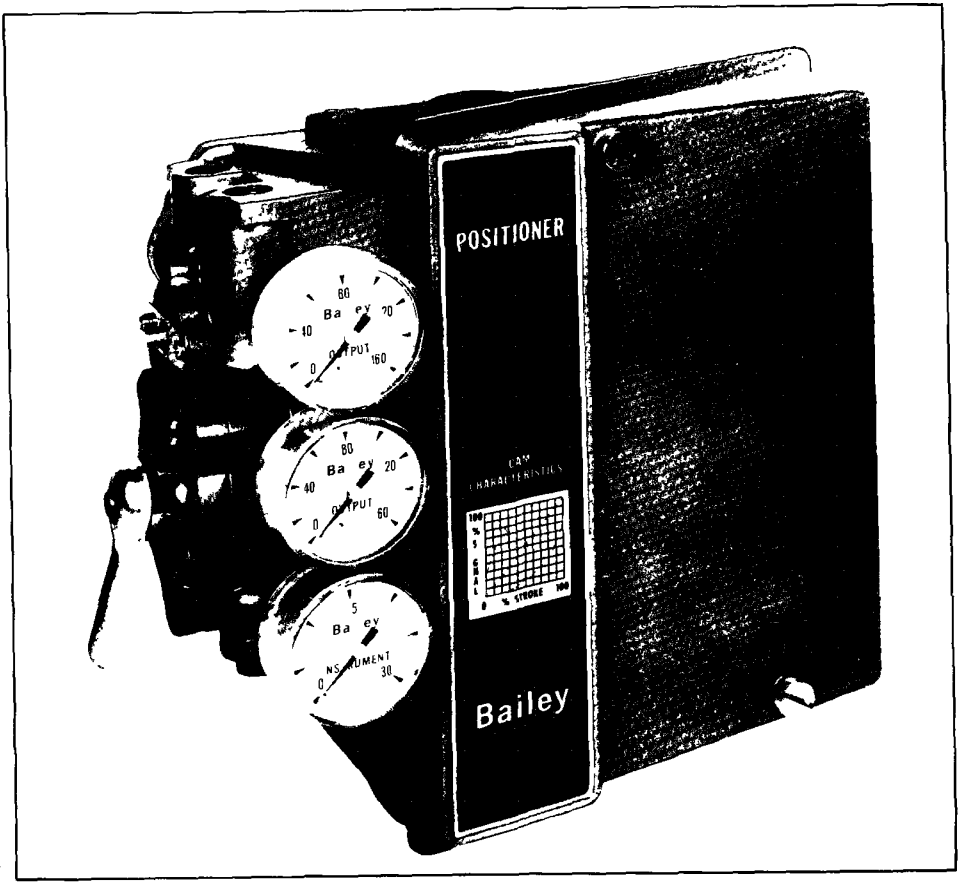
Characterizable Pneumatic Positioner
Type AP2



Babcock & Wilcox
Bailey Meter Company U S A

WARNING

DO NOT INSTALL MAINTAIN OR OPERATE TH S EQU P MENT WITHOUT READING UNDERSTANDING AND FOL LOW NG PROPER Bailey Babcock & Wilcox IN STRUCT ONS AND MANUALS OTHERWISE INJURY OR DAMAGE MAY RESULT

INDEX

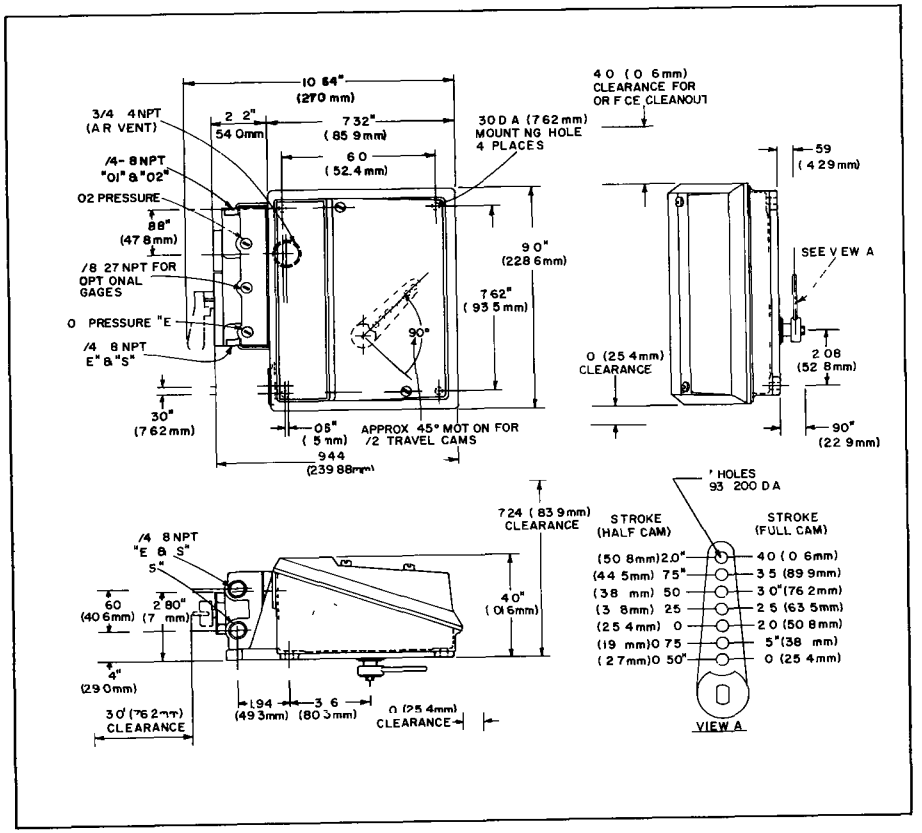


FIGURE 1 Mounting and External Dimensions of Type AP2 Character izable Pneumatic Positioner

INSTALLING THE POSITIONER

UNPACKING

1 Check for any obvious damage to shipping carton

2 Open carton and remove all loose packing

3 Carefully remove Positioner from carton and inspect for any physical damage which may have occurred during shipping

4 Remove two cover screws and Positioner cover and examine interior for any loose components, such as nuts, screws, springs, etc Check data on nameplate (located at right side of cam) for correct Type, Series and Signal Range

CAUTION Before mounting or installing Positioner, check nameplate data to make certain Positioner is suitable for application desired DO NOT AT ANY TIME EXCEED THE RATINGS LISTED ON THE NAMEPLATE

5. If any damage to Positioner is evident, refer to inside front cover of this Instruction Book. If Positioner appears undamaged, replace cover and proceed with installation instructions.

INSTALLATION

The Characterizable Pneumatic Positioner, Type AP2, can be applied to double acting cylinder applications or single acting diaphragm actuator applications.

CAUTION. The positioner can be installed in any position with proper recalibration. It should be noted that certain installation methods will not stroke the power operator to a fail safe condition if the controller fails to send a signal. Bailey Meter Co. strongly recommends that, for increased safety, an installation method be selected to provide a fail safe mode when loss of controller signal is experienced. Mounting and external dimensions of Type AP2 Positioner are shown in Figure 1.

Double Acting Cylinder Applications

When the Positioner is applied to a double acting cylinder assembly, the piston rod is normally connected thru suitable linkage to position a valve damper or other regulating device. Position of the power operator is normally tied back to the Positioner drive arm thru a drive rod (other tie back methods may be used depending on application). The drive arm is fixed to the positioning cam which is shaped to give a desired characteristic of power operator position versus input demand control signal. Positioner mounting and pneumatic connections must be such that an increasing control signal will extend (stretch) the range spring.

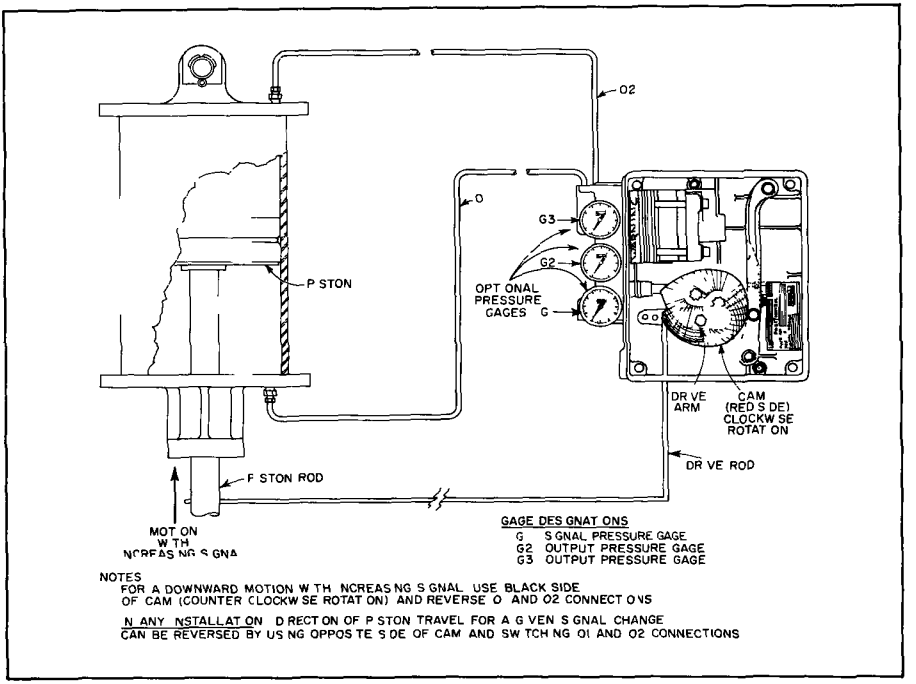
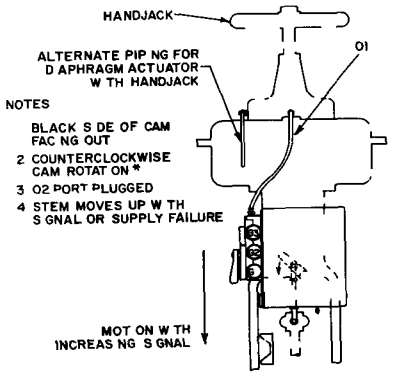
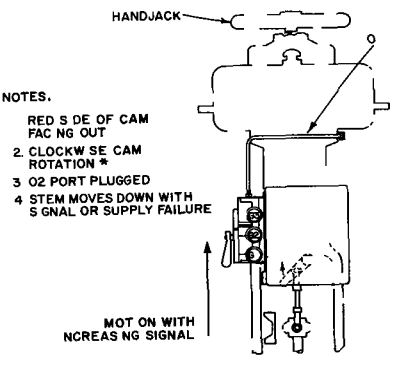
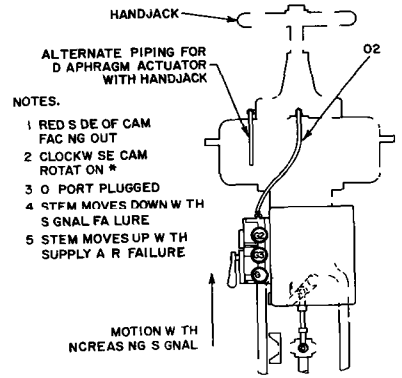
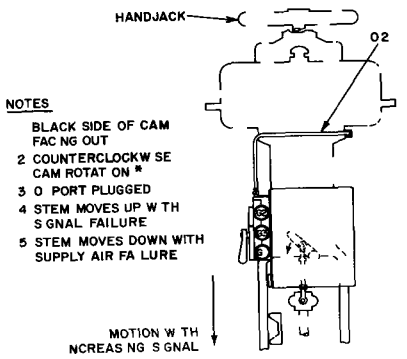


FIGURE 2. Typical Positioner Installation Mounted on Double Acting Cylinder









GAGE DES GNATIONS
G S GNAL GAGE
G2 OUTPUT GAGE
G3 SUPPLY PRESSURE GAGE

* ROTAT ON OF CAM AS V EWED FROM FRONT OF POS T ONER W TH COVER REMOVED FOR AN NCREASING S GNAL

F GURE 3 Typ cal Posit oner nsta at on Mounted on S ngle Acting Diaphragm Actuator

In any installation, the direction of piston travel for a given signal change can be reversed by using the opposite side of the cam and reversing the O1 and O2 output connections (Figure 2)

If the Positioner is included with a double acting cylinder assembly, tubing connections between the Positioner and the power operator would be as illustrated in Figure 2 Pressure gages are optional and are not included unless specified when ordering Positioner

If it is necessary to complete the pneumatic connections to the Positioner, refer to Product Instruction G18 2 for tubing methods and precautions

Single Acting Diaphragm or Spring Loaded Actuator Applications

When the Positioner is applied to a single acting actuator assembly, the valve stem is normally connected thru suitable linkage to accurately position an inner valve in response to a control demand signal Position of the valve stem (or inner valve) is normally tied back to the Positioner thru a drive rod which is attached to the Positioner drive arm The drive arm is fixed to the positioning cam which s shaped to give a desired characteristic of inner valve position versus input demand control signal Positioner mounting and pneumatic connections must be such that an increasing control signal will extend (stretch) the range spring

In any installation, the direction of valve stem travel for a given signal change can be reversed by using the opposite side of the cam, plugging the output connection being used and connecting tubing to the remaining output connection (Figure 3)

