

April 14, 1931.

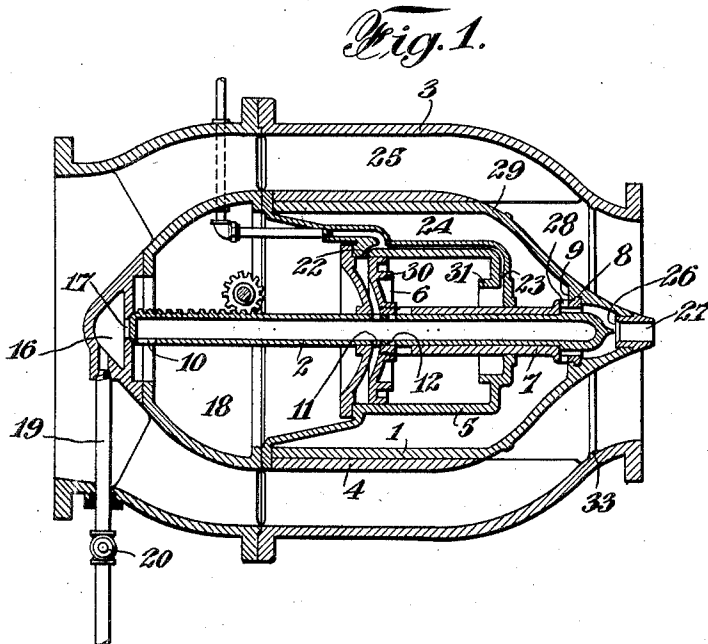
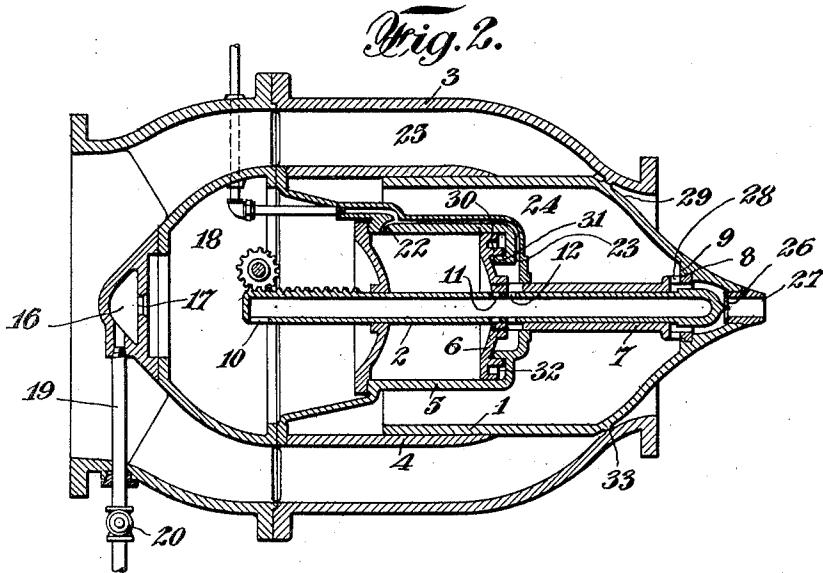
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1,801,049

VALVE

Filed June 5, 1926

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 4.

