

# Fisher® 644 and 645 Differential Pressure Pump Governors

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Figure 1. Fisher 644 Actuator Mounted on a Typical easy-e™ Valve



## Introduction

### Scope of Manual

This instruction manual provides information on installation, adjustment, maintenance, and parts ordering for the Fisher 644 and 645 differential pressure pump governors. Refer to separate instruction manuals for information about the valve and other accessories used with these governors.

Do not install, operate, or maintain 644 or 645 governors without being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance. **To avoid personal injury or property damage, it is important to carefully read, understand, and follow all the contents of this manual, including all safety cautions and warnings.** If you have any questions about these instructions, contact your Emerson Process Management sales office before proceeding.

### Description

644 and 645 actuators are used in combination with any of several sliding-stem valves to automatically control steam-driven boiler feedwater pumps (reciprocating or turbine). The 644 or 645 actuator (see figures 1 and 2), when used in combination with one of several push-down-to-close sliding-stem valves, forms a pump governor.

644 and 645 actuators may also be combined with push-down-to-open valves to be used as relief governors. Relief governors are used to divert excess pump discharge back to the suction side of the pump.



Table 1. Specifications

<b>Actuator Sizes</b> See table 2  <b>Actuator Travel</b> <b>Chloroprene Diaphragm:</b> 11 mm (0.4375 inch) maximum <b>Stainless Steel Diaphragm:</b> 3 mm (0.125 inch) maximum  <b>Operating Principle</b> <ul style="list-style-type: none"> <li>■ Direct-acting with push-down-to-close valve</li> <li>■ Reverse-acting with push-down-to-open valve</li> </ul> <b>Differential Pressure Ranges</b> See table 2  <b>Maximum Casing Pressure</b> <b>644 Actuator:</b> <i>Cast-Iron Casing:</i> 20.7 bar (300 psig) <i>Steel Casing:</i> 41.4 bar (600 psig) <b>645 Actuator:</b> <i>Cast-Iron Casing:</i> 34.5 bar (500 psig) <i>Steel Casing:</i> 69.0 bar (1000 psig)	<b>Maximum <math>\Delta P</math> Across Diaphragm</b> 13.8 bar (200 psi)  <b>Effective Diaphragm Area</b> <b>644:</b> <i>Size 1:</i> 146 cm <sup>2</sup> (8.9 inch <sup>2</sup> ) <i>Size 2:</i> 243 cm <sup>2</sup> (14.8 inch <sup>2</sup> ) <i>Size 3:</i> 364 cm <sup>2</sup> (22.2 inch <sup>2</sup> ) <b>645:</b> 338 cm <sup>2</sup> (20.6 inch <sup>2</sup> )  <b>Material Temperature Capabilities</b> <b>644:</b> <i>Chloroprene Diaphragm:</i> -40 to 82°C (-40 to 180°F) <i>Stainless Steel Diaphragm:</i> <i>Cast-iron casing:</i> -40 to 232°C (-40 to 450°F); <i>Steel casing:</i> -40 to +399°C (-40 to 750°F) <b>645:</b> -37 to 82°C (-35° to 180°F)  <b>Casing Pressure Connections</b> 1/4 NPT internal  <b>Spring Ranges and Sensitivity</b> See table 2
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## Specifications

Specifications for the 644 and 645 pump governors are shown in table 1. Information for a specific pump governor is also found on the nameplate of that pump governor.

