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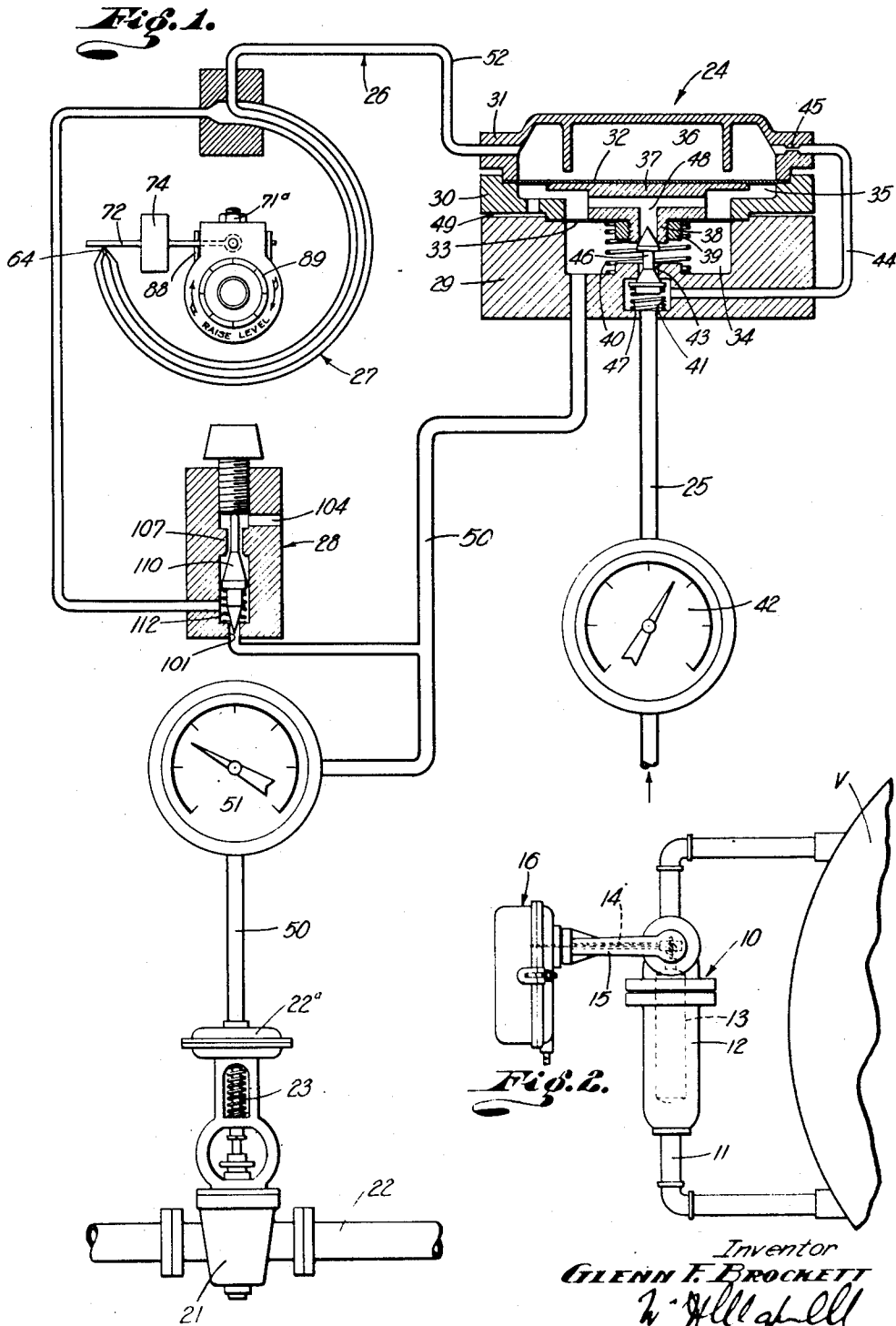
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2,356,970

