

Operator's Manual

**Multi Spring Pneumatic Diaphragm Actuator**

# **VM-500 SERIES ACTUATOR**

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# SEOJEON VALMAC INSTRUCTION MANUAL

## MODEL VM-500 SERIES ACTUATOR

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## 1.0 WARNINGS

- 1.1 All service to any control valve component is to be performed by qualified personnel who have received formal training by the owner and/or SEOJEON VALMAC Co.,Ltd.
- 1.2 Before servicing any valve components, valve should be isolated from flow with internal pressure and temperature reduced to ambient conditions. Supply air is to be shut off and all pressure removed from the actuator and positioner.
- 1.3 Actuator contains springs that are under compression with the diaphragm case. To assure safe release of spring compression, eye bolts that retain upper and lower halves of diaphragm case are to be removed last when disassembling diaphragm housing.
- 1.4 The diaphragm housing is designed to handle maximum air pressure of 70 psig(5 Barg.) with an ambient temperature limit of 150°F(65°C). User is responsible to assure these values are not exceeded.

## **2. GENERAL DESCRIPTION**

The 500 Series Actuator is a multi spring air operated diaphragm type actuator designed for linear action. No internal components exist that require adjustment and as such this actuator should require minimal servicing.

Periodic inspection of diaphragm material, diaphragm plate and spring is recommended. Diaphragm case should be checked for air leakage to assure consistent actuation.

Disassembly and assembly shall be performed as defined in Section 4 of this manual. Refer to Warning Notices given in Section 1 of this manual prior to performing any service work.

The 500 Series Actuator spring action can be “field reversed” without the need for additional parts. For example, a “spring to close” unit can be changed to a “spring to open” operation. Note that change in action can effect safety of process operation which should be fully evaluated and approved by the proper engineering authority. Section 6 of this manual describes this conversion in greater detail.

Optional equipment including top mounted or side mounted hand wheel may be included.

### **3.0 UPON RECEIPT**

3.1 When the actuator and valve are shipped together, consult the valve instructions for proper installation practices. The actuator may be installed vertically or horizontally either above or below the valve.

If the actuator is shipped separately from the valve, refer to Section 4.4 for instructions to mount the actuator to valve.

3.2 Direct Action Actuator (Spring to Open)

For the direct action actuator, the spring tends to retract the actuator stem, and air pressure acting on the diaphragm will extend the actuator stem.

3.3 Reverse Acting Actuator (Spring to Close)

For the reverse-acting actuator, the spring tends to extend the actuator stem, and air pressure acting on the diaphragm will retract the actuator stem.

## 4.0. Disassembly and Assembly of VM-500 Actuator

Prior to assembly the service technician should become familiar with the components of the actuator. The following drawings apply :

Figure 4-1, Actuator to Valve Mounting

Figure 4-2, Exploded View, Direct Action (Spring to Open)

Figure 4-3, Exploded View, Reverse Action (Spring to Close)

Figure 4-6, Bolts and Nuts of Actuator

Table 4-1, Tightening and Torque Value.

### 4.1 Removal from Valve Body

The actuator is mounted to the valve by a yoke clamp nut and bolted stem connector. To remove the actuator from the body, perform the following steps.

4.1.1 Isolate the valve from all fluid and air assuring valve internals are at ambient pressure and temperature.

4.1.2 Isolate and bleed off any air in the actuator.

4.1.3A Direct Action (spring to open) – In some cases the stem connection may be made to place a force on the valve when no air is supplied. In order to remove the stem connector, apply a small amount of air to the actuator so that the stem moves slightly toward the closed position. Note the air pressure; maintain the pressure and loosen the bolt(s) on the stem connector. Bleed off air pressure. Remove all air and electrical lines to accessories mounted on actuator. Remove yoke clamp nut. Actuator should now be free to remove from valve. Refer to Fig. 4-1.

4.1.3B Reverse Action (spring to close) – In some cases the stem connection may be made to place a force on the valve when no air is supplied. In order to remove the stem connector, apply a small amount of air to the actuator so that the valve stem moves slightly toward the open position. Note the air pressure; maintain this air pressure and loosen the bolts on the stem connector. Bleed off air pressure. Remove all air and electrical lines to accessories mounted on the actuator. Remove the yoke clamp nut. Actuator should now be free to remove from valves. Refer to Fig. 4-1.

## 4.2 Disassembly of VM-500 Series Actuator

- 4.2.1 Remove actuator from valve, Ref. to 4.1
- 4.2.2 Place actuator in vertical altitude (diaphragm case up)
- 4.2.3 Remove clamping bolts(do not remove eye bolts) of the diaphragm case. Refer to Warning 1.C.
- 4.2.4 Loosen evenly and alternately the pair of eye bolts.
- 4.2.5 Remove upper diaphragm case.
- 4.2.6A Direct Action (spring to open) – Ref. To Fig. 4-2. Pull out upward actuator rod together with diaphragm. Remove springs.
- 4.2.6B Reverse Action (spring to close) – Ref. To Fig. 4-3. Remove springs. Pull out upward the actuator rod together with the diaphragm.
- 4.2.7 Remove lower diaphragm case bolts to access lower bushing and seals.
- 4.2.8 Inspect diaphragm seals for wear and replace as required.

### Notes for Disassembly :

- 1. The nuts for the eyebolts are made of Alloy steel. Discriminate these nuts from other nuts when assembling the diaphragm case.
- 2. It is recommended to make locating marks on the top and bottom diaphragm cases before disassembly. This will help you to easily find the air piping connector location.
- 3. Store the removed parts in a clean place.

## 4.3 Assembly of VM-500 Series Actuator

- 4.3.1 Before reassembly, check parts for scrapes, damage, deformation, peeling of paint, wear or other abnormality. Replace as required.
- 4.3.2 Direct Action Type (Spring to open) (*Note: refer to fig. 4-6 and Table 4-1 for tightening torque of bolts and nuts.*)
  - a. Fix the bottom diaphragm case and yoke with bolts. Install the diaphragm case and spring plate together.
  - b. Install the springs on the diaphragm plate(with spring guide).
  - c. Insert the actuator rod(to which the diaphragm is connected) into the bushing, exercising care not to damage the bushing inside surface or dust seal with the threaded section of the rod. (For example, cover the threaded section with adhesive tape to prevent damaging the bushing.) Set the stopper in parallel with the yoke.

- d. Place the top diaphragm case and fix it with the pair of eye bolts. (Note: Set the air piping connection port in the location shown in the illustration. (Fig.4-4). Tighten the pair of eye bolts uniformly by tightening them alternately. The initial setting of the springs is complete by tightening of these eye bolts.
- e. Finish clamping the diaphragm case with other clamping bolts than the pair of eye bolts.
- f. Connect the air pipe to the air piping connection port of the top diaphragm case
- g. After assembly is complete as above, check the following;
  - 1.) Applying an air pressure of 70 psig (5 barg) via the air piping connection port of the top diaphragm case; check the diaphragm periphery for air leak by using soapsuds.
  - 2.) Reset air pressure as defined on Copes-Vulcan Data Sheet.
  - 3.) Check to assure that the actuator operates smoothly for its full stroke. Note: Check this operation by operating the actuator as an independent unit.

