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PRESSURE OPERATED REGULATING VALVE AND CONTROL DEVICE

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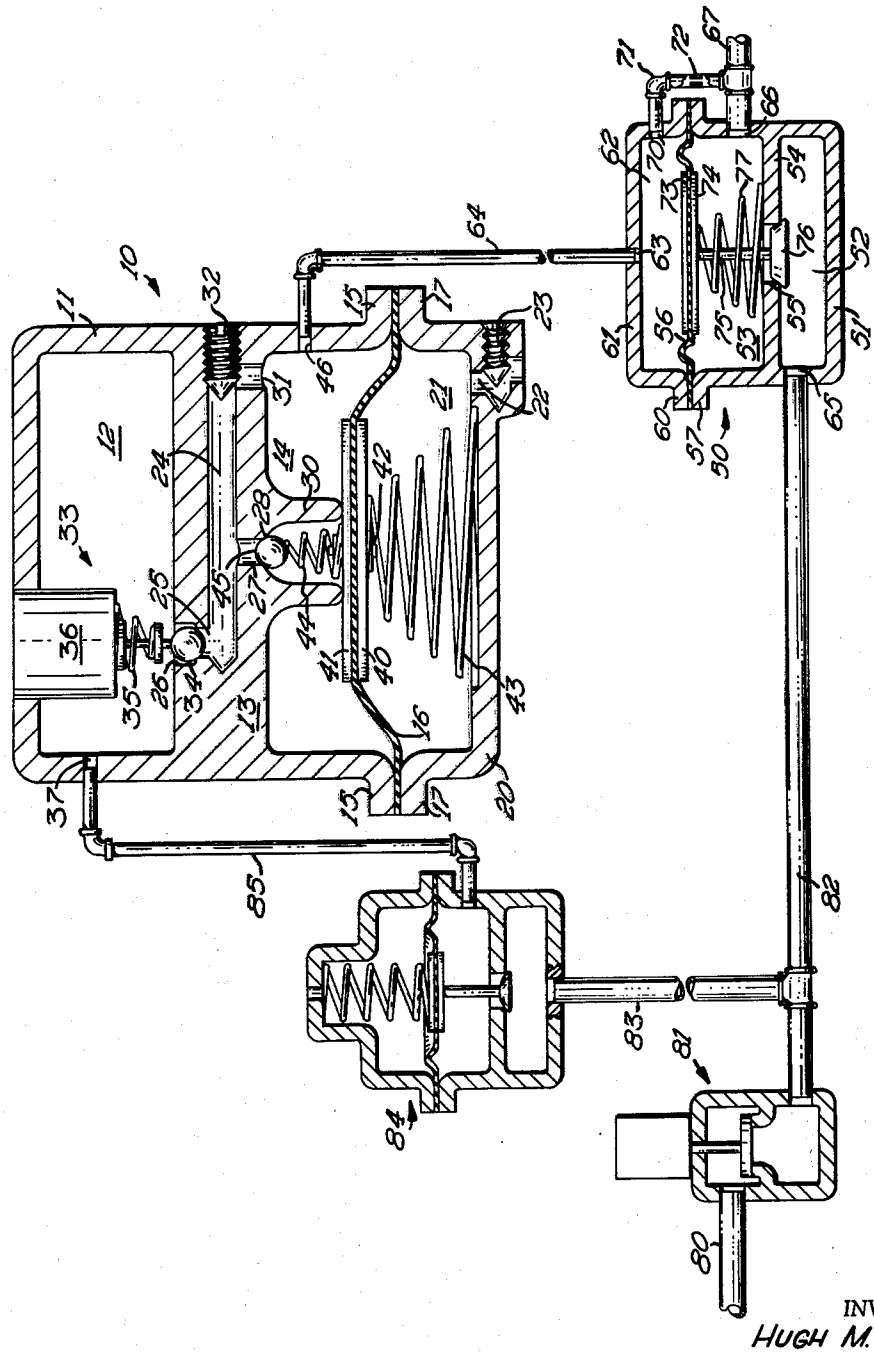

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PRESSURE OPERATED REGULATING VALVE AND CONTROL DEVICE

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The present invention relates to fluid flow control devices and more particularly to a diaphragm controller or pilot valve for controlling the operation of a pressure-operated flow control valve.