PILOT MEANS FOR LIQUID LEVEL CONTROLS AND THE LIKE

Filed Feb. 26, 1942

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

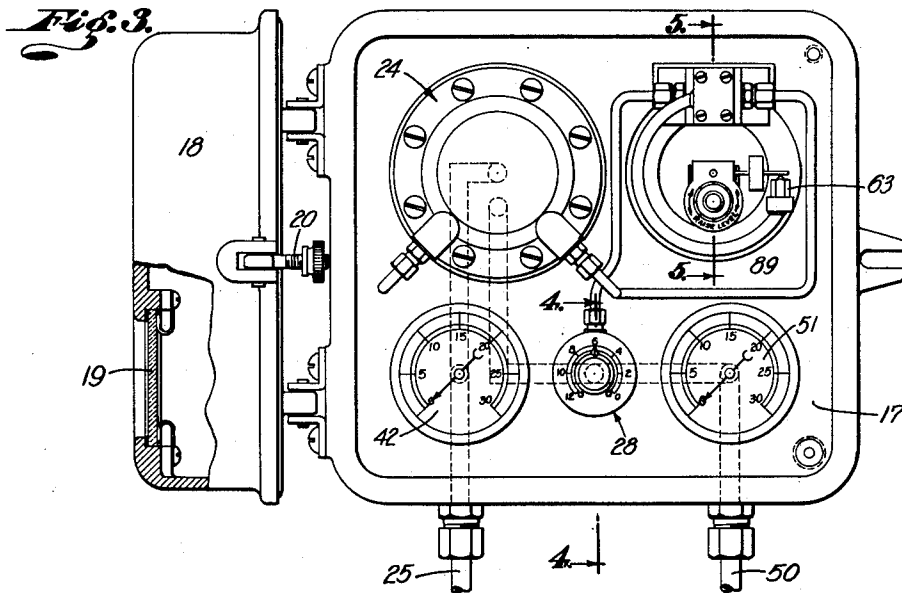


Fig. 4.

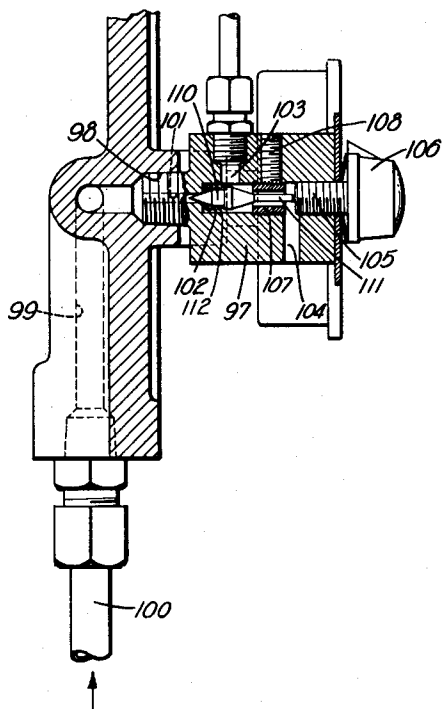
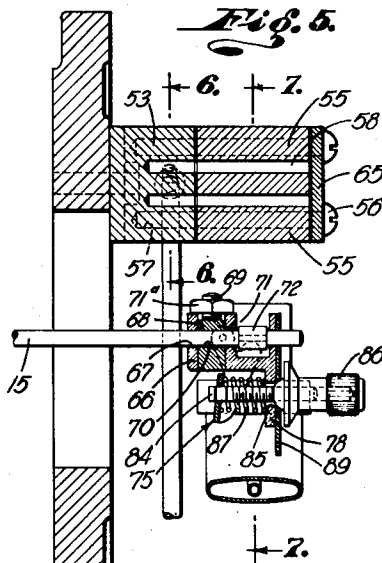


Fig. 5.



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Fig. 6.

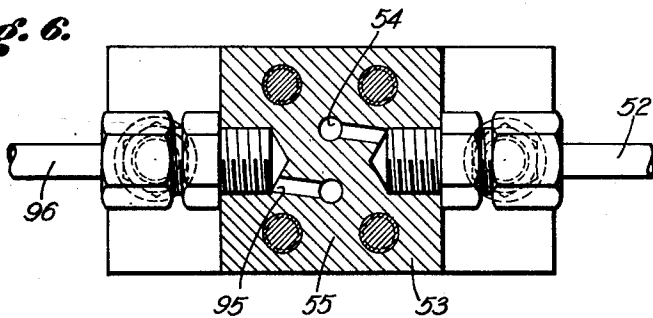


Fig. 7.

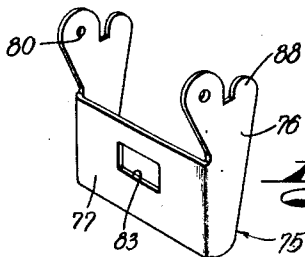
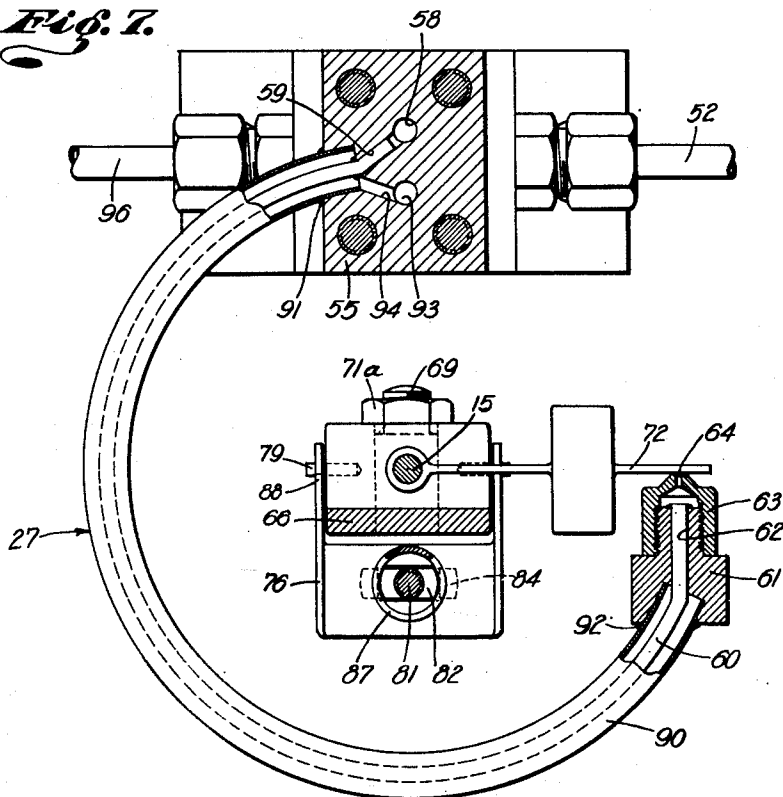