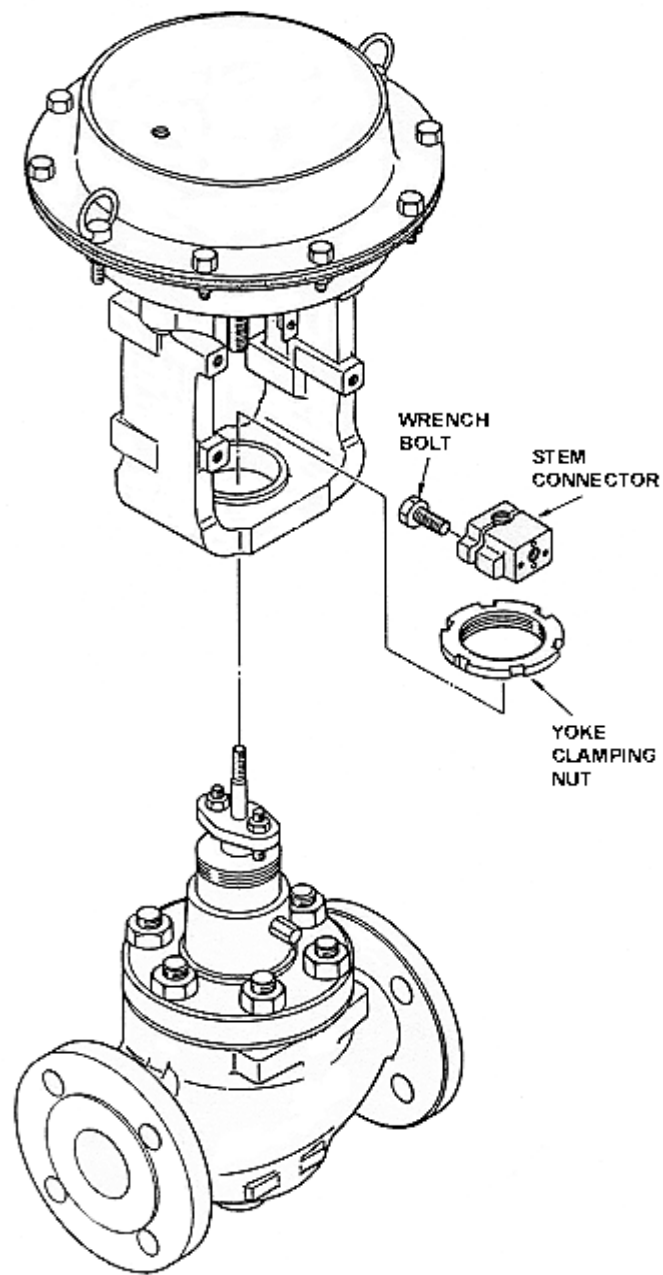
4.3.2 Reverse Action Type (Spring to open) (*Note: Refer to fig. 4-6 and Table 4-1 for tightening torque of bolts and nuts.*)

- a. Fix the bottom diaphragm case and yoke with the bolts.
- b. Insert the actuator rod(to which the diaphragm is connected) into the bushing, exercising care not to damage the bushing inside surface or dust seal with the thread section of the rod. (For example, cover the threaded section with adhesive tape to prevent damaging the bushing.)
- c. Make the stopper(in the diaphragm plate) in parallel with the yoke by turning the nut.
- d. Install the springs on the diaphragm plate
- e. Place the top diaphragm case and fix it with the pair of eye bolts. Set the air vent hole in the location shown in the illustration (Fig. 4-5). Uniformly and alternately tighten the eye bolts. The initial setting of the springs is complete by tightening of these eye bolts.
- f. Finish Clamping the diaphragm case with other clamping bolts than the pair of eye bolts.
- g. Install the rain cap on the air vent port.
- h. Connect the air pipe to the air piping connection port of the bottom diaphragm case.

- i. After the assembly is complete as above, check the following:
  - 1.) Applying an air pressure of 70 psig(5 barg) via the air piping connection port of the bottom diaphragm case, check the diaphragm periphery for air leak by using soapsuds.
  - 2.) Reset air pressure as defined on Copes-Vulcan Data Sheet.
  - 3.) Check to assure that the actuator operates smoothly for its full stroke.

#### 4.4 Assembly of Actuator of Valve

- 4.4.1 Place actuator on bonnet taking care to orient actuator accessories to permit easy access for adjustments.
- 4.4.2 Screw yoke clamp nut on bonnet to secure actuator to valve. Use steel bar and hammer to engage the cast protrusions of the yoke to apply torque.



**Fig. 4-1 Actuator to Valve Mounting**

When disassembling the actuator, keep it in the vertical attitude.  
For the tightening torques of bolts and nuts, see Tables 4-1.  
For the parts List, see Figs. 4-7 and 4-8.

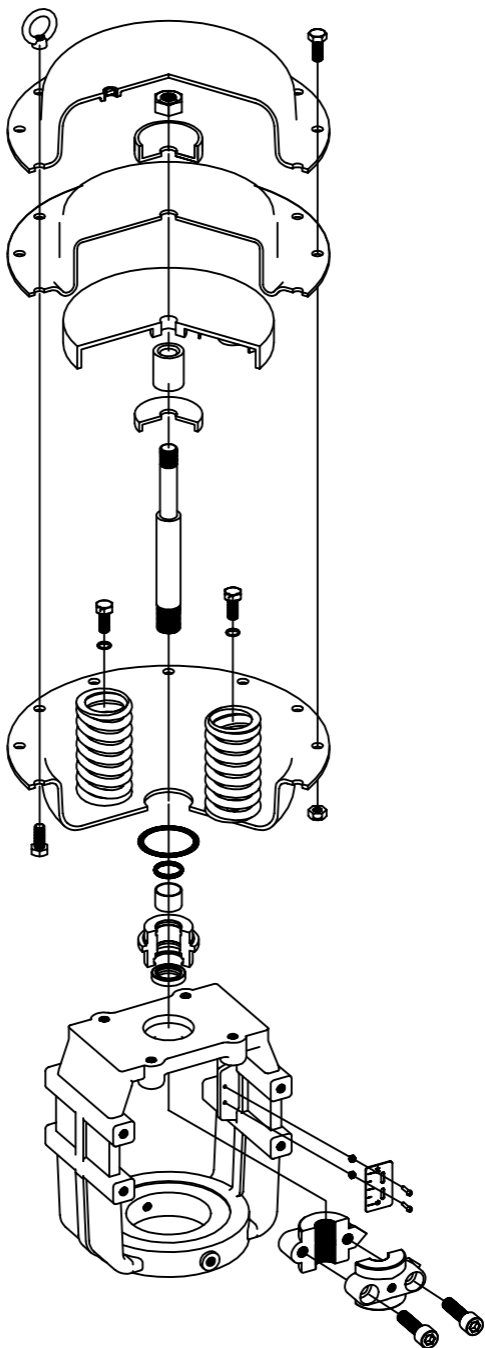


Fig. 4-2 Series 500 Actuator(Direct Action)

