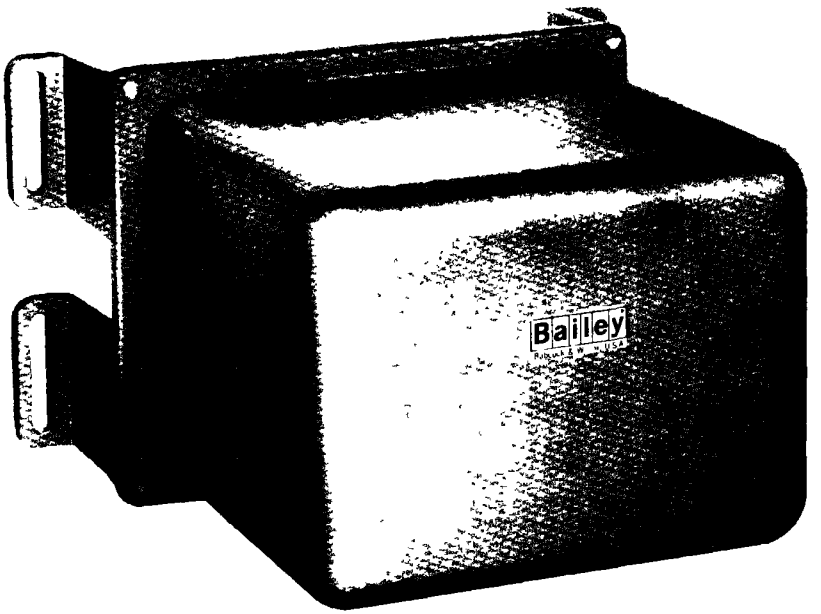


Function Generator Type AF

Bailey Babcock & Wilcox

WARNING

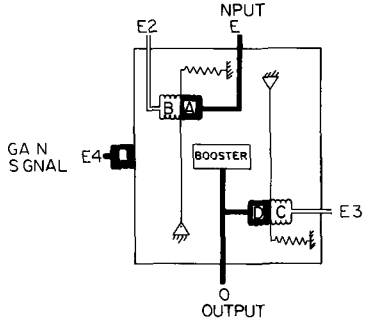
DO NOT INSTALL MAINTAIN OR OPERATE THIS EQUIPMENT WITHOUT READING UNDERSTANDING AND FOLLOWING PROPER Bailey Babcock & Wilcox INSTRUCTIONS AND MANUALS OTHERWISE INJURY OR DAMAGE MAY RESULT

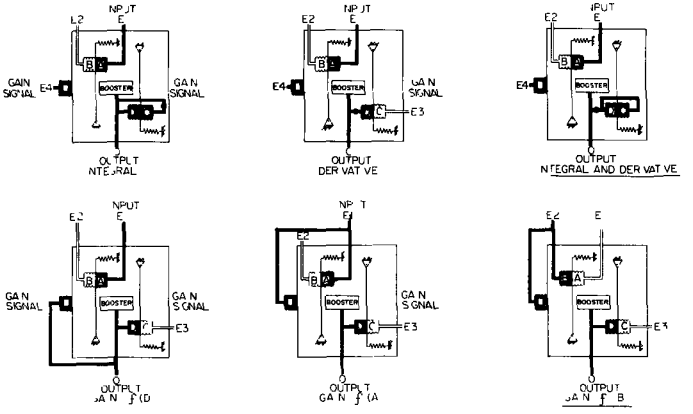
INDEX

BASIC FUNCTION GENERATOR

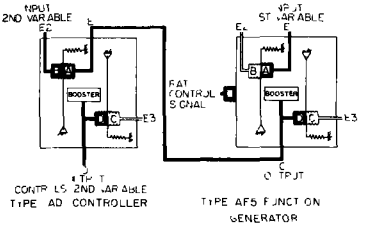
THE BASIC MINI LINE 500 FUNCTION GEN ERATOR IS A PROPORTIONAL ACTION CON TROLLER WITH AN EXTERNALLY SUPPLIED GAIN CONTROL SIGNAL

CONNECTION E2 CAN BE USED AS THE IN PUT FOR REVERSE PROPORTIONAL ACTION, AS AN OPTIONAL PNEUMATIC SET POINT OR FOR APPLYING THE SECOND INPUT FOR DIFFERENTIAL CONTROL APPLICATIONS ADDITIONAL CONTROL ACTIONS CAN BE ADDED TO THE BASIC FUNCTION GENERA TOR IF REQUIRED





SPECIAL APPLICATIONS THE FUNCTION GENERATOR CAN BE USED IN APPLICATIONS WHERE IT IS DESIRABLE TO HAVE THE GAIN VARY AS A FUNCTION OF THE OUTPUT OR AS A FUNCTION OF ONE OF THE INPUT SIGNALS



RATIO CONTROL THE FUNCTION GENERATOR CAN BE USED IN CONJUNCTION WITH A TYPE AD CONTROLLER TO PROVIDE RATIO CONTROL THE OUTPUT OF THE FUNCTION GENERATOR MODIFIED BY THE GAIN CONTROL (RATIO) SIGNAL BECOMES THE INPUT TO A PROPORTIONAL ACTION CONTROLLER REGULATING THE SECOND VARIABLE

FIGURE 1 - Type AF Function Generator Control Actions

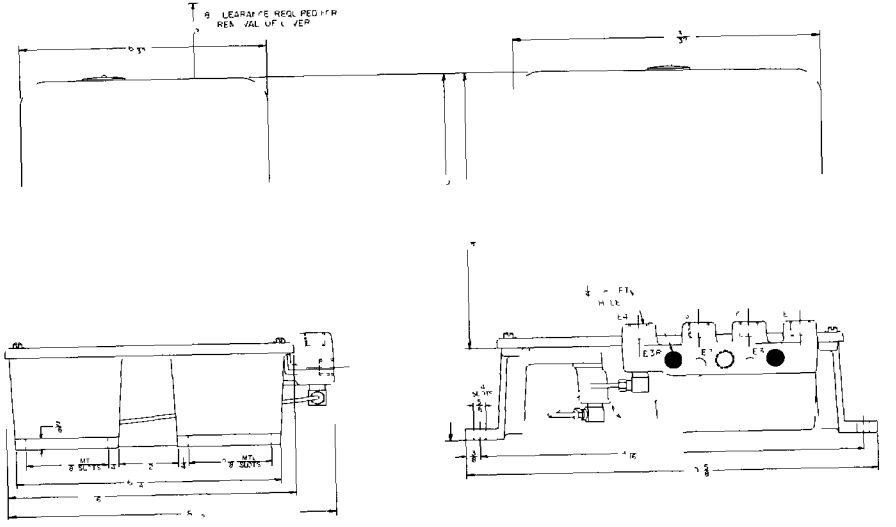


FIGURE 2 - Function Generator Mounting Dimensions

CONTROLLER FUNCTION OR ACTION	MOUNTING BASE CONNECTIONS*					DISC SWITCHES (SEE FIGURE 3)		DISC SWITCHES (SEE FIGURE 6)		PLUG IN UNITS (SEE FIGURE 6)	
	E1	E2	E3	E3R	O	D R	P P+I	Int	Der	Int	Der
Direct Prop	Input	Vent	Vent	Vent	Output	D	P	Closed	Open	None	None
Reverse Prop	Input	Vent	Vent	Vent	Output	R	P	Closed	Open	None	None
Differential	Input	Input	Vent	Vent	Output	D	P	Closed	Open	None	None
2 Element Controller	Input	Input	Input	Vent	Output	D	P	Closed	Open	None	None
Summing 2 Input	Input	Vent	Input	Vent	Output	D	P	Closed	Open	None	None
Integral (Floating)	Input	Vent	Output (1)	Plug	Plug (2)	D	P+I	None	Open	Closed	None
Diff Plus Integral	Input	Input	Output (1)	Plug	Plug (2)	D	P+I	None	Open	Closed	None
Prop Plus Integral	Input	Vent	Plug (3)	Plug	Output	D	P+I	None	Open	Closed	None
Diff Prop Plus Integral	Input	Input	Plug (3)	Plug	Output	D	P I	None	Open	Closed	None
Prop Plus Derivative	Input	Vent	Vent	Vent	Output	D	P	Closed	None	None	Open
Diff Prop Plus Der	Input	Input	Vent	Vent	Output	D	P	Closed	None	None	Open
Prop Plus Int Plus Der	Input	Vent	Plug (3)	Plug	Output	D	P+I(4)	None	None	Closed	Open
Diff Prop Int Plus Der	Input	Input	Plug (3)	Plug	Output	D	P+I(4)	None	None	Closed	Open

(1) Input for adjustment, output in service
(2) Output for adjustment plugged in service
(3) Input for calibration plugged in service
(4) P for adjustment P+I in service

*Air supply is connected to S in all cases
E4 is gain control signal

TABLE A Mounting Base Connections and Switch Settings

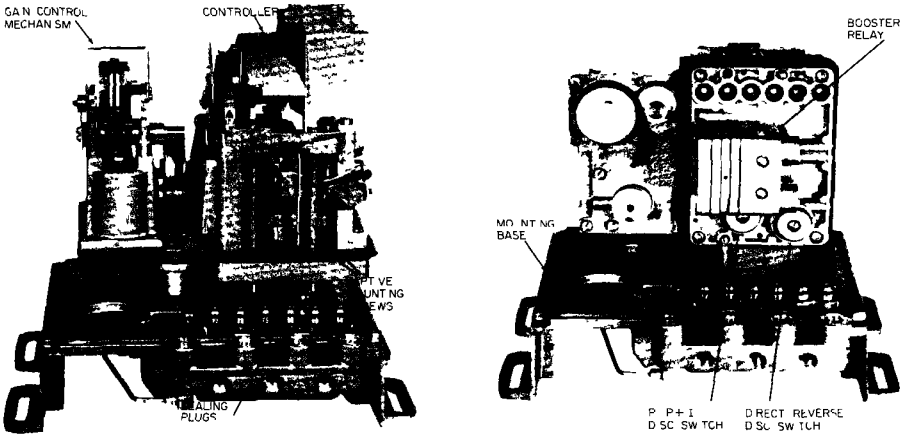


FIGURE 3 Removing Unit from Mounting Base

INSTALLATION

1. Remove cover from Function Generator unit. Remove Function Generator from mounting base by loosening captive mounting screws (Figure 3) and pulling assembly directly from base. *Remove locking knob from gain arm if* fitted for shipping (red tag).

2 Attach mounting base to wall or panel in accordance with dimensions given in Figure 2. Locate Function Generator not more than 400 feet from transmitters or final control elements

3 Make external connections to mounting base as required for particular service Refer to Figure 1 and Table A. Connecting tubing of copper or aluminum (028 to .032 inch wall thickness) or plastic tubing is recommended. (Connections are spaced to permit use of 1/4 inch NPT elbow connectors.)

4. Connect air supply to mounting base connection S '. 18 psig for 3 to 15 psig range, 30 psig for 3 to 27 psig range

5. On applications involving integral control action, plug manifold connections E3 and E3R (E3 must be used as an input to 'C ' bellows during adjustment as noted in Placing in Service".)

6 Make certain that D R disc switch on rear of Controller assembly (Figure 3) is in "D" position

7. Check position of P P+I disc switch. Switch should be in "P ' position for all applications which do not employ integral action. For integral control action, switch should be in "P+I" position

8 Mount Function Generator unit on mounting base by pressing firmly into position with sealing plugs (Figure 3) correctly aligned with holes in Function Generator assembly casting Tighten captive mounting screws to secure unit to mounting base

9. Check that integral and derivative switches or plug-in units are correctly set Integral switch or valve of integral plug-in unit must be in closed position Derivative switch or valve of derivative plug-in unit must be in open position (Valves of plug-in units are "open or closed ' when adjusting screw is turned to full clockwise or counterclockwise position respectively.)

10 Function Generator installation is complete However, do not replace cover assembly until necessary adjustments required for particular application are made in accordance with "Placing in Service" on page 6

PLACING IN SERVICE

SPECIAL FACTORY CALIBRATION

Function Generators which have been specially calibrated at the factory for a particular service (Type AF5□□□□X assemblies), can be placed directly in service after setting the integral and derivative units, if included, to the required rate of response However, it is recommended that the calibration be verified by applying several input pressures for which the desired output pressures are known (see calibration data sheet) If incorrect output pressures result, apply minimum input pressure to the unit and set the correct output with the gain control zero adjustment, Figure 4 Repeat the application of input pressures with known outputs. If output pressures are now correct, the unit may be placed in service If output pressures remain incorrect, the calibration has shifted and must be reset in accordance with the applicable following procedure

CONTROLLER NULL POINT ADJUSTMENT

The standard Function Generator is nulled at the factory with the minimum range pressure (3 psig for either range) applied to E1 bellows of the Controller If this is the desired null condition, the Function Generator can be placed in service after performing the applicable gain control mechanism adjustment outlined below

If the service for which the Function Generator is to be used requires a different null point (and the unit has not been handled as a 'Special Factory Calibration'), the Controller portion of the Function Generator assembly must be reset to the proper null point in accordance with the following procedure

IMPORTANT If the Controller has had the factory calibration disturbed, it must be completely recalibrated as outlined under Complete Calibration on page 31.

1 Disengage gain control mechanism from Controller assembly by loosening set screws holding flexible coupling to Controller gain arm shaft Figure 5

2 Make certain that D R disc switch on rear of Controller assembly (Figure 3) is in D position

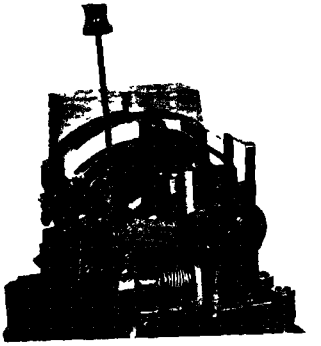


FIGURE 4 Gain Control Zero Adjustment

3. On applications involving integral control action, make certain that manifold connection E3R is plugged (Connection E3 will be used as an input to 'C' bellows during adjustment, but must be plugged in service)

4 Check position of P P + I disc switch Switch should be in P" position for all applications which do not employ an integral control action If an integral control action is used for particular application, switch should be in P + I position See Figure 3

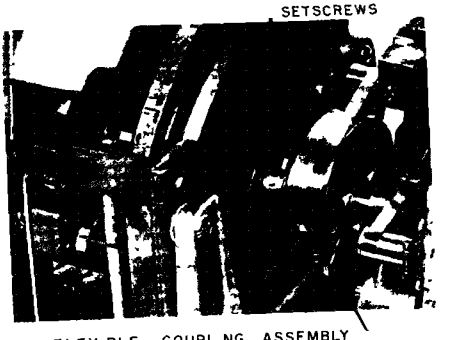


FIGURE 5 Disengaging Gain Control Mechanism

5. Check that integral and derivative switches or plug-in units are correctly set. Integral switch or valve of integral plug-in unit must be in closed position. Derivative switch or valve of derivative plug-in unit must be in open position. (Valves of plug-in units are "open" or "closed" when adjusting screw is turned to full clockwise or counterclockwise position respectively.) See Figure 6.

6. Set Controller gain at 1.0

7 Connect separate variable input pressures to input connections required for particular service. (Connection E3 is used as an input to "C" bellows for adjustment on applications that require integral control action. On integral action units, E3 must then be plugged at manifold when unit is placed in service.)

8 Apply midrange pressure to input connections If full range is not used in particular application, apply midrange pressure of actual input range employed, (i.e., for a range span of 3 to 11 psig, applied input pressure should be 7 psig.)