Fig. 8.

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UNITED STATES PATENT OFFICE

2,356,970

PILOT MEANS FOR LIQUID LEVEL CONTROLS
AND THE LIKE

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Application February 26, 1942, Serial No. 432,380

5 Claims. (Cl. 137—68)

This invention relates to liquid level controls and the like and relates more particularly to pilot mechanisms for such controls. A general object of this invention is to provide a pilot mechanism of this character that is smooth in operation, dependable and sensitive and fully responsive throughout any portion of a wide range of operation.

Another object of this invention is to provide a pilot means of the character referred to that is readily adjustable for an extensive range of uses or applications and that is devoid of levers, pivots and other parts likely to produce friction to interfere with the smooth dependable operation.

Another object of this invention is to provide a pilot means of the character mentioned that is entirely pneumatic and adapted for control or operation by air under pressure or any other suitable non-corrosive gas under pressure.

Another object of this invention is to provide a control of the character referred to embodying a system for carrying the auxiliary fluid pressure for the operation of the motor valve which governs the fluid under control, a pilot controlling the pressure of the auxiliary fluid as delivered to the motor valve and having a continuously operative bleeder under the control of a selected level responsive means which operates to govern or throttle the discharge from said bleeder and thus control the pilot, and a novel compensating means associated with the bleeder. The compensating means is responsive to the pressure of the auxiliary operating fluid supplied to the motor valve and upon an increase in this pressure, resulting from a throttling of the bleeder, the compensating means produces relative movement between the bleeder orifice and the flapper or member controlling the same to counteract or partially compensate for the restriction or throttling of the bleeder and thus assure a smooth operation of the motor valve without a loss in the sensitivity of the apparatus and providing for the employment of a throttling range adjustment to be later referred to.

Another object of this invention is to provide a pilot mechanism of the character referred to embodying a simple readily manipulated means for adjusting the "level" setting, that is, for adjusting the pilot to operate at any selected or required level or level range of the fluid being governed, without resorting to the necessity of disturbing or adjusting the liquid level responsive unit.

Another object of this invention is to provide a pilot means of the character mentioned that

may be employed either as a direct action control or as a reversed action control, depending upon the conditions of operation and the installation. In some installations it may be desired to open the motor valve upon a rise of the liquid level, while in other cases it may be desired to close the motor valve upon a rise of the liquid level. Further, the motor valve may be constructed to open or to close upon an increase in the pressure on its diaphragm and there may be other reasons for reversing the action of the pilot. The pilot may be easily and quickly reversed by merely reversing the position of the Bourdon tube compensating means, an operation merely necessitating the removal and re-installation of a few screws.

A further and important object of this invention is to provide a pilot mechanism of the class referred to embodying a throttle range adjustment providing for movement of the motor valve through its entire stroke or any portion thereof for any given or selected level change, throughout a wide range of level variation. The throttling range adjustment of the invention provides for a full stroking of the motor valve through a wide or narrow level variation while maintaining the sensitivity and smoothness of operation of the apparatus. The throttling range adjustment is readily adjustable to control the ratio between the auxiliary pressure being bled off at the throttling range adjustment and the auxiliary pressure being supplied to the compensating Bourdon tube, thus producing the throttling range adjustment without decreasing the sensitivity or accuracy of the pilot means at any setting of the throttling range adjustment.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of my invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a diagrammatic view of the pilot means of the invention associated with its motor valve with certain of the diagrammatically illustrated parts in cross section. Fig. 2 is an elevational view illustrating the manner in which the pilot mechanism may be associated with a liquid level responsive means. Fig. 3 is an enlarged front elevation of the pilot mechanism with the door of the case in the open position. Fig. 4 is an enlarged fragmentary detailed sectional view of the throttling range adjustment means taken as indicated by line 4—4 on Fig. 3. Fig. 5 is an enlarged fragmentary detailed sectional view of

the compensating means and the level adjusting means taken as indicated by line 5-5 on Fig. 3. Fig. 6 is an enlarged vertical detailed sectional view taken as indicated by line 6-6 on Fig. 5. Fig. 7 is an enlarged vertical detailed sectional view taken as indicated by line 7-7 on Fig. 5 and Fig. 8 is an enlarged perspective view of the adjustable stop of the liquid level adjustment.

