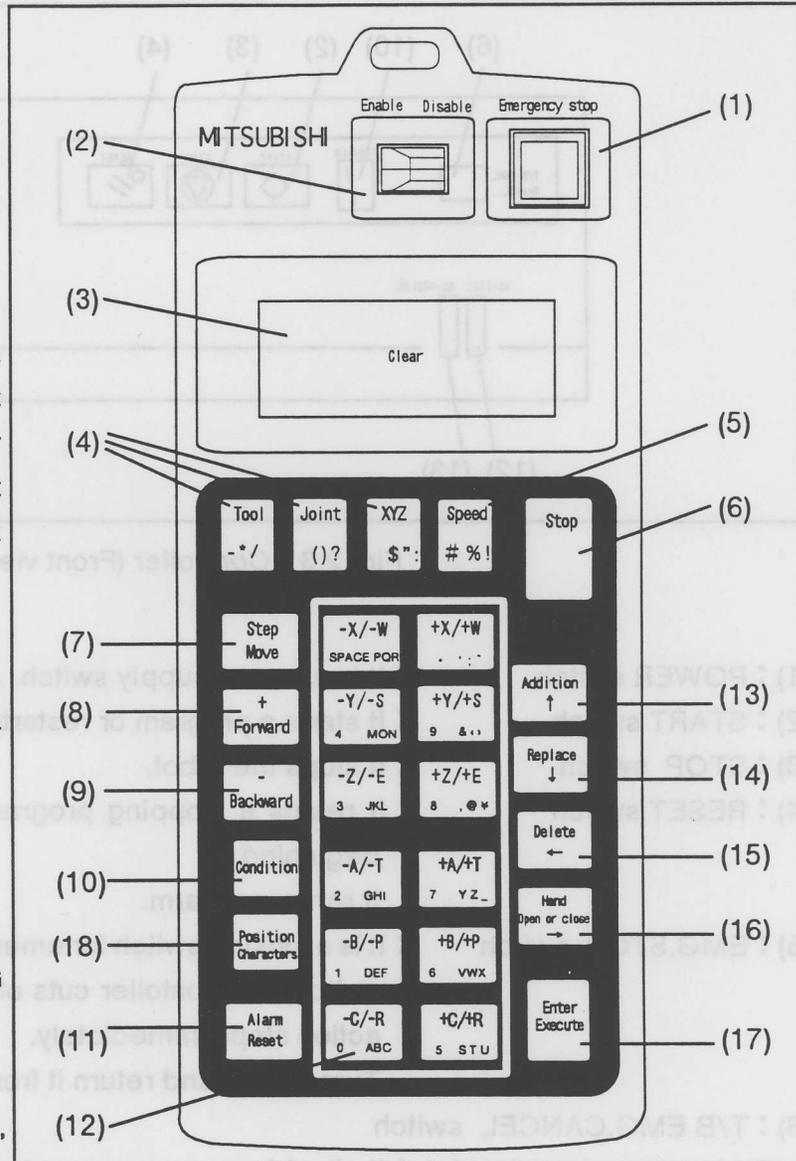


Fig. 2.4 Teaching box

(9) : [-/ BAKWD] key

Push it with [INP / EXE] key to feed steps backward.

(10) : [COND] key

Push it to set interpolation mode ,speed and timer.

(11) : [ALARM / RESET] key

Push it to reset a program in stop or alarm status.

(12) : 12 keys: {JOG operation} key [-X/-W] ~ [+C/+P]key

This manual calls them as JOG operation keys. at joint jog mode, you move each joints with them. at XYZ JOG mode, you move a robot with them along each coordinate axes. you can also input numbers with them at menu selection or step number.

(13) : [ADD ↑] key

Push it to input position and condition data for step data, or to move a cursor to upper direction.

(14) : [RPL ↓] key

Push it to modify location and condition data, or to move a cursor to down direction.

(15) : [DEL ←] key

Push it to delete location and condition data, to move a cursor to left direction.

(16) : [HAND →] key

Push it with [+C/+R] or [-C/-R] key when you move hand, or to move a cursor to right direction.

(17) : [INP / EXE] key

Push it to enter data or execute a step feed.

(18) : [POS / CHAR] key

Push it to change an editing screen, or to select digit or alphabet.

Reference manual /2.2.2: teaching box operation explains each keys.

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- (9) : [-\ BAKWD] key
Push it with [INP \ EXE] key to feed steps backward.
 - (10) : [COND] key
Push it to set interpolation mode, speed and timer.
 - (11) : [ALARM \ RESET] key
Push it to reset a program in stop or alarm status.
 - (12) : 12 keys: [JOG operation] key [-X-W] ~ [+C+P] key
This manual calls them as JOG operation keys. At joint jog mode, you move each joint with them. At XYZ JOG mode, you move a robot with them along each coordinate axes. You can also input numbers with them at menu selection or step number.
 - (13) : [ADD ↑] key
Push it to input position and condition data for step data, or to move a cursor to upper direction.
 - (14) : [RPL ↓] key
Push it to modify location and condition data, or to move a cursor to down direction.
 - (15) : [DEL ←] key
Push it to delete location and condition data, to move a cursor to left direction.
 - (16) : [HAND →] key
Push it with [+C+R] or [-C+R] key when you move hand, or to move a cursor to right direction.
 - (17) : [INP \ EXE] key
Push it to enter data or execute a step feed.
 - (18) : [PROG \ CHAR] key
Push it to change an editing screen, or to select digit or alphabet.
- Reference manual V3.2.2: teaching box operation explains each keys.

3. Setting up the Move Master Super

This chapter explains how to set up the Move Master Super.

- (1) Open the cardboard box as figure 3.1 (1).
- (2) Put aside the box gently as figure 3.1(2).
- (3) Draw the packing A and B as figure 3.1(3).
- (4) Put off the packing A.
- (5) Keep the packing B with the robot. Put it up as figure 3.1(4).
- (6) Put away the packing B.

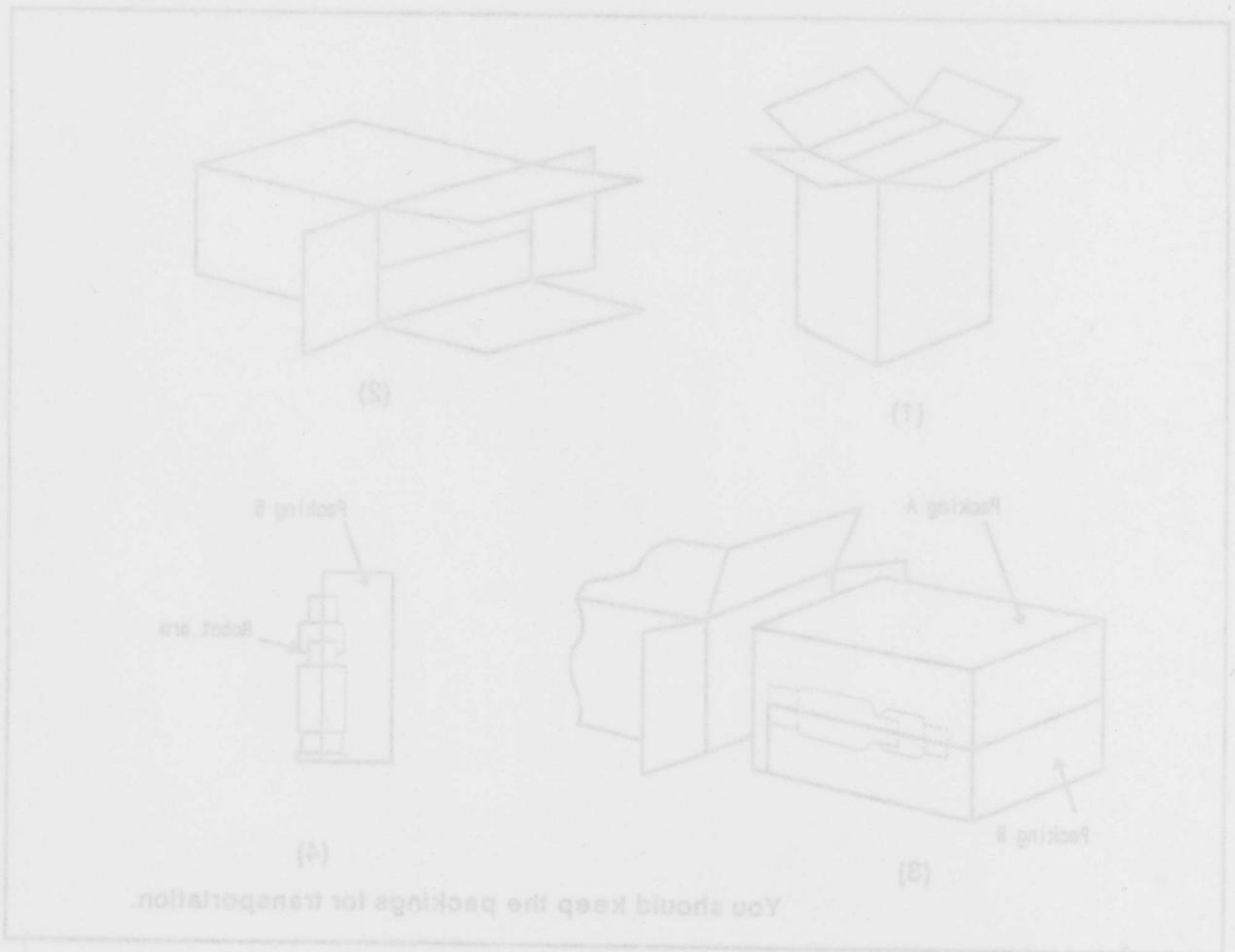


Fig. 3.1 Unpacking the robot arm

3.1. How to unpack the robot

3.1.1 The robot arm

The cardboard box contains the robot. Figure 3.1 shows how to unpack the robot. This manual /3.2: robot arm explains how to handle the robot.

- (1) Open the cardboard box as figure 3.1 (1).
- (2) Put side down the box gently as figure 3.1(2).
- (3) Draw the packing A and B as figure 3.1(3).
- (4) Put off the packing A.
- (5) Keep the packing B with the robot. Put it up as figure 3.1(4).
- (6) Put away the packing B.

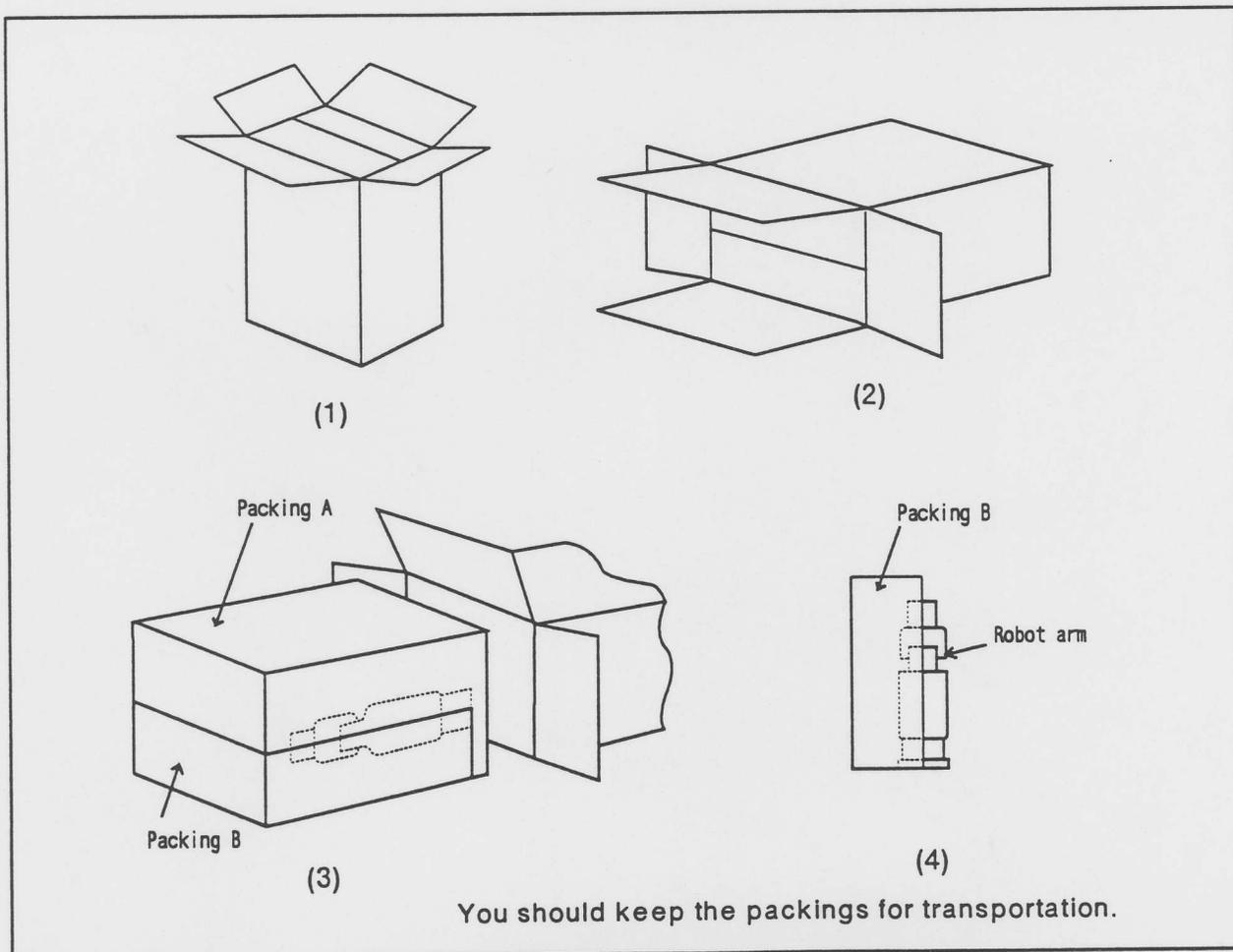


Fig. 3.1 Unpacking the robot arm

3.1.2 controller

The cardboard box contains the controller. Figure 3.2 shows how to unpack the controller. This manual /3.3: controller explains how to handle the controller.

- (1) Open the cardboard box as figure 3.2(1).
- (2) Draw the controller with inner packing as figure 3.1 (2).
- (3) Put away an accessory.
- (4) Lift up the controller to put away the packing as figure 3.2 (3).
The left side of the controller is so heavy that you should pay attention to it.
- (5) Put down the controller.

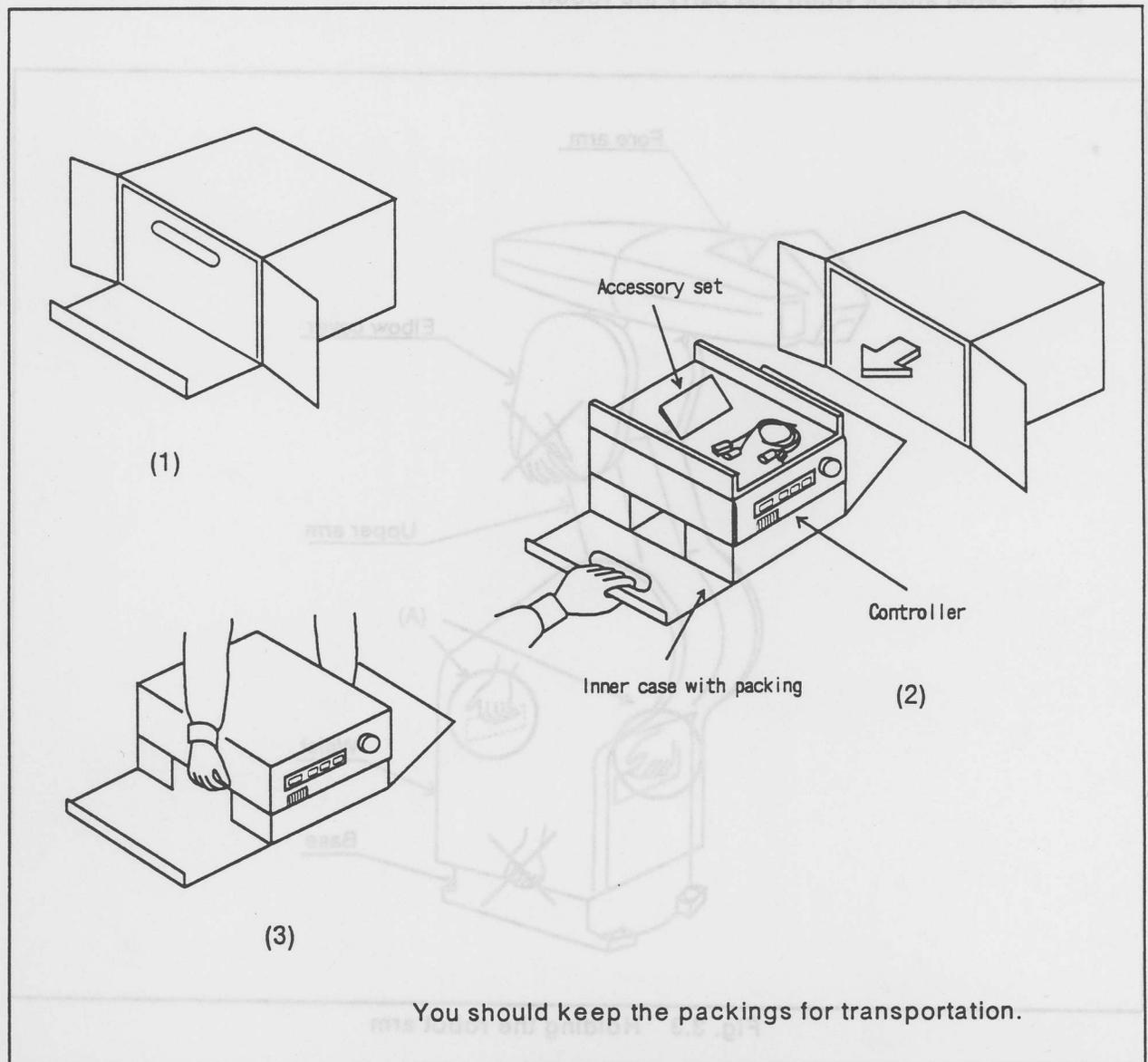


Fig. 3.2 Unpacking the controller

3.2 How to handle the robot arm.

This section explains how to handle the robot arm.

■ How to handle the robot arm.

Figure 3.3 Shows the pause and handling points at holding.

- (1) Hold the robot arm to take the handle (A) at transportation.
You will destroy to take the covers without handle.
- (2) Do not put the force on the covers at transportation.
- (3) Carry it with a cart. Take it with handle only temporarily.
- (4) Do not carry the robot by one person.
- (5) Avoid shock when you carry the robot.

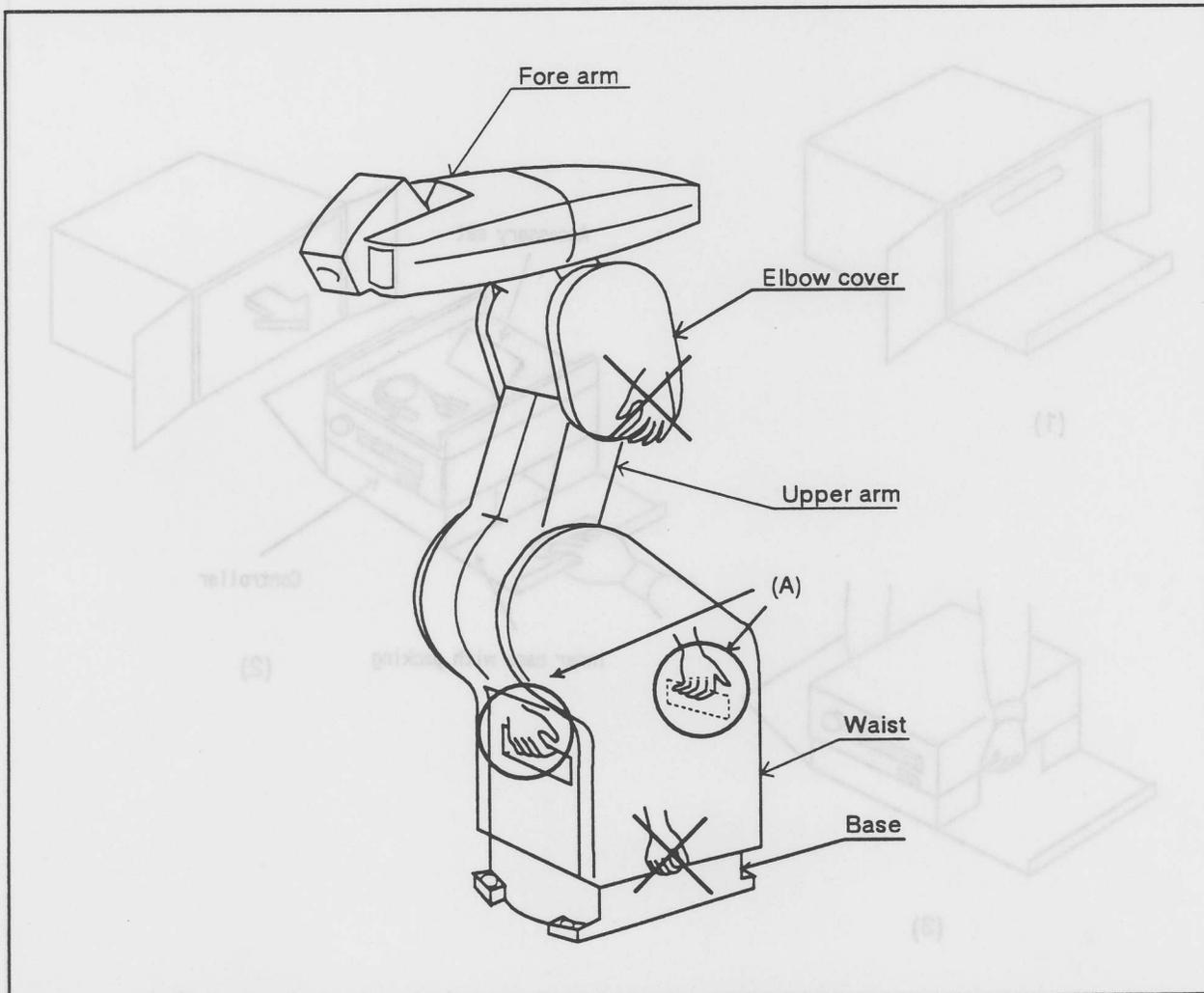


Fig. 3.3 Holding the robot arm

■ How to attach the robot arm

Figure 3.4 shows how to attach the robot arm to the floor and a set screw dimension of the robot arm.

- (1) Set side of robot arm has machining finish.
- (2) Fix robot arm surely to use the fix hole opened at base corners (4- $\phi 9$) and with bolts (M8 * 30 hexagon socket head bolts). Fix the robot arm horizontally.
- (3) Face relative roughness of installation face should be above $\nabla \nabla$. When installation face is rough, the robot may get malfunction.

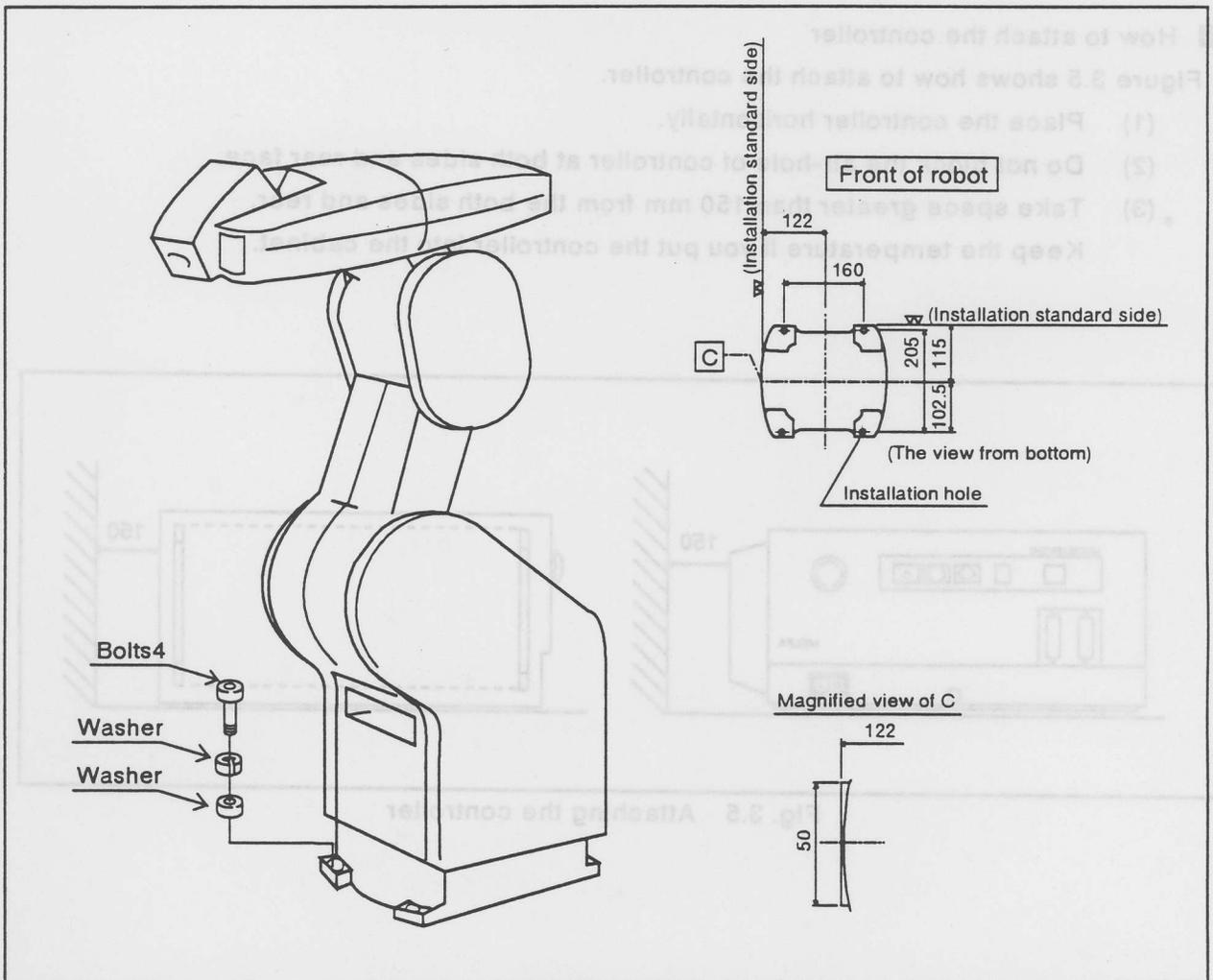


Fig 3.4 Attaching the robot arm

3.3 How to handle the controller

This section Explains how to handle the controller.

■ How to hold the controller

This sub-section explains how to hold the controller.

- (1) Do not hold the controller by one person.
- (2) Hold the front and rear side to lift it up. Do not hold the switches, connectors and radiation fins.
- (3) The left side of the controller is so heavy that you should pay attention to it.

■ How to attach the controller

Figure 3.5 shows how to attach the controller.

- (1) Place the controller horizontally.
 - (2) Do not block the air-hole of controller at both sides and rear face.
 - (3) Take space greater than 150 mm from the both sides and rear.
- Keep the temperature if you put the controller into the cabinet.

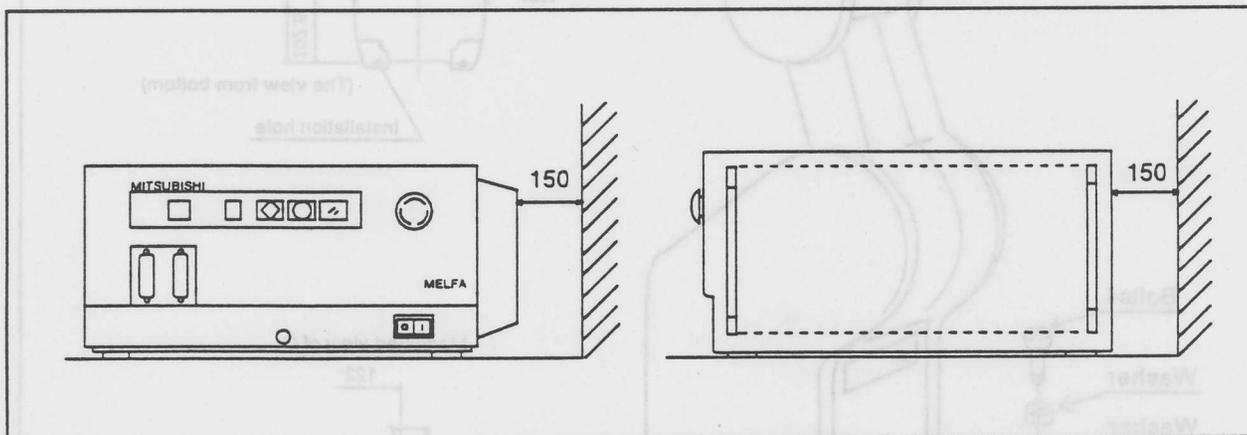


Fig. 3.5 Attaching the controller

3.4 How to connect the machine cables.

Figure 3.6 shows how to connect the machine cables.

- (1) Turn off the controller.
- (2) Connect the machine cables to the robot arm and the controller.
- (3) Screw up the connector shells.
- (4) Do not pull or bend the cables extremely to avoid their damage.

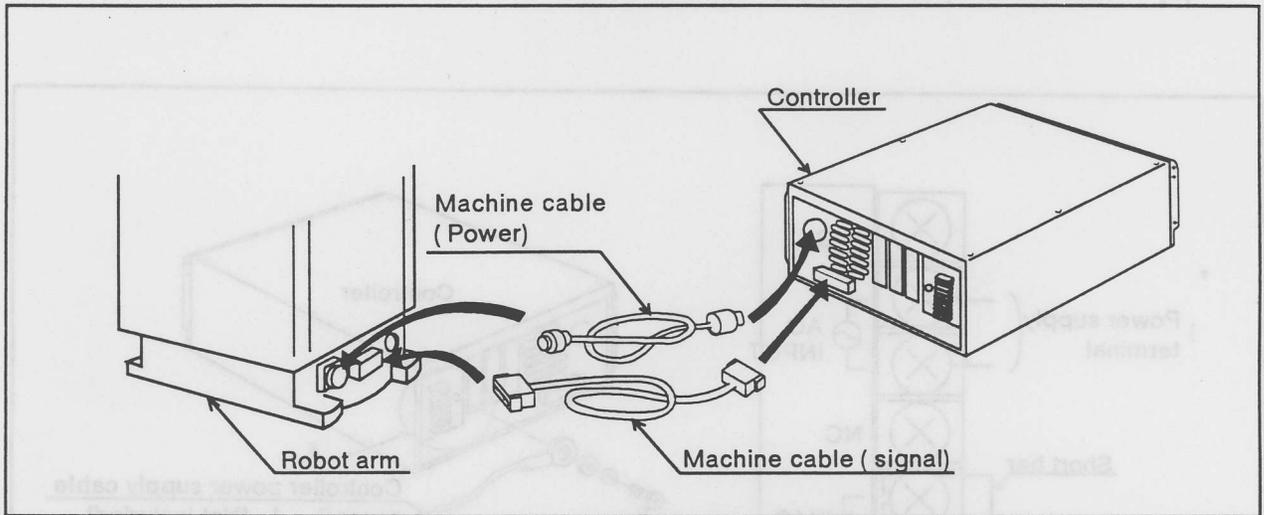


Fig. 3.6 Connecting the machine cables

3.5 How to connect the power cable

Figure 3.7 shows how to connect the power cable.