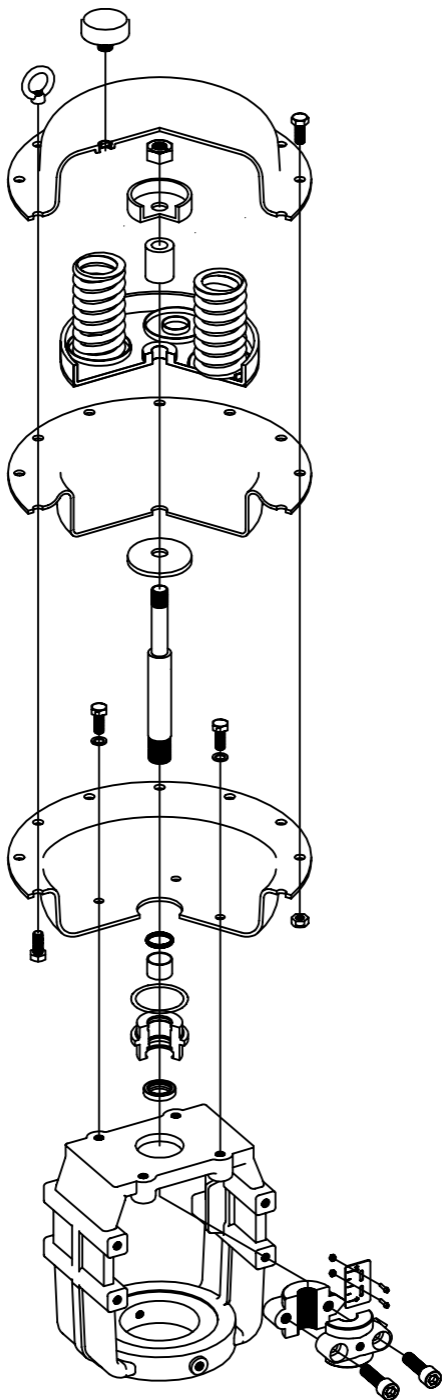


Fig. 4-3 Series 500 Actuator (Reverse Action)