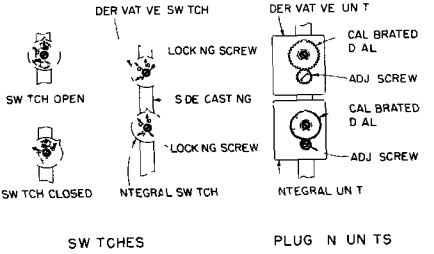


FIGURE 6 - Integral and Derivative Switches

9. Connect a pressure gage or manometer to output connection "O". Apply supply air to connection 'S"; 18 psig for a 3 to 15 psig range, 30 psig for a 3 to 27 psig range.

10 Turn A-B bias adjustment screw until tie plate hinges are in line with hinges on C-D beam (see upper beam alignment line, Figure 7).

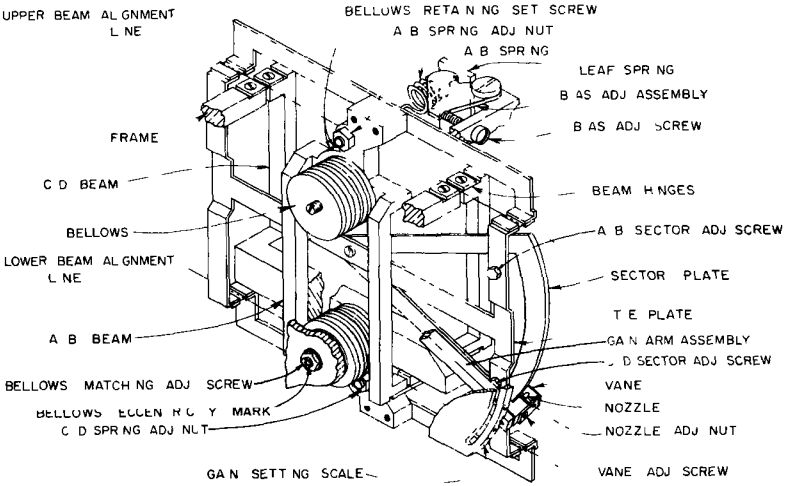


FIGURE 7 Controller Adjustments

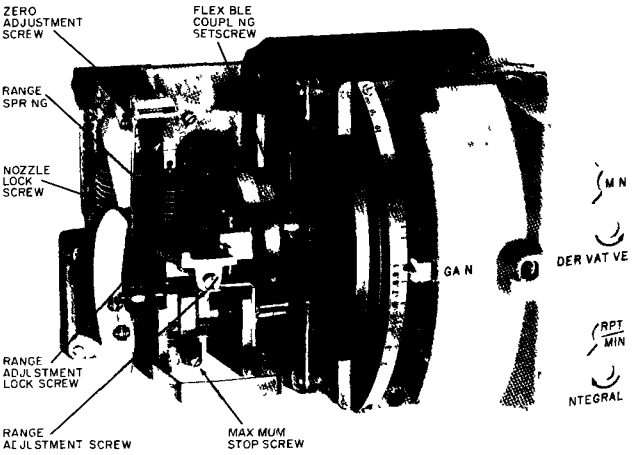


FIGURE 8 Gain Control Mechanism Adjustments

NOTE Do not turn bias screw if service involves inputs to both A and B bellows Correct matching of A and B bellows is set at factory (If bellows match has been destroyed, see Complete Calibration on page 31.)

11 Remove indicating panel (Item 20 in Figure 32 and turn C D sector screw until tie plate hinges are in line with hinges of A B beam (see lower beam alignment line, Figure 7)

12 Adjust output pressure to midrange with C D bias screw

NOTE Do not turn bias screw if service involves pressures in both C and D bellows (such as integral control action, differential applications, etc) Correct matching of C and D bellows is set at factory (If bellows match has been destroyed, see Complete Calibration on page 31)

13 Apply required null pressure to input connections as dictated by particular system application

14 Set gain at 0 2 Turn C D sector screw to obtain output null pressure

15 Set gain at 20 Turn A B sector screw to obtain output null pressure

16 Set gain at 1 0 and note output pressure. If output pressure is not equal to required null, unlock and rotate nozzle until output deviation is approximately doubled Lock nozzle in this position

NOTE Large nozzle adjustments may disturb parallel relationship of vane and sector plate. To readjust vane loosen vane adjustment screw (Figure 7) and slide vane support until vane appears to be approximately parallel to sector plate.

17 Repeat steps 14 thru 16 until gain may be shifted from 0 2 to 20 without changing output pressure more than 0 5 psig

18 Set gain at 1 0 Controller portion of Function Generator is now correctly nulled Refer to applicable heading below for adjustment procedure required for gain control mechanism

NOTE If Controller portion of Function Generator assembly cannot be nulled following above procedure, basic Controller alignment has been disturbed Reset Controller in accordance with procedures outlined under Complete Calibration on page 31

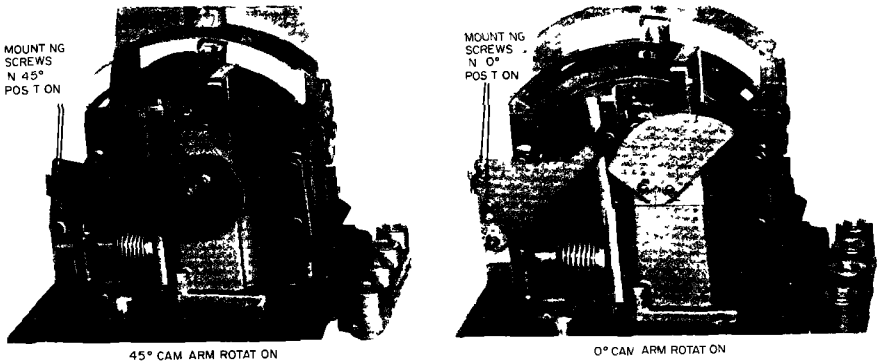


FIGURE 9 - Positioning of Zero Adjustment Assembly

GAIN CONTROL MECHANISM ADJUSTMENT

Linear Function, 45° Gain Arm Rotation, Direct Action

This is the standard factory calibration for the Function Generators.

1 Turn on supply air. Apply 3 psig air pressure to gain control signal bellows (connection E4).

2. Check position of cam follower roller on cam. If cam roller is not on cam zero mark (second line), rotate gain control zero adjust ment screw (Figure 8) until cam position is correct.

3. Apply air pressure to Controller "A" bellows (connection E1) 6 psig for 3 to 15 psig units, 9 psig for 3 to 27 psig units. Connect output connection "O" to a gage or manometer.

4 Output pressure should be 3.92 psig for 3 to 15 psig units; 4 84 psig for 3 to 27 psig units.

5. If output pressure is not correct loosen flexible coupling screws on Controller gain shaft and shift gain arm until output pressure is correct When correct output is obtained, retighten screw on flexible coupling assembly.

6. Apply maximum input, 15 psig or 27 psig, to gain control assembly bellows (connection E4) and note output pressure.

7. Output pressure should be 13 41 for 3-15 psig units and 23 82 for 3-27 psig units If output pressure is not correct, loosen range adjustment locking screw (Figure 8) and turn range adjustment screw to provide full range output.

8. Apply 3 psig to gain control bellows (connection "E4") and reset zero adjustment screw to obtain correct output pressure. 3.92 psig for 3 to 15 psig units, 4 84 psig for 3 to 27 psig units. (Rotate zero adjustment screw counterclockwise to lower output pressure.)

9. Repeat steps 6, 7, and 8 until output pressure range is correct. Tighten range adjustment locking screw.

10. Function Generator is now ready to be placed in service after connecting inputs as required for particular service and setting integral and derivative units, if employed, to desired speed of response.

NOTE. If Function Generator cannot be adjusted as outlined above basic Controller alignment has been disturbed. Reset Controller in accordance with applicable procedure outlined under "Complete Calibration" on page 31

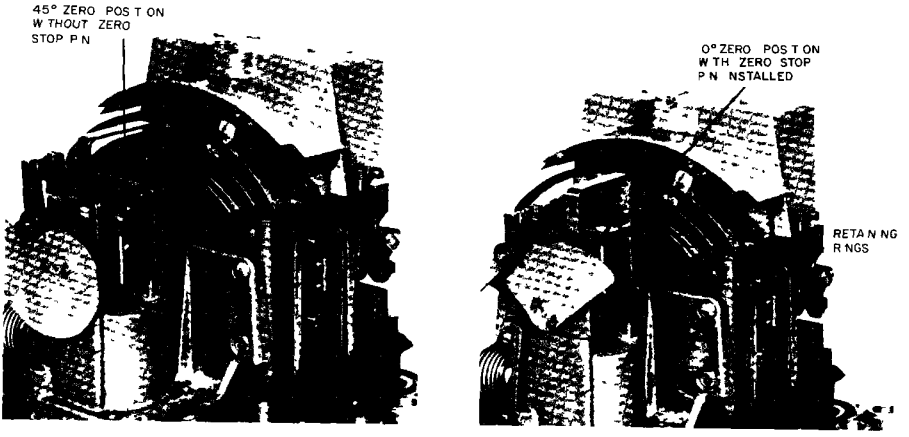


FIGURE 10 Installation of Zero Stop Pin

Linear Function, 10° Gain Arm Rotation, Direct Action

The 10° gain arm rotation arrangement is used to provide greater accuracy on applications where the desired function is covered by 10° of gain arm rotation or less For a linear function with a minimum range null, the Controller portion of the Function Generator remains as calibrated at the factory The gain control mechanism must be reset as follows

1 Remove two 4 40 screws holding zero adjustment assembly in 45° position on cam follower arm See Figure 9 Shift zero adjustment assembly to 10° position on cam follower arm (second and outside holes). Replace and tighten mounting screws.

2 Turn on supply air to Function Generator

3 Gain control assembly position shaft will move to fully extended position Install zero stop pin (Figure 10) Lock zero stop pin in position with two retaining rings

4 Turn off supply air to Function Generator.

5 Remove 45° gain arm rotation cam from gain control assembly and install 10° gain arm rotation cam Rotate cam to place position alignment line (first line on cam) to a point directly below cam follower arm roller Lock cam in this position (see Figure 11)

6 Apply 3 psig air pressure to gain control signal bellows (connection E4)

7 Loosen range adjustment locking screw (Figure 8) and turn range screw to position range spring approximately in line with zero adjustment assembly. Tighten range adjustment locking screw

8 Turn on supply air to Function Generator.

9. Check position of cam follower roller on cam If cam roller is not on cam zero mark (second line). rotate gain control zero adjustment screw (Figure 8) until cam position is correct

10. Apply air pressure to Controller A" bellows (connection E1) 6 psig for 3 to 15 psig units, 9 psig for 3 to 27 psig units Connect Function Generator output connection 'O to a gage or manometer

11. Output pressure should be 5.34 psig for 3 to 15 psig units, 7.68 psig for 3 to 27 psig units.

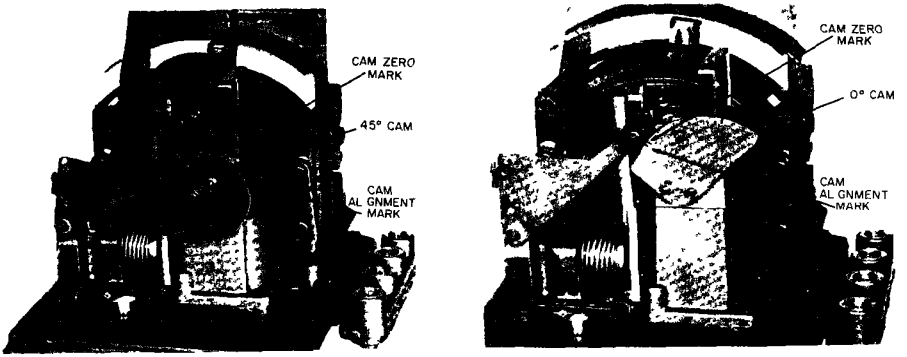


FIGURE 11 - Positioning Cam on Gain Control Mechanism

12. If output pressure is not correct, loosen flexible coupling screws on Controller gain shaft and shift Controller gain arm until output pressure is correct. When correct output is obtained, retighten screws on flexible coupling assembly. See Figure 5.

13. Apply maximum input, 15 psig or 27 psig, to gain control assembly bellows (connection E4) and note output pressure.

14. Output pressure should be 6.84 psig for 3 to 15 psig units. 10.68 psig for 3 to 27 psig units.

15. If output pressure is not correct, loosen range adjustment locking screw and turn range adjustment screw to provide correct output pressure (see Figure 8).

16. Apply 3 psig to gain control bellows (connection E4) and reset zero adjustment screw to obtain correct output pressure, 5.34 psig for 3 to 15 psig units, 7.68 psig for 3 to 27 psig units. (Rotate zero adjustment screw counterclockwise to lower output pressure.)

17. Repeat steps 13 thru 16 until output pressure range is correct. Tighten range adjustment locking screw.

18. Function Generator is now ready to be placed in service after connecting inputs as required for particular service and setting integral and derivative units, if employed, to desired speed of response.

NOTE If Function Generator cannot be adjusted as outlined above, basic Controller alignment has been disturbed. Reset Controller in accordance with applicable procedure outlined under "Complete Calibration" on page 31.

Linear Function, 45° Gain Arm Rotation, Reverse Action

1. Loosen set screw holding flexible coupling assembly to Controller Gain Arm Shaft and slide flexible coupling off shaft.

2. Remove four screws holding gain control mechanism to Controller.

3. Lift complete gain control mechanism free of Function Generator Assembly

4. With left thumb on inner radius of driven pulley below tape tension spring, rotate driven pulley clockwise. Lower tape will slacken. Remove lower tape with right hand and hold under slight tension

5 Rotate driven pulley about 330° counter clockwise from original position Upper tape will now become lower as in Figure 12 Reverse Action. (This is done without disengaging upper tape and spring)

6. Rotate original lower tape one more turn counterclockwise around driving pulley then pass up between pulleys and over top of driven pulley. Rotate driven pulley slightly to provide slack and engage tape.

7. Reinstall gain control mechanism on Function Generator assembly and tighten flexible coupling set screw

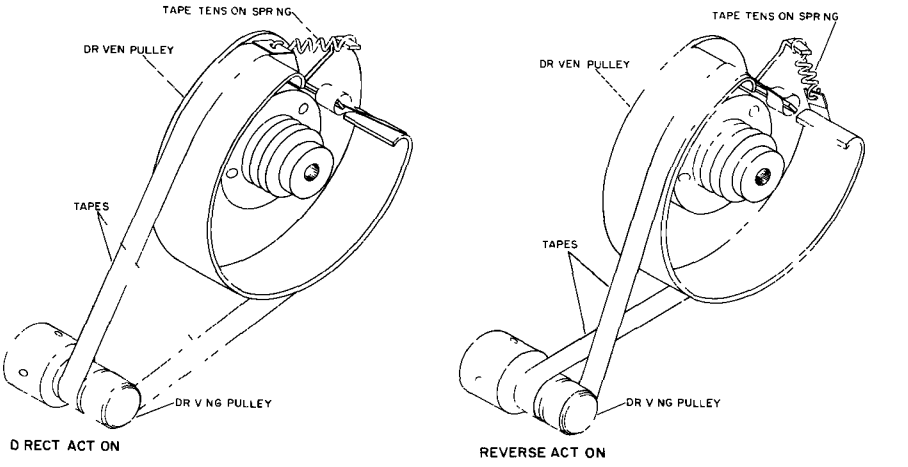


FIGURE 12 - Tape Drive Positions

8. Turn on supply air. Apply 3 psig air pressure to gain control signal bellows (connection E4).

9. Check position of cam follower roller on cam. If cam roller is not on cam zero mark (second line), rotate gain control zero adjustment screw (Figure 8) until cam position is correct.

10 Apply air pressure to Controller A bellows (connection E1): 6 psig (3 to 15 psig units) or 9 psig (3 to 27 psig units). Connect output connection 0 to pressure gage or manometer.

