CKD

SM-8156-A

INSTRUCTION MANUAL

FEATHER HAND

FH Series

- Please read this instruction manual carefully before using this product, particularly the section describing safety.
- Retain this instruction manual with the product for further consultation whenever necessary.

2nd

CKD Corporation

For Safety Use

To use this product safely, basic knowledge of pneumatic equipment, including materials, piping, electrical system and mechanism, is required (to the level pursuant to JIS B 8370 Pneumatic System Rules).

We do not bear any responsibility for accidents caused by any person without such knowledge or arising from improper operation.

Our customers use this product for a very wide range of applications, and we cannot keep track of all of them. Depending on operating conditions, the product may fail to operate to maximum performance, or cause an accident. Thus, before placing an order, examine whether the product meets your application, requirements, and how to use it.

This product incorporates many functions and mechanisms to ensure safety. However, improper operation could result in an accident. To prevent such accidents, read this instruction manual carefully for proper operation.

Observe the cautions on handling described in this manual, as well as the following instructions:

⚠ Precautions

- Before performing an overhaul inspection on the actuator, deactivate residual pressure completely.
- While the actuator is operating, do not step into or place hands in the driving mechanism.
- To prevent an electric shock, do not touch the electric wiring connections (exposed live parts) of the actuator equipped with a solenoid valve or switch.
  Perform an overhaul inspection with the power off. Also, do not touch these live parts with wet hands.

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FH Series
FEATHER HAND
Manual No. SM-8156-A

NOTE : Letters & figures enclosed within Gothic style bracket (examples such as [C2-4PP07] · [V2-503-B] etc.) are editorial symbols being unrelated with contents of the book.

Apr.26.1994
Revision : Jun.16.2000

1. PRODUCT

1.1 Specification

1) Prallel hand

Item \ Model & group	FH100									
	FH110-D	FH112-D	FH116-D	FH120-D	FH125-D	FH110-O	FH112-O	FH116-O	FH120-O	FH125-O
Operating method	Double action type					Single action type				
Media	Compressed air									
Max. working pressure MPa	0.7									
Min. working pressure MPa	0.15					0.25				
Proof pressure MPa	1.05									
Ambient tempreature ℃	5 to 60									
Port size	M3×0.5		M5×0.8			M3×0.5		M5×0.8		
Operational stroke	8	11	14	17	20	8	11	14	17	20
Mass of product (g)	51	71	124	176	284	51	71	124	177	286
Repeatability (Initial value) mm	±0.03									
Max.operational frequency Times/sec	3									
Cushioning	Rubber cushion at jaw open end									
Option	Reed switch (2-wire type & 3-wire type) · ※Speed controller at jaw closing end									

2) Fulcrum type hand

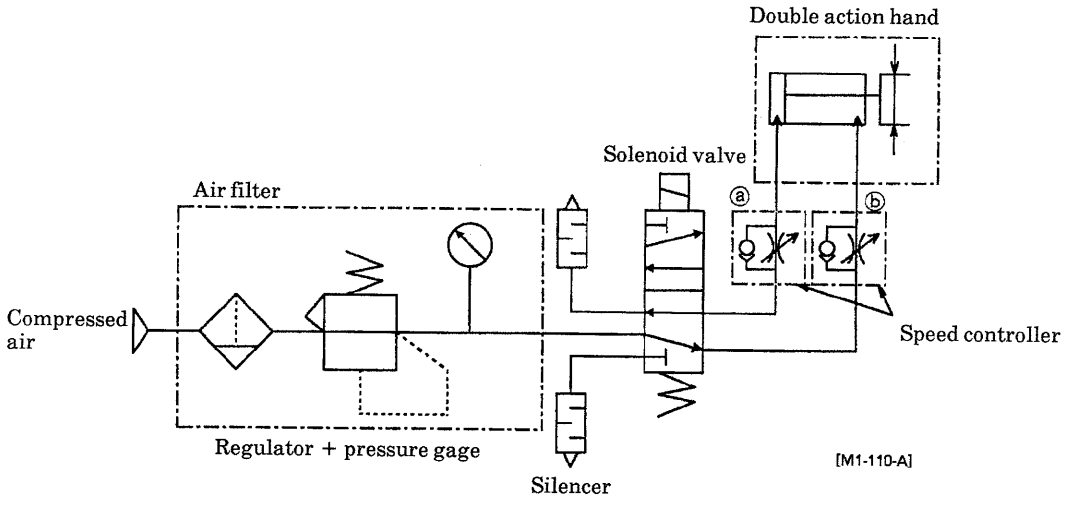
Item \ Model & group	FH500							
	FH110-D	FH112-D	FH116-D	FH120-D	FH110-O	FH112-O	FH116-O	FH120-O
Operating method	Double action type				Single action type			
Media	Compressed air							
Max. working pressure MPa	0.7							
Min. working pressure MPa	0.15				0.25			
Proof pressure MPa	1.05							
Ambient tempreature ℃	5 to 60							
Port size	M3×0.5		M5×0.8		M3×0.5		M5×0.8	
Angle at open and close °	Open jaws 20, close jaws -5							
Mass of product (g)	43	53	92	135	43	53	92	136
Repeatability (Initial value) mm	±0.03							
Max.operational frequency Times/sec	3							
Cushioning	Rubber cushion at jaw open end							
Option	Reed switch (2-wire type & 3-wire type) · ※Speed controller at jaw closing end							

※ Speed controller built-in is available to double action type only.

1.2 Basic schematic diagram

1) Basic schematic diagram of Double-action hand (FH※※※-D) (Non lubrication)

It is, generally, as illustrated below.

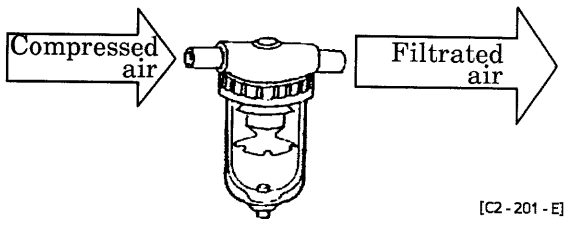


Note : Speed controller built-in type (Optional) does not require the unit (a) in the diagram.