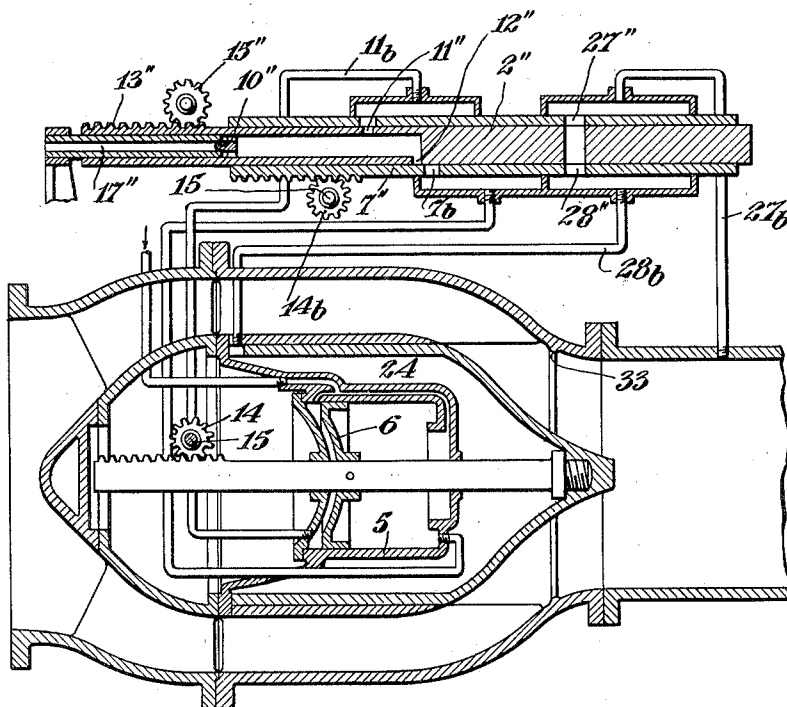
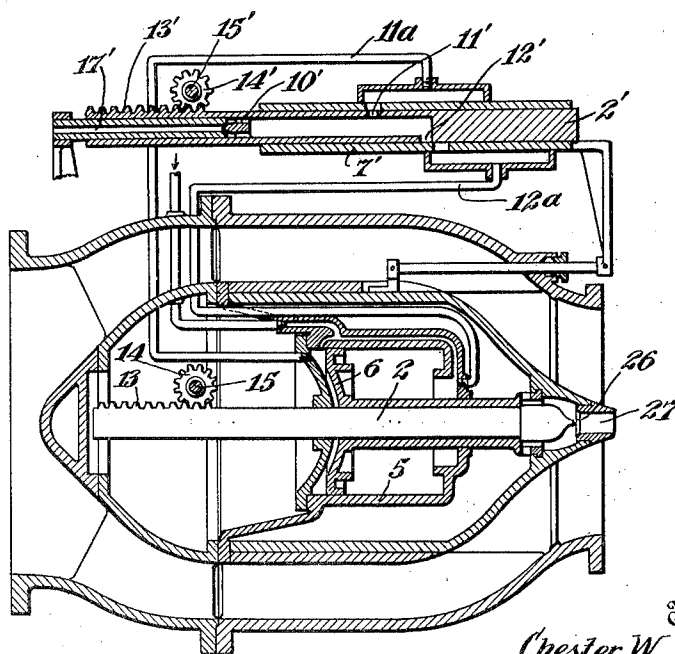


Fig. 3.



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VALVE

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This invention relates to valve mechanisms and more particularly to improved controlling means therefor.

8 An object of my invention is to provide particularly for a valve of the plunger type improved hydraulic controlling means therefor whereby the plunger may be controlled and actuated by fluid pressure, and when the pressure on the plunger nose is suddenly reduced the plunger will be prevented from jumping to its seat.

10 A further object is to provide an improved combination of fluid operating chambers and fluid controlling means therefor whereby the primary plunger moving force is created in one chamber and if this does not suffice for effecting plunger movement, fluid pressure in another chamber may be suitably controlled so as to produce a supplementary closing force. The first chamber is normally sufficient for closing the plunger.

15 A further object is to provide an improved dashpot and operating cylinder arrangement whereby the dashpot is connected to the plunger and is effective thereon at the instant the dashpot action commences. In this respect a more specific object is to provide improved means for maintaining a positive operating force and at the same time having effective dashpot action.

20 A further and more specific object of the invention is to provide in combination with the plunger and operating piston and cylinder therefor an improved control valve arrangement which may be disposed either within or without the plunger valve mechanism. In either case, however, the valve controls a suitable port whereby pressure within and outside of the plunger may be equalized, and it is one of the objects of this invention to so control the said valve mechanism that normally communication will constantly occur between the inner and outer sides of the plunger.

