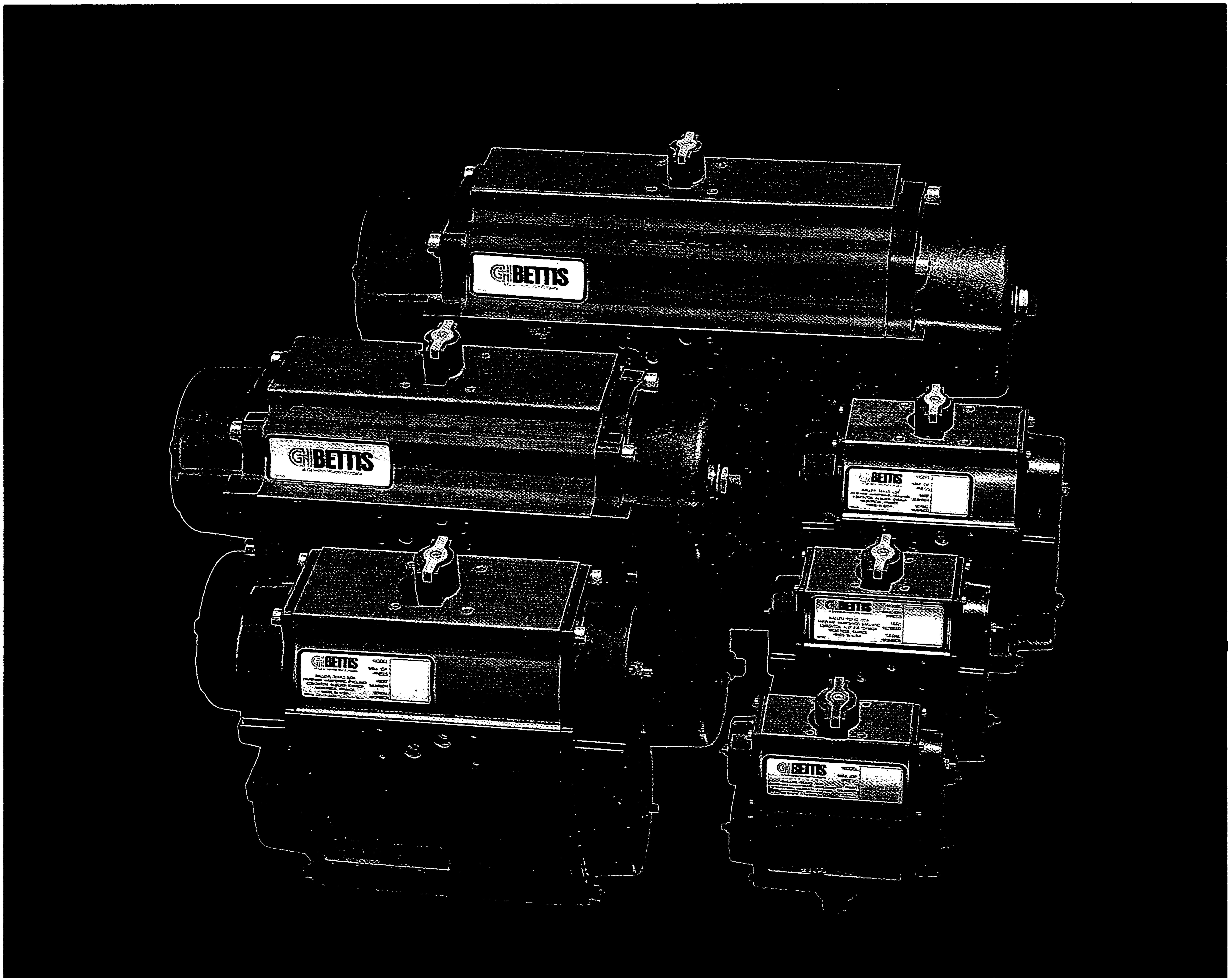
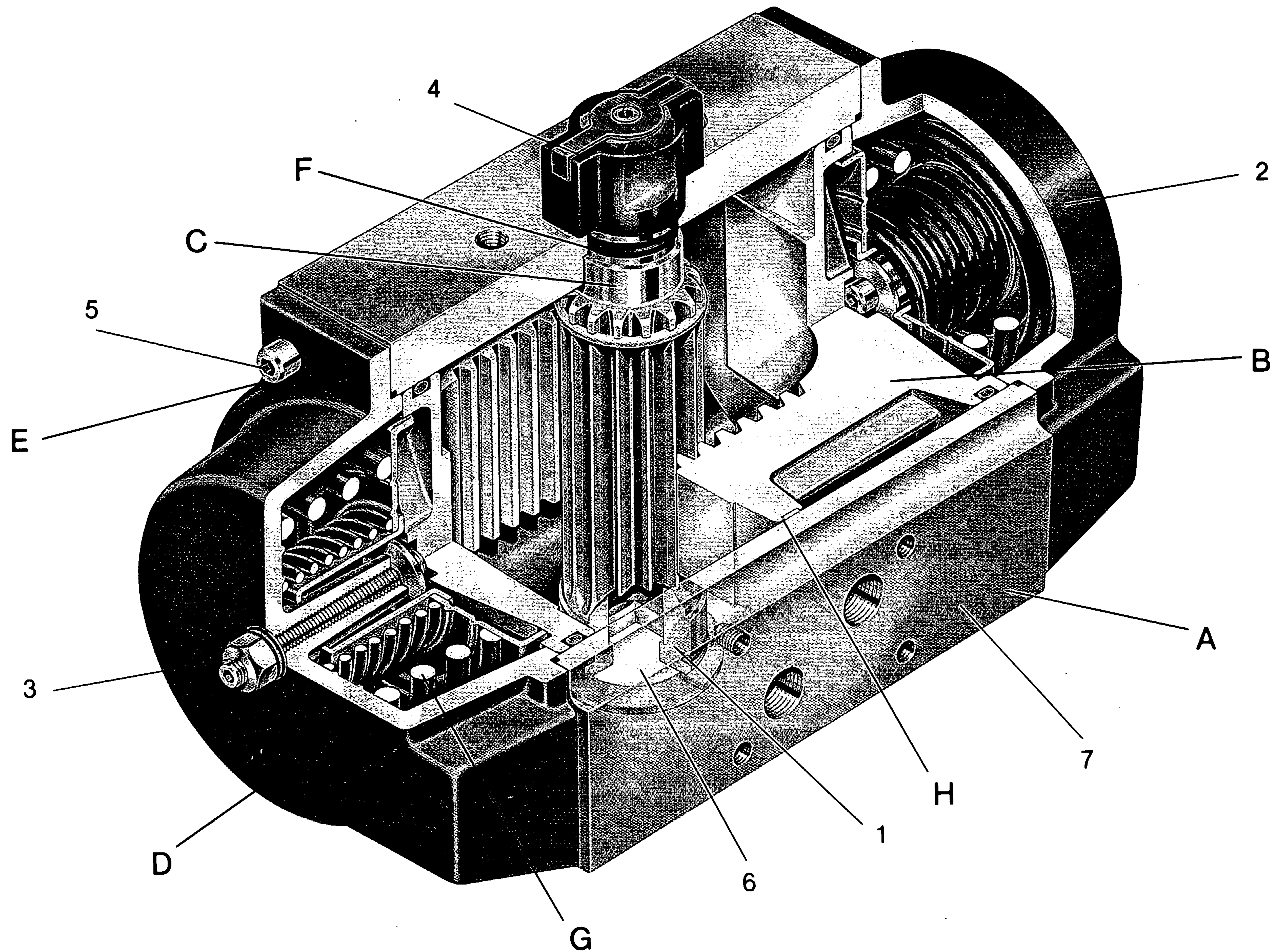


# RP-Series Pneumatic Actuators



# Design and Construction

## Models RP250-RP2250



### Mechanical Components

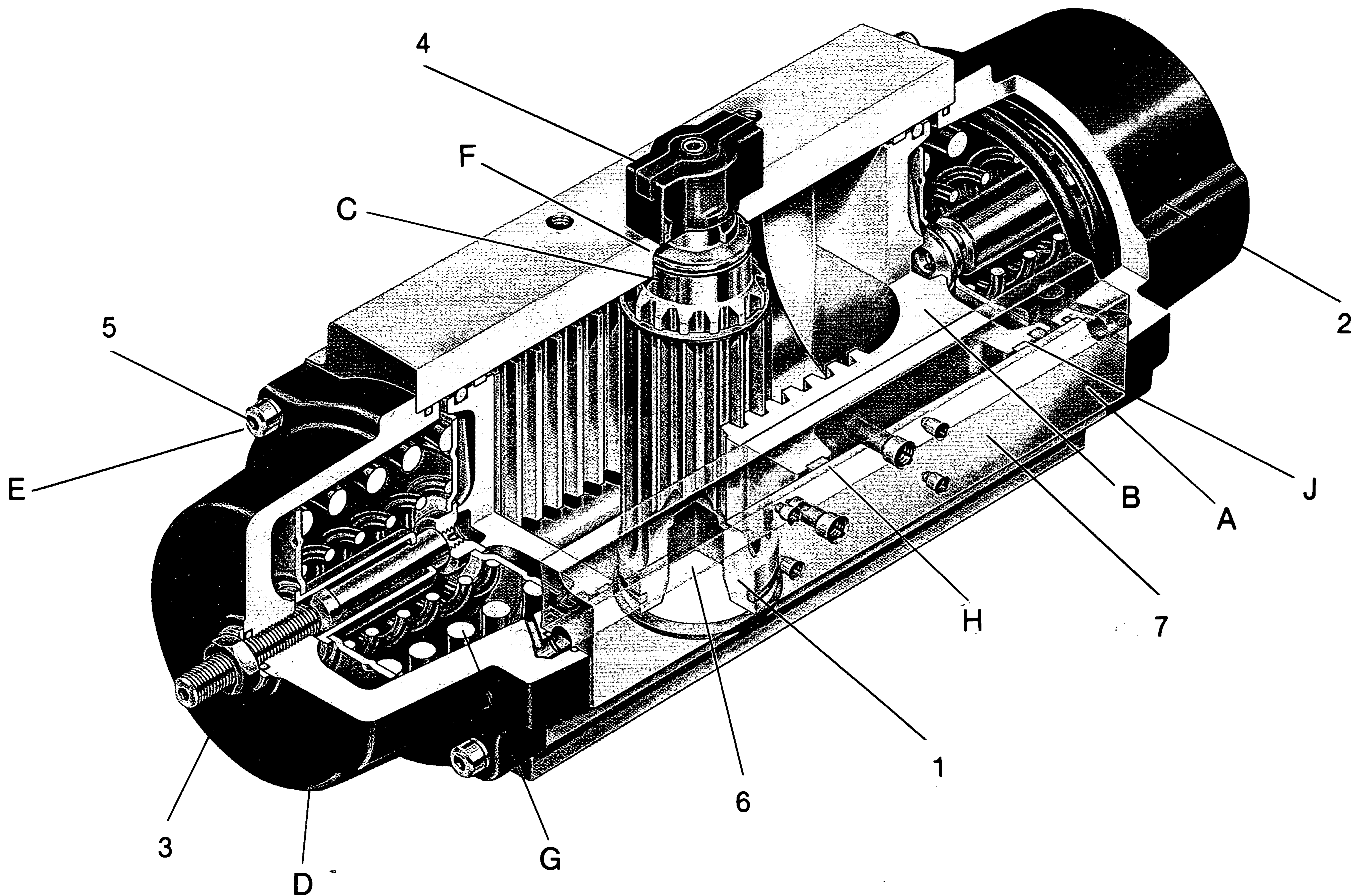
The Bettis RP-Series pneumatic rack & pinion actuators are specifically designed for "quarter-turn" rotating mechanisms and are ideally suited for operation of plug, butterfly, or ball valves. These quality constructed and uncomplicated actuators provide a dependable, reliable and economic method of opening and closing a valve.