The control or pilot of the present invention may be employed in connection with apparatus varying considerably in character and has many applications. In the drawings I have shown the pilot associated with a liquid level responsive means 10 of the general character described and claimed in my co-pending application Serial No. 430,161, filed February 9, 1942. The level responsive means 10 is connected in a level equalizing pipe 11 which has communication with a vessel V at vertically spaced points. This type of level responsive means includes a casing 12 containing a float 13 responsive to the liquid level and operatively connected with a torsion tube 14 to twist the same. A shaft 15 is connected to the torsion tube 14 and extends from the casing of the means 10 to operate the control or pilot. The pilot is preferably, though not necessarily, arranged at the outer end of the casing arm 15 and preferably includes a housing or case 16. The case 16 of the pilot has a vertically disposed base plate 17 secured to the outer end of the casing arm 15 and further includes a cover 18 hinged to the plate 17. The cover 18 is cupped or shaped to receive the various elements of the control which are mounted on the plate 17 and has suitable sights or windows 19 to make the dials and other parts of the pilot readily visible. Fig. 3 of the drawings shows the cover 18 in the open position, it being understood that the cover is normally closed and held in the closed position by a latch or screw 20.

In the particular application of the invention illustrated the pilot serves to operate or control a motor valve 21. It may be assumed that the valve 21 is connected in a pipe 22 for conducting fluid to the vessel V, it being understood that in many cases the valve under the control of the pilot may serve to govern a pipe line carrying fluid from the vessel. The valve 21 embodies a motor diaphragm means 22* and a spring 23 for effecting opening and closing of its inner valve. It is to be understood that the valve 21 may be either opened or closed by the auxiliary operating fluid pressure supplied to its diaphragm means 22*.

The automatic pilot mechanism of the present invention may be said to comprise, generally, a relay 24 interposed in the auxiliary fluid pressure line 25, bleeding means 26 for the relay 24 controlled by the shaft 15 to govern the action of the motor valve 21, compensating means 27 associated with the bleeding means 26, and throttling range adjustment means 28.

The relay 24 is responsive to the rate of discharge of the auxiliary operating pressure from the bleeding means 26 and serves to govern the magnitude of the auxiliary operating pressure supplied to the motor valve 21. Thus, the motor valve 21 is responsive to the action of the shaft 15 through the medium of the relay 24 and the bleeding means 26. The relay 24 is mounted on the supporting plate 17 and includes a body made up of an inner section 29, an intermediate section 30 and an outer section 31. The sections 29, 30 and 31 are shaped to constitute a hollow or chambered assembly and diaphragms 32 and 33 have

their peripheral edge portions secured between the opposing faces of the sections 29, 30 and 31 and extend across the interior of the assembly to partition the same into inner, intermediate and outer chambers 34, 35 and 36, respectively. The outer diaphragm 32 is of larger effective diameter than the inner diaphragm 33 and may be termed the primary diaphragm, while the inner diaphragm 33 may be termed the secondary diaphragm. The diaphragms 32 and 33 are connected or associated to form a differential diaphragm element. A floating block 37 is engaged against or secured to the opposing faces of the diaphragms 32 and 33 and has a stem 38 passing through a central opening in the diaphragm 33. A nut 39 is threaded on the stem 38 and engages against the under side of the diaphragm 33 to positively secure the block to the diaphragm. A spring 40 is arranged under compression between the under side of the diaphragm 33 and the bottom wall of the chamber 34 to counter balance the weight of the block 37 and to urge the diaphragms 32 and 33 outwardly.

The auxiliary operating fluid pressure, which may be air under pressure or any other selected non-corrosive gas under pressure, is delivered to a distribution opening 41 in the inner section 29 of the relay body. The auxiliary operating pressure line 25 may extend directly to the opening 41 and may be equipped with a suitable pressure gauge 42. A port 43 leads from the opening 41 to the inner diaphragm chamber 34 and ports and a conduit 44 conduct the auxiliary operating pressure from the distribution opening 41 to the outer diaphragm chamber 36. An orifice fitting 45 is provided in the port and conduit system 44 to reduce or bean down the fluid flow and to create a pressure drop in the fluid delivered to the outer diaphragm chamber 36.

