Sept. 5, 1939. H. G. VANCE 2,171,613

VALVE

Filed May 29, 1937

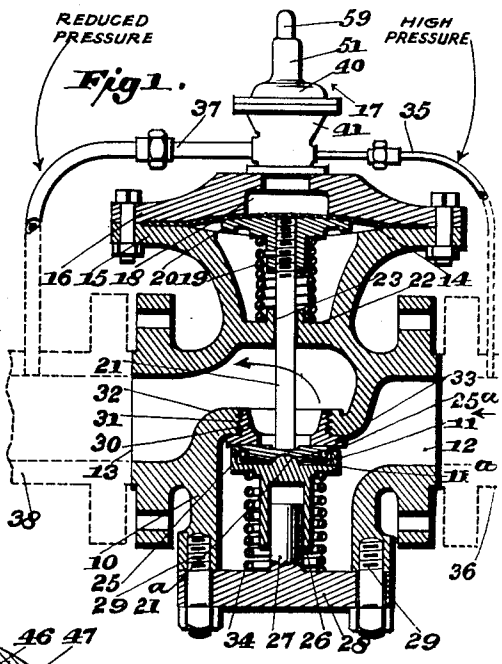

Fig. 1.

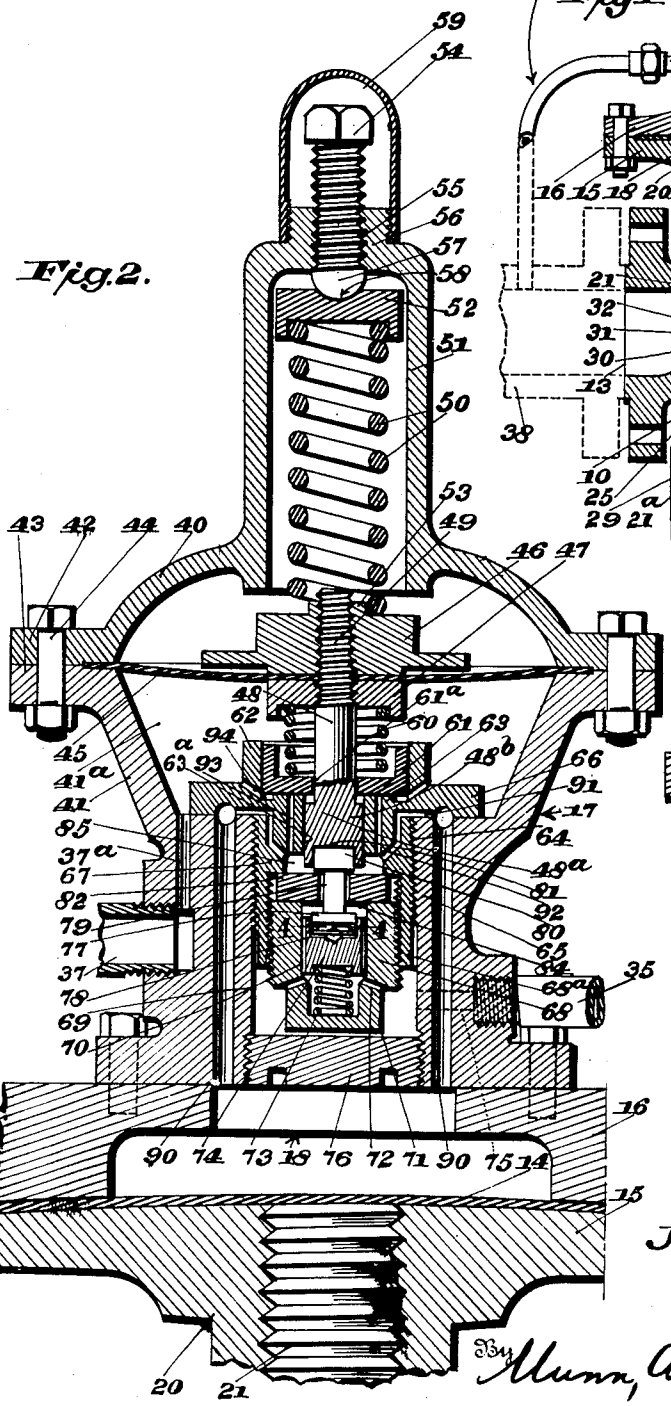

Fig. 2.

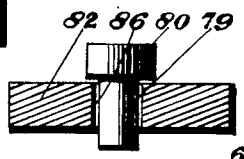

Fig. 3.