Double-acting models, requiring pressure to rotate in both directions, are available with output torques to 16,500 lb-in. Spring-return models, requiring pressure to rotate in one direction, are available with spring ending output torques up to 5150 lb-in. Standard operating pressures are 40 to 120 PSIG. Operating media for both double-acting and

spring-return models may be dry or lubricated non-corrosive gas. Standard operating temperatures are from  $-40^{\circ}$  to  $+200^{\circ}$  Fahrenheit. Optional, high temperature trim is available for  $0^{\circ}$  to  $+350^{\circ}$  Fahrenheit. All models are factory lubricated for the optimum cycle life of the actuator. All actuators are constructed for indoor or outdoor installation.

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**Models: RP5000-RP11000**



**Features**

1. Bottom loaded, one piece blow-out proof output shaft, is retained by a safety redundant internal retaining ring.

2. Self-contained space saving spring modules allow safe and simple conversion from double-acting to spring-return or to a different spring configuration.

3. Integral position stops allow up to  $+/- 5$  degrees field adjustment at the 90 degree position.

4. Easily removable position indicator allows access to male output shaft and accessory mounting.

5. All fasteners are stainless steel.

6. Square female drive allows direct mount capability for a "low profile" valve actuator assembly.

7. Advanced UV resistant fluoropolymer impregnation of internal and external housing surfaces plus fluoropolymer coating on output drive shaft and end caps provides excellent hostile environment protection.

**Materials of Construction**

**A. Body:** Precision-extruded aluminum alloy, hard anodized and fluoropolymer impregnated.

**B. Pistons:** Cast aluminum alloy, dichromate dipped.

**C. Output Shaft/Pinion:** Carbon steel, fluoropolymer coated.

**D. End Caps:** Cast aluminum alloy, fluoropolymer coated.

**E. Fasteners:** All stainless steel.

**F. Seals:** Nitrile standard. Viton, optional.

**G. Springs:** Carbon steel, phosphate coated, oil dipped.

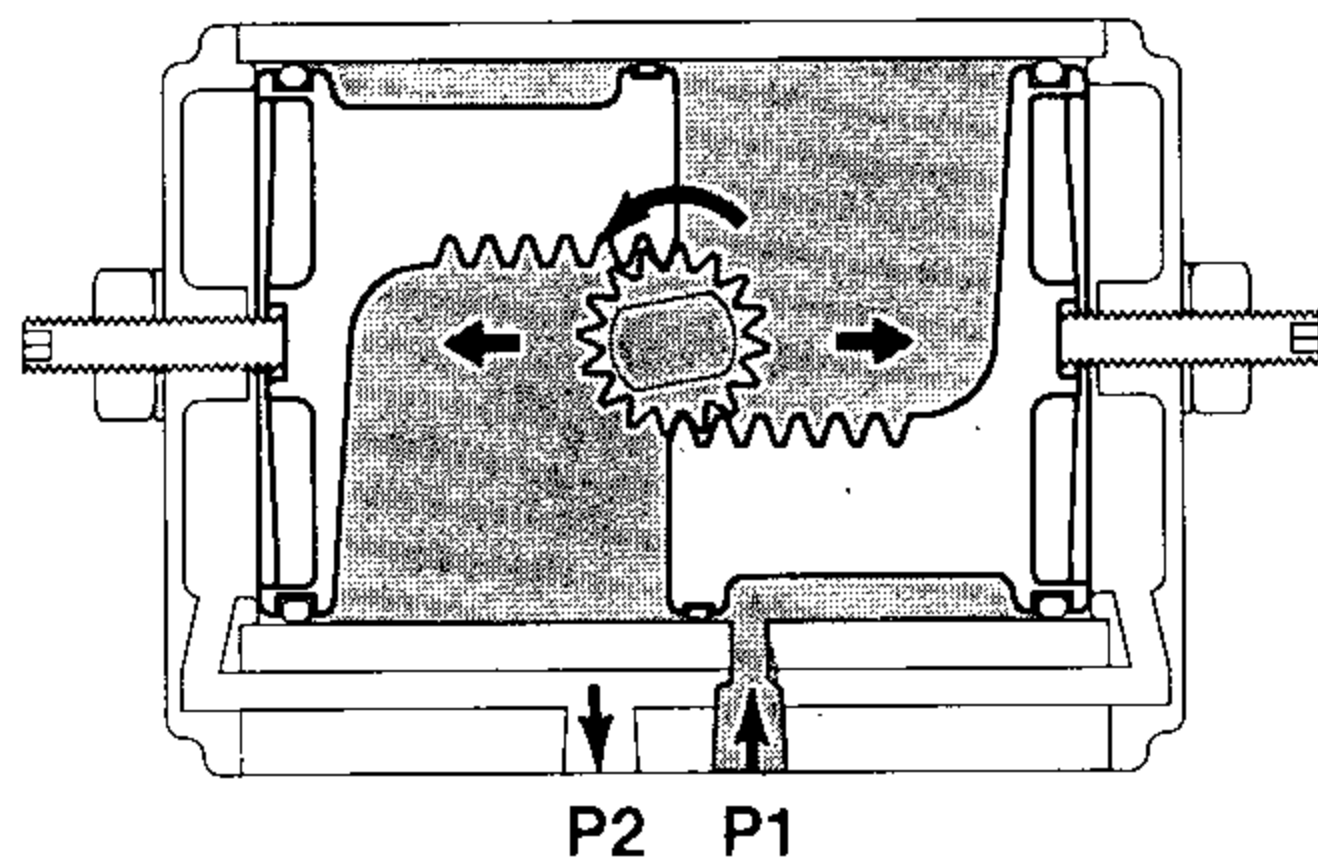
**H. Heel Bearing:** PEEK Alloy.

**J. Piston Bearing:** Fluoroplastic.

# Operation

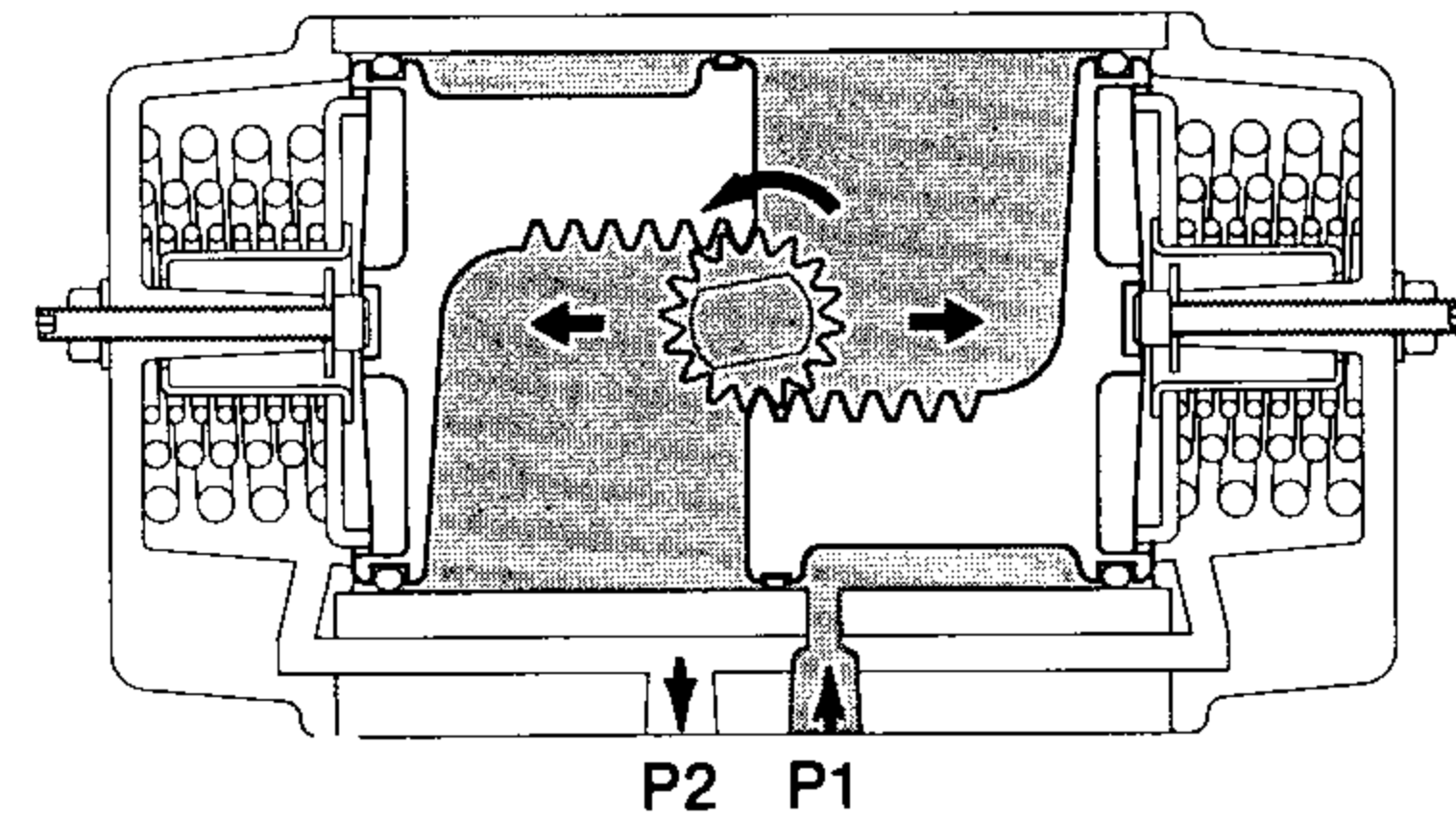
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**Double-acting**  
(TOP VIEW)