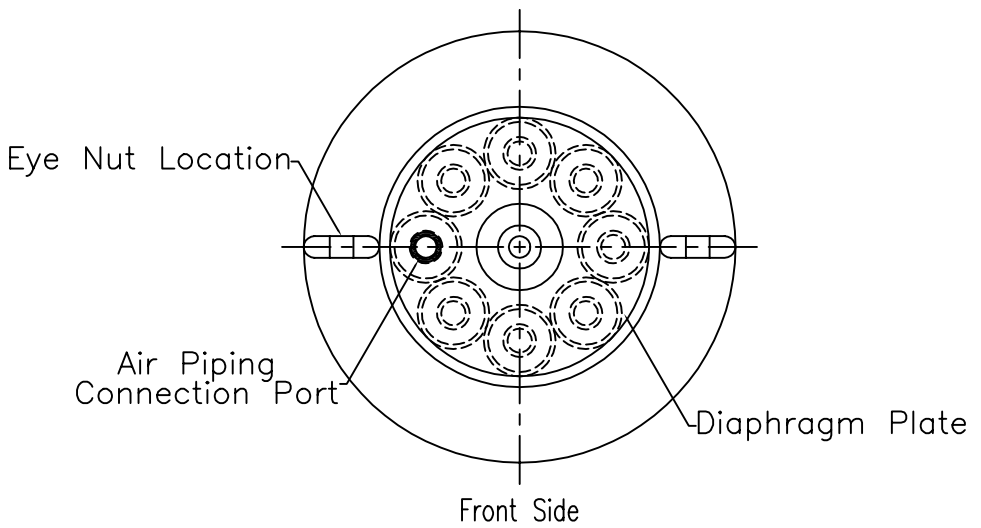


Fig. 4-4. Direction Action Type

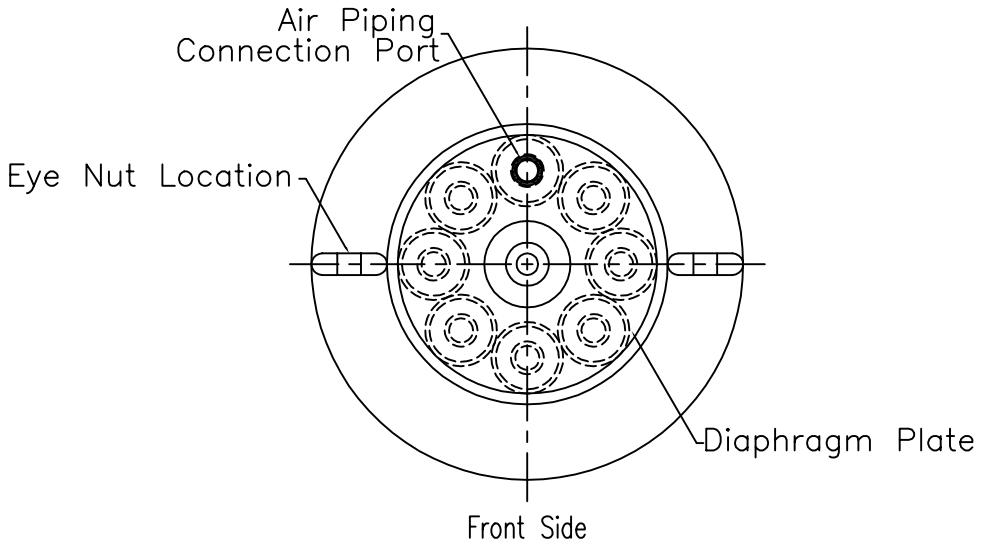


Fig. 4-5. Reverse Action Type

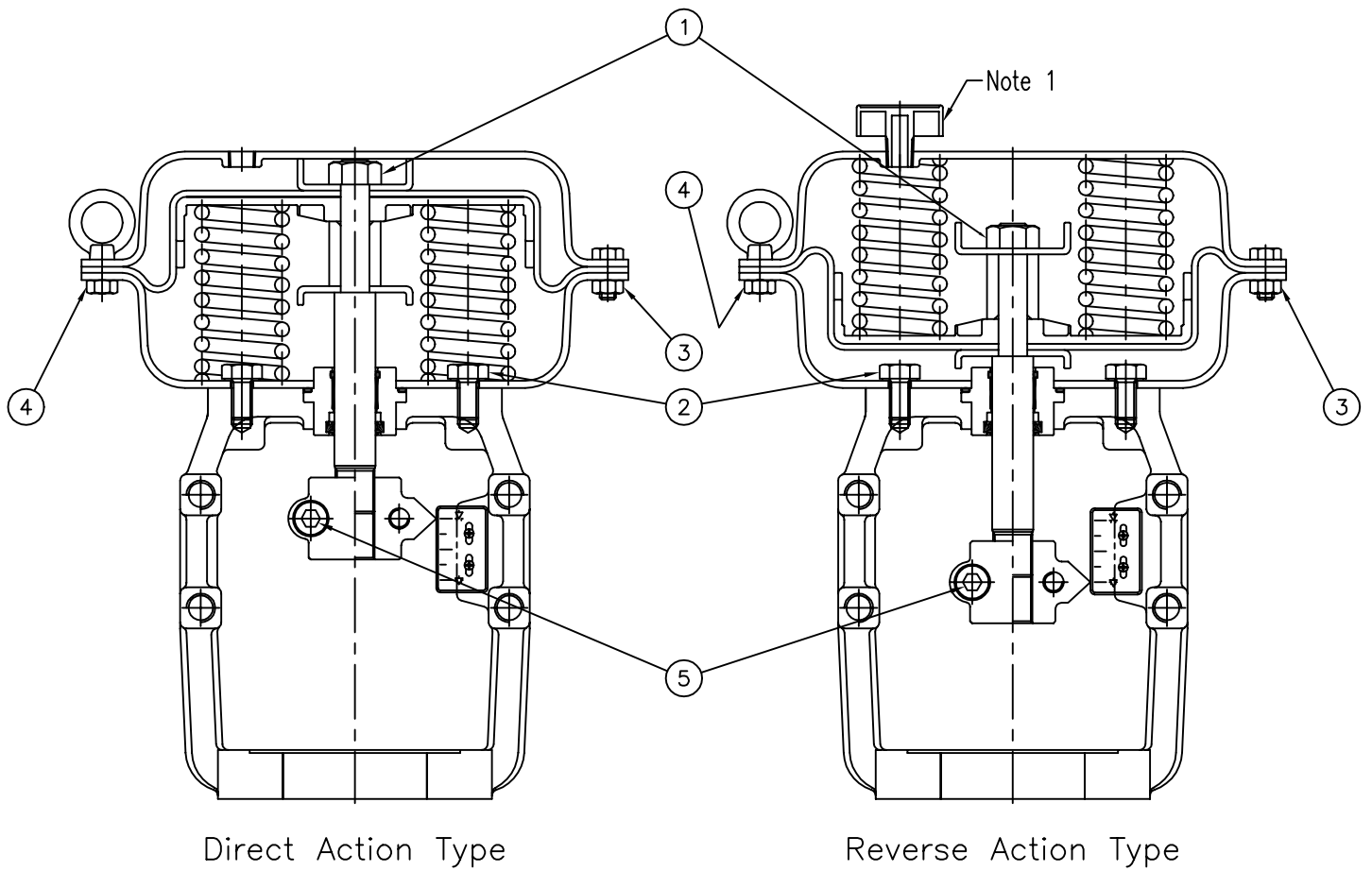


Fig. 4-6. Bolts and Nuts of Actuator

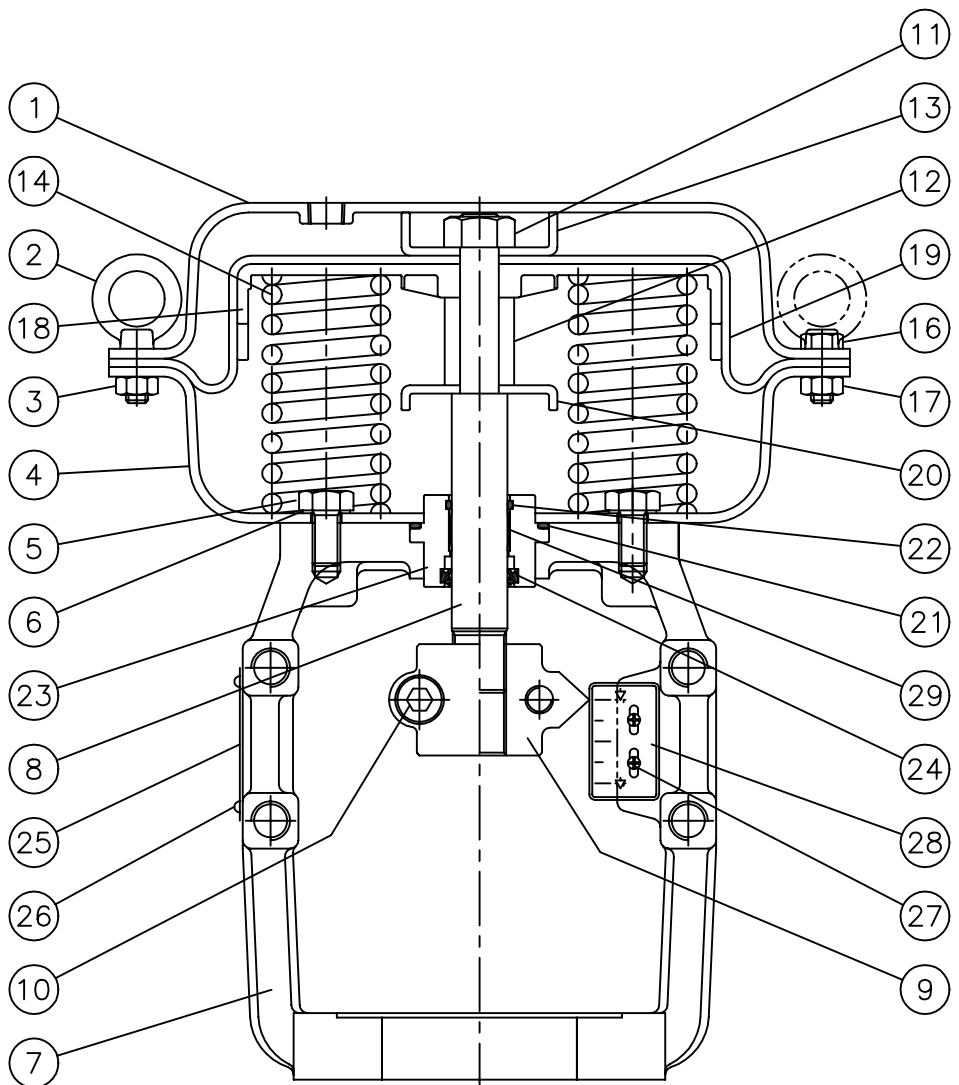
Table 4-1. Tightening Torques of Bolts and Nuts of Actuator

Units : ft-lb (kgf-cm)

NO.	MATERIAL	500-23		500-42		500-74		500-145	
		BOLT SIZE	TORQUE	BOLT SIZE	TORQUE	BOLT SIZE	TORQUE	BOLT SIZE	TORQUE
1	AISI	M14	50 (690)	M14	50 (690)	M16	76 (1,050)	M24	260 (3,600)
2	A 193 Gr. B7	M10	41 (560)	M10	41 (560)	M12	46 (630)	M18	105 (1,450)
3	A 193 Gr. B7	M8	14 (185)	M8	14 (185)	M8	14 (185)	M10	41 (560)
4	A 193 Gr. B7	M8	14 (185)	M8	14 (185)	M8	14 (185)	M10	41 (560)
5	A 193 Gr. B7	M10	41 (560)	M10	41 (560)	M18	105 (1,450)	M18	105 (1,450)

Note 1 : Fix the rain cap of the reverse type of actuator as follows :

