CONAIR
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USERGUIDE

MNL-00043

FX(F) - 250
FX(F) - 350
FX(F) - 450

Automatic Pick & Place Mechanism

⚠ **WARNING - Reliance on this Manual Could Result in Severe Bodily Injury or Death!**

This manual is out-of-date and is provided only for its technical information, data and capacities. Portions of this manual detailing procedures or precautions in the operation, inspection, maintenance and repair of the product forming the subject matter of this manual may be inadequate, inaccurate, and/or incomplete and cannot be used, followed, or relied upon. Contact Conair at info@conairgroup.com or 1-800-654-6661 for more current information, warnings, and materials about more recent product manuals containing warnings, information, precautions, and procedures that may be more adequate than those contained in this out-of-date manual.

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A. AUTOMATIC PICK AND PLACE MECHANISM

1. Concept

The FX(F) robot will take the product(s) and/or sprue runner system molded by the injection molding machine, and load it out from the machine by the arm swing. These models are mounted on the fixed platen of the injection machine ranging from 150 to 450 tons.

Using these robots helps to save man power and also ensure high quality products because of constant cycle time (condition).

The FX(F) series robot is equipped with the remote adjustment for arm stroke and strip forward and backward end position. So, no tool is required for stroke adjustment.

The aluminium profile is used for main arm so the arm motion to be stable and smooth.

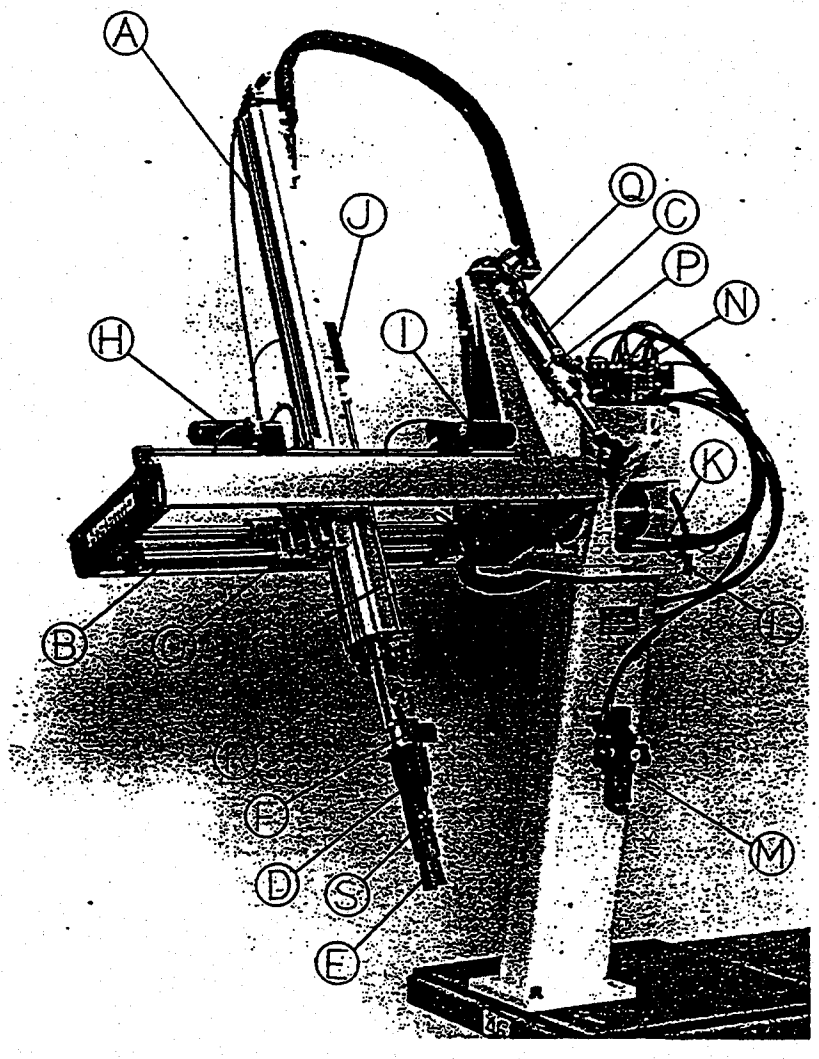
The control pendant is convenient for mode/timer setting and each stroke adjustment.

FXF robot has an additional function to FX robot with the gripper's wrist rotation by 90° to release the part(s) on the conveyor or other down stream equipment.

In addition to the vacuum suction system for the gripping of part(s), this model is capable to adopt mini cylinders and nippers for wider range of applications.

2. Names of parts

A. Main arm cylinder
B. Strip cylinder
C. Swing cylinder
D. Gripper assembly
E. Finger
F. Main arm lock cylinder
G. Slide unit
H. Strip forward end position adjust motor (C)
I. Strip backward end position adjust motor (B)
J. Main arm stroke adjust motor (A)
K. Ratchet lever
L. Pivot stopper
M. F.R. unit
N. Air solenoid valve
O. Main stopper
P. Swing outward end prox. switch (LS-1)
Q. Swing inward end prox. switch (LS-2)
R. Arm upward end prox. switch (LS-3)
S. Sprue verification prox switch (LS-4)



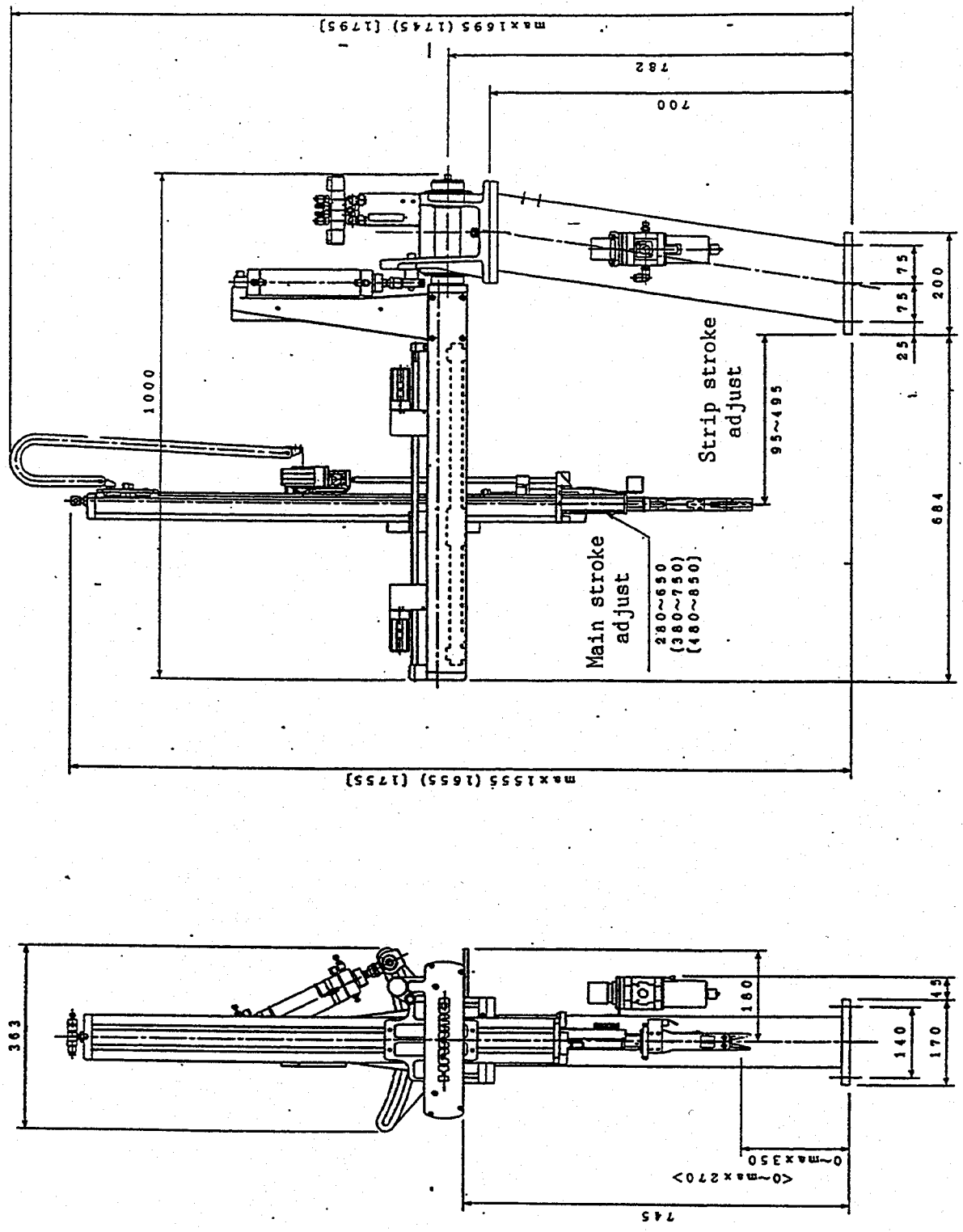
B. SPECIFICATIONS

1. Standard specifications

Model	FX(F)-250	FX(F)-350	FX(F)-450
Injection machine size range (ton)	150--250	250--350	350--450
Working air pressure (kg/cm^2)	4.0 -- 6.0 (Mpa 0.4 - 0.6)		
Max. primary air pressure (kg/cm^2)	9.0 (Mpa 0.9)		
Air consumption (Nℓ/cycle)	6.4	6.5	6.6
Min. take out time (sec.)	1.2	1.3	1.4
Min. cycle time (sec.)	3.8	4.0	4.2
Gripper center to top platen (mm)	0 - 350 (0 - 270)		
Max. main arm stroke (mm)	280 - 650	380 - 750	480 - 850
Max. strip stroke (mm)	400 (Rodless)		
Strip stroke adjustable range(mm)	95 - 495		
Swing angle	50 - 90		
Wrist rotation angle	(90)		
Max. payload [*]	200g ; Without wrist rotation (FX) 100g ; With wrist rotation (FXF)		
Weight (kg) [**]			

* : Including the end of arm tooling
** : Less control box
( ) : F type

Dimensions


max1695 (1745) [1795]
782
700
1000
Strip stroke adjust
95~495
Main stroke adjust
280~650
(380~750)
[480~850]
25
75
75
200
684
max1555 (1655) [1755]
Unit ; mm
FX(F)-250 /350 /450
( )---- 350 [ ] ---- 450
363
180
45
140
170
0~max350
<0~max270>
745

3. Standard sequence

Following motion sequences are available by selecting modes on control pendant.