11. Output pressure should be full range Controller output, 13.41 psig or 23.82 psig.

12. To correct output pressure, loosen flexible coupling screws on Controller gain shaft and shift Controller gain arm until output pressure is correct. When correct output pressure is obtained, retighten screws on flexible coupling assembly.

13. Apply maximum input, 15 psig or 27 psig, to gain control assembly bellows (connection E4) and note output pressure.

14. Output pressure should be 3.92 psig for 3 to 15 psig units, 4.84 psig for 3 to 27 psig units. If output pressure is not correct, loosen range adjustment locking screw (Figure 8) and turn range adjustment screw to provide correct output.

15. Apply 3 psig to gain control bellows (connection E4) and reset zero adjustment screw to obtain correct output pressure, 13.41 psig for 3 to 15 psig units, 23.82 psig for 3 to 27 psig units. (Rotate zero adjustment screw counterclockwise to increase output pressure.)

16. Repeat steps 13, 14, and 15 until output pressure range is correct. Tighten range adjustment locking screw.

17. Function Generator is now ready to be placed in service after connecting required inputs for particular service and setting integral and derivative units (if employed) to desired speed of response.

NOTE: If Function Generator cannot be adjusted as outlined above, basic Controller alignment has been disturbed. Reset Controller in accordance with applicable procedure outlined under "Complete Calibration" on page 31.

Linear Function, 10° Gain Arm Rotation, Reverse Action

The 10° gain arm rotation arrangement is used to provide greater accuracy on applications where the desired function is covered by 10° of

gain arm rotation or less For a linear function with a minimum range null, the Controller portion of the Function Generator remains as calibrated at the factory The gain control mechanism must be reset as follows

1. Remove two 4 40 screws holding zero adjustment assembly in 45° position on cam follower arm. See Figure 9. Shift zero adjustment assembly to 10° position on cam follower arm (second and outside holes) Replace and tighten mounting screws.

2. Turn on supply air to Function Generator.

3. Gain control assembly piston shaft will move to fully extended position. Install zero stop pin (Figure 10) Lock zero stop pin in position with two retaining rings.

4. Turn off supply air to Function Generator

5. Remove control gain mechanism from Function Generator assembly (step 1 thru 3 on page 11).

6. With left thumb on inner radius of driven pulley below tape tension spring, rotate driven pulley clockwise. Lower tape will slacken. Remove lower tape with right hand and hold under slight tension.

7. Rotate driven pulley about 330° counter clockwise from original position. Upper tape will now become lower as in Figure 12 Reverse Action. (This is done without disengaging upper tape and spring.)

8. Rotate original lower tape one more turn counterclockwise around driving pulley then pass up between pulleys and over top of driven pulley. Rotate driven pulley slightly to provide slack and engage tape.

9. Remove 45° gain arm rotation cam from gain control assembly and install 10° gain arm rotation cam. Rotate cam to place position alignment line (first line on cam) to a point directly below cam follower arm roller. Lock cam in this position. (Refer to Figure 11.)

10. Reinstall gain control mechanism of Function Generator assembly.

11. Apply 3 psig air pressure to gain control signal bellows (connection E4).

12. Loosen range adjustment locking screw (Figure 8) and turn range screw to position range spring approximately in line with zero adjustment assembly. Tighten range adjustment locking screw.

13. Turn on supply air to Function Generator.

14. Apply 3 psig air pressure to gain control signal bellows (connection E4).

15. Check position of cam follower roller on cam. If cam roller is not on zero mark (second line), rotate gain control zero adjustment screw (Figure 8) until roller position is correct.

16. Apply air pressure to Controller A bellows (connection E1) 6 psig for 3-15 psig units, 9 psig for 3 to 27 psig units. Connect output connection 0 to a pressure gage or manometer.

17. Output pressure should be 6.84 psig for 3 to 15 psig units, 10.68 psig for 3 to 27 psig units.

18. To correct output pressure, loosen flexible coupling screws on Controller gain shaft and shift Controller gain arm until output pressure is correct. When correct output pressure is obtained, retighten screws on flexible conpling assembly.

19. Apply maximum input, 15 psig or 27 psig, to gain control assembly bellows (connection E4) and note output pressure.

20. Output pressure should be 5.34 psig for 3 to 15 psig units, 7.68 psig for 3 to 27 psig units. If output pressure is not correct, loosen range adjustment locking screw (Figure 8) and turn range adjustment screw to provide correct output.

21. Apply 3 psig to gain control bellows (connection E4) and reset zero adjustment screw to obtain correct output pressure 6.84 psig for 3 to 15 psig units; 10.68 psig for 3 to 27 psig units. (Rotate zero adjustment screw counterclockwise to increase output pressure.)

22. Repeat steps 19, 20, and 21 until output pressure range is correct. Tighten range adjustment locking screw.

23. Function Generator is now ready to be placed in service after connecting required inputs for particular service and setting integral and derivative units, if employed, to desired speed of response.

NOTE: If Function Generator cannot be adjusted as outlined above, basic Controller alignment has been disturbed. Reset Controller in accordance with applicable procedure outlined under "Complete Calibration' on page 31.

Non-Linear Function, Direct or Reverse Action

The following procedure is intended for use where a blank cam is to be cut for a specific function. If a special calibration unit (Type AF□□□□□X) is involved, the cam has been cut at the factory. Refer to "Special Factory Calibration" on page 6 for information on placing the unit in service.

For service involving a specific function with a 3 psig null, the Controller portion of the Function Generator remains as calibrated at the factory. The gain control mechanism must be reset and a blank cam must be shaped in accordance with the following procedure (If the Controller null is to be other than 3 psig, the null point must be reset in accordance with "Controller Null Point Adjustment on page 6 before proceding.)

1 State desired function in terms of Controller input pressures and outputs desired

2 Determine required Controller gain settings in accordance with following formula

$$\text{Gain} \quad \frac{\Delta D - \Delta C}{\Delta A - \Delta B}$$

Where

- ΔA change in pressure in A Bellows
- ΔB change in pressure in B Bellows (if employed)
- ΔC change in pressure in C Bellows (if employed)
- ΔD change in pressure in D Bellows (Controller output)

3. Gain control action is 'direct" if an increase in gain control signal pressure is to produce an increase in Controller gain. If desired function requires a decrease in gain on an increase in gain control signal pressure, unit must have 'reverse' gain control action. On reverse action gain control applications only, direction of gain arm rotation must be reversed as follows

Refer to Figure 12.

a. With left thumb on inner radius of driven pulley below tape tension spring, rotate driven pulley clockwise Lower tape will slacken Remove lower tape with right hand and hold under slight tension

b Rotate driven pulley about 330° counterclockwise from original position. Upper tape will now become lower as in Figure 12 Reverse Action (This is done without disengaging upper tape and spring)

c Rotate original lower tape one more turn counterclockwise around driving pulley then pass up between pulleys and over top of driven pulley. Rotate driven pulley slightly to provide slack and engage tape.

4. Plot gain control bellows input vs required Controller gain on Graph A.

5. Determine total gain arm rotation required for function by subtracting value on right hand scale corresponding to minimum gain from value corresponding to maximum gain of plotted function.

6 If gain value is between 10° and 45°, proceed with step 7. If gain value is 10° or less, modify gain control mechanism as follows

a. Remove two 4-40 screws holding zero adjustment assembly in 45° position on cam follower arm See Figure 9 Shift zero adjustment assembly to 10° position on cam follower arm (second and outside holes). Replace and tighten mounting screws

b. Turn on supply air to Function Generator

c. Gain Control piston shaft will move to fully extended position Install zero stop pin (Figure 10) Lock zero stop pin in position with two retaining rings.

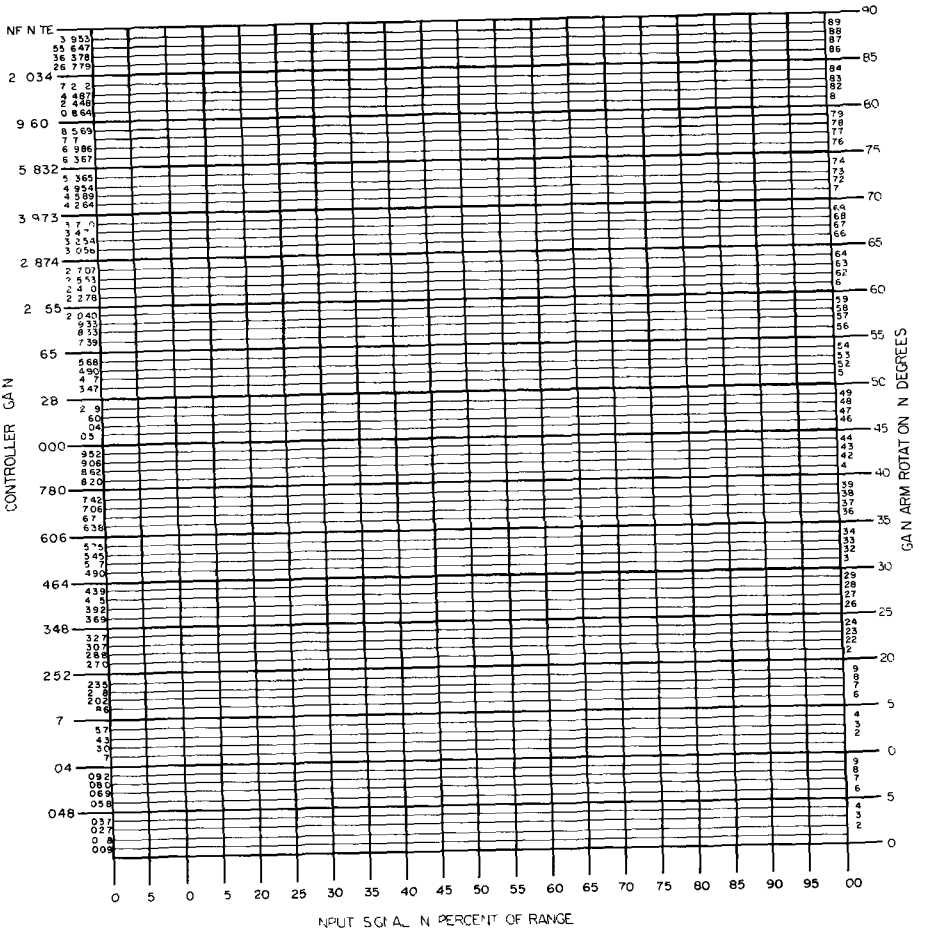
d Turn off supply air to Function Generator

7. Determine slope of plotted function at intervals of 5% of gain control signal. The slope of the plotted function is the difference between highest and lowest value from right hand scale corresponding to particular 5% input change.

8. Value determined in step 7 must not exceed 6.6 or be less than 0.21 for any 5% input change interval. If desired function is not within these limits, function cannot be performed unless it is modified so that sections of curve beyond 6.6 or less than 0 21 are eliminated. (These figures represent maximum and minimum workable cam rise limitations.)

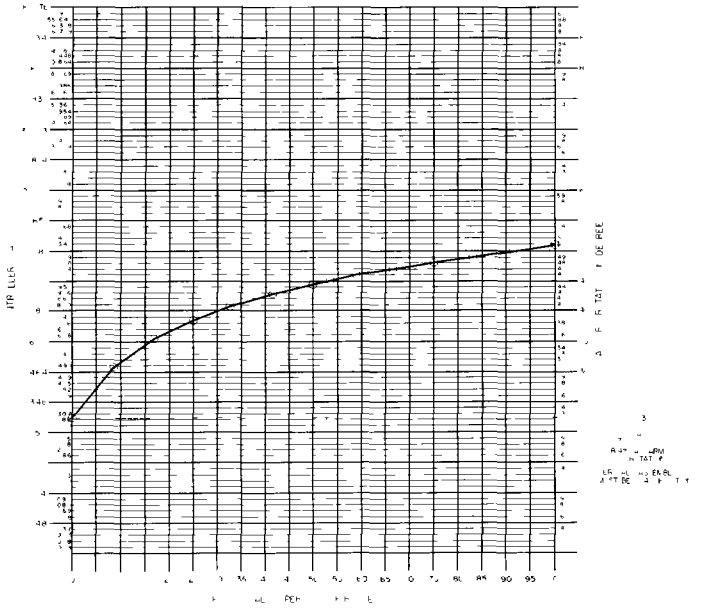
9. Remove 45° gain arm rotation cam from gain control assembly and install blank gain arm rotation cam.

10. Loosen range adjustment locking screw (Figure 8) and turn range screw to position range



IMPORTANT: The plotted curve of the desired function must be a continuous line and may not change direction. (The sign of the slope must remain constant for any point although the value of the slope may change with the function) An example showing the application of this graph to a typical function is given on page 16

GRAPH A Function Generator Gain vs Input Limits



A	B	C
E4 INPUT PSIG	DESIRED GAIN	% INPUT RANGE
3 00	2937	0
5 00	4867	8 33
7 00	6184	6 66
9 00	7236	25 00
11 00	8150	33 33
13 00	8974	41 66
15 00	9719	50 00
15 80	1 0000	53 33
17 00	1 0408	58 33
19 00	1 1055	66 66
21 00	1 1667	75 00
23 00	1 2248	83 33
25 00	1 2805	91 66
27 00	1 3340	100 00

D	E	F	G
INPUT INCREMENT	MINIMUM ROTATION	MAXIMUM ROTATION	ACTUAL ROTATION
0 5%	22 3	27 0	4 7
5 10%	27 0	31 7	4 7
10 15%	31 7	34 4	2 7
15 20%	34 4	36 7	2 3
20 25%	36 7	38 4	1 7
25 30%	38 4	39 9	1 5
30 35%	39 9	41 2	1 3
35 40%	41 2	42 4	1 2
40 45%	42 4	43 5	1 1
45 50%	43 5	44 4	9
50 55%	44 4	45 2	8
55 60%	45 2	46 0	8
60 65%	46 0	46 8	8
65 70%	46 8	47 5	7
70 75%	47 5	48 2	7
75 80%	48 2	48 8	6
80 85%	48 8	49 4	6
85 90%	49 4	49 9	5
90 95%	49 9	50 3	4
95 100%	50 3	50 7	4

1 STATE DESIRED FUNCTION IN TERMS OF GAIN CONTROL INPUT COLUMN A AND DESIRED CONTROLLER GAIN (COLUMN B

2 CALCULATE PERCENT OF INPUT RANGE (COLUMN C AND PLOT FUNCTION ON GRAPH A

3 DETERMINE ACTUAL GAIN ARM ROTATION (COLUMN G BY SUBTRACTING MINIMUM ROTATION (COLUMN E FROM MAXIMUM ROTATION (COLUMN F) FOR EACH 5% INCREMENT OF INPUT RANGE (COLUMN D GAIN ARM ROTATION VALUES ARE READ ON RIGHT HAND SCALE OF GRAPH A

4 SINCE ALL VALUES IN COLUMN G LIE BETWEEN 21 AND 6 6 GAIN CONTROL CAM CAN BE SHAPED TO PROVIDE THIS FUNCTION

EXAMPLE A *Method of Checking Desired Function*

spring approximately in line with zero adjust ment assembly. Tighten range adjustment locking screw.

11. Connect an accurate gage or manometer to output connection 'O" Connect a variable pressure input and a gage or manometer to each Controller input and to gain control input E4. Turn on supply air.

12. Supply maximum inputs to Controller and gain control mechanism for which there is a known output.

13 Scribed line on blank cam should be dir ectly below follower arm roller. If not, set line beneath follower arm roller by turning zero ad justment screw (Figure 8).

14. Loosen set screws on flexible coupling assembly to free Controller gain arm See Fig ure 5. Position gain arm to provide correct known output. Lock gain arm in this position by retightening set screws of coupling assembly.

15. Apply next lower input condition to all inputs and mark cam at point of contact with cam follower arm roller.

16. Adjust input to gain control mechanism (input to E4) until correct output pressure is ob tained. Mark cam with a radial line from center to point of contact with cam follower arm roller.