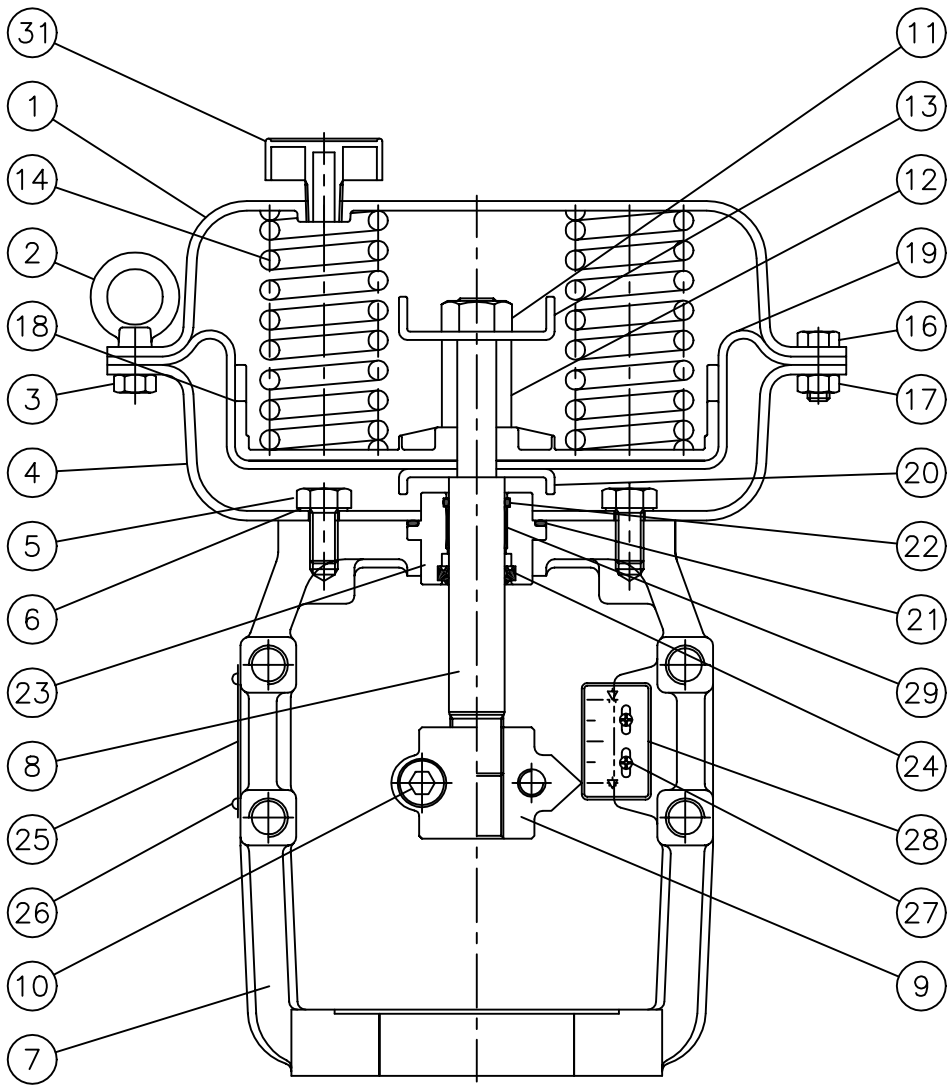
Drive the cap into the diaphragm case until the shoulder(brim) of the cap is brought into contact with the diaphragm case and then drive the cap further into the diaphragm case by half of a turn.



NO.	PART NAME
1	DIAPHRAGM CASE (TOP)
2	EYE BOLT
3	HEX. NUT
4	DIAPHRAGM CASE (BOTTOM)
5	HEX. BOLT
6	SEAL WASHER
7	YOKE
8	ROD
9	STEM CONNECTOR
10	STEM CONNECTOR BOLT
11	HEX. NUT
12	STOPPER COLLAR
13	STOPPER RING
14	SPRING
16	HEX. BOLT

NO.	PART NAME
17	HEX. NUT
18	DIAPHRAGM PLATE
19	DIAPHRAGM
20	DIAPHRAGM RETAINER
21	O-RING
22	O-RING FOR ROD
23	SEAL BOX
24	DUST SEAL
25	WARNING LABEL
26	RIVET
27	TRUS SCREW + NUT
28	SCALE PLATE
29	DU DRY BEARING
31	RAIN CAP

Fig. 4-7. Series 500 Actuator Parts List (Direct Action Type)



NO.	PART NAME
1	DIAPHRAGM CASE (TOP)
2	EYE BOLT
3	HEX. NUT
4	DIAPHRAGM CASE (BOTTOM)
5	HEX. BOLT
6	SEAL WASHER
7	YOKE
8	ROD
9	STEM CONNECTOR
10	STEM CONNECTOR BOLT
11	HEX. NUT
12	STOPPER COLLAR
13	STOPPER RING
14	SPRING
16	HEX. BOLT

NO.	PART NAME
17	HEX. NUT
18	DIAPHRAGM PLATE
19	DIAPHRAGM
20	DIAPHRAGM RETAINER
21	O-RING
22	O-RING FOR ROD
23	SEAL BOX
24	DUST SEAL
25	WARNING LABEL
26	RIVET
27	TRUS SCREW + NUT
28	SCALE PLATE
29	DU DRY BEARING
31	RAIN CAP

Fig. 4-8. Series 500 Actuator Parts List (Reverse Action Type)

## **5.0 ADJUSTMENT; STROKE**

5.1 As a general rule the 500 Series Actuator requires no adjustment other than the proper alignment and setting of the stroke of the actuator.

5.2 Referring to Figures 1-1 and 5-1, stroke of the actuator is adjusted as follows:

5.2.1 Fix actuator to valve body by securely tightening yoke clamping nut.(Ref. 4.4.2 above)

5.2.2 Connect an adjustable air pressure source(with pressure regulator) to actuator. Note, maximum pressure should not exceed 70 PSIG (5 Barg.). Connections should be on top of diaphragm case for direct action and lower case for reverse action.

5.2.3 Assure valve is properly seated and loosen packing to permit free travel of valve stem.

### **5.2.4 FOR THE DIRECT ACTION TYPE**

5.2.4.1 Slowly apply maximum air pressure to actuator, 70 PSIG (5 Barg.) to fully extend the actuator stem. Repeat this process three time to assure full travel is reached.

5.2.4.2 Assure stroke of actuator stem is equal to or greater than stroke defined on name plate.

5.2.4.3 With actuator stem fully extended, attach stem connector block to actuator and valve stem (valve stem to remain in place per 5.2.3) It is important to assure proper thread engagement is achieved between stem and block.

Securely tighten clamping bolts of stem connector (Ref. to Item 5 on Table 4-1).

5.2.4.4 Reduce air pressure and confirm full stroke of valve is possible.

### **5.2.5 FOR THE REVERSE ACTION TYPE**

5.2.5.1 Slowly apply maximum air pressure to actuator, 70 PSIG (5 Barg.) to fully retract the actuator stem. Repeat this process three time to assure full travel is reached.

5.2.5.2 Note travel distance of actuator stem during 5.2.5.1 and confirm it is equal to or greater than stroke defined on nameplate.

5.2.5.3 Note position of actuator stem with full air pressure. slowly reduce air pressure measuring change in actuator stem travel. Stop change of air when distance traveled is equal to stroke distance defined on nameplate.

5.2.5.4 Holding this location of actuator stem travel, attach the stem connection block to actuator and valve stem. (Valve stem is to

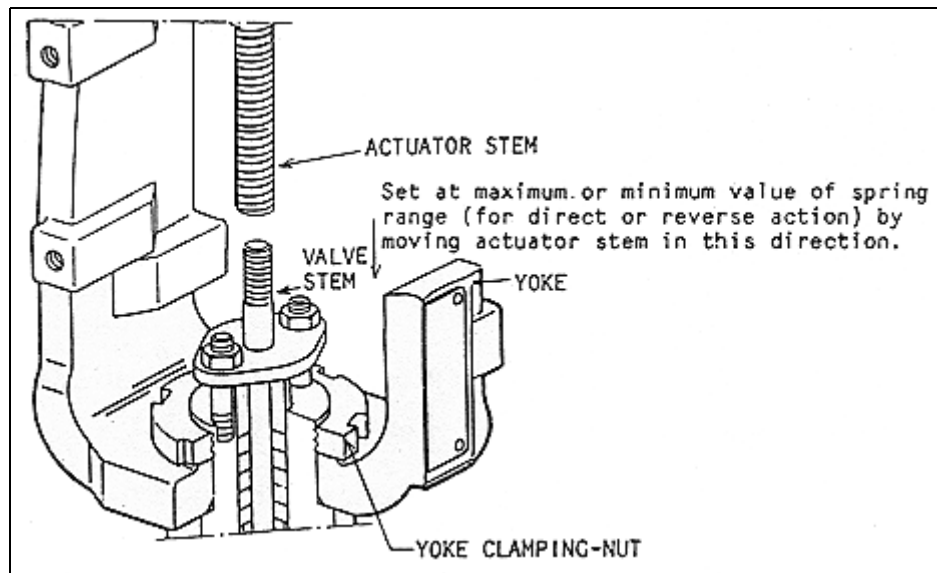
remain in position per 5.2.3 above).