In applications where valves are used to control the flow of fluids, such as fuel gas, it is well known that it is often desirable, if not absolutely necessary, that the valve be initially opened to a first position to allow a proper flow of fuel so that ignition at the burner may be accomplished safely and efficiently. After some time delay, during which ignition is accomplished, the control valve is moved to a second position to allow a greater rate of flow and thereby a greater combustion rate at the burner.

It has been found that one of the most satisfactory arrangements for obtaining such operation is the use of a pilot controlled pressure operated valve. This, however, necessitates the provision of a suitable diaphragm controller or pilot valve for controlling the valve. In the past, various types of pilot valves have been proposed for accomplishing this function. These include the use of lost motion connections between various valves, the use of heat motors, and various other arrangements. However, many of these arrangements have resulted in structure which is extremely complicated and therefore expensive to build and to maintain. In addition, proper adjustment has often been extremely difficult to obtain.

The present invention provides a diaphragm controller which is adapted to control a fluid flow control valve and which co-acts therewith to render the desired performance. When it is desired to establish a flame at the burner, the diaphragm controller acts initially to move the control valve to a first position to provide fuel flow for ignition purposes. After a time delay the diaphragm controller is effective to cause the control valve to open to a greater flow position to provide fuel for normal combustion purposes. When the control valve is in this position it is also effective to prevent transmission of pressure surges in the fuel supply to the burner. While fulfilling all of these desired functions, the structure is simple, relatively inexpensive to produce, easily adjusted and is extremely reliable in operation.

It is therefore an object of my invention to provide an improved diaphragm controller for a pressure-operated valve.

Another object of my invention is to provide a diaphragm controller for a pressure-operated flow control valve which, when flow is to be initiated, co-acts therewith to provide substantially step opening of the pressure operated valve to a first position and, after a time delay, to provide further opening thereof to a second flow position.

A further object of my invention is to provide a diaphragm controller for a pressure-operated valve as previously described wherein the diaphragm controller controls the flow of a portion of the fluid being valved, which in turn, controls the pressure-operated valve.

Still another object of my invention is to provide a diaphragm controller which is simple, compact, relatively inexpensive and easily adjusted, and yet is reliable and safe in operation.

These and other objects of the invention will become

apparent upon reading the following detailed description of the invention in conjunction with the accompanying drawing wherein:

The single figure of the drawing is a somewhat schematic showing of the diaphragm controller and pressure-operated valve of the present invention connected with other components in a system for controlling the flow of a fluid fuel, such as natural gas.

Referring to the drawing, the reference numeral 10 generally designates the diaphragm controller or pilot valve of my invention. Controller 10 includes a body member 11 having an inlet chamber 12 therein. Also located in body member 11 and separated from chamber 12 by a wall 13 is an opening which forms an outlet chamber 14. Body member 11 has, at its lower extremity, a flange 15 around its outer periphery. A flexible diaphragm 16 is clamped at its outer periphery between flange 15 and a similar flange 17 of a cup-shaped cover member 20. Cover member 20 is fixed to body member 11 by appropriate means, such as screws (not shown) extending through the flanges 15 and 17. Diaphragm 16 thus forms one wall of outlet chamber 14 and separates the outlet chamber from a control chamber 21 formed in the interior of cover member 20. Cover member 20 also includes a passage 22 connecting control chamber 21 with the atmosphere. A screw 23, threaded into cover 20 substantially perpendicular to passage 22, intersects the passage and adjustably restricts the flow of air therethrough.

Formed in wall 13 and extending substantially parallel to the plane thereof is an elongated passage 24. Substantially perpendicular thereto and connecting passage 24 with inlet chamber 12 is a passage 25. Adjacent its intersection with inlet chamber 12, passage 25 has an enlarged diameter portion 26 which forms a valve seat around the passage 25. Located substantially on the central axis of the valve is a passage 27 in wall 13 which connects outlet chamber 14 and passage 24. At the intersection of passage 27 with outlet chamber 14 is formed a valve seat 28. Formed around passage 27 and substantially coaxial therewith, wall 13 has a sleeve-like portion 30 which extends into outlet chamber 14. Located near an outer wall of body member 11, a passage 31 connects passage 24 and outlet chamber 14. A screw 32 is threaded into an internally threaded portion of passage 24 at the outer wall of body member 13. Screw 32 is positioned so that it may be adjusted to selectively restrict the connection between passages 24 and 31.