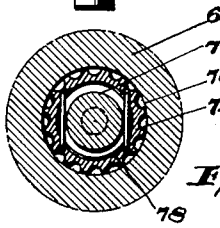

Fig. 4.

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VALVE

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8 Claims. (Cl. 50—11)

This invention relates to valves.

An object of the invention is the provision of a pilot valve controlling the operation of a main valve in accordance with pressure at the high pressure side of the main valve, the pilot valve controlling the flow of high pressure fluid to a chamber in the main valve which operates a diaphragm, piston or other means to open said main valve.

Another object of the invention is the provision of a pilot valve for controlling the operation of a main valve in accordance with pressure at the high pressure side of the main valve, said pilot valve including means to depress a stem connected with a diaphragm, a compression chamber for moving the diaphragm against the tension of the depressing means, and a pair of cooperating valves, one controlling the flow of high pressure fluid to one side of a diaphragm, or means for causing opening of the main valve, the other valve releasing pressure causing closure of said main valve.

Another object of the invention is the use and arrangement of a single relief valve performing two separate operations in effecting release of pressure to permit the main valve to approach closing position.

And still another object of the invention is the provision of a reducing valve having a minimum of friction and where all of the parts may be readily replaced, flat valve seats being employed in connection with specially constructed valves and holders so that binding will be eliminated.

A still further object of the invention is the provision of a reducing valve in which a relief valve and a pilot valve are operated by means of a vertically operating stem and pin so that direct downward pressure is had and binding and lost motion are eliminated, the pin being so constructed that sudden application of pressure to the main valve diaphragm is obviated.

This invention will be best understood from a consideration of the following detailed description, in view of the accompanying drawing forming a part of the specification; nevertheless, it is to be understood that the invention is not confined to the disclosure, being susceptible of such changes and modifications as define no material departure from the salient features of the invention as expressed in the appended claims.

In the drawing:

Figure 1 is a vertical section showing my pilot valve operatively connected with the main valve,

Figure 2 is a vertical section of a pilot valve construction,

Figure 3 is a fragmentary vertical section showing the control pin in operative relation with a disk,

Figure 4 is a fragmentary horizontal section taken along the line 4—4 of Figure 2,

Referring more particularly to the drawing, 10 generally designates a housing for a main valve 11. This housing has an inlet passage 12 for high pressure fluid and an outlet passage 13.

A diaphragm 14 is secured at its periphery between the upper end 15 of the housing and a cover plate 16 in any approved manner. A pilot valve housing generally designated by the numeral 17 is secured to the cover plate 16 and has its lower end in open communication with a chamber 18 formed between the cover plate 16 and the diaphragm 14, so that high pressure fluid which enters the chamber 18 from the pilot housing 17 will act on the diaphragm 14 and force it downwardly against the tension of a spring 19, which has its upper end in engagement with a nut 20 threaded on to a stem 21. The opposite end of the spring rests upon a shoulder 22 of the housing 10. The stem 21, it will be noted, is slidably mounted in a passage 23 formed in the shoulder 22.

The valve 11 at the lower end of the stem 21 is in the shape of a hard metal disk having on the underside at the exact center a semi-circular recess 21*a*. At the periphery of the disk is cut a groove sufficiently large to engage a loose retaining means 25*a* in a cup-shaped holder 25.

The specially constructed cup-shaped member 25 is provided for holding the main valve 11 and is provided with a depending sleeve 26 which receives a post 27 carried by the base plate 28 connected to the housing by means of bolts 29. The cup-shaped member has a greater diameter than the valve 11 and at the exact center of the bottom of the cup-shaped member is provided a semi-spherical projection upon which the valve disk 11 rests. The retaining means 25*a* are attached to the sides of the cup 25 and project inwardly and loosely fit within the groove 11*a* in the periphery of the valve disk 11. It will be seen that this specially constructed valve disk holder allows free frictionless movement of valve disk in any direction.

A seat ring 30 is threaded at 31 into an opening formed in a shoulder or partition 32. The lower end of the seat ring is provided with an annular flange 33 against which the valve 11 is pressed by the action of a spring 34 and fluid pressure. The flange 33 acts as a seat for the valve 11. The upper end of the spring is in

engagement with the underface of the cup-shaped member 25, while the lower end of the spring rests upon the base plate 28 and surrounds the sleeve 26.