If the Positioner is included with a control valve furnished by Bailey Meter Company, it is mounted on the valve yoke and piped to the actuator as illustrated in Figure 3 Pressure gages are optional and are not included unless specified when ordering Positioner

If it is necessary to complete the pneumatic connections to the Positioner, refer to Product Instruction G18 2 for tubing methods and precautions

SUPPLY PRESSURE

Supply pressure range is 18 to 150 psi Because of the minimal effect of supply pressure variations on output positions, a regulated supply is not normally required for either application However, for single acting diaphragm actuator applications, a minimum supply pressure of 5 psi over maximum input signal range (20 psi for 3 15 psi unit or 32 psi for 3 27 psi unit) must be maintained

WARNING TYPE AP2 POSITIONERS ARE SUITABLE FOR MAXIMUM AIR SUPPLY PRESSURE OF 150 PSIG ADHERENCE TO THIS LIMITATION WILL ENSURE SATISFACTORY PERFORMANCE DO NOT SUPPLY PRESSURE TO THE POSITIONER IN EXCESS OF THAT WHICH THE RELATED ACTUATOR OR CYLINDER CAN SAFELY ACCEPT

NOTE It is recommended that a filter or dripwell be installed in the supply line to prevent improper operation of the Positioner due to entrained moisture or dirt

PLACING IN SERVICE

Make the following adjustment checks to ensure correct operation of the valve actuator or cylinder assembly and the Positioner before placing in operation

1 Make certain connecting linkage brackets and any mounting hardware are secure

2 Make certain supply input control signal and output pressure connections are tight Check for leakage while under pressure with soapsuds solution

3 If optional pressure gages were furnished make certain gages are installed in correct location for application (Figure 2 or 3) and all connections are tight Check for leakage, while under pressure, with soapsuds solution

4 Perform procedures outlined under "Calibrating the Positioner" to check output pressure level adjustment and to set zero and range adjustments for the required application prior to placing the Positioner in service

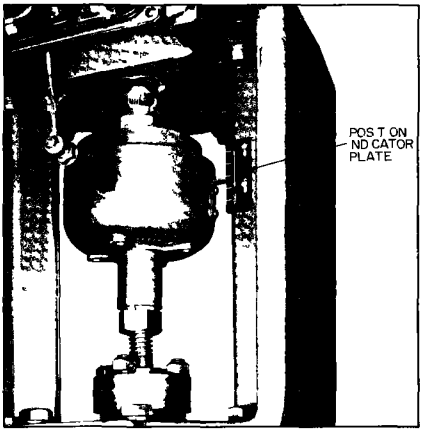


FIGURE 4 Typical Position Indicator Plate Mounted on Valve Actuator Yoke

NOTE It is recommended that a position indicator plate be fabricated and installed on valve actuator yoke (or cylinder) and a pointer be installed on valve stem (or piston rod) to indicate full OPEN and full CLOSED travel of power operator (Figure 4)

ROUTINE SERVICING

1 Once each year check all air connections for leakage, while under pressure, with a soapsuds solution

2 Maintain a clean air supply (free of dirt oil or moisture) to assure satisfactory operation of Positioner If recommended filter is installed (refer to "Supply Pressure") in supply line, remove and clean if necessary

3 Whenever power operator is out of service (or when required) remove Positioner output valves as outlined under "Troubleshooting" and clean with an aliphatic hydrocarbon solvent (like gasoline or kerosene)

WARNING USE SOLVENT IN A WELL VENTILATED AREA AVOID PROLONGED OR REPEATED BREATHING OF VAPORS AVOID PROLONGED OR REPEATED CONTACT WITH SKIN DO NOT USE NEAR OPEN FLAME

4 Periodically check orifice and nozzle for deposits and clean if necessary as outlined under "Troubleshooting"

5 Once each year (or when required), check adjustment and calibration of Positioner and power operator as outlined under "Calibrating the Positioner"

6 Also, if Positioner is equipped with optional integral shut off and equalizing valve clean valve assembly and cavity each year with aliphatic hydrocarbon solvent Disassemble by removing valve handle and valve retainer (Figure 23 items 16 and 15) and lifting out valve assembly 17) Inspect o rings 13 and 14) and replace if necessary Relubricate with minimum amount of o ring lube (Dow Corning No 4 or equivalent) and reassemble

NOTE Be sure same shims are installed between valve assembly (17) and valve retainer (15)

TROUBLESHOOTING

If trouble occurs which is definitely traced to the Positioner, check supply pressure, input and output pressure connections and mechanical linkage adjustments before removing from service If no obvious defects are noted, refer to "Fault Correction Chart" Locate applicable heading for type of Positioner failure encountered Correct procedures for checking or replacing various components are listed below

WARNING MAKE CERTAIN POSITIONER IS DISCONNECTED FROM SUPPLY PRESSURE SOURCE OR REMOVED FROM SERVICE BEFORE ATTEMPTING ANY REPAIR OR REPLACEMENT PROCEDURES

CLEANING NOZZLE ORIFICE
(Refer to Figure 5)

NOTE Diameter of hole in orifice is approximately 0 016 inch Dirt or foreign particles could easily be trapped in orifice before reaching nozzle

1 An access hole on top of Positioner cover is provided for servicing or cleaning nozzle orifice Remove pipe plug from nozzle chamber section of relay assembly using a 5/32 inch allen wrench to gain access to orifice

2 Use a wire approximately 0 015 inch in diameter and remove any dirt or foreign particles obstructing orifice hole

WARNING USE EXTREME CARE WHEN CLEANING ORIFICE TO PREVENT SCRATCHING OR ENLARGING ORIFICE HOLE ENLARGING HOLE COULD AFFECT "GAIN" CHARACTERISTICS OF POSITIONER

3 Reassemble pipe plug in nozzle chamber section of relay assembly

REPLACING RELAY ASSEMBLY

NOTE To remove the Positioner from the case, refer to Figure 12 for identification of item numbers listed parenthetically in steps 1 thru 4 only

1 Remove cam (34) from cam shaft (33)

2 Disconnect range spring (4) from spring retainer (15)

3 If Positioner is equipped with gain suppression accessory kit (items 7 thru 11), remove kit as follows

a Remove two screws (9), lockwashers (10) and small washers (11) from base assembly (13)

b Disassemble retainer (8) and spring (7)

4 Remove two screws (30) from rear of base assembly (13) and carefully remove Positioner assembly (3)

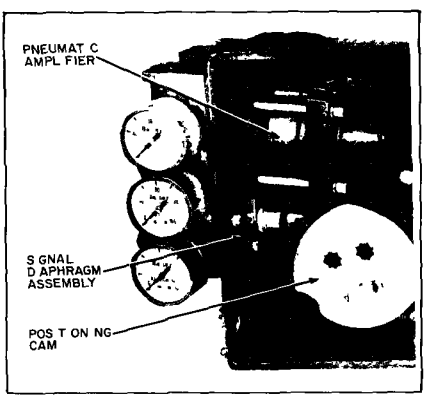
5 To remove signal nut (40), place a 9/16 inch thin head or tappet, open end wrench on hex of signal diaphragm assembly (26) guide to secure guide in position and prevent rotation (Figure 6) With guide held firmly, place a 3/4 inch open end wrench on flats of signal nut (40) Remove signal nut and spring retainer (39) from threaded section of guide

NOTE Spring retainer (39) is loctite sealed into signal nut (40) and should not have to be separated

CAUTION Damage could result to signal diaphragm assembly if guide is not held in position when removing signal nut

6 Remove tabbed retainer (25) from signal diaphragm assembly (26) guide

7 Remove screws (46) and lockwashers (47) securing base manifold assembly (36), relay assembly (27) and manifold assembly (8) in position (Dowel pins in both ends of relay assembly prevent rotation of assemblies after cap screws have been removed)



F GURE 5 Clean ng Nozzle Or f ce

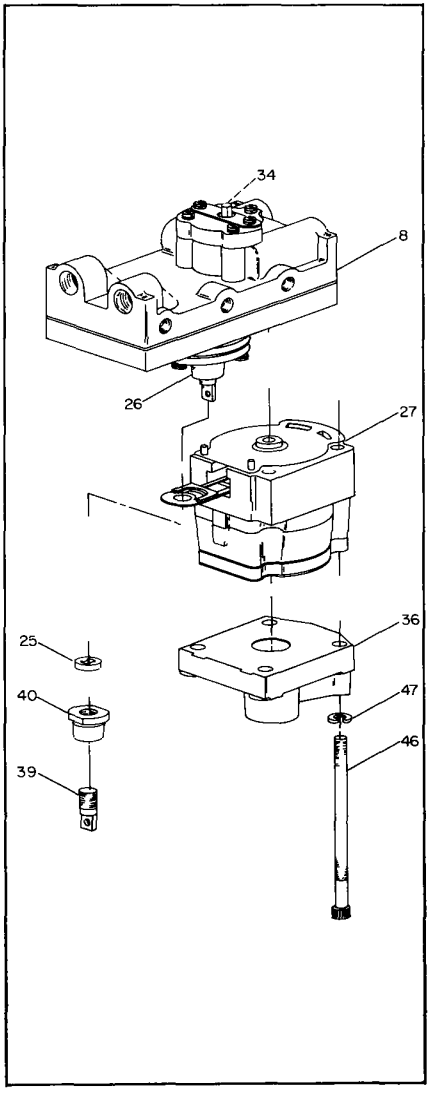


FIGURE 6 - Replacing Relay Assembly

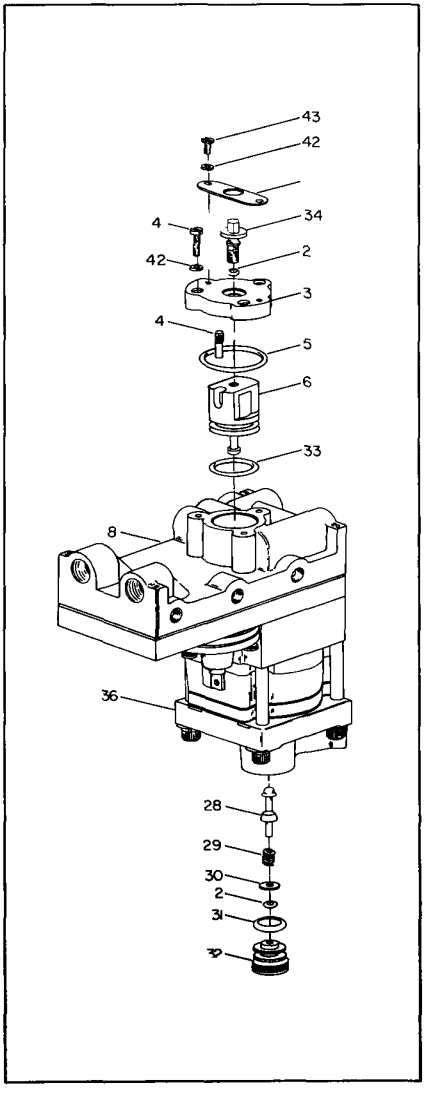


FIGURE 7 Replacing Output Valves

8 Remove base manifold assembly (36)

9 When removing relay assembly (27), guide vane by hand until vane is clear of signal diaphragm assembly (26) guide

10 To install new relay assembly, reverse steps 3 thru 9 above Tighten four screws (46) uniformly in rotation, 70 to 75 in lb Wait 15 minutes and retorque screws

CAUTION To prevent damage to relay assembly, make certain exposed diaphragms (at each end of relay assembly) are in flat, re axed position before tightening screws (46) Also, be sure that dowel pins which protrude from each end of relay, enter holes in mating parts before tightening screws

11 Make a preliminary setting of small slotted set screw in vane assembly so that set screw point lifts vane overtravel hinge end away from vane assembly approximately 1/64"

12 Complete reassembly of relay into Positioner by reversing steps 1 and 2

13 Recalibrate Positioner for correct application as outlined under "Calibrating the Positioner"

14 Apply minimum input signal pressure Using a stop watch or watch with a sweep second hand as a timing device, rapidly increase input signal pressure from minimum to maximum while noting the time necessary for piston or valve to stroke from one extreme to the other

15 Again noting time necessary for piston or valve to stroke from one extreme to the other, rapidly decrease input signal from maximum to minimum

NOTE Rate of input signal change should be approximately the same as in step 14

16 Compare two stroke times If an undesirable differential exists, adjust small slotted set screw in vane assembly approximately 1/2 turn and re zero calibration

17 Repeat steps 14, 15 and 16 until stroke time differential is reduced to within desired limits At this point supply and exhaust capacities of 01 and 02 output valves are balanced Apply a drop of Loctite Grade 290 or equivalent to set screw threads

REPLACING OUTPUT VALVE O1
(Refer to Figure 7)

1 Using slot in end of valve plug (32), remove plug from base manifold assembly (36) (Plug assembled at factory with adjustable sealant on threads) Plug can be removed by unscrewing until all the threads are exposed A 3/4 16 UNF hex nut should then be screwed over the plug threads and the plug removed by grasping the nut with pliers Remove hex nut Examine o ring (31) and replace if necessary

2 Remove valve (28), valve spring (29), washer (30) and o ring (2) from base manifold assembly (36) Examine o ring and replace if necessary

3 Clean valve (28) using an aliphatic hydrocarbon solvent (i e , gasoline, kerosene, etc) and visually inspect for damage to seating surfaces Remove any sealant remaining on valve plug (32) and threads inside base manifold assembly (36) Examine valve seats inside of base manifold assembly for dirt Clean if necessary