Inlet chamber 12 has located therein an on-off valve 33 which may be of a conventional solenoid operated type. Valve 33 is shown as having a valve closure member 34 which cooperates with a valve seat around passage 25 to control communication between chamber 12 and passage 24. Valve closure member 34 is normally biased to a closed position by a spring 35 and may be opened in response to energization of an operator 36 which may be controlled by a condition responsive device, such as a conventional room thermostat (not shown). An inlet 37 into chamber 12 is adapted to be connected to a source of fluid under pressure as will be described hereinafter.

Diaphragm 16 has, on opposite sides thereof, backing plates 40 and 41 which are attached thereto by appropriate means, such as a bolt 42 passing through the center thereof. A spring, such as coil spring 43, is located in control chamber 21 and is positioned between the bottom of cover member 20 and backing plate 40 and normally urges diaphragm 16 toward outlet chamber 14 to a position wherein backing plate 41 abuts the lower extremity of sleeve portion 30. Located in outlet chamber 14 and carried by diaphragm 16, is a spring member 44 which

may also be attached at one of its ends to the diaphragm by bolt 42. Spring member 44 is located so that it extends from the diaphragm and into sleeve portion 30. Carried by the other end of spring 44 is a valve member 45 which is adapted to cooperate with valve seat 28 to control the flow of fluid through passage 27. Valve member 45 is shown as being spherical in shape but obviously may be of any suitable shape. Outlet chamber 14 has an opening 46 which is adapted to be connected to the control chamber of a pressure-operated valve, as will be described hereinafter.

Reference numeral 50 generally designates a pressure-operated fluid control valve having a body member 51 which, usually, is much larger than the valve 10. Body member 51 has formed therein an inlet chamber 52 and an outlet chamber 53 separated by a wall 54 having an aperture 55 formed therein. Opposite wall 54, a diaphragm 56 is clamped at its outer periphery between a flange 57 on body member 51 and a similar flange 60 on an inverted cup-shaped cover member 61. Diaphragm 56 thus forms one wall of outlet chamber 53 and separates outlet chamber 53 from a control chamber 62 which is formed in the interior of cover member 61. Cover member 61 has an inlet port 63 which is adapted to be connected to outlet port 46 of pilot valve 10 by a pipe or passage 64. An inlet port 65 in chamber 52 is adapted to be connected to a source of fluid under pressure, as will be described hereinafter. An outlet port 66 in chamber 53 is adapted to be connected to a pipe 67 which, in turn, may be connected to a burner (not shown). An outlet port 70 from control chamber 62, is connected to pipe 67 through a passage or pipe 71 having a restriction 72 formed therein.

Diaphragm 56 has centrally located thereon, on opposite sides thereof, backing plates 73 and 74. Carried by diaphragm 56 and attached thereto by appropriate means (not shown) is a stem 75 which has mounted at its extremity, a valve closure member 76 which is adapted to cooperate with aperture 55 to control the flow of fluid therethrough. A spring member 77 is located within chamber 53 between wall 54 and diaphragm 56 and normally urges diaphragm 56 to a position wherein valve 76 seats against wall 54 at the periphery of aperture 55 and is thus in a closed position.

Fluid, such as fuel gas, under pressure is supplied to the system through a pipe 80 and through a safety valve 81, which may be a conventional thermocouple safety valve that is energized in response to the presence of a pilot flame at the burner. Since this type of valve is well known in the art, a detailed description of its structure and function will not be given. From valve 81, a main flow of fluid is supplied to the inlet chamber 52 of control valve 50 through a pipe or passage 82. A branch passage or pipe 83 intersects passage 82 and supplies a portion of the fluid under pressure to the inlet chamber of a conventional pressure regulator valve generally designated as 84. A similar pipe or passage 85 connects the outlet of pressure regulator valve 84 to port 37 in the inlet chamber 12 of diaphragm controller 10.

While the components of the present system have been shown and described as separate elements connected by piping, it will be obvious that they might be incorporated into a unitary body member commonly known as a manifold valve. Such a manifold valve might also include a manual plug valve as is well known in the art for providing manual on-off control of the system described and also for controlling the flow of fuel to a pilot burner.