a) Release parts outside mold

A : U type motion
Pick-up molded parts from movable mold

B : U type motion
Pick-up molded parts from stationary mold

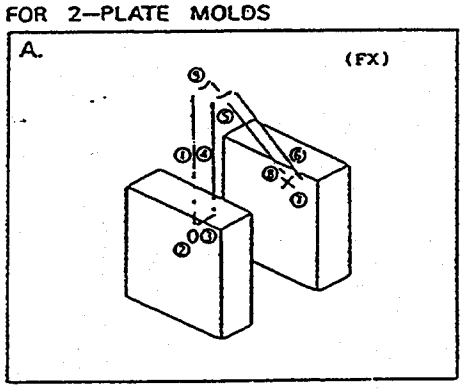
C : L type motion
Pick up molded parts from movable mold

D : L type motion
Pick-up molded parts from stationary mold

** To change parts release side whether operator side or rear side, please refer " C. FUNCTION AND ADJUSTMENT "

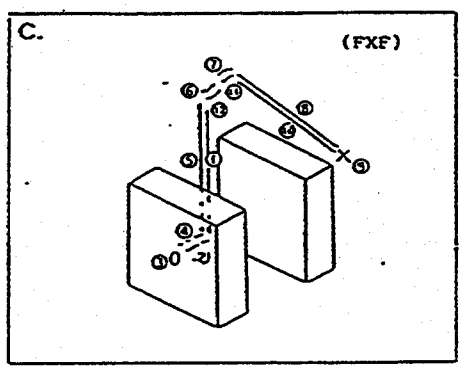
FOR 2—PLATE MOLDS

A. (FX)



① Extension downward
② Grip
③ Kick backward
④ Retraction upward
⑤ Swing outward
⑥ Extension outward
⑦ Release
⑧ Retraction inward
⑨ Swing inward to home position

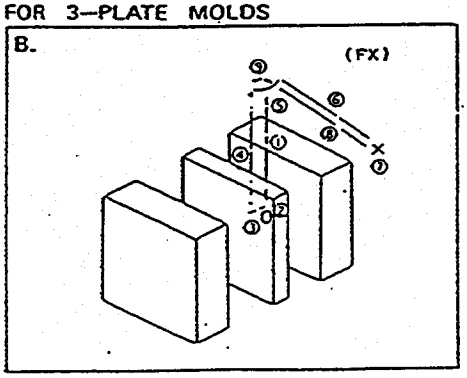
C. (FXF)



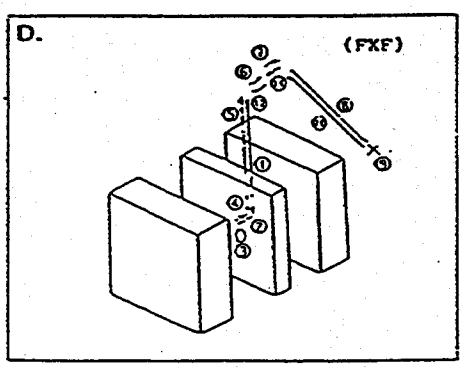
① Extension downward
② Kick forward(approach)
③ Grip
④ Kick backward(strip-off)
⑤ Retraction upward
⑥ Swing outward
⑦ Positioning
⑧ Extension outward
⑨ Release
⑩ Retraction inward
⑪ Positioning back
⑫ Swing inward to home position

FOR 3—PLATE MOLDS

B. (FX)



D. (FXF)



b) Release parts inside mold

E : U type motion
Pick-up molded parts from movable mold

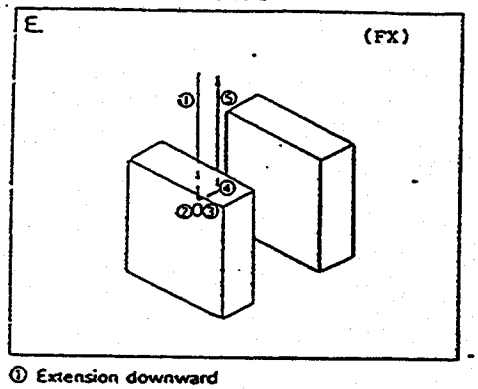
F : U type motion
Pick-up molded parts from stationary mold

G : L type motion
Pick up molded parts from movable mold

H : L type motion
Pick-up molded parts from stationary mold

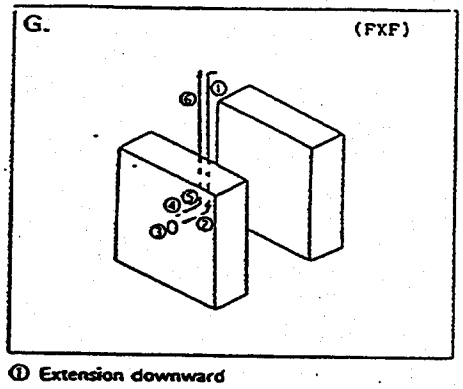
FOR 2-PLATE MOLDS

E. (FX)



① Extension downward
② Grip
③ Kick backward (strip-off)
④ Release
⑤ Retraction upward

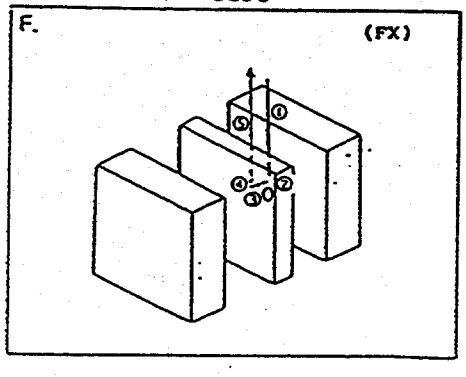
G. (FXF)



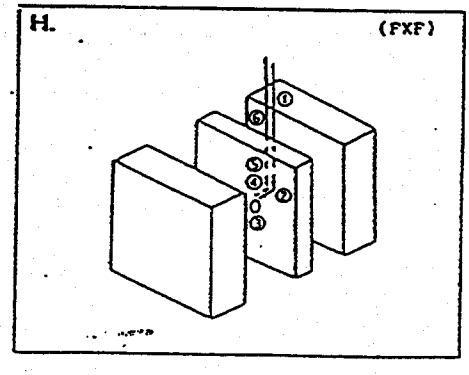
① Extension downward
② Kick forward(approach)
③ Grip
④ Kick backward(strip-off)
⑤ Release
⑥ Retraction upward

FOR 3-PLATE MOLDS

F. (FX)



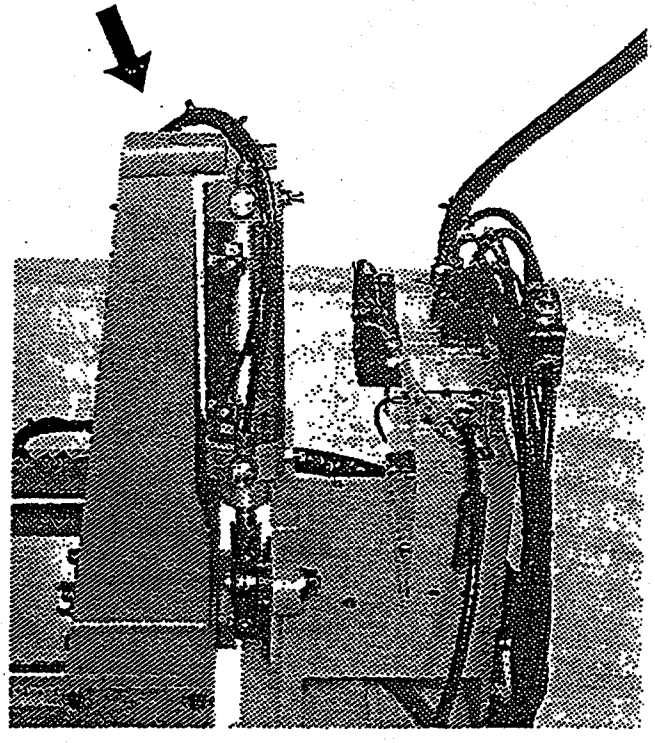
H. (FXF)



C. FUNCTION AND ADJUSTMENT

1. Hanging the robot up

When hang the robot up, in order to avoid damages, please suspend it with a textile belt making use of a tap hole made on top of the base shown in the picture.
This designated method of hanging is only recommended. Any other method of hanging the robot will be out of our guarantee.

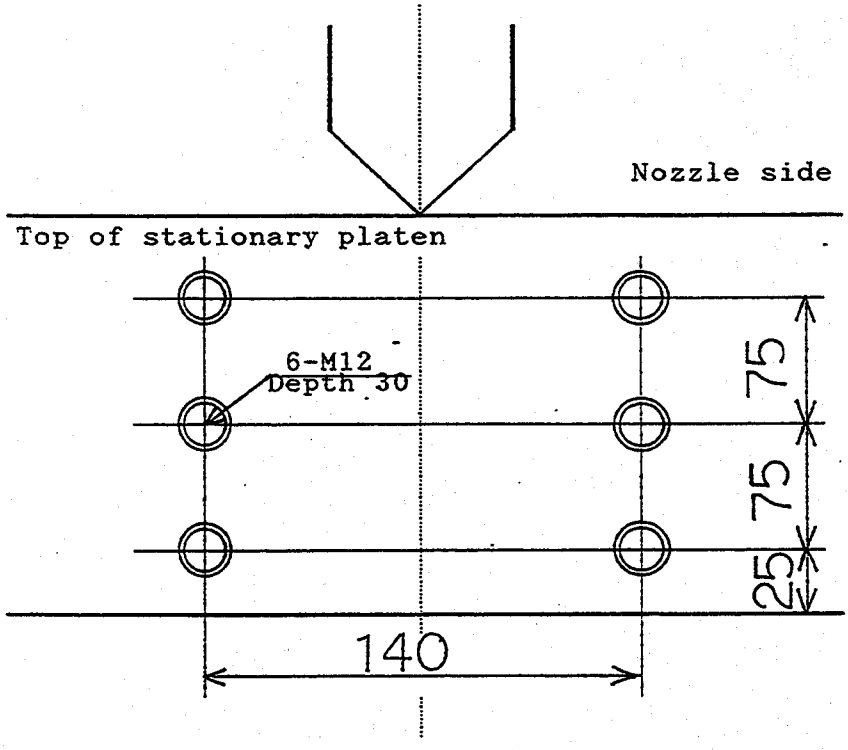


2. Mounting and setting gripper height

a) Mounting

To set the robot on the top of stationary platen. Make 6 of M12 with 30mm deep tap hole on the stationary platen as shown below. Fix the robot with attached screws, lock and plane washers tightly.

ROBOT MOUNTING TAP HOLES



b) Gripper height setting

The gripper height (from top of stationary platen to gripper center) is minimized when FX -factory the robot in order to make the packing size small. It is necessary to readjust it after mounting.

It is available to adjust a gripper height in the following ranges on the FX series robot.