WARNING USE SOLVENT IN A WELL VENTILATED AREA AVOID PROLONGED OR REPEATED BREATHING OF VAPORS AVOID PROLONGED OR REPEATED CONTACT WITH SKIN DO NOT USE SOLVENT NEAR OPEN FLAME

4 Apply minimum amount of o ring lubricant (Dow Corning No 4, or equivalent) to o ring (2) Assemble valve spring (29), washer (30) and o ring (2) on valve stem Install valve (28) subassembly in base manifold assembly (36)

5 Apply small amount of lubricant on o-ring (31) and install on valve plug (32)

6 Apply adjustable seal (Loctite Sealant, Grade No 242, or equivalent) to threads of valve plug (32) and install in base manifold assembly (36) End of valve plug must be flush with base manifold housing when assembled

REPLACING OUTPUT VALVE O2
(Refer to Figure 7)

1 Remove as a unit, screw retainer (1), valve cover (3) and valve seat assembly (6) from manifold assembly (8) by removing screws (41) and lockwashers (42)

NOTE After removing subassembly described in step 1, visually check (or take a quick measurement) of the gap between the bottom side of

valve cover (3) and the top of valve seat assembly (6). This procedure is necessary in order to obtain the same approximate dimension when reassembling valve seat assembly and will assist in recalibration of the Positioner after final assembly is completed

2 To disassemble valve seat assembly (6) from valve cover (3), back off adjustment screw (34) until valve cover can be removed. It is not necessary to remove screw retainer (1) to disassemble valve seat assembly

3 Examine o rings (5) and (33). Replace if necessary

4 If o ring (2) must be replaced, disassemble screw retainer (1) by removing screws (43) and lockwashers (42). Remove adjustment screw (34) from valve cover (3) and replace o ring

5 Clean valve using an aliphatic hydrocarbon solvent (i.e., gasoline or kerosene) and blow dry with air hose. Visually inspect for damage. If valve is damaged, valve seat assembly (6) must be replaced

WARNING USE SOLVENT IN A WELL VENTILATED AREA. AVOID PROLONGED OR REPEATED BREATHING OF VAPORS. AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. DO NOT USE NEAR OPEN FLAME.

6 Examine valve chamber in manifold assembly for dirt and clean if necessary

7 Apply minimum amount of lubricant (Dow Corning No. 4 or equivalent) to o rings (2), (5) and (33).

8 Install o ring (2) on adjustment screw (34), o ring (5) in valve cover (3) and o ring (33) on valve seat assembly (6).

9 With notch in valve seat assembly (6) in alignment with dowel pin (4) in valve cover (3), turn in adjustment screw (34) until correct distance is obtained between bottom of valve cover and top of valve seat assembly (refer to NOTE following step 1).

CAUTION Threads on adjustment screw are very fine pitch. Use care to avoid cross threading.

10 Install valve subassembly in manifold assembly (8). Secure in position using screws (41) and lockwashers (42).

11 If screw retainer (1) was removed, install retainer on valve cover (3) with screws (43) and lockwashers (42).

12 Recalibrate as outlined under "Calibrating the Positioner".

REPLACING SIGNAL DIAPHRAGM ASSEMBLY
(Refer to Figure 8)

NOTE To remove the Positioner from the case, refer to Figure 22 for identification of item numbers listed parenthetically in steps 1 thru 3 only.

1 Disconnect range spring (4) from spring retainer (15) using needle nose pliers.

2 If Positioner is equipped with optional gain suppression kit (items 7 thru 11) remove kit as follows:

a Remove two screws (9), lockwashers (10) and small washers (11) from base assembly (13).

b Disassemble retainer (8) and spring (7).

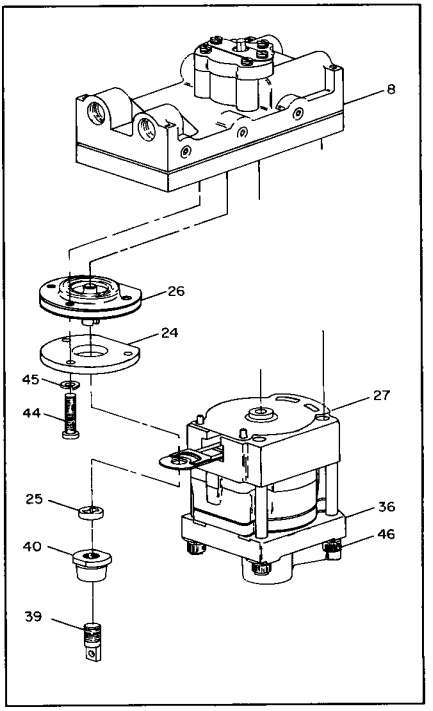


FIGURE 8 Replacing Signal Diaphragm Assembly

APPLICATION	GAIN SUPPRESSION KIT PART NO 5327328 1		GAIN SUPPRESSION KIT PART NO 5327328 2	
	Positioner with Standard Gain (250 300)	Positioner with High Gain (300-400)	Positioner with Standard Gain (250 300)	Positioner with High Gain (300-400)
Cylinders with 50 in^3 or less displacement	X			X
Cylinders with 50 in^3 to 200 in^3 displacement		X	Not Required	
Diaphragm actuators with high packing friction	X			X

TABLE 1 Suggested Gain Suppression Kit Guide Lines

3 Remove two screws (30) from rear of base assembly (13) and carefully remove Positioner assembly (3)

4 To remove signal nut (40), place a 9/16 inch thin head or tappet open end wrench on hex of signal diaphragm assembly (26) guide to secure guide in position and prevent rotation With guide held firmly, place a 3/4 inch open end wrench on flats of signal nut (40) Remove signal nut and spring retainer (39) from threaded section of guide

CAUTION Damage could result to signal diaphragm assembly if guide is not held in position when removing signal nut

5 Remove tabbed retainer (25) from signal diaphragm assembly (26) guide

6 Loosen four hex socket head cap screws (46) until base manifold assembly (36) and relay assembly (27) can be disassembled from manifold assembly (8) (Dowel pins in both ends of relay assembly prevent rotation of assemblies after cap screws have been removed)

CAUTION To prevent damage to vane of relay assembly, carefully guide relay assembly (27) vane over signal diaphragm guide when separating relay assembly and manifold assembly (8)

7 Remove three screws (44) and disassemble signal cover (24)

8 Remove signal diaphragm assembly (26)

9 To install new signal diaphragm assembly (26) reverse steps 1 thru 8 above Tighten three screws (44) 25 to 30 in lb Tighten four cap screws (46) 70 to 75 in lb uniformly in rotation Wait 5 minutes and retorque screws

INSTALLING OPTIONAL GAIN SUPPRESSION KIT (Refer to Figure 22 and Figure 9)

An optional gain suppression kit is available for Tyvpe AP2 Positioner (refer to Table 1) Installing the gain suppression kit might be necessary to control oscillation of the final control element to reduce sensitivity and prevent overshoot where high packing friction is evident, where oscillation occurs in a rapid rise portion of the cam or to adapt the Positioner to a change in application The need for gain suppression will vary according to actuator and valve characteristics If it is necessary to add the gain suppression kit, refer to applications listed in Table 1 and procedure outlined below

1 Remove cam (Figure 22 item 34) from cam shaft (33)

2 Disconnect range spring (Figure 9, item 4) from spring retainer (15) using needle nose pliers

3 Install spring (7) over signal nut (45) until spring contacts signal nut flange

4 Install "bonnet" portion of retainer (8) over spring retainer (15) until retainer (8) secures spring (7) in position

5 Install screws (9) lockwashers (10) and small washers (11) thru retainer (8) and into Positioner base assembly (13) Do not tighten securely

6 Reassemble range spring (4) to spring retainer (15)

7 Install cam (Figure 22 item 34) on cam shaft (33)

FAULT CORRECTION CHART

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
1 F na dr ve e ement at one end of stroke and does not respond to nput change	a Obstruct on n or f ce ead ng to nozz e	a Check or f ce as out ned under "C ean ng Nozz e Or f ce '
	b Re ay (amp f er) sect on eak ng nterna y	b Rep ace as out ned under ' Rep ac ng Re ay Assemb y '
2 Excess ve a r consump t on (exhaust oud)	a Leakage at jo nts of man fo d assemb y re ay assemb y or base man fo d assemb y	a T ghten four 250 28 x 4 hex socket head sta n ess stee cap screws 70 to /b n b
	b mproper seat ng of output va ves	b Remove va ves as out ned under "Rep ac ng Output Va ve O1" or 'Rep ac ng Output Va ve O2 ' C ean va ves and seats Rep ace va ves f necessary
3 Osc at on of f na dr ve e ement	a Output pressure eve too ow	a Reset output pressure eve adjust ment as out ned under "Ca brat ng the Pos t oner"
	b Ga n too h gh	b nsta opt ona sp ng k t as ot t ned under 'Insta ng Ga n Suppress on K t '
	c Dr ve arm not secure y attached to f na dr ve e ement	c T ghten or correct nkage as necessary
4 S ow response	a Output pressure eve too h gh or too ow	a Reset output pressure eve ad justment as out ned under 'Ca brat ng the Pos t oner"
	b Output va ves b ocked	b Remove va ves as out ned under "Rep ac ng Cutput Va ve O1 ' or "Rep ac ng Output Va ve O2 ' C ean va ves and ports
	c Re ay (pneumat c amp f er) assemb y not operat ng correct y	c Rep ace as out ned under "Rep ac ng Re ay Assemb y"
5 F na dr ve e ement at m n mum trave stop *and w not respond to* nput change	a S gna d aphragm eakage	a T ghten three 190 32x1 00 pan head screws to 25 30 n b or rep ace as out ned under 'Re p ac ng S gna D aphragm Assemb y '
6 Uprange zero sh ft that cannot be adjusted	a S gna d aphragm eakage	a T ghten three 190 32x1 00 pan head screws to 25 30 n b or rep ace as out ned under "Re p ac ng S gna D aphragm Assemb y'
7 Fu range cannot be obta ned w th adjustment	a Incorrect range spr ng	a Remove range spr ng and nsta correct spr ng for range requ red
	b S gna d aphragm eakage	b T ghten three 190 32x1 00 pan head screws to 25 30 n b or rep ace as out ned under Re p ac ng S gna D aphragm Assemb y"

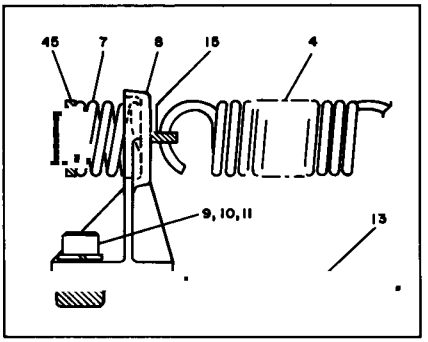


FIGURE 9 Insta ng Opt onal Gain Suppression K t

8 Position retainer (Figure 9, item 8) on its slotted holes so it is in position to exert a slight, even compression load on spring (7) when cam and signal pressure are at 0% Tighten screws (9) in this position

9 Readjust range and zero adjustments as outlined under "Calibrating the Positioner" If unit is unstable or sluggish, reta ner (8) can be repositioned in its slotted holes

10 Check to verify that there is a slight load on spring (7) when unit is pressurized and in a static position

INSTALLING OPTIONAL HIGH GAIN RANGE SPRING

Two optional high gain range springs are avail able for Type AP2 Positioner (refer to Table 2) Installation of the high gain range spring is recom mended for increasing accuracy on large displace ment cylinders or actuators only, where h gh gain should not affect stability of the final control ele ment To instal high gain range spring, follow procedures outlined below

1 Remove cam from cam shaft

2 D sconnect standard gain range spring from threaded adjuster and spring retainer using needle nose pliers Install new high gain range spring

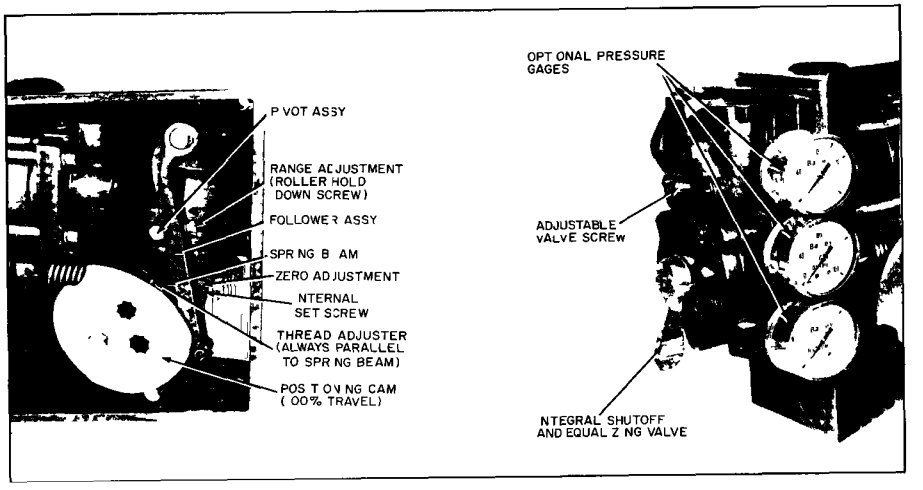
3 Install cam on cam shaft

4 Readjust range and zero adjustme nts as outlined under "Calibrating the Pos t oner"

Range Spr ng Part No	No of Coils	Input Signal (psi)	Application
5327330 1	15	3 15	Opt ona h gh ga n range spr ng
5327330 2	14	3 27	Opt ona h gh ga n range spr ng
		3 15	*Standard ga n range spr ng
5327330 3	11	3 27	*Standard ga n range spr ng

*Standard ga n (250 300) range spr ngs are assemb ed n p ace and sh pped w th Pos t oner

TABLE 2 Opt ona H gh Ga n Range Spr ng



F GURE 10 Pos t oner Adjustments

CALIBRATING THE POSITIONER

Calibration of Type AP? Characterizable Pneumatic Positioner consists of adjusting the linkage from the power operator so that the positioning cam rotates thru full range for full travel of the piston or valve stem and to adjust for balance) the output pressure level

The following adjustments are performed with Positioner mounted on the power operator These adjustments are specifically for checking operation of the two units prior to adapting the Positioner to a particular application Once these adjustments have been completed proceed to "Calibration Adjustments for Particular Applications"

OUTPUT PRESSURE LEVEL ADJUSTMENT

Double Acting Cylinder Applications

If necessary to change or correct output pressure level of Positioner, follow the procedure outlined below and refer to Figure 10

1 Use B (straight line) positioning cam which is shipped in place in Positioner assembly

CAUTION Make certain correct side of cam (red or black) is facing outward for application desired (Figure ?)