- (1) Confirm if the electric supply voltage is correct.
- (2) Turn off the power supply.
- (3) Cable should be above 2 mm square.
- (4) Connect power cable to the AC-INPUT terminal at the back panel.
- (5) Confirm if the cable connects the terminal block firmly.
- (6) Turn on the power supply after setup.

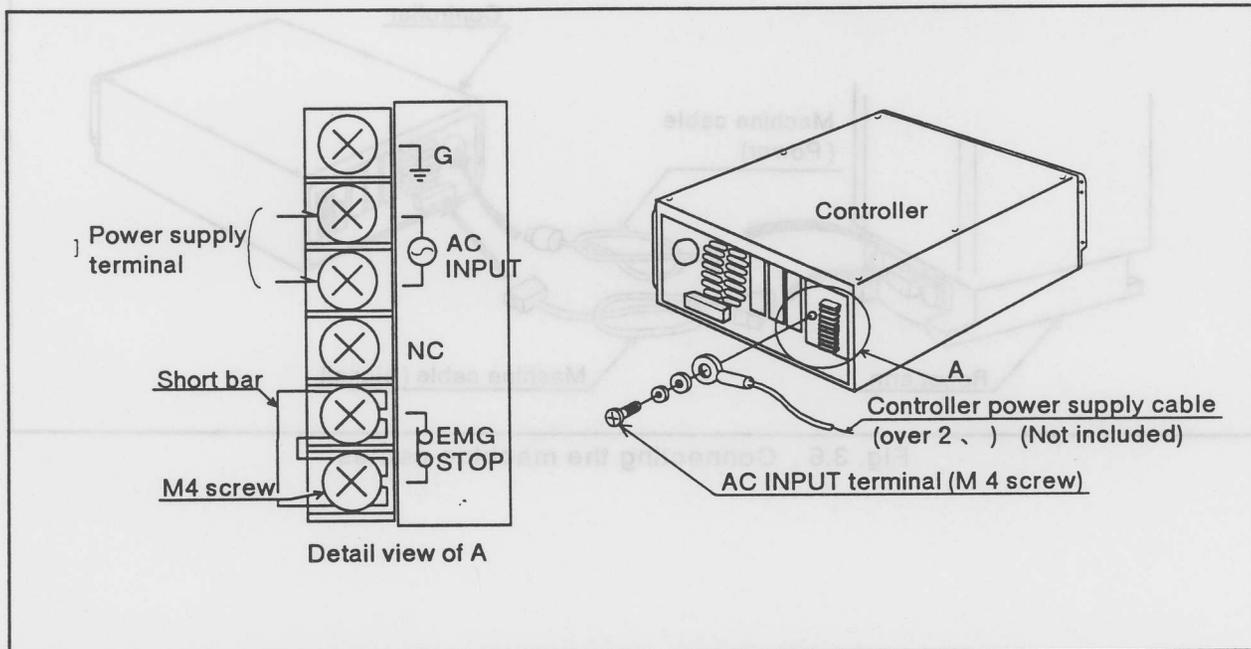


Fig. 3-7 Connecting the power cable

■ Emergency stop terminal

An EMG.STOP terminal has a short bar. External emergency stop switch shall be normally close type.

Do not take off a short bar without the external switch.

Emergency stop switch should put it on for safety.

3.6 How to ground the robot.

This section explains how to ground the robot arm and controller.

- (1) Figure 3.8 shows how to ground.

The independent grounding is the best.

- The robot arm grounds with a M 3 screw hole in base. (A cf. figure 3.9)
- The controller grounds with a ground terminal on rear face. (A cf. figure 3.10)

- (2) The grounding resistance should be less than 100 ohm.

It is better to separate the robot grounding from other equipments.

- (3) The grounding cables should be more than 2 mm square.
 (4) The ground cables should be as short as possible.

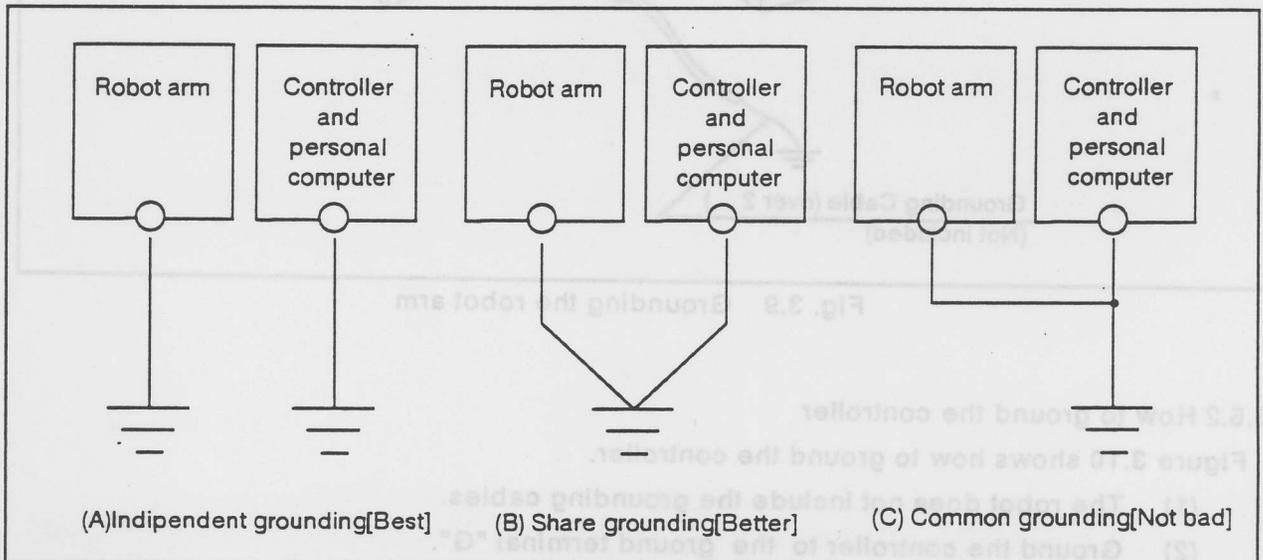


Fig. 3.8 Grounding



3.6.1 Grounding the robot arm

Figure 3.9 shows how to ground the robot arm.

- (1) The robot do how to connect the controller.
- (2) Confirm the grounding screw without coating or rust, or remove them
- (3) Connect grounding cable to grounding terminal.

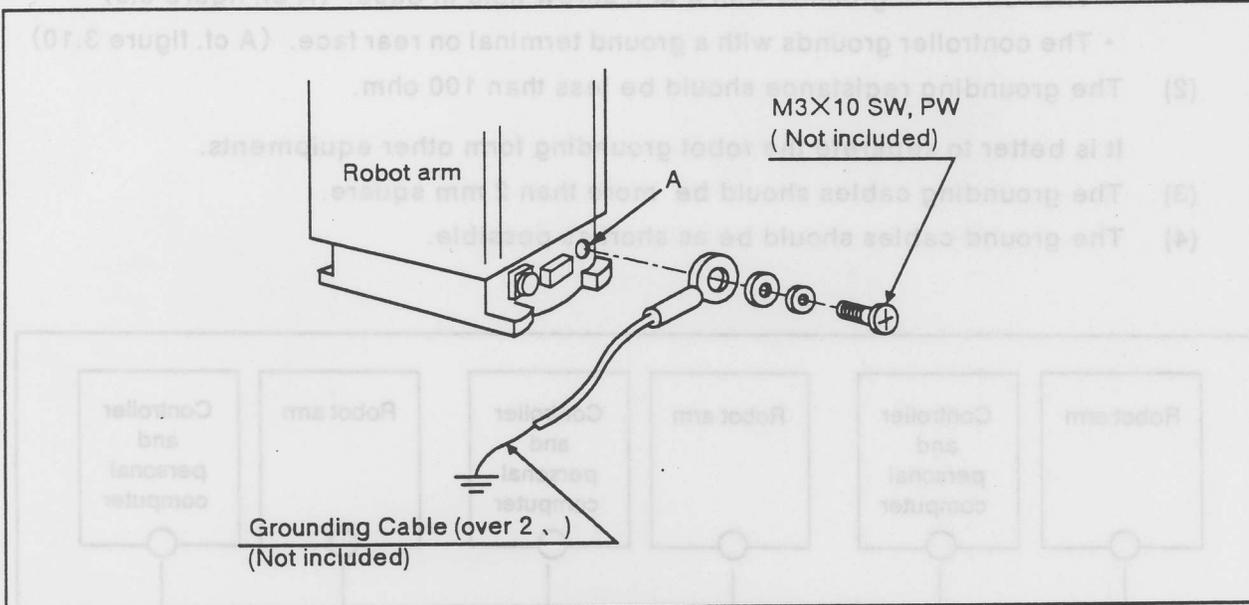


Fig. 3.9 Grounding the robot arm

3.6.2 How to ground the controller

Figure 3.10 shows how to ground the controller.

- (1) The robot does not include the grounding cables.
- (2) Ground the controller to the ground terminal "G".

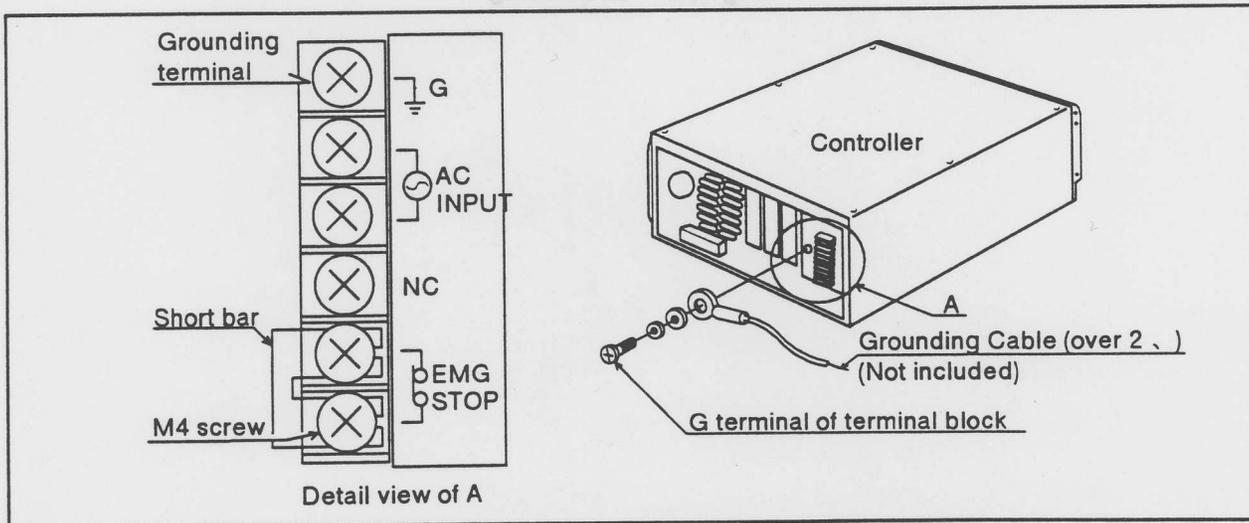


Fig. 3.10 Grounding the controller

3.7 How to connect the teaching box

Figure 3.11 shows how to connect the teaching box.

- (1) Turn off the controller.
- (2) Connect the teaching box to RS - 422 connector of controller.
- (3) Fix it with set screws firmly.
Do not pull or bend the cable extremely to avoid their damage.
- (4) T/B EMG. on the front confirm that CANCEL switch is not down. The controller beeps when CANCEL switch is down. Push it once to rise.
- (5) Operation is enable to turn on the power.

TIPS

Push EMG. CANCEL switch on the teaching box when you unplug it.

The robot gets emergency stop status when you put up EMG. CANCEL switch.

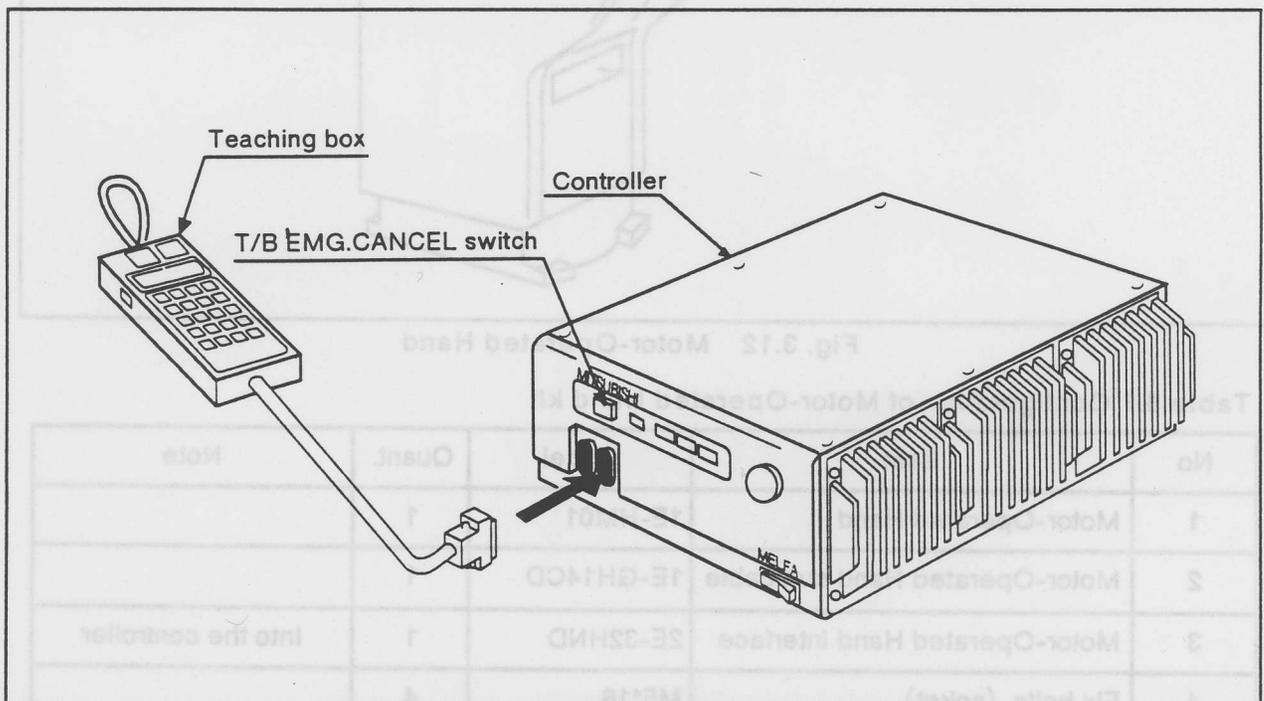


Fig. 3.11 Installing the teaching box

3.8 How to installation of the Motor-Operated Hand

The model 4E-HM01 kit that includes the Motor-Operated Hand and accessory is necessary to use the Motor-Operated Hand.

Figure 3.12 and table 3.1 show the Motor-Operated Hand set.

Reference manual /1: Handling explains the air hand kit: 4E-HP01.

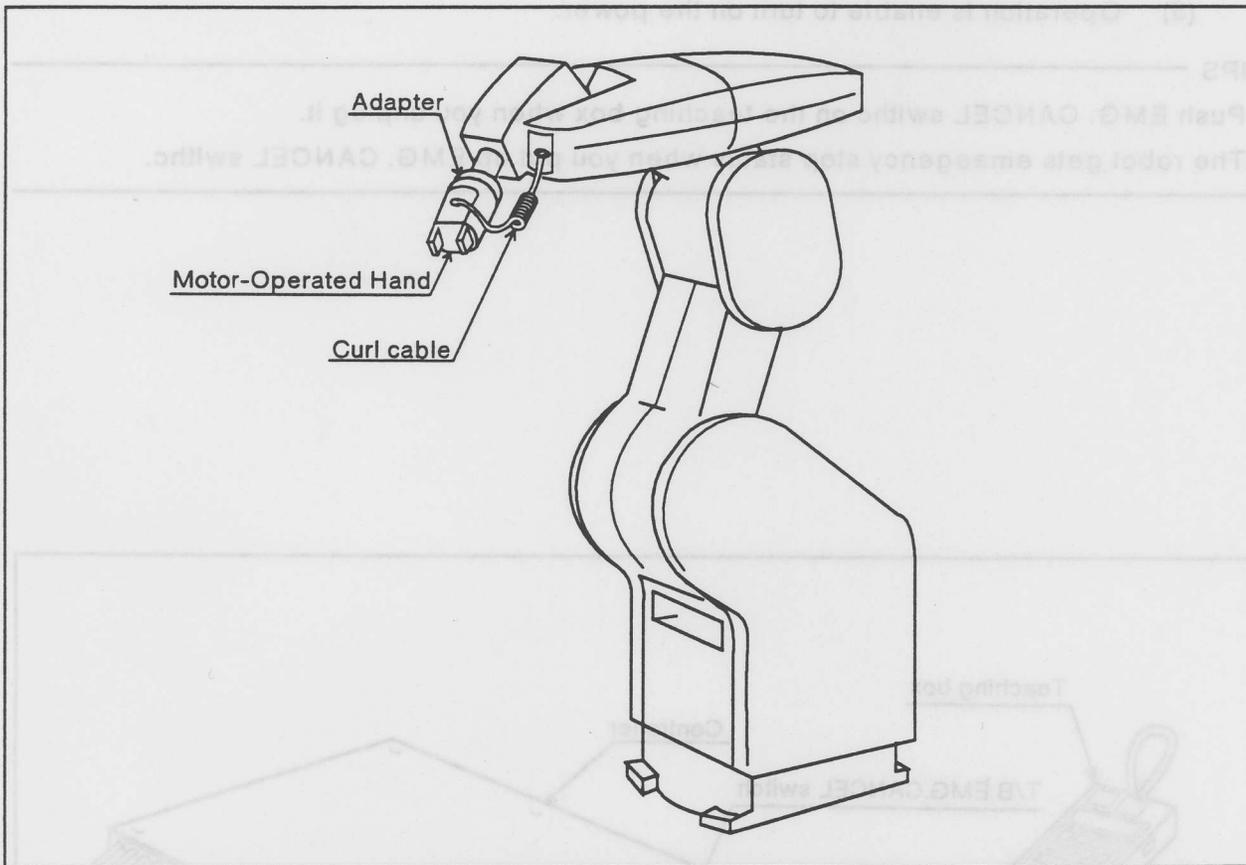


Fig. 3.12 Motor-Operated Hand

Table 3.1 Configuration of Motor-Operated Hand kit

No	Item	Model	Quant.	Note
1	Motor-Operated Hand	1E-HM01	1	
2	Motor-Operated Hand curl cable	1E-GH14CD	1	
3	Motor-Operated Hand interface	2E-32HND	1	Into the controller
4	Fix bolts (soket)	M5*16	4	
5	Fix bolts (soket)	M3*12	2	
6	Adapter	BU144D697H01	1	

3.8.1 How to install the Motor-Operated Hand interface

Figure 3.13 shows how to install the Motor-Operated Hand interface.

- (1) Turn off the power switch.
- (2) Take off cover.
- (3) install the Motor-Operated Hand interface board in the connector.
- (4) Tighten it with a attached mount screw.
- (5) Put on the cover.

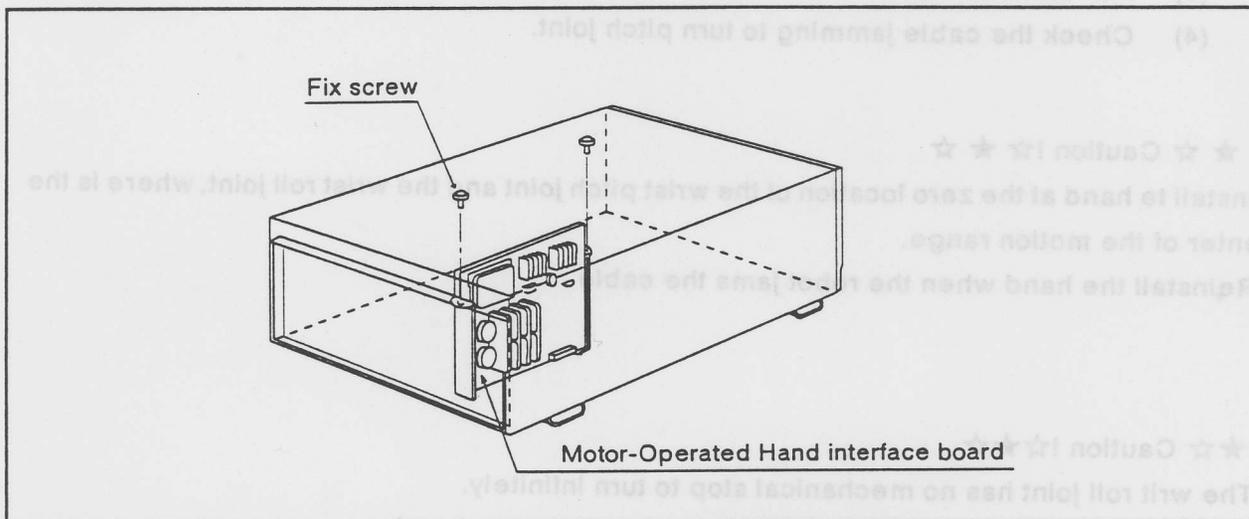


Fig. 3.13 Installing the interface board

3.8.2 How to install the Motor-Operated Hand

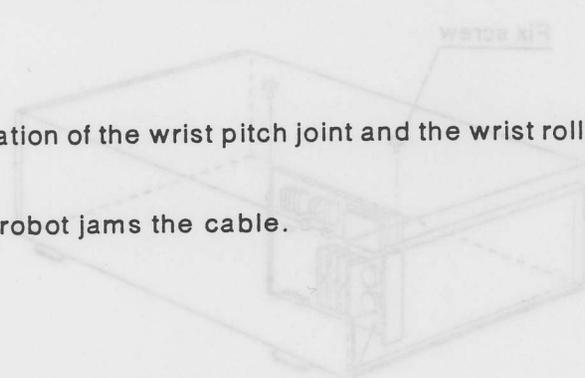
Figure 3.14 shows how to install the Motor-Operated Hand.

- (1) Fix the mechanical interface adapter on the robot arm tip with four M 5*16 hexagon socket bolts.
- (2) Fix the Motor-Operated Hand on the mechanical interface adapter with two M 3*12 hexagon socket bolts. Figure 3.15 shows the Motor-Operated Hand and the mechanical interface adapter.
- (3) Fix curl cable after of the Motor-Operated Hand as figure 3.14 firmly.
- (4) Check the cable jamming to turn pitch joint.

☆☆☆ Caution !☆☆☆

Install te hand at the zero location of the wrist pitch joint and the wrist roll joint, where is the center of the motion range.

Reinstall the hand when the robot jams the cable.



☆☆☆ Caution !☆☆☆

The writ roll joint has no mechanical stop to turn infinitely.

The forced over turn (over +/-200 deg.) may cause encoder alarm.

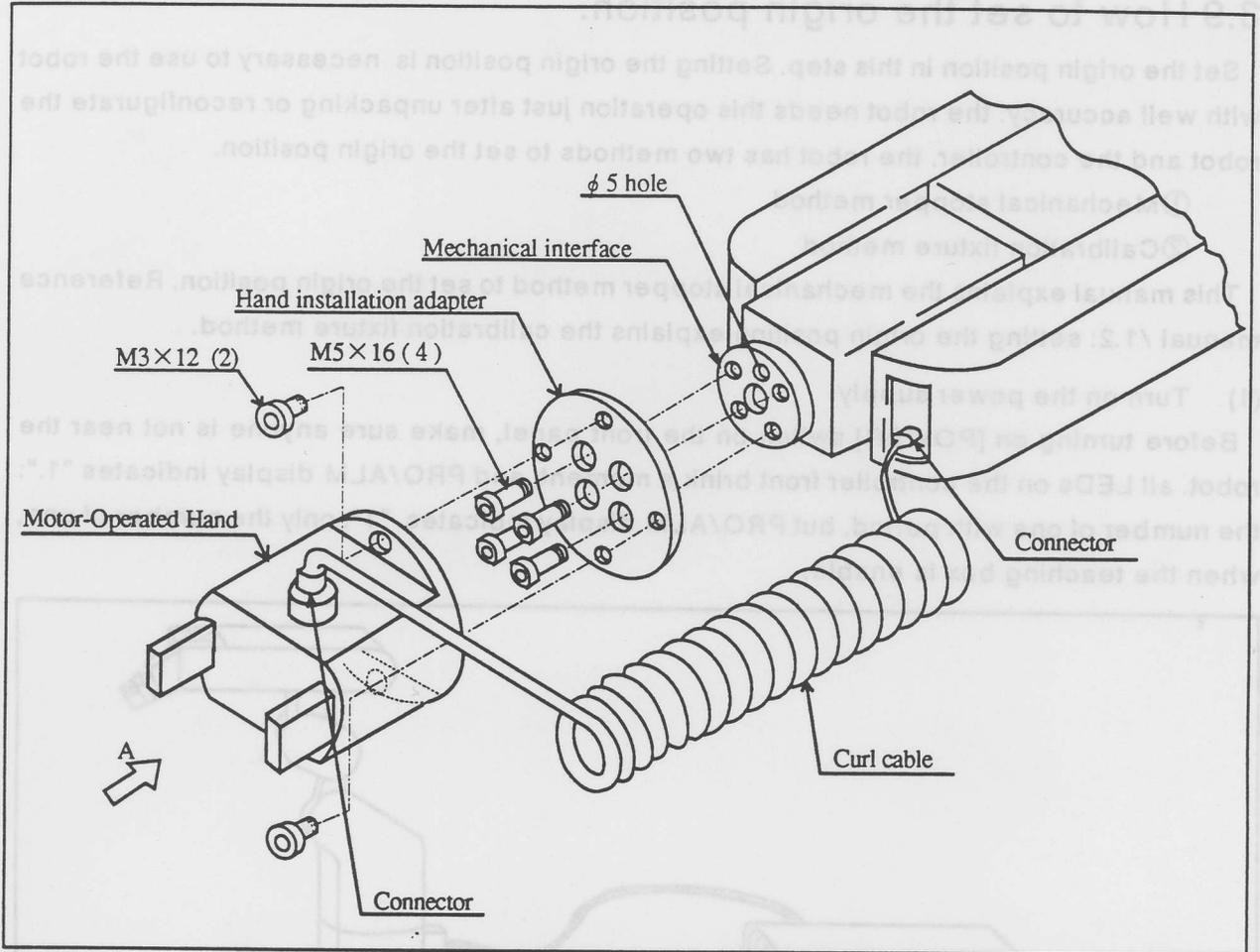
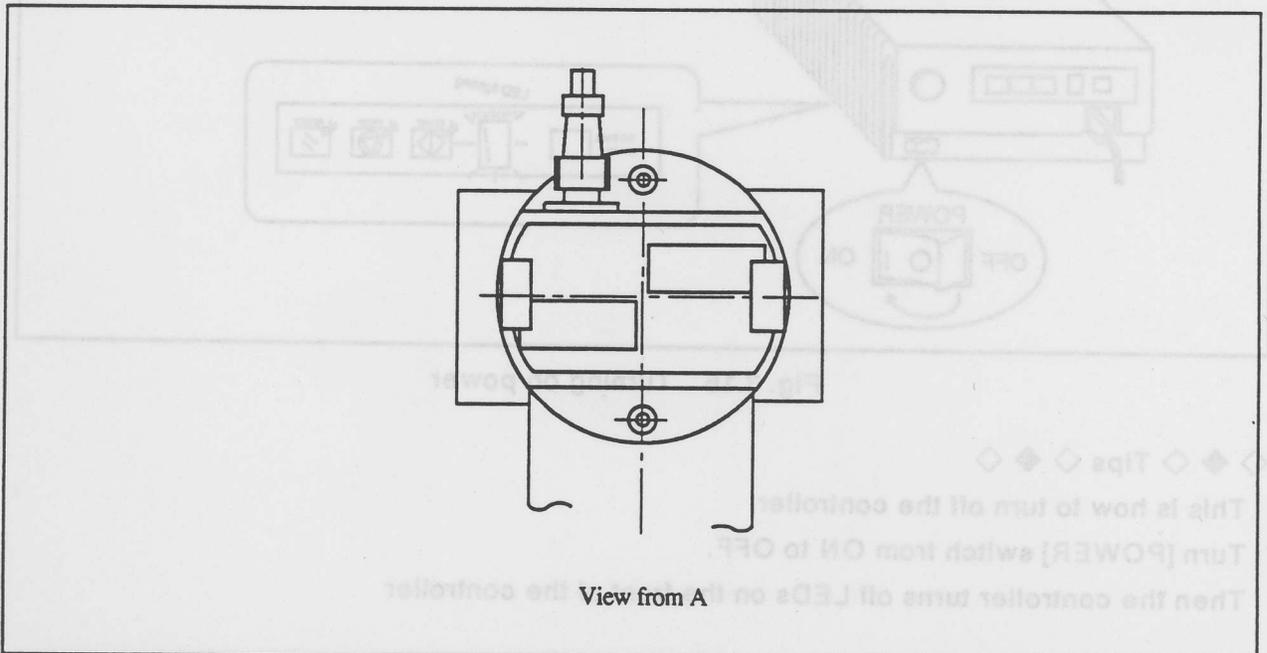


Fig. 3.14 Installing the Motor-Operated Hand



View from A

Fig. 3.15 Hand installation location

3.9 How to set the origin position.

Set the origin position in this step. Setting the origin position is necessary to use the robot with well accuracy. the robot needs this operation just after unpacking or reconfigure the robot and the controller. the robot has two methods to set the origin position.

- ① Mechanical stopper method
- ② Calibration fixture method

This manual explains the mechanical stopper method to set the origin position. Reference manual /1.2: setting the origin position explains the calibration fixture method.

(1) Turn on the power supply.

Before turning on [POWER] switch on the front panel, make sure anyone is not near the robot. all LEDs on the controller front brink a moment, and PRO/ALM display indicates "1.": the number of one with period. but PRO/ALM display indicates "1": only the number of one, when the teaching box is enable.