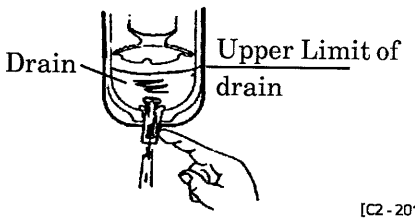
2. CAUTION

2.1 Fluid

1) Use the compressed air, filtrated and dehumidified. Carefully select a filter of an adequate filtration rate (5μm or lower preferred), flow rate and its mounting location (as closest to solenoid valve as possible).
2) Be sure to drain out the accumulation in filter periodically.
3) Note that the intrusion of carbide of compressor oil (such as carbon or tarry substance) into the circuit causes malfunction of solenoid valve and cylinder. Be sure to carry out thorough inspection and maintenance of compressor.



[C2-201-E]



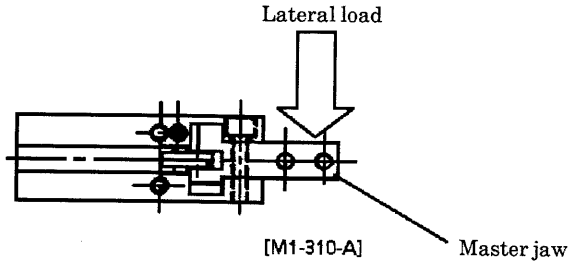
[C2-201-F]

4) This cylinder does not require lubrication. It is recommended, however, to use Turbine oil Grade 1, ISO VG32 as lubricant if lubrication is preferred.

3. OPERATION

1) Operate hand within the range of pressure specified in "1. Specification of product".

2) Operate it preventing lateral load to master jaw.



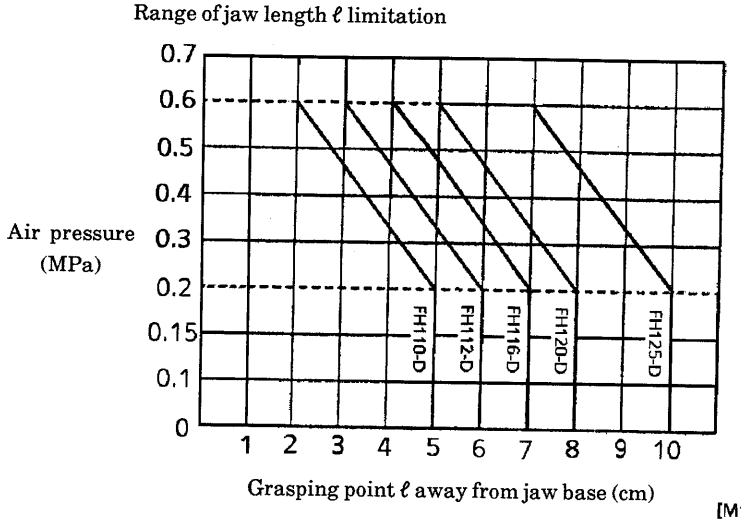
[M1-310-A]

3) Fill grease periodically to the sliding part of master jaw. It will extend the service life of jaws.

4) Accuracy is achieved by clamping tenderly with slow speed as allowed and repeatability also is stabilized.

5) Select an appropriate model of hand making the followings guide lines,

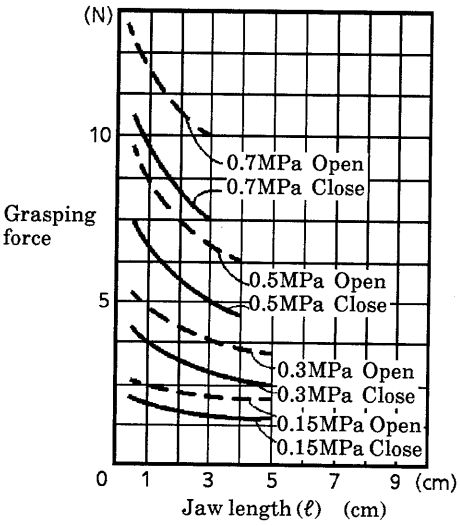
- The standard of grasping force (F) against transporting load (W)
  W : F = 1:10 (Ordinal transportation)
  W : F = 1:20 (Rapid acceleration)



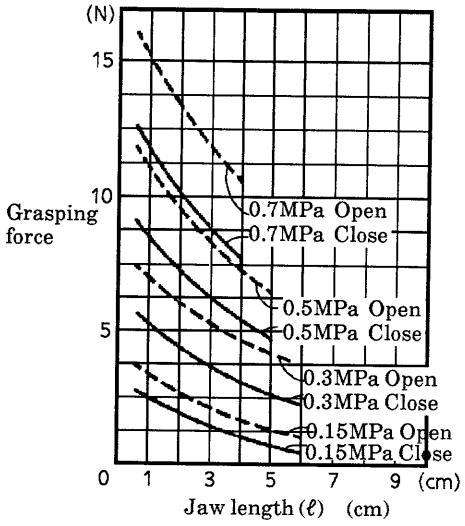
[M1-310-B]