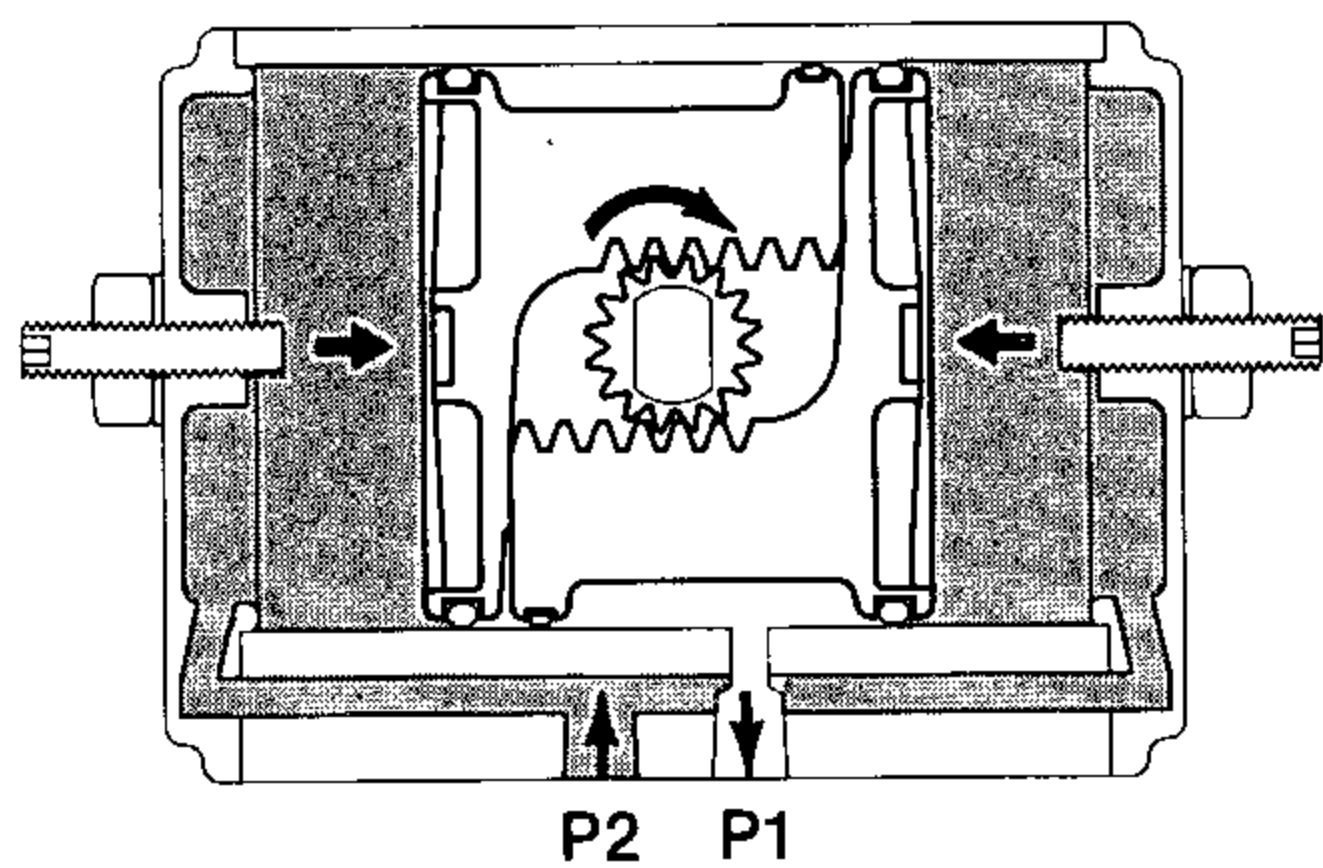


For counterclockwise output rotation, apply pressure to Port 1, which will force the pistons apart. The linear travel of the pistons is converted to a rotation of the drive shaft by the rack to pinion connection. The volume outside each piston is exhausted at Port 2.

**Spring Return**  
(TOP VIEW)



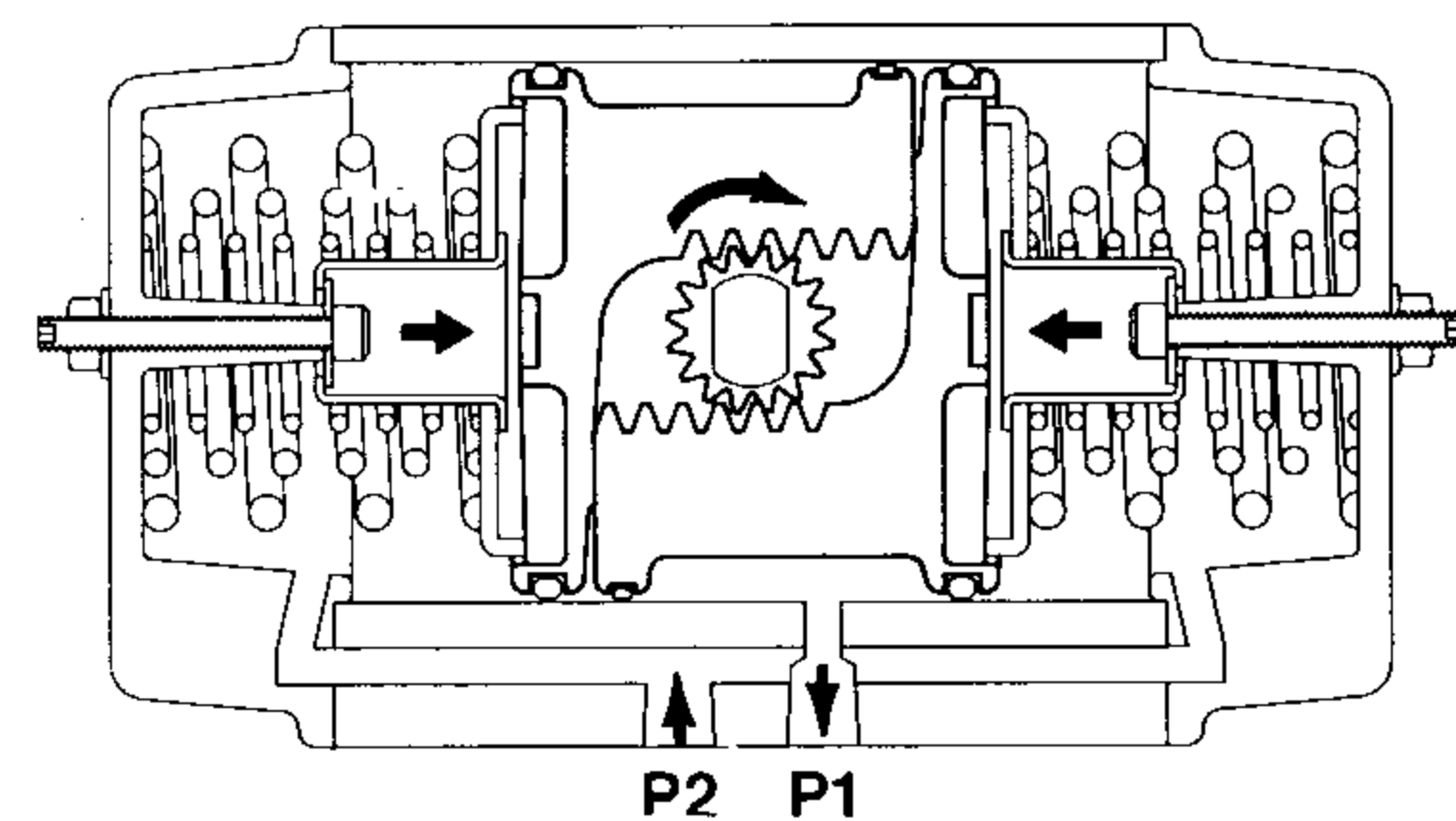
For counterclockwise output rotation, apply pressure to Port 1, which will force the pistons apart and compress the springs. The linear travel of the pistons is converted to a rotation of the drive shaft by the rack to pinion connection. The volume outside each piston is exhausted at Port 2.



For clockwise output rotation, apply pressure to Port 2, which will force the pistons to move together. The volume between the pistons is exhausted at Port 1.

## Reverse Rotation

When required, the pistons can be inverted in the housing resulting in a clockwise rotation when pressure is applied to Port 1.



For clockwise output rotation, the volume between the pistons is exhausted at Port 1, causing the springs to force the pistons together. The volume outside the pistons is vented at Port 2.