17. Measure distance from cam center to point marked in step 15. Scribe this distance on radial line marked in step 16

18. Repeat steps 15, 16 and 17 for each decending increment of inputs for which there is a known output until piston shaft hits minimum stop

19. Remove all pressure from Function Generator and remove blank cam.

20. Connect points scribed on radial lines with a smooth continuous curve. At last radial line, continue curve parallel to remaining blank cam slope.

21. Begin shaping cam. Cut cam 1/16 inch outside of scribed curve except at highest point (maximum input). Highest point is used as reference and must not be changed. Do not attempt to complete cam shaping operation in one or two cycles of pressure applications. Remove cam material only in small amounts until desired accuracy for input-output relationship is attained.

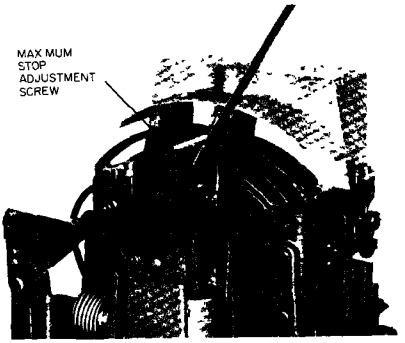


FIGURE 13 - Maximum Stop Adjustment

NOTE Take care, when finishing cam, not to bend it and to avoid making a series of flat increments instead of a smooth curve Draw file along edge of cam, with curve, rather than across edge. After filing is completed, smooth edge of cam with progressively finer grits of emery cloth Finish edge of cam with crocus cloth.

22. Replace blank cam on gain control mechanism and tighten mounting screws.

23. Turn on supply air. Supply maximum inputs to Controller and gain control mechanism for which there is a known output.

24. If output pressure is not correct, turn zero adjustment screw (Figure 8) until correct output pressure is obtained

25. Repeat steps 13 thru 22 until desired function is generated by shaped cam.

26. Apply maximum input to gain control connection E4 and adjust maximum stop (Figure 13) to obtain approximately 1/16-inch clearance between maximum stop screw and maximum stop bracket.

27. Function Generator is now ready to be placed in service after connecting inputs as required for particular service and setting integral and derivative units, if employed, to desired speed of response.

NOTE· If Function Generator cannot to adjusted as outlined above, basic Controller alignment has been disturbed. Reset Controller in accordance with applicable procedure outlined under 'Complete Calibration" on page 31.

MAINTENANCE

The air supply to the Function Generator must be kept free of dirt, oil, and moisture for satisfactory operation. Inspect the felt filters in the Function Generator mounting base and replace them if they are dirty. These filters are included as added protection only and are not intended to supplement the required clean air supply.

All pressure connections must be kept air tight. Periodically check all air pressure connections for leakage with a soapsuds solution.

If the Function Generator is not operating satisfactorily, refer to applicable heading on fault correction chart below.

FAULT CORRECTION CHART

FAULT	CAUSE	CORRECTION
CONTROLLER		
Controller unstable	a. Interference of parts	a. Adjust clearance or replace parts as necessary.
Unit has insufficient sector plate adjustment	a. Hinges out of alignment	a. Reset hinge alignment (page 31 step 8)
Gain adjustment rough and unrepeatable	a. Excessive bearing end play	a. Replace bearing assembly.
Bellows cannot be matched	a. Hinges out of alignment	a. Reset hinge alignment (page 31 step 8).
Controller inoperable	a No air supply b Booster orifices clogged c. Vane not touching nozzle d Dirty air supply e Derivative switch is closed	a Check supply connection. b Depress orifice cleanout plungers WARNING Do not depress plunger if Type AF is used with a selector station, unless station is in manual operation c Reposition vane d Replace booster and blow out lines e Check derivative switch
Non-linearity	a. Hinges out of alignment b. A-B bellows not matched	a. Reset hinge alignment (page 31 step 8). b. Match bellows (see page 31).
Poor sensitivity	a. C D bellows not matched b. Leak in output line	a. Match bellows (see page 31) b. Check and repair line
Set Point changes with integral adjustment	a. Leak beyond integral valve (C bellows)	a Check seals and repair or replace bellows.
Integral Time not equal in both directions	a Leak beyond integral valve (C bellows)	a. Check seals and repair or replace bellows
Derivative Time not equal in both directions	a Leak beyond derivative valve (D bellows)	a Check seals and repair or replace bellows

FAULT	CAUSE	CORRECTION
GAIN CONTROL MECHANISM:		
Controller gain arm does not follow changes in gain control signal	a. Coupling assembly locking screw loose	a Tighten coupling assembly screws (see Figure 5)
	b. Broken drive tapes	b Check condition of gain arm drive tapes. Replace if necessary (see page 21)
	c. Output tape drive pulley loose on tape drum shaft	c Check and tighten set screws which lock pulley on end of tape drum shaft.
Output shifts in one direction only	a. Broken center tape on tape drum assembly	a Check for broken tape and replace tape drum assembly if required (see page 22).
	b. Broken return spring in rolling diaphragm assembly	b Disassemble rolling diaphragm assembly (see page 23) and replace spring if necessary.
Output remains at maximum while gain control signal changes	a. Broken return spring in zero adjustment assembly	a Check return spring and replace if cracked or broken
	b Nozzle of gain control mechanism clogged	b Remove and clean nozzle Remove and blow out connecting tube Check condition of air supply Change filters if necessary
Output remains at minimum while gain control signal changes	a Gain control (E4) bellow ruptured	a Check gain control bellows and replace if damaged (see page 23).
	b Rolling diaphragm assembly leaking or rolling diaphragm ruptured	b Disassemble rolling diaphragm unit (see page 23) Replace rolling diaphragm or realign assembly as required.
Gain control mechanism does not provide full travel for full range control signal change	a Gain control nozzle and vane are not correctly aligned	a Inspect nozzle to make certain it is perpendicular to vane. Loosen nylon nozzle locking screw and reposition nozzle if required.
Excessive hysteresis or poor repeatability	a. Loose tape on tape drum assembly	a Inspect tape drum assembly for a loose tape If screw held end of tape is loose, replace and tighten screw If tape is loose at drum end (broken weld), replace tape drum assembly.

FAULT	CAUSE	CORRECTION
BOOSTER RELAY·		
1. Booster unit output pressure does not immediately in crease when flow of air is blocked.	a. Clogged nozzle orifice	a. Depress orifice cleanout plungers. WARNING Do not depress plunger if Type AF is used with a selector sta tion, unless station is in manual operation.
	b Leakage around sec tions of Booster casing	b Torque four screws clamp ing Booster sections to gether to 30 in lb
	c Dirty filters	c Remove and replace filters.
	d. Booster calibration incorrect	d Check Booster calibra tion (see Complete Cal ibration on page 31).
2 Booster output sluggish or output increases then drops to zero when flow of air is blocked	a Internal leakage.	a Replace Booster Relay
	b. Dirty filters	b Remove and replace filters
3 Booster unit output pressure does not immediately decrease when vane is pulled away from nozzle.	a. Blocked air line from Booster unit to nozzle.	a Remove line a id clean
	b Booster calibration incorrect.	b Check Booster Calibra tion (see "Complete Cal ibration" on page 31)
	c. Internal leakage.	c. Replace Booster Relay.

CONTROLLER ASSEMBLY

The following disassembly procedures re quire that the controller portion of the Function Generator assembly be removed from the mount ing manifold.

NOTE· Before attempting to remove the Control ler from the mounting manifold, make certain that the three captive mounting screws (refer to Figure 3 on page 5) are completely unscrewed from the base The Controller, with gain mech anism attached, can then be pulled free. (Some resistance will be evident due to the O ring seals on the manifold)

Removal of Bellows, Sector Plate, or Tie Plate

1 Remove screws (10) attaching balance beam (25) to castings (Figure 32)

2 Unlock bellows set screws (26).

3. Remove range spring nuts (45) Remove spring supports (8 or 9) with springs attached

4 Remove gain assembly vane (41) and vane adjustment (24) by removing screw (48)

5 Remove bolts (23) attaching side cast ings (30 and 31) to rear manifold (22) Remove screw (18) holding side casting together Pull castings forward slightly and remove castings with bellows attached

6 Remove retaining ring (12) and push bellows (13) out of casting.

7. Disassemble center structure only if sector (29) or tie plate (15) replacement is necessary.

8. Reassemble unit following steps 1 thru 7 in reverse order. Coat all O-rings lightly with silicone grease.

Bearing Adjustment (refer to Figure 32)

Normally, the bearing adjustment of the Controller portion of the Function Generator assembly should not have to be disturbed. If, however, the Controller gain adjustment arm appears loose and the Controller cannot be properly nulled, the gain adjustment arm can be removed and the bearing adjusted as follows

1. Remove vane (41) and nozzle (52) from Controller assembly.

2. Remove Booster Relay unit (2) from rear of Controller manifold (22).

3. Remove rear Controller manifold (22).

NOTE: Be sure to remove bolts attaching nozzle arm assembly from between bellows (13)

4. Rotate nozzle arm assembly (38) and withdraw arm from between bellows (13).

5 Remove nozzle arm assembly (38) from pivot support

6. Clean bearings in upper (35) and lower (37) bearing plates with solvent. Both bearings must turn freely and without excessive free play Add a light grease to bearings. Lubricate all O-rings lightly with silicone grease.

7. Install nozzle arm assembly (38) in upper bearing plate (35) Add lower bearing plate (37) with two screws. Do not fully tighten screws.

8. Place entire pivot support assembly in a vise. Rotate nozzle arm 90 degrees If nozzle arm turns smoothly, tighten screws (18). If nozzle arm rotation discloses a tight spot, tap lower bearing plate (37) lightly with a hammer. Direction of tapping should be perpendicular to nozzle pivot shaft and such that axis of this shaft is shifted.

9. Repeat bearing plate adjustment until nozzle arm turns freely When proper alignment is obtained, tighten screws (18).

Integral Valve Dial Range

The integral valve setting is adjusted by turning the adjustment screw beneath the dial indicator on the integral plug-in unit attached to the Controller. The dial is graduated on one side for a range of 0.5 to 24 repeats per minute. The other side is calibrated for 15 to 100 repeats per minute. To change the scale range:

1. Set indicating dial to 15 repeats per minute by turning integral adjustment screw.

2. Remove "E" type retaining ring which holds indicating dial in position.

3. Remove indicating dial, turn over and replace in position to read 15 repeats per minute on reverse side. Replace "E" type retaining ring to hold dial in position.

GAIN CONTROL MECHANISM

Before attempting maintenance on the gain control mechanism separate it from the Control assembly as follows.

1. Loosen set screw holding flexible coupling assembly to Controller Gain Arm Shaft and slide flexible coupling off shaft.

2. Remove four screws holding gain control mechanism to Controller Assembly.

CAUTION: The steel tapes used in the gain control mechanism are .0015 inch thick. They must be handled properly. Take extreme care during any assembly or adjustment that involves the tapes to avoid any sharp bends, nicks or other damage. Nicked or bent tapes will function properly, but service life will be considerably shortened.

Drive Pulley and Tapes (refer to Figure 33)

The tapes of the drive pulley assembly are welded to the output pulley. If the tapes have been damaged, the drive pulley and tapes must be replaced as a unit, as follows.

1. Release tapes from drive pulley by sliding tape off tab on driven pulley and unhooking second tape from spring (see Figure 12).

2. Loosen two set screws (23) holding drive pulley assembly (25) to output shaft assembly (16) and slide drive pulley assembly off end of output shaft.

3. Mount replacement drive assembly on output shaft. Make certain that set screws (23)

are correctly aligned with holes drilled in out put shaft.

4. Direct Action Units Only· Wrap tape with hole for spring twice around drive pulley and hook spring (32) into end of tape. Place other end of spring over tab provided on driven pulley as shown in Figure 15. Wrap remaining tape once around drive pulley in opposite direction. Slip end of tape over tab provided on driven pulley. Make certain that tapes are tight.

Reverse Action Units Only Wrap tape which was connected to spring, 3/4 of a turn around drive pulley and reconnect spring (32) by pass ing one end thru end of tape and hooking other end in reverse direction over spring tab pro vided on driven pulley Remaining (outside) tape is wound 3 turns around output pulley and slide in reverse direction over tab on driven pulley (Figure 15). Make certain that tapes are tight.

Zero Adjustment Tape

The tape of the zero adjustment assembly is welded to the zero adjustment drum (50) If nec essary to replace the tape, the complete zero adjustment assembly must be replaced as follows Refer to Figure 33.

1. Tip gain control mechanism bellows beam (38) towards zero adjustment assembly to re lieve tension on zero adjustment tape. Unhook tape from range spring (51).

2. Note position of zero adjustment assem bly on cam follower arm assembly (first and third holes from pivot for 45° gain arm rota tion units, second and fourth holes for 10° gain arm rotation units) Remove screws (24) hold ing zero adjustment assembly to cam follower arm and remove zero adjustment assembly

3 Install new zero adjustment assembly in correct holes for desired gain arm rotation Replace and tighten mounting screws

4. Tip bellows beam towards zero adjust ment assembly and reconnect range spring to zero adjustment tape.

5. Refer to applicable procedure listed un der Placing in Service" on page 6 for required readjustment

Piston Shaft Tapes

The piston shaft tapes are welded to the drum assembly If a tape is damaged or broken, the complete tape drum assembly must be replaced as follows Refer to Figure 33.

1. Release drive pulley tapes from driven pulley by sliding tape off tab on driven pulley and unhooking tape from spring (see Figure 12).

2. Loosen two set screws (23) holding drive pulley assembly (25) to output shaft assembly (16).

3. Slide drive pulley assembly off end of output shaft.

4. Remove upper cylinder housing (12) from gain control mechanism by loosening screws (36). Remove two screws (24) to re lease top piston shaft tapes from extended bracket of piston shaft.

5. Lift piston shaft to extended position to reach screw (13) holding bottom piston shaft tape to piston shaft and release bottom tape.

NOTE· Move piston shaft carefully to avoid dam aging tapes. Do not allow piston shaft to slip back to retracted position after tapes are loose.

6. Release two set screws (23) locking tape drum assembly (14) on output shaft assembly (16) Withdraw output shaft assembly (with cam attached) from upper cylinder housing assembly (12).

7. Tape drum assembly is now free and can be removed from upper cylinder housing assembly. Take care not to damage tapes.

8. Place new tape drum assembly in posi tion and retain by sliding output shaft assembly thru bearing of upper cylinder housing, thru drum assembly, and thru bearing on opposite side of upper cylinder housing.

9. Lock tape drum assembly in place on output shaft with set screws (23). Make certain both set screws are correctly aligned with holes drilled in output shaft.

10. Wrap two outside tapes one turn around tape drum and attach to piston shaft with screws (24). Take care not to damage tapes.

11. Fasten center tape from drum assembly to bottom piston shaft using shoulder screw (13).

12. Carefully lower piston shaft from extend ed position while observing tapes to make cer tain that they are winding properly.

13. Mount drive pulley assembly on output shaft. Make certain that screws (23) are correct ly aligned with holes drilled in output shaft be fore tightening set screws.