Table 2. Spring Information

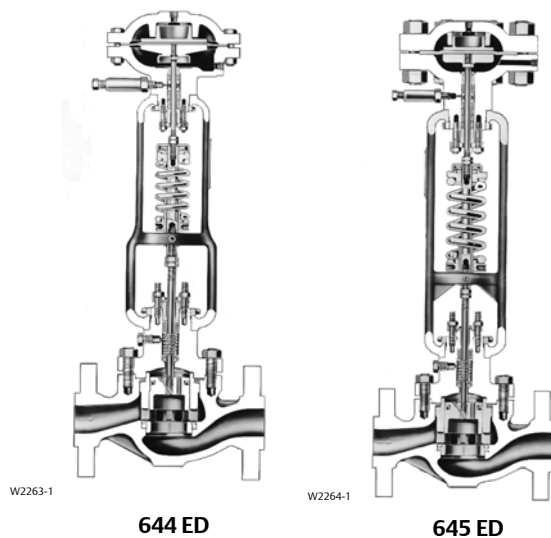
ACTUATOR		DIFFERENTIAL PRESSURE RANGE		SPRING RATE		SENSITIVITY		SPRING PART NUMBER
		Bar	Psi	N/mm	Lbf/in	mm/N	in/Psi	
644	Size 3 Casing	0.3-1.2	5-18	56	314	26.1	0.0707	1F945527032
		1.2-1.9	18-27	107	609	13.5	0.0365	1F945627032
	Size 2 Casing	1.9-2.8	27-40	107	609	9.0	0.0244	1F945627032
		2.8-3.8	40-55	165	940	6.2	0.0168	1F945727042
645	Size 1 Casing	3.8-4.7	55-68	107	609	5.4	0.0146	1F945627032
		4.7-6.9	68-100	165	940	3.7	0.0101	1F945727042
		1.0-1.7	14-24	43	246	21.0	0.057	1F714427112
		1.7-2.4	24-35	64	368	14.0	0.038	1F176727032
		2.4-3.2	35-47	86	490	10.5	0.0286	1F176827092
		3.2-4.1	47-59	107	612	11.0	0.0299	1F176927092
		4.1-4.3	59-62	129	735	7.1	0.0191	1E792327092
		4.3-5.9	62-85	145	830	6.2	0.0169	1F714327092
		5.9-6.8	85-99	221	1260	4.1	0.0111	1E795327082
		6.8-8.2	99-119	257	1470	3.5	0.0095	1E792427082
		8.2-9.7	119-140	310	1770	2.9	0.0079	1E795427082
		9.7-10.7	140-155	368	2100	2.5	0.0067	1E793327082

## Educational Services

For information on available courses for Fisher 644 and 645 pump governors, as well as a variety of other products, contact:

Emerson Process Management  
Educational Services - Registration  
P.O. Box 190  
Marshalltown, IA 50158-2823  
Phone: 800-338-8158 or 641-754-3771  
FAX: 641-754-3431  
e-mail: education@emerson.com

Figure 2. Typical Pump Governor Sectionals



### **⚠ WARNING**

These governors must be installed, operated, and maintained in accordance with Fisher instructions and all applicable federal, state, and local codes, laws, rules and regulations.

If a leak develops in the system or if any of the equipment is damaged, service is required. Failure to investigate problems immediately may cause a hazardous condition.

Call a serviceman in case of trouble. Only a qualified person must install or service the actuator.

## Installation

### **⚠ WARNING**

Always wear protective gloves, clothing, and eyewear when performing any maintenance operations to avoid personal injury.

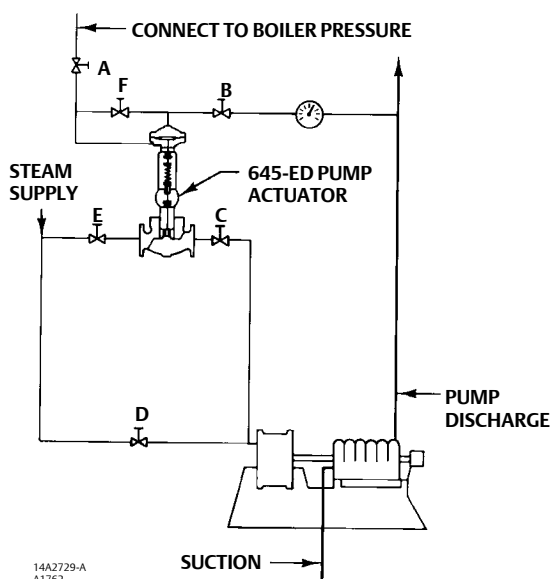
To avoid personal injury or property damage caused by bursting of pressure-retaining parts, be certain the service conditions do not exceed the casing pressure limit (maximum  $\Delta P$  across the diaphragm) of 13.8 bar (200 psi). Use pressure-limiting or pressure-relieving devices to prevent service conditions from exceeding this limit.