FX - 250,350,450 ..... 0 - 350 mm

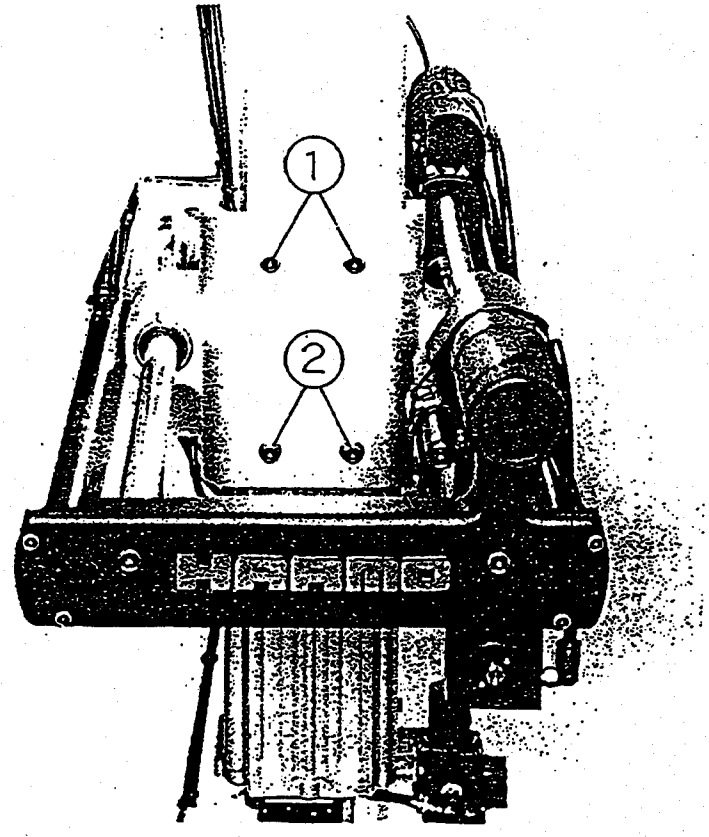
FXF - 250,350,450 ..... 0 - 270 mm

1. Loosen the screws (No. 1 and 2).

   Hold the main arm while loosen the screws.

2. Set the gripper height to desired position by move the main arm up and down.

3. Tighten the screws.



3. Main arm stroke adjustment

The adjustment of main arm stroke can be done with air supplied and with remote pendant.
When EX -factory the robot, the main arm stopper is set to lower position.

a) Open the mold.

b) Check if the strip stroke and starting position are correctly set so that gripper will not hit the mold when descends. If not, adjust them first.

c) Press "ARM DOWN" key (4) so the arm descends.

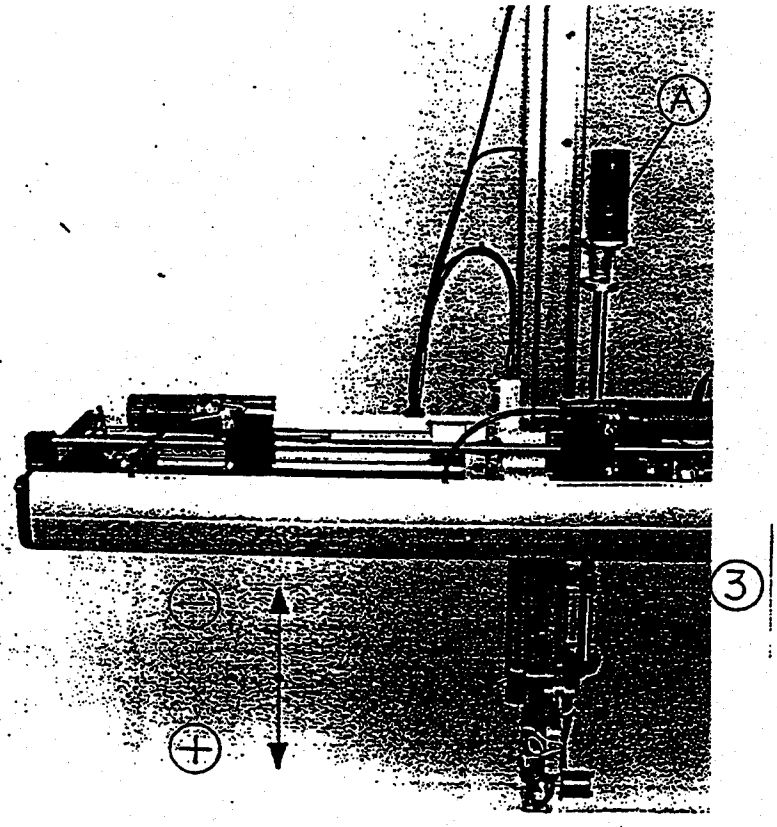
d) Select the direction to move the main arm stopper (3) by "MOTOR +/-" key (5). Under the LED "+" lights, the main stopper moves to lower by pressing "MOTOR A" key (5) and it obtains longer main arm stroke.

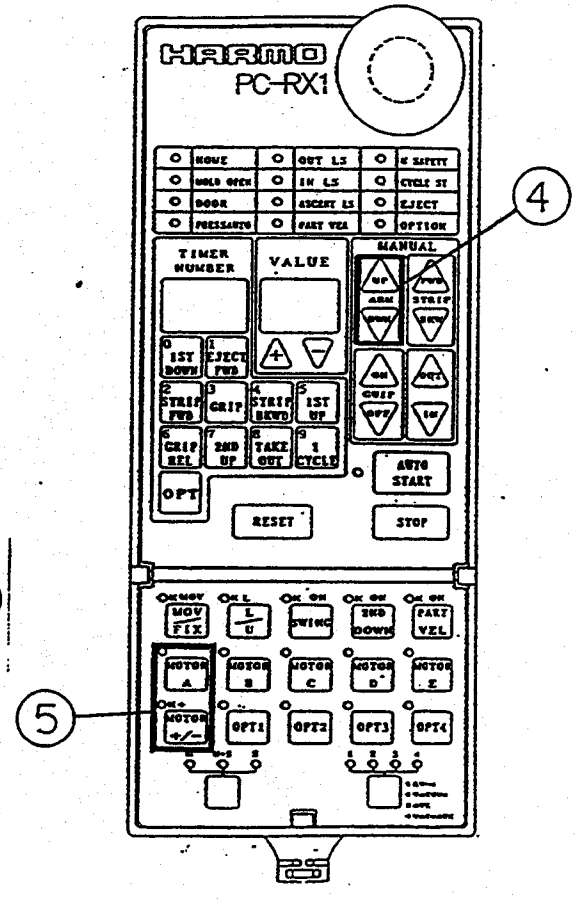
e) Under the LED turns off by pressing "+/-" key, the main stopper moves to upper by pressing "MOTOR A" key.

CAUTION: DO NOT CONTINUE TO ACTUATE THE MOTOR OVER 1 MINUTE WITH LOAD

f) After setting the stroke, make the arm at up end position by "ARM UP" key (4).

NOTE: The stroke adjustment is not available during auto operation.





4. Strip forward/backward end position adjustment

It is also available to adjust it with air supplied to the robot.
When ex-factory the robot, the arm position is set to base side.

a) Open the mold.

b) Press the key (3) so the LED (+) lights.

c) Press "MOTOR C" key (4) so the strip stroke stopper (2) moves toward the movable platen.

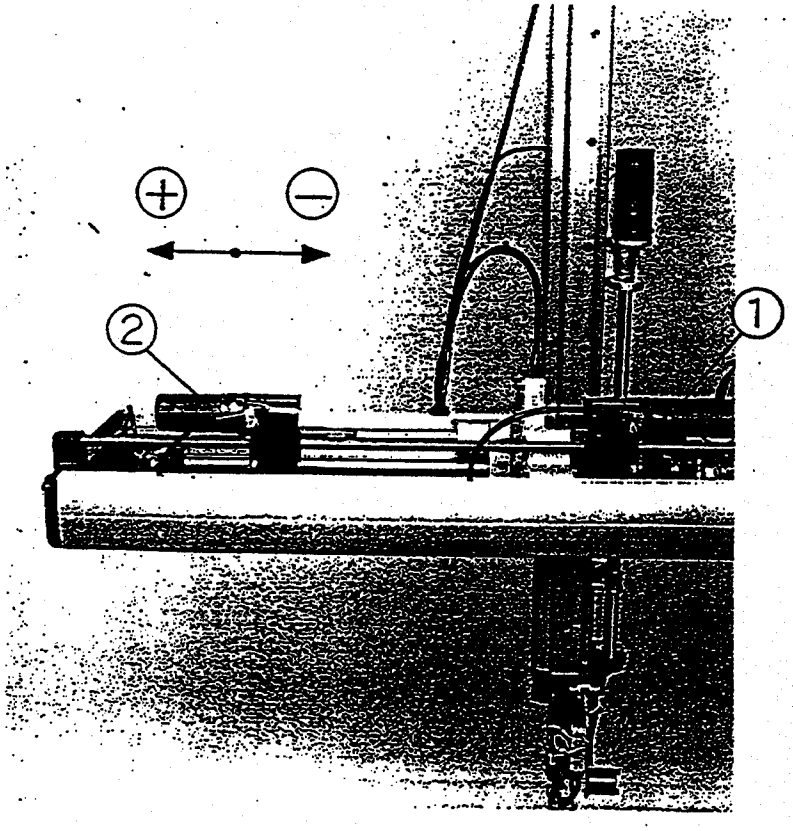
d) If make that position toward stationary platen, press "MOTOR +/-" key (3) and make the LED turn off. Then press the "MOTOR C" key (4).

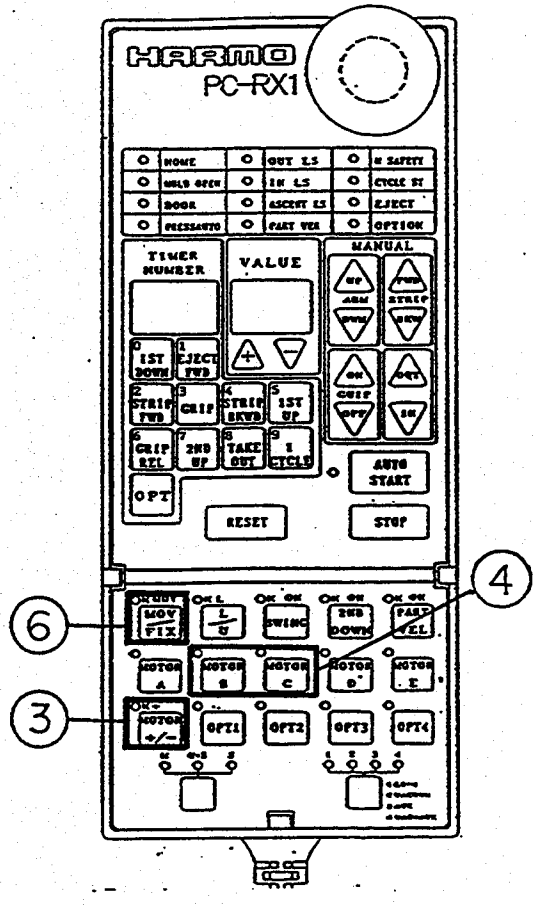
CAUTION: DO NOT CONTINUE TO ACTUATE THE MOTOR OVER 1 MINUTE WITH LOAD

NOTE: **When adjust the forward end position, move the main arm forward by "STRIP" key (6) so to have easy adjustment.**

e) Adjust the strip backward end position moving stopper (1). by "MOTOR +/-" (3) and "MOTOR B" (4) keys with a same manner.