14 Direct Action Units Only Wrap tape with hole for spring twice around drive pulley and hook spring (32) into end of tape. Place other end of spring over tab provided on driven pulley as shown in Figure 14. Wrap remaining tape once around drive pulley in opposite direction. Slip end of tape over tab provided on driven pulley Make certain that tapes are tight

Reverse Action Units Only Wrap tape which was connected to spring, 3/4 of a turn around drive pulley and reconnect spring (32) by passing one end thru end of tape and hooking other end in reverse direction over spring tab provided on driven pulley Remaining (outside) tape is wound 3 turns around output pulley and slid in reverse direction over tab on driven pulley (see Figure 15). Make certain that tapes are tight

15 Refer to applicable procedure listed under "Placing in Service on page 6 for required readjustment

Rolling Diaphragm (refer to Figure 33)

1 Loosen set screw (26) holding bellows coupling assembly to Controller gain arm shaft Slide sleeve of bellows coupling off gain arm shaft

2. Remove four screws (35) which hold gain control mechanism to Controller.

3 Lift complete gain control mechanism free of Function Generator assembly

4. Remove four screws (36) which hold upper cylinder housing assembly (12) to lower cylinder housing base (6).

5 Upper cylinder housing assembly with piston and shaft attached can now be lifted from lower cylinder base, releasing rolling diaphragm (8)

NOTE Lift upper cylinder housing carefully while holding cam follower arm Since gain control cam will be removed, it is desirable to release tension on cam follower arm, caused by range spring, gradually to prevent damage to flexible tape of zero adjustment assembly

6 With shaft held in 10^{0} position, cover sealing lip of new rolling diaphragm (8) with a light coating of O ring lubricant and install over piston (10). (Make certain correct side of diaphragm is against piston.) Place diaphragm sealing lip in groove of upper cylinder housing

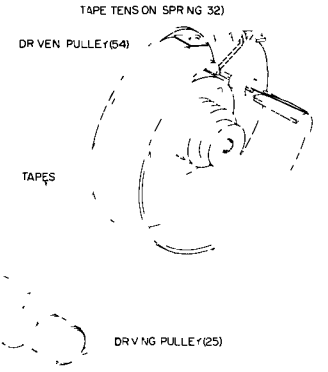


FIGURE 14 - Direct Action Units

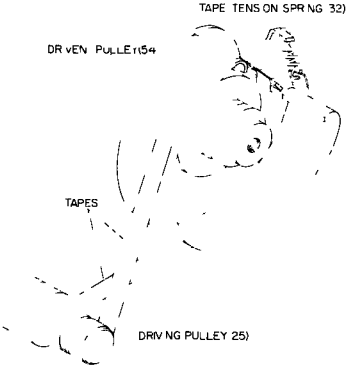


FIGURE 15 Reverse Action Units

7. Carefully fasten upper cylinder housing to lower cylinder base with four screws (36) Check, while tightening screws, that diaphragm remains in place and is seating properly

8 Return gain control mechanism to position in Function Generator assembly Lock gain control mechanism to Controller with four screws (35)

9. Place flexible coupling assembly in position over Controller gain arm shaft DO NOT TIGHTEN SET SCREW (26)

10. Refer to applicable section under "Plac ing in Service' on page 6 for correct method of realigning gain control mechanism with gain arm shaft of Controller portion of Function Generator

Feedback Bellows Replacement
(refer to Figure 33)

1 Loosen set screw (26) holding flexible coupling assembly to Controller gain arm shaft. Slide sleeve of flexible coupling off gain arm shaft.

2 Remove four screws (35) which hold gain control mechanism to Controller.

3. Lift complete gain control mechanism free of Function Generator Assembly.

4 Remove three screws (36) which hold transmitter casting (48) to lower cylinder hous ing base (6) Disconnect flexible air line (44) from nozzle (58) Lift transmitter casting from base with bellows beam assembly attached

NOTE Support cam follower arm when lifting assembly clear of base. It is desirable to re lease tension on cam follower arm, caused by range spring, gradually to prevent damage to flexible tape of zero adjustment assembly.

5. Remove screw (34) which holds bellows beam (38) to bellows assembly (47). Unscrew and remove bellows taking care not to place ex cessive strain on hinges of bellows beam Re move O-ring (37) from bellows assembly

6. Lubricate O ring (37) and place over end of new bellows assembly. Thread bellows assembly into transmitter casting Tighten firmly Re attach bellows beam to bellows assembly with screw (34).

7. Remount transmitter casting on lower cylinder housing base with three screws (36) Reconnect flexible air line to nozzle.

8 Return gain control mechanism to position in Function Generator assembly Lock gain control mechanism to Controller with four screws (35).

9 Place flexible coupling assembly in position over Controller gain arm shaft DO NOT TIGHTEN SET SCREW (26).

10 Refer to applicable section under Placing in Service" on page 6 for correct method of realigning gain control mechanism with gain arm shaft of Controller portion of Function Generator.

BOOSTER RELAY

It is recommended that the Booster Relay portion of the Function Generator be returned to the factory for repair, since realignment of the diaphragm clamping assembly and the required recalibration is extremely critical

DESCRIPTION OF OPERATION

The MINI-LINE 500 Function Generator is essentially a pneumatic Controller to which a pneumatic gain control mechanism has been added. The gain control mechanism is sensitive to an air pressure signal and acts to reposition the gain arm of the Controller whenever a change in this signal occurs. Refer to Figure 16.

The gain control mechanism includes a cam which controls the vane to nozzle distance for any given signal pressure applied. The shape of the cam determines the amount of gain change that will occur in the Controller. It is this cam that enables the unit to generate any given function within its range.

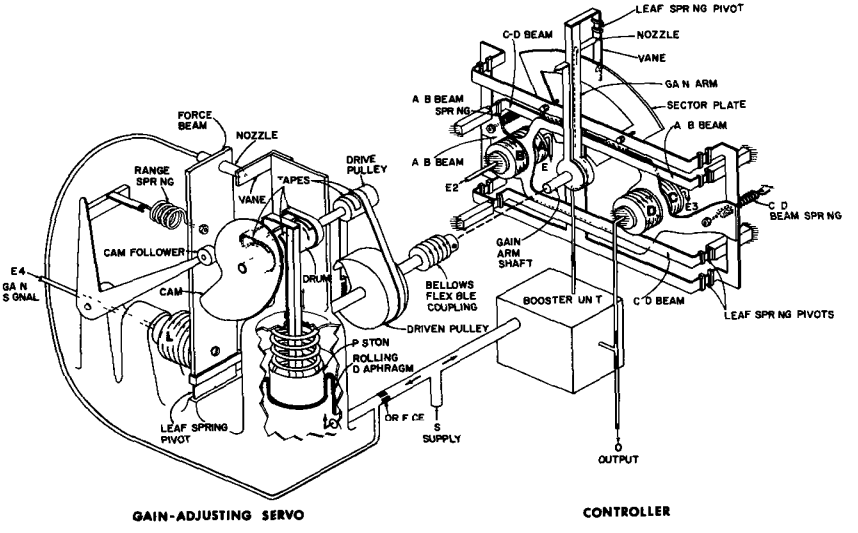


FIGURE 16 - Schematic of Pneumatic Function Generator

In addition, the Function Generator has a Booster Relay connected directly to the Controller The Booster Relay operates in conjunction with the nozzle and vane assembly of the Controller to provide an output pressure signal proportional to the variable influencing the Controller

The operation of the Controller, the pneumatic gain control mechanism, and the Booster Relay are discussed separately below

PNEUMATIC CONTROLLER

Refer to Figure 17 A change in input pressure to the bellows units repositions the two balance beams The resultant shift in balance beam alignment causes a change in the angle of the tie plate connecting the free ends of the balance beams The tie plate supports a sector plate which positions the vane of the Controller gain mechanism The shift in vane to nozzle distance produces a nozzle back pressure change that is amplified and transmitted by the Booster Relay as the output pressure

The Booster Relay also supplies the amplified pressure to the D bellows to eliminate the unbalance caused by the input pressure change and restore the vane and nozzle to the "at balance" distance

The effect a given input pressure change has upon the output pressure depends upon the function for which the Controller is set, the gain setting of the unit at that point, and the control actions employed

Controller Functions

With input pressure applied only to the A bellows, the Controller transmits an output pressure proportional to the input pressure. The amplification of the output pressure is dependent upon the gain setting of the unit at that point.

With the input pressure applied only to the B bellows (either directly thru connection E2 or thru connection E1 with the direct reverse switch in the "R" position), the Controller transmits an output pressure proportional to the input pressure, but acting in the opposite direction The amplification of the output pressure is dependent upon the gain setting at that point

Inputs directly to the C bellows are used only for subtracting or averaging functions There is a C bellows pressure on all applications which involve integral control action However, this

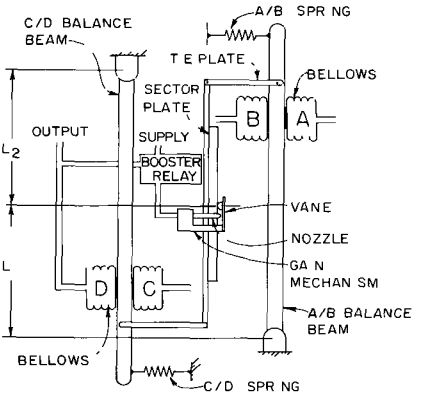


FIGURE 17 - Schematic of Controller

pressure is received from the D bellows thru a throttling valve and not from a separate manifold connection Pressure in the C bellows is unaffected by the gain setting.

The D bellows does not have an individual input signal, but is connected directly to the Booster Relay output pressure (feedback)

With input pressures applied to more than one bellows of the Controller (as in differential pressure applications), the output pressure is the algebraic sum of the resultant forces on the A B and C D balance beams Pressures applied to the A and C bellows act in the same direction and a totalizing function is obtained. Pressures applied to the A and B bellows (or the C and D bellows) are in opposition (differential function) and the output pressure is proportional to their difference The change in output pressure from the Function Generator for given input pressure changes is determined as follows

$$\Delta D \quad \text{Gain Setting } (\Delta A \; \Delta B) + \Delta C$$

where.

- ΔD output pressure change
- ΔA input pressure change to A bellows
- ΔB - input pressure change to B bellows
- ΔC input pressure change to C bellows

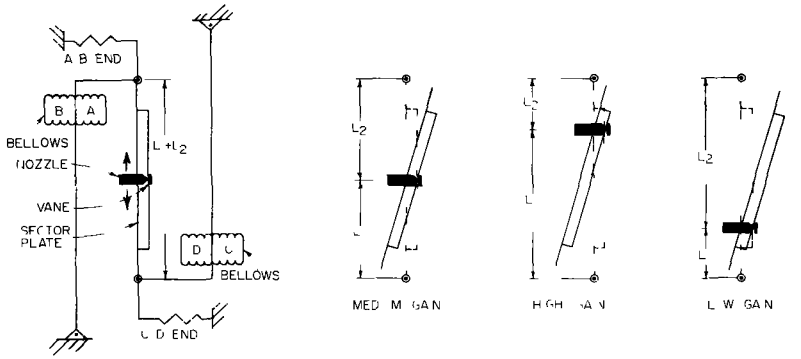


FIGURE 18 Schematic of Controller Gain Mechanism

Gain Setting

Gain is the ratio of the resulting output pressure change for a given change in input pressure.

$$\text{Gain} \quad \frac{\text{change in output pressure}}{\text{change in input pressure}}$$

The gain mechanism of the Controller is shown schematically in Figure 18. The amount of gain for any given position of the gain adjustment arm is the ratio of distance L1 to L2. If the nozzle and vane assembly is positioned near the A B bellows end of the sector plate, a small change in A-B bellows pressure will require a large change in output pressure to rebalance the Controller. With the nozzle and vane positioned near the C D bellows end of the sector plate, the same input pressure change to the A B bellows will produce a smaller output pressure change.

The gain of the Controller can be varied from 0.2 to 20. This represents a Controller gain arm rotation of approximately 90° (The gain control mechanism, when the Controller is used as part of a Function Generator, can provide 45° of Controller gain arm rotation. This 45°, however, can be taken at any point within the 90° span of the Controller.) The gain in a standard factory calibrated unit is set to range from 3 to 3. A 10 psi change in the input pressure will produce a 2 psig change in the output at the lowest gain setting. At the highest gain setting, a 1 psig change in input pressure will produce a 20 psig change in the output pressure.

Null Balance

The Controller portion of the Function Generator is 'nulled' when the sector plate is made parallel to the balance beams with the "null pressures' required for the particular application applied to the Controller. This is accomplished by proper adjustment of the Controller as outlined under "Placing in Service" on page 6.

At null balance, the gain adjustment arm can be positioned at any point thru the full gain range without causing a change in the output pressure since, as a result of the parallel alignment with "null pressures" applied, no change in the nozzle to vane distance occurs during full travel of the gain mechanism.

The required "null pressures" for any particular installation depend upon the conditions of the individual control system and the range of input pressures which will be applied to the Function Generator.

Integral Control Action

Integral control action of the Controller portion of the Function Generator is accomplished by means of a volume chamber and adjustable throttle valve assembly plugged into the air line between the C and D bellows. Refer to Figure 19

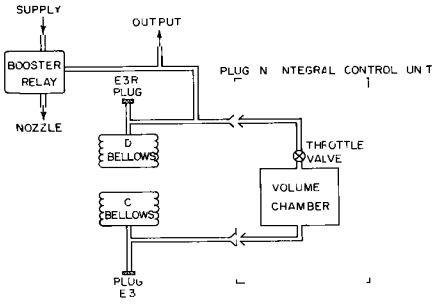


FIGURE 19 Integral Control Action

The speed at which the integral action takes place is determined by the throttle valve setting and is expressed as the integral rate in repeats per minute The plug in integral unit provides an integral rate from 05 to 100 repeats per minute.

Derivative Control Action

Derivative action in the Controller portion of the Function Generator is accomplished by a unit containing a spring loaded bellows inclosed in a volume chamber. Refer to Figure 20 The unit is plugged into the air line between the Booster Relay assembly and the D bellows

The restriction, controlled by an adjustable throttle valve, between the Booster Relay and the D bellows causes an initially amplified output pressure change. The amplified output pressure returns to normal as the volume chamber pressure bleeds to the D bellows.

The throttle valve assembly setting determines the time interval required for the accelerated output signal to return to normal The plug in derivative unit provides a derivative time of from 1 to 10 minutes.

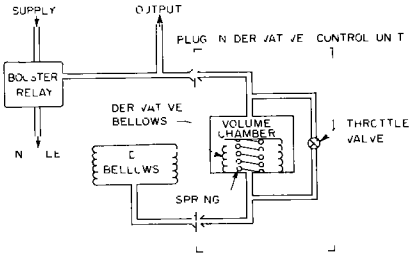


FIGURE 20 Derivative Control Action

GAIN CONTROL MECHANISM

The gain control mechanism is shown in Figure 21. The unit utilizes a piston and rolling diaphragm (bellofram) assembly to provide the force required to shift the Controller gain arm The pressure in the diaphragm chamber depends upon the pressure applied to the E4 connection (gain control signal pressure). A pressure increase at connection E4 moves the vane towards the nozzle The resultant back pressure increase causes movement of the piston of the diaphragm assembly This movement is transmitted by the tape drum shaft, thru a pulley arrangement, to the gain arm of the Controller In addition, the tape drum shaft repositions the vane of the vane and nozzle assembly by means of a cam The shape of this cam determines the amount of Controller gain arm rotation which will take place for any given change in the gain control signal pressure to connection E4.