? Make supply air connections (18 to 150 psig) designated "S" on manifold Maintain this pressure during adjustments and after Positioner has been placed into service

WARNING TYPE AP? POSITIONERS ARE SUITABLE FOR A MAXIMUM AIR SUPPLY PRESSURE OF ?0 PSIG ADHERENCE TO THIS LIMITATION WILL ENSURE SATISFAC TORY PERFORMANCE DO NOT EXCEED MAXIMUM RECOMMENDED CYLINDER OPERATING PRESSURE

3 If optional pressure gages are not included, connect customer supplied pressure gages to Positioner output ports O1 and O? or to 1/8 inch NPT gage ports (Figure ?)

4 Apply midrange signal (9 psi for 3 15 unit or 15 psi for 3 ?7 unit) with no load on cylinder

CAUTION Make certain midrange signal is applied Output pressure level cannot be adjusted if piston is against travel stop

5 Turn integral shutoff and equalizing valve (AP?□□1□) to AUTO position

6 Each output pressure gage should stabilize at approximately ?/3 of supply pressure (O1 gage reading plus O? gage reading should equal 4 3 of supply pressure)

7 If reading is not correct, turn adjustable valve screw counterclockwise to increase pressure or clockwise to decrease pressure until correct reading is obtained

NOTE If oscillation occurs, gain suppression spring kit (available option from Bailey Meter Co , Pt No 5327328 □) must be installed Refer to "Installing Gain Suppression Spring" for table of spring applications and installation procedure

Single Acting Diaphragm Actuator Applications

If necessary to change or correct output pressure level of Positioner, follow procedure outlined below and refer to Figure 10

1. Use B (straight line) positioning cam which is shipped in place in Positioner assembly

CAUTION Make certain correct side of cam (red or black) is facing outward for application desired (Figures 2 and 3)

2 Make supply air connections (18 to 150 psig) designated "S" on manifold Maintain this pressure during adjustments and after Positioner has been placed in service

NOTE For single acting diaphragm actuator applications, a minimum supply pressure of 5 psi over maximum input signal range (20 psi for 3 15 psi unit or 32 psi for 3 27 psi unit) must be maintained

WARNING TYPE AP2 POSITIONERS ARE SUITABLE FOR A MAXIMUM AIR SUPPLY PRESSURE OF 150 PSIG ADHERENCE TO THIS LIMITATION WILL ENSURE SATISFACTORY PERFORMANCE DO NOT EXCEED MAXIMUM DESIGN OPERATING PRESSURE OF ACTUATOR

NOTE For single acting diaphragm actuators, a minimum supply pressure of 5 psi over maximum input signal range (20 psi for 3 15 psi unit or 32 psi for 3 27 psi unit) must be maintained

3 If optional pressure gages are not included, connect customer supplied gages to 1/8 inch NPT gage ports in location shown in Figure 3 for application desired

4 Apply midrange signal (9 psi for 3 15 psi unit or 15 psi for 3-27 psi unit) with no load on actuator

CAUTION Make certain midrange signal is applied Output pressure level cannot be adjusted if valve is against travel stops

5 If reading on supply gage G3 (Figure 3) does not equal supply pressure being applied turn adjustable valve screw counterclockwise until supply pressure is obtained If reading is at supply pressure, turn screw clockwise to decrease pressure, then counterclockwise until full supply pressure is obtained

NOTE Supply gage may momentarily drop if large step change is applied

6 Once supply pressure is obtained, turn adjustable valve screw one (1) full turn counterclockwise

ZERO AND RANGE ADJUSTMENTS
(Refer to Figure 10)

The range spring assembly applies a proportional feedback force to the input signal diaphragm assembly A threaded adjuster applies initial tension on the spring and provides a zero adjustment

Range adjustment of the Positioner is obtained by repositioning a pivot assembly along the cam follower arm Moving the pivot assembly towards the cam results in a shorter final control element stroke for a given signal change The opposite holds true for moving the pivot assembly away from the cam

Double Acting Cylinder Applications

The adjustment procedure below is based on a direct acting application as shown in Figure 2 If power operator is being used for a reverse acting application, note that the movements and positions will be opposite those listed below Normally, the regulating device (valve, damper, etc) used in direct acting applications will be in the CLOSED position when piston is at bottom of cylinder, and the OPEN position when piston is at top of cylinder Therefore, the words OPEN and CLOSED used below refer to these positions

Single Acting Diaphragm Actuator Applications

The adjustment procedure below is based on a direct acting, top-connected diaphragm actuator as shown in Figure 3 If the power operator is being used for a reverse-acting application, note

that the movements and positions will be opposite those listed below Normally, a control valve used in direct acting applications will be in the CLOSED position when the valve stem has traveled out of the valve body to its fullest extent, and in the OPEN position when the stem has traveled into the valve body to its fullest extent Therefore the words OPEN and CLOSED used below refer to these positions

NOTE It is recommended that a position indication plate be installed on the valve actuator yoke (or cylinder) and a pointer be installed on valve stem (or piston rod) to indicate full stroke travel in both directions

1 Position piston (or valve) to CLOSED position If cam follower is not at zero mark on positioning cam, disconnect and adjust Positioner drive rod (or other connecting linkage used to tie back to power operator) until Positioner drive arm assumes position which places follower on zero mark. Reconnect drive rod

2 Set input signal at minimum range value (3 psi for 3 15 psi unit or 3 27 psi unit) Piston (or valve) should remain in CLOSED position

3 If piston (or valve) begins to move from its CLOSED position, loosen set screw located in recessed hole of knurled adjustment nut and turn zero adjustment (Figure 10) clockwise to increase range spring tension until piston (or valve) returns to a CLOSED position

4 Increase input signal above minimum range value (3 5 psi for 3 15 unit or 3 27 psi unit) If piston (or valve) does not begin to leave CLOSED position immediately, turn zero adjustment nut (Figure 10) counterclockwise until such movement is obtained Once zero adjustment is completed, retighten set screw to lock zero adjustment in place

5 Return to minimum input signal (3 psi) Piston (or valve) should go to CLOSED position

6 Set input signal at maximum range value (15 psi for 3 15 psi unit or 27 psi for 3 27 psi unit) If piston (or valve) does not move to full OPEN position, loosen roller hold down screw (Figure 10) and slide roller along beam until piston (or valve) reaches full OPEN position After adjustment, tighten hold down screw firmly in place

7 Decrease input signal below maximal range value (14 5 psi for 3 15 psi unit psi for 3 27 psi unit) If piston (or valve) does not begin to leave full OPEN position (or valve) immediately, change range adjustment as outlined in step 6 until such movement is obtained

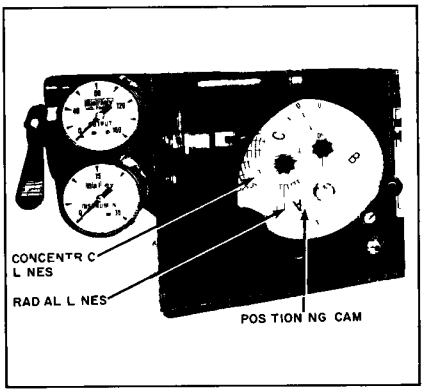
8 If range adjustment (step 6) was necessary, recheck zero adjustment as outlined in steps 2 thru 5

CALIBRATION ADJUSTMENTS FOR PARTICULAR APPLICATIONS

The Positioner adjustments described below may be used to improve the operation of the power operator system either by itself or in relation to other systems or parts of a multiple system

Zero or Suppression Adjustment

By using the zero adjustment (Figure 10) an additional tension may be imposed upon the range spring so that the piston (or valve) will not begin to move from its minimum position until input signal has increased from 3 psi to any value up to 9 psi (3 15 psi unit) or 15 psi (3 27 psi unit) This adjustment is of value when two or more power operators are to be operated in sequence, where the power operator is equipped with a minimum stop, or where the characteristics of the device which the operator is moving must be matched with that of another regulated device



F GURE 11 Character zed Cam

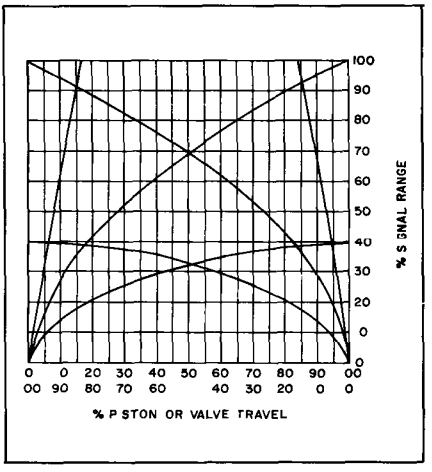


FIGURE 12 Cam A, Square Root Re ation

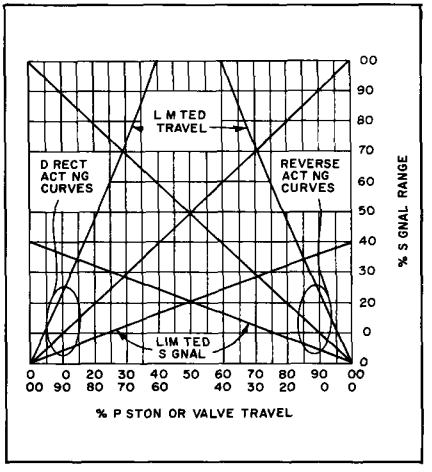


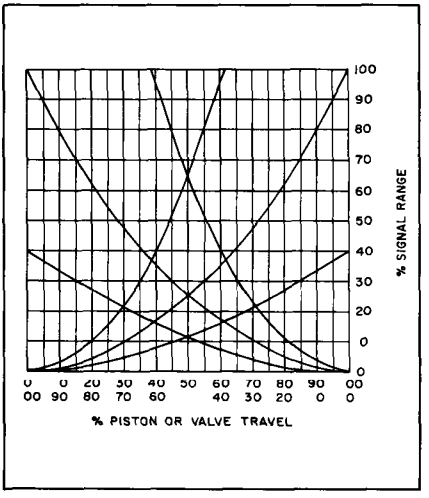
FIGURE 13 Cam B, L near Re ation

Split Range Adjustment

The range adjustment affords a variation of power operator motion for a given range of control signal pressure In combination with the zero adjustment described above, full piston (or valve) travel may be obtained for a signal pressure change as small as 6 0 psi (3 15 psi unit) Range adjustments available for each of the three cam variations furnished are shown in Figures 12, 13 and 14 This adjustment is of value when the device being regulated by the power operator is oversized, since the adjustment allows operation of the power operator thru its useful motion for the desired full change in control signal pressure It is also useful in matching the signal versus position characteristic of the power operator with those of related power devices in the same control system

Cam Characteristic Adjustment

This adjustment involves selecting or shaping the proper positioning cam in order to obtain that characteristic of piston (or valve) position versus control signal pressure which will afford the desired characteristic of controlled medium versus control signal pressure The definition of "controlled medium" as applied to this section is the rate of action of that medium (water, air, etc) being controlled



F GURE 14 Cam C, Square Relation

CONTROL SIGNAL PRESSURE		
Percent Value	Signal Value (psig)	
	Control System Ranges	
	3 15	3 27
0	3 0	3 0
10	4 2	5 4
20	5 4	7 8
30	6 6	10 2
40	7 8	12 6
50	9 0	15 0
60	10 2	17 4
70	11 4	19 8
80	12 6	22 2
90	13 8	24 6
100	15 0	27 0

TABLE 3 Conversion Tab e for Control System Ranges

Positioning cams A, B and C (Figure 11) are furnished with each Positioner (the B cam is shipped assembled in place and the A and C cam are included on the same part, but are inactive) The characteristics for which the cams are shaped are listed in Table 4 and are shown in Figures 12, 13 and 14 The figures show a family of curves for each cam, each curve representing a range adjustment when used with that specific cam Table 3 shows control signal pressure values of the two control system ranges equivalent to the signal range percent values in Figures 12, 13 and 14