5.2.5.5 Increase air pressure and confirm travel is equal to value on nameplate.

5.2.5.6 Decrease air pressure to 0 PSIG (0-Barg.); extend actuator stem fully. Gradually increase air pressure and note reading when the stem starts to move. This value should be equivalent to pre-compression value listed on nameplate.

Deficient pre-compression will effect ability to maintain tight shut-off of valve.

If a lower value is obtained repeat process. If lower values continue, consult VALMAC as springs in use may require change out.



**Fig. 5-1 Stem Connector**

## **6.0 CONVERSION of Actuator Action : Reverse to Direct Acting**

The Model 500 Actuator can be changed in action. The following text defines a change from REVERSE to DIRECT acting.

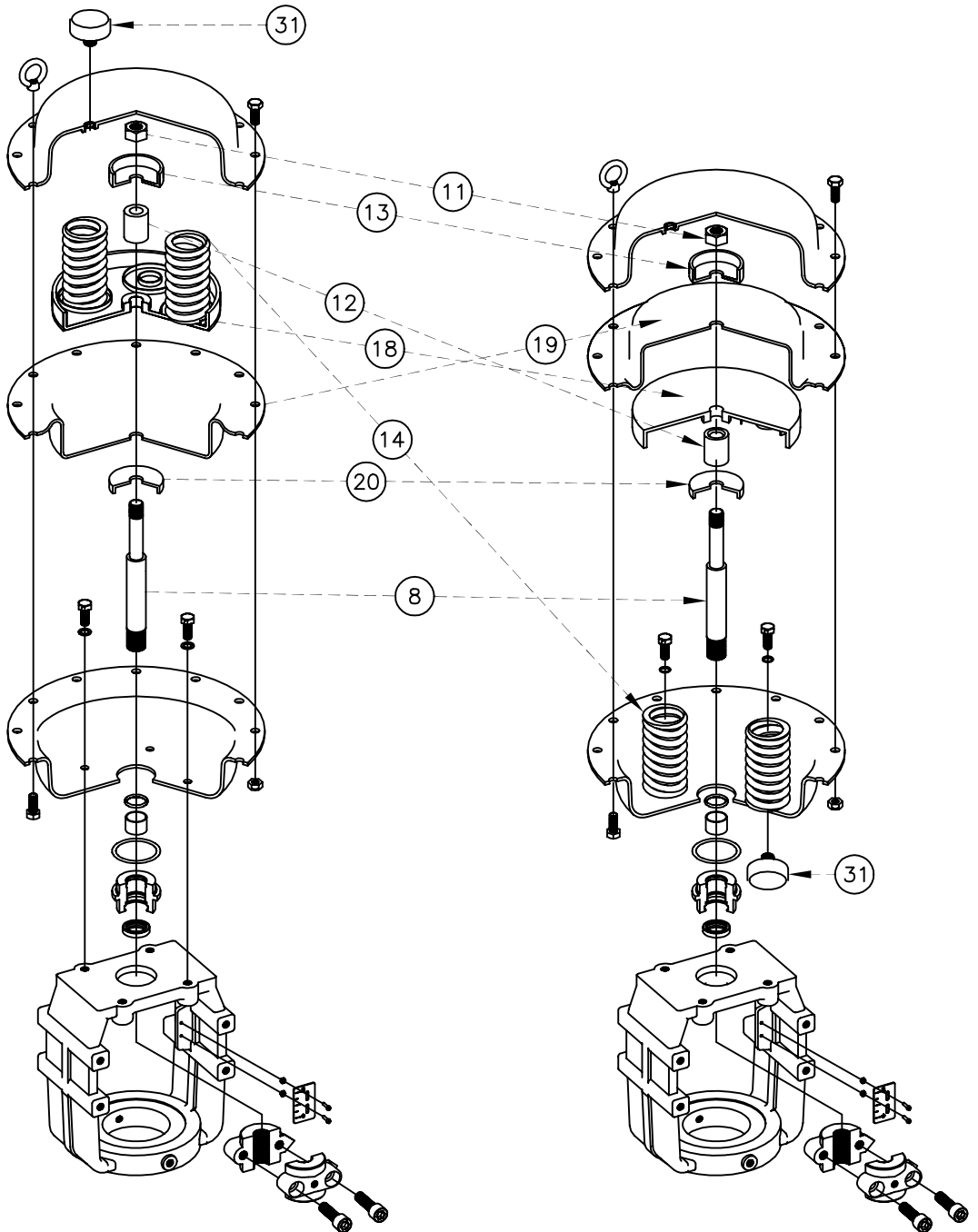
(Note: For proper valve operation, the spring selection should be reviewed to assure proper seat contact load is provided.)

### 6.1 Disassembly

- A. Remove clamping bolts of diaphragm case; refer to WARNING 1.C.
- B. Loosen evenly and alternately the pair of eye bolts.
- C. Remove upper diaphragm case.
- D. Remove springs(14); pull out upward the actuator rod (8) together with diaphragm(19).
- E. Loosen Actuator rod lock nut (11); remove stopper ring(13), diaphragm plate(18), diaphragm.

### 6.2 Reassembly

- A. Install springs in lower diaphragm case. Note: Avoid contact with lower case hex bolt.
- B. Place stopper collar(12) on actuator rod(8)
- C. Turn diaphragm plate(18) upside down and place on actuator rod(8).
- D. Place diaphragm(19) on actuator rod(8).
- E. Locate stopper ring(13) a top the diaphragm and tighten actuator rod lock nut(11).
- F. Replace top actuator case and bolt closed.
- G. Relocate rain cap(31) to lower actuator case.



Note : Part Numbers are as given on Fig. 4-7 & 4-8 Parts List

Fig. 6-1. Series 500 Actuator (Reverse → Direct Action)

## 7.0 INSTRUCTIONS FOR TOP HANDWHEEL OF ACTUATOR (Optional)

### 7.1 Operating Instructions

To manually operate the actuator, refer to Fig 7-1 through Fig. 7-4 and proceed as follows:

- 7.1.1 First, loosen the lock nut (which has a bar-shape handle and which locks the handwheel) and turn the handwheel in the direction indicated by the corresponding arrowhead mark.

As you turn the handwheel clockwise, the actuator stem moves downward regardless of whether the actuator is of the direct action type or reverse action type. The handwheel bears the "SHUT" mark to indicate that the valve is closed as the handwheel is turned clockwise and the "OPEN" mark to indicate that the valve is made open as the handwheel is turned counterclockwise.

- 7.1.2 For automatic operation of the actuator, fully raise the handwheel if the actuator is of the direct action type or fully lower the handwheel if the actuator is of the reverse action type, and then tighten the lock nut to secure the handwheel in such position.