Grasping force of Parallel Hand

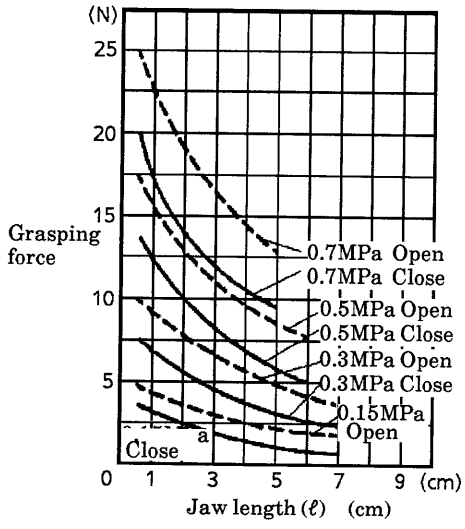
● FH110-D



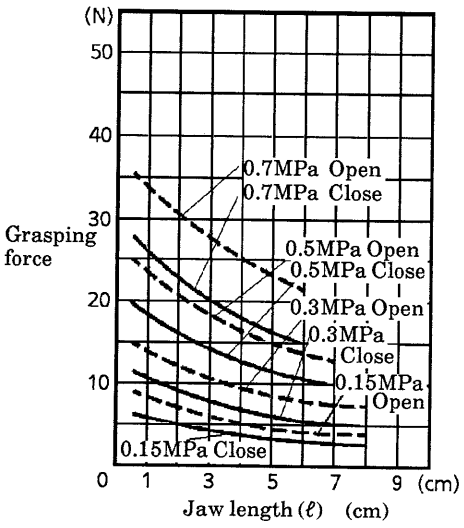
● FH112-D



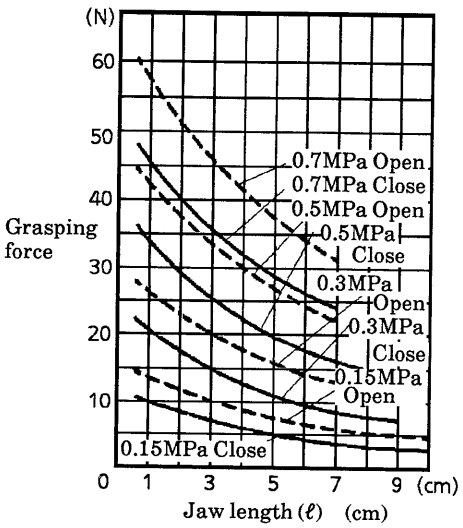
● FH116-D



● FH120-D

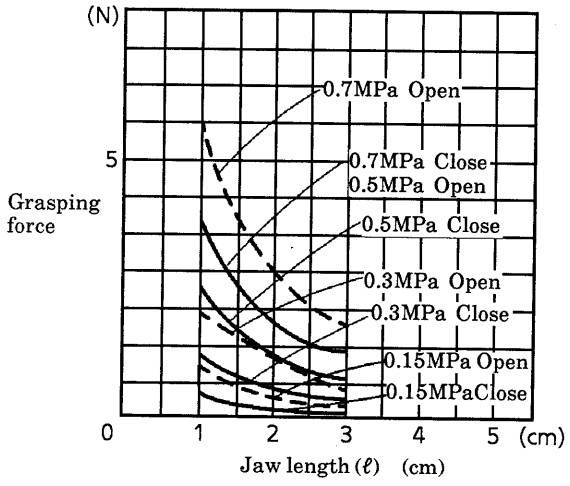


● FH125-D

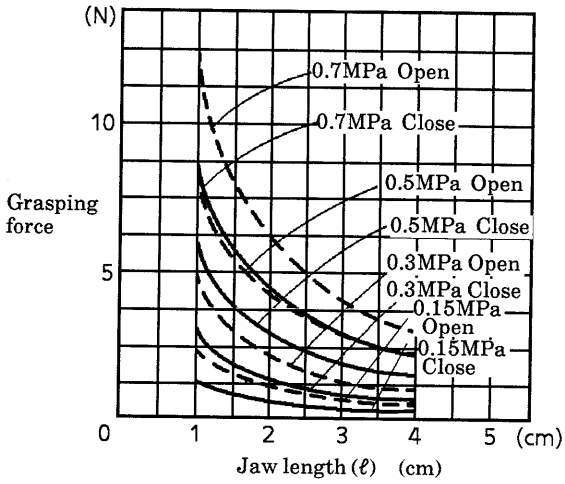


Grasping force of Fulcrum type Hand

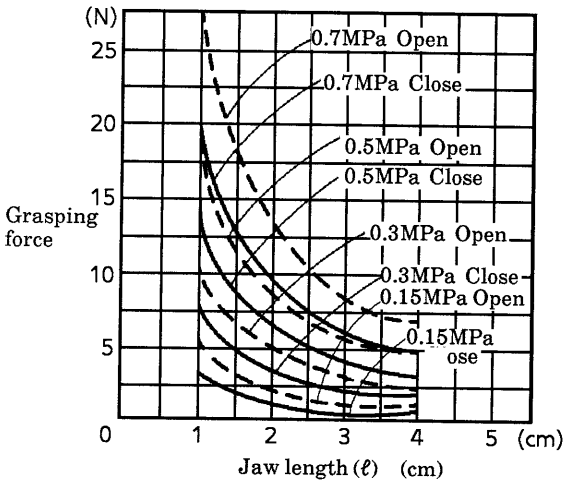
• FH510-D



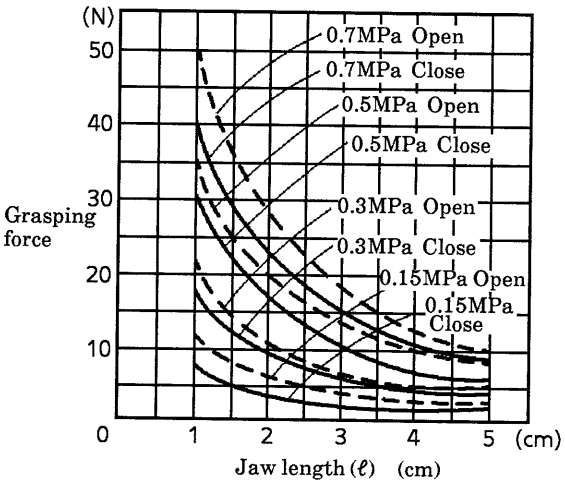
• FH512-D



• FH516-D



• FH520-D



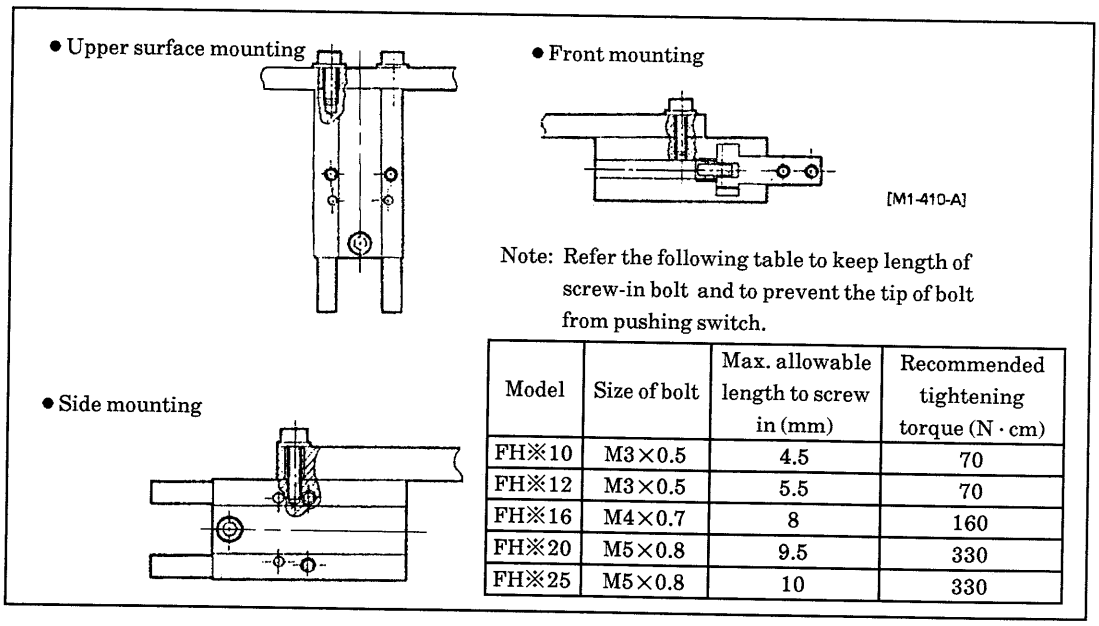
4. INSTALLATION

4.1 Piping

1) Select the pipes after a filter, such as galvernized, nylon tube or rubber hose which are least- or non-corrosive.
2) As for connecting pipe between cylinder and solenoid valve, select pipe with sufficient effective sectional area to retain specified piston speed of cylinder.
3) Install filter as near to solenoid valve as possible so as to filterate rust, foreign particle and drain.

4.2 Installation

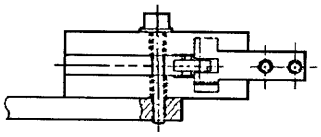
1) Suitable range of ambient termperate is 5℃~60℃ Install it in the place within such range.
2) Carefully prevent from giving any nick or gauge, which hinders leveling or perpendicular, on mounting surface of body and master jaw.
3) Refer to the following articles concerning mounting the body.



Note: Refer the following table to keep length of screw-in bolt and to prevent the tip of bolt from pushing switch.

Model	Size of bolt	Max. allowable length to screw in (mm)	Recommended tightening torque (N · cm)
FH※10	M3×0.5	4.5	70
FH※12	M3×0.5	5.5	70
FH※16	M4×0.7	8	160
FH※20	M5×0.8	9.5	330
FH※25	M5×0.8	10	330

• Use of pass through hole



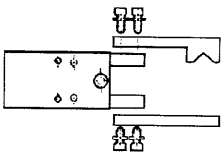
[M1-410-B]

Note: It is unable to make use of the pass through hole when the Hand is of switch mounted.

Model	Size of bolt	Recommended tightening torque (N · cm)
FH※10	M2.5×0.45	32
FH※12	M2.5×0.45	32
FH※16	M3×0.5	90
FH※20	M4×0.7	210
FH※25	M4×0.7	210

4) Refer to the following illustration concerning attachment mounting.

• Mounting an attachment



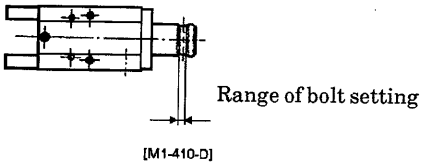
[M1-410-C]

Note: · Carefully prevent lateral load from charging onto master jaw by mounting attachment.