A pipe 35 is in open communication with an inlet pipe 36 which communicates with the inlet port 12. An outlet pipe 37 is adapted to drain off the reduced pressure from the housing of the pilot valve, as will be presently explained. This pipe, however, is connected with a discharge pipe 38 that is in communication with the outlet port 13 of the housing 10.

A pilot valve construction cooperates with the main valve construction in such a manner that the opening of the valve 11 will depend upon the operation of the pilot valve construction in the housing 17.

The housing 17 consists of an upper shell 40 and a lower shell 41 with both of the shells having annular flanges 42 and 43 respectively, and these flanges, as shown at 44, are bolted together. Before these flanges, however, are bolted together, the periphery of a diaphragm 45 is located between the flange of the shells 40 and 41, so that when the bolts 44 are drawn up tight the diaphragm will be rigidly secured in place. At opposite sides of the diaphragm 45 are disposed nuts 46 and 47 and a stem 48 is threaded at 49 into the nuts, and thereby lock the stem 48 to said diaphragm.

A coil spring 50 is located in the upper reduced end 51 of the shell 40, and has one end received by a cup-shaped member 52 while the opposite end of the spring rests upon the nut 46 and embraces a boss 53 on said nut.

A screw 54 is threaded at 55 into a boss 56 at the upper end of the extension 51 and has a rounded portion 57 engaging a seat 58 in the cup-shaped member 52. A cap 59 is threaded on to the boss 56 to permit accidental displacement of the setting of the screw 54. Said screw is adjusted to increase the tension of the spring 50 on the diaphragm 45 when necessary.

A spring 60 has its upper end located in a seat at the underface of the nut 47. The lower end of the spring is seated within a hollowed cup section of a flanged valve 61. This relief valve is slidably mounted in a hollow boss 62 formed in the member 63, and on the stem 48.

The member 63 in the form of a plug with a flange 66 is threaded at 64 into a reduced section 65 of the shell 41 so that it may be detached from said member. A central passage 61*a* in the relief valve 61 is provided for the stem 48. An enlarged portion 48*b* of the stem 48 is received by a central passage 63*a* in the plug 63. The plug has an enlarged passage or chamber into which projects an annular flange 67 against which rests a pilot seat ring 82. The central passage is formed in a skirt 68*a* depending from the plug 63 and has internal threads into which is screwed a plug 68. This plug secures the disk in place.

The plug 68 has a central passage 70. An extension 71 is formed at the bottom of the plug 68 and is provided with a plurality of radially inclined passages 72 leading to the central passage 70 in the plug 68. A spring 73 is located in the passage 70 and has its lower end resting on the bottom of the extension 71 while the upper end engages a slidable member 74. It will be noted that the body member 63, when screwed into the upper part of the section 65 of the shell 41 at 64 separates this interior of said section into two parts, top chamber 41*a* and bottom chamber 69. The bottom chamber is in communication with pressure pipe 35 through passageway 75.

A closure 76 is threaded into the lower open end of the lower shell 45 and closes the central passage 69 to the pressure chamber 18 in the main valve housing. The closure may be formed integrally with the section 65 since the plug 63 together with the plug 68 and the enclosed pilot valve construction.

A pilot valve 77 is located in a pocket 78 formed in the upper end of the slidable member 74 and is forced downward by pin 79 having a head 80 detachably mounted in a pocket 81 in the lower end of the stem 48.

A flat disk 82 held in place by the removable plug 68 divides the central passage into an inlet pocket 84 and an outlet pocket 85. The disc also has a central discharge passage 86 which has a greater cross-sectional area than the pin 79, thereby providing a passage so that the fluid may pass from the inlet pocket 84 to the outlet pocket 85.

The lower casing 41 of the housing 17 has a plurality of vertically disposed passages 90 which communicate with the horizontal passages 91 formed in the member 63 and the passages 92 connect the passages 91 with the outlet pocket 85.

The member 63 is also provided with relief passages 93 which are in communication with the outlet pocket 85 and are normally closed at their upper ends by the relief valve 61. When the relief valve is raised, these passages 93 are placed in communication with passages 94, also formed in the member 63 and extending radially from the passages 93.

The operation of my device is as follows: The pilot valve construction in the housing 17 is adapted to control the operation of the main valve 11 in accordance with the pressure of the fluid from the pipe 36.

The spring 19 of the main valve tends to move the diaphragm 14 to the inward position shown in Figure 1, while the spring 34 tends to maintain the main valve 11 closed. Thus it will be seen that both springs 19 and 34 cooperate to maintain the valve 11 in closed position.