Operation

As shown in the drawing, the system is in a completely "off" position and all of the valve closure members are seated against their respective seats and there is no flow of fuel through the system. If valve 81 were opened and held open by the establishing of a pilot flame at the burner, the system would then be ready for operation. However, opening of valve 81 will not affect the position of valves 84, 10 or 50, unless valve 84 is open as a result of valve 81 having closed before valve 33 closed. Assume now that valve 81 is in an open position and that actuator 36 of valve member 33 in the inlet chamber of valve 10 is energized, as by a call for heat by a room thermostat. Valve closure member 34 would thus be moved away from the seat 26, establishing a fluid flow path from the outlet of the pressure regulator 84 through passage 85, chamber 12 of diaphragm controller 10, passage 25, passage 24, partially restricted passage 31, outlet chamber 14 and passage 64 to control chamber 62 of valve 50. Since control chamber 62 is connected to the burner pipe 67 through the restricted passage 71, chamber 62 is initially at substantially atmospheric pressure. Thus upon opening of the valve 33 in the inlet chamber of the diaphragm controller, the pressure in the outlet chamber of the pressure regulator valve 84 drops causing the pressure regulator valve to move to an open position. Therefore, fuel under pressure flows through the pressure regulator valve 84 and passage 85 to the inlet chamber 12 of the diaphragm controller. At this time valve member 45 is in a closed position but fuel is supplied through restricted passage 31 to the outlet chamber 14 of the diaphragm controller. Since restriction 72 in the pipe 71, which connects control chamber 62 of the valve 50 with the burner pipe, is smaller than the restriction provided by screw 32 in passage 31, pressure builds up in the control chamber 62 of valve 50. This pressure, which is determined by the adjustment of screw 32 in passage 31, acts on diaphragm 56 and causes it to move in opposition to the spring 77 a distance sufficient to move valve member 76 to a low or minimum flow position. Thus fuel is allowed to flow from inlet chamber 52 past valve 76 and into outlet chamber 53 and to burner pipe 67 at a rate sufficient to safely establish combustion at the burner.

Upon the initial opening of valve 33 and the establishment of a flow of fuel through passages 24 and 31, valve member 45 is maintained in a closed position by springs 43 and 44. When pressure is admitted to chamber 14, diaphragm 16 is moved downward in opposition to spring 43, but this movement is retarded by the slow passage of air from chamber 21 under the diaphragm, through the restricted passage 22, to atmosphere. Thus movement of diaphragm 16 takes place slowly. Initial movement of the diaphragm 16 does not remove valve member 45 from its seat 28 since spring 44 expands to maintain the valve in a closed position until diaphragm 16 has moved some predetermined distance downward. Thus it can be seen that a time delay, of a length determined by the amount of restriction in passages 31 and 22, is obtained between the initial opening of valve 33 and the opening of valve member 45. When diaphragm 16 has moved downwardly to a point where valve 45 is moved away from its seat, fluid under pressure rushes into chamber 14 through passage 27. This increased pressure in chamber 14 is almost immediately communicated to control chamber 62 of valve 50 thus moving diaphragm 56 downwardly to move valve member 76 to a greater flow position, thus providing a greater flow of fuel through valve 50 and allowing a greater combustion rate at the burner.

After opening of valve 45, the pressure supplied to control chamber 62 of valve 50 is substantially constant since it is regulated by the pressure regulator 84. Thus valve closure member 76 is maintained in a substantially constant position as long as the supply pressure is constant. Since the position of valve closure member 76 is determined by the combined effect of the spring 77 and the pressure in outlet chamber 53 acting on one side of diaphragm 56 and the pressure of the fluid in chamber 62 acting on the other side thereof, and since the pressure in the chamber 62 is substantially constant, it can be seen

that valve 50 also provides a pressure regulation effect on the fluid being supplied to burner pipe 67. Particularly, since any pressure surge in chamber 53 tends to move valve 76 to closed position, the valve is thus effective to prevent transmission of such pressure surges to the burner.

When the actuator 36 of valve 33 is deenergized, closure member 34 is seated and flow to passage 24 is discontinued. Due to the bleed passage 71, the pressure in chambers 62 of valve 50 and chamber 14 of valve 10 is soon reduced to a level so that spring 77 moves diaphragm 56 upwardly and seats valve member 76, thus shutting off flow of fuel to the burner.