· As for the attachment to be mounted on the master jaw itself, make it light as little as possible.

Model	Size of bolt	Recommended tightening torque (N · cm)
FH※10	M3×0.5	80
FH※12	M3×0.5	80
FH※16	M4×0.7	170
FH※20	M4×0.7	170
FH※25	M5×0.8	310

5) When fixing the End-mount (optional) with set bolt, be sure to tighten the bolt withing the range of set bolt illustrated below.

• End-mount (optional) attaching



[M1-410-D]

5. MAINTENANCE

5.1 Periodic inspection

1) Carry out periodic inspection once or twice a year basis to operate the Hand with the most suitable condition.

2) Inspection items

ⓐ Slackness of mounting bolts for attachment to master jaw or that of body mounting.

ⓑ Smooth actuation.

ⓒ Variation of master jaw speed or cycle time.

ⓓ External or internal leakage

ⓔ Any flaw or transformation of master jaw, attachment or body itself.

ⓕ Abnormal opening of master jaw.

Verify above items and refer to the "5.2 Trouble shooting" if any abnormality is disclosed. Futhermore,re-tighten if any loosen bolts are disclosed.

5.2 Trouble shooting

1) Cylinder segment

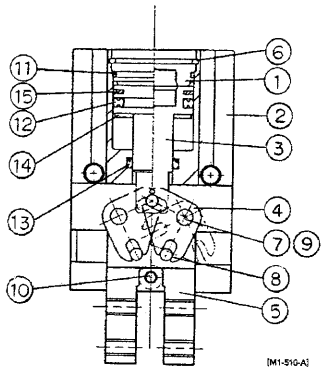
Trouble	Possible cause	Remedies
Does not move	No pressure or insufficient pressure	Secure the source of pressure
	No signal comes into Solenoid valve	Correct the control circuit
	Off alignment of mounting	Revise the mounting condition. Revise the mounting type
Unsmooth motion	Improper setting of Speed control valve	Open adjusting needle.
	Off alignment of mounting	Revise the mounting condition. Revise the mounting type
	Excessive lateral load to master jaw	Install a guide. Revise the mounting condition.
	Excessive weight of attachment	Weight reduction of attachment Install a guide.
Grasped work slips off or slips down	The weight of work is excessive	Revise the tube diameter one step larger. Raise the pressure.
	Improper design of attachment	Revise the attchment design (Material or type)
Breakage or transformation	Impact force due to high speed motion	Reduce the speed. Reduce the weight of attachment and/or work load. Install an external cushion.
	Excessive lateral load to master jaw	Install a guide. Adjust mounting condition Revise the mounting type