Two sets of steel tapes are used in each gain control mechanism One set is used to transmit the bellofram piston movement to tape drum shaft rotation and the second is used in turn to transmit the tape drum shaft rotation to the rotation of the Controller gain arm assembly Refer to Figure 16

The piston of the bellofram assembly is rigidly connected to a piston shaft that transmits the linear motion of the piston to three steel tapes One end of the tapes is fastened to the tape drum shaft and wrapped around its circumference The tapes are wrapped in opposite directions (see Figure 12) and attached to the piston shaft so that during motion of the shaft at least one tape is wrapping and one unwrapping from the tape drum shaft. The tapes convert linear motion to rotational motion with a minimum of backlash

Full travel of the bellofram piston produces 270 degrees of rotation of the tape drum shaft and the feedback cam which is mounted on the end of the shaft. (This rotation is reduced to 45 degrees when the tape drum shaft motion is transmitted to the Controller gain arm shaft)

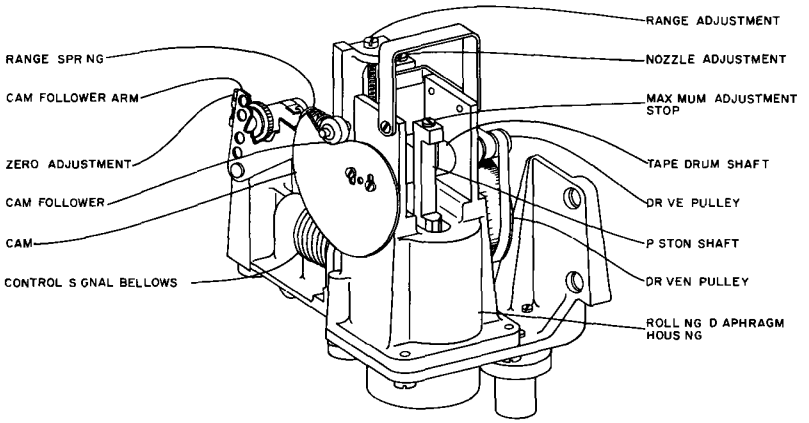


FIGURE 21 Gain Control Mechanism

The second set of tapes have one end fixed to the tape drum shaft and are wound in opposite directions around its circumference. The other end of each tape is attached to the circumference of the output pulley which is coupled to the gain arm fo the Controller. Refer to Figure 16. Rotation of the tape drum shaft is transmitted to the output pulley. However, since the output pulley is larger than the tape drum shaft the amount of angular rotation is considerably reduced.

The gain control mechanism cam is mounted on the end of the tape drum shaft and is used for feedback control to the gain unit vane and nozzle assembly.

Any rotational motion of the tape drum shaft also rotates the feedback cam This motion is picked up by the cam follower connected to the cam follower arm of the pivot shaft. The motion of the pivot shaft exerts a force proportional to the cam rise on the range spring. The spring is connected to the bellows beam which acts as the vane of the gain units vane and nozzle assembly. The movement is in the direction required to oppose the motion of the bellows beam caused by the input pressure change in the gain control signal pressure applied to connection E4. At balance conditions, the forces acting on the bellows beam from the range spring and from the gain control signal pressure are equal

Three cams are supplied with the Function Generator. The 45° cam provides a full range linear function. The 10° cam provides a more accurate linear Function when the total required Controller gain arm rotation is 10° or less. In addition, a blank cam is supplied which must be shaped to provide a desired non linear function (For cam shaping procedure, refer to "Placing in Service".)

Figure 22 shows the relationship between degrees of gain arm rotation and the actual gain of the Controller. The 45° or 10° span can be taken over any portion of the gain scale. The gain change for any given gain control input signal change depends upon the section of the Controller gain range selected.

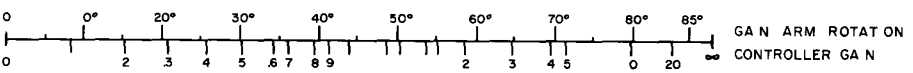


FIGURE 22 - Gain Arm Rotation Relationship to Gain Scale

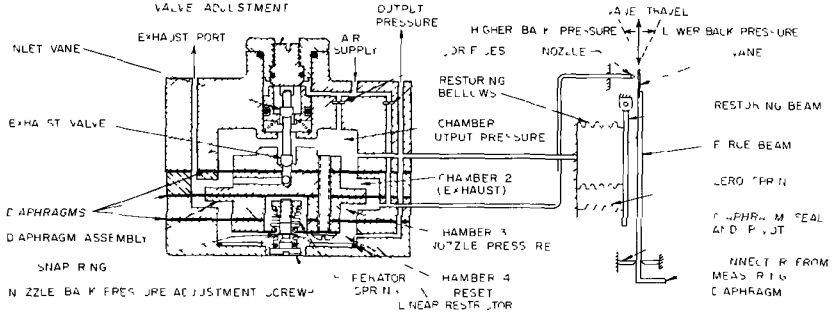


FIGURE 23 Schematic of Booster Relay

BOOSTER RELAY

The Booster Relay amplifies the D bellows pressure of the Function Generator in order to re establish the vane and nozzle distance This amplified pressure is also the output pressure of the Function Generator.

Figure 23 is a schematic operating diagram of the Booster Relay assembly

Three diaphragms divide the inside of the unit into four air pressure chambers. The diaphragms move together since they are clamped at their centers by the diaphragm clamp assembly Since chambers 1 and 4 are connected and are equal in effective diaphragm area, their opposing forces on the diaphragm assembly are balanced out. Chamber 2 is open to atmosphere. The operator spring exerts a downward force on the diaphragm assembly Thus, since chamber 3 pressure exerts an upward force, the position of the diaphragm assembly is a direct function of chamber 3 pressure

Supply air enters chamber 3, and the nozzle of the Controller portion of the Function Generator, thru a pressure-reducing orifice The rate of air flow from the Controller nozzle determines the magnitude of the pressure in chamber 3. At balance, this pressure is approximately 2 psig, which is the pressure required to balance the downward force of the operator spring

When the measured input to the Function Generator increases, the sector plate of the Controller assembly shifts to position the vane closer to the nozzle tip. This retards the flow of air from the nozzle and increases the pressure in chamber 3. The pressure increase moves the diaphragm assembly upward, opening the inlet valve and closing the exhaust valve Supply air enters chamber 1 thru the inlet valve, causing the output pressure of the Function Generator to begin to increase.

Chamber 1 pressure is also applied to the D bellows As the pressure increases, the D bellows extends, tipping the sector plate to move the vane away from the nozzle. The resulting increased rate of air flow from the nozzle causes the pressure in chamber 3 to begin to decrease.

Chamber 1 pressure will continue to increase until the vane is restored to the position with respect to the nozzle which produces a pressure of approximately 2 psig in chamber 3 The operator spring by then has moved the diaphragm assembly downward to its original position, closing the inlet valve and causing the Function Generator output pressure to stabilize at the new increased value

When the measured input to the Function Generator decreases, the operation of the Booster Relay as described above is reversed

COMPLETE CALIBRATION

The Function Generator consists of three basic assemblies, the Controller, the gain control mechanism, and the Booster Relay. Each of these assemblies can be separately calibrated for basic alignment If it has been necessary to replace or repair parts in any of the separate assemblies, the basic alignment of the unit can be reestablished following the applicable procedure outlined below After the individual unit has been realigned, it will be necessary to repeat the steps outlined under Placing in Service" to adjust the complete Function Generator for the required service.

Controller Assembly

If the Controller has been disassembled for replacement or repair of parts, or if the Function Generator could not be correctly adjusted for service as outlined under "Placing in Service", the basic Controller alignment must be reestablished as follows.

1. Release gain control mechanism from Controller by loosening set screws holding flexible coupling assembly to Controller gain arm shaft. See Figure 24

2. With Controller in place on mounting manifold, connect output connection "O" to a gage or manometer.

3 Connect supply pressure to manifold connection "S", 18 psig for 3 to 15 psig range, 30 psig for 3 to 27 psig range.

4. Open derivative switch or valve of derivative plug-in unit. Close integral switch or valve of integral plug-in unit. Refer to Figure 25.

NOTE. If integral or derivative plug in units are employed, valve will be "open" or "closed" when adjusting screw is turned to full clockwise or counterclockwise position respectively.

5. Make certain that direct-reverse switch is in "D" position. Place proportional - proportional plus integral switch in "P" + I" position (see Figure 3). Plug connection E3R at manifold.

6. Apply midrange pressures to "E1", "E2" and "E3" connections, 9 psig for 3 to 15 psig range, 15 psig for 3 to 27 psig range. Turn on supply air.

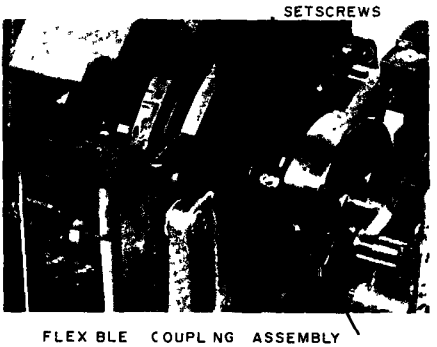


FIGURE 24 - Disengaging Gain Control Mechanism

7 Position gain arm at 1.0 Lock with knob mounted on base (item 70 Figure 32). Adjust A B and/or C-D sector screws (see Figure 26) to obtain an output equal to midrange pressure

8. Beam hinges should be aligned with hinges on tie plate (refer to upper and lower beam alignment lines in Figure 26). If not, adjust beam position with A B and/or C-D sector bias screws until proper alignment is obtained. (This will neccessitate readjusting A-B and/or C-D sector screws to regain midrange output pressure.)

9. Connect output "O" to connection E2 (in addition to gage or manometer). Connect separate variable inputs to E1 and E3. Tee connection

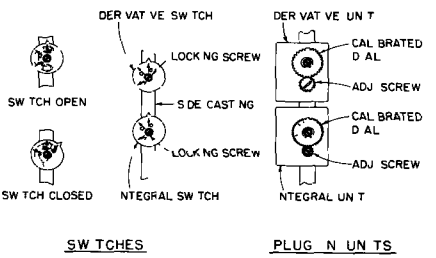


FIGURE 25 - Integral and Derivative Switches

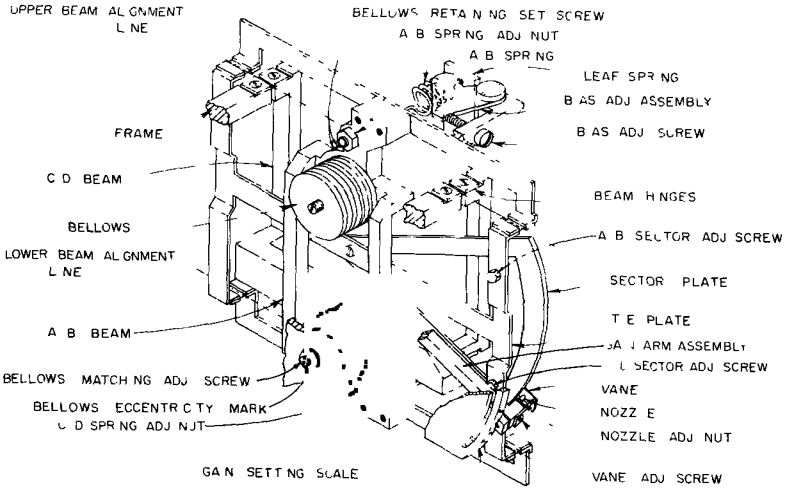


FIGURE 26 Controller Adjustments

E3R to E3 if recalibration is being performed on a Controller with an integral plug in unit in place

10 Open integral switch or valve of integral plug in unit Close derivative switch or valve of derivative plug-in unit

11 Remove pressure from connection E3. Unlock set screws retaining C and D bellows (see Figure 26) and rotate bellows with bellows matching screws until eccentricity marks are located toward front of Controller

12 Lock pointer of gain adjustment arm at line across scale below gain of 0.1 Adjust pressure to connection E3 to midrange value Adjust C D sector to provide midrange output pressure

13 Apply pressure from minimum to maximum range to connection E3 while noting output pressure. Remove pressure from connection E3

14 If output pressure increased, rotate C and D bellows clockwise by equal amounts (as viewed from their respective side of Controller). If output decreased, rotate bellows counterclockwise by equal amounts. Do not exceed 90 degrees of rotation of either bellows

15 Repeat steps 13 and 14 until output pressure change is less than 1.0 psig Apply pressure to connection E3 and lock bellows with set screws.

16 Repeat step 13 If output pressure increases, rotate C-D bias screw clockwise If output pressure decreases, rotate screw counterclockwise.

17 Repeat step 13 and step 16 until output pressure change is less than 0 5 psig. If more than 1, 2 turn of C D bias screw is required, return screw to original position, unlock C and D bellows and repeat steps 13 thru 17

18 Tee connection E1 to E2 and connect a separate variable input pressure and gage Connect a variable input pressure and gage to connection E3R

19. Open derivative switch or valve of deriv ative plug-in unit. Close integral switch or valve of integral plug-in unit.

20. Unlock set screws retaining A and B bel lows (see Figure 26) and rotate bellows until ec centricity marks are towards front of Controller.

21 Lock gain arm at line across gain scale above 20 Adjust pressure to connection E3 to midrange value Adjust A B sector screw to provide a midrange output pressure

22. Apply pressure from minimum to maximum range to connection E1 while noting output pressure. Remove pressure from connections E1 and E2.

23. If output increased, rotate A and B bellows counterclockwise by equal amounts (as viewed from their respective side of Controller). If output pressure decreased, rotate bellows clockwise by equal amounts Do not exceed 90 degrees of rotation ot either bellows

24. Repeat steps 22 and 23 until output pres sure change is less than 1 0 psig Apply pressure to connections E1 and E2 and lock bellows.

25. Repeat step 22 If output pressure in creases, rotate A B bias screw clockwise. If pressure decreases rotate screw counterclock wise

26. Repeat steps 22 and 25 until output pressure change is less than 0 5 psig (If more than 1/2 turn of A-B bias screw is required, return screw to original position, unlock A and B bellows and repeat steps 22 thru 26.)

27. Remove locking knob. Controller portion of Function Generator assembly is now ready to be adjusted as outlined under applicable section of "Placing in Service".

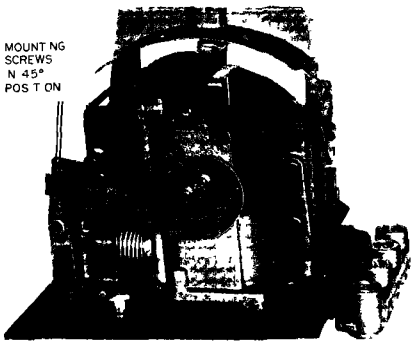
IMPORTANT Do not reconnect flexible coupling between Controller and gain control mechanism This connection must be made only after determining that full 45° rotation of Controller gain arm is possible without exceeding maximum or minimum gain arm position limits.

Gain Control Mechanism

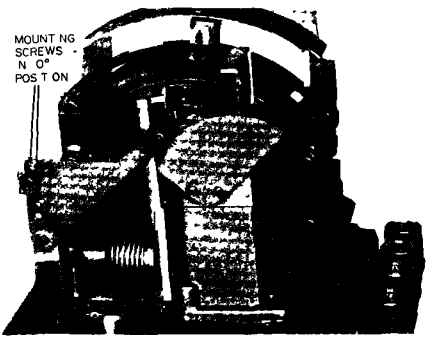
The actual calibration of the gain control mechanism is accomplished during the procedure outlined under "Placing in Service". How ever, if the gain control mechanism is disassembled for repair or replacement of parts, the basic alignment of the components can be es tablished after reassembly as follows.

1. Place zero adjustment assembly (see Figure 27) in either 45 degree or 10 degree position on cam follower arm assembly.

2 Place end of range spring thru hole in lower pivot assembly. Slip other end of range spring thru hole in end of flexible tape (see



45° CAM ARM ROTATION



0° CAM ARM ROTATION

FIGURE 27 - Positioning of Zero Adjustment Assembly

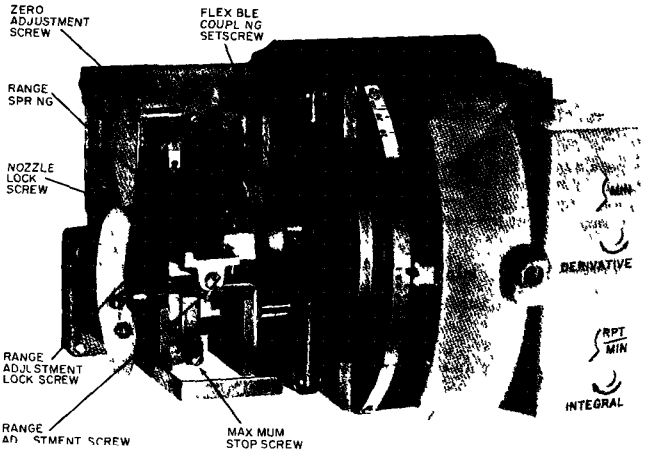


FIGURE 28 - Gain Control Mechanism Adjustments

Figure 28) (Zero adjustment screw can be turned clockwise to lower tape to facilitate mounting spring)

3 Loosen gain control mechanism nozzle locking screw to release nozzle. Adjust bellows beam, by positioning free end, until signal bellows convolutions are approximately parallel Hold bellows beam in this position and slide nozzle in until it contacts vane Lock nozzle in this position.