NOTE: **When adjust the backward end position, move the main arm backward by "STRIP" key (6) so to have easy adjustment.**





f) Select the take out direction by "MOV/FIX" key (5).

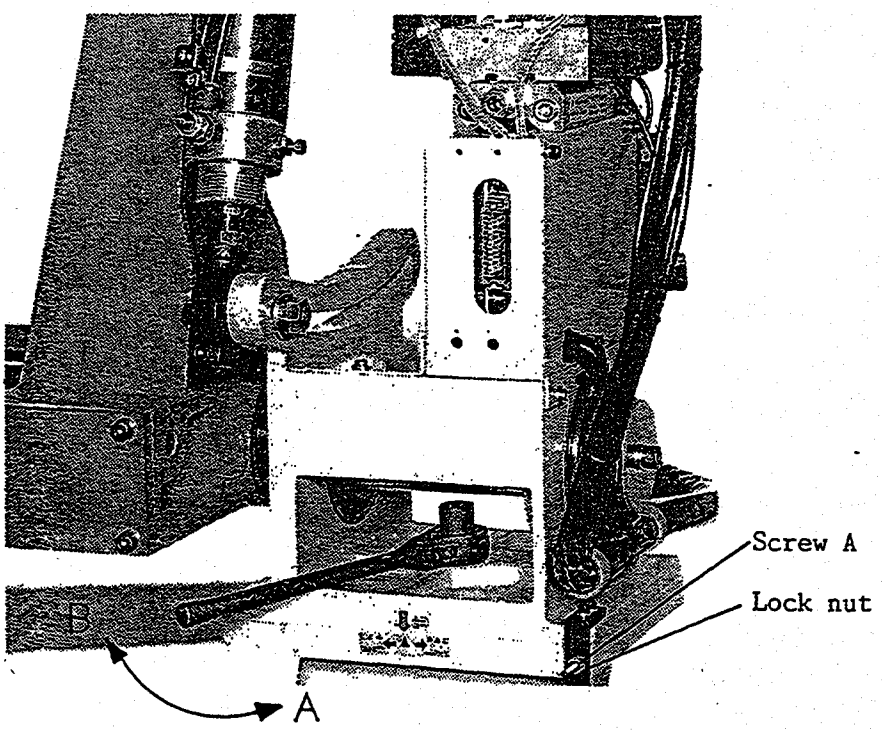
g) After finish the position setting, make the arm position to backward end by "STRIP" key (6).

NOTE: The position adjustment is not available during auto operation.

5. Ratchet lever for pivot base

Easy to pivot the robot main body by ratchet lever when change the mold.Turn the ratchet lever to direction A several times. Turn the robot body to the rear side of injection molding machine.
After change the mold, return the robot body to its home position. Then fix the robot by turning ratchet lever to direction B.

After the gripping position of part and/or sprue runner system is settled, set the screw A so that the end of screw touches to the mounting base. Then lock the screw by the lock nut. Since then, it is not necessary to readjust the Pivot Home Position from next mold change (pivot base).



6. Change swing out direction and angle

The robot has been set at operator side parts release when delivered from HARMO factory.

The swing out direction and swing angle can be easily changed by the following manner.

FX-R series

a) Exhaust compressed air completely.

b) Loosen the nut.

c) Set swing out direction and angle by adjusting the nut position.

d) Tighten the nut.

CAUTION : 1) Do not set in the area of oblique lined.
2) Do not set the swing angle over 90°.

FXF-R series

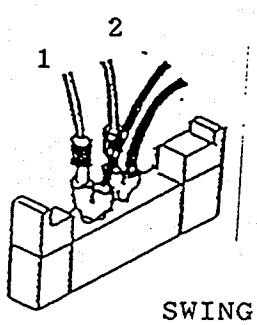
In addition to the above mentioned procedure, the following changes are necessary.

f) Reverse the tubing (4mm dia.) for wrist rotation mechanism as shown.

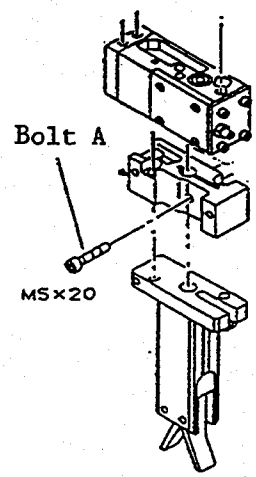
g) Supply compressed air, then gripper rotates by 90 degrees.

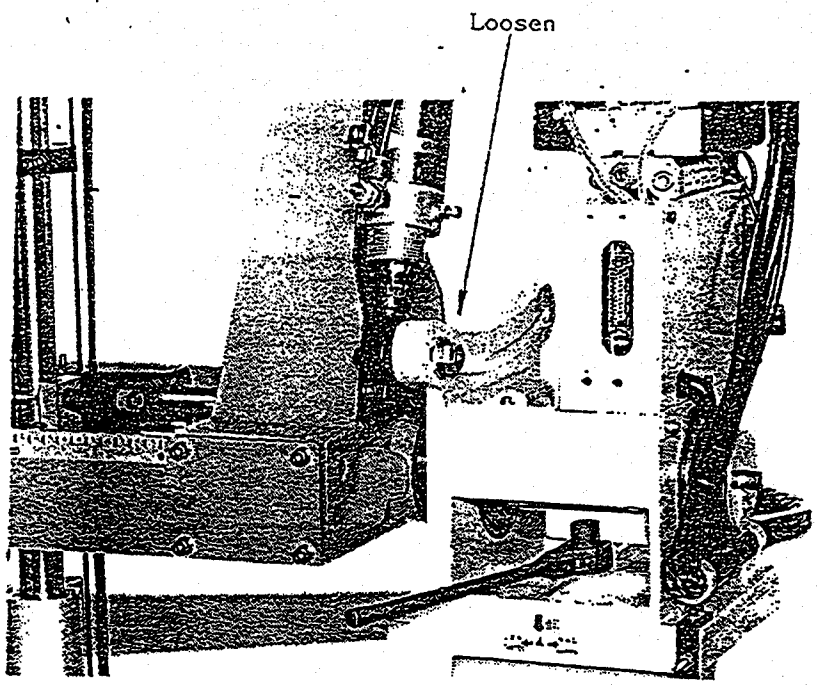
h) Loosen the bolt A and set the gripper to proper position (rotate 90 degrees) by hand, then tighten the bolt A.

Reverse tubing
1 and 2

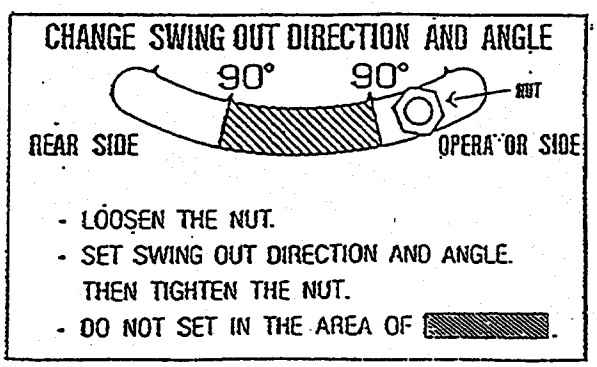


SWING valve





Sticker affixed on the terminal case



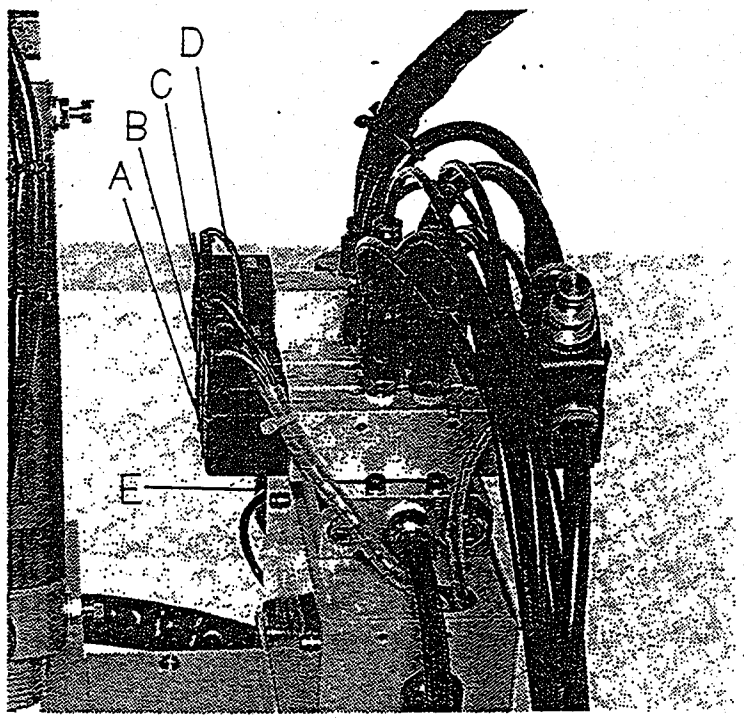
7. Air solenoid valves and speed controllers

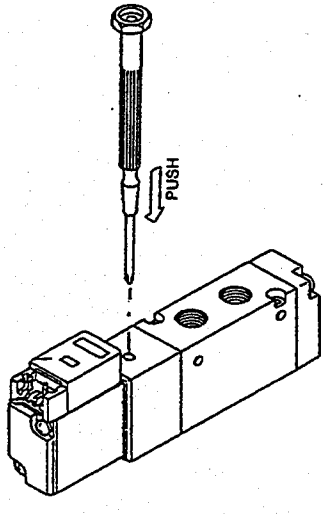
Air Solenoid Valves regulating the movement of cylinders are located in the main body in the following order.

	FUNCTION	TYPE OF VALVE
A	SWING OUT & WRIST ROTATION (FXF)	180 - 4KE - 2 (24V DC) Double solenoid valve
B	STRIP FORWARD/ BACKWARD	180 - 4E - 1 (24V DC) Single solenoid valve
C	MAIN UP/DOWN	180 - 4E - 1 (24V DC) Single solenoid valve
D	GRIP	180 - E1 (24V DC) Single solenoid valve

Manufacturer : KOGANEI

All of solenoid valve has a diode which absorb the surge current.
For manual operation, a manual button on top of the coil case installed in the body of valve should be pressed.
To keep the cylinder actuated, press and rotate the push button by 45° to lock it. Release the lock before the robot auto operation.


