June 9, 1964 C. E. SWANSON 3,136,483

INSERTION TYPE CONTROL WITH REMOTE SETTING MEANS

Filed Dec. 29, 1960 3 Sheets-Sheet 1

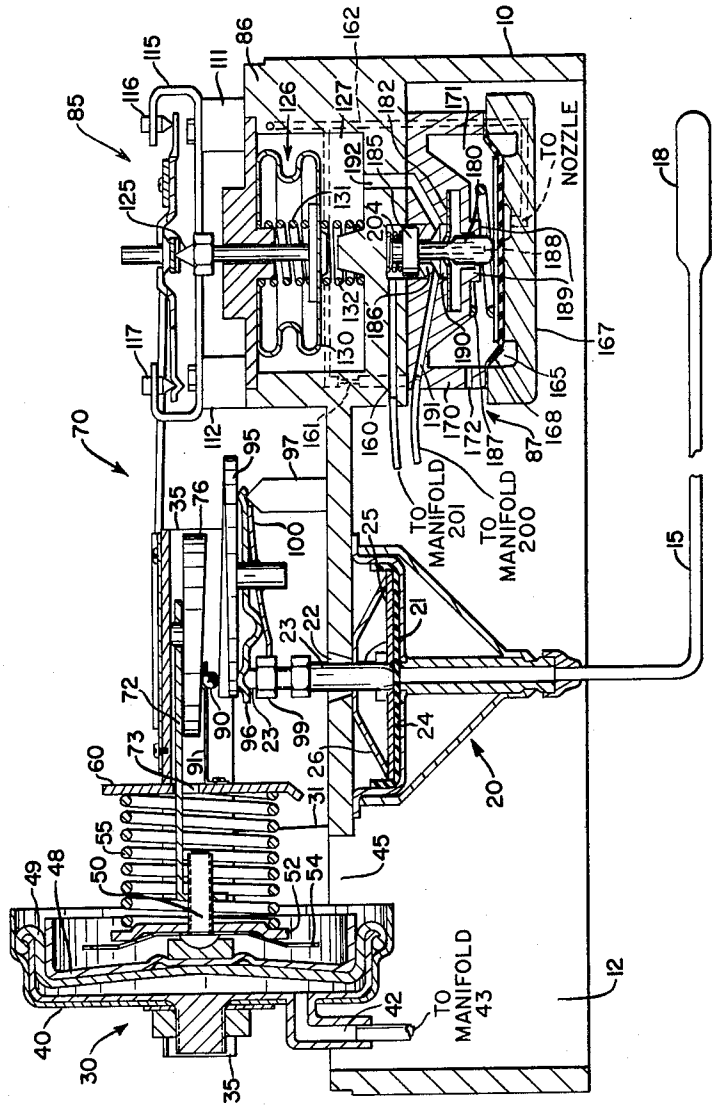


FIG. 1

INVENTOR.
CHARLES E. SWANSON

BY
Joseph E Ryan
ATTORNEY

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FIG. 3

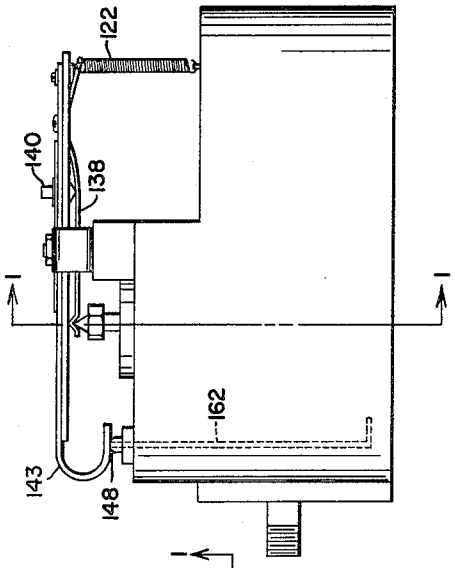
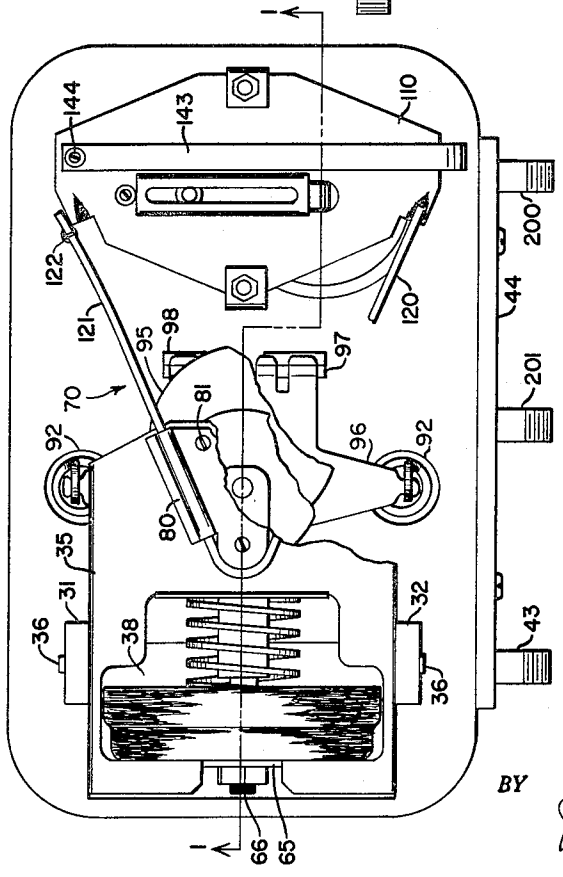