PRECAUTIONS: If you forcefully turn the handwheel after it has reached the mechanical stop position, the valve stem may be damaged. Do not turn the handwheel with forces larger than the below-mentioned limits.

Series 500-42	-	ft-lb ( 19 kgf )
Series 500-74	-	ft-lb ( 26 kgf )
Series 500-145	-	ft-lb ( 41 kgf )

(At the outermost periphery of the handwheel)

### 7.2 Disassembly and Assembly of Top Handwheel

To disassemble or assemble the top handwheel, refer to Fig. 7-1 through 7-4 and proceed as described in this section. For disassembly work, keep the actuator in the vertical attitude.

#### 7.2.1 (a) Direct Action type

- (1) Disconnect the air piping.
- (2) Set the handwheel shaft in the automatic operation position

(fully raise the handwheel shaft).

- (3) Remove the top diaphragm case. When doing this, loosen the pair of eye bolts uniformly and alternately, after removing all other clamping bolts of the diaphragm case.
- (4) Sufficiently insert the handwheel shaft by turning it and then remove the handwheel and the lock nut. Insert the shaft further and then remove the screw shaft from the housing.
- (5) Remove the O-ring.

To assemble the top handwheel, follow the disassembly procedure in the reverse order.

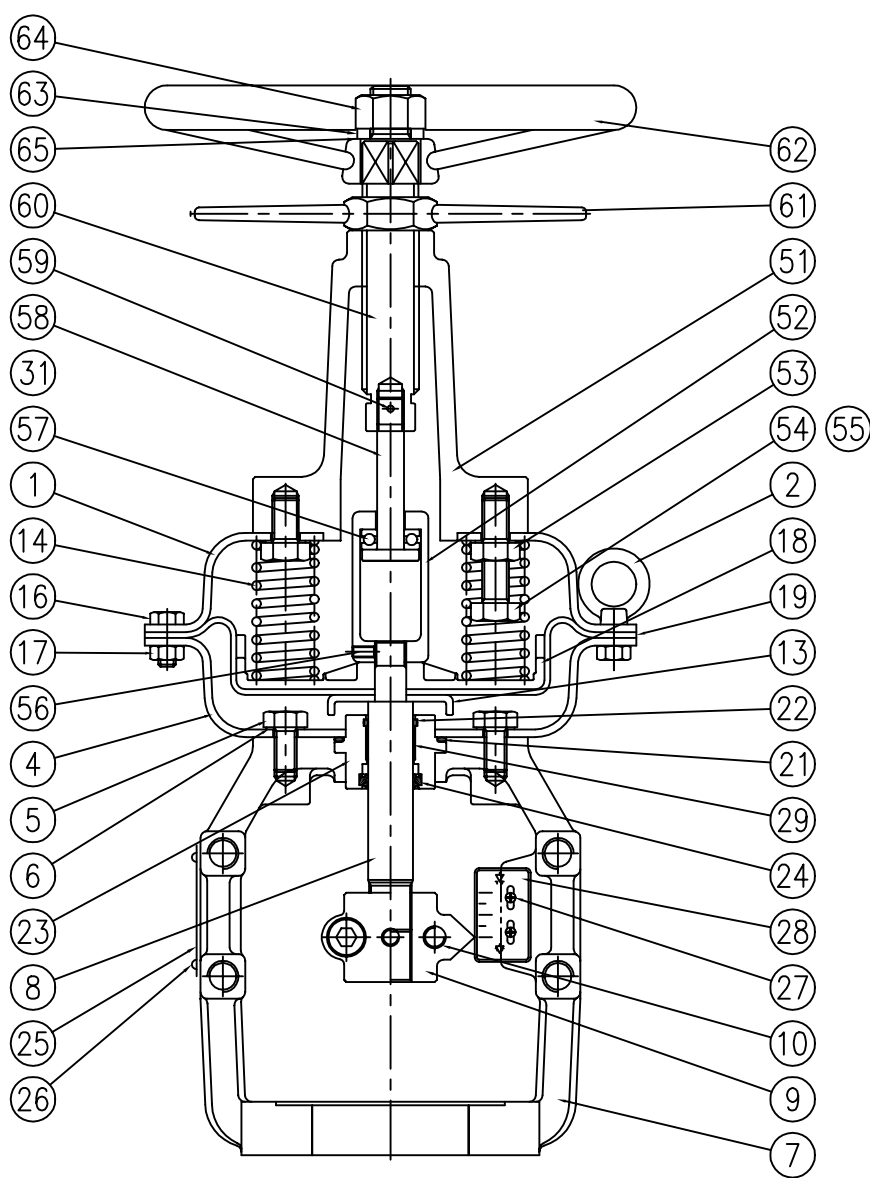
#### 7.2.2 (b) Reverse Action Type

- (1) Disconnect the air piping.
- (2) Set the handwheel shaft in the automatic operation position (fully lower the hand wheel shaft).
- (3) Remove the hand wheel and the lock nut. Insert the shaft into the housing by means of the threading until the threaded sections are disengaged.
- (4) Remove the top diaphragm case. When doing this, loosen the pair of eye bolts uniformly and alternately, after removing all other clamping bolts of the diaphragm case.
- (5) Remove the housing by loosening its clamping screw.
- (6) Remove the set screw and then remove the bearing case.
- (7) Remove the spring pin and then remove the castle nut.
- (8) Remove the bearing retainer and then remove the bearing.

To assemble the top hand wheel, follow the disassembly procedure in the reverse order.

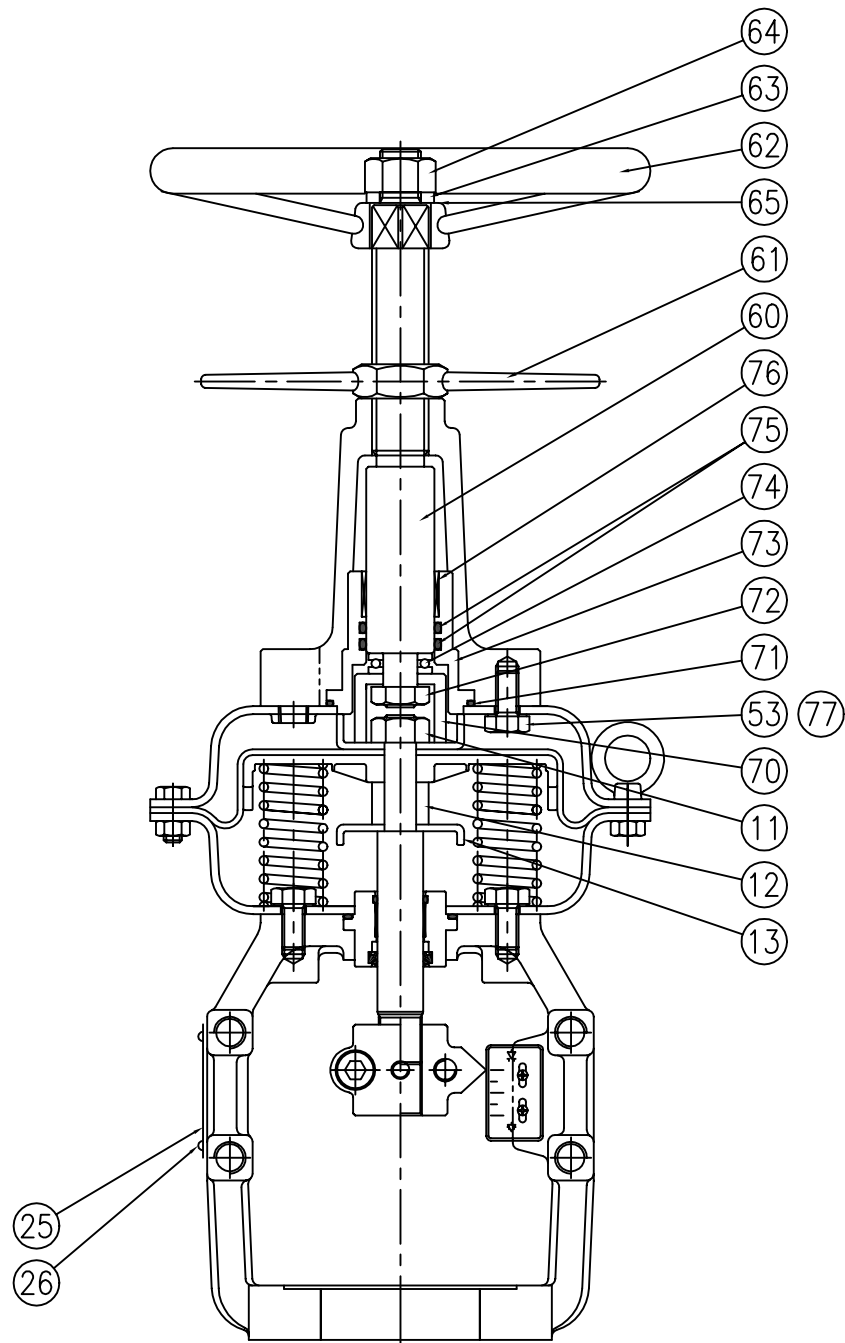
#### 7.2.3 (c) Inspection After Assembly