## Reverse Rotation

When required, the pistons can be inverted in the housing resulting in a clockwise rotation when pressure is applied to Port 1 and a counterclockwise rotation when Port 1 is vented.

## Travel Stop Adjustment

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Drive shaft rotation is limited to  $90^\circ$  plus or minus  $5^\circ$  by the stop screws located in each end cap which limit the pistons outward travel.

### Standard Assembly

Adjustment of the counterclockwise rotation limit is accomplished by rotating the stop screws to reduce or increase output rotation.

### Reverse Assembly

When required, the pistons can be inverted in the housing allowing travel stop adjustment of the clockwise output rotation.

# Typical Specifications

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The following information may be used as a guide to compile specifications for rack and pinion pneumatic actuators. GH-Bettis RP-Series actuators meet, or exceed, all the specifications stated below.

## 1.0 Bettis RP-Series Pneumatic Rack & Pinion Actuators

**1.1** The pneumatic actuator shall be quarter-turn, opposed piston rack and pinion type of a totally enclosed design with no external moving linkages.

**1.2** The actuator shall be capable of  $95\frac{1}{2}^{\circ}$  rotation and shall include external travel stops with a minimum of  $10^{\circ}$  adjustment.

**1.3** The actuator shall be rated for continuous operation using dry or lubricated non-corrosive gas and suitable for mounting in any position.

**1.4** Ambient temperature range shall be from  $-40^{\circ}\text{F}$  to  $+200^{\circ}\text{F}$ . For high temperature service, the actuator shall be rated from  $0^{\circ}\text{F}$  to  $+350^{\circ}\text{F}$ .

## 2.0 Construction

**2.1** Actuator housing shall be precision extruded aluminum, hard anodized with external and internal UV resistance fluoropolymer impregnation.

**2.2** Actuator shall be supplied with all stainless steel fasteners.

**2.3** The drive shaft and pinion shall be one piece steel, bottom loaded blowout-proof with a fluoropolymer coating and secured by non-exposed, redundant stainless steel retaining rings for safety.

**2.4** End caps shall be cast aluminum UV resistant fluoropolymer coated.

**2.5** Actuator shall incorporate internal porting to permit use of either direct mount or remote controls with a minimum of external tubing.

**2.6** Actuator shall be provided with a mechanical visual position indicator, easily removable to expose drive shaft to permit manual and accessory operation.

## 3.0 Design

**3.1** Double-acting and spring-return models shall be offered and field convertible by only the replacement of end caps or spring module assemblies.

**3.2** All spring module assemblies must be of self contained field service safe design.

**3.3** Spring design shall allow safe conversion of spring modules to fit application requirements.

**3.4** Special tools shall not be required to adjust or accomplish field conversions.

**3.5** There shall be no bearing area outboard of the pressure containing or weather seals.

**3.6** Use of self-threading or thread forming fasteners shall be strictly prohibited.

**3.7** Actuator must not incorporate any metal-to-metal pressure seals.

**3.8** All springs must be shot peened and corrosion protected to ensure maximum cycle life.

**3.9** Actuator shall be field reversible to provide  $\pm 5^{\circ}$  travel adjustment at outboard end of travel and non-adjustable  $\frac{1}{2}^{\circ}$  nominal over travel in opposite direction.

**3.10** Full tooth engagement, at the pitch line, shall be maintained throughout full range of travel minimizing potential tooth failure.

## Materials of Construction

**A. Body:** Precision-extruded aluminum alloy, hard anodized and fluoropolymer impregnated.

**B. Pistons:** Cast aluminum alloy, dichromate dipped.

**C. Output Shaft/Pinion:** Carbon steel, fluoropolymer coated.

**D. End Caps:** Cast aluminum alloy, fluoropolymer coated.

**E. Fasteners:** All stainless steel.

**F. Seals:** Nitrile standard.

Viton, optional.

**G. Springs:** Carbon steel, phosphate coated, oil dipped.

**H. Heel Bearing:** PEEK Alloy.

**J. Piston Bearing:** Fluoroplastic.

# Sizing Information

The following is designed to aid in correctly selecting GH-Bettis Rack and Pinion Actuators.

Accurate valve torques must be determined at extremes and intermediate valve positions, valve size and type, as application requirements including differential pressure, media, temperature, and the valve manufacturers suggested safety factor affect required torque at specific valve positions and direction of travel.

## For Double-Acting

Using the minimum operating pressure available at the actuator's installed location, select a column from the Torque Rating Chart of less than, or equal pressure. Look down the column until an output torque is selected which is greater than the valve's maximum operating requirement. Determine the correct actuator model number which appears on the same line as the selected output torque.

## For Spring-Return

The valve's maximum torque requirement at specific positions and direction of travel must be

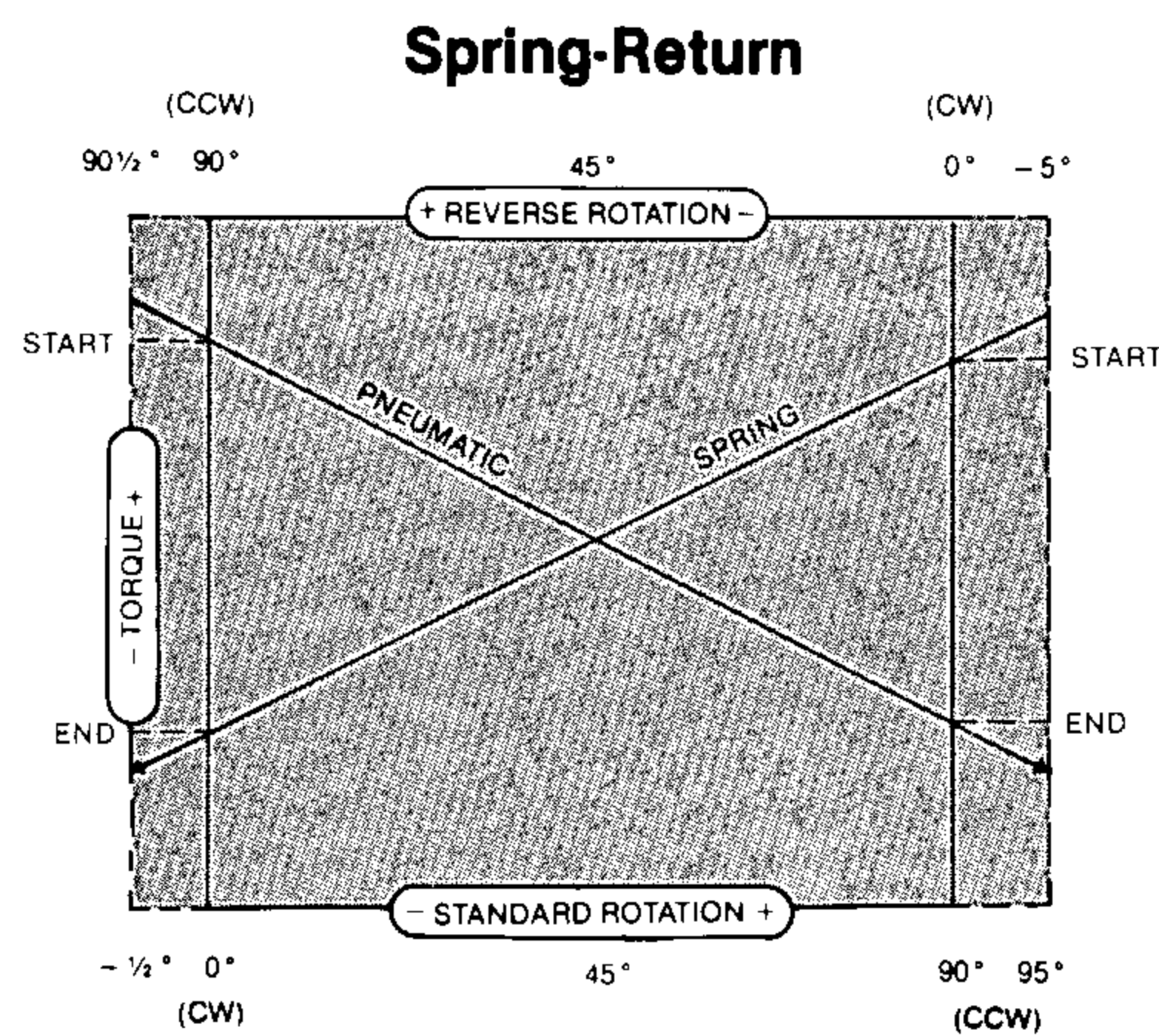
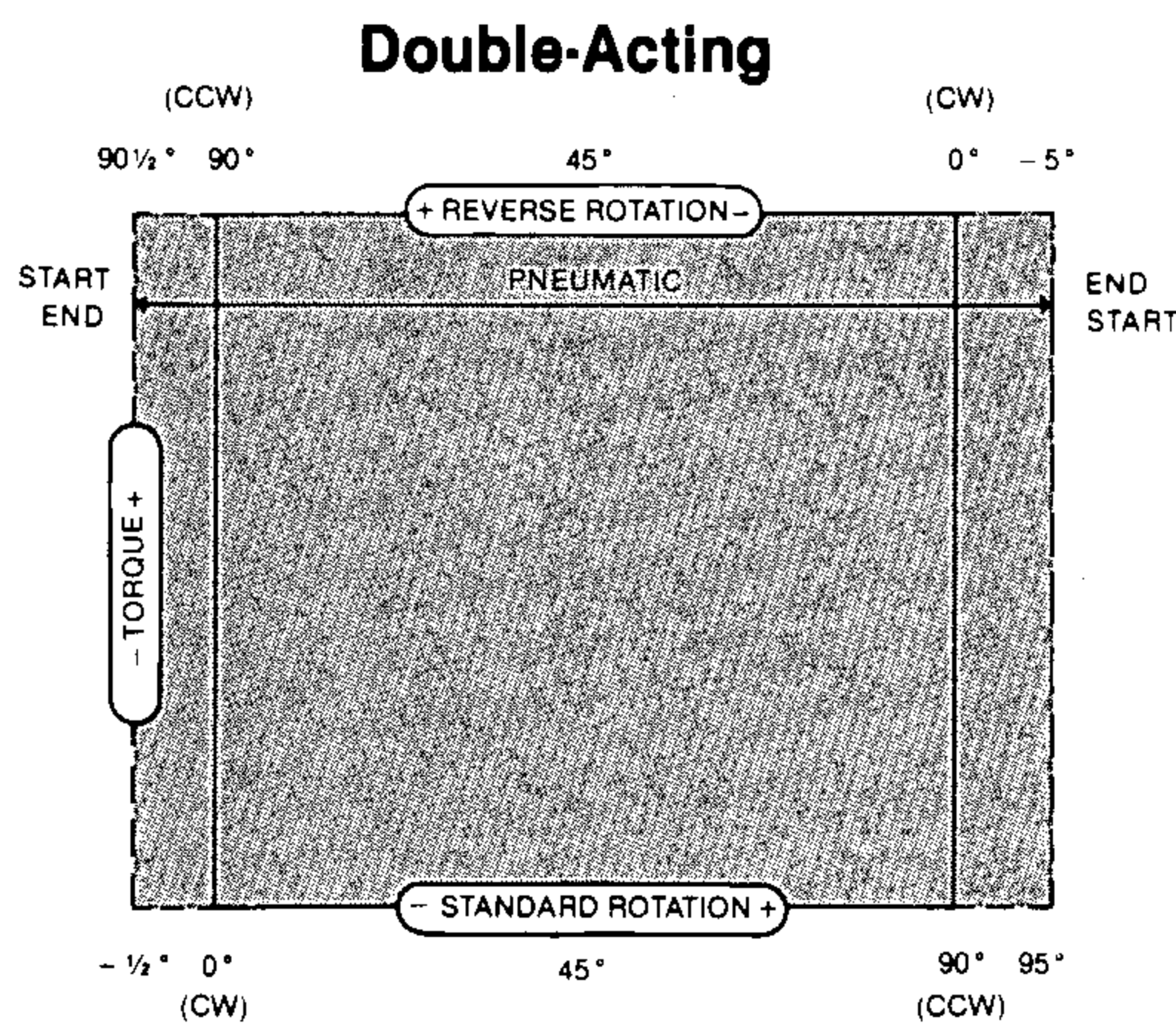
exceeded by the actuator's spring start, end, air start, and end, as appropriate.