FIG. 2



INVENTOR.
CHARLES E. SWANSON

BY

Joseph E. Ryan

ATTORNEY

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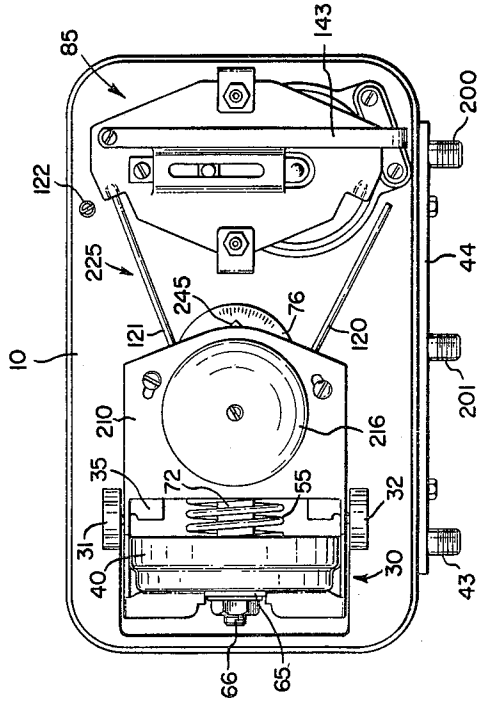


FIG. 5

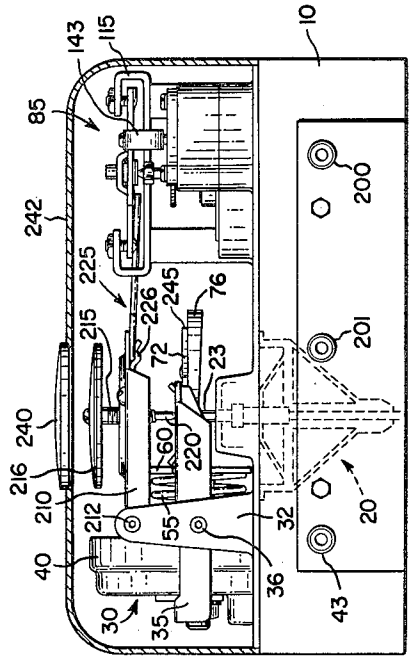


FIG. 4

INVENTOR.
CHARLES E. SWANSON
BY
Joseph E Ryan
ATTORNEY

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3,136,483

INSERTION TYPE CONTROL WITH REMOTE SETTING MEANS

Charles E. Swanson, Chicago, Ill., assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

Filed Dec. 29, 1960, Ser. No. 79,258
10 Claims. (Cl. 236—51)

This invention relates to control apparatus and more particularly to an improved pneumatic control apparatus of the insertion type employing a remote sensing element and being reset by a remote signal.

Apparatus of this type has been known and used in the past and have generally the combination of several elements to perform the remote sensing and remote setting function or complex apparatus to provide in addition to these functions, adjustments to the same. The present invention is directed to an improved insertion type control apparatus of this type which utilizes a simplified structure and a simplified adjusting mechanism to set the authority and set point for the control. Therefore it is an object of this invention to provide an improved insertion type control apparatus. A further object of this invention is to provide in an insertion type control apparatus a simplified provision for remote setting or control reset and calibration of both setting and sensing elements. These and other objects of this invention will become apparent from a reading of the attached description together with the drawings wherein:

FIGURE 1 is a side elevation view in section of one embodiment of the invention with the cover and certain parts removed,

FIGURE 2 is a top view of the control apparatus of FIGURE 1 with parts broken away and the cover removed,

FIGURE 3 is an end elevation view of the improved control apparatus of FIGURE 1, and

FIGURES 4 and 5 are side elevation and top views of another embodiment of the improved control apparatus.

My improved insertion type control apparatus shown in FIGURE 1 in section with a cover removed, includes a base section **10** having a recessed under surface **12**. The insertion type control includes a capillary **15** with a remote bulb sensing element **18** connected thereto, the capillary terminating in an expansion element indicated generally at **20** mounted on the under surface of the base in the recess portion being suitably secured thereto through suitable means not shown. Expansion element **20** which includes a diaphragm **24**, and movable spider positioning member **25** and a retaining spring **26** has a thrust portion **21** extending through an aperture **22** in the base and terminating in a push pin **23** on the upper side of the base. This expansion element connected through the capillary to the bulb operates on expansion of the bulb fill therein upon change in temperature of the ambient surrounding the bulb to move the thrust pin.

In addition to the thrust portion of the sensing element being mounted on the under surface of the base, it will be seen in FIGURE 2 that a remote setting or remote control member indicated generally at **30** is mounted on the upper surface of the base through a pair of upstanding flange pivots **31**, **32** thereon. The setting member apart from the adjustment or setting of the expansion element and bulb of the control apparatus operates to introduce a second signal in the form of a motion or thrust in accordance with a remote input which acts on the sensing portion of the apparatus to change the operating point of the same in the control of the output of the apparatus, as will be later described. The setting member is actually mounted in a frame **35** which is

pivoted on the flanges through trunnions indicated at **36**. The supporting frame having an aperture **38** therein in which is positioned an expansion element **40** of the setting member. The expansion element **40** as shown herein, is of the pneumatic type having an inlet line **42** which is connected to a conduit **43** in a manifold **44** positioned on the side of the base structure through a flexible conduit shown in part in FIGURE 1. The member **30** which may be used for remote setting or control of the apparatus will hereinafter be identified as a setting member for simplicity. It extends through an aperture indicated at **45** in the upper surface of the base. The expansion element of the setting member includes a thrust cup **48**, best seen in FIGURE 1, positioned against the diaphragm **49** of the same and carrying a thrust pin **50** on which is adjustably positioned a spring retaining member **52**. Arm **54**, rigidly attached to threaded pin **50**, cooperates adjustably with actuating thrust link **72** which has a portion **74** through which pin **50** threads. Movement of the arm **54** will thread the pin into and out of the link portion **74** to change its position on the pin **50**. Retainer **52** cooperates with one extremity of the return spring **55** of the setting member, the other extremity being retained and defined by bracket **60** resting against and suitably secured to the support **35**.