From the foregoing it can be seen that I have provided a diaphragm controller or pilot valve which provides for a step-opening movement of an associated diaphragm valve. In addition I have provided in combination with the aforementioned diaphragm controller, a pressure operated control valve, with the combination providing a quick limited opening of the valve, to allow a minimum flow of fuel for ignition purposes, and after a selectively sufficient time delay, opening of the valve to a greater flow position for combustion purposes. In addition, I have provided a system which is simple and compact and is reliable and trouble free in operation.

While I have described and shown my invention in a specific embodiment, it is obvious that modifications and variations thereof may become apparent to those skilled in the art. Therefore, I do not wish to limit the invention to the preferred embodiment shown herein, but intend that it should be limited only by the scope of the appended claims.

I claim:

1. In combination: a main pressure operated valve having a valve closure member normally biased to a closed position and operable in response to fluid pressure in a control chamber; a control valve for controlling the application of fluid pressure to said control chamber, said control valve including a valve body having a chamber therein, said chamber having a movable wall, the outside of said movable wall being restrictively connected to an area of low fluid pressure; a main inlet port, a restricted inlet port and an outlet port in said chamber; means adapted to connect said inlet ports to a source of fluid under pressure; means connecting said outlet port to the control chamber of said main valve; valve means in said chamber and cooperable with said main inlet port to prevent fluid flow therethrough; yieldable means between said movable wall and said valve means and urging said valve means toward said main inlet port; and means normally biasing said movable wall to a position wherein said valve means closes said main inlet port and yieldable in response to fluid pressure in said chamber to permit movement of said movable wall and said valve means to open said main inlet port.

2. In combination: a main pressure operated valve having a valve closure member normally biased to a closed position and operable in response to fluid pressure in a control chamber; a pressure operated control valve including a valve body having first and second chambers therein separated by a movable wall; means adapted for restrictively connecting said second chamber to an area of low fluid pressure; first and second inlet openings into said first chamber, said first inlet opening having a valve seat associated therewith, said second inlet opening having flow restricting means associated therewith; an outlet opening from said first chamber; means adapted to connect said first and second inlet openings to a source of fluid under pressure; means connecting said outlet opening to the control chamber of said main valve; valve means associated with said valve seat; yieldable means between said movable wall and said valve member and urging said valve member toward said valve seat; and means normally biasing said movable wall toward said first chamber to maintain said valve means in engagement with said valve seat to prevent fluid flow through said first inlet opening and yieldable in response to fluid pressure in said first chamber to permit movement of said movable wall and said valve means to move said valve means away from said valve seat.

3. The combination comprising: a main pressure operated valve having a valve closure member normally biased to a closed position and operable in response to fluid pressure in a control chamber; a pressure operated control valve including a valve body having first and second chambers therein separated by a movable wall; adjustable means for restrictively connecting said second chamber to atmosphere; first and second inlet ports into said first chamber, said first inlet port having a valve seat associated therewith, said second inlet port having adjustable flow restricting means associated therewith; an outlet port from said first chamber; means connecting said outlet port to the control chamber of said main valve; means adapted to connest said first and second inlet ports to a source of fluid under pressure; valve means associated with said valve seat; means between said movable wall and said valve member normally urging said valve member toward said valve seat; means normally biasing said movable wall toward said first chamber to urge said valve means onto said seat to close said first inlet port and yieldable in response to fluid pressure in said first chamber to move said valve means to open said first inlet port.

4. In combination: a main pressure operated valve having a valve closure member normally biased to a closed position and operable in response to fluid pressure in a control chamber; a control valve for controlling the application of fluid pressure to said control chamber, said control valve comprising first and second chambers separated by a movable wall; first and second inlet openings into said first chamber, said first inlet opening having a valve seat associated therewith, said second inlet opening having flow restricting means associated therewith; means adapted to connect said inlet openings to a source of fluid under pressure, said means including an on-off valve; an outlet opening from said first chamber; means connecting said outlet opening to said control chamber; a restricted opening connecting said second chamber to atmosphere; valve means associated with said valve seat; yieldable means between said movable wall and said valve means and urging said valve means toward said valve seat, and means normally biasing said movable wall toward said first chamber to seat said valve means on said valve seat to close said first inlet opening, said biasing means and said restricted opening in said second chamber being effective upon initial opening of said on-off valve to prevent movement of said movable wall and to thereby maintain said valve means in closed position to permit only flow of fluid at reduced pressure through said second inlet opening to said first chamber and said control chamber to open said main valve to a minimum flow position, and being further effective, after a build-up of pressure in said first chamber, to permit movement of said movable wall to open said valve means to facilitate fluid flow at full pressure through said first inlet opening and to said control chamber to open said main valve to a greater flow position.