Check with your process or safety engineer for any other hazards that may be present from exposure to process media.

If installing into an existing application, also refer to the WARNING at the beginning of the Maintenance section in this instruction manual.

Normal operating temperature range for the 644 actuator is from -40 to 82°C (-40 to 180°F). For the 645 actuator, the range is from -37 to 82°C (-35 to 180°F).

Figure 3. Typical Installation for a Direct-Acting Governor

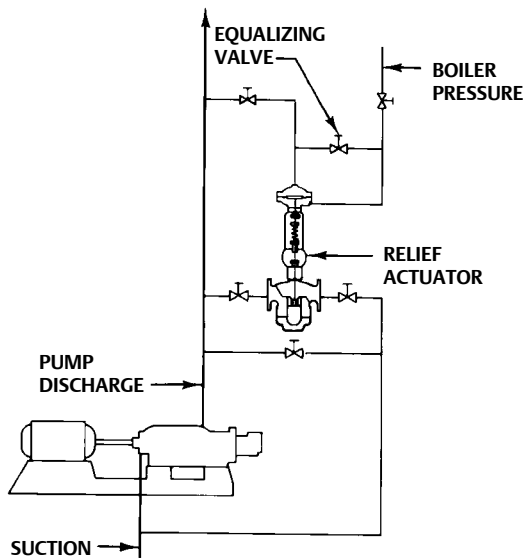


## Direct-Acting Actuators

Proceed as follows to install 644 and 645 actuators that are used with push-down-to-close valves (644-ED, 645-ED). Refer to figure 3.

1. Place the governor in the steam line between a hand operated throttle valve (C) and the steam inlet to the pump. The governor may be installed in any position, as long as the flow is in the direction of the arrow cast on the valve body. However, when used for steam service, the unit should be installed so condensate will drain back into the diaphragm casing and maintain a water seal on the diaphragm. Failure to do so may impact performance.
2. Install a hand-operated throttle valve (E) between the governor and the steam supply line.
3. Run a 1/4-inch control line from the upper diaphragm casing to the side or top of the pump discharge line. Keep the control line away from any nipple, swage, or elbow.
4. Install a lock-shield needle valve (B) and a pressure gauge in this control line.
5. Run a second 1/4-inch control line from the lower diaphragm casing to the boiler steam pressure line. Install a needle valve (A) in this line. Slope the line toward the actuator in order to form a water seal on the diaphragm.
6. Connect the two control lines with an equalizing line in which a needle valve (F) has been installed.

Figure 4. Typical Installation for a Relief Governor



14A2789-A  
A1763

## CAUTION

The equalizing line helps prevent damage to the diaphragm when the system is started up.

## Reverse-Acting Actuators

Proceed as follows to install 644 and 645 actuators that are used with push-down-to-open valves (644-EDR, 645-EDR).

Table 3. Maximum Static Casing Pressures

Diaphragm Casing Material		Cast Iron	Steel
Valve Body Ratings		CL125 and CL250	CL150, CL300 and CL600
Actuator	644	300 psig	600 psig
	645	500 psig	1000 psig

1. Place the governor in the steam line. It may be installed in any position as long as the flow is in the direction of the arrow cast on the valve body. However, when used for steam service, the unit should be installed so condensate will drain back into the diaphragm casing and maintain a water seal on the diaphragm. Failure to do so may impact performance.
2. Run a bypass line from the pump's discharge line to the suction line of the pump. In this line, install a hand-operated throttle valve (D).
3. Run a 1/4-inch control line from the upper diaphragm casing to the pump discharge line. Install a needle valve (B) in this line.
4. Extend a second 1/4-inch control line from the lower diaphragm casing to the boiler steam pressure line. Place a needle valve (A) in this line.
5. Connect the two control lines with an equalizing line in which a needle valve (F) has been installed.

## Overpressure

### WARNING

Overpressuring any portion of this equipment may cause damage to the governor parts, leaks in the system, or personal injury due to bursting of pressure-containing parts.