## On-Off Fail-Closed Applications

1. Select appropriate actuator spring end and air start torque for maximum valve seating and break torque requirements respectively.
2. Select spring start and air end torque for maximum valve torque requirement at full open position.
3. Compare spring start torque to maximum valve stem allowable torque.

## On-Off Fail-Open Applications

1. Select appropriate actuator spring start and air end torque for maximum valve break and seating torque requirement respectively.
2. Select spring end and air start torque for maximum valve torque requirement at full open position.
3. Compare air start torque to maximum stem allowable torque. For modulating and other severe service applications minimum actuator torque 25% greater than valve torque requirement at all positions of travel is recommended.



# Torque Ratings

## Double-Acting Actuators

Model	Air Torque Output at Operating Pressure—Psig					
	Torque Unit	40	60	80	100	120
250	lb.-in.	125	187	250	312	375
450	lb.-in.	225	337	450	562	675
1000	lb.-in.	500	750	1000	1250	1500
2250	lb.-in.	1125	1687	2250	2812	3375
5000	lb.-in.	2500	3750	5000	6250	7500
11000	lb.-in.	5500	8250	11000	13750	16500

# Torque Ratings

## Spring-Return Actuators

Model Number		Torque Unit	Spring Torque Output		Air Torque Output at Operating Pressure—Psig									
Basic	Spring Set				40		60		80		100		120	
					Start	End	Start	End	Start	End	Start	End	Start	End
250	2	lb.-in.	69	45	76	47	138	109	201	172	263	234	326	312
	3	lb.-in.	104	67	—	—	113	70	176	133	229	195	301	258
	4	lb.-in.	140	90	—	—	88	31	151	93	213	156	276	218
	5	lb.-in.	175	112	—	—	—	—	126	54	189	116	251	179
	6	lb.-in.	209	135	—	—	—	—	—	—	164	77	227	139
450	2	lb.-in.	126	81	135	83	248	196	361	309	473	421	586	533
	3	lb.-in.	190	121	—	—	203	125	316	238	428	350	541	463
	4	lb.-in.	254	162	—	—	158	54	271	167	383	279	496	392
	5	lb.-in.	317	202	—	—	—	—	226	96	339	209	451	321
	6	lb.-in.	381	243	—	—	—	—	—	—	293	137	406	251
1000	2	lb.-in.	279	179	300	184	549	433	798	682	1048	931	1297	1181
	3	lb.-in.	418	270	202	48	449	278	698	526	947	775	1196	1025
	4	lb.-in.	559	360	—	—	350	120	599	371	848	618	1097	867
	5	lb.-in.	698	450	—	—	—	—	500	212	749	464	998	710
	6	lb.-in.	839	540	—	—	—	—	—	—	650	304	899	557
2250	2	lb.-in.	659	394	690	395	1253	958	1816	1521	2379	2084	2939	2647
	3	lb.-in.	990	590	—	—	1034	591	1596	1154	2159	1717	2722	2280
	4	lb.-in.	1320	787	—	—	816	226	1379	788	2029	1351	2505	1914
	5	lb.-in.	1650	984	—	—	—	—	1161	424	1724	984	2287	1549
	6	lb.-in.	1980	1181	—	—	—	—	—	—	1506	621	2069	1181
5000	2	lb.-in.	1560	785	1590	803	2780	1990	3970	3180	5160	4380	6350	5570
	3	lb.-in.	2340	1180	—	—	2380	1200	3570	2400	4760	3590	5960	4780
	4	lb.-in.	3130	1570	—	—	1980	414	3180	1600	4370	2800	5560	3990
	5	lb.-in.	3910	1960	—	—	—	—	2780	815	3970	2010	5160	3200
	6	lb.-in.	4690	2360	—	—	—	—	—	—	3570	1220	4760	2410
11000	2	lb.-in.	3400	1720	3460	1760	6060	4360	8660	6960	11300	9560	13900	12200
	3	lb.-in.	5100	2570	2600	49	5200	2650	7790	5240	10400	7840	13000	10400
	4	lb.-in.	6790	3430	—	—	4330	932	6930	3530	9520	6130	12100	8730
	5	lb.-in.	8490	4290	—	—	—	—	6060	1810	8660	4410	11300	7010
	6	lb.-in.	10200	5150	—	—	—	—	—	—	7790	2700	10400	5300

# Performance Data

**Operating Pressure Range:** 40 to 120 PSIG.

**\*\*\* Maximum Allowable Working Pressure:** 150 PSIG.

**Maximum Operating Pressure:** 120 PSIG.

**Operating Media:** Dry or lubricated non-corrosive gas.

**Operating Temperature:**

Standard: -40°F to +200°F

Optional: 0°F to +350°F

Double Acting Actuator				
Model	Volume Cu. In.**		Weight lb.	Opr. Time* seconds
	cw.	ccw.		
250	12.0	13.3	3	0.2
450	20.5	24.2	4.2	0.4
1000	45.4	55.8	7.7	0.9
2250	95.6	118.6	15.5	1.8
5000	228.8	205.6	41	1.8
11000	464.3	477.0	82	3.8

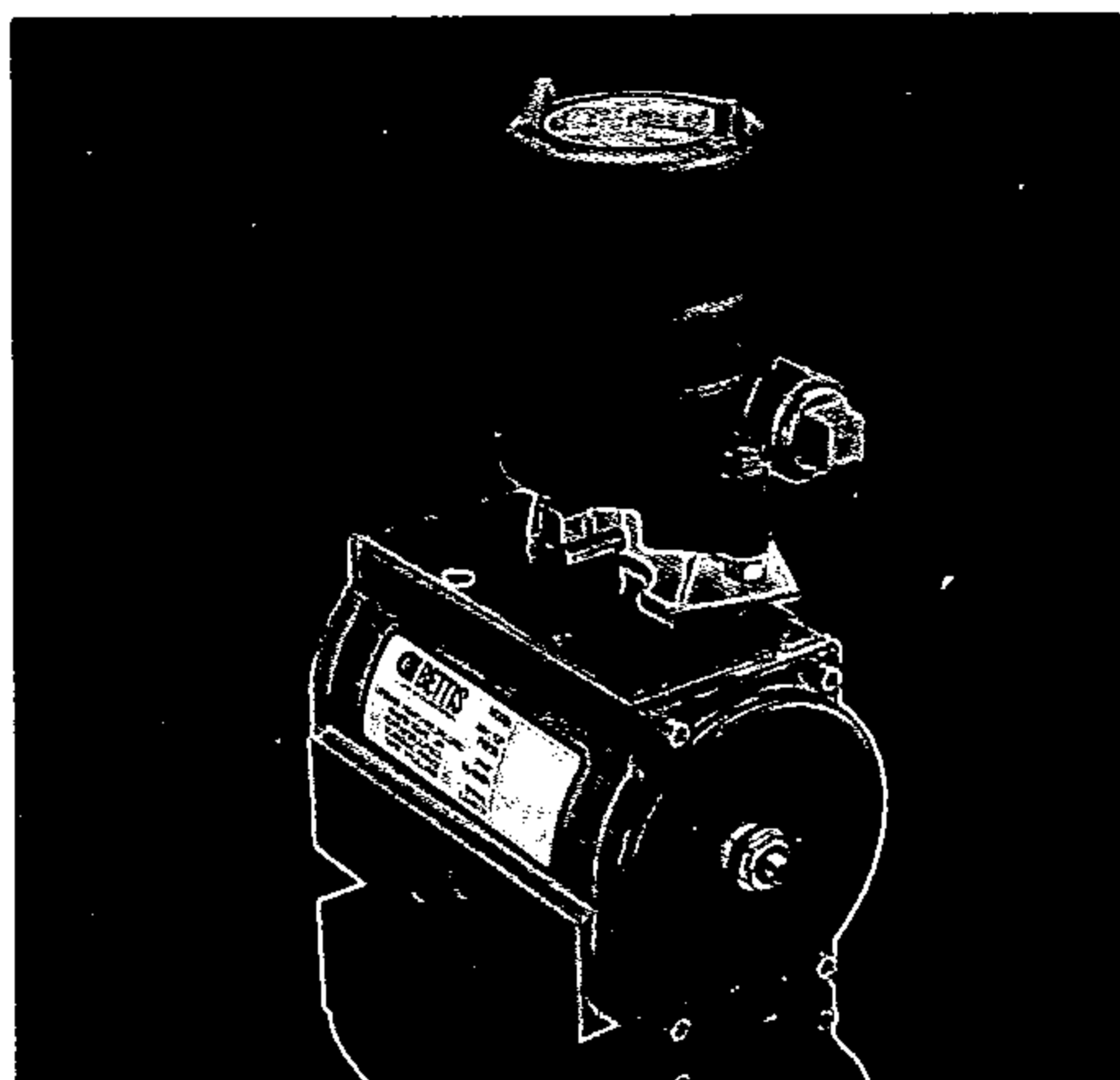
Spring Return Actuator				
Model	Volume cu. in.**	Weight lb.	Opr. Time Seconds	
			Spring	Gas
250SR	13.3	3.4	0.6	0.4
450SR	24.2	5.5	1.1	0.6
1000SR	55.8	10.7	2.4	1.4
2250SR	118.6	20	2.9	5.5
5000SR	205.6	68	1.0	1.3
11000SR	477.0	127	2.1	3.0