A valve 46 governs the port 43 to control the delivery of the auxiliary operating fluid pressure to the inner diaphragm chamber 34. The valve 46 is a free floating valve urged toward the closed position by a spring 47. The valve 46 has a second head engaged in or adapted to close a port 48 in the block 37. The engagement of the block 37 with the valve 46 causes the valve to move downwardly or open, upon inward movement of the diaphragms 32 and 33, and upon outward movement of the diaphragms the spring 47 moves the valve 46 to the closed position. The port 48 leads through the block 37 to the intermediate chamber 35 and the chamber 35 is vented to the atmosphere at 49. The valve 46 normally closes the port 48 during the operation of the pilot but in the event the pressure in the chamber 34 becomes excessive the diaphragms 32 and 33 move outwardly away from the valve 46 so that the port 48 is open to permit the bleeding of the excess pressure to the atmosphere.

The valve 46 is normally "cracked" or slightly open during the operation of the pilot to put the inner diaphragm chamber 34 in communication with the source of auxiliary operating pressure. Thus, the auxiliary operating pressure is supplied to both diaphragm chambers 34 and 36. The bleeding means 26 bleeds off pressure from the outer chamber 36, as will be later described, providing for a differential in pressures in the chambers 34 and 36 but this differential in pressure is compensated for, at least to some extent, by the differential in diaphragm diameters so that during normal operation the valve 46 is only slightly cracked to put the chamber 34 in partial communication with the pressure

supply opening 41. A pipe or conduit 50 leads from the inner diaphragm chamber 34 to the motor diaphragm means 22^a of the motor valve 21. A suitable pressure gauge 51 may be provided on the conduit 50. It is to be understood that the mounting plate 17 of the pilot casing 16 is ported and has ports and passageways forming parts of the conduits 25 and 50.

The bleeding means 26 serves to vent or bleed auxiliary operating pressure from the primary diaphragm chamber 36 and this venting action is under the control of the level responsive shaft 15 and the compensating means 27 so that the action of the relay 24 is dependent upon movement of the shaft 15 and the setting or adjustment of the throttle range adjustment 28 which controls the compensating means 27. The bleeding means 26 comprises a tube or conduit 52 leading from the outer diaphragm chamber 36. The conduit 52 extends to a mounting base 53 suitably secured to the casing plate 17. The conduit 52 communicates with a port 54 in the base 53 and the port 54 extends outwardly or perpendicularly to the face of the base. A block 55 is detachably mounted on the outer or forward end of the base 53. In accordance with the invention the block 55 is secured to the base 53 by screws 56 engaged in symmetrically disposed openings 57 in the base and block. A port 58 extends longitudinally through the block 55 and its inner end has communication with the port 54. The outer end of the port 58 is closed by a plate 65 held in place by the screws 56. Suitable gaskets are provided between the opposing faces of the base 53 and block 55 and between the outer end of the block and the plate 65. The block 55 is provided with a lateral port 59 leading from the longitudinal port 58.

A tube 60 is secured to the block 55 and extends outwardly or laterally from the port 59. The end of the tube 60 may be anchored in the port 59 and the tube may be welded to the block as illustrated in Fig. 7. The tube 60 has the shape or curvature of a Bourdon type for the purpose to be later described. A block or head 61 occurs at the outer end of the tube 60 and has a passage or opening 62 which receives or passes the end portion of the tube 60. An orifice cap 63 is threaded on the outer portion of the head 61. A reduced discharge orifice 64 occurs in the outer wall of the cap 63 for the discharge of the auxiliary operating pressure. The bleeding means 26, as thus far described, is such that the auxiliary operating fluid pressure in the chamber 36 would bleed away to the atmosphere leaving little more than atmospheric pressure in the chamber 36 in the event the orifice 64 is uncontrolled or fully open.

The invention provides novel means operable by the shaft 15 for controlling the discharge of the auxiliary operating fluid pressure from the nozzle orifice 64 to thereby govern the relay 24. This means comprises a clamp or frame 66 secured to the shaft 15 to turn therewith. The frame 66 has a horizontal opening 67 passing the shaft 15 and a vertical opening 68 intersecting the opening 67. A clamp screw 69 is arranged in the opening 68 and has a horizontal opening 70 receiving or passing the shaft 15. A nut 71^a is threaded on the upper end of the screw 69 and is engaged with the upper end of the frame 66 to draw the screw upwardly and thus tightly clamp the frame on the shaft 15. A horizontal groove 71 is formed in the upper side of the frame

66 in transverse relation to the shaft 15 and the shaft passes through this groove.

A flapper or blade 72 is pivoted on the shaft 15 within the groove 71 and projects outwardly beyond the frame 66. The notch or groove 71 serves to guide the blade 72 and is such that the blade may be swung through an arc of more than 180° to project beyond either side of the frame as desired. A weight 74 of the desired magnitude is fixed on the blade 72 to urge the same downwardly. The blade has flat sides and is adapted to oppose the orifice 64 of the nozzle 63 to close or substantially close the orifice to control the discharge of the auxiliary operating pressure therefrom.