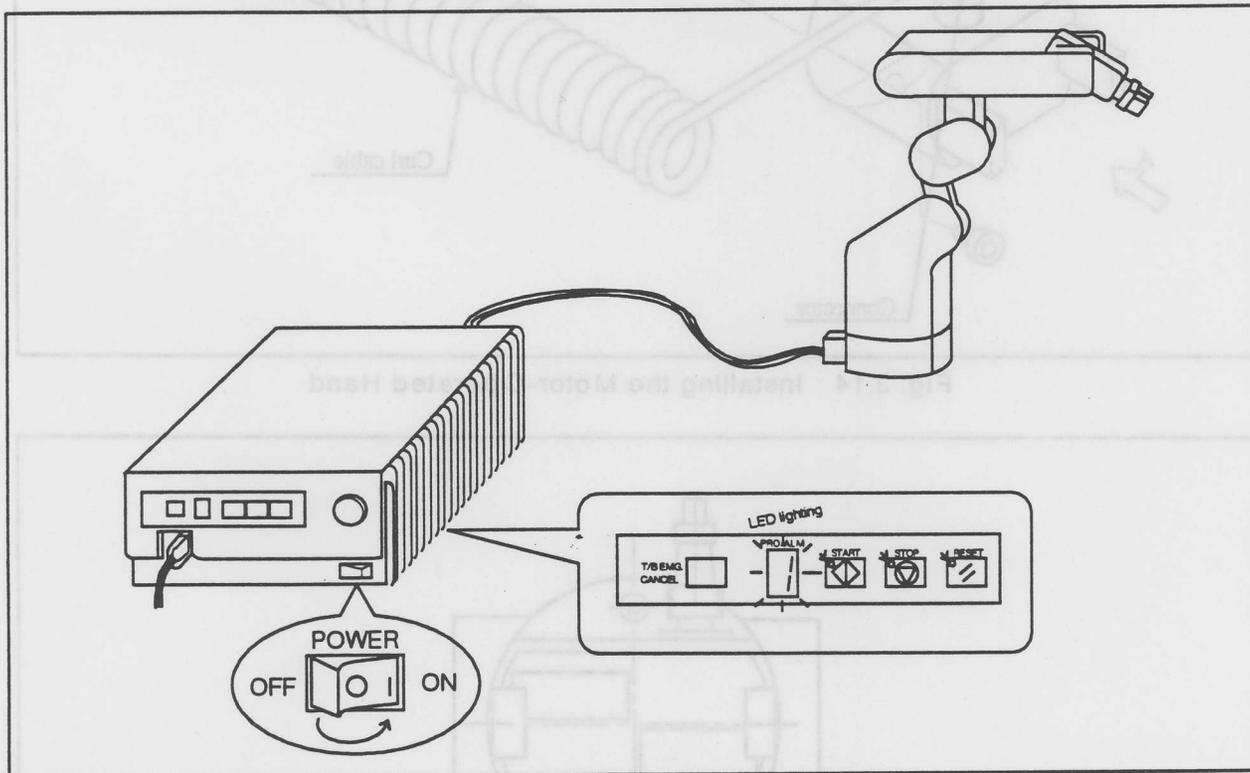


Fig. 3.16 Turning on power

◆ ◆ ◆ Tips ◆ ◆ ◆

This is how to turn off the controller

Turn [POWER] switch from ON to OFF.

Then the controller turns off LEDs on the front of the controller

(2) Set up the teaching box

Turn on [enable/ disable] switch to set up the teaching box.

The display shows menu selection screen.

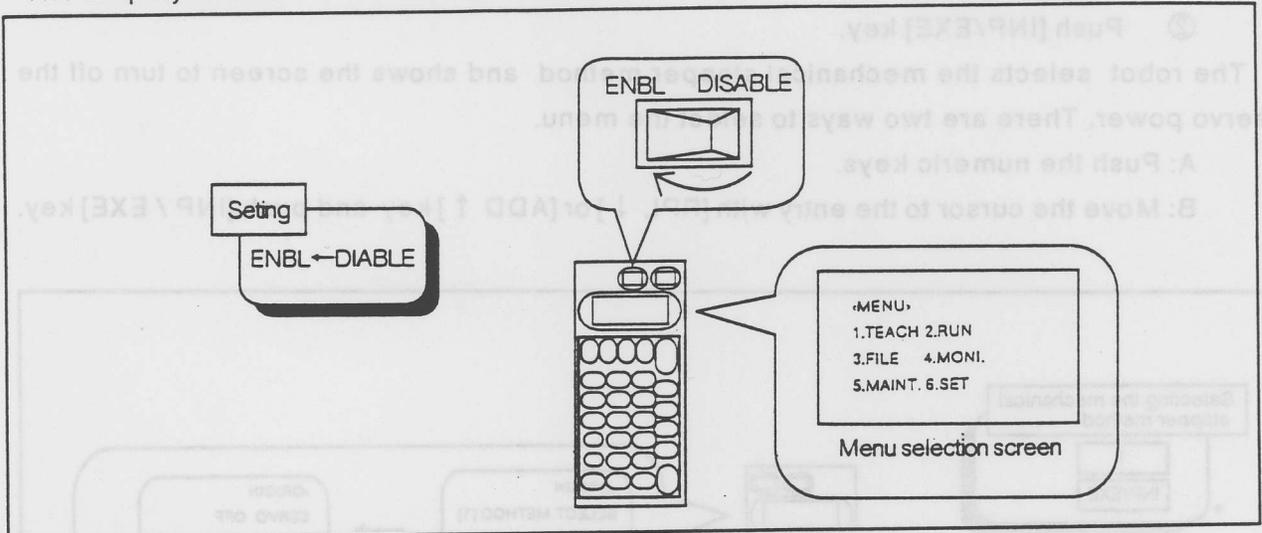


Fig. 3.17 Setting up the teaching box

☆☆☆ Caution! ☆☆☆

You should turn [ENBL/ DISABLE] switch to ENABLE to get control from teaching box. so no one can get control from the controller nor the external equipments. although EMG. STOP and STOP are effective from any equipment for safety. You should turn [ENABL/ DISABLE] switch to DISABLE, and then quickly backing to ENABLE to undo.

(3) Select the origin position screen.

- ① Push [5] (+C/+R) key. (Select 5. "Maintenance" in the menu screen)
The display shows Maintenance screen.
- ② Push [5] (+C/+R) key. (Select 5. "Origin position" in the maintenance screen)
The display shows the Select screen of the origin position setting method.

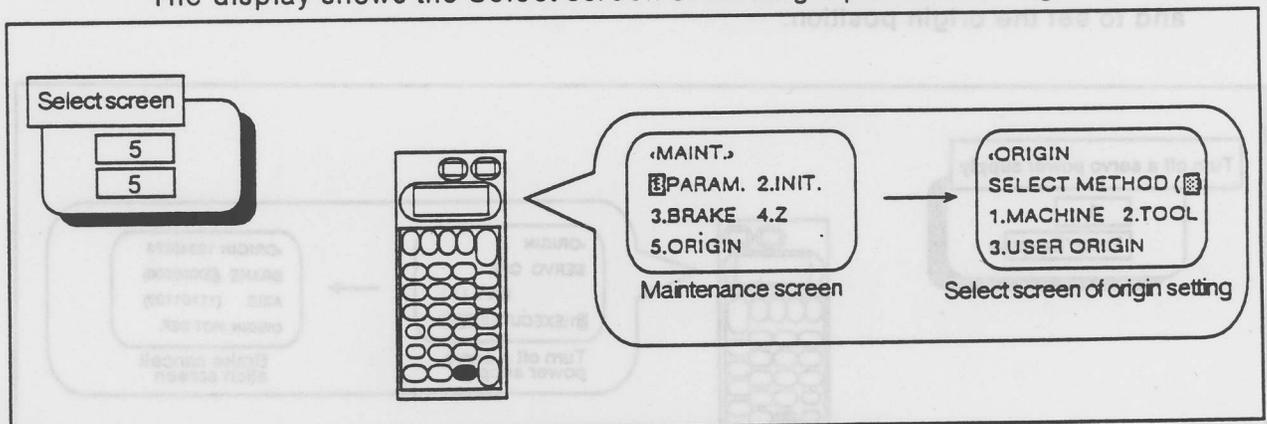


Fig. 3.18 Select screen of origin setting

(4) Select the mechanical stopper method.

① Push [1] key. (Select 1. "mechanical stopper" in select screen of origin position setting method)

② Push [INP/EXE] key.

The robot selects the mechanical stopper method and shows the screen to turn off the servo power. There are two ways to select the menu.

A: Push the numeric keys.

B: Move the cursor to the entry with [RPL ↓] or [ADD ↑] key and push [INP / EXE] key.

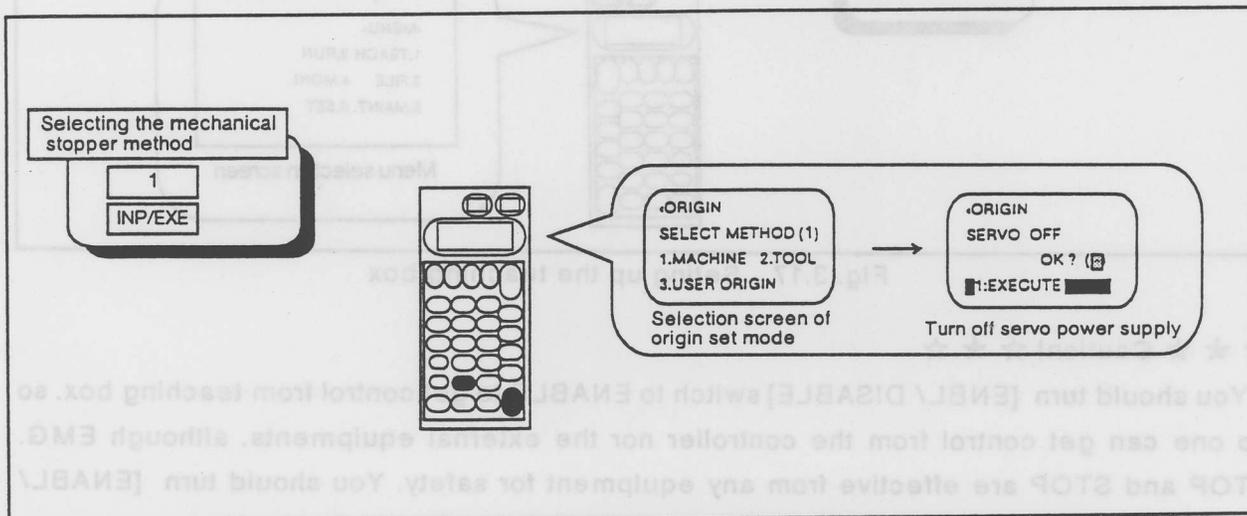


Fig. 3.19 Selecting the mechanical stopper mode

(5) Turn off the servo power.

① Push [1] key.

② Push [ENT / EXE] key.

The servo power is out, and the display shows the screen to release the brake and to set the origin position.

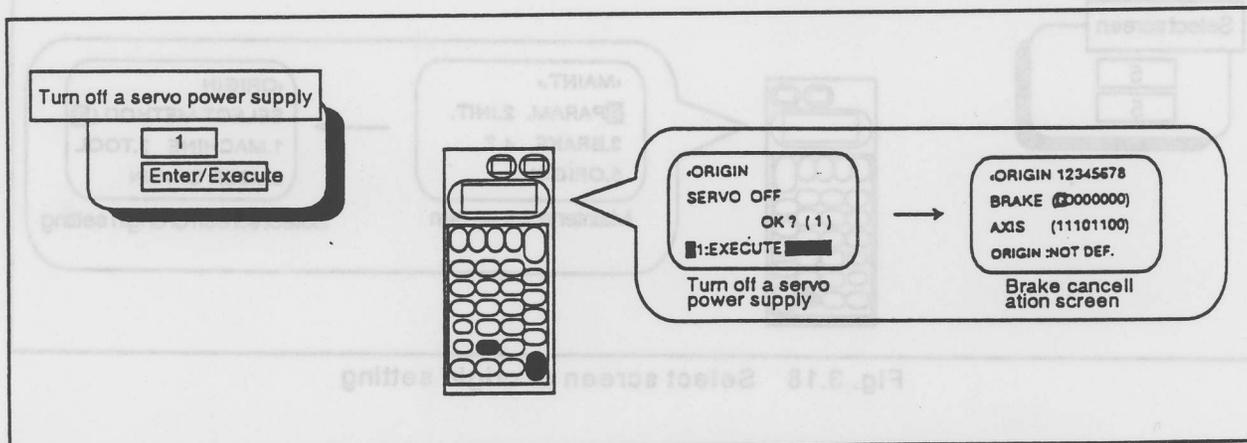


Figure 3.20 Turn off a servo power supply

(6) Setting the waist origin position

- ① Push [1] key. The "1" appears at the first position: (waist) to release brake.

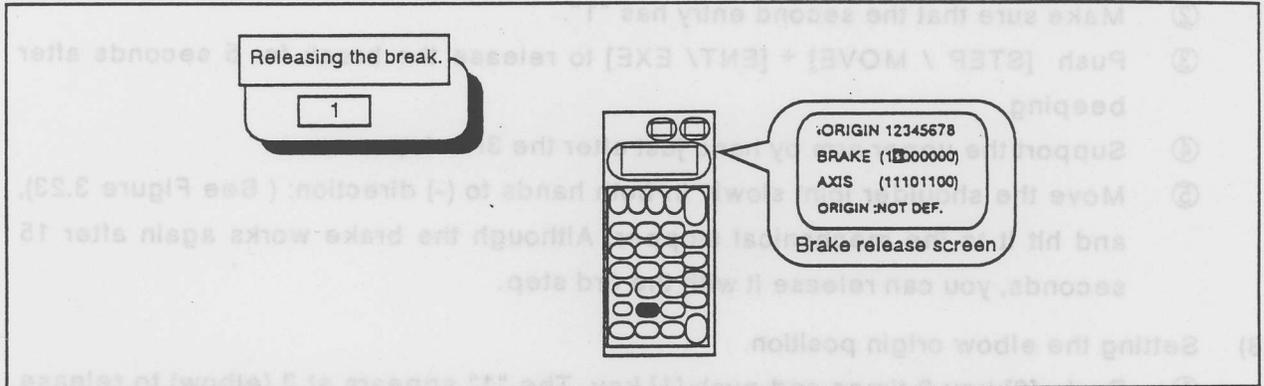


Fig. 3.21 Releasing the brake

- ② Make sure that the first entry has "1".
- ③ Push [STEP / MOVE] + [ENT / EXE] to release the brake for 5 seconds after beeping.
- ④ Move the waist joint slowly in both hands to (-) direction: (See Figure 3.22), and hit it to the mechanical stopper. Although the brake works again after 15 seconds, you can release it with the 3rd operation.

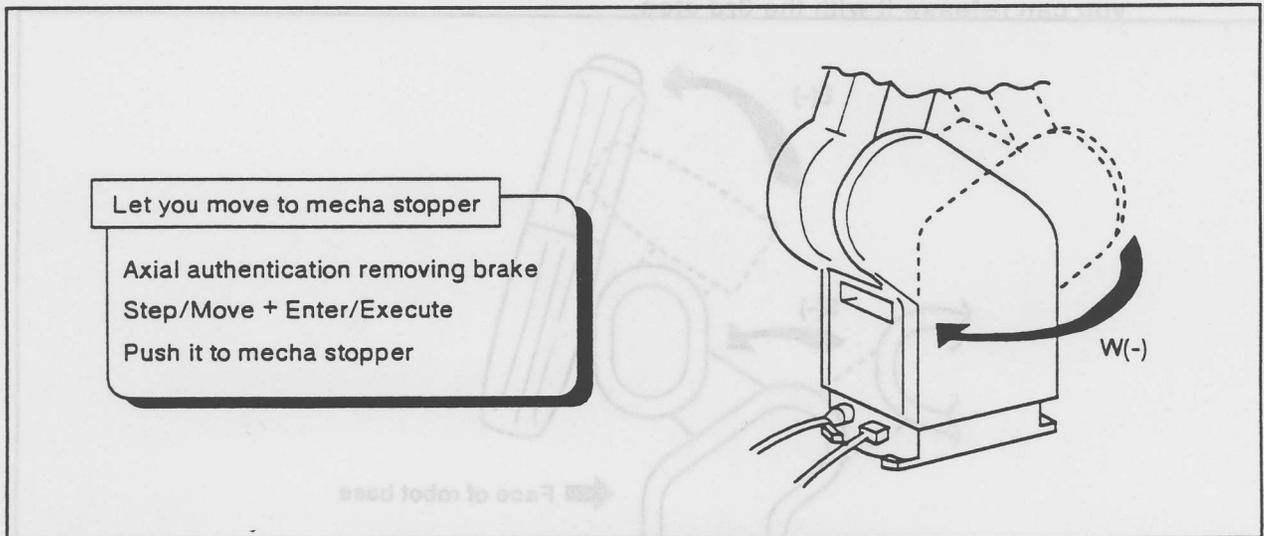


Fig. 3.22 Setting the wrist axial origin

◆ ◆ ◆ Tips ◆ ◆ ◆

Move the cursor with [DEL ←] or [HAND →] key to each entries. the first entry means the waist joint. the second means the shoulder joint. the third entry means the shoulder joint. the 4th, 5th and 6th entry are ineffective.)

Set "0" at the entry / entries to keep the break / breaks. Only the joint that has "1" at its entry.

Push any key on the teaching box to make break immediately.

- (7) Setting the origin position for the shoulder joint.
- ① push [0] key, and then push [1] key.
The "1" appears at the second entry (the shoulder joint) to release the brake.
 - ② Make sure that the second entry has "1".
 - ③ Push [STEP / MOVE] + [ENT/ EXE] to release the break for 5 seconds after beeping.
 - ④ Support the upper arm by hand just after the 3rd step.
 - ⑤ Move the shoulder joint slowly in both hands to (-) direction: (See Figure 3.23), and hit it to the mechanical stopper. Although the brake works again after 15 seconds, you can release it with the 3rd step.
- (8) Setting the elbow origin position.
- ① Push [0] key 2 times and push [1] key. The "1" appears at 3 (elbow) to release brake.
 - ② Make sure that the third entry has "1".
 - ③ Push [STEP / MOVE] + [ENT / EXE] to release the break for 5 seconds after beeping.
 - ④ Support the elbow joint by hand just after the 3rd step.
 - ⑤ Move the elbow joint slowly in both hands to (-) direction: (See Figure 3.23), and hit it to the mechanical stopper. Although the brake works again after 15 seconds, you can release it with the 3rd step.

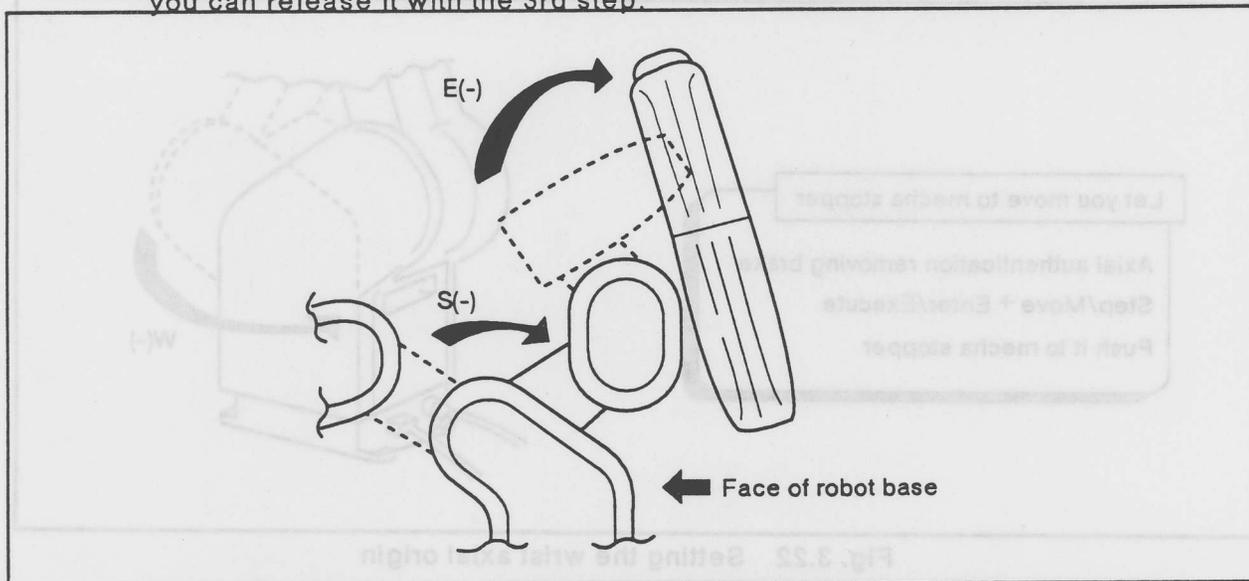


Fig. 3.23 Setting origin position: Shoulder, Elbow

☆☆☆ Caution!☆☆☆

1. Pay attention to the tripping robot arms, when you release the break / breaks.
2. Keep pushing [STEP / MOVE] key with [+X/+W] key to release the break of the joint that has "1" at its <BREAK> entry.

(9) Setting the wrist twist origin position.

Move a wrist twist joint slowly in both hands to a (-) direction: (See Figure 3.24), and hit mechanical stopper. This joint has no break so that releasing break is not necessary.

(10) Setting the wrist pitch origin position.

Move a wrist pitch joint slowly in both hands to (-) direction: (See Figure 3.25), and hit it to the mechanical stopper. This joint has no break so that releasing break is not necessary.

(11) Setting the wrist roll origin position.

- ① Install the Motor-Operated hand or two bolts at the mechanical interface.
- ② Turn the mechanical interface with the Motor-Operated hand or two bolts by hand to attach the mark as figure 3.26. Figure 3.27 shows the posture when this operation is all over.

This joint has no break so that releasing break is not necessary.

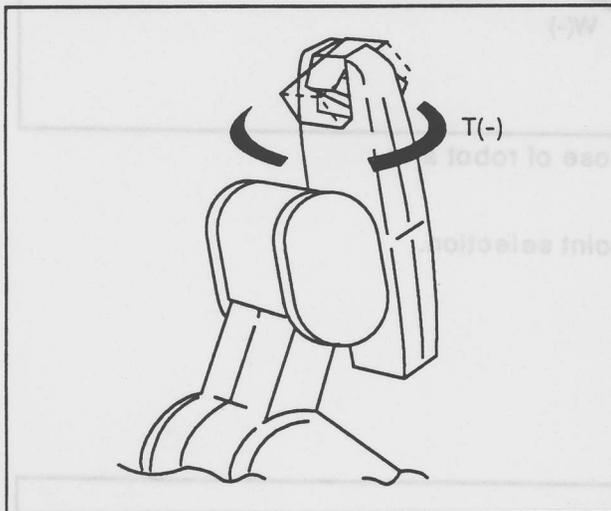


Fig. 3.24 Setting the origin position: twist

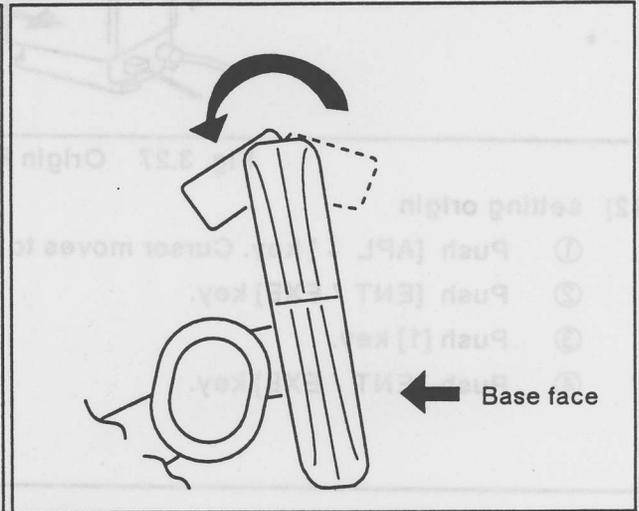


Fig. 3.25 Setting the origin position: writ pitch

☆☆☆ Caution!☆☆☆

The wrist roll joint has no mechanical stop so that you shall not turn it over limit turn: (from +200 deg. to -200 deg.), while setting the origin position.

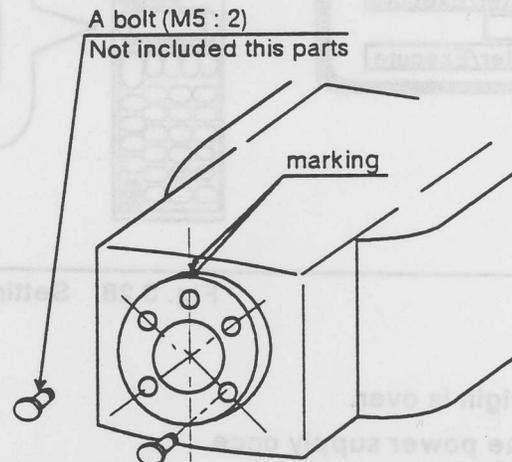


Fig. 3.26 Setting the origin position: writ roll

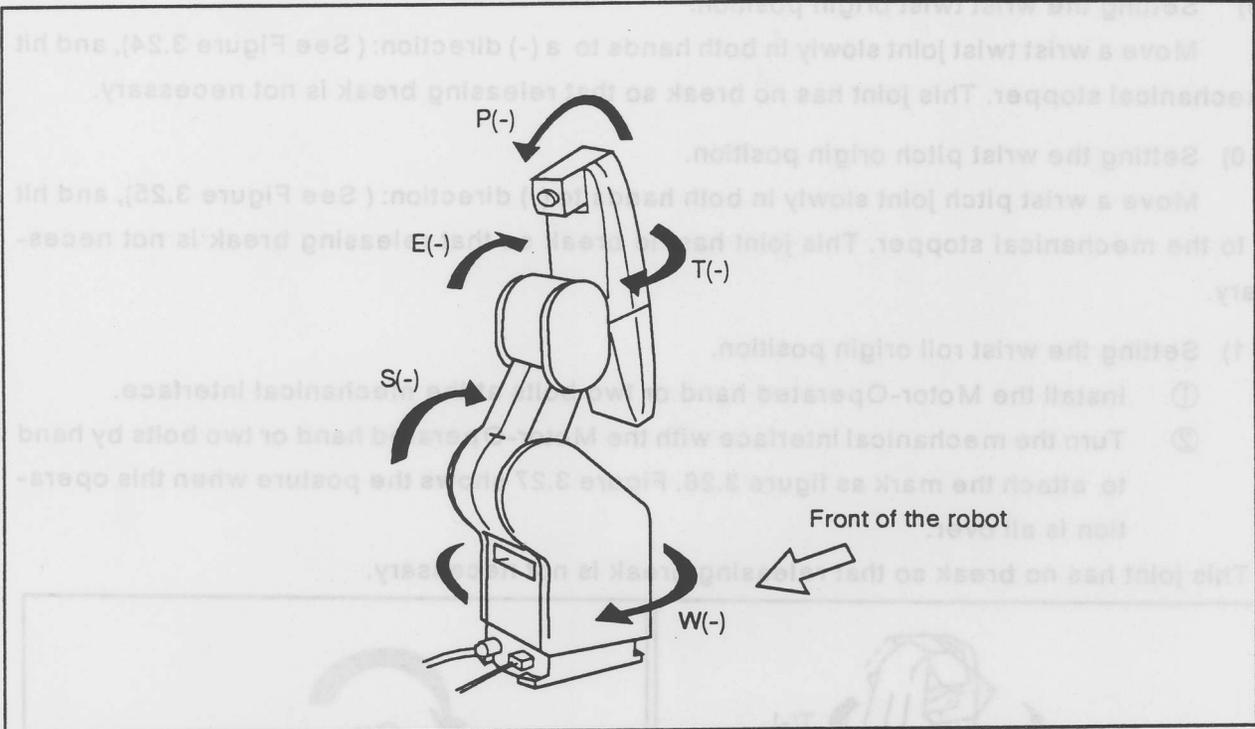


Fig. 3.27 Origin Pose of robot arm

(12) setting origin

- ① Push [APL ↓] key. Cursor moves to joint selection.
- ② Push [ENT / EXE] key.
- ③ Push [1] key.
- ④ Push [ENT / EXE] key.

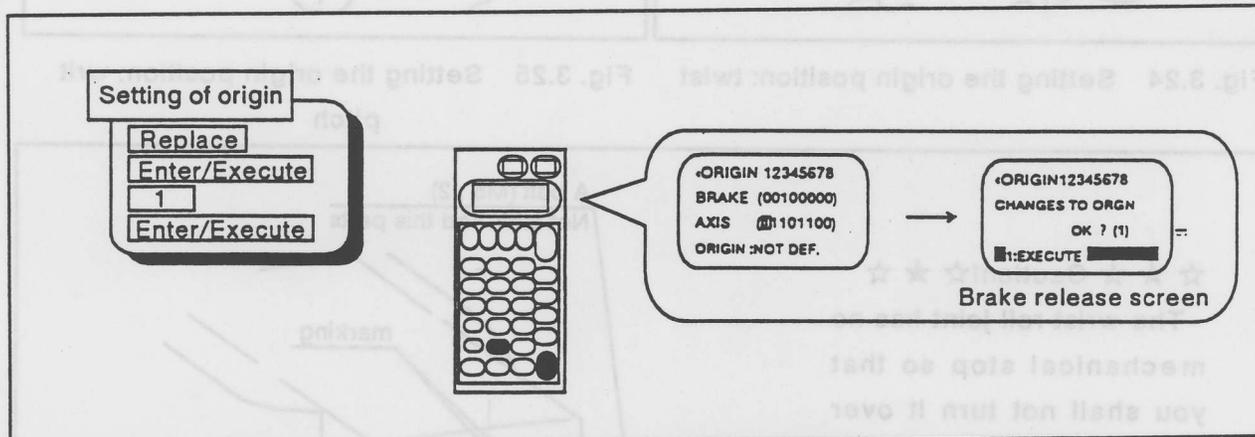


Fig. 3.28 Setting the origin

Setting origin is over.
Turn off the power supply once.

4. Let's start

This chapter explains the basic operation for novices.

The reference manual explains more information.

This chapter is quick start.

-Explanation (1)
-Explanation (2)



- 1 The robot hits itself in some case accidentally. Pay attention especially for shoulder joint, elbow joint and pitch joint.
 - 2 Teaching box alerts warns you that the robot is overrunning to show the inequality mark (t). Then, reverse the joint.
 - 3 Push [STEP/MOVE] key with [SPEED] key to change the jog speed. At the beginning you should move the robot in low speed. You can move it in high speed after you get enough experience. Reference manual 2.2.2: how to operate the teaching box. JOG speed explains it.
 - 4 Move the robot into the operative area manually, because the robot is on the boundary just after the origin setting.
- Make sure before you move the robot.