Pressure fluid within the pipe 36 flows through inlet 12 against the bottom of main valve 11, and since pilot pipe 35 is in communication with the pipe 36, fluid pressure will flow through passages 75 to the central chamber 69 of the shell 41 (Fig. 2) and then through passages 72 and 70 in the plug 68 to inlet pocket 84, to outlet 85, and then through passages 92, 91 and 90 to pressure chamber 18, and with the accumulation of sufficient pressure to overcome forces assisting main valve to remain closed diaphragm 14 will be deflected and open main valve 11, permitting flow of fluid to the reduced pressure side into pipe 38, pilot pipe 37 and passage 37*a* into pressure chamber 41*a*. When the pressure within this chamber is sufficiently great, diaphragm 45 will be forced upwardly, carrying with it stem 48 and pin 79, allowing the pilot valve to close. Please note at this point that we have pilot valve 77 closed, relief valve 61 closed, it being slidable on stem 48, and main valve 11 open.

When the supply of fluid under pressure passing through main valve 11 exceeds consumption, the fluid pressure in chamebr 41*a* becomes greater than normal and pilot diaphragm 45 is forced upward carrying with it stem 48. A shoulder 48*a* on this stem engages the relief valve 61, lifting it from its seat, thereby placing the main valve pressure chamber 18 in direct communication with

outlet pipe 38 through pasages 90, 91, 95, 93, 94, chamber 41a, and passages 37a and 37 thus relieving pressure in said chamber. Release of pressure from chamber 18 allows main valve to close toward its seat in direct relation to the amount of the decrease in the fluid pressure.

When the supply passing through main valve 11 is less than the consumption, fluid pressure in chamber 41a becomes less than normal, and the diaphragm 45 is deflected downwardly carrying with it stem 48. The relief valve 61 slidably mounted on the stem 48 and supported by the shoulder 48a is disengaged from the shoulder, allowing spring 60 to hold it upon its seat. The pin 79 forces open the pilot valve 77, establishing fluid pressure flow to chamber 18. This pressure forces the main valve farther away from its seat in direct relation to the fluid pressure supplied.

Chattering, noisy operation and fluctuating reduced pressure flow caused by friction and binding valve parts and large lightning-like application of the high pressure fluid to the chamber 18, actuating the main valve 11, are prevented by applying all forces in a straight line and by the use of specially constructed valves and holders. Lightning-like application of the high pressure fluid to the chamber 18 is prevented by the valve opening pin 77 being made the correct size to restrict the flow through port opening of pilot valve.

When the main valve 11 is in its normal position it is held closed by the inlet pressure and the spring 34. By turning the adjusting screw 54, spring 50 is placed under greater tension and the pilot valve diaphragm 45 is bowed inwardly, thereby causing the stem 48 and pin 79 to move downwardly through the relief valve 61. Said valve is compressed harder to its seat by the additional compression of spring 60, and the pilot valve 77 is moved to the open position shown in Figure 2. The fluid can then pass through passages 90 to chamber 18 and deflect the main valve diaphragm 14 for opening the main valve 11. When said main valve is open the fluid passes from the pipe 36 to the pipe 38.

Closure of the main valve 11 is had by the release of fluid pressure from pressure chamber 18. This release occurs on the opening of relief valve 61. One opening is under the direct control of the pilot diaphragm's upward deflection carrying with it the stem 48. The engagement of the shoulder 48a with the valve 61 lifts it off its seat. The other operation which is independent of the pilot diaphragm 45 is where the valve 61 acts as an internal safety valve to the pressure chamber 18 and this becomes effective when said valve is forced off its seat by fluid pressure acting on its face and overcoming the force holding it against its seat. As this valve is slidable upward on stem 48, this force is effected mostly by spring 60.

Illustrating this latter operation: Maximum safety pressure allowed on a heating system is 15 lbs., while the operating pressure is 3 lbs. The reducing valve is non-operative to any pressure in excess of 10 lbs. A 10 lb. reduced pressure flow through the main valve 11 would require approximately 20 lbs. fluid pressure within the pressure chamber 18, with a pressure of 180 lbs. in the inlet chamber of each main valve. Now the proper selection or setting of the relief valve spring 60 will allow the relief valve 61 to be opened by a 20 lb. fluid pressure acting on the valve face and will render the reducing valve non-operative to any reduced pressure flow in excess of 10 lbs.