4 Install cam (45°, 10°, or blank, depending on service requirements) and rotate cam until position alignment line (first line on cam) is directly below cam follower arm roller. Tighten screws to lock cam in this position.

5 Apply 3 psig air pressure to gain control signal bellows (manifold connection "E4").

6 Adjust range screw (see Figure 28) to place range spring assembly approximately in line with zero adjustment assembly.

7 Turn zero adjustment screw to raise gain control nozzle approximately .005 inch off of vane

8. Turn on supply air to gain control thru common supply connection 'S" on Function Generator mounting manifold.

9. Turn zero adjustment screw until cam follower arm roller is directly above cam zero line (second line on cam).

10. If unit is to be used for an application requiring only 10° of Controller gain arm movement, install zero stop pin in extended piston shaft Lock stop pin in position with two retaining rings. (See Figure 10).

11. Gain control mechanism of Function Generator assembly can now be calibrated for particular service application in accordance with procedures outlined under Placing in Service" on page 6

Booster Relay

The Booster Relay portion of the Function Generator assembly has only one adjustment The valve adjustment, shown in Figure 29, adjusts the inlet valve seat to balance the effective areas of the chamber 1 and chamber 5 diaphragms to obtain an even rate of output pressure change.

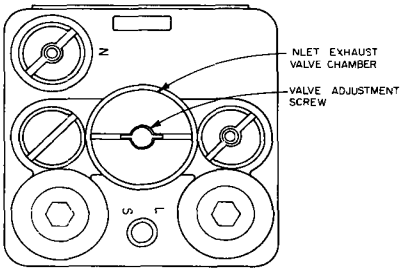


FIGURE 29 - Booster Relay Valve Adjustment

This adjustment normally does not require attention and is not part of the calibration procedure. The adjustment is sealed after calibration with a drop of Loctite cement (Grade C) at the factory. Do not change the setting of this adjustment unless absolutely necessary.

If the Booster Relay has been disassembled, or if the setting of the valve adjustment has been changed for any reason, check the calibration of the unit as outlined below.

1. Remove Booster Relay from Controller portion of Function Generator by removing mounting screws.

2. Attach calibration block (Bailey Part Number 5320549-2) to Relay using screws which held Relay to Controller. Connect unit in calibration set-up as shown in Figure 30.

3. Connect a mercury manometer to output pressure connection (on calibration block). Connect a second mercury manometer to tee fitting in piping to input connection of calibration block.

4. Apply supply air to Booster Relay supply pressure connection on calibration block; 18 psig for 3 to 15 psig units, 30 psig for 3 to 27 psig units.

5. Gradually apply about 2 psi air pressure to calibration block input connection to simulate nozzle back pressure from Controller portion of Function Generator. Note value of pressure (on nozzle back pressure manometer) at which output pressure increases at a constant rate. Gradually reduce nozzle back pressure and note nozzle pressure at which output pressure decreases at a constant rate.

a. If rate of output pressure rise slows down (decelerates), turn valve adjustment screw clockwise a small amount.

b. If rate of output pressure rise speeds up (accelerates), turn valve adjustment screw counterclockwise a small amount.

6. Repeat step 5 above until output pressure changes at a constant rate. The difference between the nozzle back pressure which causes a constant rise and that which causes a constant drop should be less than 0.1 psi and should occur between 1.6 psi and 2.5 psi.

7 If Booster Relay cannot be calibrated as described above, difficulty may be caused by leakage. Refer to 'Booster Relay" under "Maintenance' for correct method of assembling and proper alignment

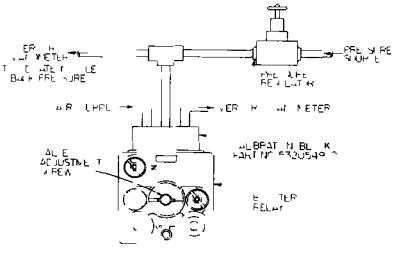
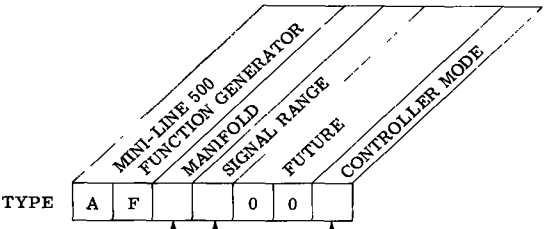


FIGURE 30 - Booster Relay Calibration

EXPLANATION OF NOMENCLATURE



0	WITHOUT MANIFOLD
5	WITH MANIFOLD

	CONTROLLER	GAIN CONTROL
1	3-15 PSIG	3-15 PSIG
2	3 27 PSIG	3 27 PSIG
3	3-15 PSIG	3-27 PSIG
4	3 27 PSIG	3 15 PSIG

1	PROPORTIONAL ONLY
2	PROP. PLUS INTEGRAL
3	PROP. PLUS INT. PLUS DERIV
4	PROP. PLUS DERIVATIVE

An "X" in any Nomenclature position indicates that in this respect the unit is special. An "X" as a suffix to the Type Nomenclature indicates that the unit has been calibrated for a special function at the factory

TABLE B Type AF Function Generator Specifications

A. Performance Characteristics (% Range Span, 75F)

Accuracy	1%
Conformity	0.5%
Dead Band	0.25%
Hysteresis	0.25%
Repeatability	0.25%
Speed of Response	2.5 sec.

B. Operating Conditions

Influence	Reference	Normal	Operative Limits
Ambient Temperature	75F	40F to 140F	20 to 180F (dry air below 30F)
Air Supply, 3 27 psig range	30 psig ±2%	28 to 35 psig	40 psig maximum
Air Supply, 3 15 psig range	18 psig ±2%	16 to 20 psig	25 psig maximum

Ambient Temperature Effect	0% error at 75F
Zero Shift Error per 100F Change	1% output range span
Supply Pressure Effect	0.03% per psi

C. General

Air Consumption	0.135 scfm
Enclosure	Weatherproof

REPLACEMENT PARTS

Spare Parts Kit

The Spare Parts Kits shown in Figures 31 thru 35 should be carried in stock. Specify the Spare Parts Kit part number to order a complete kit.

Ordering Individual Parts

Parts Drawing for the Type AF Function Generator are shown in Figures 31 thru 35 Normally these drawings will apply to the units furnished. However, there may be individual differences in specific units because of

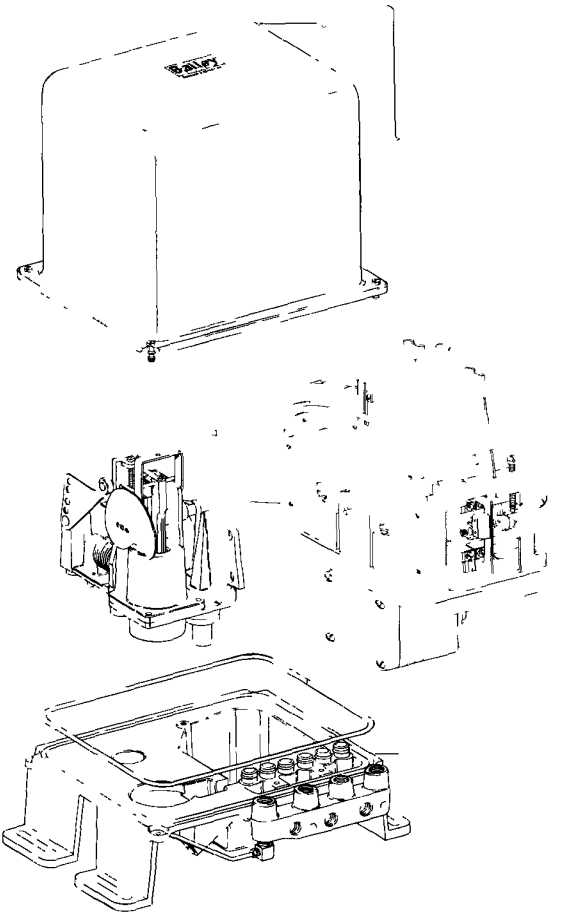
a Design changes made since the printing of this Instruction Section.

b. Special design of the Type AF Function Generator furnished to make it suitable for special applications

Therefore, when ordering parts, assure the receipt of correct replacements for the Function Generator by specifying on the order

1 The complete nomenclature (stamped on instrument nameplate) of the Function Generator for which parts are desired

2 The Parts Drawing on which each part is illustrated (The Parts Drawing Number is given in the title for the Figure)



ITEM	PART NO	NAME
1	5323955 1	COVER ASSY INCLUDES ITEMS 2 AND 3
2	5324422 1	COVER
3	6d9354 1	RETAINED SCR 4 REQD
4	SEE TABLE	CAIN CONTROL MECH INCLUDES ITEM 5
5	SEE TABLE	CONTROLLER ASSY
6	6614522 1	26 IN SEALING CORD
7	5323944 1	MOUNTING BASE

TYPE	ITEM 4	ITEM 5
AF51001	5323954 1	53235 2
AF52001	5323954 2	53235 1
AF53001	5323954 3	53235 2
AF54001	5323954 4	53235 1
AF51002	5323954 5	53235 4
AF52002	5323954 6	53235 3
AF53002	5323954	53235 4
AF54002	5323954 8	53235 3
AF51003	5323954 9	53235 8
AF52003	5323954 10	53235
AF53003	5323954 11	53235 6
AF54003	5323954 12	53235
AF51004	5323954 13	53235 6
AF52004	5323954 14	53235 5
AF53004	5323954 15	53235 6
AF54004	5323954 16	53235 5

FIGURE 31 Parts Drawing P92 2, Type AF Function Generator Assembly

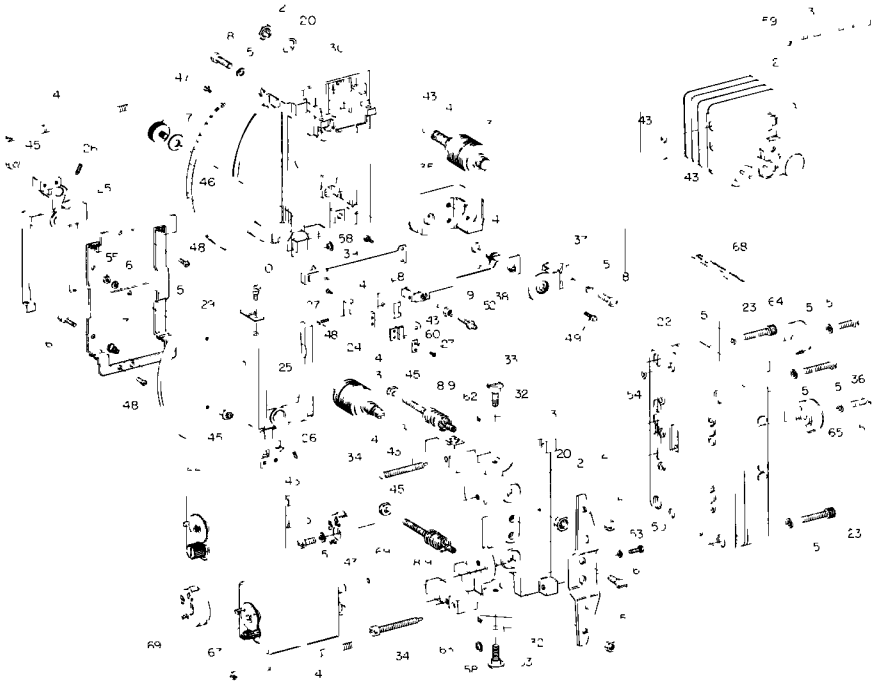


FIGURE 32 Parts Drawing P92-4,

ITEM	PART NO	NAME
1	SEE NOTE	CODE LABEL
2	5319700 5	BSTR RELAY ASSY, SEE PTS DWG P92 15
3	8 32x2 1 2	FIL HD SST SCR 2 REQD
4	5320444 1	MOUNTING SCR 3 REQD
5	10 32x1 2	FIL HD SST SCR 4 REQD
6	5320626 1	SHLD SCR 2 REQD
7	5320646 1	SPRING
8	5320676 1	SPG ASSY FOR 3 15 PSIG RANGE 2 REQD
9	5320675 1	SPG ASSY FOR 3 27 PSIG RANGE 2 REQD
10	5320627 1	SHOULDER SCR 8 REQD
11	5322986 1	HINGE ASSY 4 REQD
12	19 528 1	THIN NUT 4 REQD
13	5320674 1	BELLOWS ASSY 4 REQD
14	5311428 3	O RING 4 REQD
15	5320640 1	VANE ADJ SPT ASSY
16	5320652 1	VANE ADJ STUD 2 REQD
17	5320672 1	CONICAL SPG, 2 REQD
18	10 32x5 8	FIL HD SST SCR 4 REQD
19	5323030 1	NOZZLE LOCKNUT
20	19 526 1	SPRING WASH 4 REQD
21	5325272 1	O RING & GASKET SHEET
22	5321596 2	MANIFOLD ASSY
23	10 32x1	SOC HD SST SCR 4 REQD
24	5322332 1	VANE ADJUSTMENT
25	5321468 1	BELLOWS BEAM 2 REQD
26	4 40x5 8	HEX SOC HDLS SET SCR 4 REQD
27	2 56x3 16	PAN HD SST SCR 4 REQD
28	5323720 1	ADJ INSERT
29	5320650 1	VANE SUPPORT ASSY
30	5321465 2	B D BELLOWS BASE
31	5321463 1	A C BELLOWS BASE
32	5320659 1	SPRING ADJ 2 REQD
33	5320634 1	SPG ADJ PIVOT 2 REQD
34	5320632 1	ADJ SCREW 2 REQD
35	5320647 2	UPPER BEARING PLATE
36	10 32x7 8	SOC HD SST SCR 6 REQD
37	5322647 2	LOWER BEARING
38	5324466 1	NOZZLE ARM ASSY
39	4 40x1 4	FIL HD SST INT SEMS 2 REQD
40	5322713 1	NOZZLE ARM SPG ASSY
41	5322333 1	VANE ASSY
42	5311428 10	O RING
43	5311428 2	O RING SEE TABLE
45	5320661 1	SPG ADJ NUT 4 REQD
46	5323006 1	GAIN SCALE
47	3 48x1 8	PAN HD SST SEMS EXT 2 REQD
48	4 40x5 16	PAN HD SST SEMS EXT 5 REQD
49	3 48x1 8	FLAT HD SST SCR
50	6 32x3 8	HEX SOC SST CAP SCR AS REQD
51	NO 10SAE	SST REG SPRING LKWASH 18 REQD
52	5322337 1	NOZZLE
53	NO 6 32SAE	SST LKWASH AS REQD
54	19934 162	SPACER 3 REQD
55	4 40	SST HEX NUT
57	10 32	SST HEX NUT 2 REQD
58	5323017 1	RETAINING RING 3 REQD
59	NO 8SAE	SST LKWASH 2 REQD
60	5320639 2	CLAMP PLATE
61	532172 7	SPRING WASHER 3 REQD
62	5323028 1	DESIGNATION DECAL
63	5323028 2	DESIGNATION DECAL
64	5320657 1	PROP PROP + INTEGRAL SWITCH ASSY
65	5320658 1	DIRECT REV SWITCH ASSY
66	5320702 1	DERIVATIVE ASSY SEE TABLE
67	5322996 1	INT ASSY SEE TABLE
68	1961561 □	NAMEPLATE SPECIFY TYPE & RANGE OF CONT FOR CORR ENGRAVING
69	5322979 1	INT & DERIVATIVE SWITCH ASSY SEE TABLE
70	5322650 1	LOCK KNOB
71	532172 12	SPRING WASHER