To avoid overpressure, provide an appropriate overpressure protection device to ensure that none of the limits listed in table 3 will be exceeded.

Check the system for damage after any overpressure condition.

## Startup

Proceed as follows **to start up direct-acting actuators** (644-ED, 645-ED). See figure 3.

1. Close all valves except the bypass valve (D).
2. Open the equalizing valve (F).
3. Open the needle valve (B) in the pump discharge line approximately 1/2 turn.
4. Open needle valve (A) in the pressure control line and close equalizing valve (F).
5. Open valve (C) that is downstream of the governor. Close bypass valve (D).
6. Slowly open valve (E) which is upstream of the governor.
7. To increase the discharge pressure, if it is too low, turn the lower spring seat (key 19, figures 6 and 7) clockwise into the yoke.
8. If the discharge pressure is too high, slightly open needle valve (B). If the pressure does not fall to the desired setting, turn the lower spring seat counterclockwise out of the yoke.
9. Open or close the lock-shield needle valve (B) to a point where a very slight movement of the valve stem (approximately 1/64-inch) is noticeable with each stroke of the pump. Greater stem movement will result in erratic operation and shorten the life of the diaphragm.

**To start up reverse-acting actuators** (644-EDR, 645-EDR) proceed as follows. See figure 4.

1. Close all valves except the bypass valve (D).
2. Open the equalizing valve (F).
3. Open valve (A) that is in the boiler pressure control line.
4. When the pump has built up the discharge pressure, open valve (B) that is in the discharge pressure control line. Close equalizing valve (F).
5. Valve (C), downstream of the governor, should now be opened. Close bypass valve (D).
6. Slowly open upstream valve (E).
7. To increase the discharge pressure if it is too low, turn the lower spring seat (key 19, figures 6 and 7) clockwise into the yoke.
8. If discharge pressure is too high, slightly open equalizing valve (F). If the pressure does not fall low enough, turn the lower spring seat counterclockwise out of the yoke.
9. Open or close valve (B) to a point where very slight movement (approximately 1/64-inch) of the stem is noticeable with each stroke of the pump. Greater stem movement will result in erratic operation and shorten the life of the diaphragm.

## Adjustment

No adjustment is required other than that described in the procedure for putting the governor into operation. If it is necessary to change the setting, turn the lower spring seat clockwise into the yoke to increase the pressure setting. Turn the lower spring seat counterclockwise, out of the yoke, to decrease the pressure setting.

## Principle Of Operation

Figure 3 shows a 645-ED being used to directly maintain a differential setting between the pump discharge pressure and the boiler steam pressure in a boiler feedwater system.

If pump discharge pressure increases, the change is registered on the top of the actuator diaphragm. The increased pressure forces the diaphragm and valve plug downward. With the steam supply thus restricted, less steam reaches the pump. This causes the discharge pressure to drop so that a difference between the discharge pressure and the boiler pressure will return to the desired differential setting.

In figure 4, a 644-EDR is being used as a relief governor maintaining a differential pressure between the boiler and pump discharge.

An increase in the pump discharge pressure is registered on the top of the actuator diaphragm. The increased pressure forces the diaphragm and valve plug downward. Since this governor is reverse-acting, this action opens the valve and allows the excess pump discharge to flow to the pump suction line. The pump discharge pressure drops and the difference between the boiler pressure and the pump discharge pressure returns to the desired level.

## Maintenance

Actuator parts are subject to normal wear and must be inspected and replaced when necessary. The frequency of inspection and replacement depends on the severity of service conditions.

### WARNING

**Avoid personal injury or property damage from sudden release of process pressure or bursting of parts. Before performing any maintenance operations:**

- Do not remove the actuator from the valve while the valve is still pressurized.
- Always wear protective gloves, clothing, and eyewear when performing any maintenance operations to avoid personal injury.
- Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.
- Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure from both sides of the valve. Drain the process media from both sides of the valve.
- Vent the power actuator loading pressure and relieve any actuator spring precompression.
- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.
- The valve packing box may contain process fluids that are pressurized, *even when the valve has been removed from the pipeline*. Process fluids may spray out under pressure when removing the packing hardware or packing rings, or when loosening the packing box pipe plug.
- Check with your process or safety engineer for any other hazards that may be present from exposure to process media.