- (1) Check that the handwheel turns smoothly for the full stroke.
- (2) For the direct action type of actuator, check by means of soapsuds that there is no air leak from the connecting section of the top diaphragm case.



NO.	PART NAME	NO.	PART NAME	NO.	PART NAME
1	DIAPHRAGM CASE (TOP)	19	DIAPHRAGM	53	HEX. BOLT
2	EYE BOLT	20	DIAPHRAGM RETAINER	54	HEX. BOLT FOR STOPPER
3	HEX. NUT	21	O-RING	55	HEX. NUT FOR STOPPER
4	DIAPHRAGM CASE (BOTTOM)	22	O-RING FOR ROD	56	SCREW
5	HEX. BOLT	23	SEAL BOX	57	BEARING
6	SEAL WASHER	24	DUST SEAL	58	BEARING SHAFT
7	YOKE	25	WARNING LABEL	59	SPRING PIN
8	ROD	26	RIVET	60	SCREW SHAFT
9	STEM CONNECTOR	27	TRUS SCREW + NUT	61	LOCK NUT
10	STEM CONNECTOR BOLT	28	SCALE PLATE	62	HANDWHEEL
14	SPRING	29	DU DRY BEARING	63	SPRING WASHER
16	HEX. BOLT	31	RAIN CAP	64	HEX. NUT
17	HEX. NUT	51	HOUSING	65	WASHER
18	DIAPHRAGM PLATE	52	BEARING CASE		

Fig. 7-1. Series 500 Actuator With Top Handwheel (Direct Action Type)



NO.	PART NAME	NO.	PART NAME	NO.	PART NAME
11	HEX. NUT	61	LOCK NUT	72	HEX. NUT
12	STOPPER COLLAR	62	HANDWHEEL	73	SEAL BOX
13	STOPPER RING	63	SPRING WASHER	74	BEARING
25	WARNING LABEL	64	HEX. NUT	75	O-RING
26	RIVET	65	WASHER	76	DU-DRY BEARING
53	HEX. BOLT	70	SPRING RETAINER	77	SEAL WASHER
60	SCREW SHAFT	71	O-RING		

Fig. 7-2. Series 500 Actuator With Top Handwheel (Reverse Action Type)

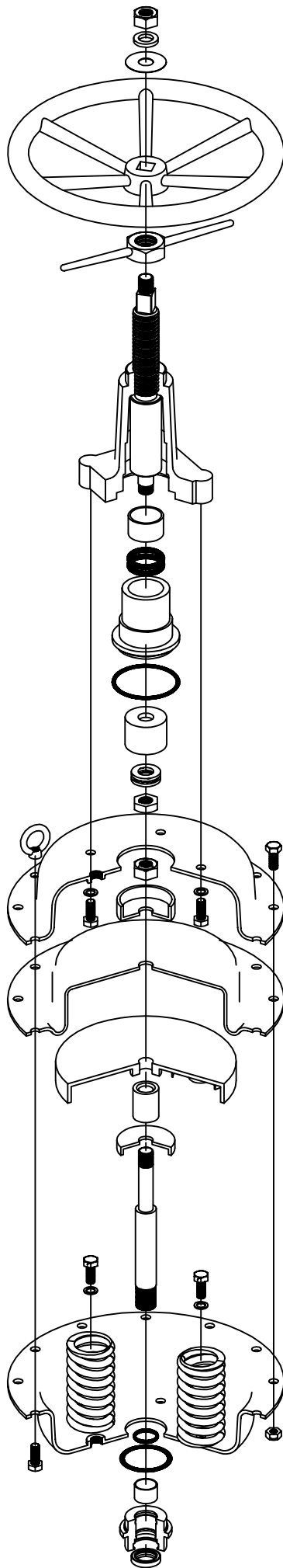


Fig. 7-3 Series 500 Actuator with Top Handwheel  
(Direct Action)

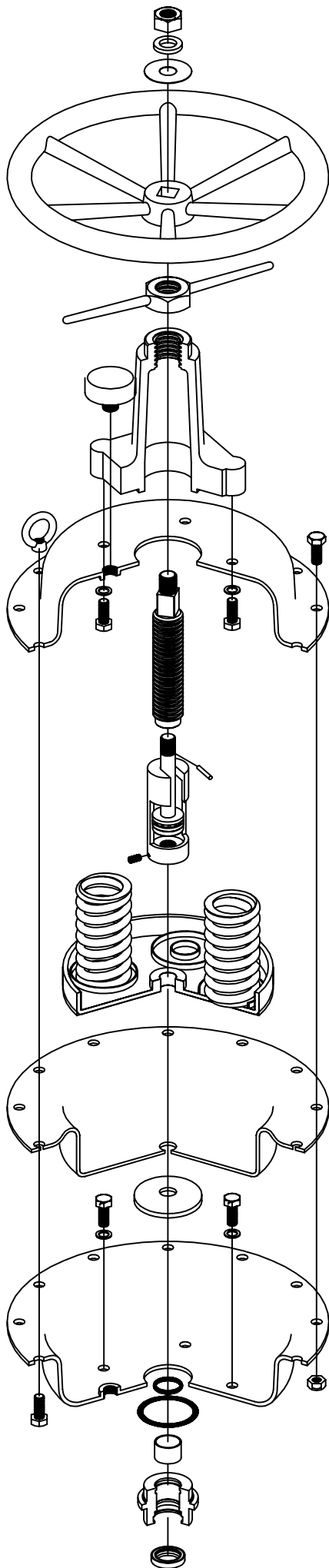


Fig. 7-4 Series 500 Top Handwheel Actuator  
(Reverse Action)