TABLE

CONTROLLER ACTION	RANGE PSIG	ITEM 43	ITEM 66	ITEM 67	ITEM 69
PROPORTIONAL ONLY	3 27 3 15	7 REQD 7 REQD			2 REQD 2 REQD
PROP PLUS INTEGRAL	3 27 3 15	9 REQD 9 REQD		1 REQD 1 REQD	1 REQD 1 REQD
PROP PLUS DERIVATIVE	3 27 3 15	9 REQD 9 REQD	1 REQD 1 REQD		1 REQD 1 REQD
PROP PLUS INT & DER	3 27 3 15	11 REQD 11 REQD	1 REQD 1 REQD	1 REQD 1 REQD	

SPARE PARTS KITS PART NUMBERS

	256 31 1 PROPORTIONAL 3 27 PSIG RANGE	256131 2 PROPORTIONAL 3 15 PSIG RANGE	256131 3 PROPORTIONAL 3 27 PSIG RANGE	256131 4 PROPORTIONAL 3 15 PSIG RANGE
QTY	ITEM NOS	ITEM NOS	ITEM NOS	ITEM NOS
1 EA	7 21 40 42	7 21 40 42	7 21 40 42	7 21 40 42
2 EA	9 17	8 17	9 17	8 17
4 EA	12 13	12 13	12 13	12 13
6 EA	14	14	14	14
11	43	43	43	43

NOTE SPECIFY NUMBER ON CODE LABEL WHEN ORDERING PARTS

Controller Assembly, Pt. No. 5323577-□

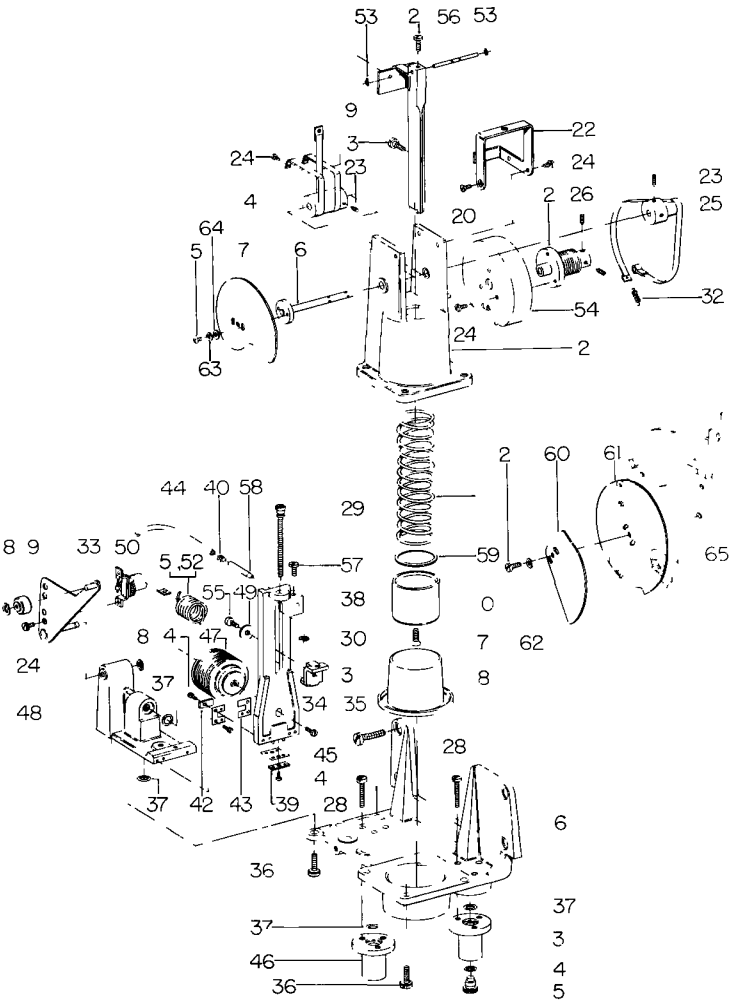
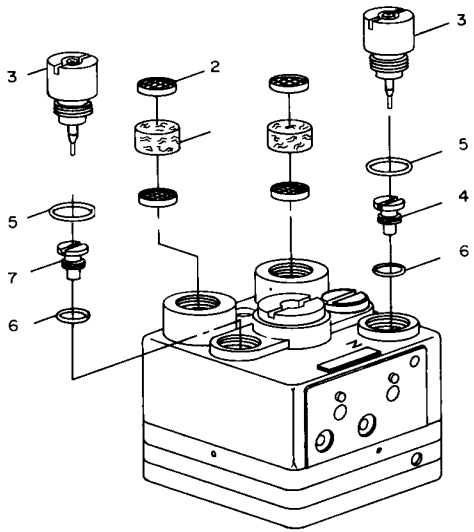


FIGURE 33 - Parts Drawing P92-3,

ITEM	PART NO	NAME
1	SEE NOTE	CODE LABEL
2	5323669 1	BELLOWS CPLG ASSY
3	5323868 2	CONNECTOR
4	5311428 2	O RING
5	5316464 1	ORIFICE ASSY
6	5323932 1	LOWER CYL HSG BASE
7	4 40x5 16	FLAT HD SST MACH SCR
8	5323956 1	ROLLING DIAPHRAGM
9	5323779 1	PISTON SHAFT ASSY
10	5324283 1	PISTON
11	5323617 1	SPRING
12	5324281 1	UPPER CYL HSG ASSY
13	5320627 1	SHOULDER SCREW
14	5324271 1	TAPE DRUM ASSY
15	2 56x3 16	PAN HD SST MACH SCR 2 REQD
16	5324425 1	OUTPUT SHAFT ASSY
17	5323869 1	45° OUTPUT CAM
18	197164 15	RET RING 2 REQD
19	5311425 1	CAM ROLLER
20	4 40x1 4	FLAT HD SST MACH SCR
21	4 40x1 3 8	IND SLOT HEX HD SST MACH SCR
22	5324280 1	MAX STOP BRACKET
23	661617 1	HEX SOC HD CONE POINT SCR 4 REQD
24	4 40x5/16	PAN HD SST SEMS INT 10 REQD
25	5324274 1	TAPE PULLEY ASSY
26	5 40x1 4	HDLS HEX SOC CUP PT SST SET SCR 2 REQD
27		
28	4 40x3 4	PAN HD SST SEMS EXT 6 REQD
29	5324417 1	ADJUSTMENT SCREW
30	5323005 2	RETAINING RING
31	5323919 1	RANGE ADJ SLIDE
32	5323548 1	SPRING
33	5323725 1	FOLLOWER ARM ASSY
34	6 32x1 4	PAN HD SST SEMS EXT 4 REQD
35	10 32x3 4	PAN HD SST SEMS EXT 7 REQD
36	10 32x1 2	PAN HD SST SEMS EXT 7 REQD
37	5311428 3	O RING 4 REQD
38	5323644 1	BELLOWS BEAM
39	5323639 1	CLAMP PLATE 2 REQD
40	1951049 3	COMPR CLIP 2 REQD
41	2 56x1 4	PAN HD SST SEMS INT 6 REQD
42	6611566 1	CLAMP PLATE 4 REQD
43	6611565 1	SPRING HINGE 2 REQD
44	5325121 1	FLEXIBLE AIRLINE
45	5323640 1	BELLOWS BEAM HINGE
46	5325276 1	CONNECTOR ASSY
4	45200 1	BELLOWS ASSY
48	5323942 1	TRANSMITTER CASTING
49	5324409 1	WASHER
50	5324416 1	ZERO ADJ ASSY
51	5323921 1	3 15 PSIG RANGE SPRING
52	5323651 1	3 2" PSIG RANGE SPRING
53	197164 12	RET RING 2 REQD
54	5323550 1	DRIVEN PULLEY
55	4 40x5 16	HEX SOC HD CAP SST SCR
56	5323915 1	STOP PIN
57	19748 1	NYLON SCREW
58	68840 2	NOZZLE
59	5324467 1	WASHER
60	5323924 1	10° OUTPUT CAM
61	5324405 1	BLANK CAM
62	NO 4	SST SPR LKWASH
63	NO 2	SST SPR LKWASH 2 REQD
64	NO 2	SST FLAT WASH 2 REQD
65	5323577 □	CONTROLLER ASSY SEE PTS DWG P92 4

NOTE SPECIFY NUMBER ON LABEL WHEN ORDERING PARTS

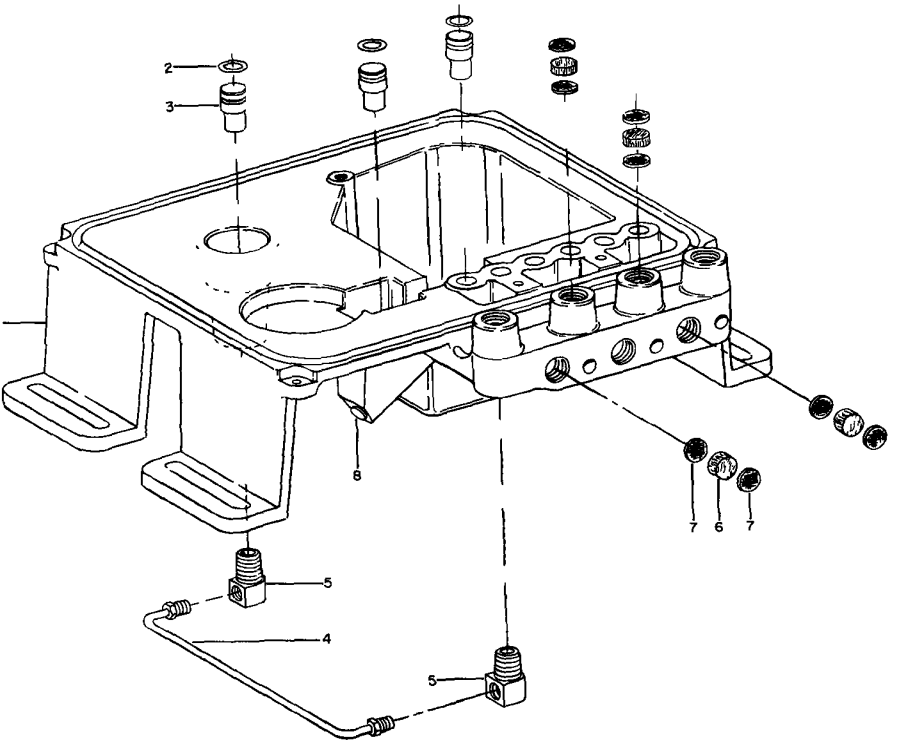
Gain Control Assembly, Pt. No 5323954 □



TEM	PART NO	NAME	TEM	PART NO	NAME
1	5320414 1	FELT PAD 2 REQD	4	5316464-4	OR CE ASSY
2	5320413 1	W RE MESH 4 REQD	5	5311428 11	O R NG 2 REQD
3	5316478 1	CR F CE CLEANOUT ASSY 2 REQD	6	5311428 2	O R NG 2 REQD
			7	5316464 1	OR F CE ASSY

NOTE THE ABOVE TEMS, N THE QUANT T ES L STED ARE AVA LABLE AS SPARE PARTS K T PT NO 256073A1 SPEC FY TH S NUMBER TO ORDER A COMPLETE K T

FIGURE 34 Parts Drawing P92 15, Booster Relay Assembly, Pt Nc 5319700 5



ITEM	PART NO	NAME	ITEM	PART NO	NAME	ITEM	PART NO	NAME
1	5323933	1 WALL MTD MANIFOLD	4	5323913	1 TUBING ASSEMBLY	7	5320413	1 WIRE MESH DISC 8 REQD
2	5311428	11 O RING 8 REQD	5	195167	CONNECTOR NUT	8	5323018	1 PLUG 4 REQD
3	5322981	1 D CONN PLUG 8 REQD	6	5320414	1 FELT PAD 4 REQD			

FIGURE 35 Parts Drawing P92 6, Mounting Base Assembly Pt No 5323944-1

Product Warranty

Bailey Meter Company warrants the products manufactured by it to be free from defects in material and work manship and will repair or replace, at its option, free of charge, f o b its factcry, such part or parts which prove defective within one year from date of shipment In respect to any products which are not an integral part of a product manufactured by the Company, the warranty given by the manufacturer thereof shal. apply

Shipping Damage

We strongly recommend that you inspect and test your instrument as soon as you receive it If the instrument is damaged or operates improperly, notify the carrier for inspection of the shipment The carrier's claim agent will prepare a report of damage a copy of which should be forwarded to your nearest Bailey District Office (see back cover for location) The District Office will then tell you how to have the instrument repaired or replaced

Service

The Bailey Meter Company is vitally concerned that your Bailey instrument provides continued, fine perform ance This instruction manual is designed to fully describe the correct installation. operation. and maintenance of your instrument under recommended conditions If the need arises, factory trained Service Engineers are on call for prompt, in plant maintenance Telephone or wire your nearby Bailey D strict Office to make arrangements for this service

Replacement Parts and Supplies

Complete parts drawings and recommended spare parts kit information are included in this instruction manual When replacement parts or supplies are required for maintenance of your Bailey instrument, contact your nearest Bailey District Office (see back cover for location) Always specify complete data on the instrument nameplate on your inquiry or order for parts. Common parts are available for shipment with n 48 hours on a speed order basis

00 23 15 04 11 07

BA LEY METER COMPANY
HEADQUARTERS

29801 Euc d Avenue
W ck ffe Oh o 44092

U S A D STR CT OFF CES

Ca forn a Los Ange es
Ca forn a San Fra nc sco
Co orado Denver
Connect cut New Haven
F or da Jacksonv e
Georg a At a ta
no s Ch cago
Kentucky Lou sv e
Lou s ana New Or ea s
Ma ne Augusta
Mary and Ba t mo e
Massach setts Boston
M ch ga Det o t
M ch gar Ka ama oo
M nnesota St Pau
M ssour Kansas C ty
M ssour St Lou s
North Caro na Char c tte
New Jersey East Ora ge
New York Buffa o
New York Syrac se
Oh o C nc nnat
Oh o Cleve and
Pe nsy van a Ph ade ph a
Pennsy van a P ttsburgh
Texas Da as
Texas Houston
V rg n a R c mo d
Was ngto Seatt e
W scons n M waukee

BA LEY METER COMPANY L M TED
PO NTE CLA RE 730, QUEBEC

A berta Edmonto
Br t sh Co umb a Vancouve
Ma toba W nn peg
Nova Sco a Ha fax
O ta o Ottawa
Onta o Tr ro to
Quebec Montrea

BA LEY METER AUSTRAL A PTY LTD
REGENTS PARK, N S W 2143

N S W Sydney
Queens and Br sbane
South Austra a Ade a de
V ctor a Me bourne
Weste n Au stra a Perth

NTERNAT ONAL REPRESENTAT VES

Argent na Bu enos A res
Bra R o de Jane o
Ch e Sa t ago
Eng and Croydo
F ance Pa s
nd a New De h
ta y M an
Japa Tokyo
Mex co Mex co C ty D F
Puerto R co San Juan
Spa n Madr d
Ta wan Ta pe
Turkey Ankara
And Other Pr nc pa C t es

Bailey

a subs d ary of Babcock & W cox U S A

Form P92 7 1271
L tho n U S A