If the system involves a single power operator, it is probable that the B (straight line) cam will be satisfactory However, one of the other cams may provide a more uniform controlled medium versus signal pressure characteristic, providing stable control over a wide range of operation with a given proportional band adjustment on the controller For a power operator which is an integral part in a complex control system, the cams provide a selection of characteristics which, when used in conjunction with the range adjustment, should allow close paralleling of the controlled medium versus signal pressure characteristic

Refer to "Characterized Cams" for selecting or shaping the proper positioning cam for a power operator which is to be part of a complex control system

Cam Selection

Depending upon nomenclature, the Positioner will be provided with one of two standard 3 obe cams The following table is a comparison of possible stroke lengths vs feedback drive arm hole locations for the Full Stroke 90° cam and the Half Stroke 45° cam

Feedback Arm Hole Position from Cam Shaft	Length of Stroke Inches	
	Full Stroke 90° Cam	Half Stroke 45° Cam
1	1	5
2	1 5	75
3	2	1
4	2 5	1 25
5	3	1 5
6	3 5	1 75
7	4	2

CHARACTERIZED CAMS

In order to match the inherent characteristics of the power operator to the final control device, it may be practical to reduce the controlled medium versus piston (or valve) position characteristic of each device in the system to a straight line relationship with regard to control signal pressure This straight line relationship is established by calibrating the Positioner with respect to the correct positioning cam by the following method

1 Use B (straight line) cam to determine actual controlled medium versus piston (or valve) characteristic (Figure 15)

2 Determine exact controlled medium versus control signal pressure characteristic desired (Figure 16)

3 Using values determined in steps 1 and 2, plot a curve to determine exact control signal pressure versus piston (or valve) position characteristic (Figure 17)

Positioning Cam, Any Stroke	Piston or Valve Position (P) vs Control Signal (I)	Figure No
A	Square Root ($\sqrt{P}$)	12
B	Straight Line (P)	13
C	Square (P^2)	14

TABLE 4 Positioning Cam Characteristics

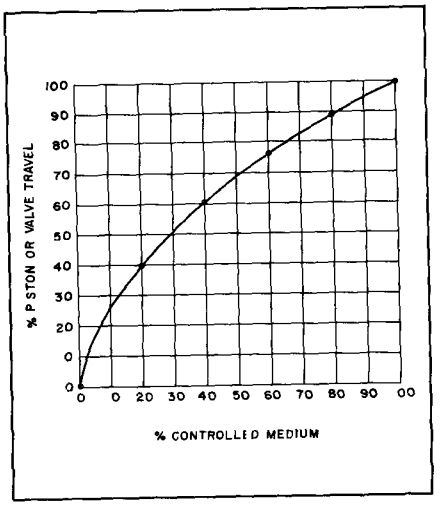


FIGURE 15 Regulated Dev ce Character stic

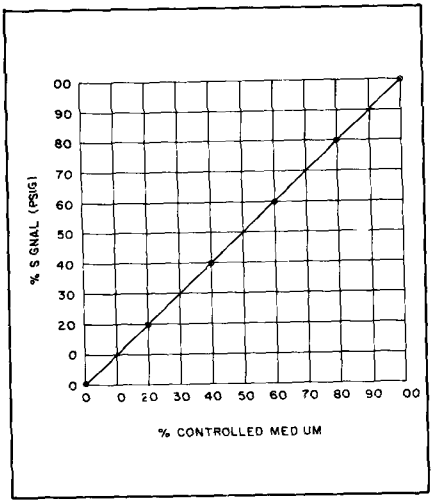


FIGURE 16 Desired Control

4 Compare curve plotted in step 3 with curves shown in Figures 12, 13 and 14 Select positioning cam whose characteristic most closely matches control signal pressure versus piston (or valve) characteristic plotted in step 3

5 If necessary, set range and zero adjustments to match control signal pressure versus piston (or valve) characteristic more accurately as outlined under "Zero and Range Adjustments"

6 If required characteristic cannot be ob tained using the above procedure, or if a more exact characteristic is required, alter shape of cam as outlined under "Cam Shaping Method"

Cam Shaping Method

To assist in the alteration process, cams are marked with radial lines (ndex of % piston or valve travel) and concentric lines (index of con trol signal pressure) The ten concentric lines on the cam correspond to actual control signal pressure values shown in Tible 3 for the specific control system signal range being used

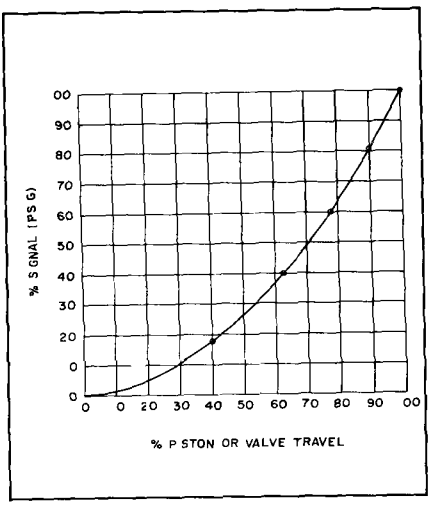


FIGURE 17 Cam Character st c

CAUTION Before cutting any cam, make certain cutting will involve REMOVAL OF CAM MATERIAL, rather than building up of material For example, if the characteristic plotted lies between the A and B cam (Figure 17 and 13) the A cam should be cut

1 Use cam selected in step 4 under "Characterized Cams" For each increment of control signal pressure (concentric lines), locate the piston (or valve) position (radial lines) required for specific control signal pressure Refer to Figure 18 for method of locating these points

CAUTION If a cam shape has too steep a rise there is danger of cam follower becoming locked Line printed on cam (part no 5327322 1) indicates the maximum rise which should be cut into the cam When a cam shape is required that includes such a rise, it is necessary to introduce sufficient angularity in the power operator device drive rod linkage to allow a less radical cam shape

2 A curve drawn thru points located on cam in step 1 above will be desired cam shape Either alter cam or cut new cam to this shape

NOTE An optional blank cam, Pt No 5327322 1 is available from Bailey Meter Company if alteration of the original cam is not desired

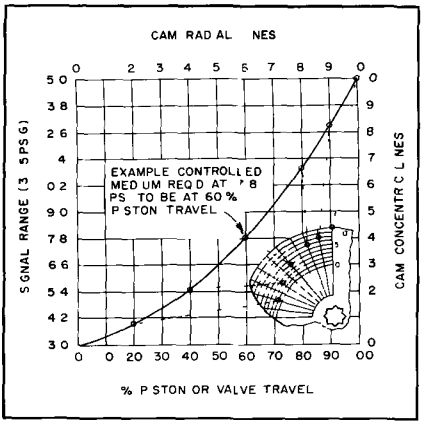


FIGURE 18 Locating Points for Shaping Positioner Cam for 3 15 psi Unit

Speed Adjustment

When the system involves only a single power operator, a high positioning speed is usually an advantage In a complex control system, however, it is generally desirable to operate all power devices at the same speed to avoid interaction between units or undesirable process conditions during control pressure changes If it is necessary to reduce the speed of operation, speed control orifices (0 040") are available as an option from Bailey Meter Company (Pt No 5327327 1) These orifices are installed directly into the output ports (O1 and O2) and have 1/4 inch NPT ports for connecting plumbing from the power operator If orifices are too small, they may be drilled out to obtain desired speed control Blank orifices (Pt No 5327327 2 are also available

HOW THE POSITIONER OPERATES

The Type AP2 Characterizable Pneumatic Positioner is a two-stage amplification, "push pull" action, force balance type control instrument, normally located in the control loop (Figure 19) between the controller and the final control element (valve actuator or cylinder assembly) A pneumatic input (3 15 psig or 3 27 psig) is applied to the Positioner to produce a power operator position which can be characterized for a particular application thru the use of a positioning cam A mechanical linkage connection to the piston (or valve) stem serves to feed back the actual stem position movement When the controller calls for the piston (or valve) to change position, the Positioner acts as a pneumatic relay, thru an independent air supply, and changes the piston (or valve) to its new required position

The Type AP2 Positioner can be applied to double acting cylinder assemblies where a load is applied to one side of the cylinder while simultaneously unloading the opposite side of the cylinder for a change in controller output By plugging one of the output connections (unused connection depends on application, Figure 3), the Type AP2 Positioner can also be used with single acting diaphragm actuators where a load is applied to top or bottom of the acutator for a change in controller output

PNEUMATIC AMPLIFIER RELAY ASSEMBLY
(Refer to Figure 20 and 21)

The Positioner's pneumatic amplifier is constructed in a "stack" design Several pneumatic

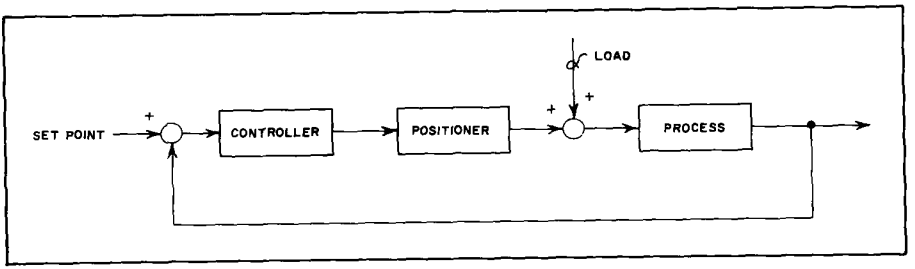


FIGURE 19 Block D agram of Type AP2 Pos t oner App cat on

chambers are formed by alternating fabric reinforced, elastomer diaphragms and aluminum spacers The outer spacers are secured by stainless steel bolts while the movable center sections are clamped together by flaring the ends of the aluminum guide tubes

When a change in control signal pressure is applied to the signal diaphragm assembly the distance between the vane a id nozzle changes As the vane moves, the nozzle backpressure will increase or decrease (depending on direction of the signal applied) and the entire relay assembly center structure will displace Movement of this center structure will open (or close) output valves O1 and O2

CAM AND LINKAGE
(Refer to Figure 20)

Power operator position is fed back to the Positioner for comparision with the input control signal pressure The feedback mechanism consists of 1) a drive rod which follows the motion of the power operator, 2) an adjustable, swivel ended drive arm which is driven by the drive rod, and 3) a cam and shaft which are driven by the adjustable drive arm The prime function of the cam is to permit characterization of the power operator position versus input control signal pressure

A series of alternate drive l nk attachment holes in the Positioner dr ve arm prov des for nominal strokes of 0 50 to 4 00 inches The drive arm may be repositioned in 45 degree increme nts with respect to the case (i e at midstroke the arm can be at any of eight positions which are parallel to or disp aced 45° re at ve to the sides of the Positioner) One of two cam configurat ons (45° or 90° rotation) are used, depending upon actuator stroke

Since the cam shaft and drive arm move as an assembly, cam motion is 45 or 90 degrees The cam base circle rad us is 1 30 inches and maximum rise is 0 90 inches In each case a square root cam A, straight line cam B and square cam C are stamped on one blank The Positioner is shipped with t he straight line cam B in position (red side facing out) By flipping the cam over and reversing output connections O1 and O2, a reverse acting application can be obtained

SEQUENCE OF OPERATION

NOTE Because of the variety of applications available with the Type AP2 Positioner, the description below will apply to a double acting cylinder assembly used in a direct acting applica tion The input control signal pressure being applied will be of an increasing nature Refer to

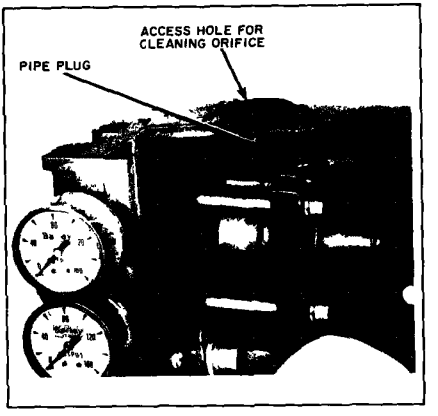


FIGURE 20 Type AP2 Pos tioner Components

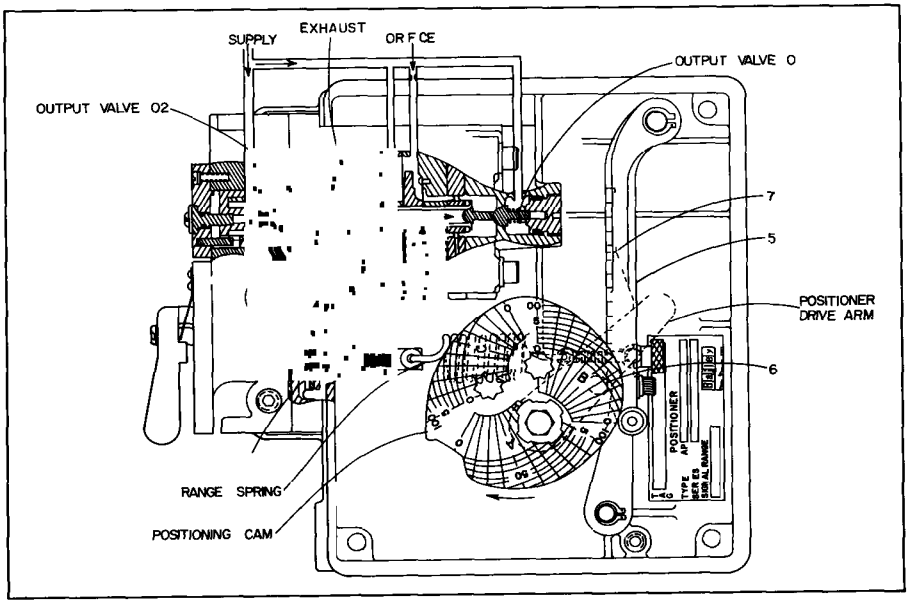


FIGURE 21 Cutaway V ew of Type AP2 Positioner

Figure 21 for identification of item numbers listed in parentheses below and as a guide for steps listing direction of movement (clockwise, counterclockwise right, left, etc) of various components