D
C
B
A
E


PUSH

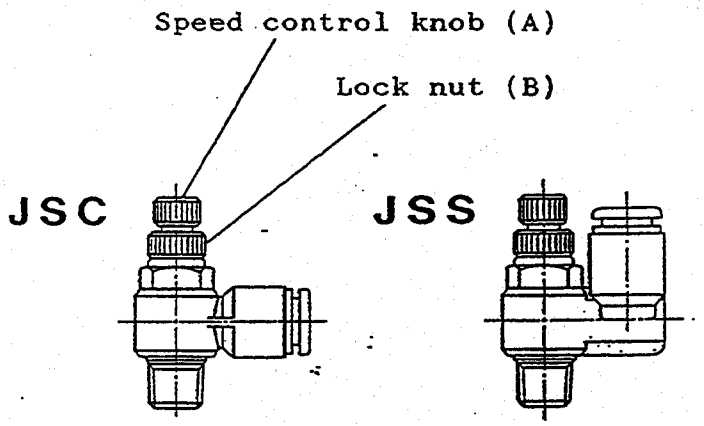
8. Air cylinder speed control

The working speed is controlled by adjusting knob A and lock nut B.
The usage of those two is as follows.

a) Loosen lock nut B.

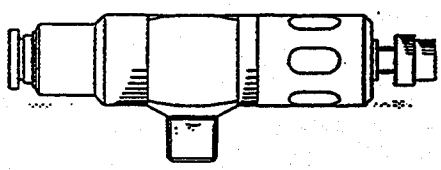
b) Obtain the proper speed of the cylinder by turning knob A.

c) After adjustment, tighten lock nut B.

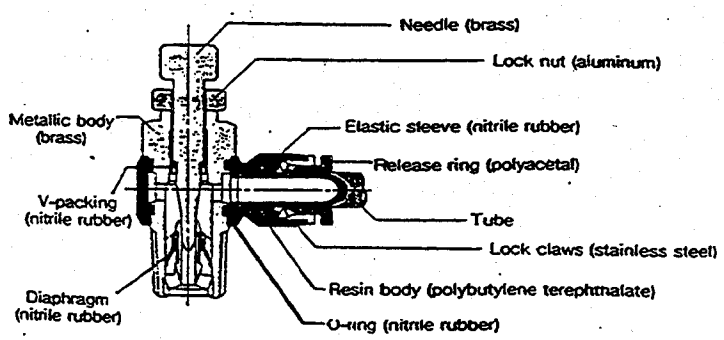


Speed controller for swing cylinder

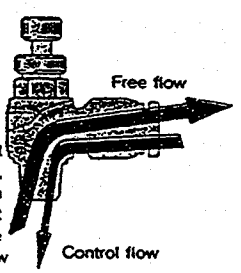
Speed controller for strip cylinder



Speed controller for main cylinder



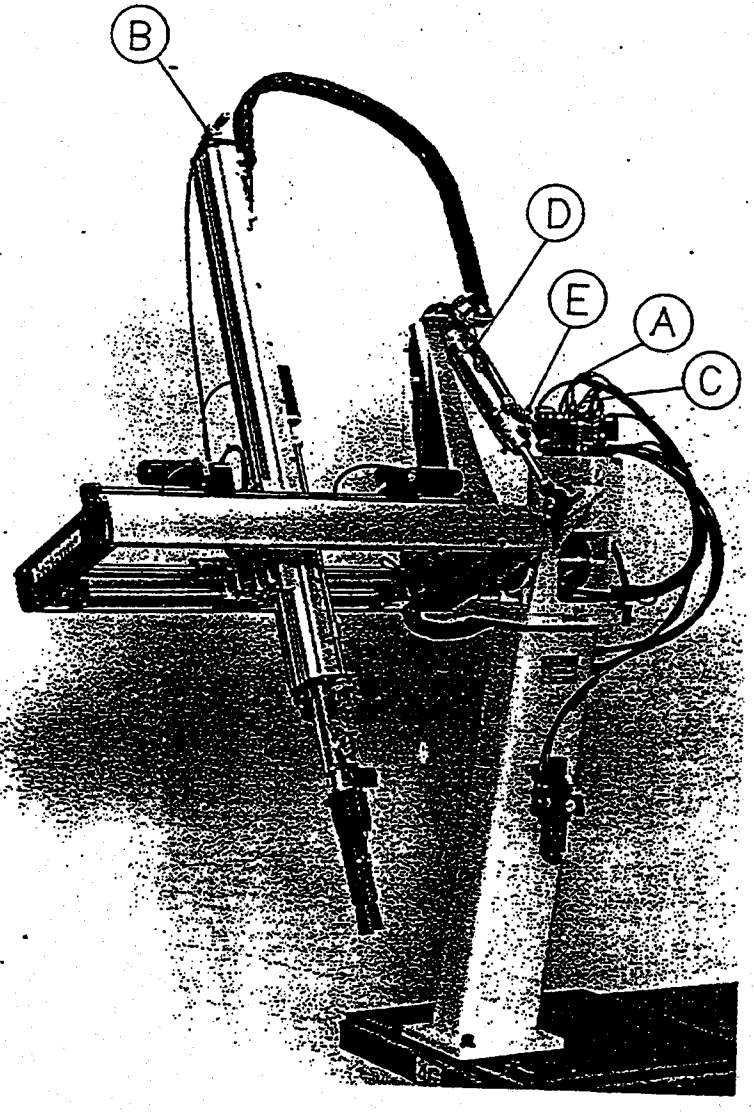
B TYPE



Meter-in control
The flow rate of air entering from the joint side can be controlled, whereas air entering from the thread side comes out from the joint side at the same (not controlled) flow rate.

* Function of Each Speed Controller

A: Main arm downward speed
B: Main arm upward speed
C: Strip foward/backward speed
D: Swing in speed
E: Swing out speed



9. Proximity switch

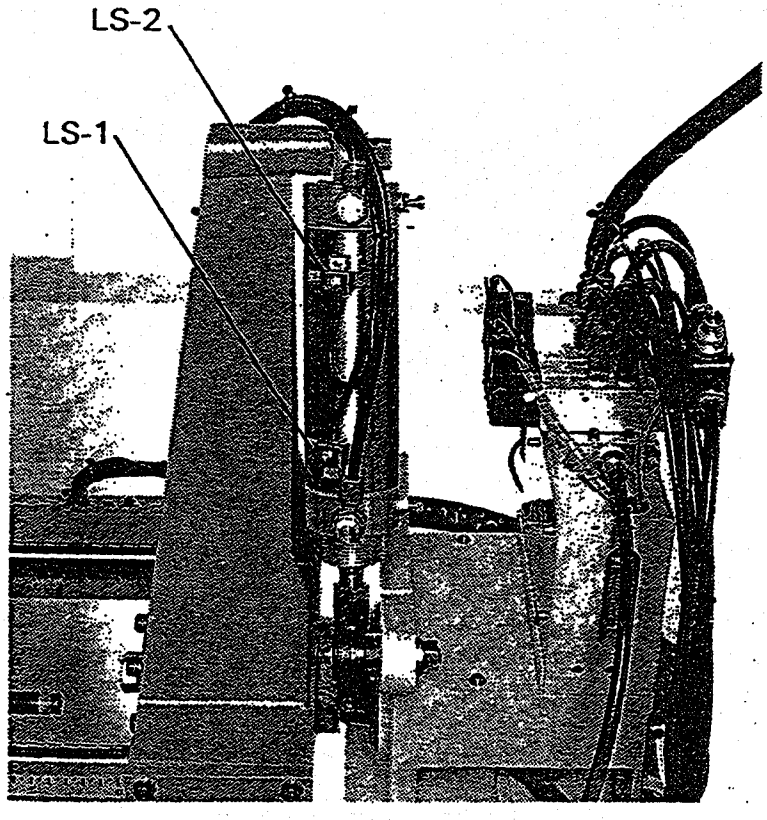
The proximity switches are equipped on the robot as follows.

a) LS-1 (Proximity switch : SW-RO)

To detect that the main arm cylinder reached its swing outward end position. If LS-1 is not actuated, the main arm will not extend to outside mold to release parts and/or sprue runner system.

b) LS-2 (Proximity switch : SW-RO)

To detect that the main arm cylinder is VERTICAL (swing inward end limit) position. If LS-2 is not actuated, the fingers will not go down even if mold open complete signal is given from injection machine.



c) LS-3 (Proximity switch : FUJI PE-B4D)

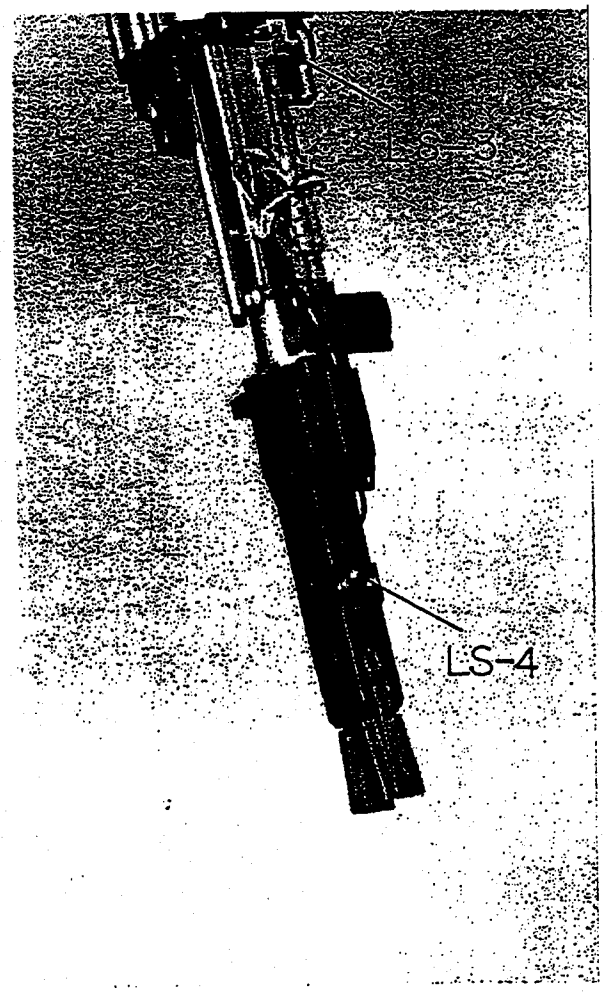
To detect that the main arm is in the upward end limit position.
Unless LS-3 is actuated, the mold clamping function is not permitted. (Safety Interlock Circuit)

d) LS-4 (Proximity switch : HARMO MS-C2A)

To detect the pick-up failure of the part to be held by the gripping fingers. When LS-4 is not actuated after take out motion, the main arm will not be swung out and the warning buzzer shall be sound. This switch is built in the gripper body.