The setting member **30** is basically a pneumatic actuator similar to the type disclosed in the patent to Peter De May No. 2,939,486, dated June 7, 1960, entitled "Pneumatic Actuator." The frame of the expansion member **40** is provided with a diaphragm **49** to define an expansion chamber into which control air is introduced through the passage **42** connected to the manifold pipe or conduit **43** (the connection not being shown). The expansion chamber **40** is mounted on the pivoted support **35** by means of a flange **65** best shown in FIGURE 2 which is secured to the expansion member by means of a nut threaded on to a threaded hub **66** of the casing of the expansion member. The bracket **35** extends beyond the setting member and as will be later described in detail carries the actuating arm **70** for the control. In addition the thrust member **50** or pin mounts the thrust link **72** which extends through an aperture **73** in the spring support **60** and on the under surface of a support **35** and carries a cam **76** which will be described in detail hereinafter. It will be recognized that while I have shown a pneumatic type setting member, that other suitable types of setting actuators could be utilized and designed to be initiated or operated from a remote source.

The actuating arm **70** of the control extends along the upper surface of the support member **35** and, as will be seen in FIGURE 2, is a wire-like V-shaped member which is secured to the upper surface by means of a mounting bracket **80** through suitable screw means **81**. The actuating arm extends to the control or relay section **85** of the apparatus which is positioned in and mounted on a raised portion of the base structure indicated at **86** and including a relay housing **87** connected to the under surface of the base structure. This portion of the apparatus will be more fully described in detail later. A control mechanism or pneumatic relay **85** is similar to the type shown in the Patent No. 2,828,077 to Richard Mott entitled "Pneumatic Thermostat" dated March 25, 1958.

As will be seen in FIGURES 1 and 2, the support **35** carries the actuating arm **70** for the control operating into the pneumatic relay, this support being pivoted on the pivots **31**, **32** and carrying the setting member **30**. The operation of the setting member, that is expansion and contraction of its chamber through the thrust portion or pin **50** merely moves the link **72** attached thereto with a cam **76** mounted on the extremity thereof. This

cam is a circular cam to be rotatably journaled or positioned in the thrust link 72 and is characterized on its surface to provide for reverse or direct action of the control depending upon the slope of the same. As will be seen in FIGURE 1, cam 76 is sloped about its periphery with a shape produced by passing a plane through a cylinder at other than a right angle thereto. Thus the cam will have a high point and a low point in the axial direction and with uniform slopes therebetween. As the cam 76 is rotated on link 72, relative to the link between the high and low points, the slopes of the camming surfaces will be reversed. A ball member 90 which is held in position by means of a guide key 91 attached to the spring support 60 engages this camming surface. The operation of the setting member 30 will move the link 72 with the cam 76 attached thereto relative to the ball member 90 which relative movement will be in a radial direction with respect to the cam and over differing slopes depending upon the circular adjusted position of the cam 76. In FIGURE 1 the cam 76 is shown in a circular adjusted position in which the low point of the cam is being used and is associated with the relative movement between the cam and the ball member. The reversed slopes of the cam 76 with respect to the relative movement with the ball member 90 brings out the reverse and the direct setting action of the setting member 30 and these slopes will vary up to a position midway between the high and low points on the cam 76 where the slope reversal takes place such that adjacent 90° sections or one-quarter of the surface of the cam will be used for reverse and direct acting adjustments of the setting member 30. Thus by rotating the cam 76 on the link 72, the different camming surfaces will be brought into engagement with the ball member 90. Also engaging the ball 90 is a second cam member 95 which is mounted in a pivoted lever 96, the lever or plate being pivoted at one extremity in a pair of knife-edge pivots 97, 98 on the upper surface of base 10 (best seen in FIGURE 2) and engaging in its opposite extremity the thrust pin 23 of the expansion member. Lever 96 is engaged by thrust pin 23 of expansion element 20 and is held in position against the pin 23 by springs or bias means 92 which attach to the lever or plate and the base 10. The cam 95 is designed to be rotatably positioned on the lever and a locking spring 100 positioned on the under surface of a lever and engaging the cam shaft clamps the same. It also fits around and bears against the nut-like retaining portion 99 on the pin 23 to maintain the spring in a flexed position around the cam shaft and frictionally hold or lock the cam in whatever position it has been set in. The cam surface 95 is characterized about its peripheral extent with a helical type slope starting from a datum point on the periphery and extending substantially around the entire periphery with a reverse slope at the end to join with the datum. This camming surface permits set point adjustment of the thermal system, that is the bulb and expansion element associated therewith. By rotatably positioning the cam varying rise portions can be brought into engagement with the ball member applying an upward or downward thrust or movement to the cam 76 and the lever 72 together with the entire setting assembly 30 and support 35 to move the actuating arm 70 of the control device upward or downward. The ball member 90 is positioned in lateral alignment with the thrust pin 23 of the expansion member 20 and operation or expansion of the expansion member 20 with change in ambient temperature at bulb 18 will cause the cam 95 to be moved toward or away from the surface of the base member pivoting the lever 96 on its upstanding pivots 97, 98 and causing the cam to move the ball and hence the setting assembly together with its mounting support to move the actuating arm in the same manner. Similarly expansion or contraction of the setting member will move the cam 76 translationally of the ball and the sloping cam surfaces of cam 76 toward and away from the periphery to the center of the cam respectively varies the position of the support member 35 and hence the actuating bar arm 70 in the same manner.