4.1 Let's move the robot in the manual operation

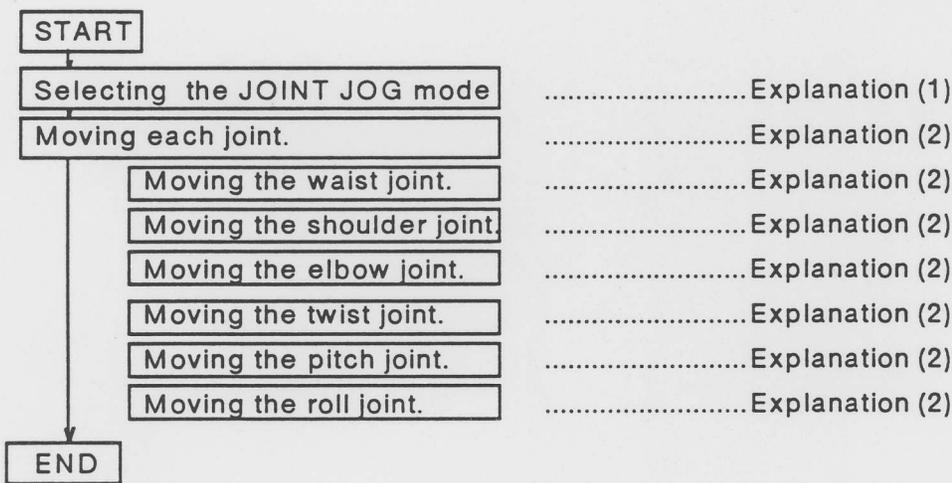
This section explains you how to move the robot with the teaching box. Turn on the controller, and checking that the [ENBL/DISABLE] switch is [ENBL] on the teaching box.

4.1.1 Moving the robot in the JOINT JOG mode.

Let's move the robot in the joint jog.

■ Over view

This is the over view flow. A () number means the sequence.



■ Make sure before you move the robot.

- 1 The robot hits itself in some case accidentally. Pay attention especially for shoulder joint, elbow joint and pitch joint.
- 2 Teaching box alerts warns you that the robot is overrunning to show the inequality mark (<). Then, reverse the joint.
- 3 Push [STEP/MOVE] key with [SPEED] key to change the jog speed. At the beginning you should move the robot in low speed. you can move it in high speed after you get enough experience. Reference manual / 2.2.2 : how to operate the teaching box ■ JOG speed explains it.
- 4 Move the robot into the operative area manually, because the robot is on the boundary just after the origin setting.

◆ ◆ ◆ Tips ◆ ◆ ◆

Push the EMG.STOP switch on the controller front or the teaching box to stop the robot in emergency. the robot stops immediately, and the controller shows "1" and "2" in turns on the PRO / ALM. (It means that the emergency stop is on.)

■ Operation

Let's move the robot.

(1) Selecting the JOINT JOG mode.

Push [STEP / MOVE] key and [JOINT] key.

Figure 4.1 shows the JOINT JOG mode screen.

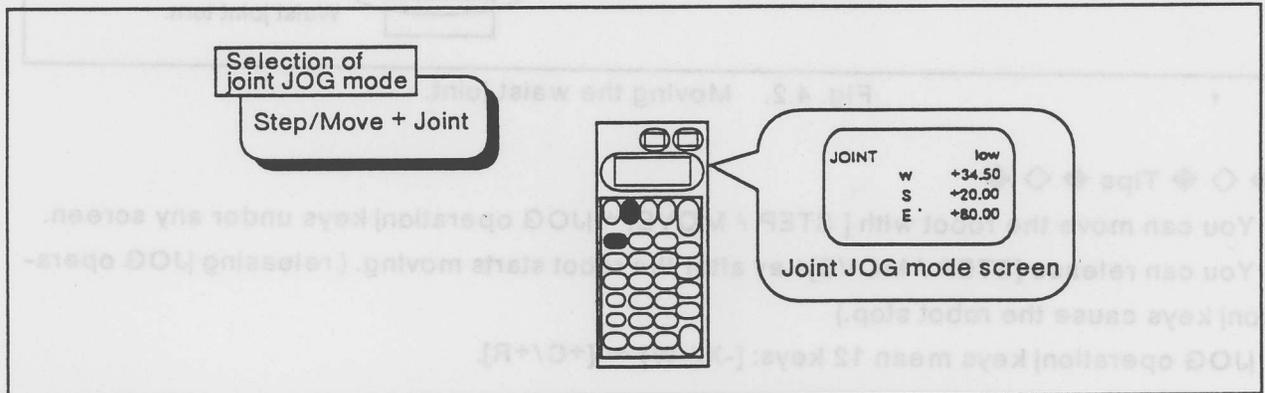


Fig. 4.1 Selecting the joint JOG mode

◆ ◆ ◆ Tips ◆ ◆ ◆

Turn [ENBL/DISABLE] switch to ENBL to get control. At that time, you can get control from only the teaching box. the controller panel nor the external equipments are ineffective.

(2) Moving each joint.

- ① Push [STEP / MOVE]+ [+X/+W] to move the waist joint to + direction.

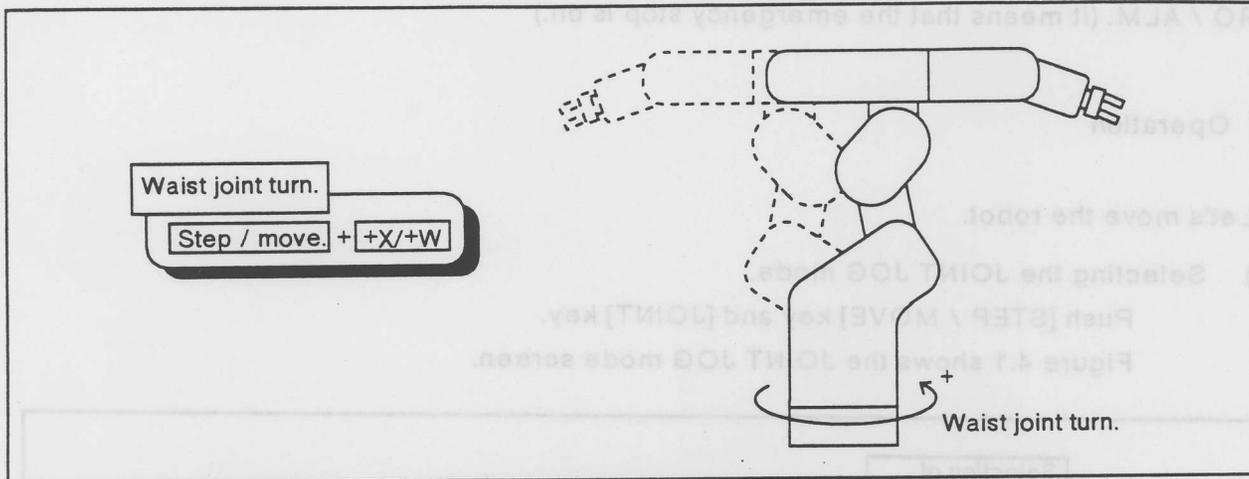


Fig. 4.2. Moving the waist joint.

◆ ◆ ◆ Tips ◆ ◆ ◆

You can move the robot with [STEP / MOVE] + {JOG operation} keys under any screen.
You can release [STEP / MOVE] key after the robot starts moving. (releasing {JOG operation} keys cause the robot stop.)
{JOG operation} keys mean 12 keys: [-X/-W] ~ [+C/+R].

- ② Push [STEP / MOVE]+ [+Y/+S] to move the shoulder joint to + direction.

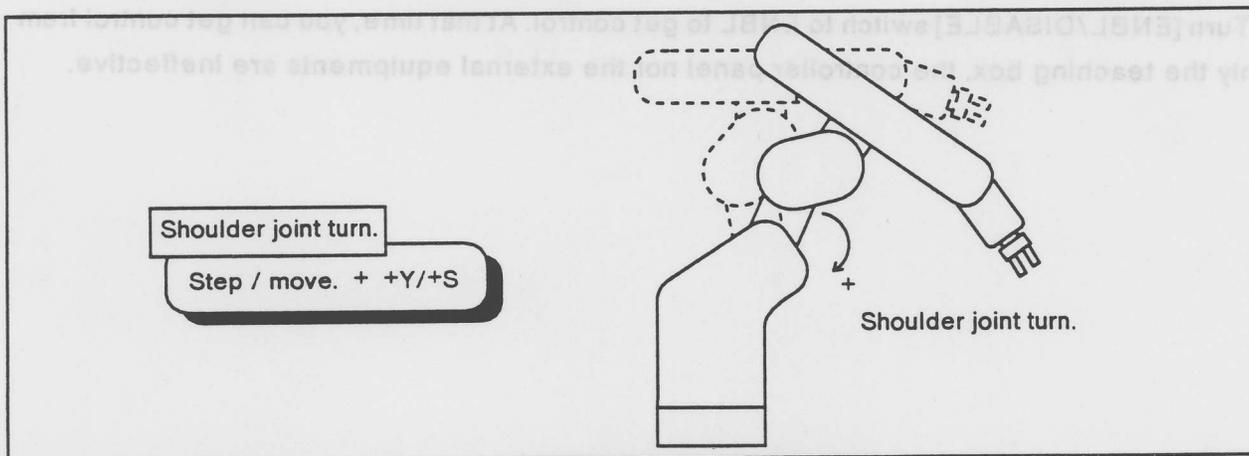


Fig. 4.3. Moving the shoulder joint.

Each joint works to this way with [STEP / MOVE]+ {JOG operation} keys.

Let's try other joints. Figure 4.4 shows the correspondence between each JOG operation key and each working joint.

- ③ Push [STEP / MOVE]+ [+Z/+E] to move the elbow joint to + direction.
- ④ Push [STEP / MOVE]+ [+A/+T] to move the wrist twist joint to + direction.
- ⑤ Push [STEP / MOVE]+ [+B/+P] to move the wrist pitch joint to + direction.

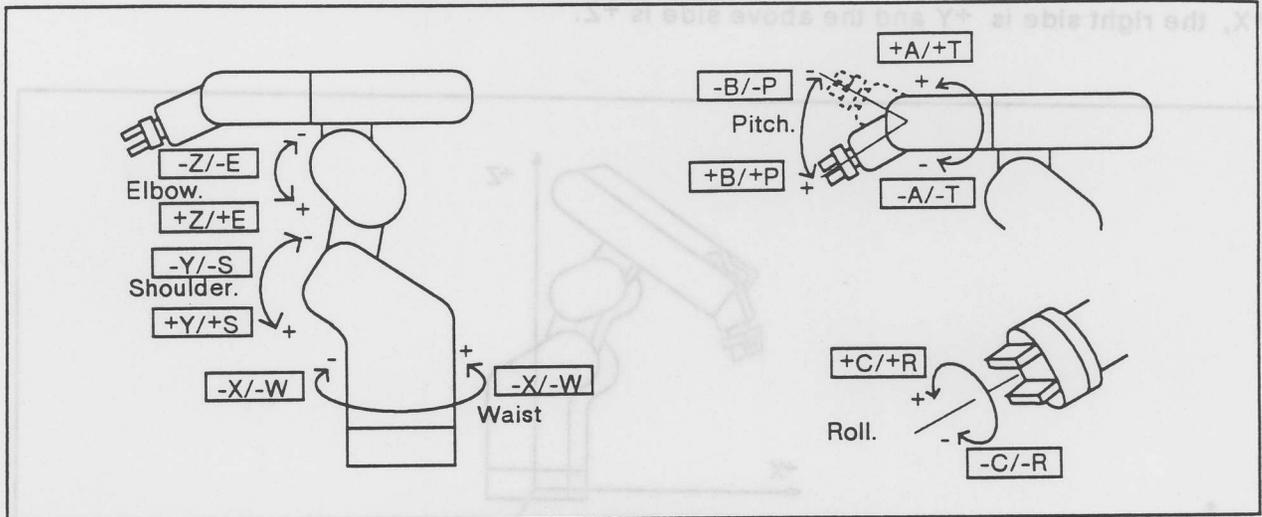


Fig. 4.4. The JOG keys and the joint motion.

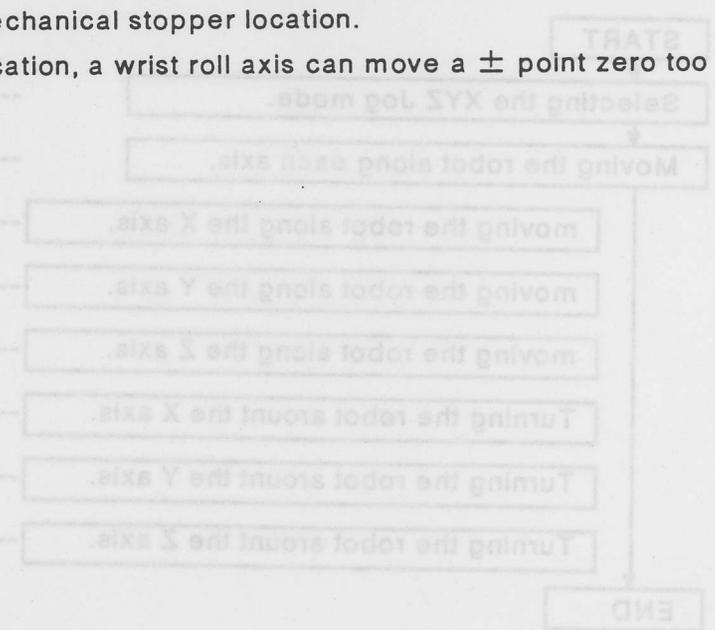
- ⑥ Push [STEP / MOVE]+ [+C/+R] to move the wrist roll joint to + directions.

Pushing [STEP / MOVE] key with minus side {JOG operation} keys moves each joint to the minus direction.

☆☆☆ caution!☆☆☆

Move to only + direction to be it too in JOG operation of origin attachment back except wrist roll joint with each joint to-side mechanical stopper location.

Because it is for origin attachment location, a wrist roll axis can move a ± point zero too with + direction-direction.



4.1.2 Moving the robot in XYZ JOG

Let's move the robot in the XYZ Jog mode. the robot moves along the coordinate axes.

The XYZ coordinates system has three orthogonal axes: X , Y, Z. The front of the robot is +X, the right side is +Y and the above side is +Z.

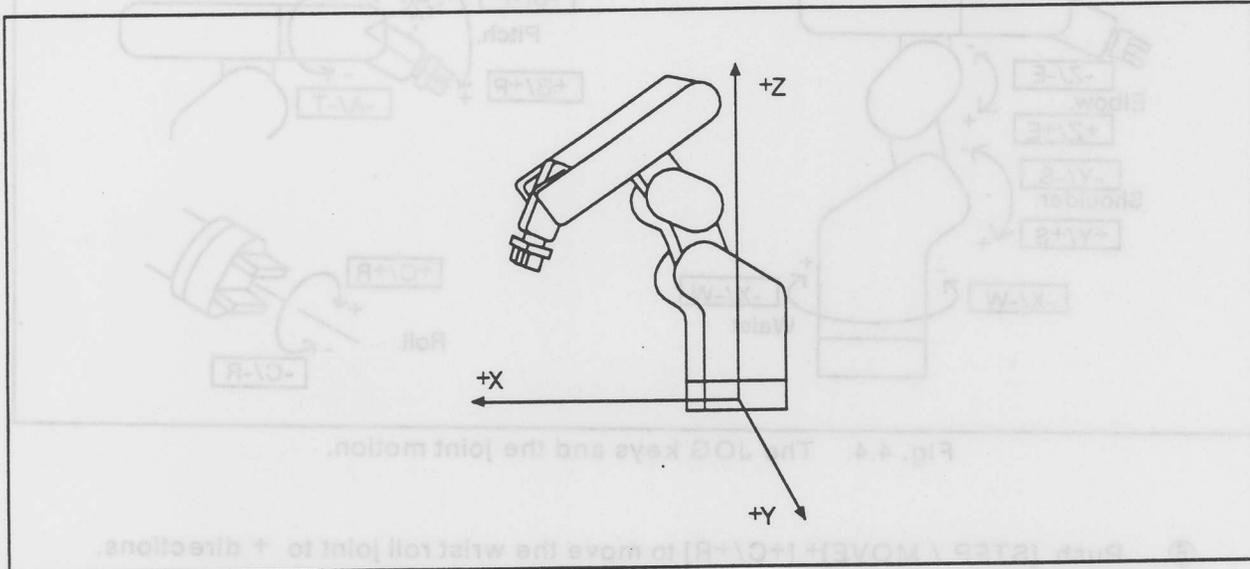
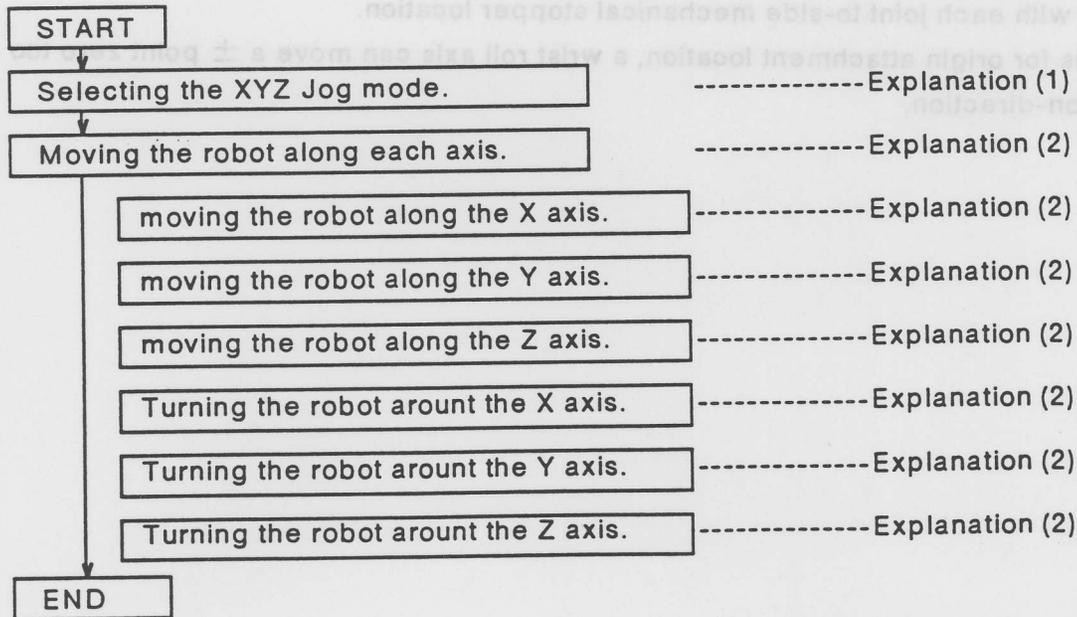


Fig. 4.5 XYZ coordinate system

■ Over view of operation



■ Operation

1 Select the XYZ Jog mode

- ① Push [STEP / MOVE]+ [XYZ].

Screen display becomes the XYZ Jog mode screen.

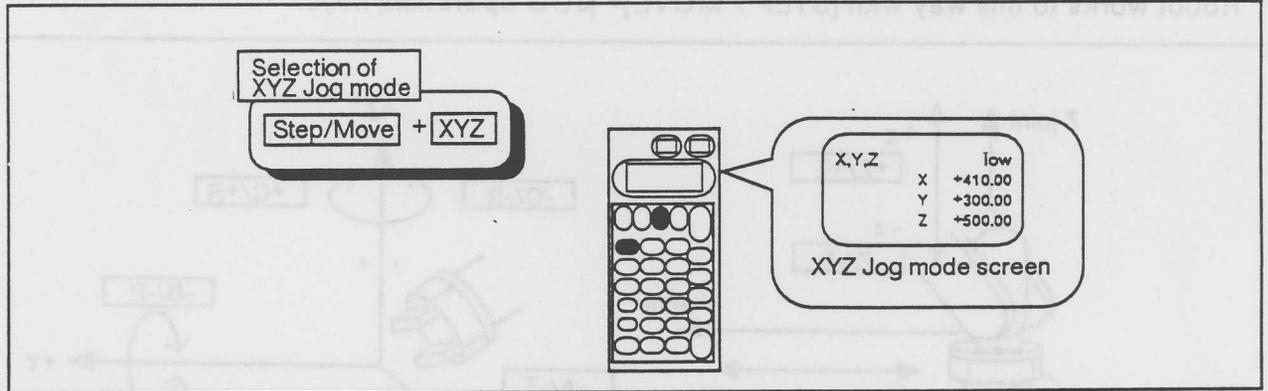


Fig. 4.6 Selecting the XYZ Jog mode

2 Move the robot along each axis.

- ① Push [STEP / MOVE]+ [+X/+W] to move the robot to the front along X axis.
- ② Push [STEP / MOVE]+ [+Y/+S] to move the robot to the right along Y axis.

Z direction is the same way.

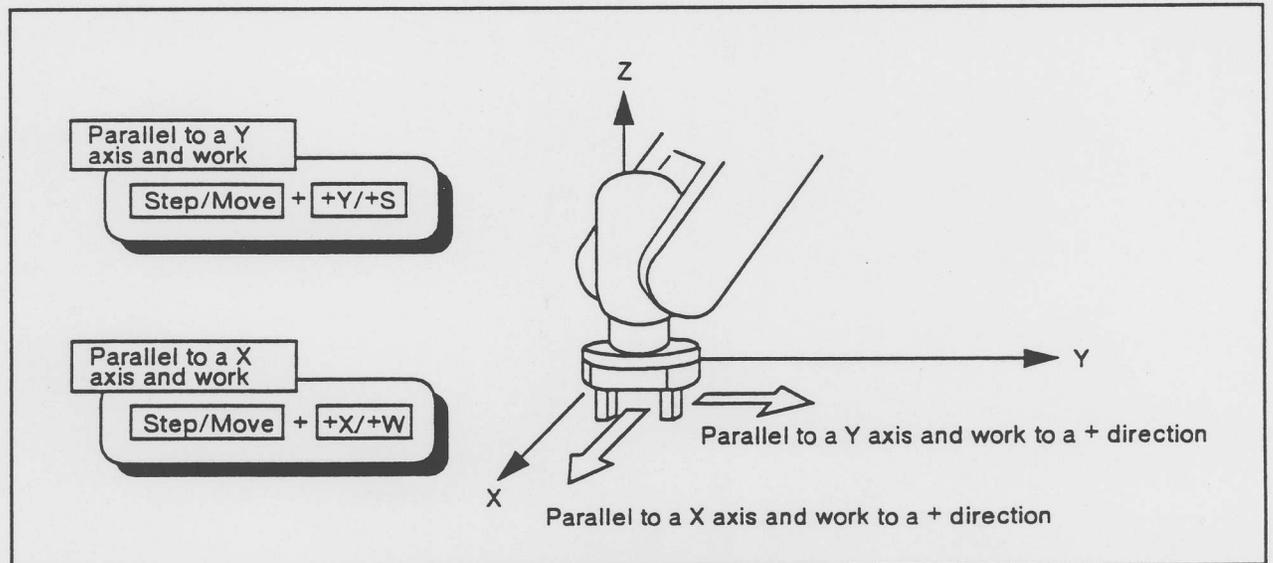


Fig. 4.7 XYZ Jog

- ③ Push [STEP / MOVE]+ [+Z/+E] to move the robot upward along Z axis.
- ④ Push [STEP / MOVE]+ [+A/+T] to turn the robot around X axis.
- ⑤ Push [STEP / MOVE] + [+B/+P] to turn the robot around Y axis.
- ⑥ Push [STEP / MOVE] + [+C/+R] to turn the robot around Z axis.

Robot works to this way with [STEP / MOVE]+ {JOG operation} keys.

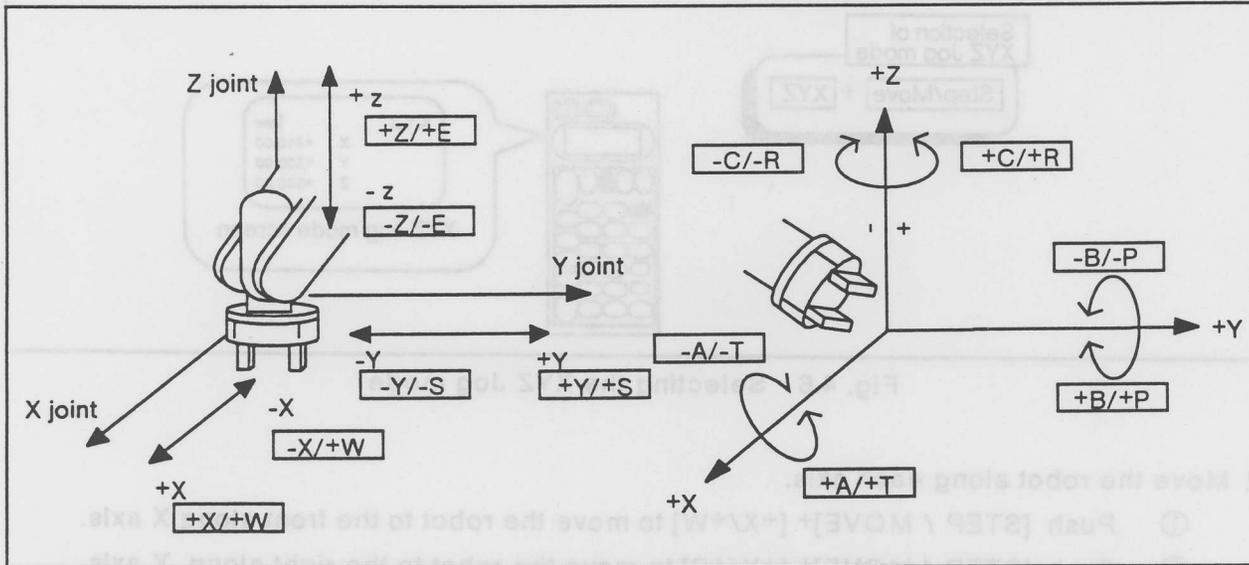


Fig. 4.8. The JOG keys and the joint motion.

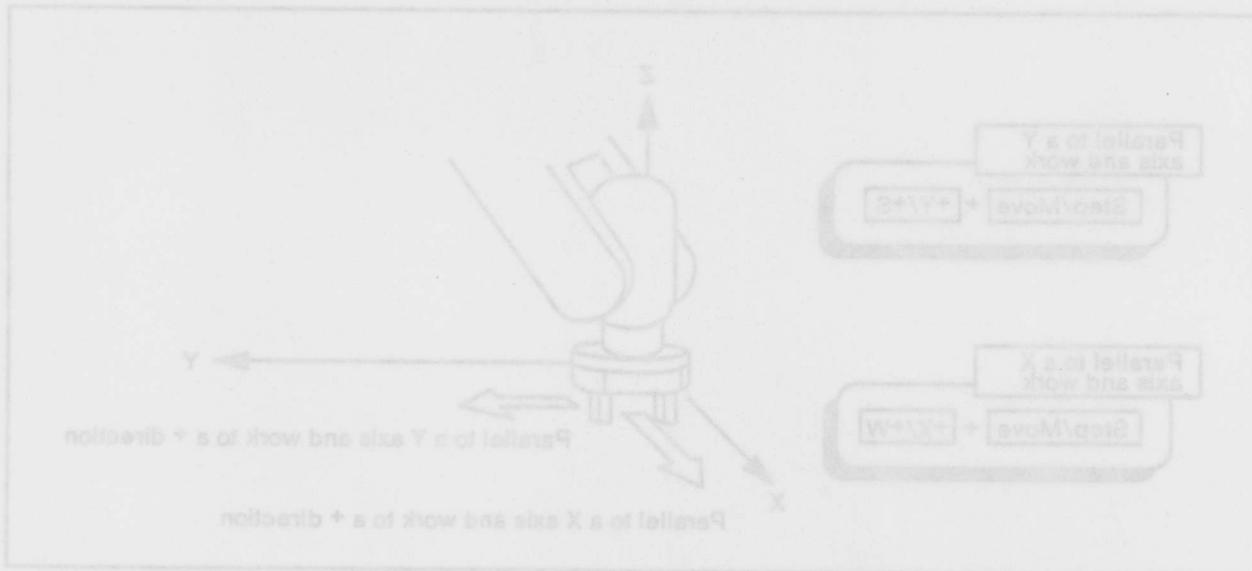
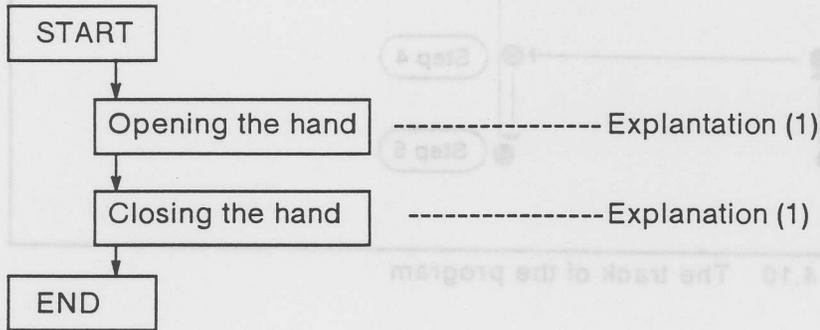


Fig. 4.7. XYZ Jog

4.1.3 Moving the Motor-Operated Hand

Let's move the Motor-Operated Hand. Skip this section, if you have no Motor-Operated Hand.

■ Over View



■ Operation

- (1) Push [HAND] + [+C/+R] to open the hand.
- (2) Push [HAND] + [-C/-R] to close the hand.

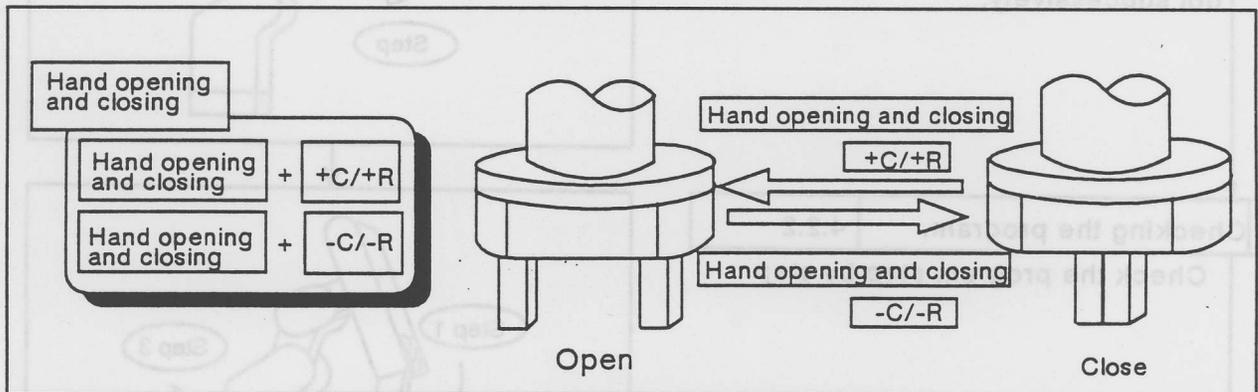


Fig. 4.9 Moving the Motor-Operated Hand

◆◆◆ Tips ◆◆◆

The hand has no effect on the screen on the teaching box.