5. In combination: a pressure operated main valve having an inlet chamber and an outlet chamber with a valve seat therebetween; a control chamber; a movable wall separating said outlet chamber and said control chamber; a valve member carried by said movable wall and cooperable with said valve seat to control fluid flow therethrough; means normally biasing said movable wall to seat said valve member on said valve seat and yieldable in response to pressure in said control chamber to permit movement of said movable wall to open said valve; a restricted outlet port from said control chamber, means connecting said restricted outlet to the outlet

chamber of said main valve; a control valve for controlling the application of fluid pressure to said control chamber, said control valve comprising first and second chambers separated by a movable wall; first and second inlet opening into said first chamber, said first inlet opening having a valve seat associated therewith, said second inlet opening having flow restricting means associated therewith; means adapted to connect said inlet openings to a source of fluid under pressure, said means including an on-off valve; an outlet opening from said first chamber; means connecting said outlet opening to said control chamber; a restricted opening connecting said second chamber to atmosphere; valve means associated with said valve seat; yieldable means between said movable wall and said valve means and urging said valve means toward said valve seat, and means normally biasing said movable wall toward said first chamber to seat said valve means on said valve seat to close said first inlet opening, said biasing means and said restricted opening in said second chamber being effective upon initial opening of said on-off valve to prevent movement of said movable wall and to thereby maintain said valve means in closed position to permit only flow of fluid at reduced pressure through said second inlet opening to said first chamber and said control chamber to open said main valve to a minimum flow position, and being further effective, after a build-up of pressure in said first chamber, to permit movement of said movable wall to open said valve means to facilitate fluid flow at full pressure through said first inlet opening and to said control chamber to open said main valve to a greater flow position.

6. A pressure operated control valve comprising a valve body having a chamber therein, a movable wall in said chamber, the space on one side of said movable wall being connected through a restriction to an area of low fluid pressure; a main inlet port, a restricted inlet port, and an outlet port in the wall of said chamber on the other side of said movable wall; a passageway for connecting said inlet ports to a source of fluid under pressure; valve means cooperable with said main inlet port to prevent fluid flow therethrough; yieldable means between said movable wall and said valve means and urging said valve means toward said main inlet port; and biasing means normally biasing said movable wall to a position wherein said valve means closes said main inlet port, said biasing means being yieldable in response to fluid pressure in said chamber to permit movement of said movable wall in a direction to move said valve means away from said main inlet port, said valve means and said yieldable means being constructed and arranged so that said valve means is opened only after a predetermined amount of such movement of said movable wall.

7. A pressure operated control valve comprising a valve body having first and second chambers therein separated by a movable wall; means adapted for restrictively connecting said second chamber to an area of low fluid pressure; first and second inlet openings into said first chamber, said first inlet opening having a valve seat associated therewith, said second inlet opening having flow restricting means associated therewith; an outlet opening from said first chamber; means adapted to connect said first and second inlet openings to a source of fluid under pressure; valve means associated with said valve seat; yieldable means between said movable wall and said valve member and urging said valve member toward said valve seat; and means normally biasing said movable wall toward said first chamber to maintain said valve means in engagement with said valve seat and yieldable in response to fluid pressure in said first chamber to facilitate movement of said movable wall to move said valve means away from said valve seat, said valve means and said yieldable means being constructed and arranged so that said valve means is opened only after a predetermined amount of such movement of said movable wall due to pressure entering said first chamber through said second inlet opening.

8. A pressure operated control valve comprising a valve body having first and second chambers therein separated by a movable wall; adjustable means for restrictively connecting said second chamber to atmosphere; first and second inlet ports into said first chamber, said first inlet port having a valve seat associated therewith, said second inlet port having adjustable flow restricting means associated therewith; an outlet port from said first chamber; means adapted to connect said first and second inlet ports to a source of fluid under pressure; valve means associated with said valve seat; means between said movable wall and said valve means normally urging said valve means toward said valve seat; and means normally biasing said movable wall toward said first chamber to urge said valve means against said seat to close said first inlet port and yieldable to facilitate movement of said movable wall toward said second chamber in response to fluid pressure in said first chamber, said valve means and said means between said movable wall and said valve means being so constructed and arranged that said valve means is maintained closed until a predetermined amount of movement of said movable wall away from said first chamber has occurred due to pressure introduced into said first chamber through said second inlet port.