This movement of the support member 35 and hence the actuating arm 70, as will be best seen in FIGURE 2, causes movement of a plate 110 of the pneumatic control which is mounted on a pair of upstanding brackets 111, 112 of the raised portion 86 of the base. The pivot structure for the plate 110 is a U-shaped pivot mounting support 115 having a pair of pivots 116, 117 located at its extremities and engaging the plate in the upper surface thereof. As will be seen in FIGURE 2 one of the arms or portions of the actuating arm 70 indicated at 120 engages the extremity of the plate while the other portion 121 of the V-shaped arm 70 remains clear of lever 110 in the direct acting arrangement. The under surface of the pivoted lever or plate 110 for the control device or pneumatic relay is supported on the cone type thrust member 125 of a feedback mechanism 126 housed in an aperture 127 in the raised portion 86 of the base, the thrust member being carried by a bellows 130 positioned in the recess and having a spring member 131 positioned therein. The under surface of the bellows is also engaged by a spring 132 to position the bellows within the recess or chamber 127 which is the feedback chamber connected to a branch line conduit 191 from the relay as will be later defined. FIGURE 1 is cross sectioned through the relay in accordance with the line 1—1 shown in FIGURE 3 to disclose the cross section of the feedback bellows and also the cross section of the relay positioned below the same. It will be seen in FIGURE 3 that the cone or thrust member 125 of the feedback bellows actually engages a spring 138 attached to the under surface of the plate 110 and having an adjustment pivot 140 slidably mounted in the upper surface of the plate and engaging the lever to vary the rate or amount of feedback to be applied to the plate by varying the locus of pivot or fulcrum arm of the lever 138. Also mounted on the upper surface of the plate 110 is the flapper spring 143 which is secured in one extremity, as at 144 to the upper surface of the plate and through suitable means such as a screw and is curved at its opposite extremity to engage or be adjustably disposed adjacent a nozzle indicated at 148 for the relay mechanism. The nozzle 148 is actually connected to a supply conduit indicated at 160 in the base portion 86 of the control device which supply conduit leads through a restriction 161 (see FIGURE 1) to a conduit 162 (shown in phantom in FIGURES 1, 3) which connects the nozzle with a pilot chamber 165 of the relay 87 defined by a recessed end cap 167 and a pilot diaphragm 168. Chamber 171 above diaphragm 168 includes the conventional pilot bias spring 187. The relay 87 also includes a main relay housing 170 having an exhaust aperture 172 therein which connects the relay to atmosphere. Positioned in an aperture in housing 170 is a tubular ported valve closure member 180 which is sealed and attached to the diaphragm 182. Diaphragm 182 is sealed to housing 170 containing a guide 189 for member 180. Valve member 180 cooperates with second valve member 185 to provide combined branch pressure valving and exhaust valving. Valve member has a passage 188 therein which is closed at one extremity by valve member 185 when it abuts member 180. The other end of the passage is always open with contact with the diaphragm 168 so that the passage 188 is always open to the chamber 171 above the diaphragm 168 and atmosphere through aperture 172 but is controlled by the relative positions of the members 180, 185 to provide the exhaust valving for the branch chamber to be hereinafter described. The second valve closure member 185 further cooperates with a valve seat 186 also in the aperture to control the inlet valving or flow from the pneumatic source or conduit 160 to a

branch pressure chamber indicated at 190 which in turn is connected to a branch outlet conduit 191 and a branch pressure conduit 192 leading to the feedback chamber 127. Thus control of air pressure or pilot pressure at the nozzle 148 by movement of the flapper 143 on the plate 110 relative thereto will vary the pressure in the pilot chamber 165 to urge the movable valve closure member in a direction to close the exhaust passage or valve defined by the members 180, 185 and open the supply valve of the relay defined by the movable valve closure member 185 and the seat 186. Air pressure will be admitted from the supply line 160 to the branch chamber 190 and from the branch chamber to the branch line 191 leading to the branch manifold pipe 200 which is connected to the relay portion through suitable means not shown. Similarly the manifold 44 includes a supply pipe 201 which connects to the supply conduit 160 through suitable means, such as flexible conduit. Branch line pressure will also be communicated to the feedback bellows which will apply a force from the thrust pin 125 to the spring 138 attached to the plate 110 urging the plate in a direction to reduce pilot pressure by moving the flapper 143 away from the nozzle. A drop in pilot pressure reducing the pressure in the chamber 165 will allow the diaphragm 168 and hence the valve closure member 180 to drop closing the valve defined by the members 185, 186 which is aided by the spring 204 in the inlet side of the valve and opening the exhaust passage from the branch line conduit 191 in chamber 190 through the valve defined by the closure member 180 and closure member 185 to the chamber 171 which is connected to atmosphere. This operation of the relay is conventional and as indicated above is shown and described in detail in the Mott patent referred to above. The control device or relay is shown in FIGURE 2 as set up for reverse action type of operation in which the lever portion 120 of arm 70 engages the upper surface of plate 10 and with the portion 121 connected by spring 122 to the base 12. With expansion of the element 20 upon a rise in ambient temperature at bulb 18, the support 35 carrying arm 70 will rotate counterclockwise, as seen in FIGURE 1, to cause the end of plate 110 carrying flapper 143 to raise from the nozzle, thus reducing pilot pressure in the chamber 165 and hence outlet pressure in the conduit 191 as it is vented to atmosphere. The control is made direct acting by releasing bracket 80 and moving arm 70 so that the portion 120 is clear of plate 110 and the portion 121 with the spring 122 removed is positioned under the adjacent extremity of plate 110. With the temperature increase at bulb 18, the expansion of element 20 and counterclockwise movement of support 35 will cause plate 110 to pivot in the opposite direction moving flapper 143 closer to the nozzle and hence increasing the pilot and branch outlet pressures.