4.2 Let's make the program

Figure 4.10 shows the track of the program that you will make in this section.

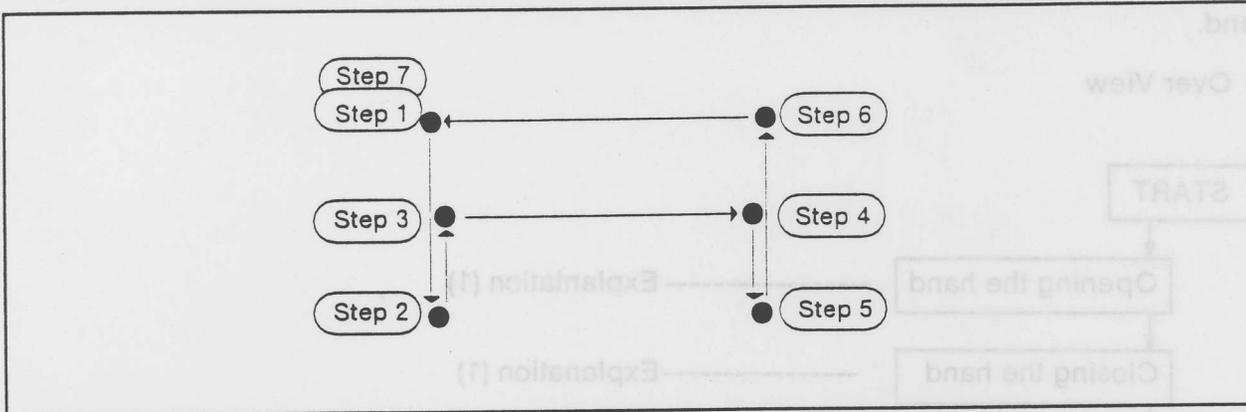
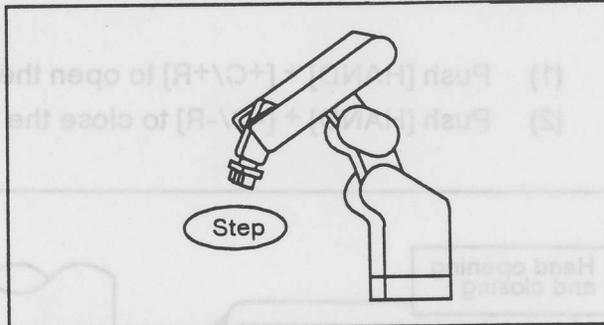


Fig. 4.10 The track of the program

This section explains the operation from making a program to start automatic operation.

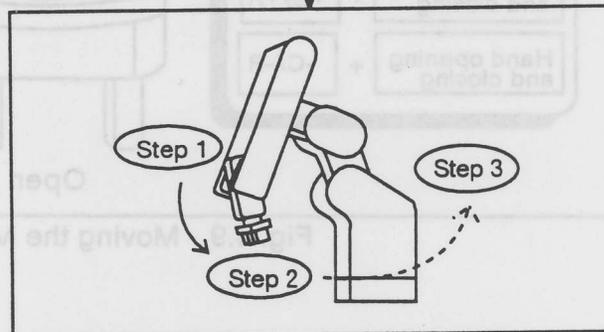
1. Making the program	4.2.1
-----------------------	-------

Move the robot arm tip where you want, and teach that position to the robot successively.



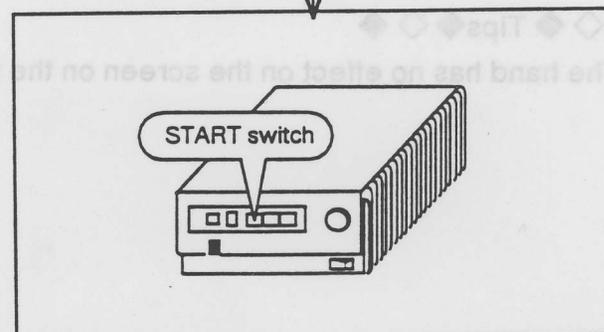
2. Checking the program.	4.2.2
--------------------------	-------

Check the program step by step.



3. Moving the robot in the automatic mode.	4.3
--	-----

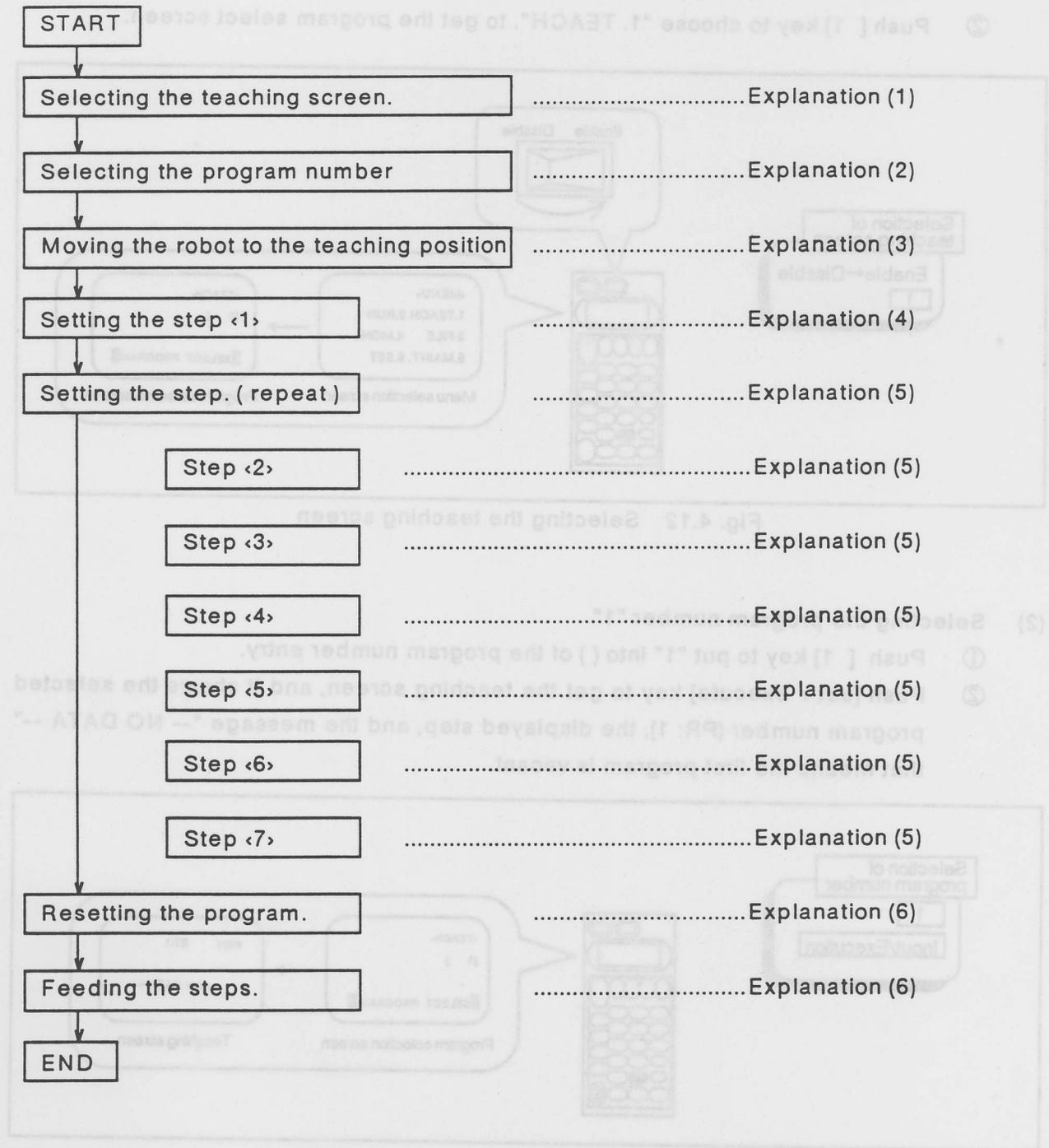
Start the program with controller panel switch.



4.2.1 Making the program

Move the robot arm tip, and teaching the position.

■ Over view



■ Operation

(1) Selecting the teaching screen.

- ① Turn [ENBL / DISABLE] switch to [DISABLE] and then backing to [ENBL] to get the menu selection screen.
- ② Push [1] key to choose "1. TEACH". to get the program select screen.

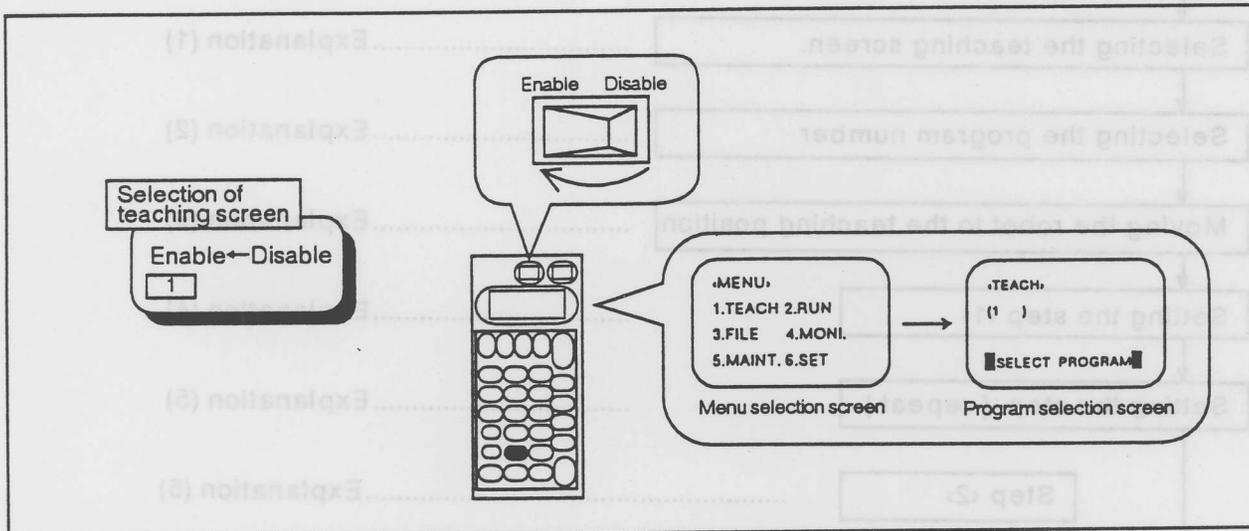


Fig. 4.12 Selecting the teaching screen

(2) Selecting the program number "1"

- ① Push [1] key to put "1" into () of the program number entry.
- ② Push [set / execute] key to get the teaching screen, and it shows the selected program number (PR: 1), the displayed step, and the message "-- NO DATA --" that means the first program is vacant.

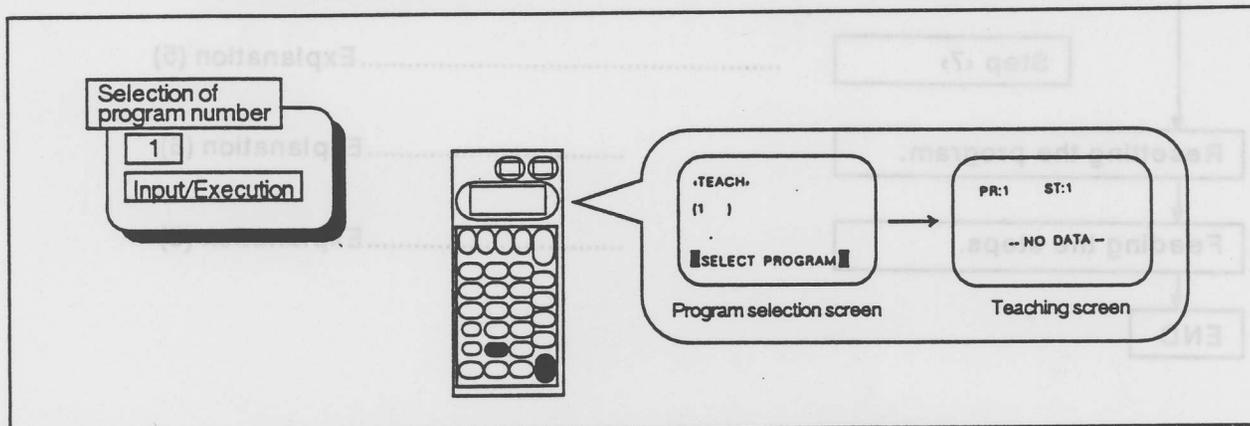


Fig. 4.13 Selecting the program number

◆ ◆ ◆ Tips ◆ ◆ ◆

The message: "-- DATA pear tree --" means that you call the vacant program or the undefined steps.

(3) Moving the robot to the teaching position

Move the robot arm tip to the position as figure 4.14.

- ① Push [STEP / MOVE] + [JOINT].
- ② Push [STEP / MOVE] + {JOG operation} keys to move the robot.

See this manual /4.1: hand control for more information.

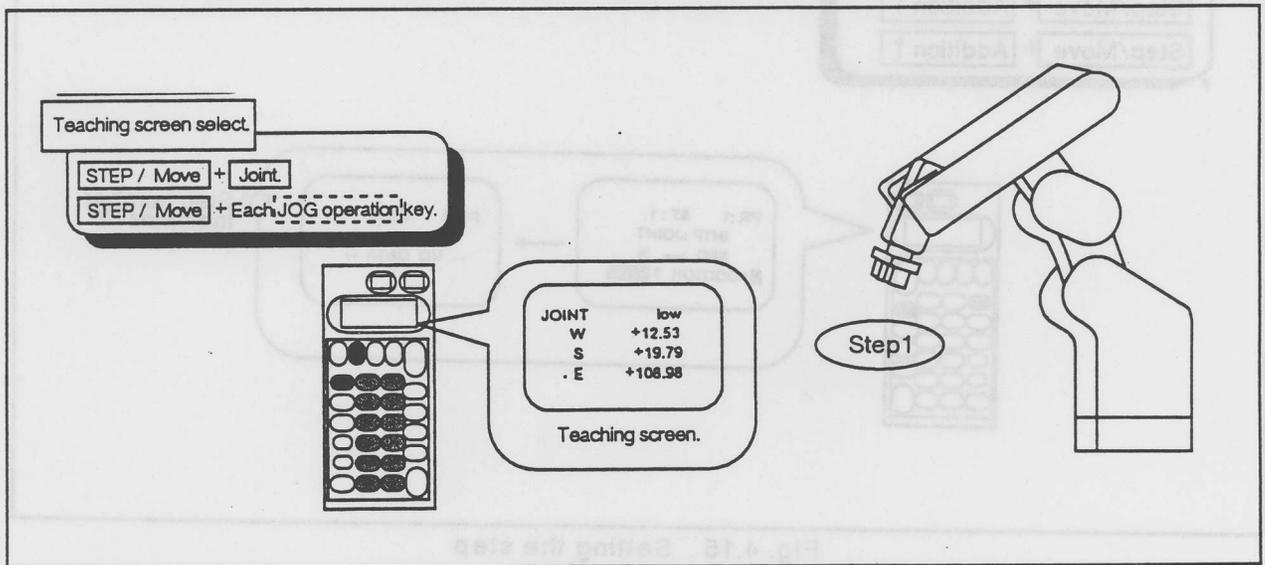


Fig. 4.14. Moving the robot to the teaching position.

(4) Setting the step

Set the current position to the robot.

- ① Push [STEP / MOVE] + [ADD ↑] key and then releasing only [ADD ↑] key. to get the confirmation screen with beep.
- ② Push [ADD ↑] key once again with keeping [STEP / MOVE] key, and then release [STEP / MOVE] key. After the teaching box indicates the message: "EXECUTING", the robot entry the first step. the step number on the screen becomes "2", when the robot enters it correctly.
Push [STEP / MOVE] key to abort the entry .

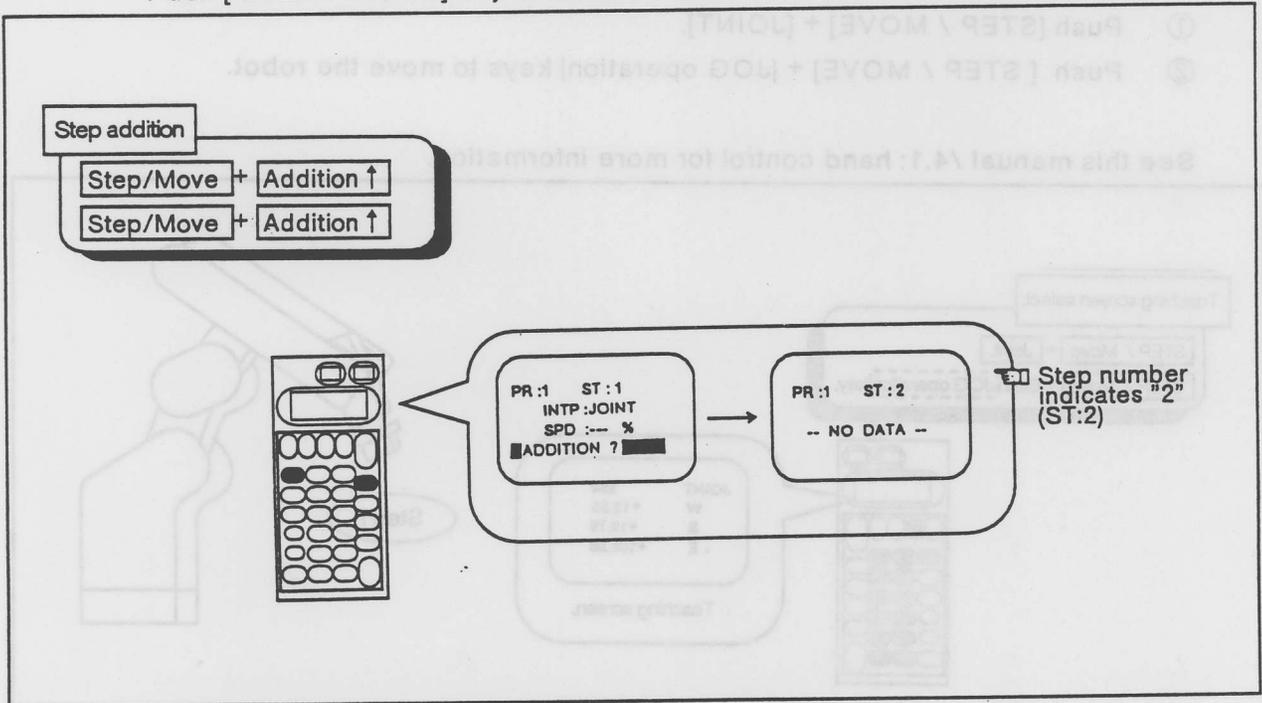


Fig. 4.15 Setting the step

◆ ◆ ◆ Tips ◆ ◆ ◆

The robot enters the position just after pushing [STEP / MOVE] key with [ADD ↑] key. You can not undo the entry with turning [ENBL / DISABLE] switch to [DISABLE].

(5) Entry the step in succession

Repeat the third and fourth operation to entry from the second step to the seventh step successively.

- ① Push [STEP / MOVE] + {JOG operation} keys to move the robot arm tip.
- ② Push [STEP / MOVE] key. to set the current position. The teaching box shows the next step number , when the robot set it correctly.

(ST :3~ ST:8):

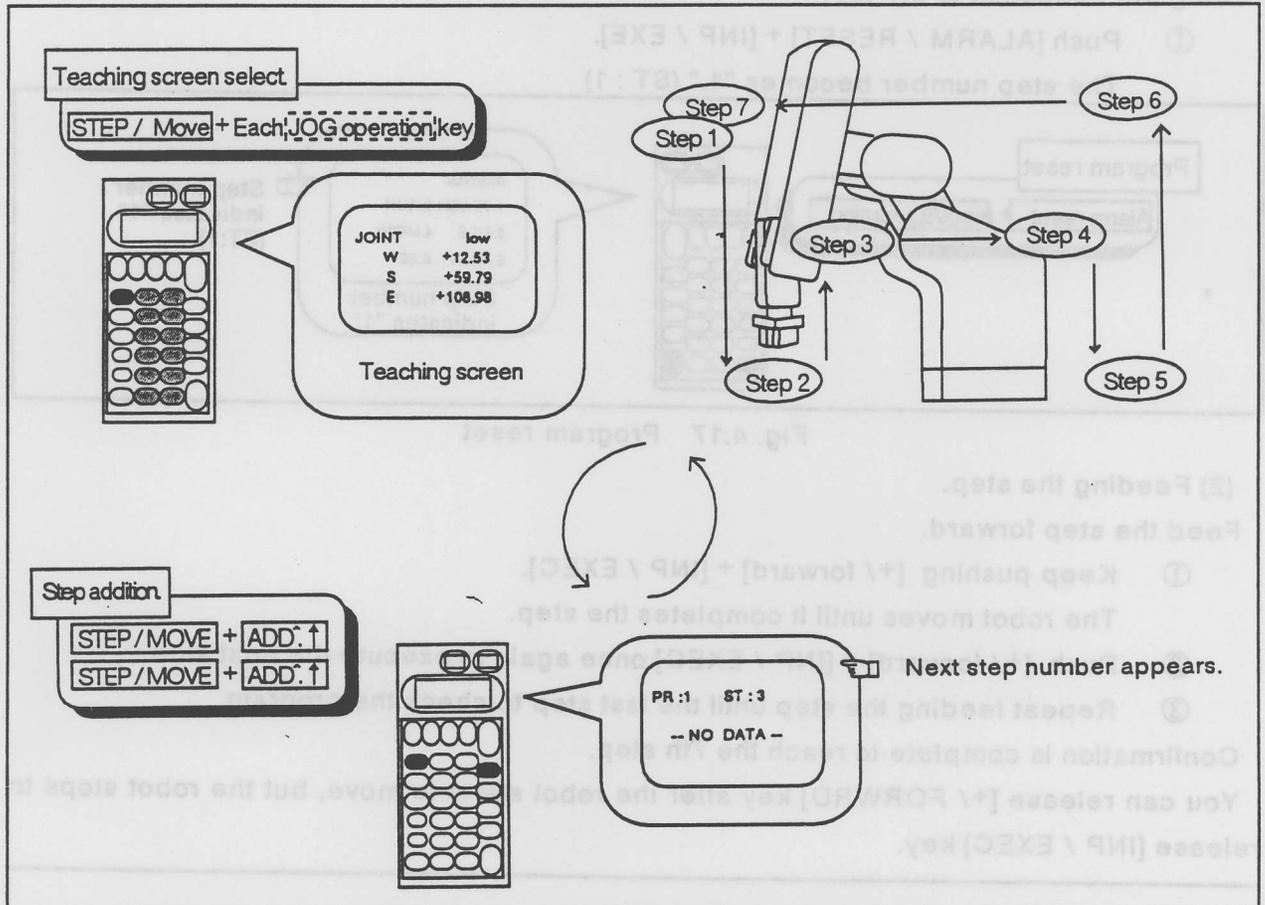


Fig. 4.16. Setting the step in succession.

Programming is complete after entering the seventh step.

◆ ◆ ◆ Tips ◆ ◆ ◆

The robot keeps the program with the internal battery, while the power is out.

4.2.2 Checking the program

Let's check the program step by step. Feed the robot from the first step to the last step to make sure the program. You should verify the program for safety, whenever you make the program.

(1) Resetting the program.

Bring the execution to the top.

- ① Push [ALARM / RESET] + [INP / EXE].

The step number becomes "1." (ST : 1)

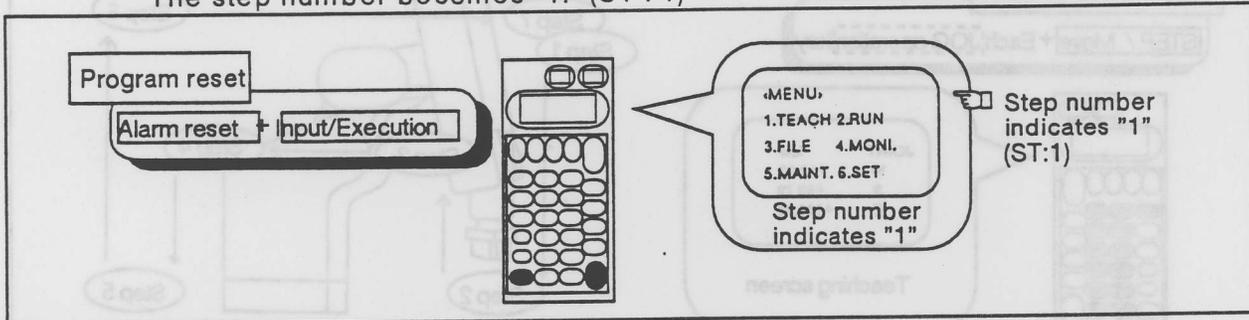


Fig. 4.17 Program reset

(2) Feeding the step.

Feed the step forward.

- ① Keep pushing [+ / forward] + [INP / EXEC].
The robot moves until it completes the step.
- ② Push [+ / forward] + [INP / EXEC] once again to execute the next step.
- ③ Repeat feeding the step until the last step to check the program.

Confirmation is complete to reach the 7th step.

You can release [+ / FORWRD] key after the robot starts to move, but the robot stops to release [INP / EXEC] key.

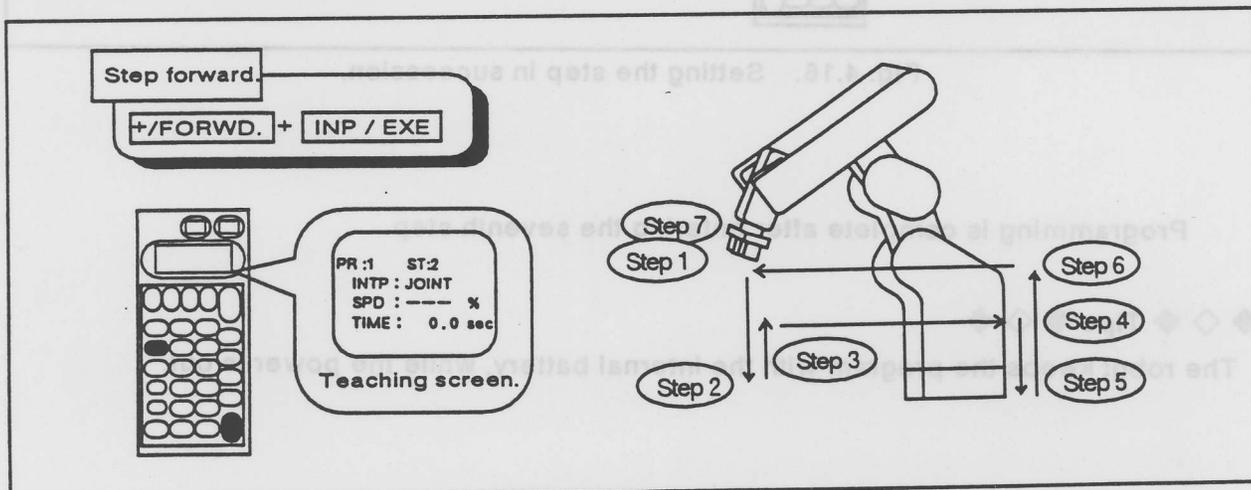
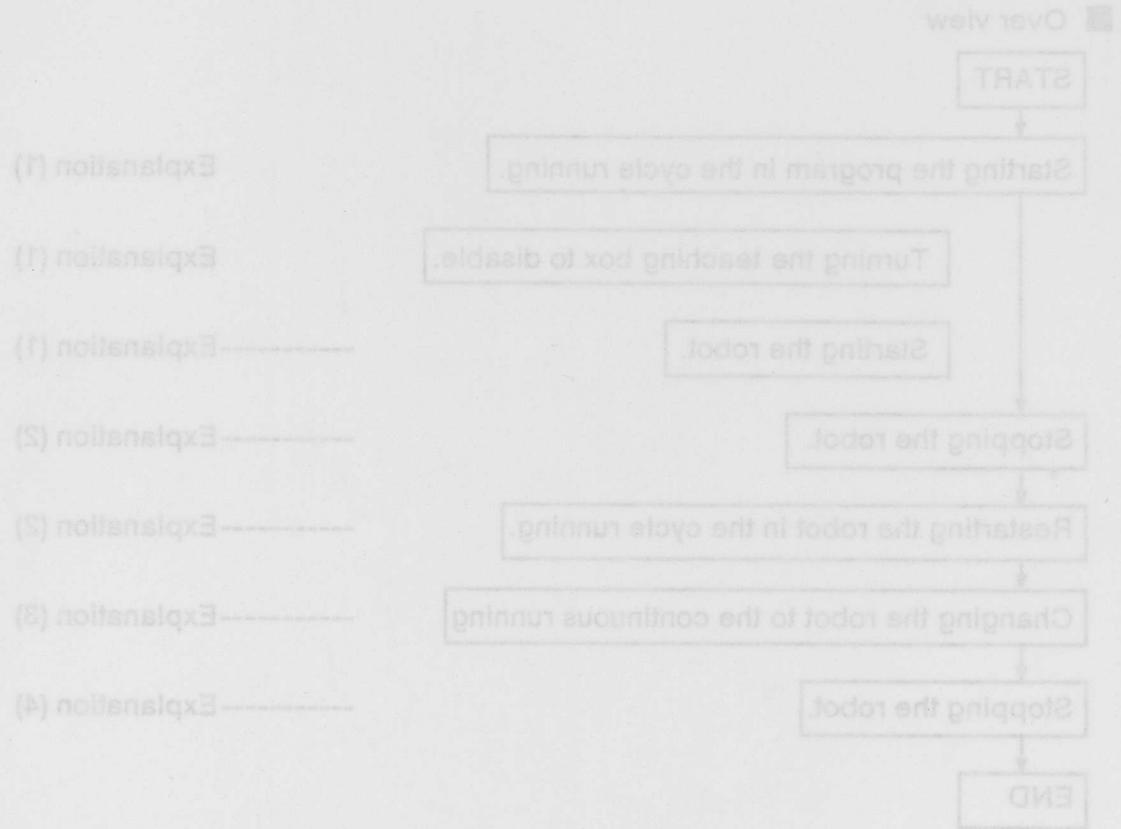


Fig. 4.18. Step forward.