5.3 Internal structure

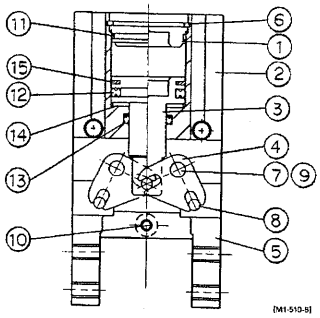
1) Parallel Hand

- Double action type

Close state

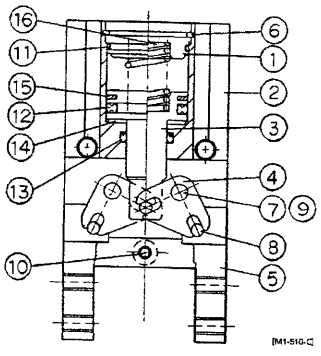


Open state



Parts No.	Parts name	Material
①	Cylinder cover	Aluminum alloy
②	Body	Aluminum alloy
③	Piston	Stainless steel
④	Arm	Stainless steel
⑤	Master jaw	Carbon steel
⑥	C type snap ring for hollow	Carbon steel
⑦	Fulcrum pin	Bearing steel
⑧	Operation pin	Bearing steel
⑨	Hex.socket head screw	Carbon steel
⑩	Hex.socket head bolt	Carbon steel
⑪	O ring	Nytrile rubber
⑫	Piston packing	Nytrile rubber
⑬	Rod packing	Nytrile rubber
⑭	Cushion	Polyurethane rubber
⑮	Magnet	Rare earth magnet

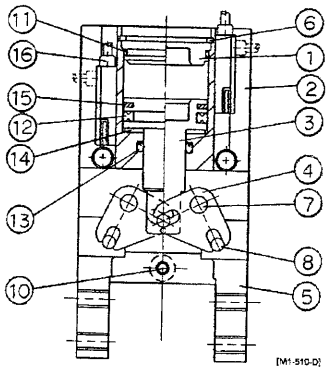
- Single action type (Normally open)



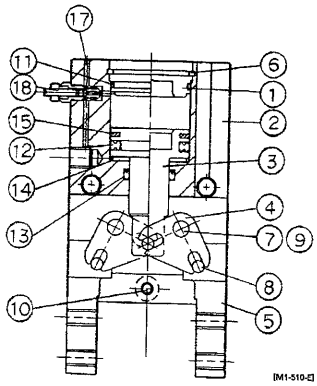
Parts No.	Parts name	Material
①	Cylinder cover	Aluminum alloy
②	Body	Aluminum alloy
③	Piston	Stainless steel
④	Arm	Stainless steel
⑤	Master jaw	Carbon steel
⑥	C type snap ring for hollow	Carbon steel
⑦	Fulcrum pin	Bearing steel
⑧	Operation pin	Bearing steel
⑨	Hex.socket head screw	Carbon steel
⑩	Hex.socket head bolt	Carbon steel
⑪	O ring	Nytrile rubber
⑫	Piston packing	Nytrile rubber
⑬	Rod packing	Nytrile rubber
⑭	Cushion	Polyurethane rubber
⑮	Magnet	Rare earth magnet
⑯	Spring	Stainless steel

• Switch or Speed controller built-in

Switch built-in type



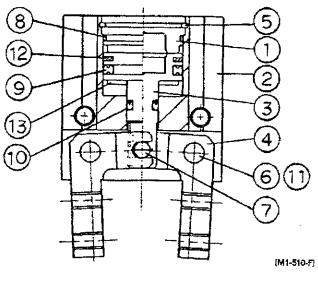
Speed controller built-in



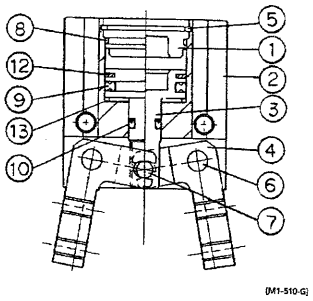
Parts No.	Parts name	Material
①	Cylinder cover	Aluminum alloy
②	Body	Aluminum alloy
③	Piston	Stainless steel
④	Arm	Stainless steel
⑤	Master jaw	Carbon steel
⑥	C type snap ring for hollow	Carbon steel
⑦	Fulcrum pin	Bearing steel
⑧	Operation pin	Bearing steel
⑨	Hex.socket head screw	Carbon steel
⑩	Hex.socket head bolt	Carbon steel
⑪	O ring	Nytrile rubber
⑫	Piston packing	Nytrile rubber
⑬	Rod packing	Nytrile rubber
⑭	Cushion	Polyurethane rubber
⑮	Magnet	Rare earth magnet
⑯	Cylinder switch	
⑰	Steel ball	Stainless steel
⑱	Speed control needle ass'y	

• Double action type

Close state

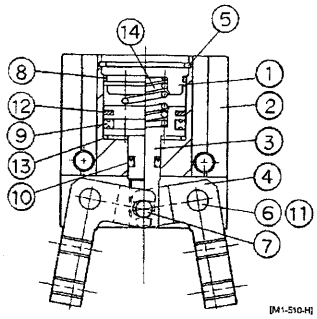


Open state



Parts No.	Parts name	Material
①	Cylinder cover	Aluminum alloy
②	Body	Aluminum alloy
③	Piston	Stainless steel
④	Master jaw	Carbon steel
⑤	C type snap ring for hollow	Carbon steel
⑥	Fulcrum pin	Bearing steel
⑦	Operation pin	Bearing steel
⑧	O ring	Nytrile rubber
⑨	Piston packing	Nytrile rubber
⑩	Rod packing	Nytrile rubber
⑪	Hex.socket head screw	Carbon steel
⑫	Magnet	Rare earth magnet
⑬	Cushion	Polyurethane rubber