The pin 79 not only opens the pilot valve 77 but it acts as a resistance in passage 86 to the flow of fluid from the inlet pocket 84 to the outlet pocket 85 to prevent the sudden application of pressure to the main valve diaphragm. By giving to the pin the proper diameter, the pressure can be limited to provide for the most effective operation of the valve. In other words, the pin may be readily replaced to give the best results.

With expanding fluids, the maximum pressure attainable in the outlet chamber 85 is controlled by the relative area inlet opening 86 to the outlet openings 93, which permits control of the reduced pressure range by changing the size of the pin 79. Using the foregoing heating system as an example, 180 initial pressure pin size would be the proper size to limit the expansion of the fluid within the outlet pocket 85 and to control the pressure so that it would not exceed 20 pounds. The pin and the internal safety valve fixed to a maximum pressure of 20 lbs. in the outlet pocket with a maximum reduced pressure range of 10 lbs. in the outlet of the main valve, would give a heating system better service and a greater degree of safety with one valve than can be attained with the common practice of today in having two reducing valves working in tandem.

The valves 11 and 77 are in the shape of a hard metal disk. Each has on the underside at the center a semi-spherical recess which receives complementarily-shaped projection at the center of the cup-shaped holder. The cotter pins as shown at 25a retain the valves 77 and 11 in the cup-shaped holders and fits loosely in the annular groove 11a on the edges of the disks. This construction of the valves provides for rotataion of the disks within the holders, free and frictionless seating and longer life.

I claim:

1. A valve mechanism comprising a main valve and a pilot valve construction for controlling the operation of said main valve, means for retaining the main valve in closed position, pressure-fluid operated means for opening the valve, a flat disc having a fluid passage, a pin in the passage having a diameter that will properly restrict the flow of fluid through the passage in the disk, a pilot valve moved to open position by the pin, a spring-pressed diaphragm for moving the pin and valve to open position, a body member enclosing the pilot valve and having passages for supplying fluid from the high pressure side of the main valve to the pilot valve and passages for conducting high pressure fluid against the retaining means of the main valve for causing opening of said main valve, a relief valve for releasing the high pressure fluid from the pilot valve body, a stem carried by the diaphragm, means on the stem for opening the relief valve when the diaphragm is operated by high pressure from the pilot valve.

2. A valve mechanism comprising a main valve having a diaphragm and a pressure chamber for causing actuation of the diaphragm, a pilot valve construction including an inlet pocket and an outlet pocket, a casing having passages for the admission of high pressure fluid to the inlet pocket, an outlet passage and passages connecting the outlet pocket with the pressure chamber of the main valve, a pin for restricting the flow of high pressure fluid from the inlet pocket

to the outlet pocket, a pilot valve for controlling the flow of the fluid from the inlet pocket to the outlet pocket, a relief valve for releasing fluid from the pressure chamber of the main valve and outlet pocket, and a spring-pressed diaphragm for causing opening of the pilot valve, said second-mentioned diaphragm being acted on by the fluid to permit closing of the pilot valve, means carried by the second-mentioned diaphragm for moving the relief valve to open position when the pilot valve is being closed, a spring acting on the second-mentioned diaphragm to normally maintain the pilot valve open and the relief valve closed.

3. A valve mechanism comprising a casing, a diaphragm providing a pressure chamber in the casing, a main valve being opened by the diaphragm when excess pressure is developed in the chamber, a hollow body having a pilot valve diaphragm forming a compression chamber, a spring acting on the second-mentioned diaphragm tending to move said second-mentioned diaphragm against pressure in the compression chamber, a stem connected to the diaphragm and projecting into the body member, a pin operated by the stem, a disk dividing the hollow body member outwardly of the compression chamber into an inlet pocket and an outlet pocket and provided with a passage through which the pin moves, the passage having a greater diameter than the pin to permit passage of high pressure fluid from the inlet pocket to the outlet pocket, the diameter of the pin properly restricting the flow of fluid through the passage, a pilot valve in the inlet pocket moved to open position away from the disc, a spring urging the pilot valve to closed position, a relief valve, a spring acted on by the second-mentioned diaphragm for closing the relief valve, said relief valve cutting off communication between the outlet pocket and the compression chamber, said body member having a passage from the outlet pocket to the compression chamber, passages connecting the outlet pocket with the pressure chamber of a main valve, an exhaust passage leading from the compression chamber, and means for supplying fluid under pressure to the inlet pocket, opening of the relief valve permitting exhaust of the high pressure fluid from the main valve pressure chamber.