The invention further includes a novel adjustable stop means for stopping or positioning the blade 72 with respect to the frame 66 and shaft 15. It will be seen that by adjusting the position of the blade 72 with relation to the shaft 15 that a "level" adjustment may be made. Such a "level" adjustment will provide for operation of the pilot at any selected or required liquid level of the vessel V. This "level" adjustment at the pilot eliminates the necessity of adjusting the shaft 15 or other elements of the means 10 and all parts of the liquid level responsive means 10 may have permanent settings in the sealed casing 12.

The level adjusting means includes a stop or contactor 75 pivoted on the clamp or frame 66 and is best illustrated in Fig. 8. The contactor has a pair of wings 76 disposed at opposite sides of the frame 66 and a depending rear part 77 spaced behind a vertical depending flange 78 of the frame 66. Horizontal trunnions or pivot pins 79 project from opposite sides of the frame 66 and are received in openings 80 in the upper portions of the wings 76 to support the contactor 75 for pivotal movement on the frame. Screw means is provided for swinging or adjusting the contactor 75 with respect to the frame 66. This means includes a screw 81 having a polygonal or flat sided part 82 engaging in a correspondingly shaped opening 83 in the rear part 77 of the contactor 75. A head 84 on the screw 81 engages against the rear face of the contactor part 77. The screw 81 passes forwardly through an opening 85 in the flange 78 and an adjusting knob 86 is fixed on the forward end of the screw. The knob 86 is formed to react or engage against the flange 78. A spring 87 surrounds the screw 81 and is engaged under compression between the contactor part 77 and the frame flange 78. It will be seen that by rotating the knob 86 the contactor 75 may be pivoted or swung forwardly or rearwardly depending upon the direction of rotation.

The wings 76 of the contactor 75 have upwardly projecting tips or lugs 88. These lugs 88 occur at the opposite ends of the groove 71 so that either one or the other is engaged by the blade 72. The blade 72 may be swung through an arc of 180° or more to project from either side of the frame 66 for the direct action or reversed action of the pilot as will later appear, and when in either of these positions the blade cooperates with a lug 88. By turning the knob 86 the engagement of the lug 88 with the blade 72 causes the blade to be pivoted upwardly or downwardly relative to the shaft 15 to effect the "level" adjustment. A calibrated dial 89 may be provided on the front of the flange 78 to indicate the setting of the blade 72 and, therefore, the "level" adjustment of the pilot. The knob 86 may be

shaped or marked to cooperate with the dial 89 for the easy reading of the level adjustment.

The compensating means 27 is under the control of the throttling range adjustment means 28 and, if desired, may be considered as an element of the means 28. The compensating means 27 serves to move the nozzle 63 with respect to the blade 72 in response to variations in the pressure of the auxiliary operating medium as supplied to the motor valve 21 to increase or decrease the amount of travel of the valve 21 per unit of movement of the float 13 or shaft 15. The means 27 includes a Bourdon tube, or the equivalent, which I will here term the "compensator tube" 90 associated with the tube 60 to vary the position of the nozzle 63 with respect to the blade 72 in response to the conditions of pressure in the auxiliary operating line 50 of the motor valve 21. The compensator tube 90 is secured to the block 55 and extends outwardly therefrom to carry the nozzle head 61 and is in surrounding or enclosing relation to the tube 60 throughout the major portion of the tube 60. The compensator tube 90 surrounds the tube 60 with ample clearance, leaving a substantial space to receive the fluid pressure. The inner end of the compensator tube 90 is anchored and sealed to the block 55 as by welding 91 and the head 61 may be fixed and sealed on the outer end of the tube 90 by welding 92. The head 61 serves to close the outer end of the compensator tube 90. The tube 90 is formed of suitable thin walled flexible and resilient stock to flex in response to variations in the internal pressure.

The block 55 has an opening or port 93 spaced from and complementary to the above described port 58. A lateral port 94 connects the port 93 with the inner end of the tube 90. The inner end of the port 93 communicates with a port 95 in the mounting base 53. A conduit 96 is suitably connected with the mounting block 53 to communicate with the port 95 and extends to the throttling range adjustment means 28, which in turn controls the communication of the conduit 96 with the auxiliary operating pressure line 50 of the motor valve 21. When the shaft 15 is moved by the fluid level responsive means 10 to cause movement of the blade 72 toward the nozzle 63 the blade limits or further restricts the orifice 64 producing a back pressure in the tube 60, conduit 52 and the chamber 36. Increased pressure in the chamber 36 results in opening or further opening of the valve 46 and there is an increase in the auxiliary operating pressure applied to the diaphragm means 22 of the pilot valve 21. Increase in the pressure on the fluid in the conduit 50 is accompanied by an increase in the pressure within the compensator tube 90 with the result that the tube tends to straighten out and thus move the nozzle 63 away from the blade 72. This movement of the nozzle terminates or reduces the effect of the initial movement of the blade 72 and the stroke or movement of the diaphragm means 22 of the motor valve 21 is reduced in proportion.