### WARNING

**To avoid personal injury and equipment damage, isolate the pump governor from all pressure before beginning disassembly. The pump governor can be isolated by throttling valve (D) and closing the shut-off valves (A, B, C, and E).**

## Disassembly

Refer to figures 6 and 7.

1. Remove the control line from the upper casing.
2. Relieve spring compression by turning the lower spring seat (key 19) clockwise into the yoke.
3. Disconnect the stem (key 22) and the diaphragm rod (key 14) by unscrewing the locknuts (key 31).

### CAUTION

**To avoid damage to the valve plug and seating surface, do not turn the stem while the valve plug is seated.**

4. Unscrew hex nuts (key 9) and remove the packing box flange (key 7) and the packing follower (key 6).
5. Remove cap screws (key 23) and hex nuts (key 24) and lift off the upper diaphragm casing (key 1).
6. Lift off the upper diaphragm head (key 29). Pull the diaphragm (key 3), lower diaphragm head (key 13), and the diaphragm rod (key 14) out of the lower diaphragm casing (key 2). (A travel stop or washer, key 17, figure 6, may also be present between the lower diaphragm head and locknut.) Do not change the position of the lower diaphragm head and locknut (key 15) on the diaphragm rod because they are set to give the proper clearance for valve travel.
7. With a wire hook, pull the packing (key 11, figure 6; key 12, figure 7) from the bottom of the lower diaphragm casing. Remove the spacer (key 5) and the upper piece of packing (key 12, figure 6; key 11, figure 7) in the same manner.

## Reassembly

### Note

Bearings and adjusting screw threads should be lubricated with anti-seize prior to the reassembly steps below.

### 644 (figure 6)

1. Install packing onto the diaphragm rod (key 14) from the bottom of the lower diaphragm casing (key 2) in the following order:

For PTFE packing:

- a. Bushing (key 10, if previously removed), packing spring (key 5), special washer (key 37), male adaptor (key 28), packing rings (key 12, 3 required), female adaptor (key 38), packing follower (key 6) and felt wiper ring (key 39.)

For graphite packing:

- a. Bushing (key 10, if previously removed), packing ring (key 11), packing ring (key 12, with zinc washer), packing ring (key 11), lantern ring (key 5), packing ring (key 11), packing ring (key 12, with zinc washers between, 2 each required), packing ring (key 11) and packing follower (key 6).
2. Replace the packing flange (key 7.)



3. Lubricate the packing flange studs (key 8) and the faces of the packing flange nuts (key 9) and install the packing flange nuts (torque: 26 lbf•in for PTFE, 53 lbf•in for graphite.)
4. Place a new diaphragm (key 3) on the lower diaphragm head (key 13).
5. Put the upper diaphragm head (key 29) onto the diaphragm. Set the upper diaphragm casing (key 1) onto the lower casing, lubricating and tightening the diaphragm casing cap screws (key 23) and hex nuts (key 24) finger-tight only.
6. Reconnect the connecting rod (key 22) and the diaphragm rod.
7. Turn the lower spring seat counterclockwise out of the yoke to remove slack from the diaphragm. Torque the diaphragm casing cap screws and nuts to the following:
  - a. Size 1: 29 lbf•ft.
  - b. Sizes 2 and 3: 67 lbf•ft.

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**Note**

For 644 reverse-acting, travel stops (key 17) are required to be installed between the lower diaphragm head and the hex jam nut (key 15.) See the Parts List for the type and quantity of travel stops required for each actuator size.

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## 645 (figure 7)

1. Install packing onto the diaphragm rod (key 14) from the bottom of the lower diaphragm casing (key 2) in the following order:

**For PTFE packing:**

- a. Packing box ring (key 10, if previously removed), packing spring (key 5), special washer (key 28), packing set (key 11), and packing follower (key 6).