9. A pilot valve for controlling the application of fluid pressure to a control chamber of a valve to be controlled comprising: first and second chambers separated by a movable wall; first and second inlet openings into said first chamber, said first inlet opening having a valve seat associated therewith, said second inlet opening having flow restricting means associated therewith; means adapted to connect said inlet openings to a source of fluid under pressure, said means including an on-off valve; an outlet opening in a wall of said first chamber; means adapted to connect said outlet opening to the control chamber of the valve to be controlled; a restricted opening connecting said second chamber to atmosphere; valve means associated with said valve seat; yieldable means positioned between said movable wall and said valve means and urging said valve means toward said valve seat; and means normally biasing said movable wall toward said first chamber to seat said valve means on said valve seat to close said first inlet opening, said valve means and said yieldable means being constructed and arranged so that said valve means is opened only after a predetermined amount of movement of said movable wall, said biasing means and said restricted opening in said second chamber being effective upon initial opening of said on-off valve to limit the rate of movement of said movable wall to thereby maintain said valve means in closed position and to thereby permit flow of fluid at a low rate only through said second inlet opening to said first chamber for a predetermined period and being further effective, after a buildup of pressure in said first chamber, to permit movement of said movable wall sufficient to open said valve means to facilitate fluid flow at a greater rate through said first inlet opening into said first chamber.

10. A control valve comprising: first and second chambers separated by a movable wall; first and second inlet openings into said first chamber, said first inlet opening having a valve seat associated therewith, said second inlet opening having flow restricting means associated therewith, means adapted to connect said inlet openings to a source of fluid under pressure; an outlet opening from said first chamber; restrictive means adapted to connect said second chamber to an area of low fluid pressure; valve means associated with said valve seat; yieldable means positioned between said movable wall and said valve means and urging said valve means toward said valve seat; and means normally biasing said movable wall toward said first chamber to seat said valve means on said valve seat to close said first inlet opening and

yieldable to facilitate movement of said movable wall toward said second chamber in response to fluid pressure in said first chamber, said valve member and said yieldable means being constructed and arranged so that the pressure acting on said valve means through said first inlet opening is ineffective to move said valve means until said movable wall is moved a predetermined distance toward said second chamber, said biasing means and said restrictive means associated with said second chamber being effective to limit the rate of movement of said movable wall so that upon initial introduction of fluid pressure at said inlet openings said valve means is maintained in closed position and to thereby permit only flow of fluid at reduced pressure through said second inlet opening to said first chamber for a predetermined period, and being further effective, after a build-up of pressure in said first chamber, to permit movement of said movable wall sufficient to open said valve means to facilitate fluid flow at full pressure through said first inlet opening.

11. A diaphragm controller comprising: first and second chambers separated by a flexible diaphragm; first and second inlet openings into said first chamber, said first inlet opening having a valve seat associated therewith, said second inlet opening having adjustable flow restricting means associated therewith, means adapted to connect said inlet openings to a source of fluid under pressure; an outlet opening from said first chamber; adjustable restrictive means adapted to connect said second chamber to atmosphere; valve means associated with said valve seat; yieldable means between said diaphragm and said valve means and urging said valve means

toward said valve seat; and means normally biasing said diaphragm toward said first chamber to seat said valve means on said valve seat to close said first inlet opening, and yieldable to facilitate movement of said diaphragm toward said second chamber in response to fluid pressure in said first chamber, the effective area of said valve means exposed to pressure at said first inlet opening when said valve means is closed and the force of said yieldable means acting thereon being such that said valve means is maintained closed against said seat until said diaphragm has moved an amount sufficient to substantially relieve the force of said yieldable means on said valve means, said biasing means and said restrictive means associated with said second chamber being effective to limit the rate of movement of said diaphragm so that upon initial introduction of fluid pressure at said inlet openings said valve means is maintained in closed position to thereby permit only flow of fluid at reduced pressure through said second inlet opening to said first chamber for a predetermined period, and being further effective, only after a build-up of pressure in said first chamber, to permit movement of said diaphragm sufficient to open said valve means to facilitate fluid flow at full pressure through said first inlet opening.

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