4. A pilot valve construction comprising a casing, a diaphragm forming a compression chamber in the casing, a spring acting on the diaphragm, a hollow body member projecting from the casing, a stem connected to the diaphragm and projecting into the body member, a pin operated by the stem, a disk dividing the hollow body member into an inlet pocket and an outlet pocket and provided with a passage through which the pin moves, the passage having a greater diameter than the pin to permit passage of high pressure fluid from the inlet pocket to the outlet pocket, a pilot valve in the inlet pocket moved to open position away from the disk by the spring acting on the diaphragm, a spring urging the pilot valve to closed position, a relief valve, a spring acted on by the diaphragm for closing the relief valve, said body member having a passage from the outlet pocket to the compression chamber and passages connecting the outlet pocket with a pressure chamber of a main valve, means for supplying fluid under pressure to the inlet pocket, and means for adjusting tension on the spring acting on the diaphragm.

5. A pilot valve construction comprising a casing having flexible means therein acted on at one face by pressure fluid, a spring acting on the other face, a pilot valve, a pin for causing opening of the pilot valve, means connecting the pin with the flexible means, a main valve construction including a main valve and a flexible means for opening said main valve, the casing having a passage for conducting pressure fluid from the casing against the flexible means of the main valve, the pilot valve controlling the flow of said fluid, said casing including a passage for conducting fluid against the first-mentioned flexible means to cause closing of the pilot valve, means for supplying high pressure fluid to the casing, and a relief valve for controlling the flow of pressure fluid through the passages, the casing having a passage for exhausting fluid under pressure away from the first-mentioned flexible means and the second-mentioned flexible means, the relief valve controlling the exhaust of the fluid from the second-mentioned flexible means.

6. A valve construction for controlling actuation of a diaphragm to open a main valve comprising a casing having passages for directing fluid under pressure against the main valve diaphragm, a pilot valve for controlling the flow of fluid to said passages, and a guide and carrier for said valve including a cup-shaped member to receive the pilot valve, a seat in the casing, a spring urging the pilot valve against the seat, said seat having a central opening, a pin loosely fitted in the opening, resilient means acting on the pin to open the pilot valve, means for supplying fluid under pressure to a point at one side of the seat, and a relief valve for controlling the exhaust of the fluid from the other side of the seat and also from the main valve diaphragm.

7. A valve construction comprising a housing, a diaphragm, a hollow plug screwed into the housing and cooperating with the diaphragm to form a pressure chamber, a valve seat in the plug dividing the hollow plug into an inlet chamber and an outlet chamber, said seat having a passage connecting the chambers, a pin in the passage restricting the communication between said chambers, a stem connected to the diaphragm and acting on the pin, a closure plug threaded into the bottom of the hollow plug, a valve holder in the closure plug having a cup, a valve in the cup, and a spring urging the valve against the seat, a spring acting on the diaphragm for forcing the stem and pin against the valve to maintain said valve open, means for supplying fluid under pressure to the closure plug, said housing having passages connecting the outlet chamber with the pressure chamber, and a relief valve for controlling the flow of fluid from the outlet chamber to the pressure chamber.

8. A valve mechanism comprising a casing, a main valve controlling the flow of fluid through the casing, and a pilot valve construction for controlling the operation of said main valve, a compression chamber associated with the main valve, a diaphragm connected with the main valve and forming a flexible wall for said chamber, an inlet pipe supplying fluid under pressure to the casing, a discharge pipe connected with the casing, said pilot valve construction including a body formed with a pocket, a conduit connecting the pocket with the inlet pipe, the body having a passage connecting the pocket with the compression chamber for supplying fluid under pressure to one side of the diaphragm for causing opening of the main valve, the body having

a pilot compression chamber, a spring-pressed pilot diaphragm forming one wall of said pilot compression chamber, a valve operated by the pilot diaphragm and controlling the flow of fluid from the pocket to the first-mentioned compression chamber, the body having a passage connecting the pilot compression chamber with the pocket, a relief valve held closed by the spring-pressed pilot diaphragm and controlling the last-mentioned passage, said body having a passage connecting the discharge pipe with the pilot compression chamber so that pressure from said pipe will act on the pilot diaphragm to close the pilot valve, means operated by the pilot diaphragm for opening the relief valve after the pilot valve is closed.

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