**For graphite packing:**

- a. Packing box bushing (key 10, if previously removed packing ring (key 11), packing ring (key 12, with zinc washer), packing ring (key 11), lantern rings (key 5, 2 required), packing ring (key 11), packing rings (key 12, with zinc washers between, 2 each required), packing ring (key 11) and packing follower (key 6).
2. Replace the packing flange (key 7.)
3. Lubricate the packing flange studs (key 8) and the faces of the packing flange nuts (key 9) and install the packing flange nuts (torque: 58 lbf•in for PTFE, 122 lbf•in for graphite.)
4. Place a new diaphragm (key 3) on the lower diaphragm head (key 13).
5. Put the upper diaphragm head (key 29) onto the diaphragm. Set the upper diaphragm casing (key 1) onto the lower casing, lubricating and tightening the diaphragm casing studs (key 23) and hex nuts (key 24) finger-tight only.
6. Reconnect the connecting rod (key 22) and the diaphragm rod.
7. Turn the lower spring seat counterclockwise out of the yoke to remove slack from the diaphragm. Torque the diaphragm casing studs and hex nuts to 385 lbf•ft.

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**Note**

For 645 reverse-acting, two washers (key 17) are required to be installed as shown in figure 7.

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## Parts Ordering

Each actuator has a serial number stamped on the nameplate. Always mention this number when corresponding with your Emerson Process Management sales office regarding technical information or replacement parts. Also, reference the complete 11-character part number of each needed part as found in the following Parts List.

### WARNING

**Use only genuine Fisher replacement parts. Components that are not supplied by Emerson Process Management should not, under any circumstances, be used in any Fisher valve, because they may void your warranty, might adversely affect the performance of the valve, and could cause personal injury and property damage.**

## Parts List

### Note

Recommended spare parts are included in the Parts Kits shown at the top of this page. For additional information or for part numbers not shown, contact your Emerson Process Management sales office.

Key	Description	Part Number	Key	Description	Part Number
			13	Lower Diaphragm Head	
			14	Diaphragm Rod	
			15	Hex Jam Nut	
			16	Yoke Lock Nut	
			17	Travel Stops	
				644 Reverse-Acting	
				Size 1, washer (2 req'd)	
				Size 2, washer (1 req'd)	
				Size 3, bearing retainer	
				645 Reverse-Acting	
				Washer (2 req'd)	
			18	Upper Spring Seat	
			19	Lower Spring Seat	
			20	Spring	
			21	Adjusting Screw	
			22	Connecting Rod	
			23	Cap Screw	
			24	Nut	
			25	Set Screw	
			26	Bearing Retainer	
			27	Pipe Plug	
				Lubricator	
				Lubricator/Isolating Valve	
			28*	Male Adaptor, PTFE	
				(with PTFE packing)	1F124801012
				Special Washer (645 with	
				PTFE packing)	1F125136042
			29	Upper Diaphragm Head	
			30	Bearing	
			31	Hex Nut	
			32	Hex Jam Nut	
			33	Name Plate	
			34	Drive Screw	
			35	Hex Nut	
			36	Needle Valve	
			37	Special Washer (644 with PTFE packing)	
			38*	Female Adaptor, PTFE (PTFE packing)	
				644 only	1F124401012
			39*	Wiper Ring, felt	
				644 only	1J872606332
			40	Nipple	
			41	Tee	
			42	Nipple	
			43	Union	
			44	Elbow	
			45	Nipple	
			47	Stem Disk	
1	Upper Diaphragm Casing				
2	Lower Diaphragm Casing				
3*	Diaphragm				
	Neoprene				
	644				
	Size 1	1F939502192			
	Size 2	1F939302192			
	Size 3	1F939602192			
	645	0F092802162			
	SST				
	644 only				
	Size 1	1J8430X0012			
	Size 2	1U5770X0012			
	Size 3	1H5791X0012			
4	Yoke				
5	Lantern Ring or Packing Spring				
6	Packing Follower				
7	Packing Box Flange				
8	Stud Bolt				
9	Hex Nut				
10*	Bushing, SST				
	644	1E943835012			
	Packing Box Ring, SST				
	645	1E839135012			
11*	Packing, 644 (4 req'd)				
	Graphite	1F3370X0322			
	Packing Ring, 645, (4 req'd)				
	Graphite	1E3190X0222			
	Packing Set, 645				
	PTFE	1R290201012			
12*	Packing, 644 (3 req'd)				
	Graphite	1V3160X0022			
	PTFE	1C752601012			
	Packing Ring, 645 (3 req'd)				
	Graphite	1V3802X0022			