• Single action type



Parts No.	Parts name	Material
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②	Body	Aluminum alloy
③	Piston	Stainless steel
④	Master jaw	Carbon steel
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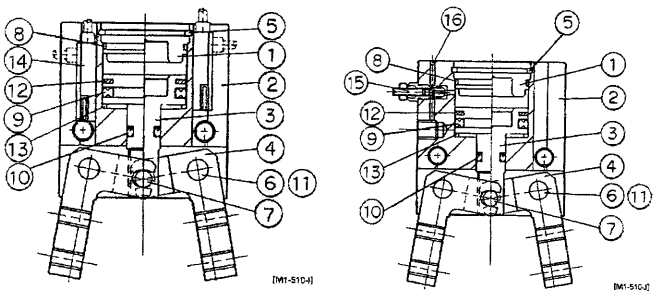
⑩	Rod packing	Nytrile rubber
⑪	Hex.socket head screw	Carbon steel
⑫	Magnet	Rare earth magnet
⑬	Cushion	Polyurethane rubber
⑭	Spring	Stainless steel

• Switch or Speed controller built-in



Parts No.	Parts name	Material
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②	Body	Aluminum alloy
③	Piston	Stainless steel
④	Master jaw	Carbon steel
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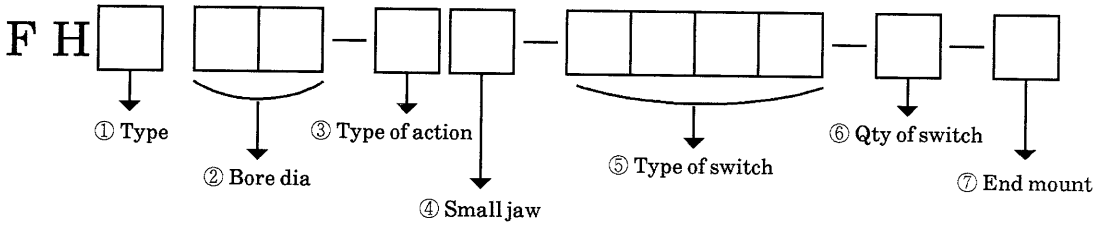
⑥	Fulcrum pin	Bearing steel
⑦	Operation pin	Bearing steel
⑧	O ring	Nytrile rubber
⑨	Piston packing	Nytrile rubber
⑩	Rod packing	Nytrile rubber
⑪	Hex.socket head screw	Carbon steel
⑫	Magnet	Rare earth magnet
⑬	Cushion	Polyurethane rubber
⑭	Cylinder switch	
⑮	Speed control needle ass'y	
⑯	Steel ball	Stainless steel

6. MODEL CODING



Classification item	Symbol	Classification
(1) Type	1 5	Parallel type, standard Fulcrum type, standard
(2) Bore diameter	10 12 16 20 25	ϕ10 ϕ12 ϕ16 ϕ20 ϕ25
(3) Speed controller	D O Z	Double action type Single action (Normally open) Speed controller built-in
(4) Small jaw	No code Y_1 Y_2	No small jaw with small jaw Material S50C with small jaw Material MC nylon
(5) Type of switch	T2H※ T2V※ T3H※ T3V※	T2 Straight type T2 L type T3 Straight type T3 L type Lead wire length ※ (Symbol / Length of lead wire (m)): No code / 1; 3 / 3; 5 / 5
(6) Qty of switch	R D	1 switch, right side, open position 2 switches
(7) End mount	No code B	No end mount End mount attached

7. OPERATIONAL CAUTION OF HAND W/SWITCH

7.1 Fixing location of switch

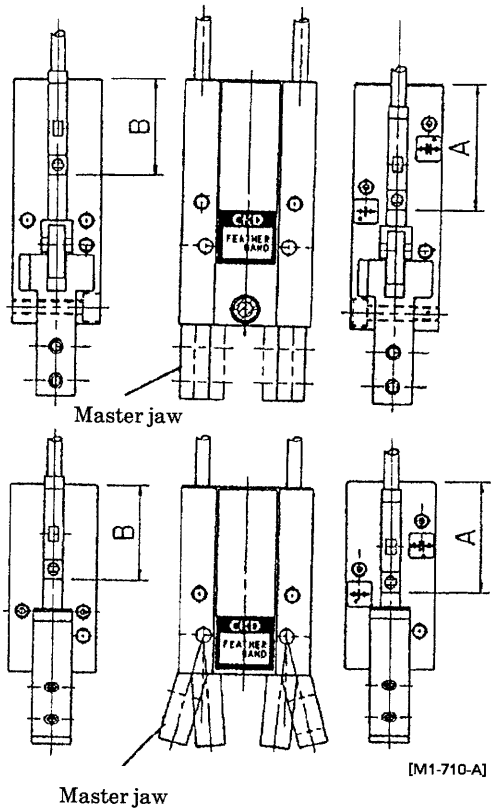
1) Cylinder switch is set, before shipping ex-factory, at the location as posted in the following table (the most sensitive location). Verify its location before puting Hand in service. Particularly when switch was purchased individually, it is the must that switch location is verified.

Unit : mm

Model \ Dimension		A Master jaw open state	B Master jaw close state
Parallel type	FH110	23	19
	FH112	25.5	19.5
	FH116	25	19.5
	FH120	27.5	20
	FH125	30.5	21
Fulcrum type	FH510	21.5	19.5
	FH512	21	19
	FH516	22	19.5
	FH520	23.5	20.5

Note : Dimensions A and B are applicable for either H type or V type.

• Switch fixing location

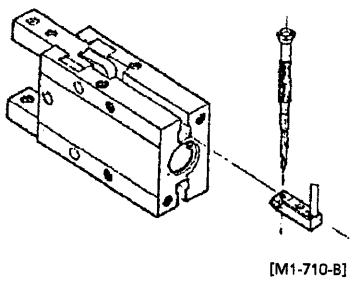


[M1-710-A]

2) To mount a switch, insert it through the groove on body for switch as illustrated to right. Find out the most sensitive location by sliding the switch back and forth.