As mentioned above, the pilot may be employed for direct action control or for reversed action control. The ports 54 and 93 which respectively supply pressure to the tubes 60 and 90 are symmetrically disposed with relation to the screw holes 57 and both pass completely through the block 55, the outer ends of the ports being closed by the plate 65. With the tubes 60 and 90 in the position illustrated in Fig. 1 it may be assumed that the apparatus is employed for direct action control. In the event that it is desired to use the

pilot for reversed action control the screws 56 are removed and the block 55 and plate 65 are detached. The block 55 carrying the tubes 60 and 90 is then turned over or moved through 180° and re-engaged against the base 53. The plate 65 is applied to its outer end and the plate and block are secured to the base 53 by the screws 56. This results in the tubes 60 and 90 being in the position shown in Figs. 3 and 7. When the block 55 is inverted or turned side for side the ends of the ports 58 and 93 are merely reversed or turned end for end and because of the symmetric disposition of the screw holes 57 the port 58 remains in communication with the port 54 and the port 93 remains in communication with the port 95 so that the actions of the nozzle 63 and compensator tube 90 are the same as before. When the tubes are reversed as just described the flapper or blade 72 is merely swung over to bring it into position where its face opposes the nozzle orifice 60. In this connection it is to be observed that there is a contactor lug 88 for engaging the blade 70 with the blade in either position.

The throttle range adjustment means 28 is interposed between the compensator tube 90 and the line 50 carrying the auxiliary operating fluid pressure to the motor valve 21. The throttle range adjustment means 28 is operable to regulate or vary the ratio between the fluid pressure in the conduit 50 and the compensator tube 90. The line or conduit 98 leading to the compensator tube 90 extends to a block or body 97 having a stem threaded in an opening 98 in the mounting plate 17. A port 99 extends through a part of the plate 17 and joins the opening 98 and a tube 100 leads from the port 99 to the motor valve line 50. The block or body 97 has a horizontal port 101 extending longitudinally through its stem and communicating with the port 99. A horizontal opening 102 of increased diameter continues through the body 97 from the port 101. A lateral port 103 joins the opening 102 and the line or conduit 98 from the compensator tube 90 extends to this port 103. A second lateral port 104 is formed in the body 97 and joins the opening 102 at a point spaced outwardly from the port 103. The port 104 is in the nature of a bleed port or vent port. An adjusting screw 105 is threaded in the outer portion of the opening 102 and has a readily manipulable adjusting knob 106. The screw 105 is proportioned so that it does not close the bleed port 104. A tubular bleed orifice fitting 107 is threaded in the opening 102 to occupy a position between the ports 103 and 104 and is fixed in place by a set screw 108.

The throttle range adjustment means further includes a valve 110 for simultaneously controlling the port 101 and the bleed orifice 107. The valve 110 may be in the nature of a double ended needle valve and is positioned in the opening 102 to have one end project into and control the port 101 and the other end control the bleed orifice 107. A stem 111 is provided on the outer end of the valve 110 and passes through the orifice fitting 107 with clearance to leave a passage for the fluid. The outer end of the stem 111 is engaged by the inner end of the screw 105. It will be seen that by threading the screw 105 inwardly the valve 110 moves inwardly to further close the port 101 and to move away from the orifice fitting 107 and thus diminish the flow of the auxiliary operating fluid pressure to the compensator conduit 96, while at the same time increasing the bleeding of the same pressure from the conduit or the conduit supply. A spring 112 is arranged

under compression between a shoulder on the double ended valve 110 and the inner wall of the opening 102 to urge the valve outwardly. When the screw 105 is threaded outwardly the spring 112 moves the valve outwardly to permit the greater flow of auxiliary operating fluid pressure through the port 101 and simultaneously reduce the flow of the fluid through the bleed orifice 107, thus simultaneously increasing the delivery of the auxiliary operating fluid pressure to the compensator tube 90 and reducing the flow of such fluid through the bleed orifice.

In the operation of the pilot the float 13 moves vertically in response to variations in the liquid level of the vessel V. These movements produce movement or turning of the shaft 15. The frame 66 is fixed to the shaft and upon turning of the shaft the weighted blade 72 likewise moves. In the event the blade 72 is moved toward the nozzle 63 the discharge of the gas from the nozzle is restricted or reduced thus producing a back pressure in the outer diaphragm chamber 36 of the relay 24. An increase of pressure in the chamber 36 results in rearward movement of the valve 46 so that the delivery of the auxiliary operating pressure to the conduit 50 is increased. An increase in the pressure of the line 50 results in operation of the valve 21 in a manner to correct or compensate for the liquid level change in the vessel V.