Remarks :

When the venturi-air ejector kit is used for suction pad (cup) to grip the part, change the verification method by selection switch (By LS-4 or By vacuum differential switch). And when the mode set "SWING" is off (release inside mold), the mold closes regardless with LS-4 verification.



10. Adjustment of sprue verification switch (LS-4) position

In order to have a secure verification, the position of LS-4 proximity switch built-in the gripper has to be adjusted according to the diameter of the sprue, and their materials.

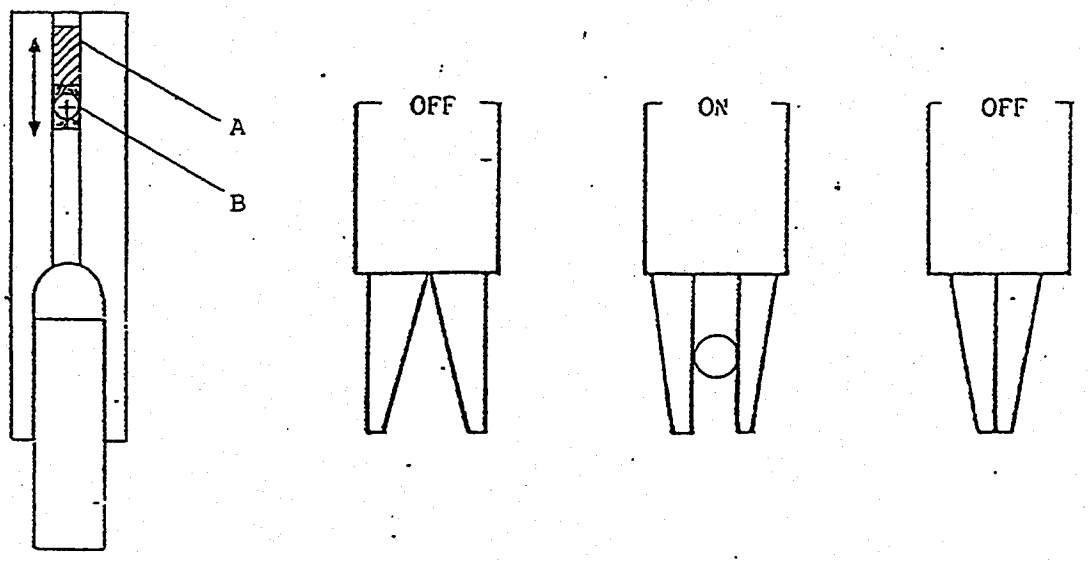
Adjust the LS-4 position as follows.

1) Loosen the fixing screw (B).

2) Actuate the "Grip" solenoid valve by manual operation switch on the handy pendant or mechanical manual push button on the valve.

3) Slide the proximity switch (A) and set it to proper position so that LED on the proximity switch or LED on the handy pendant to be ON when the gripper grips the sprue and to be OFF when the gripper opens or closes completely.

4) Tighten the fixing screw.



11. F.R. unit

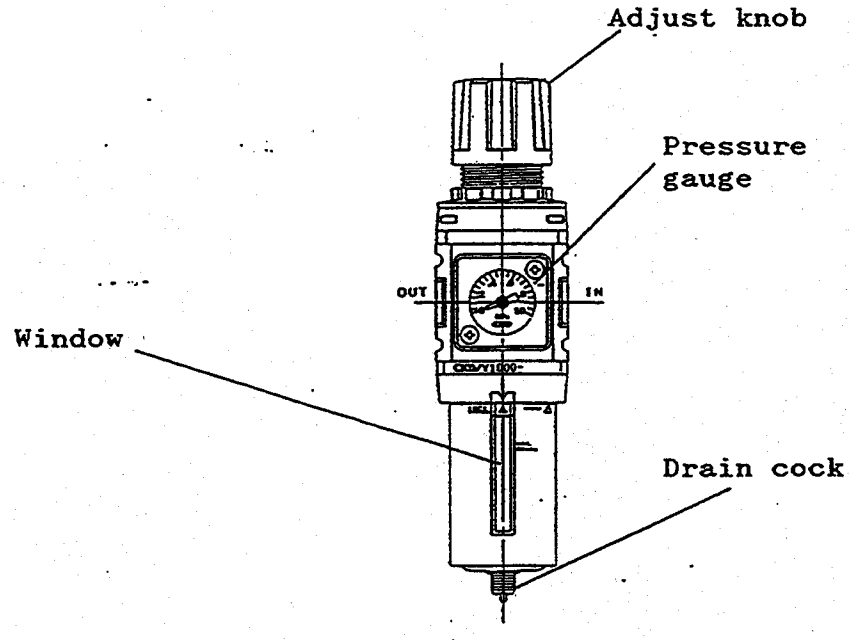
Oil free cylinders are used on the FX series robots. It is not necessary to supply lubricating oil to these robots.

* Drain Maintenance

(1) Check the level of drainage everyday through window and discharge it before the level reaches MAX LEVEL indication.
The drainage is discharged manually by pushing white colour plastic part on drain cock.

* Pressure Control

(1) The primary air pressure supplied to F.R. unit should be less than 9.0 kg/cm2 and the secondary working pressure should be 5.0 to 6.0 kg/cm^2.
(2) Clockwise rotation of the control knob permits the secondary pressure to increase and anti-clockwise rotation to decrease.
(3) Push down (lock) the adjusting knob after air-pressure adjustment is finished.



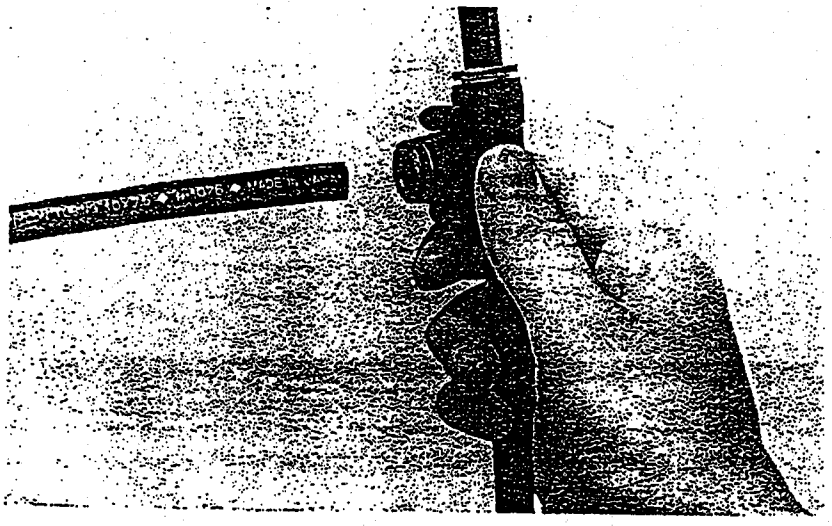
12. Main arm lock cylinder

For the Main arm , safety lock cylinders is provided, preventing the arms from dropping if the pneumatic pressure suddenly decreases, the pneumatic hose is disconnected from the compressor.

13. Quick fitting for air tube

(a) Connecting

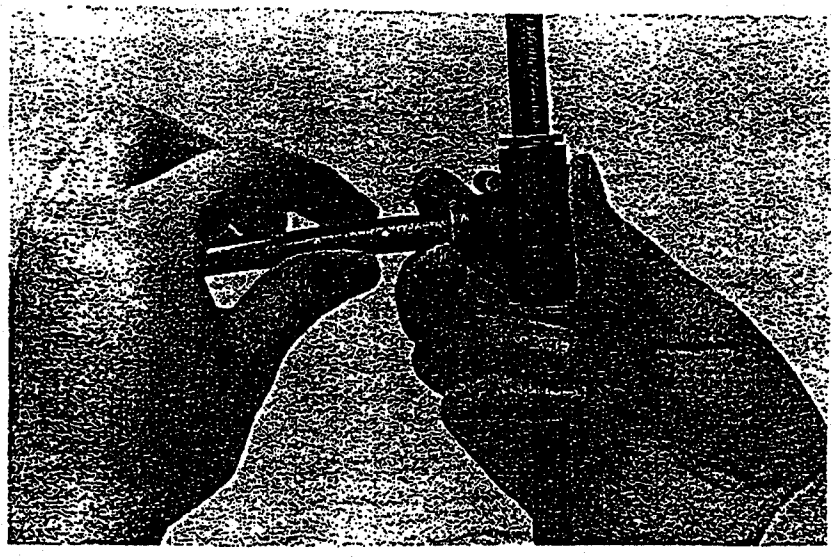
Push the tube into the joint.



(b) Disconnecting

1) Push the releasing bush in.

2) Pull out the tube with the bush pushed in.



D. MAINTENANCE MANUAL

The maintenance manual describes the items to be inspected periodically by the customer. Follow the instructions in the maintenance manual for best results, to ensure long service life.

This manual assumes that the Harmo's standard robots are operated under normal conditions.

Note that the inspection items for nonstandard models differ from those for standard models. Nonstandard models should be inspected accordingly, referring to the inspection items described in this manual.

Inspection procedures and intervals should be determined by the customer, depending on the operating conditions and the results of daily checks, because load applied to each part of the robots varies widely with operating conditions.

The followings are the major operating conditions regarding which extreme care must be taken.

1. Environmental conditions : Dust and moisture
2. Molded part specifications : Material (Emission of gas), weight and shape.
3. Molding cycle : If the molding cycle is short, check the inspection items frequently.
4. Continuous operation period
5. Removal of molded parts (Are molded parts easily removed from the molds ?)

When operating the robot, for example, moving an air cylinder for inspection, or when inspecting the robot with power supplied, extreme care must be taken to avoid an accident.

INSPECTION SCHEDULES COMMONLY APPLIED TO ALL MODELS

	Daily	Every 3 day	Every 10day	Every Month
A. Mechanical parts				
1. F.R.(L.) unit a. Regulated air pressure, amount of drain	Before operate and every two hours during operation -			
b. Filter - check for cleanliness				*
2. Screws and nuts - check for looseness a. Stoppers and adjusting for air cylinder strokes		*		
b. Screws and nuts in other sections			*	
c. Robot mounting screw			*	
3. Air leakage		*		
4. Bent or damaged hose	Before & after operation			
5. Quick fittings and speed controllers	*			
6. Air solenoid valve - check for operation by pressing the manual push pin				*
7. Shock absorbers and cushion	*			
8. Air pressure adjusted by the pressure regulators for optional circuit	*			
9. Gripper				*
10. Return spring for gripper	Before operate			

	Daily	Every 3 day	Every 10day	Every Month
11. Wrdge and wedge spring in gripper				*
12. Screws securing gripper - check for looseness			*	
13. Main & sub arm safety lock cylinders - check for operation	Before & after operation			
14. Screws securing the End Of Arm Tooling - check for looseness		*		
15. Components on E.O.A.T - check for damage	*			
16. Air nippers - check for sharpness	Every hour			
17. Suction pad - check for damage		*		
18. Exhaust cleaner - discharge the drain and clean the oil bowl	As required			*
B. Electrical parts				
1. Loose, damaged wires and wires which are pulled by robot movement		*		
2. Faulty limit switches wires		*		
3. Loose or faulty relays or timers				*
4. Limit & prox. switch	Before operate			
5. Interlocking function	Before operate			

	Daily	Every 3 day	Every 10day	Every Month
C. External equipment				
1. Compressor - check for discharge pressure and drain	Before & after operation			
2. Dryer	*			
D. Others				
1. Abnormal noise or operation	*			

Note : For details, refer to the description on the followings.