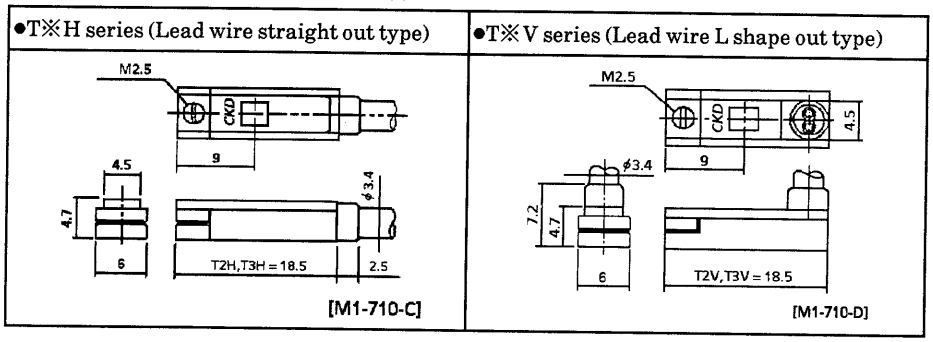
Tighten the set screw with minus tip, precision screw driver of handle diameter approx. 5mm, applying tightening torque of 10 to 20N · cm.

• Switch fixing method



[M1-710-B]

3) External dimension of switch



7.2 Operational Cautions, Non contact type switch (T2, T3)

1) Connection of lead cord

Comply with the color coding specified on the illustrations. Be sure to turn the power off before starting connecting work.

An erroneous wiring or short circuiting of load causes damage to not only switches, but also load side circuit. Wiring work without shutting electricity off may cause damage to the load side circuit.

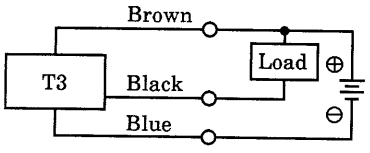


Fig.1 Basic Circuit Example (1)
(The same power source is used for switch and load.)

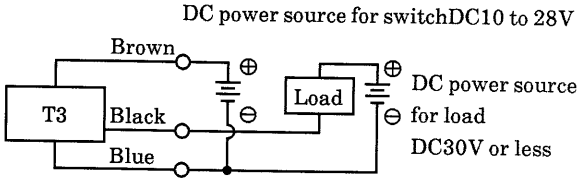


Fig.2 Basic Circuit Example (3)
(Different power sources are used for switch and load.)

2) Protection of output circuit

Install some protective circuit as illustrated in Fig. 5 when inducing type load (Relay or solenoid valve) are to be used because those types apt to generate surge current switch off.

Install some protective circuit as illustrated in Fig. 6 when capacitor type load (Capacitor type) are to be used, because these types apt to generate a dash current when turning the switch ON.

Install some protective circuit as illustrated in Fig. 5 or 6 (in case of model T2) and Fig 7 (in case of model T3)

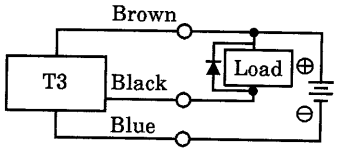


Fig.3 An example of using inducing load together with surge absorptive element (diode). (Hitachi Mfg. made diode V06C or equivalent is recommended.)

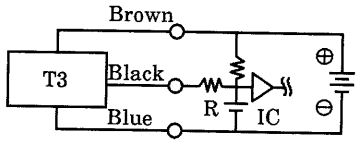


Fig.4 An example of using capacitor type load together with current regulating resister R. Comply with the following formula to figure out required R.

$$\frac{V}{0.05} = R(\Omega)$$

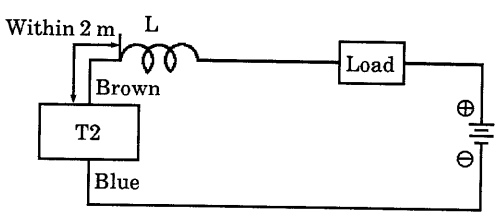


Fig.5 • Choke coil
L= a couple hundred μH ~ a couple mH surpassing high frequency characteristic
• Install it nearby the switch (within 2 m).

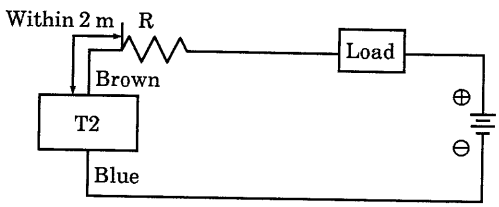


Fig.6 • Dash current restriction resister
R= As much large resister as the load circuit can afford.
• Install it nearby the switch (within 2 m).

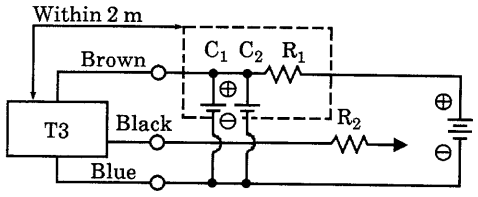


Fig.7

- Electric power noise absorptive circuit
  C_1 = 20 to 50 μF electrolytic capacitor (withstanding 50V or more)
  C_2 = 0.01 to 0.1 μF ceramic capacitor
- Dash current restriction resister
  R_1 = 20 to 30 Ω
  R_2 = As much large resister as the load circuit can afford.
- Install it nearby the switch (within 2 m).

3) Connection to a programmable controller (Sequencer)

Type of connection varies depending upon the model of the programmable controller. Refer to the following Fig. 8 to 12 respectively.