◆ ◆ ◆ Tips ◆ ◆ ◆

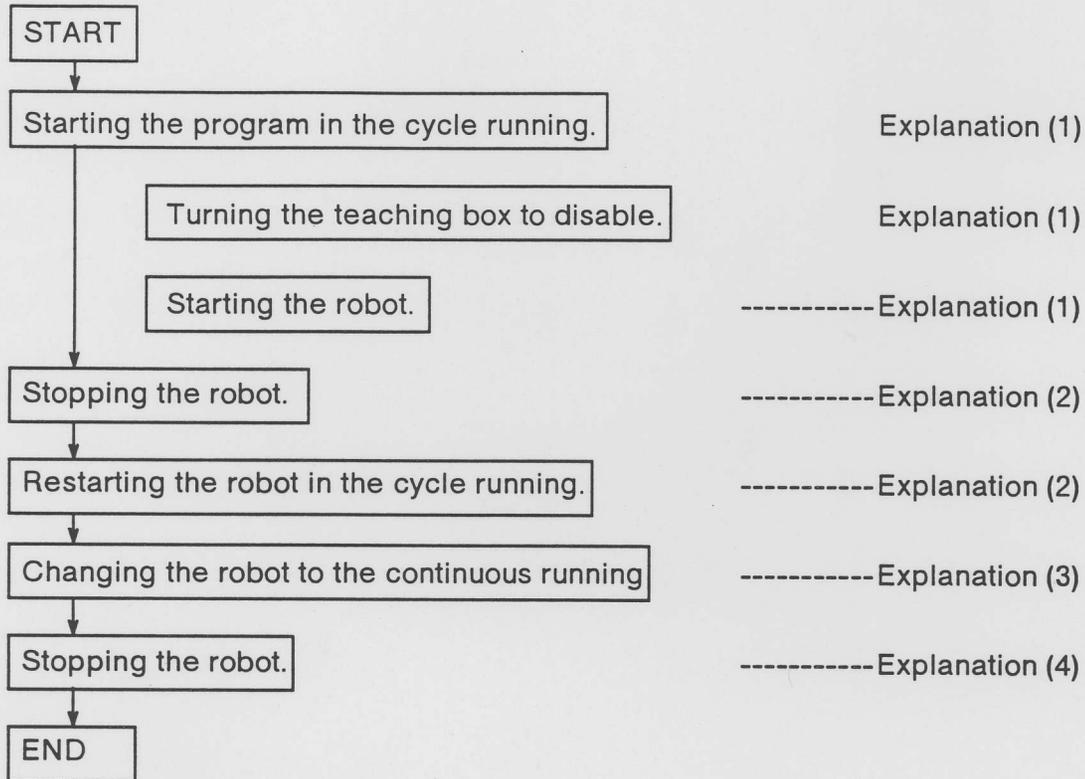
The START switch blinks in the step feeding, and the STOP switch blinks when the robot finishes the step.



4.3 Let's move the robot in the automatic mode.

Let's move the robot in the automatic mode after checking every step.

■ Over view



■ Operation

(1) Starting the program

- ① Turn [ENBL / DISABLE] switch to [DISABLE] on the teaching box.
PRO/ALM shows the program number and the period mark: "." to indicate that the controller gets control.
- ② Push START switch once.
The robot executes the program one cycle.

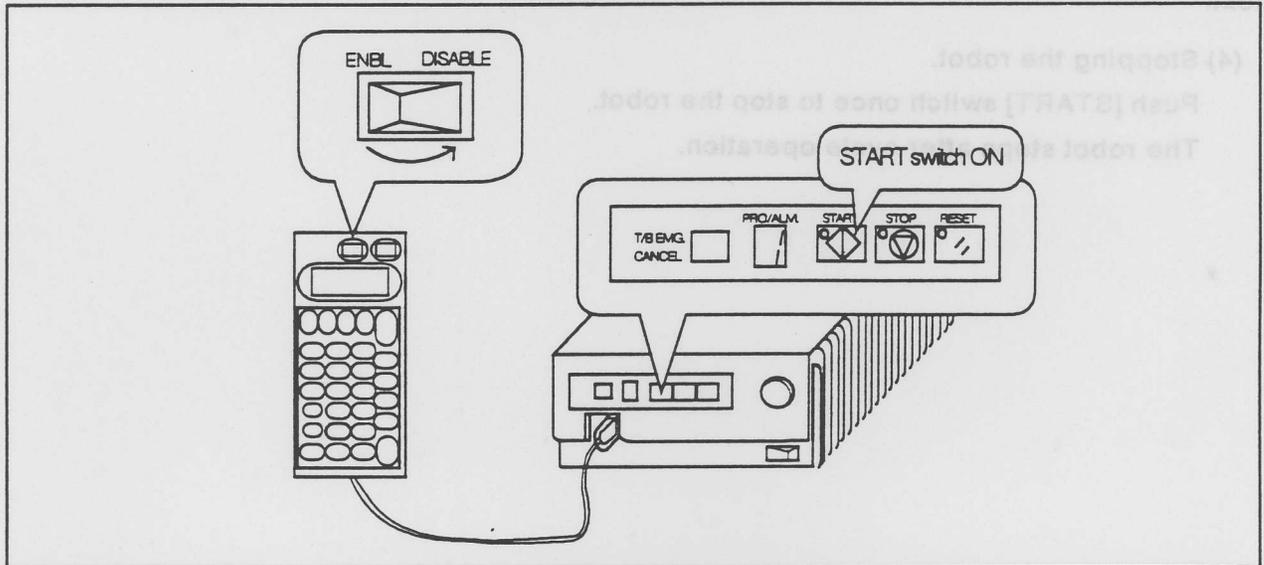


Fig. 4.19 Starting the program.

(2) Stopping and Restarting.

- Push [STOP] switch on the front panel to stop the robot.
- Push [START] switch on the front panel to restart the robot.

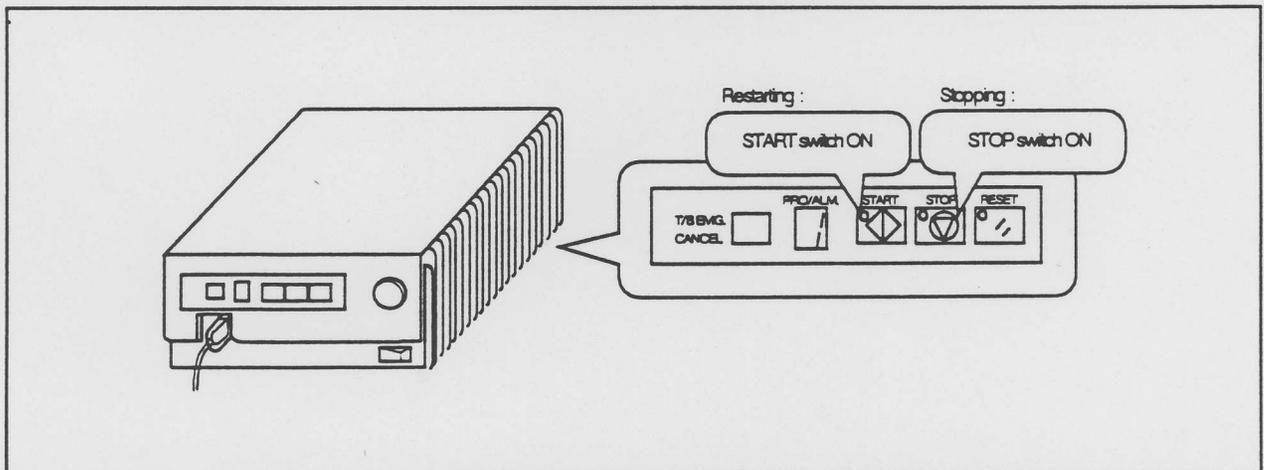


Fig. 4.20 Stopping / Restarting

◆ ◆ ◆ Tips ◆ ◆ ◆

Turn [ENBL / DISABLE] switch to DISABLE, whenever you control the robot from the controller.

(3) Changing the robot to the continuous running.

Push [START] switch twice.

The robot start cycle running at the first. It changes to the continuous running at the next.

(4) Stopping the robot.

Push [START] switch once to stop the robot.

The robot stops after cycle operation.

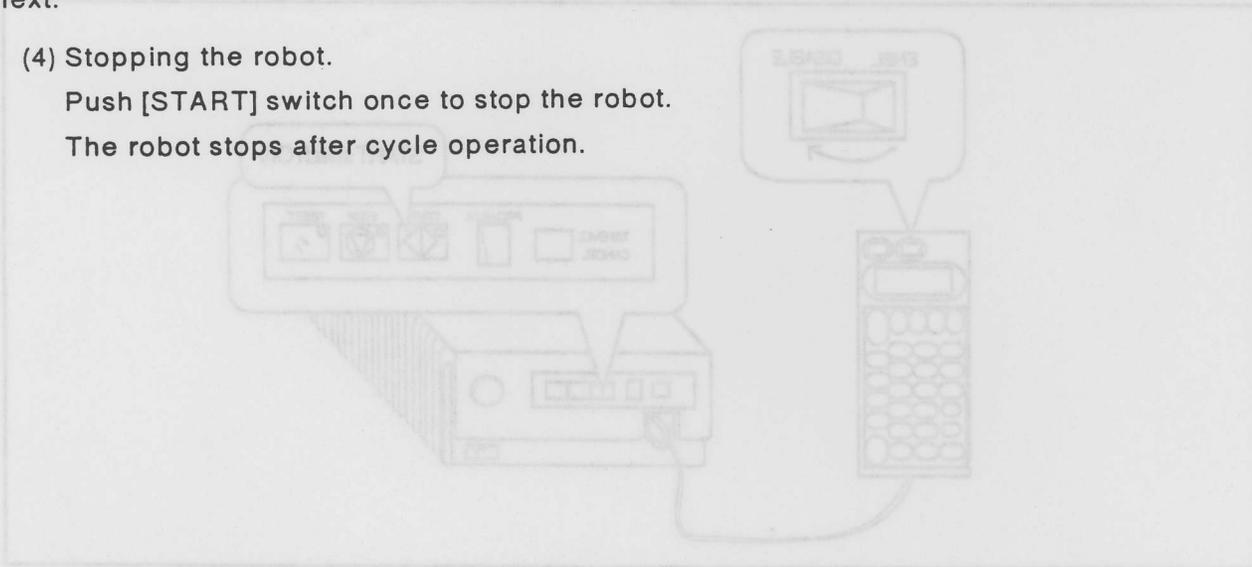


Fig. 4.19 Stopping the program

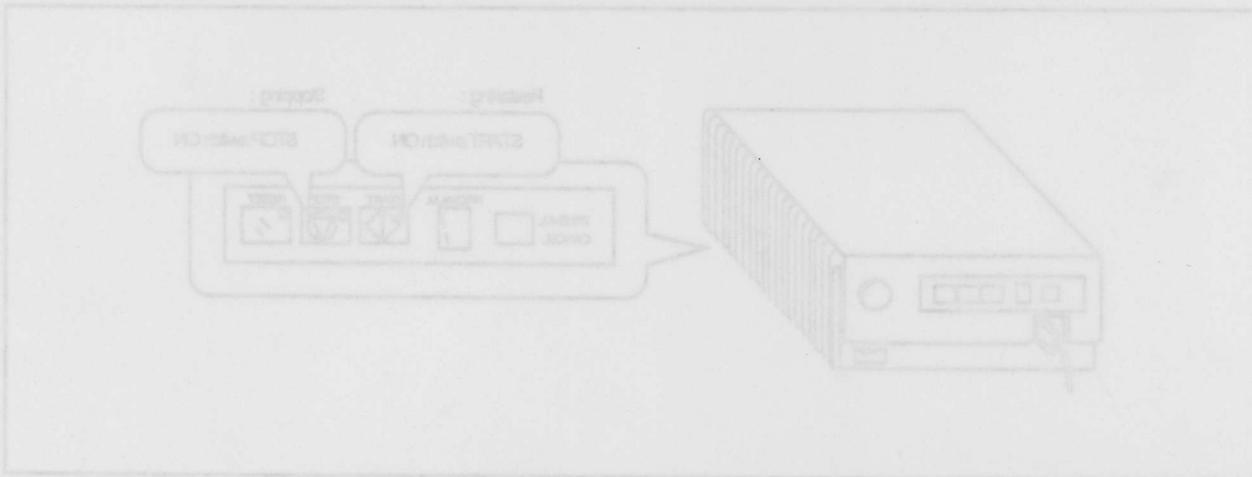


Fig. 4.20 Stopping / Restarting

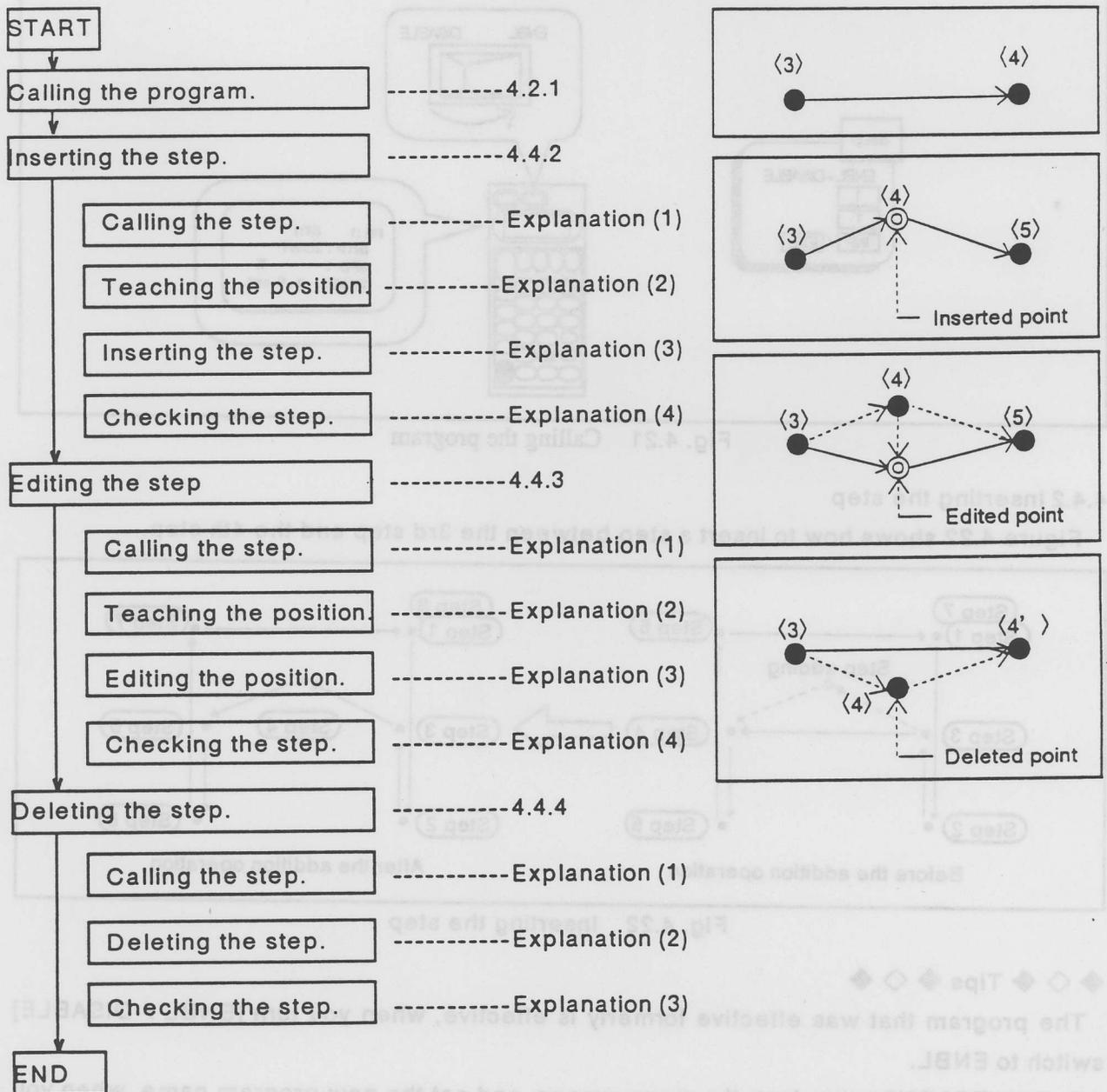
4.4 Let's edit the program (1) the location data

Let's edit the program and check the robot motion.

At first, edit the taught location data.

■ Over view

This section explains how to edit the location data. This is the Over view of editing.



4.4.1 Calling the program

Call the program to edit. Here, this section make use of the program created at the last section.

- ① Turn [ENBL / DISABLE] switch to ENBL.
- ② Push [1] key. to select "1. TEACH " at the menu screen
- ③ Push [1] key to select the program "1".
- ④ Push [INP / EXE] key to turn the first program effective.
- ⑤ Feed the step to check that the first program is effective.

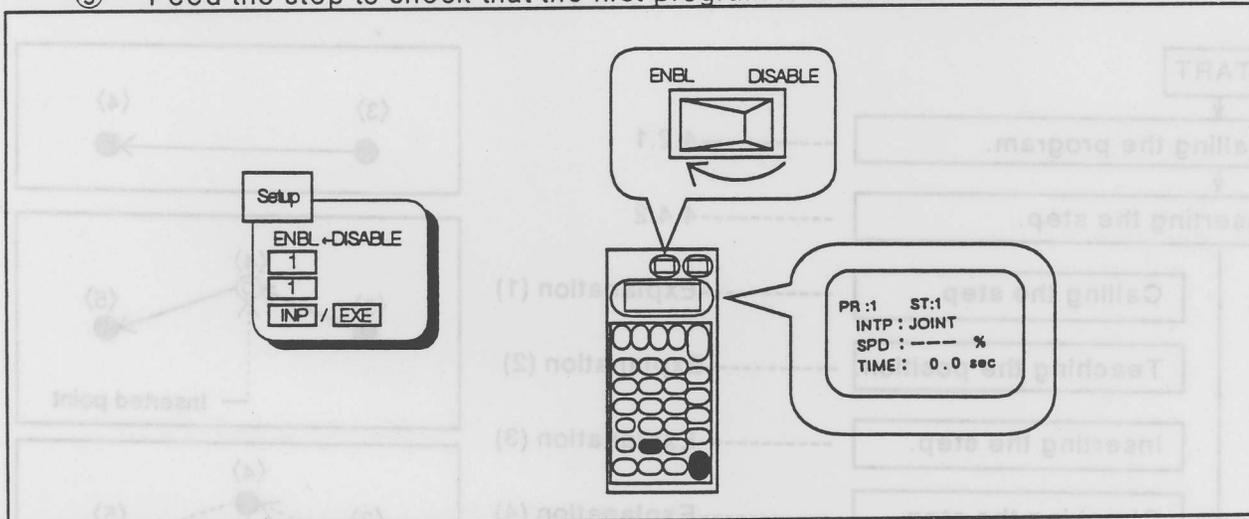


Fig. 4.21 Calling the program

4.4.2 Inserting the step

Figure 4.22 shows how to insert a step between the 3rd step and the 4th step.

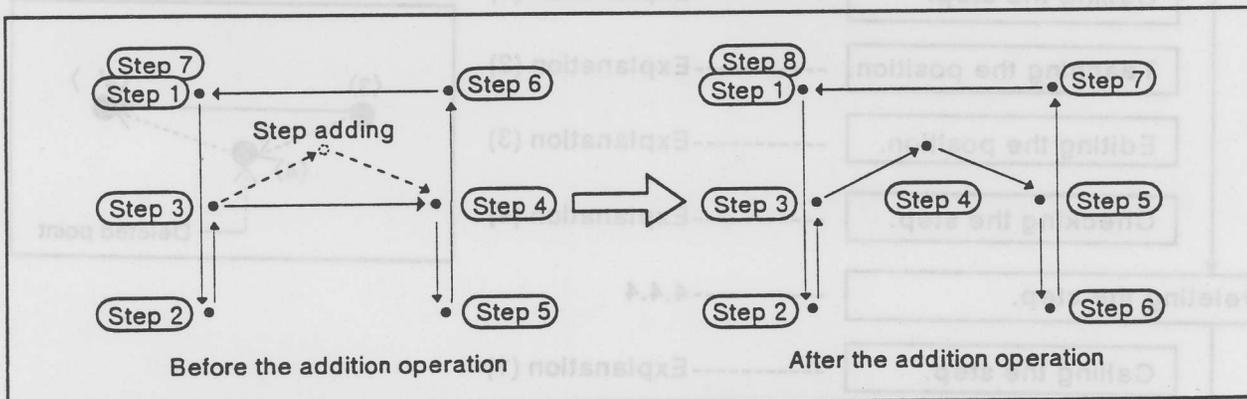


Fig. 4.22 Inserting the step

◆ ◆ ◆ Tips ◆ ◆ ◆

The program that was effective formerly is effective, when you turn [ENBL / DISABLE] switch to ENBL.

Call "1. TEACH" menu from the menu screen, and set the new program name, when you change the edited program.

(1) Calling the step.

Beforehand, select the teaching mode and call the program. (See 4.4.1)

Call the 4th step.

- ① Push [4] key.
- ② Push [INP / EXE] key.

The step number on the teaching box screen becomes 4. The 4th step is effective. (ST : 4):

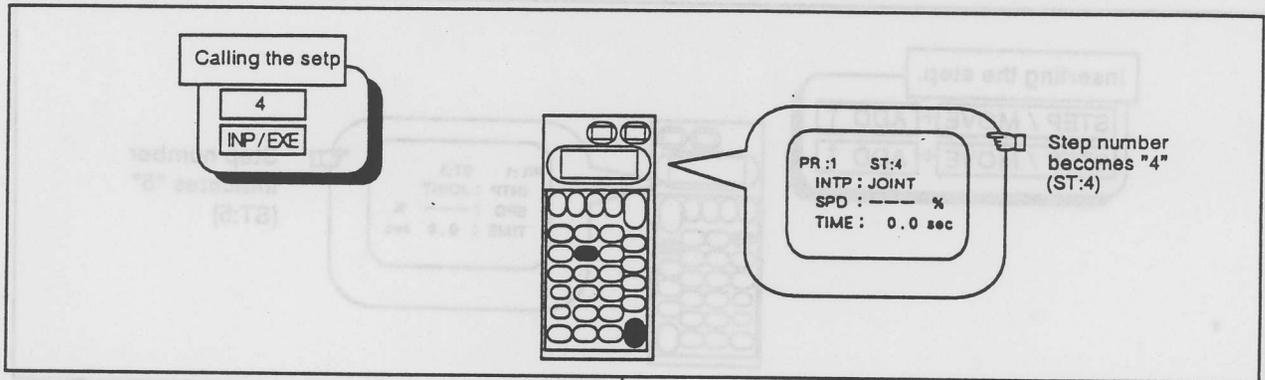


Fig. 4.23 Calling the step.

(2) Teaching the position.

Move the robot arm tip to the new position that will be inserted.

- ① Push [STEP / MOVE] + [JOINT] key to select the JOINT JOG mode.
- ② Push [STEP / MOVE] + each {JOG operation} key to move the robot.

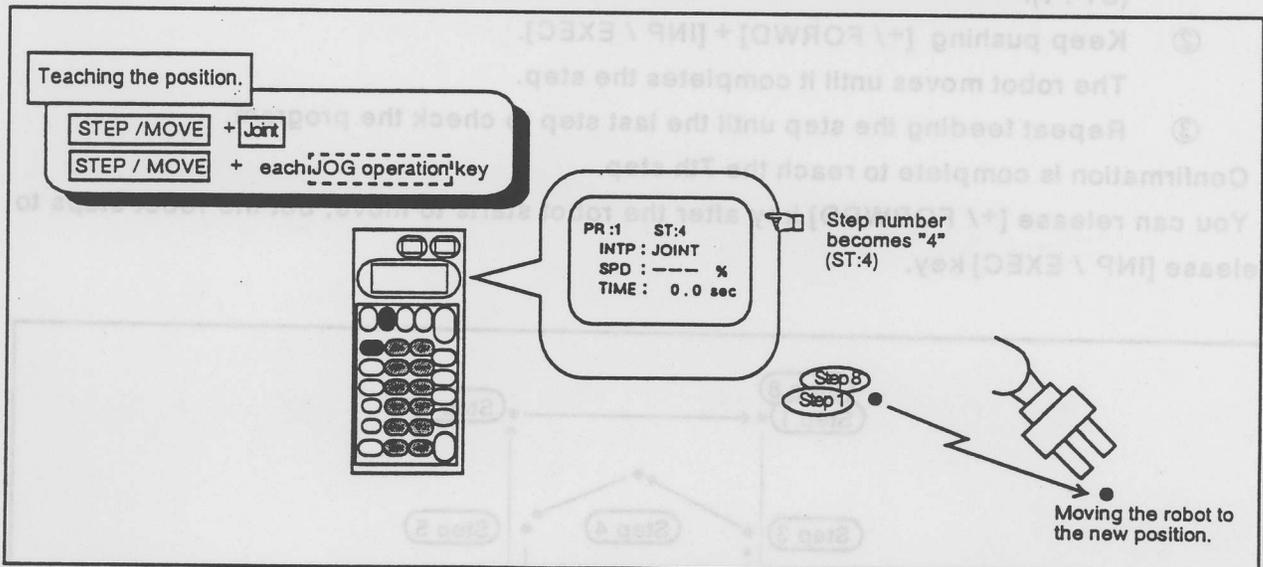


Fig. 4.24 Teaching the location

◆ ◆ ◆ Tips ◆ ◆ ◆

The robot inserts the new step before the current step, and the new step get the current step number, and the robot rennumbers all steps automatically.

(3) Inserting the step.

- ① Push [STEP / MOVE] + [ADD ↑] key, and release only [ADD ↑] key.
The robot beeps shortly, and the confirmation screen appears.
- ② Push [STEP / MOVE] key once again keeping [ADD ↑] key, and then release [STEP / MOVE] key. The robot beeps long, and the robot insert the step with "EXECUTING" message on the screen. The screen shows the number "5" : the next step number after the robot completes inserting the step correctly. (ST : 5)

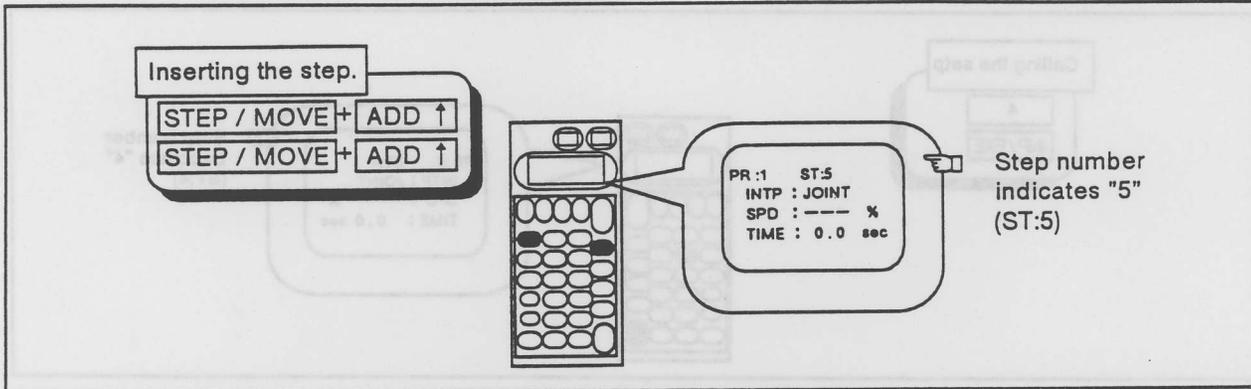


Fig. 4.25 Inserting the step.

(4) Checking the step

Confirm the operation by step feeding.

- ① Push [ALARM / RESET] + [INP / EXE]. to bring back the execution line to the top. (ST : 1):
- ② Keep pushing [+ / FORWD] + [INP / EXEC].
The robot moves until it completes the step.
- ③ Repeat feeding the step until the last step to check the program.

Confirmation is complete to reach the 7th step.

You can release [+ / FORWRD] key after the robot starts to move, but the robot stops to release [INP / EXEC] key.

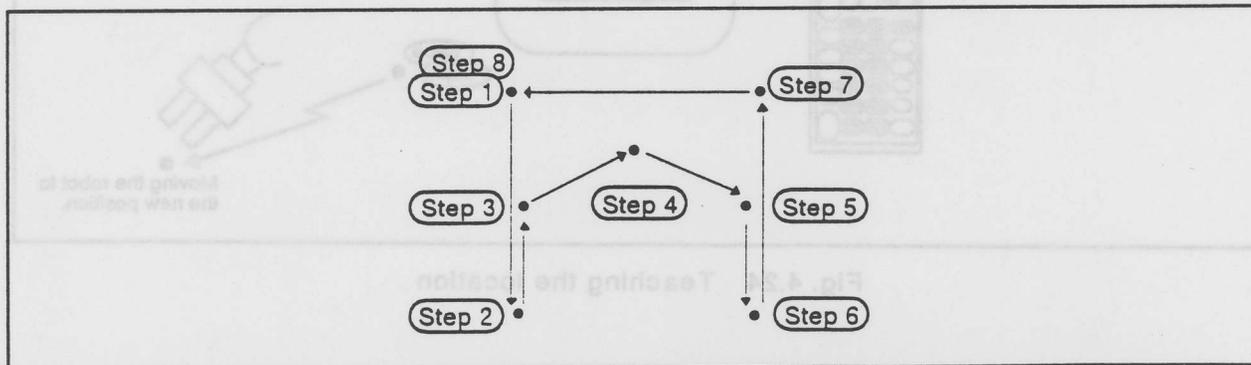


Fig. 4.26 Confirming the step

4.4.3 Replacing the step

Let's replace the 4th step added in the example at the section: 4.4.1. (Figure 4.27)

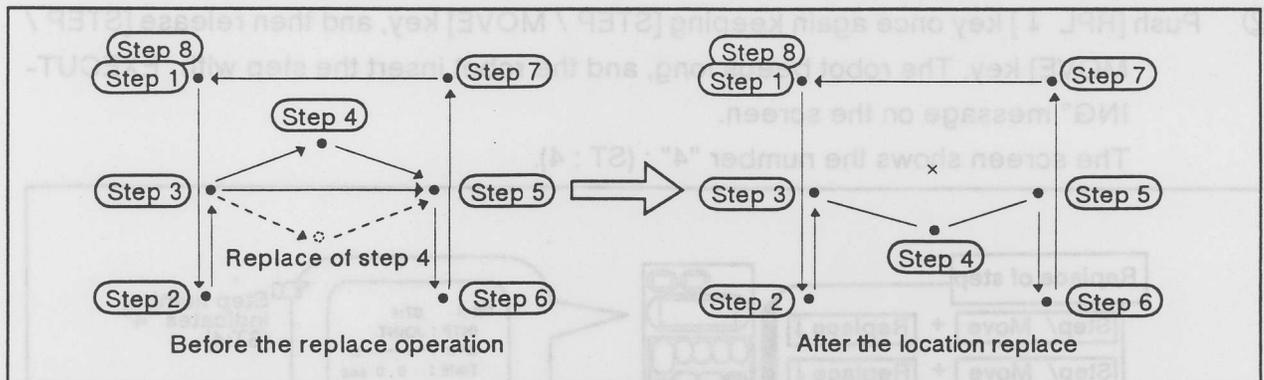


Fig. 4.27 Replacing the step.