\*For one 90° operation with BettiSolenoid—no load.

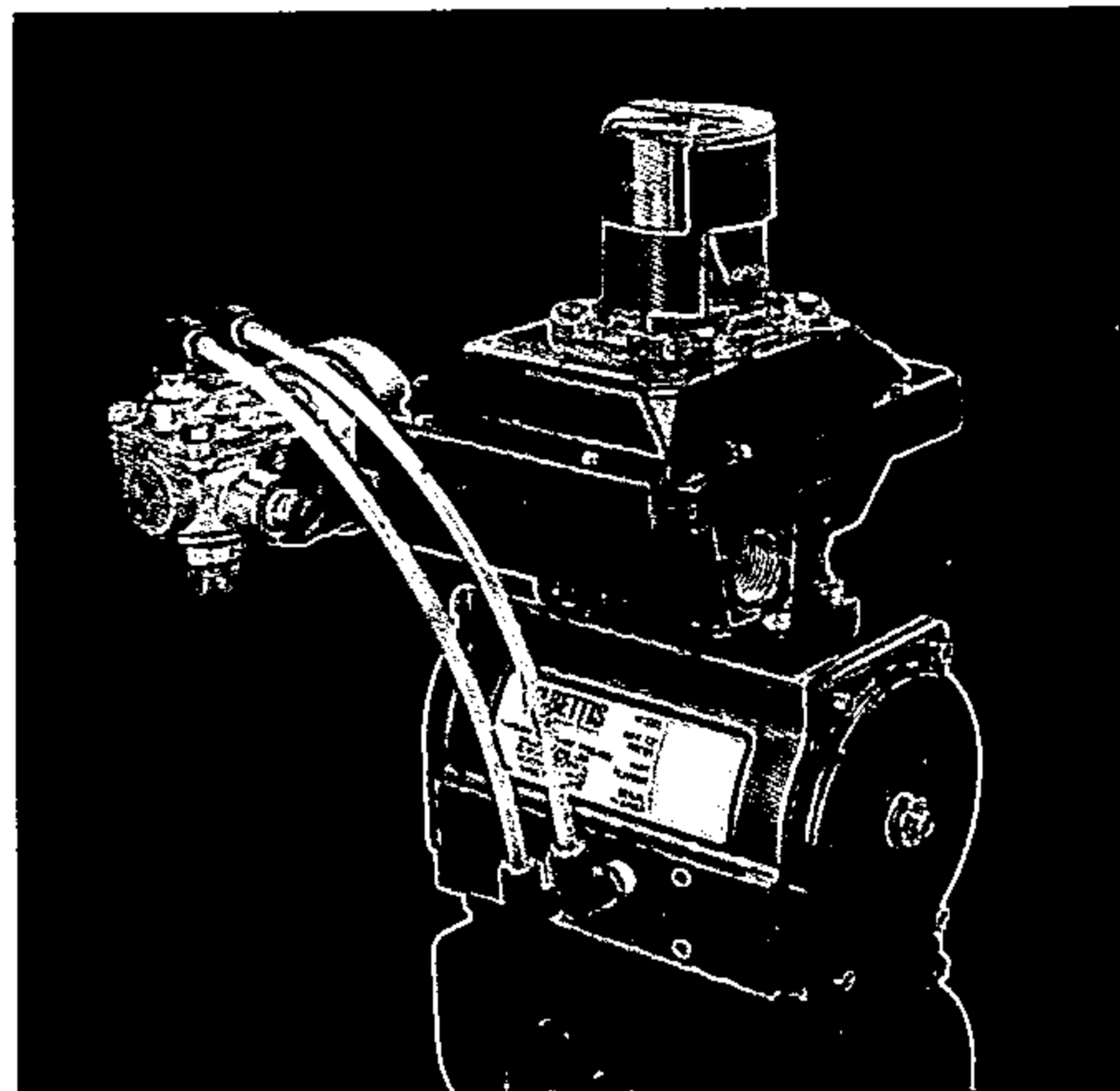
\*\*Displacement plus cavity.

\*\*\*Maximum pressure allowed on the actuator under operating conditions at the stop position.

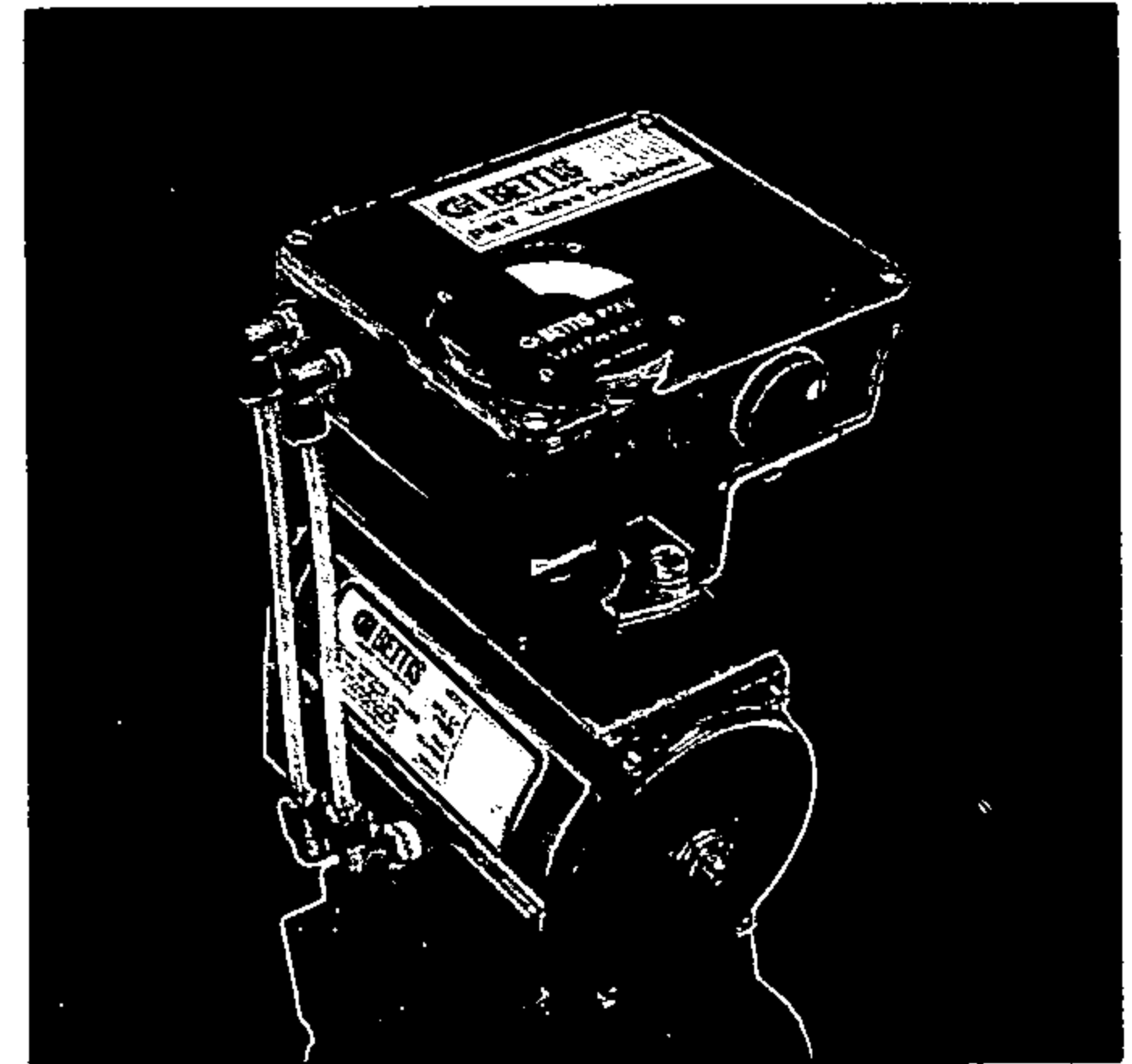
## Optional Accessories



**BettiSwitch:** offered in two configurations, the 3R and 5R, with individually adjustable switches capable of power or logic interface. BettiSwitch is UL, CSA or CENELEC listed for NEMA 1, 3, 4, 7 and 13 applications. REFERENCE BULLETIN NO. 90.10.