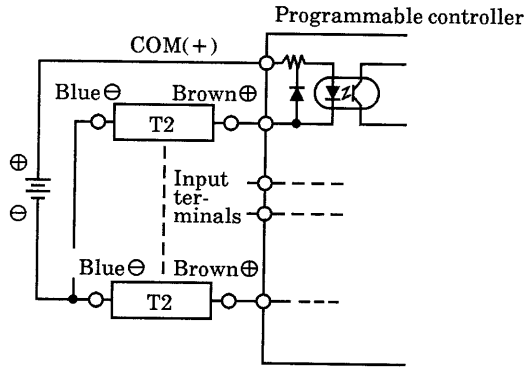


Fig.8 An example of T2 connection to source input type (an external power source)

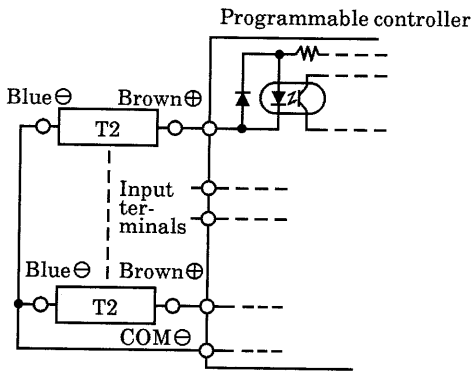


Fig.9 An example of T2 connection to source input type (an internal power source)

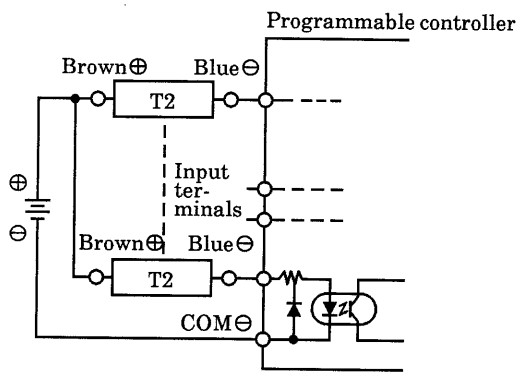


Fig.10 An example of T2 connection to sink input type

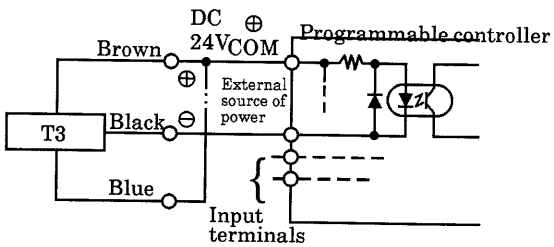


Fig.11 An example of T3 connection to source input type (an external power source)

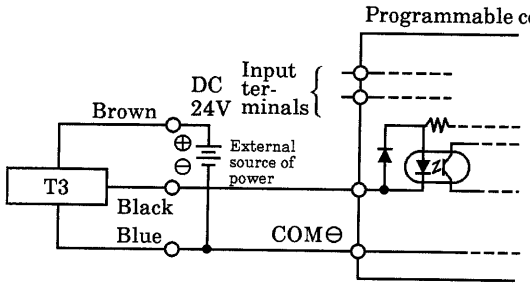


Fig.12 An example of T3 connection to source input type (an internal power source)

4) Magnetic environment

Avoid usage of these switches within the area where a strong magnetic field or large current exists. (such as a large magnet or spot welding equipment) Position censoring errors will result when installing many cylinders with a switch which is parallel or a magnetized piece come across the cylinder due to intervention among them.

5) Protection of lead cord

Pay consideration to eliminate repeating bending stress or stretching of the lead cord while laying the cord. For the moving portion, use a cord of flexibility as for building a robot.

6) Series connection

The total voltage will decrease when the T2 switches connections have a leak. Therefore, confirm the input specifications for the programmable controllers, which are the connecting load. However, dimming or total failure of the lamp may exist.

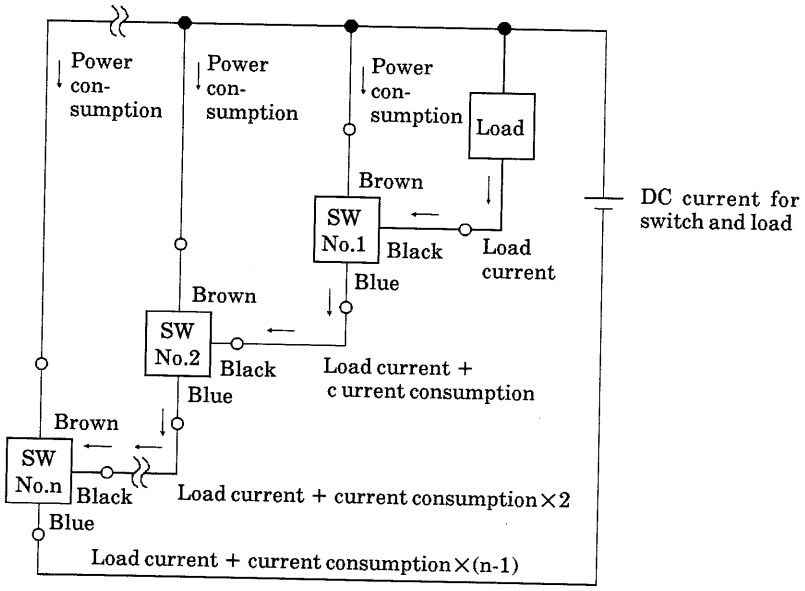
T3 switches hardly ever leak. When less than 10μA, then leakage may occur. Usually dimming and failure of the lamp do not occur.

7) Serial connection

When two or more T2 switches are connected in series, the voltage drop is equal to the sum of the voltage drops in all of the connected switches. The voltage applied to the load is the result of subtracting the total voltage drop from the power source voltage. It is necessary to determine the number of switches to be connected based on the specifications of the load.

When two or more T3 switches are connected in series, the voltage drop is equal to the sum of the voltage drops in all the connected switches as in the case of the T2 switches. The current flowing through the switches is equivalent to the sum of the current consumption of the connected switches as shown in the figure below and the load current. Determine the number of switches to be connected based on the specifications of the load so that the current will not exceed the maximum load current.

T3 switch


Power con-sumption
Power con-sumption
Power con-sumption
Load
Brown
SW No.1
Black
Load current
Blue
DC current for switch and load
Brown
SW No.2
Black
Load current + c urrent consumption
Blue
Brown
SW No.n
Black
Load current + current consumption×2
Blue
Load current + current consumption×(n-1)