To obtain the best results from the robot, the robot and control box should be periodically checked and compressed air should be kept free of moisture, oil or foreign matter.

Wet or contaminated air adversely affects the air solenoid valves, hoses and air cylinders, shortening their service life.

For operation at a place with high temperature and humidity, a dryer should be provided.

A. Mechanical parts

1. F.R.(L.) unit

a. Check that the air pressure adjusted by the filter regulator is at an appropriate level before operation, and every two hours during operation.

EX,FX sres robot ------ 4.0 - 6.0 kg/cm²
Beam type robot ------ 6.0 - 6.5 kg/cm²

b. Check that the excessive drainage is accumulating in the bowl of the filter regulator before operation and every two hours during operation.
The Harmo robot is equipped with a floating type auto drain unit.

c. Check the cleanliness of the filter every month. If the compressed air is contaminated, the filter is easily stained and clogged. If this happens, remove the filter cover, then clean the filter or replace it with a new one.

2. Screws and Nuts

a) Securely tighten the screws and nuts for such as the stoppers for each cylinder where force is directly applied, every three days.

b) Securely tighten the screws and nuts which are subject to vibration, every 10 days.

c) Check the robot mounting screws for looseness every 10 days.

3. Check for air leakage every three days

Operate air cylinders and check that there is no hissing noise caused by air leakage from the cylinders. Check for air leakage by applying turbine oil to any suspected part of the air cylinder.

4. Check for bent or damaged hoses before and after operation

If a bent or damaged hose is found, replace it with a new one to ensure correct air flow through the hose.

5. Check that the hoses are securely connected to the quick fittings and speed controllers, and that the needles of the speed controllers are securely locked by the lock nuts, every 10 days.

6. Stop robot operation, turn the power OFF. Check that the air solenoid valves operate correctly, supplying compressed air to the cylinders by pressing the manual push pins of each solenoid valve, every month.

NOTE: INTERLOCK FUNCTION IS NOT EFFECTIVE ON THIS WORK

7. Check that the shock absorbers and cushion rubbers are not damaged due to long use, every month.

8. Check that the E.O.A.T.(End Of Arm Tooling = Chuck unit) is securely attached to the E.O.A.T. mounting plate and that the components such as mini cylinder grippers and suction pads on the E.O.A.T. operate correctly.

9. Check sharpness of the air nippers, sharpen the blades if necessary.

10. Check that the main and sub arm are supported by the lock cylinders when compressed air is not supplied to the robot. Also check that the lock cylinder rod retracts when compressed air is supplied. Discharge the air from the robot after operation and check that the arms are supported by the cylinders.

11. Periodically wipe out the dust and oil sludge on the cylinder rod and guide rod of the movements.

12. Periodically apply lithium soap grease No. 2 to the grease fitting on the sliding mechanism such as slide unit on swing type robot or Linear bearing on bean type robot, to ensure smooth motion.

B. Electric parts

1. Check for loose, damaged wires and wires which are pulled by robot movement, every 10 days.

   A wire which is pulled by robot movement or whose insulation is damaged may cause broken circuits or shortcircuiting.

2. Limit switches, aux. switches should be checked for damage every three days.

   The robot cannot operate correctly if one limit switch malfunctions. Extreme care should be taken to ensure that molded part verification switches LS-4,LS-5 and VS -1 on the beam type robot and LS-4 on swing type robot and arm upward end limit switches LS-3 and LS-7 operate correctly.

3. Open the front panel of the control box, then check that the relays, timers and a PCB are securely connected and that they are free from water, oil and foreign matter, every month.

4. Controller, PC-RX1/PC-EIID

   a) Check that the emergency stop function operates correctly, every day.

   b) Check that the robot ON/OFF switch operate correctly, every 10 days.

   c) Check that the LEDs for Inputs/Outputs go on and off correctly, everyday.

The mechanical lives of limit switches, micro switches and relays are as follows ;

* Micro switch (aux. switch) : 100,000 closures
* Limit switches : 300,000 closures
* Relays : 300,000 closures

If one robot operation takes only 20 seconds, the switches should operate three times a minute, and 1.08 million times a year on the assumption that the robot operates 20 hours a day and 300 days a year. This reasonably causes some switches to malfunction within a year after the initial installation.

5. In the following manner, check that the interlocking functions operate correctrlly before operation.

Signals between the injection machine and robot

Robot issues the following signals in order to protect the mold and robot.

Mold close safety interlock

This signal is issued to prevent the robot from being damaged by molds closing when the main arm of the robot is in the mold area.

Mold open safety interlock

This signal is issued to avoid the mold opening when the main arm of the robot is not upward end position.

* Both above signals (open and close interlock) are issued at the same time.

Cycle start signal

In addition to the mold open/close safety interlock, robot issues the cycle start signal in order to ensure the safety. This signal is issued as the order signal for the mold closing when the mode selector switch of the robot is set to AUTO.

Ejector forward signal

This signal is equipped in order to make it easy to take out the parts, and it is issued when the timer can be adjusted is up.

Procedure to check the function up

It is available for making the function of signals sure to try the following procedure.

Plug in the short plug for the interface connector and confirm that the injection machine runs normally in manual, semi-auto and auto modes. If normal operation is not available in this condition, it is needed to check the interface connection.

Mold close/open/ejection interlocking function

a. Start the injection machine and stop the mold opening or closing at the middle position in between the open end limit and closed end limit.

b. Remove the short plug from the interface connector.

c. Try to open or close the mold, and confirm that it do not move at all and abnormal sound does not occur. If the molds move even slightly or abnormal sound occur, recheck the interface connection and correct it.

d. Plug in the robot interface connector.

e. Open the molds, and remove the short plug again. Confirm that ejection is not available in this condition.

f. Reduce the air-pressure until it gets possible to pull down the arm by hand.

g. Pull down the arm about 50mm so that the arm upward end prox. switch goes off. Turn on the mold close or open switch on the injection machine, and confirm that the molds do not move at all. If the molds move, even slightly, check the cable for a connection error.

Cycle start function

a. Turn the ROBOT ON/OFF switch ON (Robot manual), and operate the injection machine in AUTO mode. After one cycle of the injection machine, (mold closing, injection, mold opening, ejection) then check the molds do not move at all. If the molds move, even slightly, check the cable for a connection error.

b. Operate the injection machine in Auto. After taking out the parts, and part verification has been done, check the molds start to close. If the molds do not start to close, check the cable for a connection error.

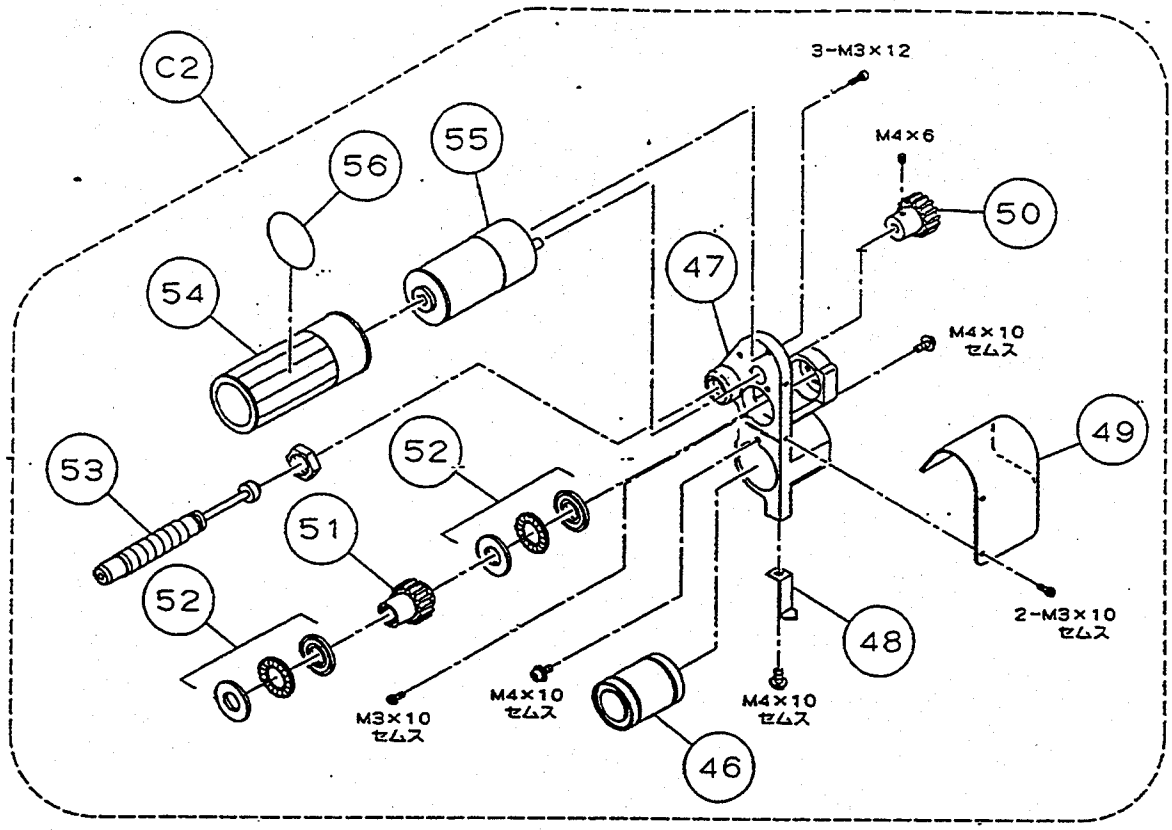
C. External Equipment

1. Check that the compressor discharges air with appropriate pressure, and discharge drainage from the compressor before and after operation.

2. Dryer

   Check that the dryer sufficiently dehumidifies the air discharged from the compressor.