(1) Calling the step.

Beforehand, select the teaching mode and call the program. (See 4.4.1)

Call the 4th step..

- ① Push [4] key.
- ② Push [INP / EXE] key.

Step number of teaching box screen display becomes 4. (ST : 4):

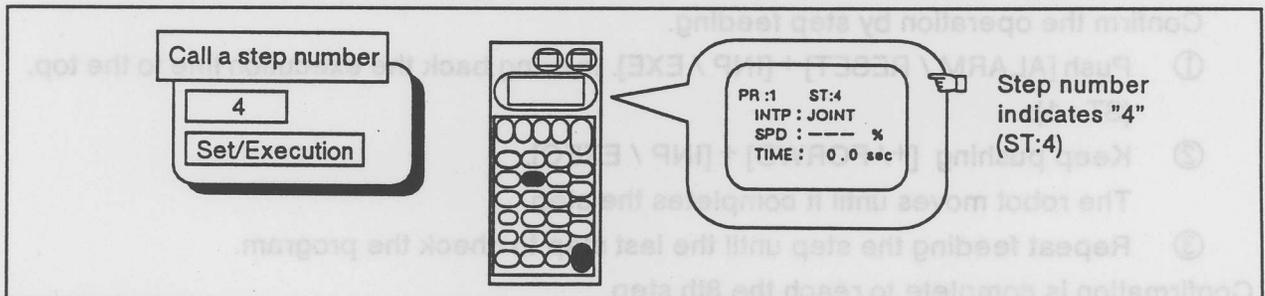


Fig. 4.28 Calling the step

(2) Teach the position.

Move the robot arm tip to the teaching position in the JOINT JOG mode.

- ① Push [STEP / MOVE] + [JOINT] key to select the Joint JOG mode.
- ② Push [STEP / MOVE] + {JOG operation} keys to move the robot hand.

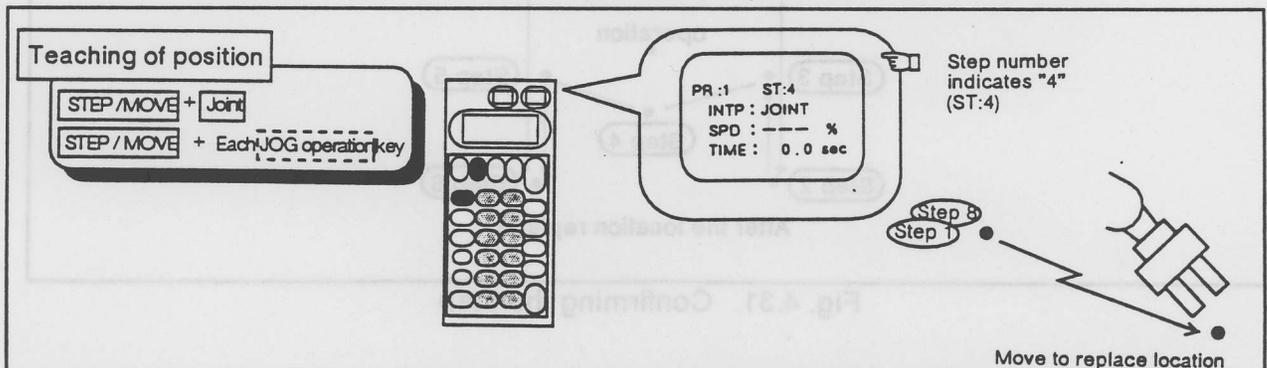


Fig. 4.29 Teaching the position.

(3) Replacing the step

- ① Push [STEP / MOVE] + [RPL ↓] key, and release only [RPL ↓] key.
The robot beeps shortly, and the confirmation screen appears.
- ② Push [RPL ↓] key once again keeping [STEP / MOVE] key, and then release [STEP / MOVE] key. The robot beeps long, and the robot insert the step with "EXECUTING" message on the screen.
The screen shows the number "4" : (ST : 4).

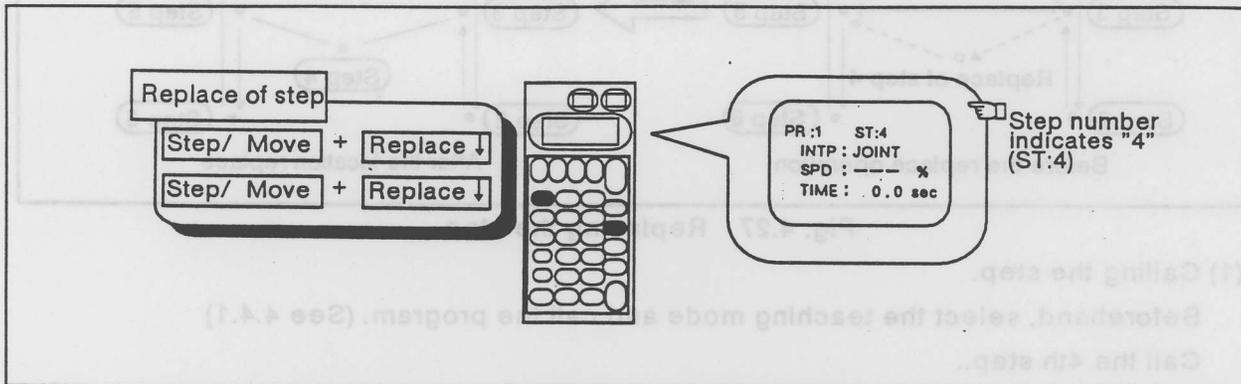


Fig. 4.30 Replacing the step

(4) Confirm step

Confirm the operation by step feeding.

- ① Push [ALARM / RESET] + [INP / EXE]. to bring back the execution line to the top. (ST : 1):
- ② Keep pushing [+ / FORWRD] + [INP / EXEC].
The robot moves until it completes the step.
- ③ Repeat feeding the step until the last step to check the program.

Confirmation is complete to reach the 8th step.

You can release [+ / FORWRD] key after the robot starts to move, but the robot stops to release [INP / EXEC] key.

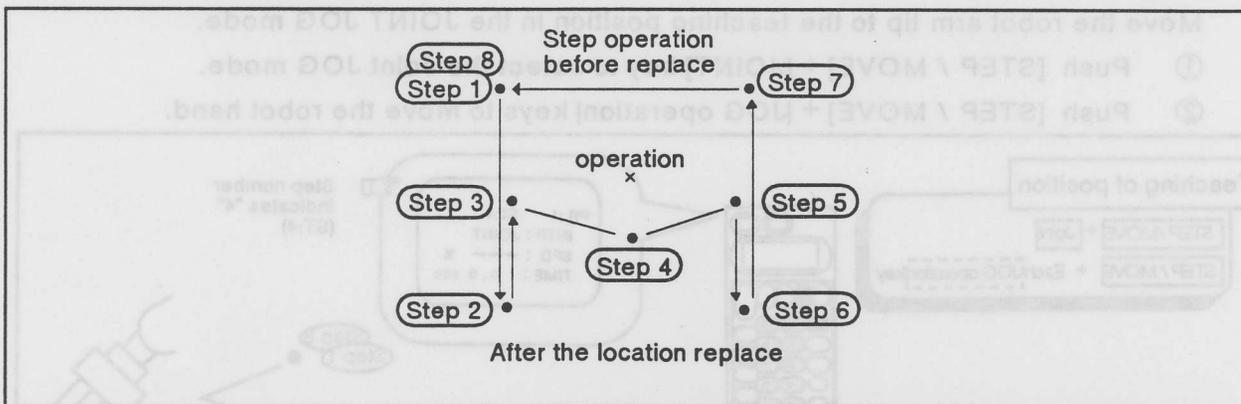


Fig. 4.31 Confirming the step

4.4.4 Deleting the step

Let's delete the added 4th step.

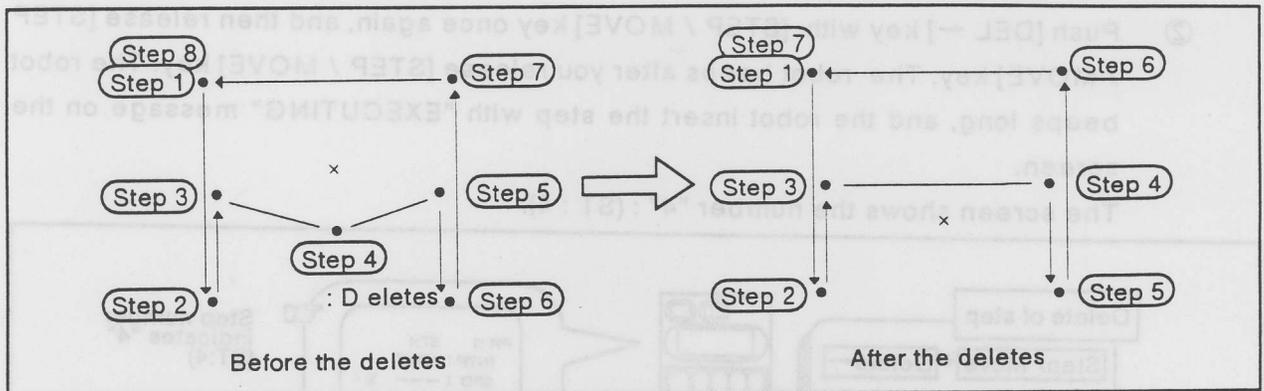


Fig. 4.32 Deleting the step

(1) Calling the step.

Beforehand, select the teaching mode and call the program. (See 4.4.1)

Call the 4th step..

- ① Push [4] key.
- ② Push [INP / EXE] key.

Step number of teaching box screen display becomes 4. (ST : 4):

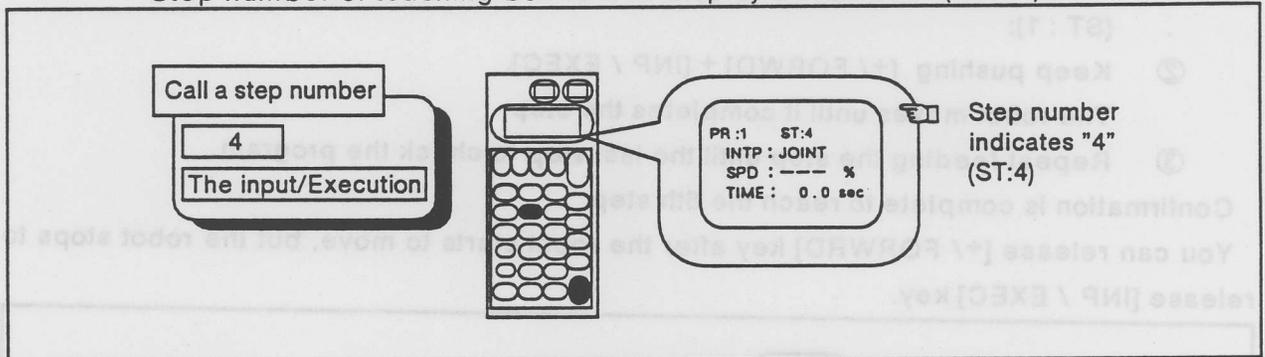


Fig. 4.33 Calling the step

(2) Deleting the step.

- ① Push [STEP / MOVE] + [DEL ←] key and only release [DEL ←] key.
The robot beeps and confirmation screen appears.
- ② Push [DEL ←] key with [STEP / MOVE] key once again, and then release [STEP / MOVE] key. The robot beeps after you release [STEP / MOVE] key. The robot beeps long, and the robot insert the step with "EXECUTING" message on the screen.
The screen shows the number "4" : (ST : 4).

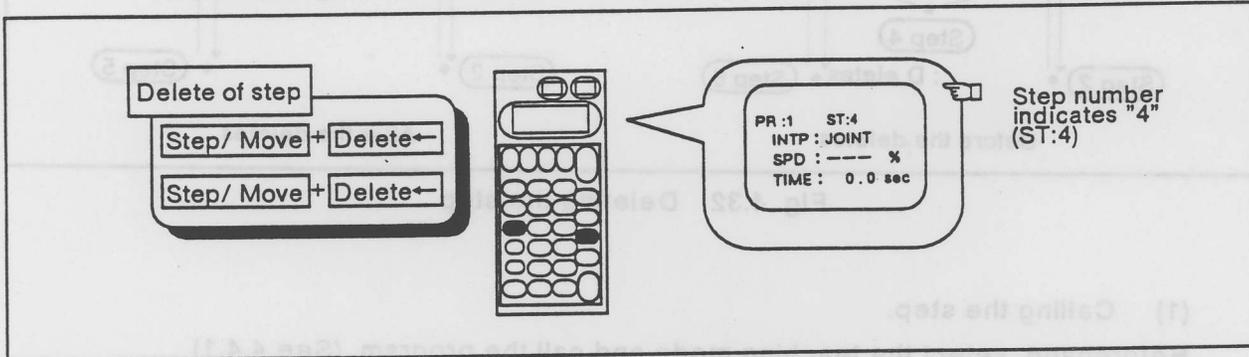


Fig. 4.34 Deleting the step

(3) Confirm step

Confirm the operation by step feeding.

- ① Push [ALARM / RESET] + [INP / EXE]. to bring back the execution line to the top.
(ST : 1):
- ② Keep pushing [+ / FORWD] + [INP / EXEC].
The robot moves until it completes the step.
- ③ Repeat feeding the step until the last step to check the program.

Confirmation is complete to reach the 8th step.

You can release [+ / FORWD] key after the robot starts to move, but the robot stops to release [INP / EXEC] key.

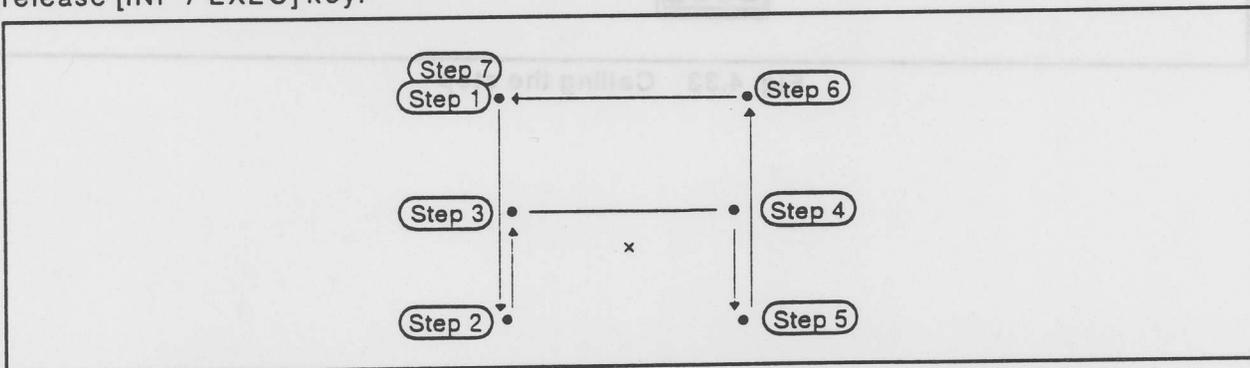


Fig. 4.35 Confirming the step

◆ ◇ ◆ point ◆ ◇ ◆

The robot rennumbers all steps automatically when you delete the step.

4.5 Let's edit the program (2) the condition data

Let's edit the condition data that you created in the former section.

■ The condition data

The created robot program has the position data with the condition data. the condition data includes the interpolation method, the speed, the timer, the hand status and the signal I/O status.

Table 4.1 Condition DATA

◁ Before ▷

- means undefined data.

Step number	Interpolation Speed	Timer	Hand Status
1	-	-	Open
2	-	-	Open
3	-	-	Open
4	-	-	Open
5	-	-	Open
6	-	-	Open
7	-	-	Open

◁ After ▷

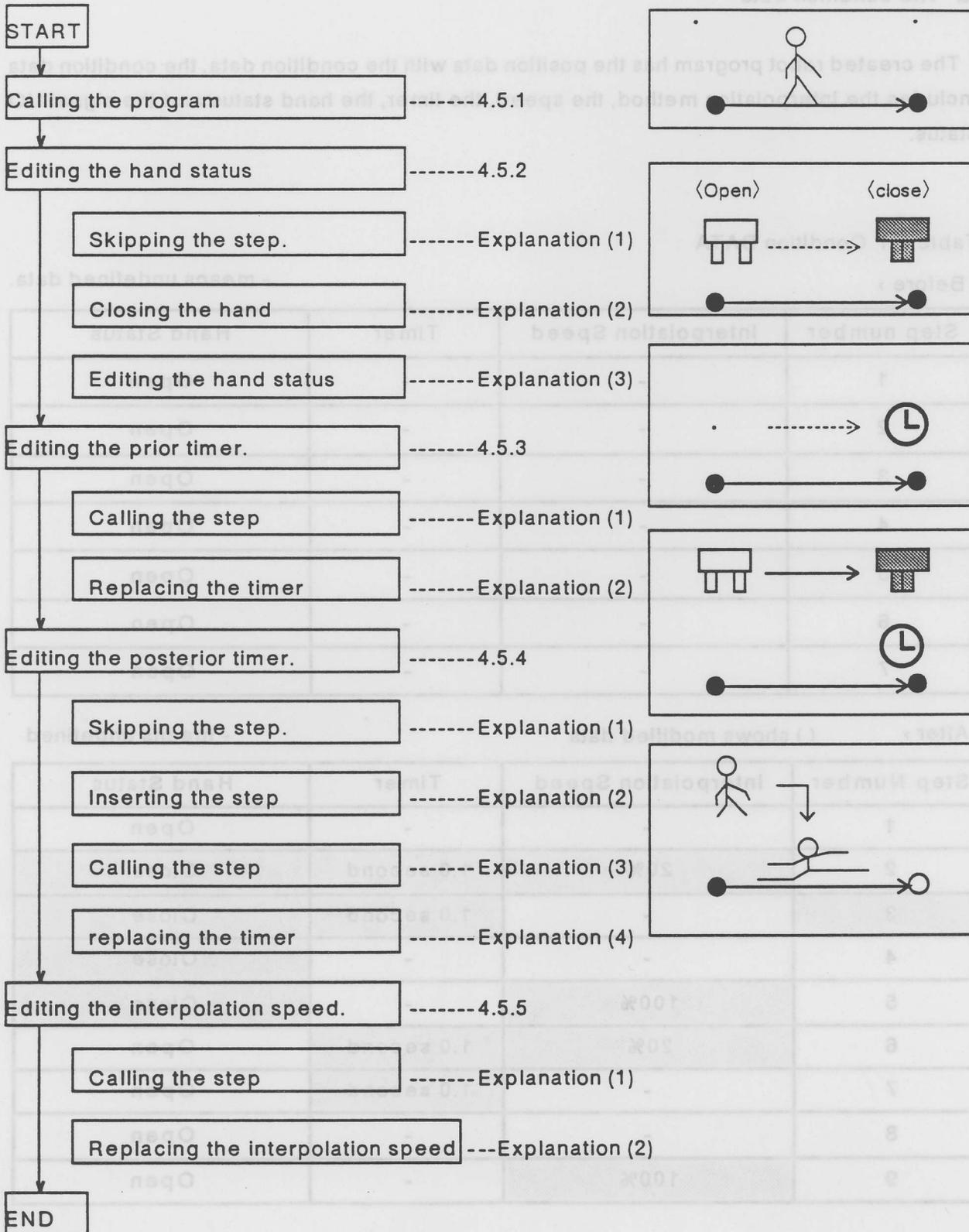
() shows modified data

- means undefined

Step Number	Interpolation Speed	Timer	Hand Status
1	-	-	Open
2	20%	1.0 second	Close
3	-	1.0 second	Close
4	-	-	Close
5	100%	-	Close
6	20%	1.0 second	Open
7	-	1.0 second	Open
8	-	-	Open
9	100%	-	Open

■ Over view

This section explains how to edit the condition data.



4.5.1 Calling the program

Call the program. See this manual /4.4.1: Calling the program.

4.5.2 Editing the hand status

Initially, all step has the open hand status.

Let's edit the hand status as Figure 4.36.

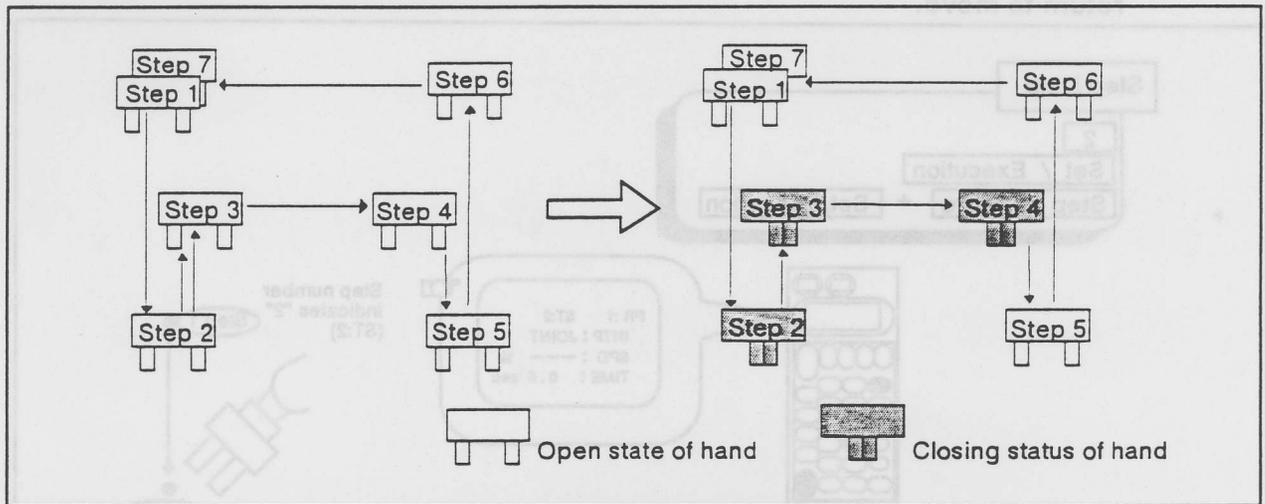


Fig. 4.36 Hand operation

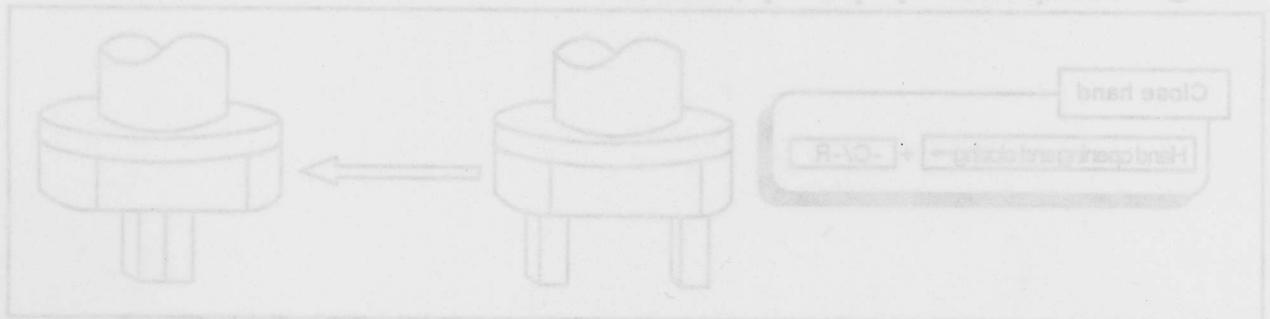


Fig. 4.38 Closing the hand

Set the hand to open in the 2nd step.

(1) Skipping the step

Skip to the 2nd step.

- ① Push [2] (-A/-T key).
- ② Push [INP / EXE] key to call the second step.
- ③ Keep pushing [STEP / MOVE] key with [INP / EXE] key

The robot starts to move to the objective position of the 2nd step. The robot keeps the motion until you release [STEP / MOVE] key. The third operation allows you to return to move.

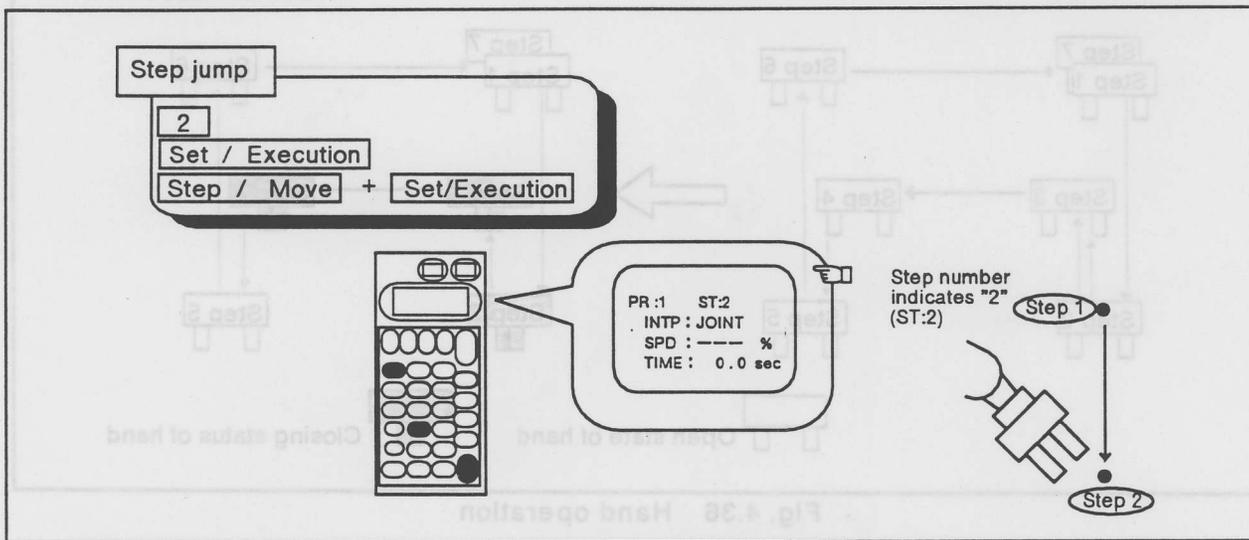


Fig. 4.37 Skipping the step

(2) Closing the hand

- ① Push [HAND →] + [-C/-R].to close the hand.

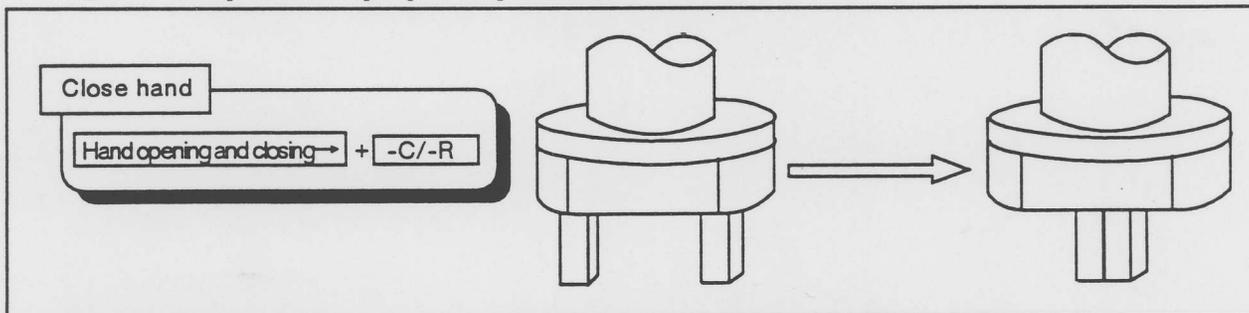


Fig. 4.38 Closing the hand

(3) Editing the hand status.

The hand is open in this step initially, so Replace the hand status from open to closed.

- ① Push [STEP / MOVE]+ [RPL ↓], and release only [RPL ↓] key.
- ② Keep [STEP / MOVE] key, and push [RPL ↓] key again.

The robot set the closed hand status in the 2nd step.

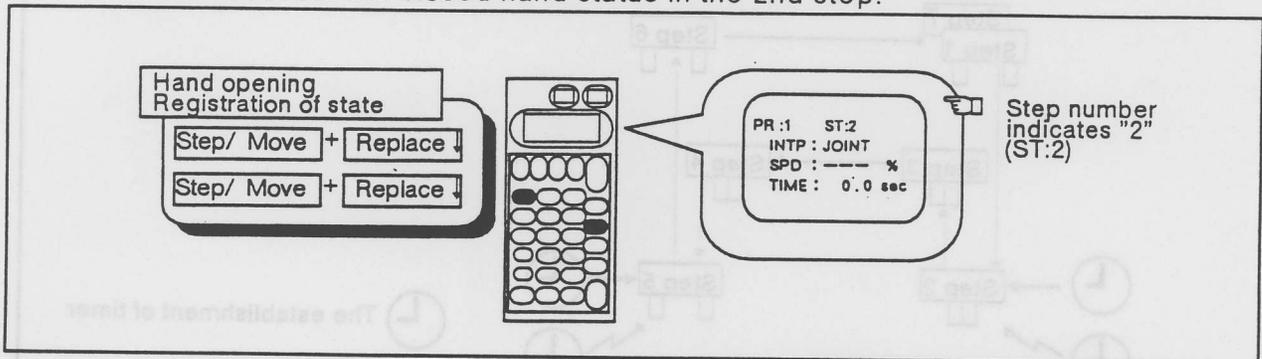


Fig. 4.39 Hand opening Registration of state

Set the closed hand status in the 3rd and 4th step in the same way.

This is the over view.

- ① Call the step.
- ② Close the hand at each step.
- ③ Replace the hand status in each step.

The robot sets the closed hand status in the 3rd and 4th step.

The Table 4.2 shows the new condition data.

Table 4.2 Condition data

Old Step Number	New Step Number	Interpolation Speed	Timer	Hand Status
1	1	-	-	Open
2	2	-	-	Close
3	3	-	-	Close
4	4	-	-	Close
5	5	-	-	Open
6	6	-	-	Open
7	7	-	-	Open

◆ ◆ ◆ Tips ◆ ◆ ◆

The robot moves the hand finger after it reaches the position.

4.5.3 Editing the prior timer.

The robot should wait a little time to stabilize the arm after the stop. Well gripping needs the prior timer that make delay to wait a standstill.