1 The controller sends out an increasing signal to change position of power operator piston

2 Increase in pressure applied displ aces signal diaphragm assembly (1), carrying vane assembly (2) away from nozzle (3)

3 Movement of vane away from nozzle de creases pressure in nozzle backpressure chamber, allowing supply pressure in opposing chamber to exert force on relay diaphragm assembly and move entire center structure (4) to the right

4 Displacement of relay assembly center structure creates the following reactions

a Opens output valve O1 to supply pressure, increasing pressure applied to one side of piston

b Opens output valve O2 to atmosphere, causing opposite side of piston to exhaust

c Amplifier vane begins to move to the right initiating a negative internal feedback which decreases tension on range spring and allows vane to move towards nozzle

5 Piston displaces because of differential pressure across O1 and O2 output ports Move ment of piston is fed back to Positioner by a drive rod which is connected to Positioner drive arm and positioning cam

6 Cam rotates clockwise and pushes follower assembly (5) Pivot assembly (6), connected to cam follower, then pushes on spring arm (7) which extends (stretches) range spring

7 As range spring extends, vane assembly is pulled toward nozzle until force exerted by range spring and force exerted on signal diaphragm assembly are equal When a "balanced" condition is obtained, relay assembly center structure will return to a neutral positior closing valves O1 and

O? nozzle backpressure wi l again return to 2/3 of supply pressure and piston position will be in equilibrium with input control signal pressure

A decreasing input control signal pressure from the controller reverses the sequence above, causing the piston to move in the opposite direction

For single acting diaphragm actuators, the sequence of operation is identical to the above example except that one output valve is made inoperative thru a valve adjustment procedure as outlined under "Output Pressure Level Adjustment" for single acting diaphragm actuators

INTEGRAL SHUTOFF AND EQUALIZING VALVE TYPE AP?□□1□
(Double Acting Cylinder Applications)

If Positioner is equipped with the integral shutoff and equalizing valve, the cylinder assembly may be manually or automatically operated as outlined below By turning the valve handle to HAND, supply pressure to the cylinder is cut off and O? and O1 are equalized allowing manual repositioning of the piston

Transfer from Manual to Automatic Operation

1 Valve handle should be in HAND position

2 If manual operator does not lock drive cylinder in position

a The piston must be positioned from prior knowledge of piston position versus signal or piston may "jump" when transferred to automatic

b Turn valve handle to AUTO position

3 If manual operator locks drive cylinder in position

a Switch valve to AUTO position Drive cylinder will oppose manual operator if drive position and input signal do not correspond

b Manually operate drive until load on manual operator decreases If output pressure gages are installed on Positioner, readings should equalize

NOTE If in step 3b it is desired that drive stay in initial position input signal must be adjusted to correspond with drive position as indicated by the load on manual operator, output pressures or prior knowledge of position versus signal

Transfer from Automatic to Manual Operation

1 Valve handle should be in AUTO position

2 If manual operator does not lock drive cylinder in position press safety latch and switch valve to HAND position Drive cylinder will move as determined by load if not restrained by hand lever

3 If manual operator locks drive cylinder in position transfer mechanism to manual Press safety latch and turn valve handle to HAND position

OPTIONAL BYPASS VALVE
(Single Acting Diaphragm Actuator Applications)

If Positioner is equipped with an optional bypass valve assembly (Figure 25) the actuator may be manually or automatically operated as outlined below Depending on application, the Positioner may be adjusted for either direct or reverse acting operation When applied for direct acting applications an increase in control signal pressure will cause an increase in control pressure to the actuator When applied for reverse acting applications an increase in control signal pressure will cause a decrease in control pressure to the actuator Determine the application to which the Positioner is being applied and follow the correct procedure

NOTE Supply valve stated in the following procedures is not supplied by Bailey Meter Co

Direct Acting Applications

To change from remote control to local manual control

1 Turn bypass valve to "BYPASS" position.

2 If the Positioner is to be serviced, close supply valve (supply valve not supplied by Bailey Meter Co)

To change from local manual control to remote control

1 Open supply valve

2 Turn bypass valve to "POSITIONER" position

Operate valves in this sequence to avoid a momentary pressure loss to the diaphragm actuator

When the valves are set for manual operation, control signal pressure goes to the signal diaphragm assembly and also thru the bypass valve to the actuator The actuator is supplied with signal pressure directly from the control system

The final control valve may be positioned either by signal pressure from the control system or preferably by manual operation of the Selector Station (if used) connected by the control pressure line to the Positioner

The Positioner cannot normally be transferred from automatic to manual or vice versa without disturbing the control system because the Positioner is usually calibrated to deliver control pressure to the diaphragm actuator which differs from control signal pressure received from the control system

To manually operate the contro valve by handjack

1 Pick up valve position with handjack

2 Close supply valve

3 Position valve using handjack

Reverse Acting Applications

WARNING WHEN ARRANGED FOR REVERSE ACTING APPLICATIONS SERIOUS DAMAGE COULD RESULT IF A "BYPASS" VALVE POSITION WERE USED AND CONTROL SIGNAL PRESSURE WERE INTRODUCED DIRECTLY TO THE DIAPHRAGM ACTUATOR THE CONTROL PRESSURE TO THE ACTUATOR DURING AUTOMATIC OPERATION IS THE OPPOSITE OF CONTROL SIGNAL PRESSURE FROM THE CONTROL SYSTEM TO THE POSITIONER TO EFFECT A BYPASS ARRANGEMENT, IT IS NECESSARY TO REVERSE THE CONTROL SIGNAL PRESSURE DURING MANUAL OPERATION OF THE POSITIONER THIS IS NOT PRACTICAL FOR THE SMALL AMOUNT OF TIME THAT THE POSITIONER WOULD BE ON MANUAL DURING NORMAL OPERATION

To change from remote control to local manual control

1 Pick up control valve position with hand jack

2 Close supply valve

3 Position valve using handjack

Position Transmitter Application

The AP2 Positioner may be used as a position transmitter, by generating a pneumatic signal which is a function of an input position The same combinations of signal ranges and stroke spans are available as are offered in the Positioner application (i e , 3 to 15 psig and 3 to 27 psig outputs for strokes from 0 5 to 4 inches)

The output signal may be made a square root, linear or square function of the input position thru use of the A, B or C portion of the cam respectively Other functions may be created thru special shaping of the cam

The AP2 may be made to function as a position transmitter by interconnecting the "E" input signal port with the "O2" output port and tapping into this interconnection for the output signal (Figure 26) A plug is placed in the "O1" output port Position transmitter kit number 537752 1 (Figure 26) provides the necessary hardware

A change in input (cam shaft position) causes a deflection of the range spring via the cam and linkage The resulting unbalance of forces between the signal capsule and the range spring causes a change in the "O2" output which is fed back to the signal capsule

The signal capsule now acts as a feedback element by opposing the input force from the range spring When the force from the "O2" pressure in the signal capsule equals the new range spring force the output will stabilize and will represent the desired function of the input position

Installation

Installation is similar to Positioner installation The device whose position is to be transmitted should be coupled to the position transmitter's cam shaft so as to cause a 90° rotation of the shaft for full travel of the device (45° for AP2□1□ □)

For a linear motion device (e g diaphragm actuators) the cam shaft is driven by the drive arm (Figure 22, item 38) and a connecting link (Figure 24 item 7) as in the Positioner application For a 90° rotation device it may be desirable to couple the cam shaft directly to the device

The "zero" position of the cam shaft can be adjusted in 45° increments by repositioning the cam on the shaft

The direction of the transmitted signal can be reversed by reversing the cam For example with the red side of the cam facing out, clockwise rotation of the cam viewed from the front of the unit, will cause an increasing signal Reversing the cam so that the black side faces out will result in a signal that decreases with clockwise rotation

Supply Pressure

Maintain a supply pressure, at the "S" connection, 5 psig above the maximum output pressure but not higher than 50 psig

Output and supply pressure gages may be installed in the positions labeled "G1" and "G2", respectively (Figure 2)

NOTE The device to which the position transmitter is applied must supply power to operate the transmitter mechanism Maximum torque to operate a 3 to 15 psi unit with a linear output is approximately 4 1/2 in lb Torque may be as high as 25 in lb for a square root characteristic and a 3 to 27 psi output with 50% suppression

Calibrating the Position Transmitter

Output Pressure Level Adjustment

Adjustable valve is set as follows

1 Connect a pressure gage to "O1" output port or to 1/8 in NPT port in "G2" position (Figure 2)

2 Position drive at mid stroke position

3 Turn adjustable valve screw (Figure 6, item 34) clockwise until "O1" pressure drops below supply pressure Now turn screw counter clockwise until supply pressure is reached on gage

4 Turn adjustable valve screw an additional one full turn counterclockwise

Zero and Span Adjustments

The following description is based upon a 3 to 15 psig output for "0" to 100% travel of the moving device

1 Install accurate pressure gage at output connection or at connection labeled "G1" (Figure 2)

2 Turn-on air supply

3 Slowly stroke drive to its "zero" position Adjust linkage between transmitter and drive such that Transmitter's cam follower is at zero on cam

CAUTION In stroking the drive, be certain that the linkage is not overstrained due to maladjustment

4 Slowly stroke drive to its 100% of travel position, taking care that linkage is free to move at all times, and is not strained due to maladjustment Adjust pivot position in drive arm (Figure 22, item 38) or other external linkage such that cam follower is at 100% of cam rotation (radial line marked "100" on cam)

5 Repeat steps 3 and 4 until cam follower is at 0° cam when drive is at 0% stroke and 100% cam when drive is at 100% stroke

6 Move drive to its 0% of stroke position If output is not 3 psig, loosen set screw located in recessed hole of knurled adjustment nut Turn nut (while keeping eye bolt from rotating) until a 3 psig output is achieved Tighten set screw

7 Move drive to its 100% of stroke position If output is not at 15 psig loosen range adjustment hold down screw (Figure 10) With hold-down screw retightened, slide pivot assembly along follower assembly until a 15 psig output is obtained

8 Recheck steps 6 and 7 until desired outputs are obtained

Large adjustments are provided in the zero and range adjustments so large deviations from the above calibration can be obtained

GENERAL SPECIFICATIONS

Standard Input Ranges	3 5 and 3 27 psig
Standard Stroke Range	0 5 in to 4 0 in Rotary input 45° and 90°
Gain*	250 to 300 with 50 psig supply pressure using standard gain range spring. Gain of 400 obtainable using optional high gain range spring. Refer to Table
Resolution*	0 1% of output span
Dead Band*	0 2% of input span
Hysteresis*	0 3% of output span
Supply Pressure	18 to 150 psig Minimum supply pressure should be maintained 5 0 psi above maximum required by actuator
Supply Pressure Effect	Diaphragm Actuators Average effect on actuator position 0 05% per 1 0 psi supply variation with 50 ± 10 psi supply Cylinders Negligible
Capacity	Greater than 25 scfm at 75 psig supply delivery and exhaust
Air Consumption	Diaphragm Actuators 0 12 scfm at balance with 20 psig supply pressure typical 0 75 scfm maximum 0 175 scfm at balance with 30 psig supply pressure typical 0 35 scfm maximum Cylinders 0 5 scfm at balance with 50 psig supply pressure typical 1 0 scfm maximum 1 5 scfm at balance with 150 psig supply pressure typical 3 0 scfm maximum
Temperature Limits	–40°F to +180°F (AP2 □□□0) 0 to +250°F (AP2 □□□1) Determined by material limitation
Mounting Position Effect	Can be adjusted for any position. With calibration

PRESSURE GAGES — TABLE 6

Gage Temperature Range	Range (psig)	Legend*	Gage Part No
–40°F to +160°F	0 30 0 160	Instrument Supply Output	5326605 1 5326605 2 5326605 3
–40°F to +250°F	0 30 0 160	Instrument Supply Output	5326605 4 5326605 5 5326605 6

*Instrument Supply and Output gages used on single acting devices. Instrument and two Output gages used on double acting devices. There are no previsions for mounting a Supply gage on double acting devices.