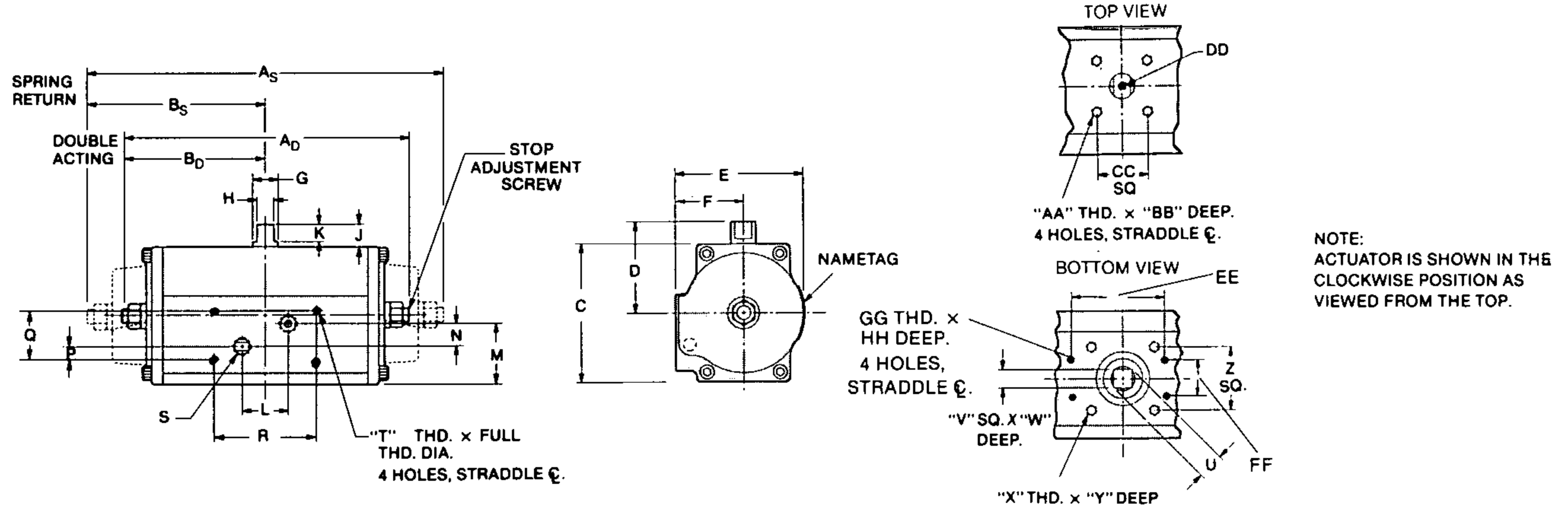


**IC Series:** Integrated system for controlling and monitoring valve operation. The IC-Series consolidates the valve actuator, position monitor, solenoid, limit switches and junction box into a single package with UL and CSA listed components. Available for NEMA 4, 7 and 9 listed applications. REFERENCE BULLETIN NO. 25.50-1.



**Betti/PMV Positioner:** Low air consumption, high accuracy positioners for single-acting or double-acting applications suitable for pneumatic or electro-pneumatic analog inputs. REFERENCE BULLETIN NO. 90.60.

# Dimensions



## Mounting Dimensions

Model	R	S	T Thd.	U min.	V min.	W	X Thd.	Y	Z	AA Thd.	BB	CC	DD	EE	FF	GG	HH	
250	in.	2.992	1/8 NPT	10-24 unc	.561	.433	1.08	1/4-20 unc	.35	1.392	10-24 unc	.28	1.57	m 5 x 0.8	3.25	1.17	1/4-20 unc	.35
450	in.	2.992	1/8 NPT	10-24 unc	.722	.551	1.08	1/4-20 unc	.35	1.392	10-24 unc	.28	1.57	m 5 x 0.8	3.25	1.17	1/4-20 unc	.35
1000	in.	2.992	1/4 NPT	10-24 unc	.996	.748	1.09	5/16-18 unc	.47	1.949	5/16-18 unc	.31	2.25	m 5 x 0.8	4.31	1.75	5/16-18 unc	.38
2250	in.	2.992	1/4 NPT	10-24 unc	1.155	.866	1.57	3/8-16 unc	.59	2.840	5/16-18 unc	.31	2.25	m 5 x 0.8	4.31	1.75	5/16-18 unc	.38
5000	in.	2.992	1/4 NPT	10-24 unc	1.320	1.063	1.38	1/2-13 unc	.75	3.480	5/16-18 unc	.31	2.25	m 5 x 0.8	10.00	3.48	1/2-13 unc	.75
11000	in.	2.992	1/4 NPT	10-24 unc	1.790	1.418	1.77	5/8-11 unc	.94	3.896	5/16-18 unc	.31	2.25	m 5 x 0.8	10.00	3.89	5/8-11 unc	.94

## General Dimensions

Model	A <sub>b</sub>	A <sub>s</sub>	B <sub>b</sub>	B <sub>s</sub>	C	D	E	F	G	H	J	K	L	M	N	P	Q	
250	in.	6.26	7.25	3.13	3.62	3.03	2.00	2.83	1.50	.56	.374	.48	.38	.98	1.33	.50	.281	1.062
450	in.	6.78	7.75	3.39	3.87	3.78	2.37	3.50	1.81	.56	.374	.48	.38	.98	1.39	.50	.281	1.062
1000	in.	8.69	9.75	4.34	4.87	4.72	3.03	4.43	2.38	.94	.625	.67	.50	.98	1.52	.50	.281	1.062
2250	in.	11.50	13.75	5.75	6.87	5.51	3.68	5.31	2.80	1.12	.875	.92	.75	.98	1.75	.50	.281	1.062
5000	in.	14.50	21.12	7.25	10.56	7.72	4.80	7.95	4.13	1.12	.875	1.00	.75	1.25	4.48	.86	.234	1.062
11000	in.	19.00	27.25	9.50	13.63	9.61	5.71	9.35	4.88	1.12	.875	1.00	.75	1.25	4.63	.86	.234	1.062

# BettiSolenoid

BettiSolenoids are custom designed for use with the RP-Series pneumatic actuator product line offering a direct mount feature which eliminates interconnecting tubing and fittings.

## General Description

1. 4-Way, 5 port, 2 position, single coil with manual override.
2. 3-Way, 2 position, normally closed, single coil with manual override.

## Operation:

The valve operates when the coil is electrically energized and returns when the coil is de-energized.

**Media:** dry or lubricated non-corrosive gas.

## Pressure:

Minimum operating differential: 35psi.

Maximum operating differential: 150psi.

## Orientation:

Valve may be mounted in any attitude/position.