An increase in the pressure in the line 50 is communicated to the interior of the compensator tube 90 through the medium of the throttling range adjustment means 28. An increase of the pressure in the compensator tube 90 tends to straighten the tube 90 so that the nozzle 63 is moved away from the blade 72. This movement of the nozzle from the blade 72 results in a change in the diaphragm motor operating pressure of lesser magnitude for given level change than would have occurred if the compensator tube was not present. Accordingly, by adjusting the magnitude of the pressure change in the compensator tube 90 in proportion to the pressure change in the motor valve pressure line 30 it is possible to adjust the motor valve travel for any given unit of liquid level change in the vessel V. This throttling range adjustment is effected by merely turning the knob 106. If the knob 106 is turned to move the valve 110 inwardly the port 101 is further closed and the choke 107 is further opened with the result that the pressure in the compensator tube 90 is increased to a lesser extent when a given pressure is built up in the motor valve operating line 50. The result of this is that the compensator tube 90 will have a shorter motion in response to the internal pressure change and there will be a proportionately greater increase in the operating fluid pressure applied to the motor valve 21, thus giving the motor valve a greater movement. Conversely, when the knob 106 is turned to allow the valve 110 to move outwardly a proportionately greater fluid pressure is admitted to the interior of the compensator tube 90 for a given increase of pressure in the line 50 and this results in a proportionately greater motion of the nozzle 63 away from the blade 72. Accordingly, a given movement of the blade 72 in response to a given liquid level change produces a proportionately smaller increase and the pressure applied to the motor valve 21 and the motion of the valve is thus reduced.

It is to be understood that the control is constant or continuous in operation without any

sudden changes or interruptions in action. The pilot control is accurate and sensitive throughout any portion of a wide range of action, this characteristic being due to the throttle range adjustment and the associated parts. The pilot may be readily adjusted to provide for any level adjustment as required without disturbing any parts of the liquid level responsive means 10.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. A control for a fluid vessel having a member movable in response to variations in the level therein and having a fluid pressure actuated valve for governing the level, the control comprising a conduit carrying fluid pressure for actuating the valve, a relay interposed in said conduit to govern the magnitude of the actuating pressure applied to the valve, a Bourdon tube, bleed means for the relay adapted to control the operation of the relay, the bleed means including a second tube extending through the Bourdon tube and a discharge nozzle for said second tube at the outer end of the Bourdon tube, a part movable by said member and operable to control the nozzle and thus control the relay, and regulable means for delivering fluid pressure to the Bourdon tube to cause movement of the nozzle relative to said part.

2. A control for a fluid vessel having a member movable in response to variations in the level therein and having a fluid pressure actuated valve for governing the level, the control comprising a conduit carrying fluid pressure for actuating the valve, a relay interposed in said conduit to govern the magnitude of the actuating pressure applied to the valve, a Bourdon tube, bleed means for the relay adapted to control the operation of the relay, the bleed means including a second tube extending through the Bourdon tube and a discharge nozzle for said second tube at the outer end of the Bourdon tube, a part movable by said member and operable to control the nozzle and thus control the relay, regulable means for delivering fluid pressure to the Bourdon tube to cause movement of the nozzle relative to said part, and means supporting said tubes so that they may be mounted to have said nozzle at either side of said member for cooperation with said part for either direct action or reversed action of the control.

3. A control for a fluid vessel having a member movable in response to variations in the level therein and having a fluid pressure actuated valve for governing the level, the control comprising a conduit carrying fluid pressure for actuating the valve, a relay interposed in said conduit to govern the magnitude of the actuating pressure applied to the valve, a Bourdon tube, bleed means for the relay adapted to control the operation of the relay, the bleed means including a second tube extending through the Bourdon tube and a discharge nozzle for said second tube at the outer end of the Bourdon tube, a part movable by said member and operable to control the nozzle and thus control the relay, regulable means for delivering fluid pressure to the Bourdon tube to cause movement of the nozzle relative to said part, means for operatively associating said part with the member to project from one side of the member for direct action control and to project

from the other side of the member for reversed action control, and means supporting the tubes for ready movement between the positions where the nozzle is operatively related to said part in either of said positions.

4. A control for a fluid vessel having a member movable in response to variations in the level therein and having a fluid pressure actuated valve for governing the level, the control comprising a conduit carrying fluid pressure for actuating the valve, a relay interposed in said conduit to govern the magnitude of the actuating pressure applied to the valve, bleed means for controlling the relay, a discharge nozzle for the bleed means, means for optionally supporting the nozzle at either side of the member, a blade pivoted on the member for controlling the nozzle, and a contactor on the member for positioning the blade for cooperation with the nozzle when

swung to extend from either side of the member.

5. A control for a fluid vessel having a member movable in response to variations in the level therein and having a fluid pressure actuated valve for governing the level, the control comprising a conduit carrying fluid pressure for actuating the valve, a relay interposed in said conduit to govern the magnitude of the actuating pressure applied to the valve, bleed means for controlling the relay, a discharge nozzle for the bleed means, means for optionally supporting the nozzle at either side of the member, a blade pivoted on the member for controlling the nozzle, a movable contactor on the member for positioning the blade for cooperation with the nozzle when swung to extend from either side of the member, and means for adjusting the contactor to vary the "level" adjustment of the control.

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