SPEED CONTROL ORIFICE — TABLE 8

Orifice Size (in)	Orifice Part No
040	5327327 1
Blank disc	5327327 2

TABLE 5

Vibration	Tested in accordance with MIL STD 167B 5 hours
Pneumatic Connections	1/4 NPT on supply signal and output connections 1/8 NPT on optional pressure gages
Size	0 750 x 3 0625 x 4 125 260 4mm x 230 2mm x 104 8mm
Weight	9 5 lb (4 3 kg)
Optional Accessories	PRESSURE GAGES for reading input signal, supply and output pressures. Refer to Table for part numbers and usage HIGH GAIN RANGE SPRING available for obtaining a gain factor of 400. Refer to Table for part numbers SPEED CONTROL ORIFICES regulates time constant of Positioner and final control element. Orifices are installed directly into Positioner output ports. Refer to Table V for part numbers and usage GAIN SUPPRESSION SPRING or element mating excessive overshoot of final control element. Refer to Table V for part numbers and usage POSITIONER MOUNTING KIT for mounting Positioner to direct or reverse acting diaphragm actuators only. Refer to Table V for part numbers BYPASS VALVE Part No 5326945 1 to single acting diaphragm actuator applications. Enables operator to use control element output signal to position actuator directly when servicing Positioner etc BLANK CAM Pt No 5327322 1) is available to adapt the Positioner to a particular application if cutting of original cam is not desirable

Typical performance characteristics of Positioner mounted on diaphragm actuator range spring in horizontal position when viewed with cover removed. Actual performance may vary with application.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

HIGH GAIN RANGE SPRING — TABLE 7

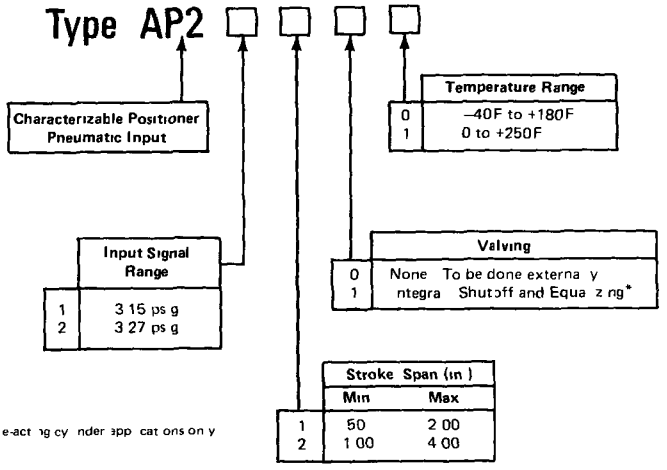
Range Spring Part No	No of Coils	Input Signal (psi)	Application
5327330 1	15	3 15	Optional high gain
5327330 2	14	3 27	Optional high gain
		3 15	*Standard gain
5327330 3	11	3 27	*Standard gain

*Standard gain 250 300 range springs are assembled in place and shipped with Positioner

GAIN SUPPRESSION KIT — TABLE 9

Application	Gain Suppression Kit Part No	
	Std Gain (250 300)	High Gain (300-400)
Cylinders with 50 in^3 or less displacement	5327328 1	5327328 2
Cylinders with 50 in^3 to 200 in^3 displacement	Not Reqd	5327328 1
Diaphragm actuators with high packing friction	5327328 1	5327328 2

EXPLANATION OF NOMENCLATURE



An "X" as a suffix to TYPE indicates that the Transmitter includes some special feature not covered by the standard Nomenclature

REPLACEMENT PARTS

Figure 22 is a parts drawing of the Type AP2 Characterizable Pneumatic Positioner Figure 23 is a parts drawing of the Positioner Assembly

These figures will normally apply to the unit furnished However, there may be individual differences in specific assemblies due to

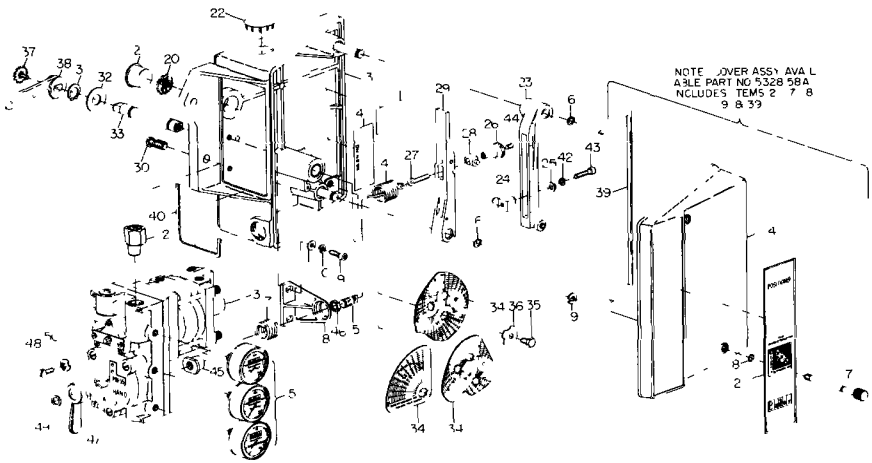
a Design changes made since the printing of this instruction section

b Special design of equipment furnished to make it suitable for special application

Therefore, when ordering individual parts, assure correct replacement by specifying on the order

1 Complete nomenclature, code number, part number, series label number and S O number of equipment for which parts are desired

2 The Parts Drawing Number on which each part is illustrated



TEM	PART NO	NAME
	SEE NOTE	NAMEPLATE
2	SEE NOTE	STYLE PLATE
3	5326600 □	POS T ONER RELAY ASSY
	OR	SEE PARTS DWG
	5328139 □	P88 3
4	SEE TABLE A	RANGE SPR NG
5	SEE TABLE B	PRESSURE GAGES OPT ONAL
6	SEE TABLE C	GA N SUPPRESS ON K T OPT ONAL NCLUDES TEMS 7 THRU
7	SEE TABLE D	SPR NG
8	5327329	RETA NER
9	250 20x 500	HEX SOC HD STN STL CAP SCR 2 REQD
0	250	STN STL REG SPR NG LKWASH 2 REQD
1	19734 18	SMALL WASHER 2 REQD
12	SEE TABLE E	SPEED CONTROL OR F CES OPT ONAL
13	5327405 2	BASE ASSY
14	5327406 1	COVER
5	9742 1	SPR NG RETA NER
6	197164 37	RETA N NG R NG 2 REQD
7	197552	COVER SCREW 2 REQD
8	53 428 3	O R NG 2 REQD
9	98 73 16	RETA N NG R NG 2 REQD
20	5327419	W RE MESH F LTER
21	1942339 4	CAPLUG
22	19981 2	BUTTON PLUG
23	5327408	FOLLOWER ASSY
24	5327440	P VOT ASSY
25	19734 44	SMALL WASHER
26	197423 1	ADJ STABLE NUT
27	197422	EYE BOLT
28	5327332	ADJ JSTABLE P VOT
29	5327409 2	SPR NG ARM
30	97591 2	PAN HD LONG LOK MACH NE SCR 2 REQD
31	97164 50	RETA N NG R NG 2 REQD
32	9734 45	SMALL WASHER 2 REQD
33	5326766	CAM SHAFT
34	5327239 1	CAM HALF STROKE TYPE AP2 □ 1□□ ONLY
	5327240 1	CAM FULL STROKE TYPE AP2 □ 2 □ □ ONLY
	5327322	BLANK CAM OPT ONAL
35	250 20x 375	HEX HD STN STL CAP SCR
36	48 4 1401 410*	STN STL SHKPRF LKWASH
37	197227	SPEC AL HEX HD SEMS SCR
38	5327445	DR VE ARM
39	SEE TABLE F	SEAL NG CORD 32 REQD
40	SEE TABLE F	SEAL NG STR P 18 REQD
41	1962883 1	WARN NG LABEL
42	190	STN STL REG SPR NG LKWASH
43	190 32x 875	HEX SOC HD STN STL CAP SCR
44	190 32x 87	HEX SOC HEADLESS STN STL OVAL PO NT SET SCR
45	5327331 1	S GNAL NUT
46	668460 1	SPEC AL NUT
47	5311459B1	HANDLE
48	164 32x 312	LG PAN HD STN STL MACH SCREW
49	64 32x 312	STN STL TYPE A PLA N WASHER
50	4808 09-4102	STN STL SHAKEPROOF WASHER

NOTE SPEC FY ALL NFORMAT ON ON NAMEPLATE AND STYLE PLATE WHEN ORDER NG REPLACEMENT PARTS

FIGURE 22 Parts Draw ng P88 30,

TABLE A ITEM 4

RANGE SPRING PART NO	NO OF COILS	INPUT SIGNAL (PSI)	APPLICATION
5327330 1	15	3 15	OPTIONAL HIGH GAIN RANGE SPRING
5327330 2	14	3 27	OPTIONAL HIGH GAIN RANGE SPRING
		3 15	STANDARD GAIN RANGE SPRING*
5327330 3	11	3 27	STANDARD GAIN RANGE SPRING*

*STANDARD GAIN 250 300 RANGE SPRINGS ARE ASSEMBLED IN PLACE AND SHIPPED WITH POSITIONER

TABLE B ITEM 5

GAGE TEMPERATURE RANGE	RANGE (PSIG)	LE[illegible]	[illegible]
-40F TO +160F	0 30 0 160 0 160	INSTRUMENT SUPPLY OUTPUT	[illegible]
-40F TO +250F	0 30 0 160 0 160	INSTRUMENT SUPPLY OUTPUT	5326[illegible] 532660[illegible] 5326606 6

*INSTRUMENT, SUPPLY AND OUTPUT GAGE USED ON SINGLE ACTING DEVICES. INSTRUMENT AND TWO OUTPUT GAGES USED ON DOUBLE ACTING DEVICES. THERE ARE NO PROVISIONS FOR MOUNTING A SUPPLY GAGE ON DOUBLE ACTING DEVICES

TABLE C ITEM 8

APPLICATION	GAIN SUPPRESSION KIT PART NO 5327328 1		GAIN SUPPRESSION KIT PART NO 5327328 2	
	POSITIONER WITH STANDARD GAIN (250 300)	POSITIONER WITH HIGH GAIN (300-400)	POSITIONER WITH STANDARD GAIN (250 300)	POSITIONER WITH HIGH GAIN (300-400)
CYLINDERS WITH 50 in³ OR LESS DISPLACEMENT	X			X
CYLINDERS WITH 50 in³ TO 200 in³ DISPLACEMENT		X	NOT REQUIRED	
DIAPHRAGM ACTUATORS WITH HIGH PACKING FRICTION	X			X

TABLE D ITEM 7

SPRING PART NO	USAGE
5326594 1	INCLUDED IN GAIN SUPPRESSION KIT (ITEM 8) PART NO 5327328 1
5326594 2	INCLUDED IN GAIN SUPPRESSION KIT (ITEM 8 PART NO 5327328 2

TABLE E ITEM 12

OPTIONAL SPEED CONTROL ORIFICE PART NO	ORIFICE SIZE IN
5327327 1	040
5327327 2	BLANK (DRILL TO SUIT)

TABLE F

TYPE	ITEM 38	ITEM 40	MATERIAL
AP2□□□□0	6614522 1H	5327724 1H	NEOPRENE
AP2□□□□1	6614522 2H	5327724 2H	SILICONE

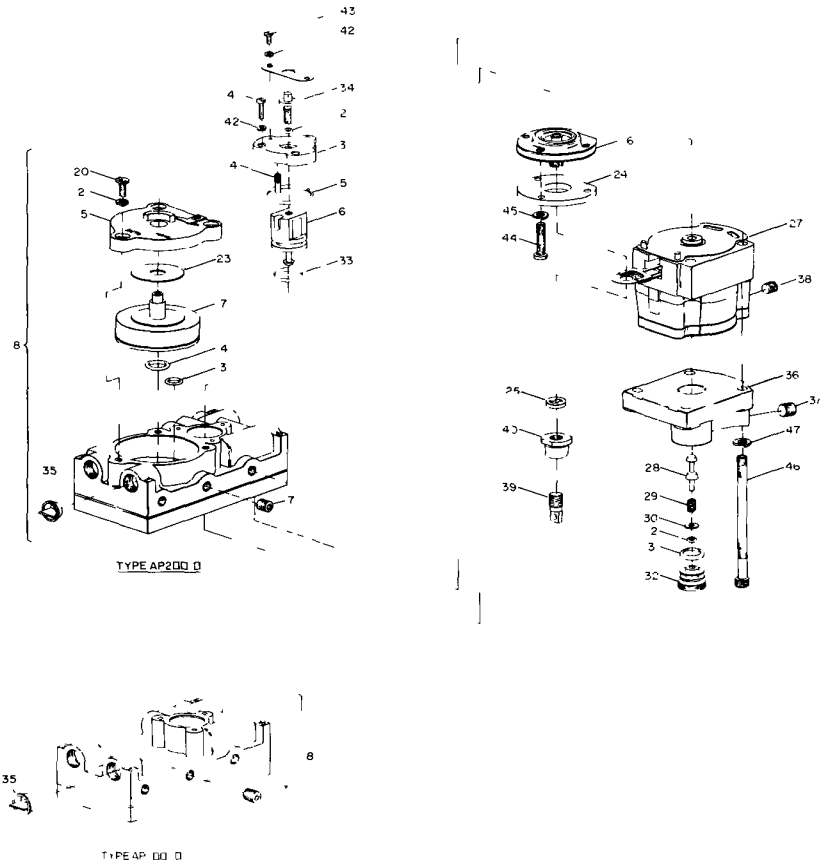


FIGURE 23 Parts Drawing P88 31,

ITEM	PART NO	NAME
1	5326682 *	SCREW RETAINER
2	SEE TABLE	O RING REQD
3	5326783	VALVE COVER
4	1975333 1	DOWEL PIN
5	SEE TABLE	O RING
6	SEE TABLE	VALVE SEAT ASSY
7	196 04 2	SOCKET HD PIPE PLUG 3 REQD
8	53 6 75	MANIFOLD ASSY FOR TYPE AP2□□0□
	5326775 2	MAN FOLD ASSY FOR TYPE AP2□□ 0 ONLY NCLUDES TEMS 3 THRU 23 27 35
	5326775 3	MAN FOLD ASSY FOR TYPE AP2□□ 1 ONLY NCLUDES TEMS 13 THRU 23 27 35
9	SEE TABLE	O RING 2 REQD
14	SEE TABLE	O RING 2 REQD
15	5326773	VALVE RETAINER ASSY