## Coil Enclosure:

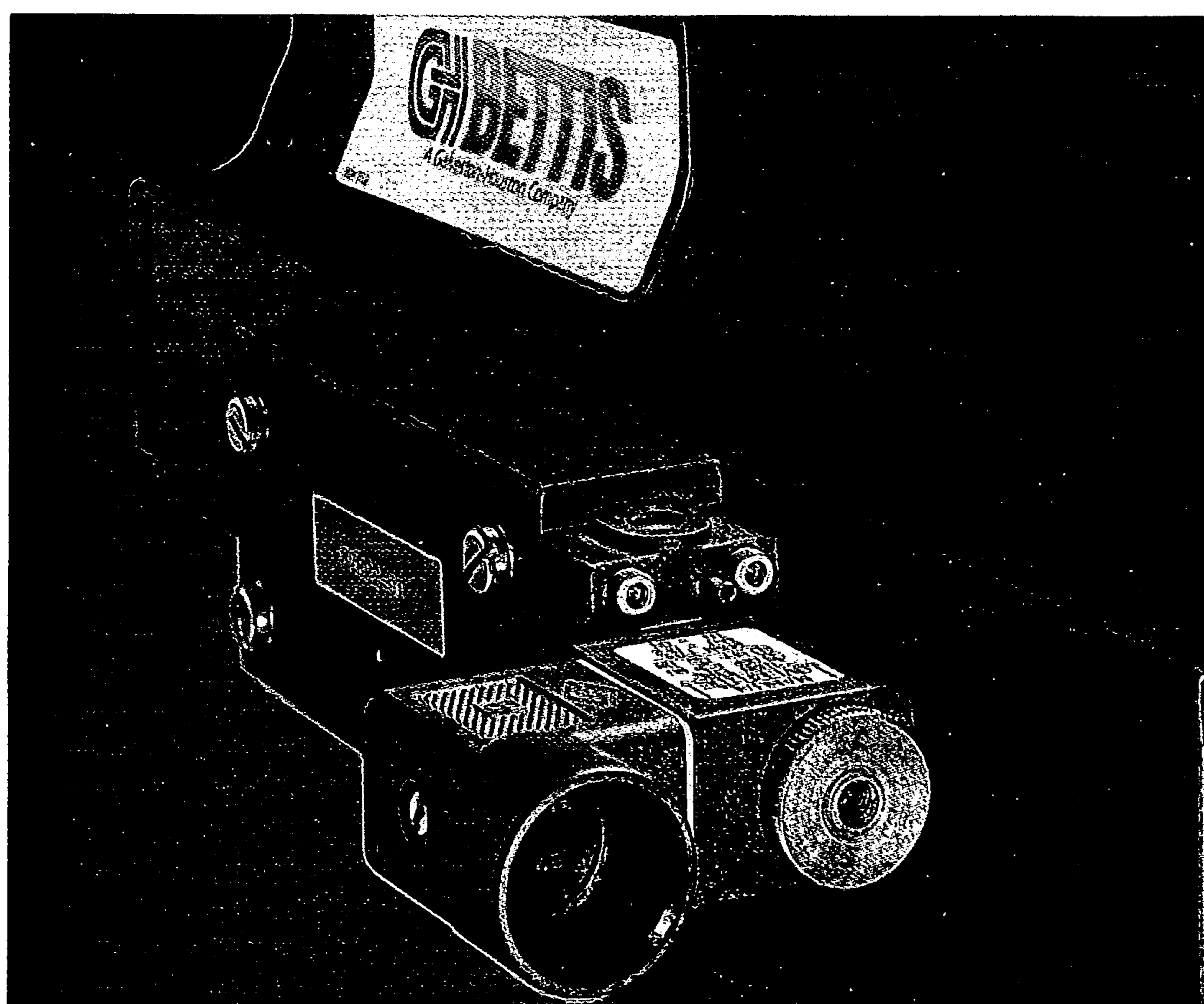
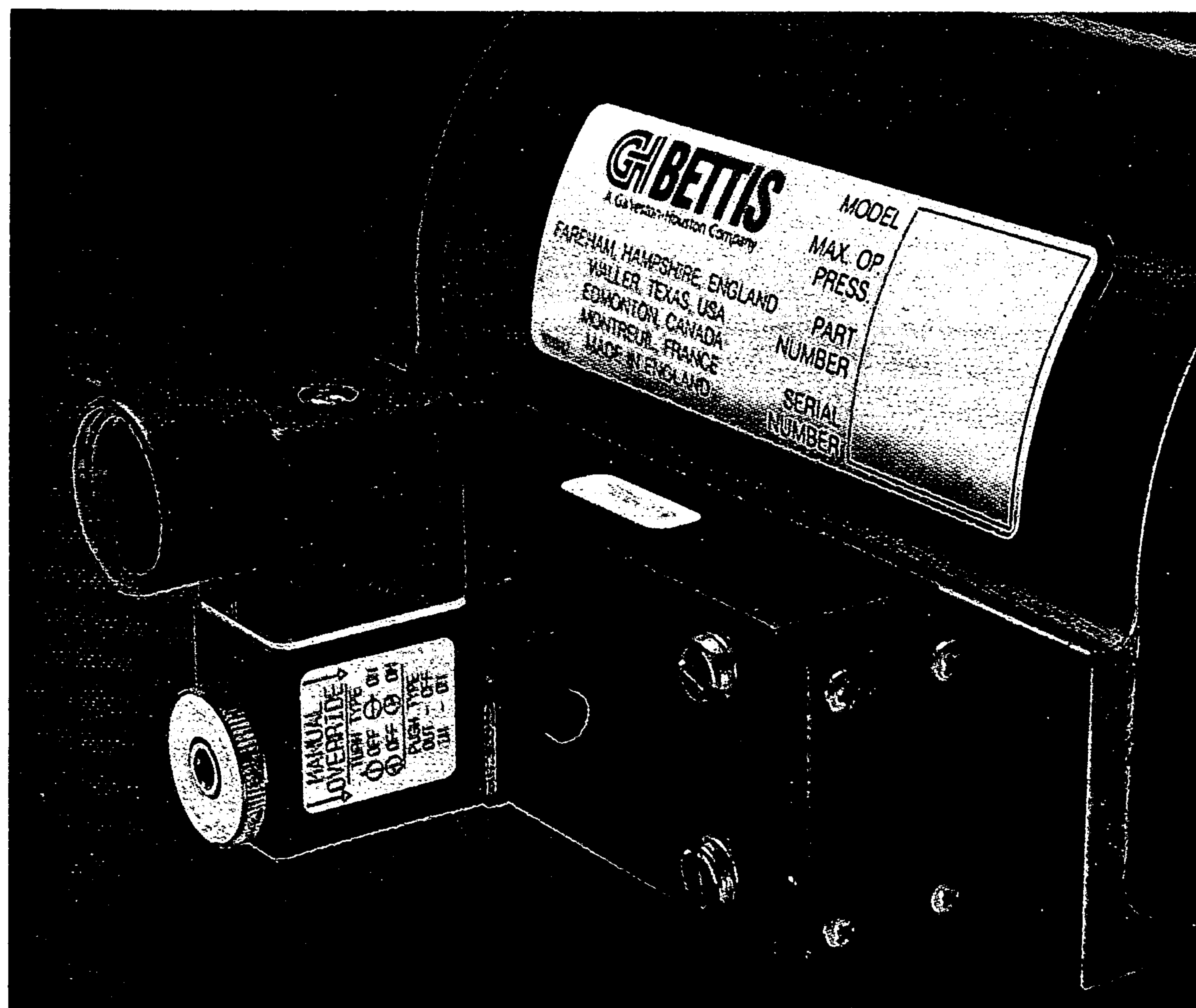
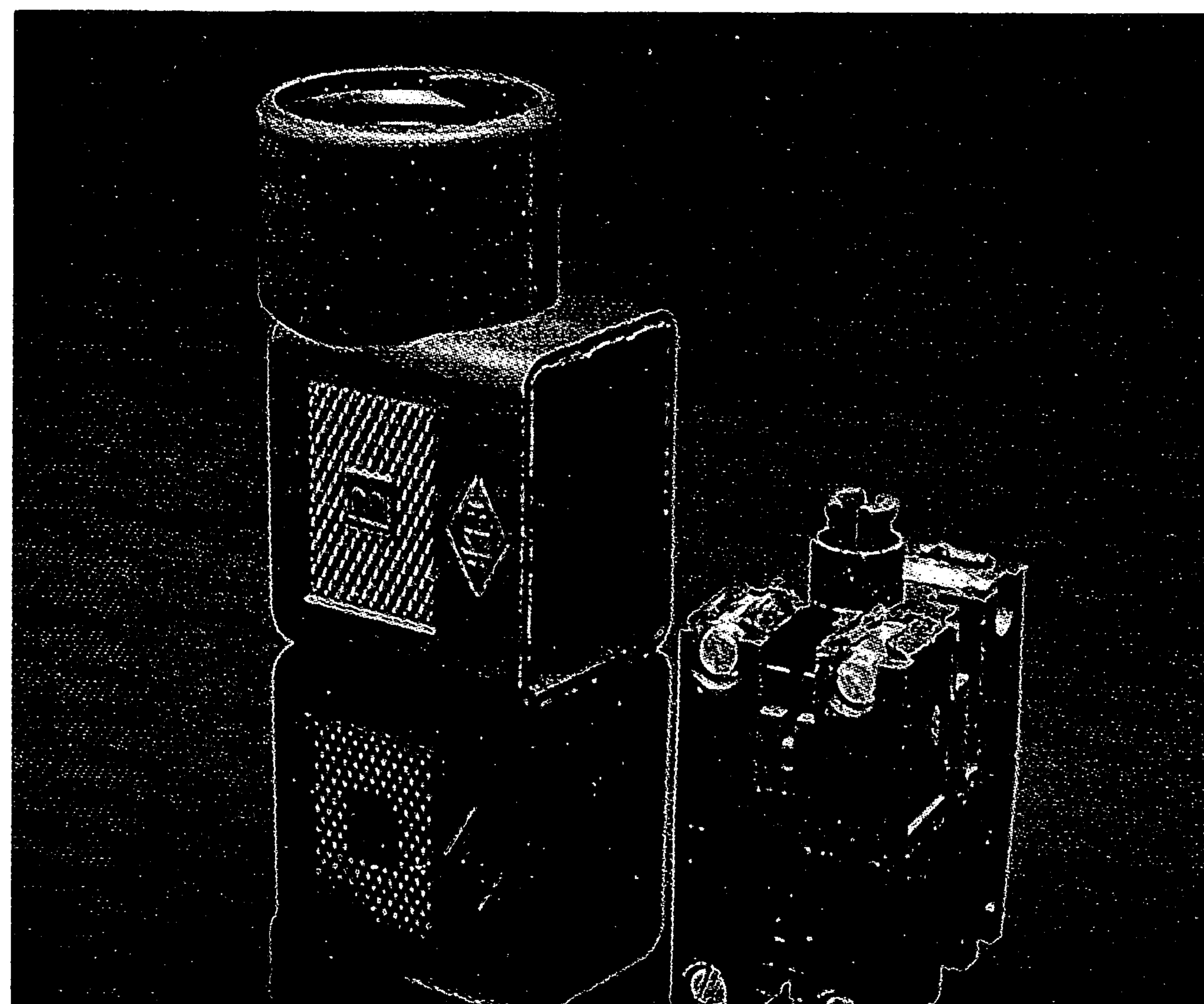
1. NEMA 4, Watertight and dust tight—indoor and outdoor. Intended for use indoors or outdoors to protect against splashing water, seepage of water, falling or hose directed water and severe external condensation. All coils are UL and CSA listed.
2. NEMA 4-7-9, combination watertight and explosion proof—indoor and outdoor. Offers the same protection as NEMA 4 listed above plus hazardous location ratings 7C, 7D, 9E, 9F and 9G (Class I & II, Groups C, D, E, F and G) Division I and II. Enclosure is UL and CSA listed.

## Coil Connection—NEMA 4:

1. ½ NPT Terminal type plug-in, standard.
2. Strain Relief, no cord, terminal type plug-in.
3. Strain Relief with 6 ft. cord, plug-in.
4. Strain Relief with 120VAC-60Hz light, no cord.
5. Strain Relief with 24VDC light, no cord, terminal type, plug-in.

## Coil Connection—NEMA 4-7-9:

½ NPT., potted, 24" leads



**Temperature:**

**Media:** - 40F to + 200F.

**Ambient:** NEMA 4, - 40F to + 180F.

NEMA 4-7-9, - 40F to + 125F.

**Coil Rating:**

1. **NEMA 4:** Continuous duty molded Class H insulation.
2. **NEMA 4-7-9:** Continuous duty molded Class B insulation.

**Coil Voltage:**

1. 120VAC-60Hz/110VAC-50 Hz.
2. 240VAC-60Hz/220VAC-50Hz/120VDC.
3. 48VAC-60Hz/44VAC-50Hz/24VDC.
4. 24VAC-60Hz/22VAC-50Hz/12VDC.

**Coil Voltage Variation:** +/- 10% of Nominal.

**Power Consumption:** 6 Watts

**Materials:**

**Valve Body** = Aluminum, anodized.

**Seals/O-Rings** = Nitrile.

**Fasteners** = Stainless Steel assembly and attachment.

**Dimensions**