The operation of the improved insertion type control apparatus is straightforward. Expansion or contraction of the fill within the bulb upon change in ambient temperature surrounding the same will cause the expansion member 20 positioned on the base to expand or contract raising or lowering the thrust pin 23 and hence the pivoted lever 96 with a cam 95 thereon. This will act against the ball 90 to pivot the setting member 30 which is attached to the movable thrust pin 50 of the setting member and hence move the supporting member 35 to move the actuating arm 70. Movement of the supporting structure 35 about its pivots and against its actuating arm 70 will pivot the plate 110 of the pneumatic relay or control device to vary the pilot pressure in the relay chamber or pilot chamber 165 moving the movable or closure member 180 of the relay to either open the inlet valve and close the exhaust valve or close the exhaust valve and open the inlet valve to increase or decrease outlet branch pressure and hence the feedback pressure applied to the under surface of the plate 110. Thus a force feedback type of control is effected on the relay in a conventional manner. The remote setting or control function on the member 30 is basically to adjust the set point of the control in accordance with a remote signal, herein indicated as a remote pressure source. Variation of pressure applied to the operating chamber 40 of the setting member will vary the position of the cam 76 relative to the ball 90 and since the cam is characterized it will cause the operating arm 70 to rise or fall or pivot about its associated mounting structure to displace the control lever or plate 110. Adjustment of the setting for the bulb fill element is affected by adjustment of the cam 95 with the rotation of the same upon its pivoted lever 96 to bring in a different cam surface into engagement with the ball causing the support structure 35 and arm 70 to rise or fall in accordance with the cam surface. Adjustment of the setting mechanism or the setting of the setting control will be affected by rotation of the cam 76 on its supporting lever 72 to bring different sloped cam surfaces into engagement with a ball connection member 90 such that the effect of the control may be set down or set up and can be positive or negative depending upon the slope of the cam surface. Thus the structure provides a simplified adjustment to both the setting member and the expansion element or the volatile fill control which operate in conjunction to control the pneumatic relay or control device associated therewith.

The embodiment of the invention shown in FIGURES 4 and 5 as a side elevation and top views respectively differs from the aforementioned embodiment basically in the details of the adjusting mechanism for the expansion element of the remote bulb. It will be seen that the base structure 10 again mounts on its upper surface the setting member or control 30 on a pivoted support member 35 mounted on the upstanding flanges 31 and being pivoted through pivots 36. The expansion element 20 which is shown in phantom is again mounted on the under surface of the base structure with a thrust pin 23 extending to the upper surface thereof. Similarly the relay or pneumatic control 85 is mounted in part on the upper structure or surface of the base member 10 and is identical with that of the preceding disclosure so it will not be described in detail herein. The setting member or control 30 which is pivoted on the upstanding flanges 31 and 32 includes an expansion element 40 identical to that previously described in FIGURES 1–3 which is mounted on the support member 35 through the flange 65 by means of the nuts threaded on the threaded hub 66 of the casing of the expansion member. The setting member again has its thrust pin 50 moving in arm 72 which carries the cam 76 at the extremity thereof. This cam is a circular cam which is rotatably journaled on the thrust lever 72. It is characterized about its periphery to provide for reverse and direct compensation by virtue of the slope thereon. In this embodiment of the invention the lever 35 is pivoted and positioned closest to this upper surface of the base 10 and cam 76 contacts directly the thrust member 90. Since the details of the setting member and this portion of the assembly including the cam 76 and its mounting structure are identical with that previously described they will not be identified in detail herein. This embodiment includes a second lever member 210 which is also pivoted on the upstanding flanges 31, 32 through pivot means such as is indicated at 212. This lever is similar to the lever 96 but is positioned above and overlying the pivoted support 35. It carries a screw type adjustment means 215 having a rotary indicia and adjusting knob 216 connected thereto, the adjusting or threaded pin 215 being threaded through the lever 210 and terminating in a thrust pin 220 engaging the upper surface of the pivoted support or lever 35. By rotatably adjusting the pin 215, the actual spacing between the levers 210 and 35 is shifted to effect a set point for the thrust or expansion member 20 in a similar manner to the positioning of the rotary cam 95 in the previous embodiment. In this embodiment the pivoted lever 210 carries an actuating arm or output