TEM	PART NO	NAME
17	5326792 1	VALVE ASSY
20	90 32× 500	PAN HD STN STL MACH SCR 3 REQD
21	90	STN STL SPRG LKWASH
22	197662 *	015 SHIM AS REQD AT ASSY 020 SHIM AS REQD AT ASSY 025 SHIM AS REQD AT ASSY
24	5326593 1	SIGNAL COVER
25	5326778 1	RETAINER
26	SEE TABLE	SIGNAL DIAPHRAGM ASSY
27	SEE TABLE	RELAY ASSEMBLY *
28	5326580	VALVE
29	5376599 1	VALVE SPRING
30	19734 20	SMALL WASHER
31	SEE TABLE	O RING
32	5326781 1	VALVE PLUG
33	SEE TABLE	O RING
34	5326575	ADJUSTMENT SCREW
35	1945750 1	PILLPLUG 4 REQD

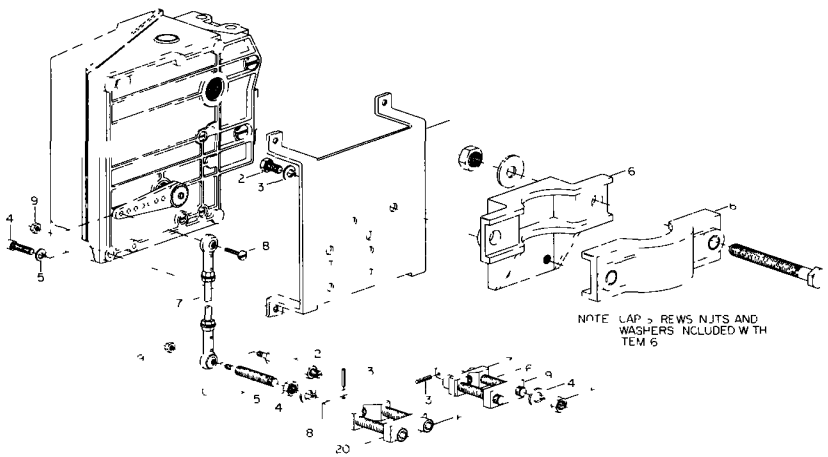
TEM	PART NO	NAME
36	5326603 1	BASE MANIFOLD ASSY NCLUDES TEM 37
37	195 04 2	SOCKET HD PIPE PLUG 2 REQD
38	95104 3	SOCKET HD PIPE PLUG
39	197497 *	SPRING RETAINER
40	5327331	SIGNAL NUT
41	1 40× 500	FILLISTER HEAD STN STL MACH SCR 3 REQD
42		STN STL REG SPRING LKWASH 5 REQD
43	112 40× 3 2	PAN HD STN STL MACH SCR 2 REQD
44	90 32×1 00	PAN HD MACH SCR 3 REQD
45	90	STN STL REG SPRING LKWASH 3 REQD
46	950 28×4 00	HEX SOC HEAD STN STL CAP SCR 4 REQD
47	950	STN STL REG SPRING LKWASH 4 REQD

NCLUDES TEM 38

TYPE	RELAY ASSY PART NO	TEM 2	TEM 5	TEM 6	TEM 13	TEM 14	TEM 26	TEM 27	TEM 31	TEM 33
AP2□□00	5326600 5	95 398	951398 5	5326785	OMIT	OMIT	5326788	5326790 1	951398 3	951398-4
AP2□□01	5326600 6	195 398 6	951398 0	5326785 2	OMIT	OMIT	5326788 2	5326790 2	951398-8	1951398 9
AP2□□10	5328 39 1	951398	95 398 5	5326785	951398 3	951398 3	5326788 1	5326790 1	951398 3	951398 4
AP2□□11	5328139 2	1951398-6	1951398 10	5326785 2	195 398 7	1951398-8	5326788 2	5326790 2	1951398-8	1951398 9

SPARE PARTS KITS TYPE	TEM 2	TEM 5	TEM 6	TEM 13	TEM 26	TEM 28	TEM 29	TEM 30	TEMS 14 & 31	TEM 33
KIT NO 258033 5										
AP2□□01	1951398 6	1951398 10	5326785 2		5326788 2	5326580 1	5326599	19734 20	1951398 8	1951398 9
KIT NO 258033 6										
AP2□□11	1951398 6	951398 0	5326785 2	1951398 7	5326788 2	5326580	5326599	19734 20	95 398 8	1951398 9
KIT NO 258033 7										
AP2□□00	1951398 1	951398 5	5326785 1		5326788 1	5326580 1	5326599	19734 20	195 398 3	195 398 4
KIT NO 258033-8										
AP2□□10	1951398 1	1951398 5	5326785 1	1951398 2	5326788 1	5326580 1	5326599	19734 20	1951398 3	1951398 4

Positioner Relay Assembly, Pt No 5326600 □ and 5328139 □



NOTE SEE TABLE FOR MOUNTING KIT PARTS REQUIRED

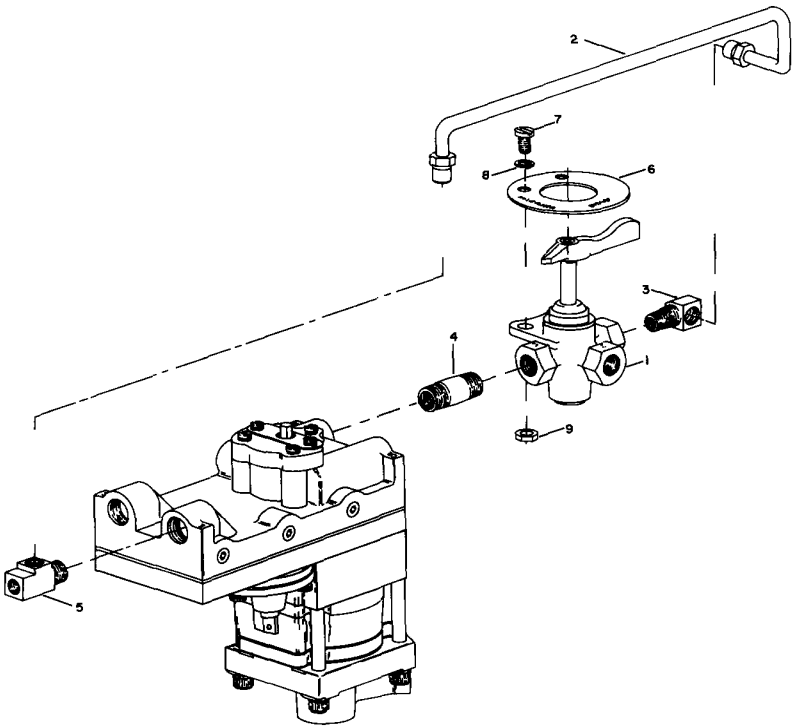
ITEM	PART NO	NAME	ITEM	PART NO	NAME	ITEM	PART NO	NAME
1	5327569 1	POSITIONER MTG BRKT	9	197 20A5	STOP NUT 2 REQD	16	375 16x 50	HEX SOC HD CAP SCR 2 REQD
2	312 18x 625	HEX SOC HD CAP SCR 2 REQD	10	5311690	ADJUSTABLE STUD 2 687 LG	7	5311687 2	STEM CLAMP 375 750 DIA
3	312	SPR LNG LKWASH 2 REQD	1	5311690 2	ADJUSTABLE STUD 3 437 LG	18	53 2483 1	STEM CLAMP (750 10 DIA
4	250 20x1 0	HEX SOC HD CAP SCR 4 REQD	12	5319500 1	ADJUSTABLE STUD (3 406 LG	19	5311691 1	CLAMP PLATE 375 750 DIA
5	250	SPR LNG LKWASH 4 REQD	13	125x 750	GROOV PIN	20	531247 1	CLAMP PLATE (750 10 DIA
6	*SEE NOTE*	*MTG BRKT (FOR VALVE YOKE W THOUT MTG BOSS*	14	375	SPR LNG LKWASH 3 REQD			
7	5312449-4	CONNECTING LINK CUT TO FIT)	5	375 16	HEX JAM NUT 3 REQD			
8	190 32x 188	PAN HD MACH SCR						

NOTE BRACKET AND ATTACHING HARDWARE NOT INCLUDED IN MOUNTING KIT IF NECESSARY TO MOUNT POSITIONER ON VALVE YOKE WITHOUT MOUNTING BOSSES ORDER OPTIONAL MOUNTING BRACKET PART NO 5313138 1

MTG KIT PART NO	USAGE	VALVE STEM DIAMETER	ITEM 1	2	3	4	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20
5327321 1	BALANCED	750 10	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X
5327321 2	BALANCED	375 750	X	X	X	X	X	X	X	X	X			X	X	X	X	X		X	
5327321 3	BALANCED	750 10	X	X	X	X	X	X	X	X		X		X	X	X	X		X		X
5327321-4	BALANCED	375 750	X	X	X	X	X	X	X	X		X		X	X	X	X	X		X	
5327321 5	FISHER	750 10	X	X	X	X	X	X	X	X			X								
5327321-6	FISHER	375 750	X	X	X	X	X	X	X	X			X								

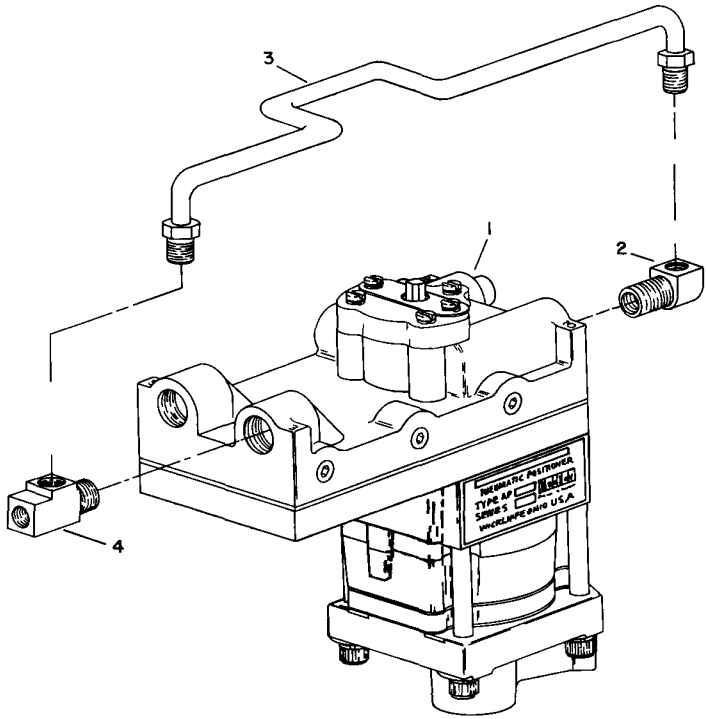
*FOR DIRECT OR REVERSE ACTING DIAPHRAGM ACTUATOR APPLICATIONS ONLY

FIGURE 24 Parts Drawing P88 28, Optional Mounting Kit, Pt No 5327321 □



ITEM	PART NO	NAME	ITEM	PART NO	NAME	ITEM	PART NO	NAME
	5327226 1	3 WAY VALVE	5	195171 3	WEATHERHEAD TEE	8	NO 10	REG SPR NG LKWASH 2 REQD
2	5326948 1	A RL NE CONNECT ON ASSY	6	1962833 1	DES GNAT ON PLATE			
3	195159 3	ELBOW CONNECTOR	7	190 32x 375	PAN HD MACH SCR 2 REQD	9	190 32	HEX NUT 2 REQD
4	95727 2	BRASS N PPLE						

F GURE 25 Parts Draw ng P88 24, Opt ona Bypass Va ve Assemb y for S ng e Act ng D aphragm Actuators, Pt No 5326945 1



KIT NO 5327252 1 ITEM	PART NO	NAME
	16 42 2	PIPE PLUG
2	65 873	ELBOW CONNECTOR
3	5327236	AIR LINE ASSY
4	95 7 6	WEATHERHEAD TEE

Figure 26 Parts Drawing P88 32, Optional Position Transmitter Conversion Kit, Pt No 5327252 1

Bailey Meter Company Wickliffe Ohio 44092, a subsidiary of Babcock & Wilcox, U S A

Bailey Meter Australia Pty Ltd Regents Park N S W Australia
Bailey do Brasil São Paulo Brazil
Bailey Meter GMBH Mannheim West Germany
Bailey Meter Company Ltd Port Credit Ontario Canada
Bailey Japan Company Ltd Tokyo Japan
Representatives Other Principal Cities