Figure 5. Equalizing Piping Configuration

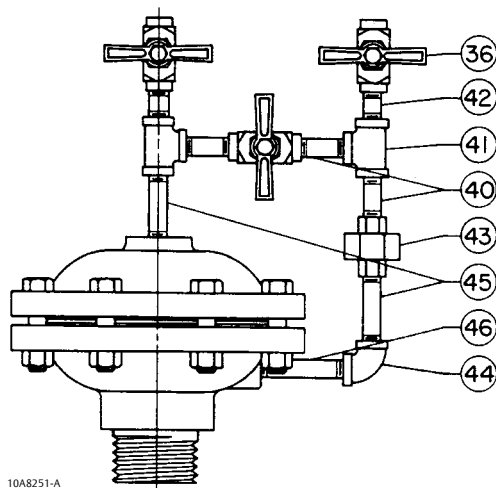


Figure 6. Fisher 644 Actuator Assembly

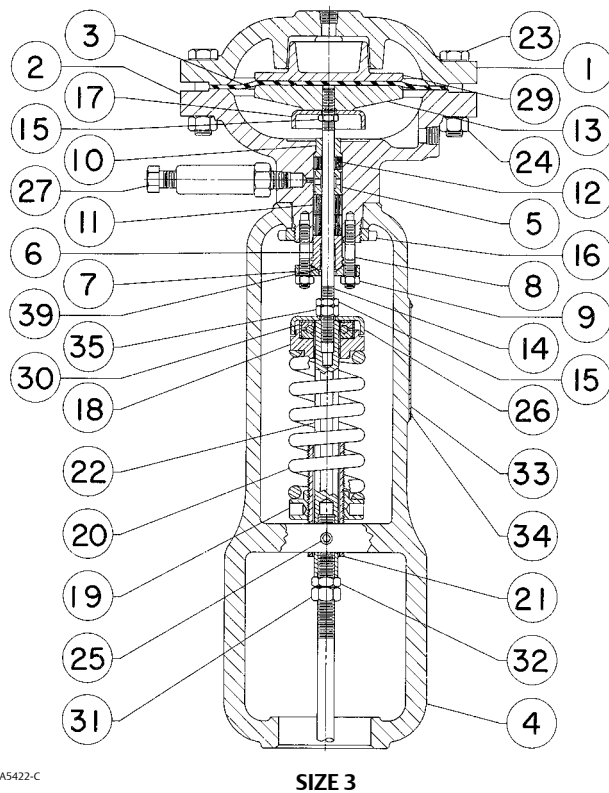
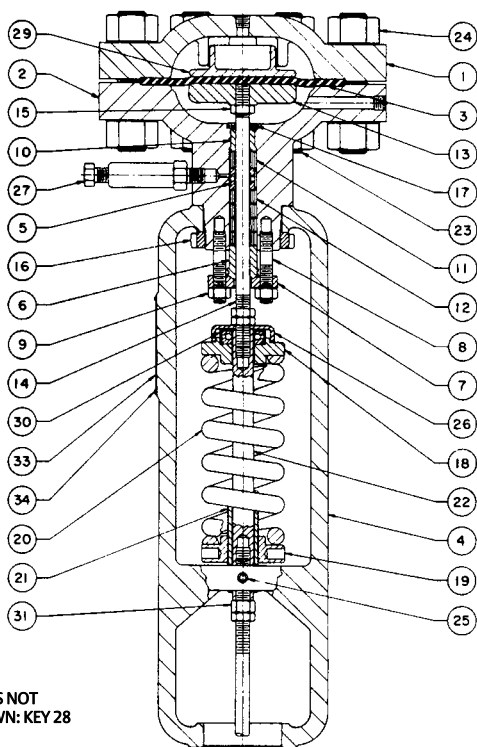


Figure 7. Fisher 645 Actuator Assembly



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