means indicated generally at 225 and being comprised of the wires 120, 121 as in the previous embodiment which are secured to the under surface of the lever 210 through suitable bracket means 226. For a direct acting control, the portion 121 of the output means 225 will engage the under surface of the pivted lever 110 of the pneumatic relay or control 85 to raise or lower the lever relative to the nozzle and hence the flapper 143 thereon relative to the nozzle to control branch line pressure to the relay. Since this portion of the apparatus is identical with the previous disclosure its details will not be defined herein. With a direct acting arrangement, the portion 120 of the output means 225 will be positioned clear of lever 110. When a reverse acting control is desired, the levers 121, 120 are reversed, that is the lever 121 is connected to the spring 122 while the lever 120 is positioned above the opposite extremity of the lever 110 so that movement of the pivoted lever 210 will have the reverse effect on the operation of the relay in a conventional manner. It will be seen that with the reverse action connection for the control relay, the bias inherent in the pneumatic relay or on the lever 110 will be applied through the portion 121 of the output means to provide a bias on the pivoted levers 210 and 35 to maintain the linkage with the thrust member or pin 23 of the expansion element 20. By rotation of the cams 76 and the adjusting means 215, the actual height between the two levers will be adjusted to effect a change in the position of the lever 210 and hence the output means 225 to adjust the setting of the relay or pneumatic control 85. Movement of the expansion element of the setting control back and forth relative to the thrust pin 23 will bring different contoured surfaces into engagement with the pin thus changing the height and hence the setting with respect to the thrust member. Similarly adjustment of the adjusting means 215, 216 will effect a setting for the expansion element 20 which may be viewed through a covered glass opening 240 in a casing 242 positioned over the upper surface of the base structure as indicated in FIGURE 4. The upper surface of the cam 76, as indicated on the FIGURE 5, cooperates with indicia or reference member, indicated at 245, which is an extension of the support bracket 72 for the cam 76 to provide a visual indication of the adjustment setting for the setting member.

The operation of this embodiment of the improved insertion type control apparatus is also straightforward and similar to the previously described embodiment. Expansion or contraction of the expansion element 20 with ambient change in temperature at the bulb of the insertion type unit will cause the thrust member to move up or down on the casing or base 10 pivoting the lever 35, the linkage pin 220 contacting the same and pivoting the lever 210 to adjustably position the output means against the control relay 85 to establish a new branch line pressure in accordance with the temperature sensed. The authority of the setting member is adjusted by means of positioning the cam and remote signals introduced into the expansion chamber 40 of the setting member 30 will adjustably position the cam relative to the thrust member to adjust the linkage or spacing between the levers 35 and 210 and operate the output means 225 as previously described. Further the set point for the thrust member or expansion element 20 is adjusted by means of the adjusting mechanism 215, 216 to also adjustably position the output means 225 and adjust the setting of the regulator or relay 85.

In considering this invention it should be remembered that the present disclosure is intended to be illustrative only and the scope of the invention should be determined only by the appended claims.

I claim:

1. An insertion type control comprising: a base; a volatile fill bulb and a connecting capillary with an expansion member attached at the extremity thereof; means mounting the expansion member on said base and including a thrust member extending through an aperture in said base; a lever; pivot means mounted on the upper surface of said base and adapted to position one extremity of said lever, the opposite extremity of said lever engaging said thrust member of said expansion member; spring bias means connected between said base and said lever to urge said lever against said thrust member; a rotatable cam mounted on said lever and journaled therein, said cam having a helical cam surface for manual adjustment and upon movement about its pivot bringing in different heights of the cam slope to effect a setting for said volatile fill bulb; a remote control member positioned on the upper surface of said base and carried in a frame; upstanding pivot means integral with the upper surface of said base and pivotally mounting said frame with said remote control member for pivotal movement; said remote control member including an expansible element and a thrust portion; a second rotatable cam mounted on the thrust portion of said reset member, said second cam having cam surfaces in which the slope varies along its periphery in a radial direction; ball linkage means positioned between said cams and held in position by a connection to said frame of said expansible element of said remote control member; the last named cam being manually rotatable to adjustably bring into contact with said ball linkage means varying slopes of said cam surface such that movement of the expansible element of said remote control member moves said cam radially in contact with said ball linkage means thereby varying the position of the frame of the remote control member; a lever connection member extending from said frame of said remote control member, the lever connection member also being movable with the expansion member of said sensing bulb through a linkage formed by said first named lever, said first and second cams, said ball linkage means and the frame of said remote control member; and control means mounted on said base and adapted to be engaged by said lever connection member to operate said control means with movement of said frame.

2. An insertion type control comprising: a base; a volatile fill bulb and a connecting capillary with an expansion member attached at the extremity thereof; means mounting the expansion member on said base and including a thrust member extending through an aperture in said base; a lever; pivot means mounted on the upper surface of said base and adapted to position one extremity of said lever, the opposite extremity of said lever engaging said thrust member of said expansion member: a rotatable cam mounted on said lever and journaled therein, said cam having a helical cam surface for manual adjustment and upon movement about its pivot bringing in different heights of the cam slope to effect a setting for said volatile fill bulb; a setting member positioned on the upper surface of said base and carried in a frame; upstanding pivot means integral with the upper surface of said base and pivotally mounting said frame with said setting member for pivotal movement, said setting member including an expansible element and a thrust portion; a second rotatable cam mounted on the thrust portion of said reset member, said second cam having cam surfaces in which the slope varies along its periphery; ball linkage means positioned between said cams and held in position by a connection to said frame of said expansible element of said setting member; the last named cam being manually rotatable to adjustably bring into contact with said ball linkage means varying slopes of said cam surface such that movement of the expansible element of said setting member moves said cam radially in contact with said ball linkage means thereby varying the position of the frame of the setting member; a lever connection member extending from said frame of said setting member, the lever connection member also being movable with the expansion member of said sensing bulb through a linkage formed by said first named lever, said first and second cams, said ball linkage means and the frame of said setting member; and control means mounted on said base and adapted to

be engaged by said lever connection member to operate said control means with movement of said frame.