Let's set the prior timer before gripping.

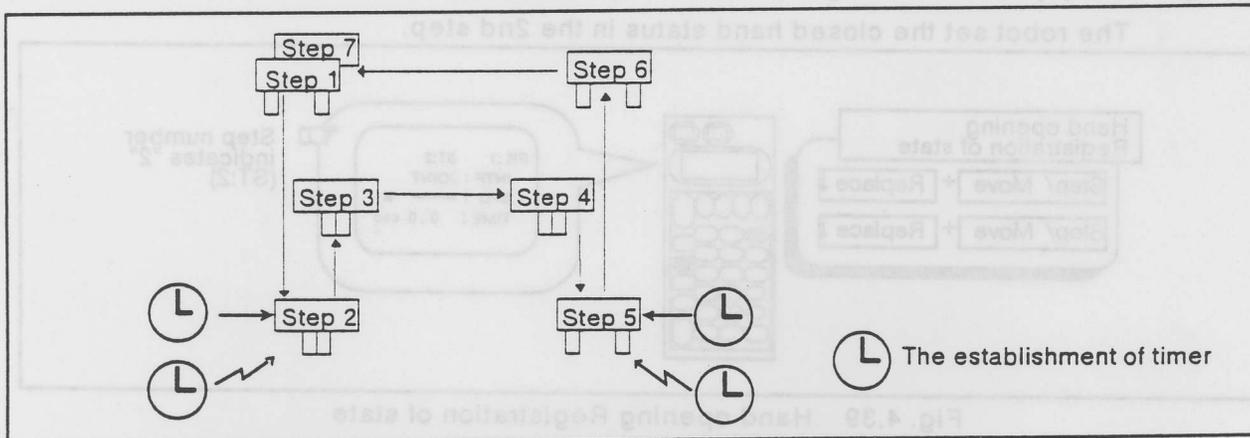


Fig. 4.40 Editing the timers

Set the timer in 1.0 sec..... before closing the hand at the 2nd step.

(1) Calling the step

- ① Push [2] key to call the 2nd step.
- ② Push [INP / EXE] key. The step number on the display becomes "2."

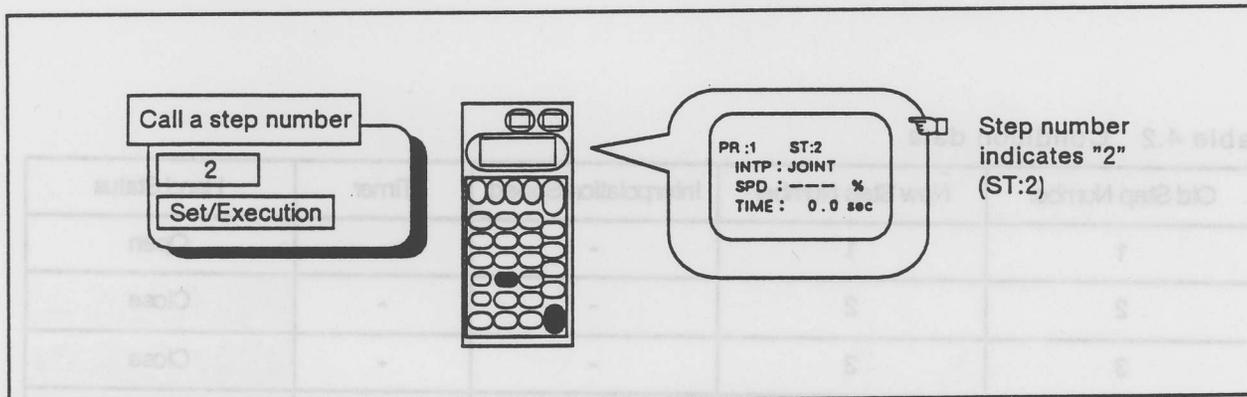


Fig. 4.41 Calling the step.

(2) Replacing the timer

Set 1.0 sec into the timer.

- ① Push [STEP / MOVE] key with [COND →] key, and alternate [COND →] key with [RPL ↓] key. The interpolation entry appears.
- ② Push [RPL ↓] key 2 times. The timer entry appears.
- ③ Push [1] key.
- ④ Push [INP / EXE] key. The robot enters 1.0 sec into the prior timer.

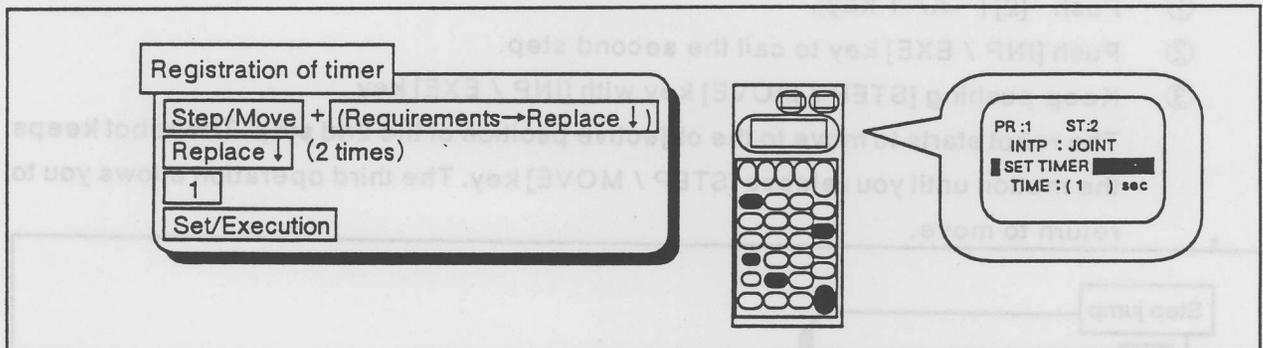


Fig. 4.42 Setting the prior timer

Set 1.0 sec delay into the 5th step in the same way.

This is Over view.

- ① Call the 5th step.
- ② Set 1.0 sec at the location of the 5th step.

Table 4.3 shows the condition data in each step.

Table 4.3 Condition data

Old Step Number	New Step Number	Interpolation Speed	Timer	Hand Status
1	1	-	-	Open
2	2	-	1.0 second	Close
3	3	-	-	Close
4	4	-	-	Close
5	5	-	1.0 second	Open
6	6	-	-	Open
7	7	100%	-	Open

4.5.4 Editing the posterior timer.

The robot should wait a little time to stabilize the hand after closing. Well gripping needs the posterior timer that makes delay to wait a standstill.

Let's set the posterior timer after gripping at the 2nd step.

(1) Skipping the step

Skip to the 2nd step.

- ① Push [2] (-A/-T key).
- ② Push [INP / EXE] key to call the second step.
- ③ Keep pushing [STEP / MOVE] key with [INP / EXE] key

The robot starts to move to the objective position of the 2nd step. The robot keeps the motion until you release [STEP / MOVE] key. The third operation allows you to return to move.

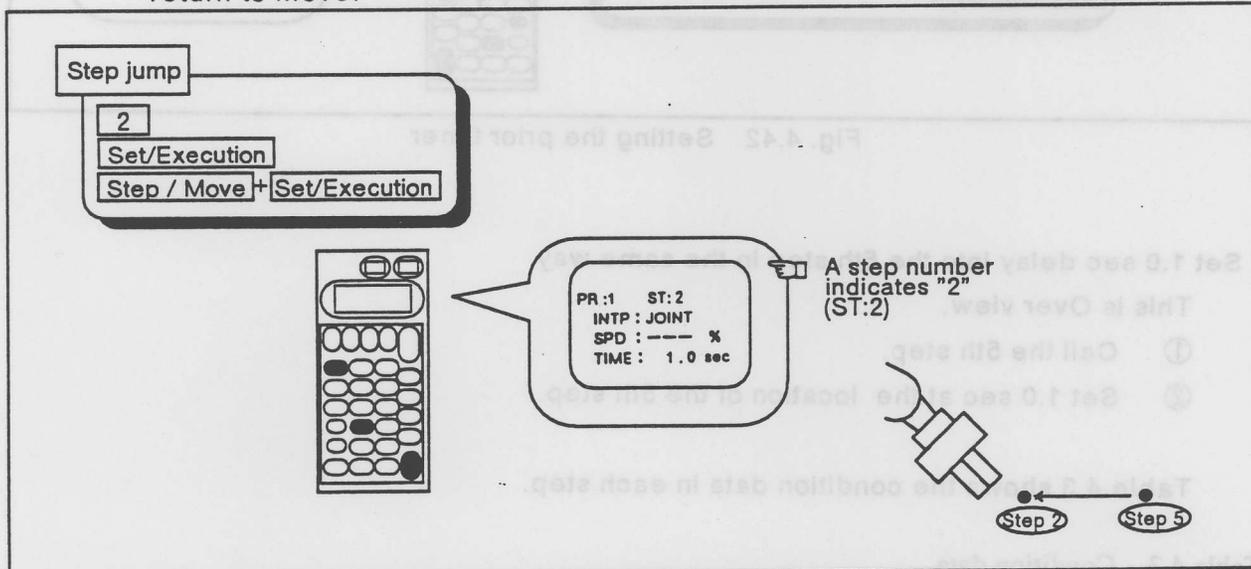


Fig. 4.43 Skipping the step.

◆ ◆ ◆ Tips ◆ ◆ ◆

This is the execution order at each step.

(1) Interpolation speed setting → (2) Moving → (3) Timer → (4) Hand

For example, when the robot moves from the 1st step 1 to the 2nd step, the robot moves from the 1st step to the 2nd step with the interpolation method and interpolation speed that the 2nd step has. The timer starts after the robot reaches the 2nd step position, and then the hand closes.

In this example, no interpolation setting at the 2nd step causes the joint interpolation.

(2) Calling the step

Call the 3rd step.

- ① Push [3] key.
- ② Push [INP / EXE] key.

The step number becomes "3." (ST : 3):

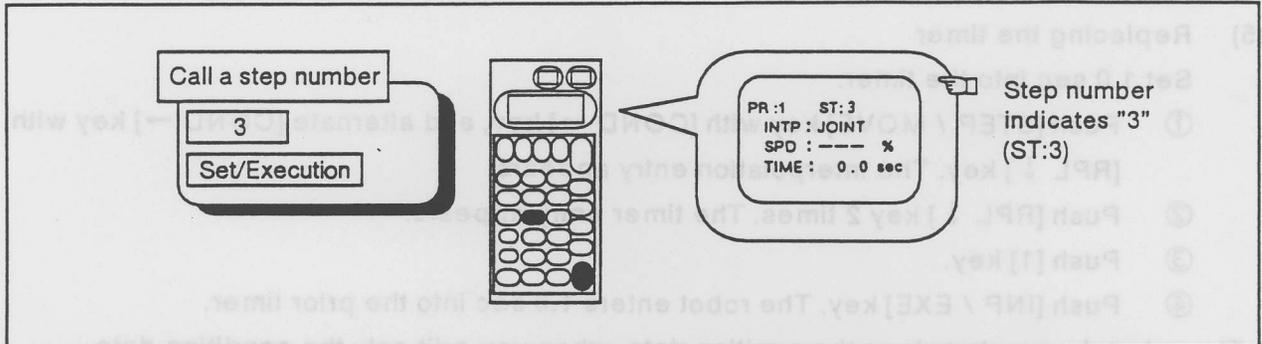


Fig. 4.44 Calling the step.

(3) Inserting the step.

- ① Push [STEP / MOVE] + [ADD ↑] key, and release only [ADD ↑] key. The robot beeps shortly, and the confirmation screen appears.
- ② Push [STEP / MOVE] key once again keeping [ADD ↑] key, and then release [STEP / MOVE] key. The robot beeps long, and the robot insert the step with "EXECUTING" message on the screen. The screen shows the number "4" : the next step number after the robot completes inserting the step correctly. (ST : 4)

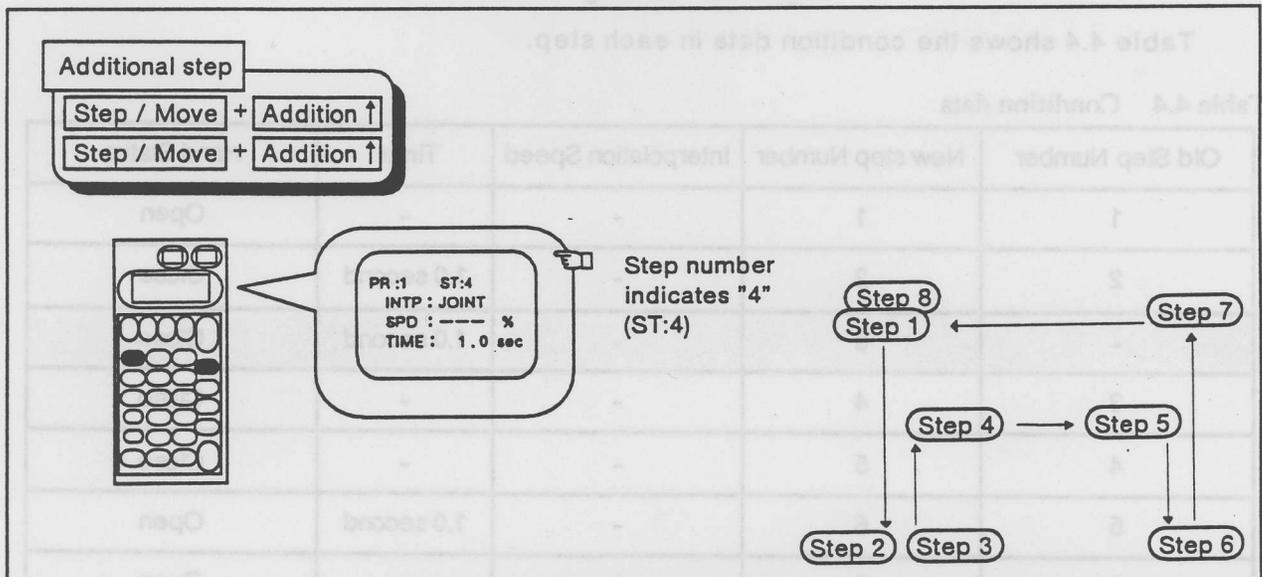


Fig. 4.45 Inserting the step.

(4) Calling the step

Call the 3rd step.

- ① Push [3] key.
- ② Push [INP / EXE] key.

The step number becomes "3." (ST : 3):

(5) Replacing the timer

Set 1.0 sec into the timer.

- ① Push [STEP / MOVE] key with [COND →] key, and alternate [COND →] key with [RPL ↓] key. The interpolation entry appears.
- ② Push [RPL ↓] key 2 times. The timer entry appears.
- ③ Push [1] key.
- ④ Push [INP / EXE] key. The robot enters 1.0 sec into the prior timer.

The robot does not replace the position data, when you edit only the condition data.

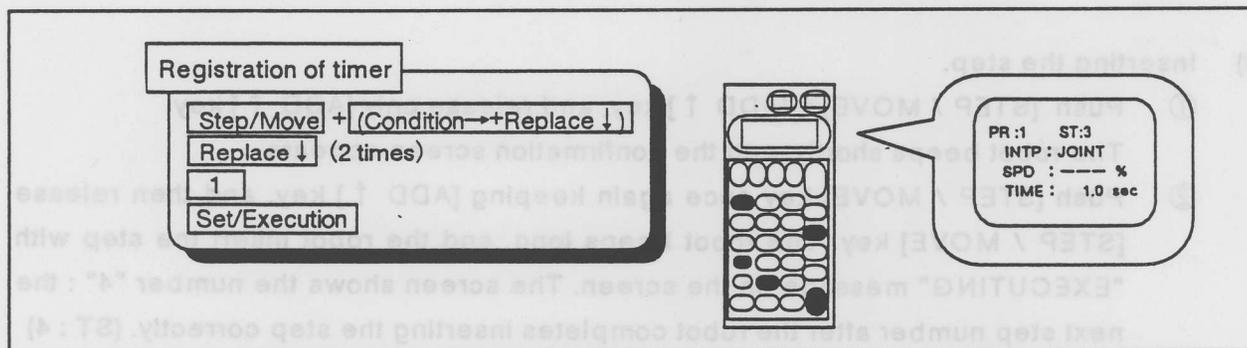


Fig. 4.46 Setting the timer

Table 4.4 shows the condition data in each step.

Table 4.4 Condition data

Old Step Number	New step Number	Interpolation Speed	Timer	Hand Status
1	1	-	-	Open
2	2	-	1.0 second	Close
-	3	-	1.0 second	Close
3	4	-	-	Close
4	5	-	-	Close
5	6	-	1.0 second	Open
6	7	-	-	Open
7	8	-	-	Open

Let's set the 1.0 sec. posterior timer after opening the hand at the 6th step.
 Here, you insert the new step with 1.0 sec. timer between the 6th step (the current step)
 and the 7th step.

This is Over view.

- ① Call the 6th step.
- ② Insert the step at the 6th step.
- ③ Call the 7th step.
- ④ Set 1.0 sec. in the timer at the 7th step.

Table 4.5 shows the condition data.

Table 4.5 Condition data

Old Step Number	New step Number	Interpolation Speed	Timer	Hand Status
1	1	-	-	Open
2	2	-	1.0 second	Close
-	3	-	1.0 second	Close
3	4	-	-	Close
4	5	-	-	Close
5	6	-	1.0 second	Open
-	7	-	1.0 second	Open
6	8	-	-	Open
7	9	-	-	Open

◆ ◆ ◆ Tips ◆ ◆ ◆

The default timer setting is 0 sec.

4.5.5 Setting the interpolation speed

Set the interpolation speed at each step as Figure 4.47.

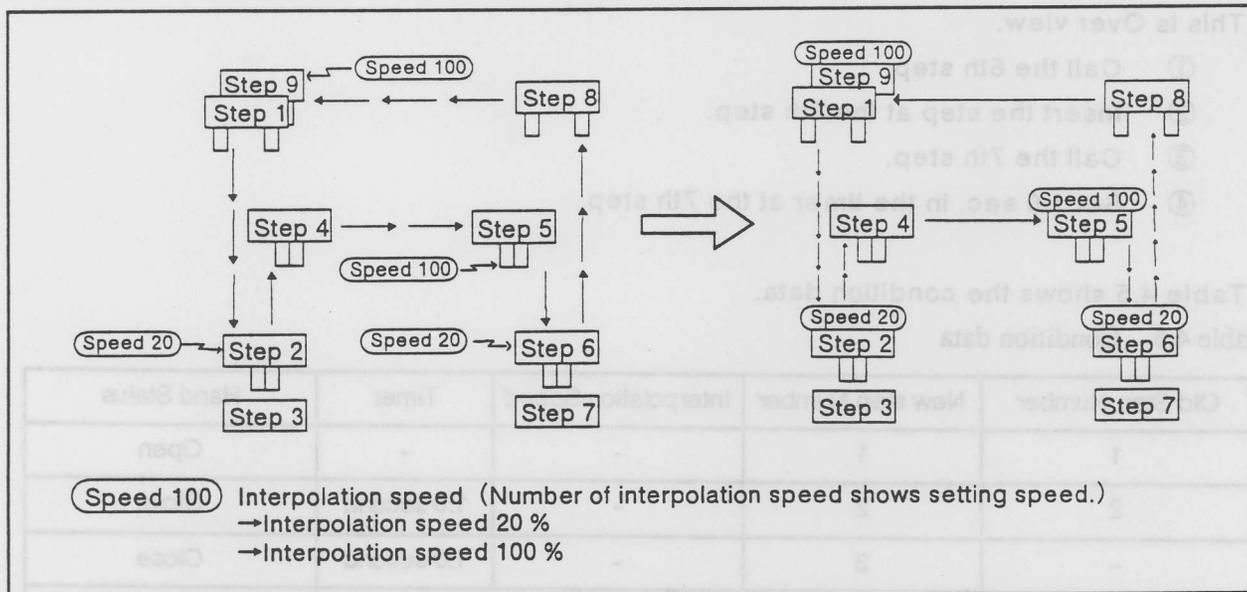


Fig. 4.47 Interpolation speed.

Set the interpolation speed moving from 1st step to 2nd step in 20%.

(1) Calling the step

Call the 2nd step.

- ① Push [2] key.
- ② Push [INP / EXE] key.

Step number becomes "2." (ST : 2):

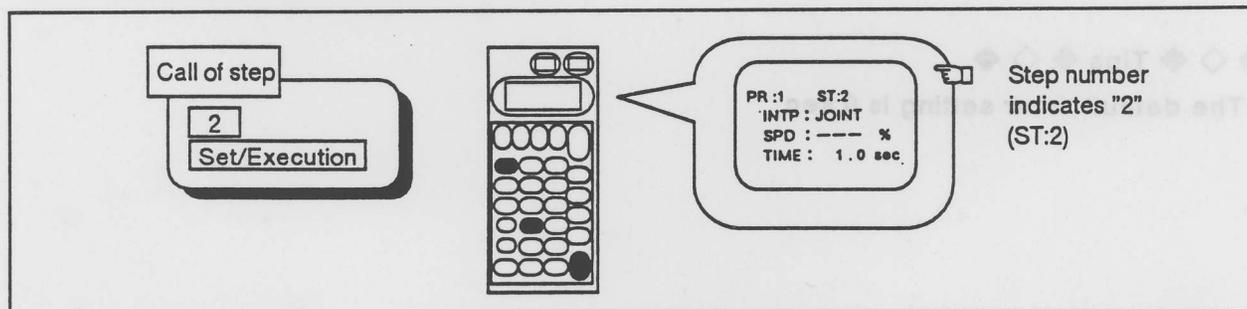


Fig. 4.48 Calling the step

(2) Replacing the interpolation speed.

Set 20% in the interpolation speed.

- ① Push [STEP / MOVE] key with [COND →] key, and alternate [COND →] key with [RPL ↓] key. The interpolation entry appears.
- ② Push [RPL ↓] key 2 times. The timer entry appears.
- ③ Push [2] and [0] key.
- ④ Push [INP / EXE] key.

The robot sets 20% in the interpolation speed.

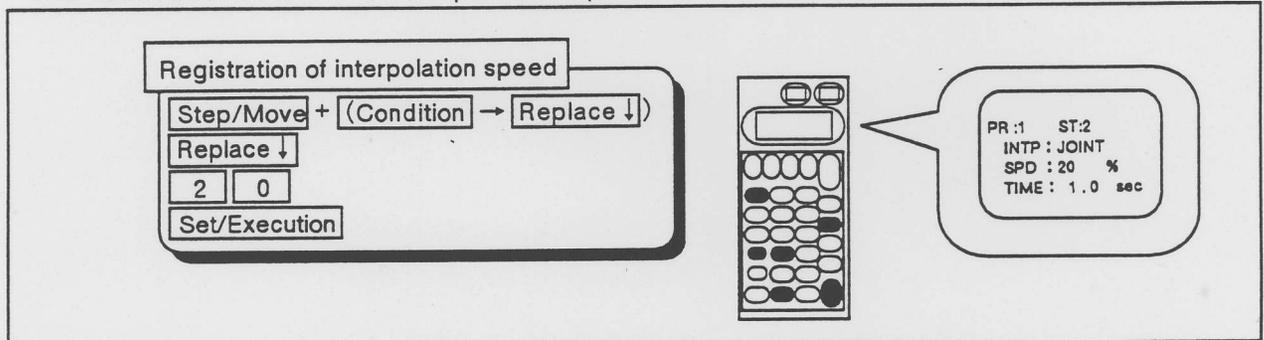


Fig. 4.49 Setting the interpolation speed

Edit the interpolation speed in the same way.

- ① Set 100% in the interpolation speed moving from the 4th step to the 5th step.
- ② Set 20% in the interpolation speed moving from the 5th step to the 6th step.
- ③ Set 100% in the interpolation speed moving from the 8th step to the 9th step.

Table 4.6 shows the condition data in each step.

Table 4.6 Condition data

Old Step Number	New Step Number	Interpolation Speed	Timer	Hand Status
1	1	-	-	Open
2	2	20%	1.0 second	Close
-	3	-	1.0 second	Close
3	4	-	-	Close
4	5	100%	-	Close
5	6	20%	1.0 second	Open
-	7	-	1.0 second	Open
6	8	-	-	Open
7	9	100%	-	Open

◆ ◆ ◆ Tips ◆ ◆ ◆

If the step has no interpolation speed setting, the robot moves with the same interpolation method and speed as former.

The default setting is 63.3 mm/s with the joint interpolation, and 9.7 % with the linear interpolation.

《Memo》

- ① Push [STEP \ MOVE] key with [COND ←] key, and alternate [COND ←] key with [RPL ↓] key. The interpolation entry appears.
 - ② Push [RPL ↓] key 2 times. The timer entry appears.
 - ③ Push [2] and [0] key.
 - ④ Push [INP \ EXE] key.
- The robot sets 20% in the interpolation speed.

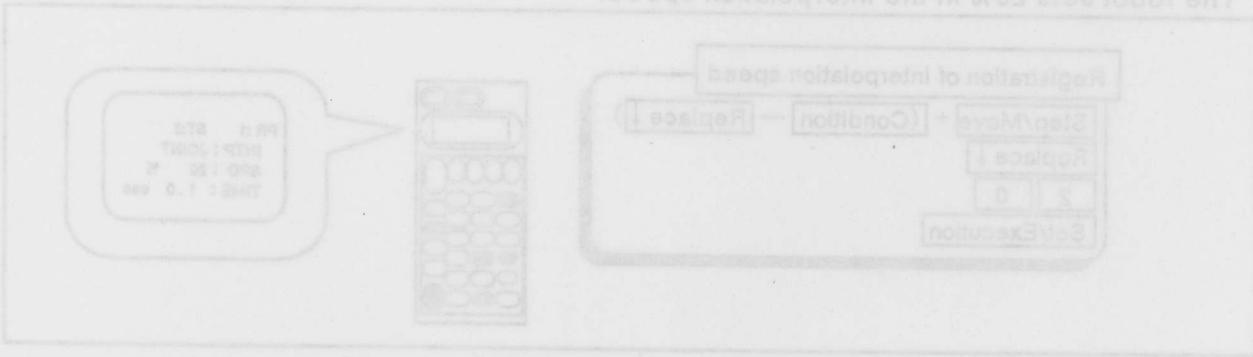


Fig. 4.18 Setting the interpolation speed

- Edit the interpolation speed in the same way.
- ① Set 100% in the interpolation speed moving from the 4th step to the 5th step.
 - ② Set 20% in the interpolation speed moving from the 5th step to the 6th step.
 - ③ Set 100% in the interpolation speed moving from the 6th step to the 7th step.

Table 4.6 shows the condition data in each step.

Table 4.6. Condition data

Old Step Number	New Step Number	Interpolation Speed	Timer	Hand Status
1	1	-	-	Open
2	2	20%	1.0 second	Close
-	3	-	1.0 second	Close
3	4	-	-	Close
4	5	100%	-	Close
5	6	20%	1.0 second	Open
-	7	-	1.0 second	Open
6	8	-	-	Open
7	9	100%	-	Open

◆◆◆ Tip ◆◆◆

If the step has no interpolation speed setting, the robot moves with the same interpolation method and speed as former.

The default setting is 63.3 mm/s with the joint interpolation, and 0.7 # with the linear interpolation.

5. Appendix

This chapter provides solutions to some common problems that you might encounter while using the MOVE MASTER SUPER.

Robot couldn't get the power. Q

- | | | |
|---|---|--|
| ① | A | Check the power cable. |
| — | — | See User's manual \3.5 How to connect the power cable to connect it correctly. |
| ② | — | Check a fuse. |
| — | — | See Reference manual \ chapter 5 : maintenance & inspection to replace it. |
| ③ | — | Check the power line. |
| — | — | Line voltage shall be single-phase 200 Vac. (Standard specification) |

The robot stopped during drive. Q

- | | | |
|---|---|--|
| ① | A | Check PROALM display if it blinked, or it indicates the alarm. |
| — | — | Reset alarm status and remove alarm factor. |
| — | — | You can get more information from Reference manual \3.5 alarm. |
| ② | — | Check if line voltage dropped. |
| — | — | Keep power voltage in specification. |
| ③ | — | Check blackout or momentary power failure. |
| — | — | Turn off the robot once, and Turn it on again. |
| ④ | — | Check the emergency stop switch. |
| — | — | Remove the emergency stop switch. |
| ⑤ | — | Check if motor smells. |
| — | — | The motors might burn out if it smelled. |
| — | — | Call service soon. |

5.1 Trouble shooting

This chapter provides solutions to some common problems that you might encounter while using the MOVE MASTER SUPER.

Q Robot couldn't get the power.

- A**
- ① Check the power cable.
→ See User's manual /3.5 How to connect the power cable to connect it correctly.
 - ② Check a fuse.
→ See Reference manual / chapter 5 : maintenance & inspection to replace it.
 - ③ Check the power line.
→ Line voltage shall be single-phase 200 Vac. (Standard specification)

Q The robot stopped during drive.

- A**
- ① Check PRO/ALM display if it blinked, or it indicates the alarm.
→ Reset alarm status and remove alarm factor.
You can get more information from Reference manual /6.5 alarm.
 - ② Check if line voltage dropped.
→ Keep power voltage in specification.
 - ③ Check blackout or momentary power failure.
→ Turn off the robot once, and Turn it on again.
 - ④ Check the emergency stop switch.
→ Remove the emergency stop switch.
 - ⑤ Check if motors smells.
→ The motors might burn out if it smelled.
Call service soon.

Q Robot does not work

- A**
- ① Check PRO/ALM display if it blinked, or it indicated alarm.
→ Remove alarm status and remove an alarm factor.
You can get more information to read reference manual /6.5 alarm.
 - ② Check the robot arm if it collides with the stopper or other machines.
→ Move the robot arm to make it free.
 - ③ Check machine cables.
→ you can get more information from User's manual /3.4 How to connect the machine cables.
 - ④ Check the robot arm if it came motion edge?
→ Move the robot arm to make it free.

Q Robot is noisy.

- A**
- ① Check bolts.
→ Fasten them up.
 - ② Check if Harmonic Drive is noisy. Check if vibration becomes large suddenly.
→ Harmonic Drive might break down.
Call service soon.

Q

Robot slips off

A

- ① Check if electromagnetic noise comes.
 - Remove electromagnetic noise source. Take noise control.
 - Take surge measures with solenoid valve. The optional products have surge control.
 - Ground the robot correctly.
- ② Check if the robot is loose.
 - Fasten it.
- ③ Check the timing belts.
 - Adjust tension of the timing belts.

you can get more information from Reference manual / chapter 5: maintenance & inspection.
- ④ check installation of the hand.
 - Fasten it.

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MITSUBISHI ELECTRIC CORPORATION

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NAGOYA WORKS 1-14, YADA-MINAMI 5, HIGASHI-KU, NAGOYA, JAPAN