* To ensure long service life for air cylinders, extreme care should be taken to remove moisture andforeign matter from the compressed air supplied to the cylinders.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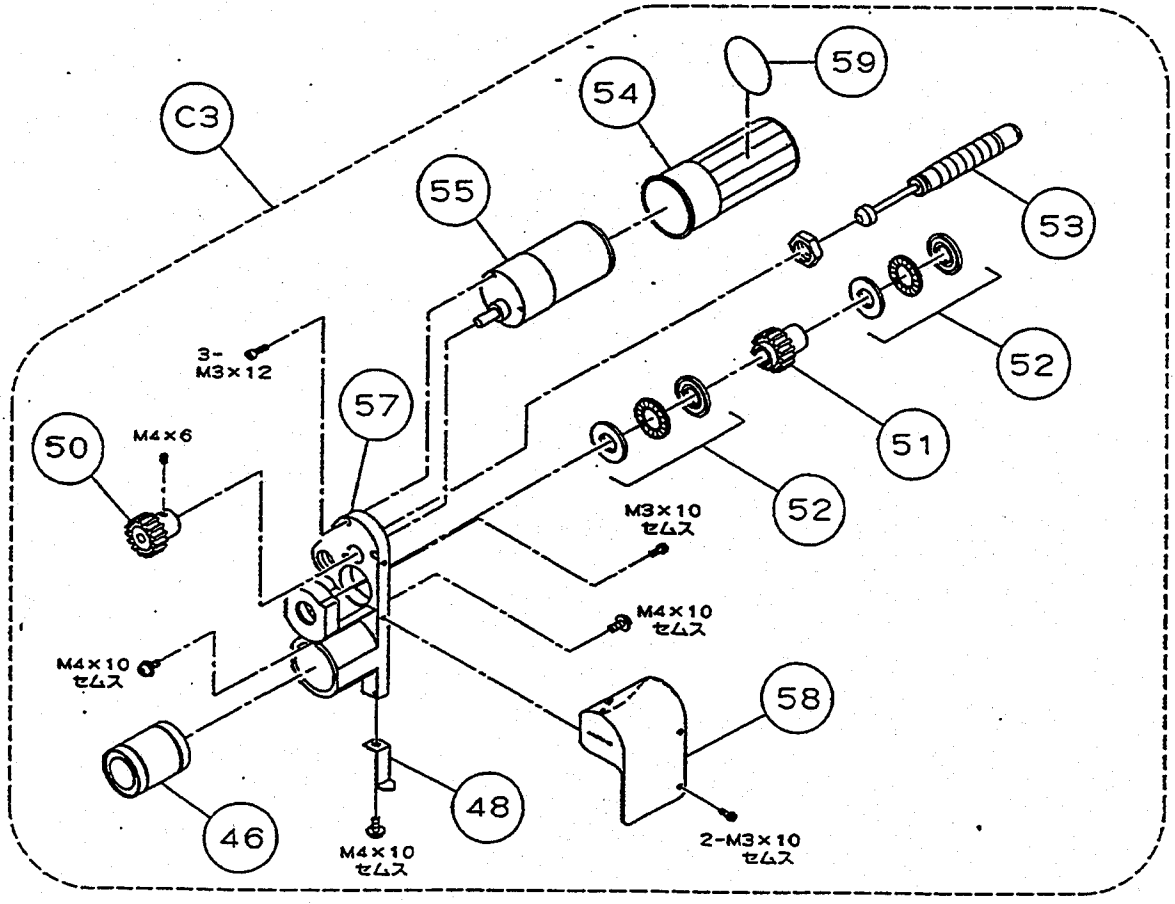
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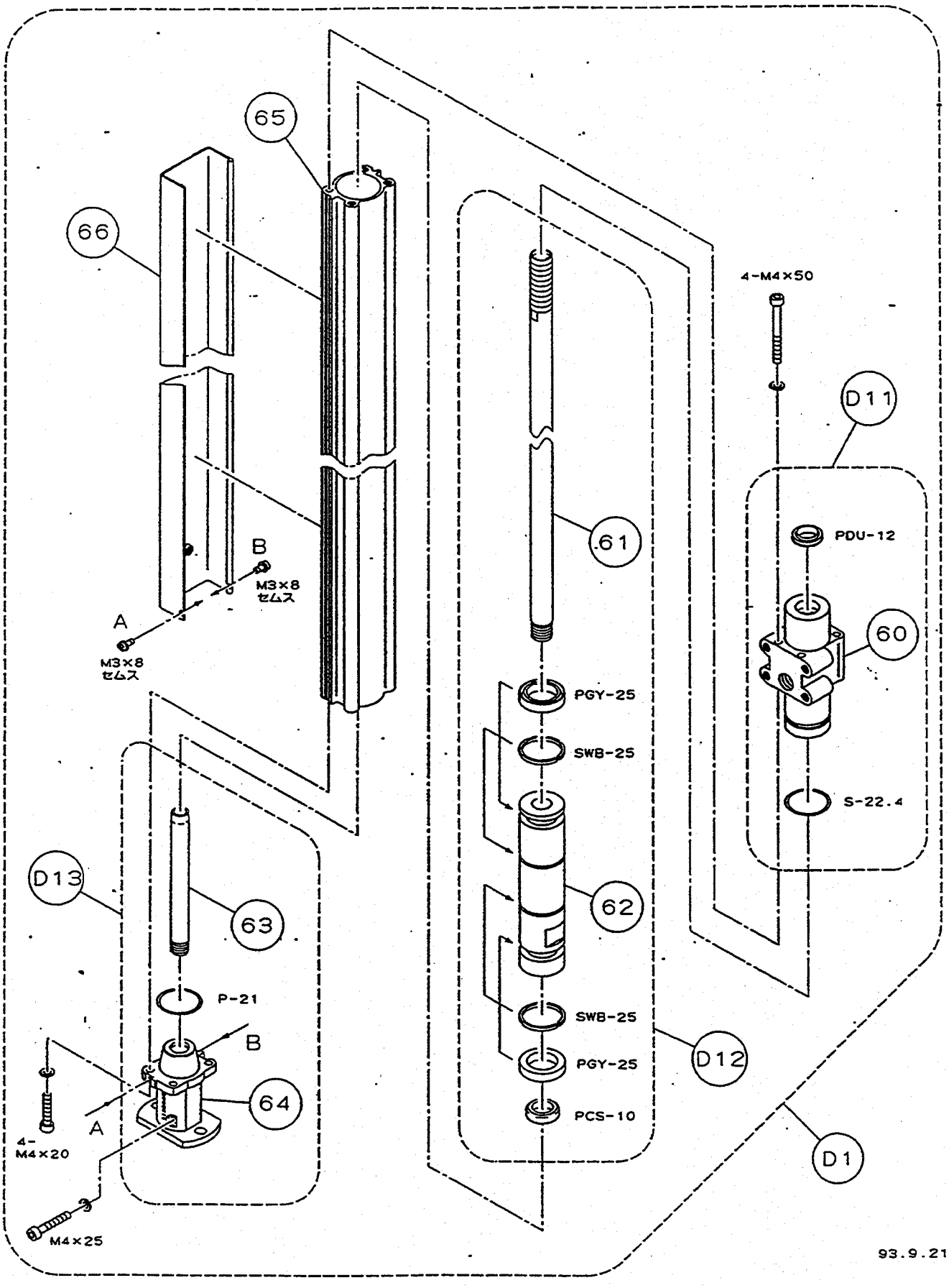
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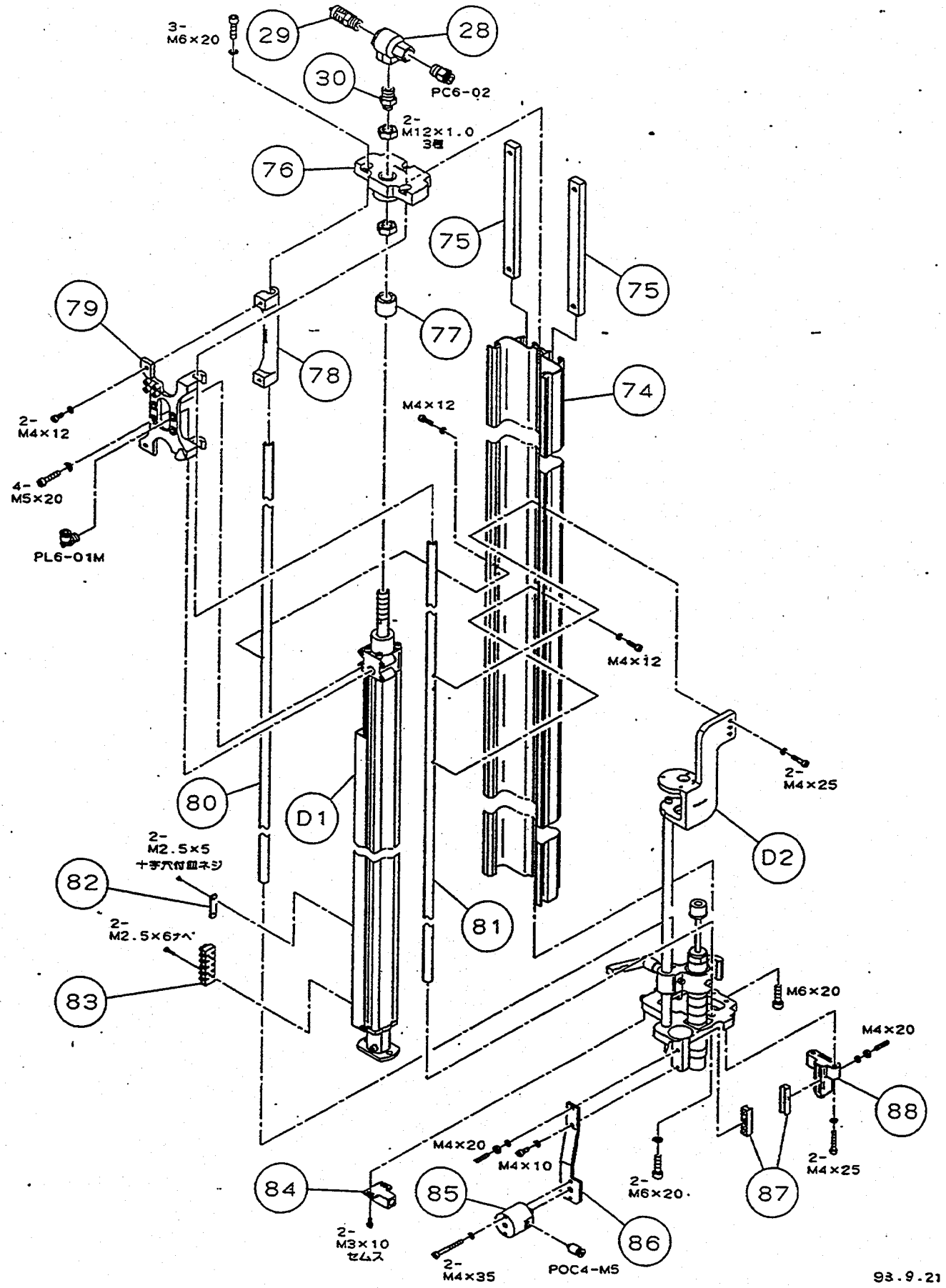
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