3. An insertion type control comprising: a base; a volatile fill bulb and an expansion member attached at the extremity thereof; means mounting the expansion member in said base and including a thrust member extending through an aperture in said base; a lever; pivot means mounted on the upper surface of said base and adapted to position one extremity of said lever, the opposite extremity of said lever engaging said thrust member of said expansion member; bias means connected between said base and said lever to urge said lever against said thrust member; an adjustable cam means mounted on said lever and journaled therein, said cam means having a uniformly sloped cam surface; a remote setting member positioned on the upper surface of said base and carried in a frame; upstanding pivot means integral with the upper surface of said base and pivotally mounting the frame and said setting member for pivotal movement; said setting member including an expansible element and a thrust portion; a second adjustable cam means mounted on the thrust portion of said reset member, said second adjustable cam means having a surface in which the slopes vary along its periphery and being manually adjustable about its pivot; linkage means positioned between said cam surfaces, said last named cam means being radially movable through said expansible element and thrust portion in contact with said linkage means to bring in varying slopes on said cam surface to thereby vary the position of the frame of the setting member relative to said base; a lever connection member extending from said frame of said setting member, said lever connection member being movable relative to said base as determined by the movement of the expansion member of said volatile fill bulb and the engagement of said first and second cam means with said linkage means which is moved by said thrust portion of said expansible element; and control means mounted on the base and adapted to be engaged by said lever connection member to operate said control means with movement of said frame.

4. An insertion type control comprising: a base; a volatile fill bulb and an expansion member attached at the extremity thereof; means mounting the expansion member in said base and including a thrust member extending through an aperture in said base; a lever; a pair of fixed pivots mounted on the upper surface of said base and adapted to position one extremity of said lever, the opposite extremity of said lever engaging said thrust member of said expansion member; bias means connected between said base and said lever to urge said lever against said thrust member; an adjustable cam means mounted on said lever and journaled therein, said cam means having a uniformly sloped cam surface; a remote setting member positioned on the upper surface of said base member and carried in a frame; upstanding pivot means integral with the upper surface of said base and pivotally mounting the frame for pivotal movement; said remote setting member including an expansible element and a thrust portion; a second adjustable cam mounted on the thrust portion of said remote setting member, said second adjustable cam means having a surface in which the slopes vary along its periphery and being manually adjustable about its pivot; thrust transmitting means positioned between said cam means and held in position by means of a connection to said frame of said expansible element of said remote setting member, said last named cam means being radially movable through said expansible element and thrust portion in contact with said thrust transmitting means to bring in varying slopes on said cam surface to thereby vary the position of the frame of the remote setting member relative to said base; a lever connection member extending from said frame, said lever connection member being movable relative to said base as determined by the movement of the expansion member of said volatile fill bulb and the engagement of said first and second cam means with said thrust transmitting means which are moved by said thrust portion of said expansible element; and control means mounted on the base and adapted to be engaged by said lever connection member to operate said control means with movement of said frame.

5. An insertion type control comprising: a base; a sensing bulb and an expansion member attached at the extremity thereof; means mounting the expansion member in said base and including a thrust member extending through an aperture in said base; a lever; a pair of fixed pivots mounted on the upper surface of said base and adapted to position one extremity of said lever, the opposite extremity of said lever engaging said thrust member of said expansion member; bias means connected between said base and said lever to urge said lever against said thrust member; an adjustable cam means mounted on said lever and journaled therein, said cam means having a uniformly sloped cam surface; a remote control member positioned on the upper surface of said base and carried in a frame; upstanding pivot means integral with the upper surface of said base and pivotally mounting the frame of said remote control member for pivotal movement; said remote control member including an expansible element and a thrust portion; a second adjustable cam means mounted on the thrust portion of said remote control member, said second adjustable cam means having a surface in which the slopes vary along its periphery and being manually adjustable about its pivot; linkage means positioned between said cam surfaces, said last named cam means being radially movable through said expansible element and thrust portion in contact with said linkage means to bring in varying slopes on said cam surface to thereby vary the position of the frame of the remote control member relative to said base; a lever connection member extending from said frame of said remote control member, said lever connection member being movable relative to said base as determined by the movement of the expansion member of said sensing bulb and the engagement of said first and second cam means with said linkage means which are moved by said thrust portion of said expansible element; and control means mounted on the base and adapted to be engaged by said lever connection member to operate said control means with movement of said frame.

6. An insertion type control comprising: a base; a sensing bulb and an expansion member attached at the extremity thereof; means mounting the expansion member in said base and including a thrust member extending through an aperture in said base; a lever; pivot means mounted on the upper surface of said base and adapted to position one extremity of said lever, the opposite extremity of said lever engaging said thrust member of said expansion member; bias means connected between said base and said lever to urge said lever against said thrust member; an adjustable cam means mounted on said lever and journaled therein, said cam means having a uniformly sloped cam surface; a setting member positioned on the upper surface of said base and carried in a frame; upstanding pivot means integral with the upper surface of said base and pivotally mounting the frame for pivotal movement; said setting member including an expansible element and a thrust portion; a second adjustable cam means mounted on the thrust portion of said setting member, said second adjustable cam means having a surface in which the slopes vary along its periphery and being manually adjustable about its pivot; linkage means positioned between said cam surfaces, said last named cam means being radially movable through said expansible element and thrust portion in contact with said linkage means to bring in varying slopes on said cam surface to thereby vary the position of the frame relative to said base; a lever connection member extending from said frame, said lever connection member being movable relative to said base as determined by the movement of the expansion member of said sensing bulb and the engage-

ment of said first and second cam means with said linkage means which are moved by said thrust portion of said expansible element; control means mounted on the base and adapted to be engaged by said lever connection member to operate said control means with movement of said frame; and means for changing the connection of said lever connection member to said control means to provide a reverse output therefrom with movement of said frame.

7. An insertion type control comprising: a base member; a volatile fill bulb and an expansion element attached at the extremity thereof; means mounting the expansion element on said base member and including a thrust member extending through an aperture in said base member; a pair of levers pivotally mounted on said base, said levers being adapted to pivot upon movement of said expansion element; a remote setting control pivotally connected to one extremity of one of said levers and including a movable element associated therewith movable normal to the direction of movement of said thrust member; characterized cam means connected to said movable element of said setting control and movable therewith to provide different camming surfaces in the direction of movement of said thrust member, said characterized cam means having cam surfaces in which the slopes vary along its periphery and such that the cam means is adjustable relative to the movable element to bring in differing slopes; additional circular adjusting means mounted on the other of said levers and having its point of adjustment aligned with said thrust member, said additional adjusting means being manually adjustable to effect the setting for said volatile bulb; an output linkage connected to the lever positioned more remote from said thrust member and cooperating with a pneumatic control device mounted on said base; means biasing said levers with said cam means and adjustable means thereon into contacting and motion imparting relationship with said thrust member of said exapnsion element; movement of said setting control member with manual adjustment and with movement of said expansion element together with movement of said additional circular adjusting means being operative to adjust the length of a linkage formed between the thrust member and said adjusting means and cam means to cause pivotal movement of said output linkage to operate said pneumatic control device.

8. An insertion type control comprising: a base member; a sensing element and an expansion element attached at the extremity thereof; means mounting the expansion element on said base member and including a thrust member extending through an aperture in said base member; a pair of levers pivotally mounted on said base, said levers being adapted to pivot upon movement of said expansion element; a setting control pivotally connected to one extremity of one of said levers and including a movable element associated therewith movable normal to the direction of movement of said thrust member; characterized cam means connected to said movable element of said setting control and movable therewith to provide different camming surfaces in the direction of movement of said thrust member, said characterized cam means having cam surfaces in which the slopes vary about its periphery and such that the cam means is adjustable relative to the movable element to bring in differing slopes; additional circular adjusting means mounted on the other of said levers and having its point of adjustment aligned with said thrust member, said additional adjusting means being manually adjustable to effect the setting for said sensing element; an output linkage connected to the lever positioned more remote from said thrust member and cooperating with a control device mounted on said base; means biasing said levers with said cam means and adjustable means thereon into contacting and motion imparting relationship with said thrust member of said expansion element; movement of said setting control with manual adjustment and with movement of said expansion element together with movement of said additional circular adjusting means being operative to adjust the length of a linkage formed between the thrust member and said adjusting means and cam means to cause pivotal movement of said output linkage to operate said control device.

9. An insertion type control comprising: a base member; a volatile fill bulb and an expansion member attached at the extremity thereof; means mounting the expansion member on the under surface of said base member and including a thrust member extending through said base member to the upper surface thereof; a pair of pivoted levers pivotally mounted on the upper surface of said base member and extending parallel to the surface thereof being pivoted with movement of said thrust member, said levers being spaced apart such that one overlies the other and both overlie the thrust member; one of said levers mounting at one extremity a setting control including an expansible element terminating in a circular adjustment cam, the other of said levers including a circular adjustment means, said cam and said circular adjustment means overlying said thrust member with said circular cam being movable by said setting control translationally of the direction of movement of said thrust member to provide varying sloped camming surfaces depending upon the condition of operation of said setting control to the point of axial alignment of said thrust member and said circular adjustment means; said adjustment means and said circular cam on said lever being effective to vary the length of linkage between said levers and said thrust member; and means connected to the lever most remote from said thrust member being movable with said levers through adjustment of said circular cam and said adjustment means or movement of said expansible element of said setting control to provide an output movement; and control means mounted in part on said base member and connected to said last named means to be operated thereby.

10. An insertion type control comprising: a base member; a volatile fill bulb and an expansion member attached at the extremity thereof; means mounting the expansion member on the under surface of said base member and including a thrust member extending through said base member to the upper surface thereof; a pair of pivoted levers pivotally mounted on the upper surface of said base member and extending parallel to the surface thereof being pivoted with movement of said thrust member, said levers being spaced apart such that one overlies the other and they both overlie the thrust member; one of said levers mounting at one extremity a remote setting control including an expansible element terminating in a circular adjustment means, the other of said levers including an adjustment means, said adjustment means overlying said thrust member with said circular adjusting means being movable by said remote setting control member translationally of the direction of movement of said thrust member to provide varying adjustments depending upon the condition of operation of said remote setting control to the point of axial alignment of said thrust member and said circular adjusting means; said adjustment means and said circular cam on said levers being effective to vary the length of linkage between said levers and said thrust member; and means connected to the lever positioned most remote from said thrust member being movable with said levers through adjustment of said adjusting means or movement of said expansion element of said remote setting control to provide a pivotal output; and control means mounted in part on said base and connected to said last named means to be operated thereby.

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