25 Still another object is to provide an improved means for connecting the operating piston to the plunger so that a relatively close fit of the operating piston and cylinder may be had without danger of undue stresses when the piston and plunger are connected.

In addition to the foregoing objects, other objects and advantages will appear from the following description of the accompanying drawings, in which

Figs. 1 and 2 are sectional views of the valve mechanism in open and closed positions respectively;

Fig. 3 is a modification with a part of the control valve mechanism disposed outside, and

Fig. 4 is a sectional view of a further modification showing the control valve mechanism disposed entirely outside of the plunger valve mechanism.

In the illustrative embodiment of my invention I have shown a usual and well-known type of plunger valve having an outer casing or body 3, internal hollow casing 4 and plunger 1 telescoping therewith. The plunger seat is preferably disposed so as to provide an external plunger surface which will be subjected to fluid pressure in the upstream pipe when the plunger is seated, thereby obtaining an opening force by this fluid pressure. The plunger valve is provided with an auxiliary cylinder 5 connected by a solid partition to the internal casing 4. Cylinder 5 is fitted with a piston 6 mounted on a hollow rod 7, which is connected to plunger 1 by lugs 8 of segmental form passing through corresponding spaces between lugs 9 on the plunger. By means of this arrangement the rod 7 is inserted axially into the position shown and locked against axial motion by turning around until lugs 8 and 9 are opposite each other. A certain amount of radial looseness is provided between rod 7 and plunger 1, thus permitting separate alignment of piston 6 in cylinder 5 and plunger 1 in cylinder 4. This is important inasmuch as the fit around cylinder 6 would in practice be closer than the fit around plunger 1.

A hollow pilot valve 2 is provided closed at both ends, but arranged with ports 10, 11 and 12. Pilot valve 2 is moved in an axial direction by a gear rack 13 engaging with a pinion 14 mounted on a shaft 15, which latter passes through the body of the valve and is operated by any usual and appropriate mechanism. Other means of moving pilot

valve 2 could be equally well employed, such as a screw gear, bell crank, piston and cylinder or other methods common in the art.

A chamber 16 is provided at the back end of the internal casing communicating with the chamber 18 within the latter by means of port 17. Port 17 is closed by plunger 2 when the latter has been moved to the left as far as it is possible to go, as shown in Fig. 1. At all other times chambers 16 and 18 are in free communication.

A drain pipe 19 is connected to chamber 16 and leads to some region of atmospheric pressure or of pressure substantially lower than the pressure of the pipe line. A valve 20 is provided in pipe 19 to cut off the exhaust and prevent leakage when plunger 1 is closed, or at any other time when it might for some special reason be desirable. Ordinarily, valve 20 is always open except when plunger 1 is closed.

A connection 21 is also provided leading from the pipe line or some other source of pressure supply and connected to both ends of cylinder 5. The ports 22 and 23, however, leading to the interior of cylinder 5 are considerably smaller than supply pipe 21 so that pressure may be exhausted from either end of cylinder 5 without materially reducing the pressure simultaneously supplied to the other end of the cylinder. By this means the cylinder 5 is automatically supplied with operating pressure, and at the same time either side of the piston may be exhausted without providing any means of shutting off the pressure supply.

The operation of the valve is as follows: Assuming plunger 1 to be open, and pilot valve 2 seated against port 17 as shown in Fig. 1, the pressures throughout chambers 18, 5 and 24 will be substantially equalized and equal to the pressure in the waterway 25, this being due to leakage through the fits between the various moving parts. There will be no leakage out of the valve itself, however, inasmuch as the exhaust port 17 is closed.

To close plunger 1 pilot valve 2 is moved towards the right. This opens port 17 and reduces the pressure in chamber 18, this reduction of pressure being communicated to the inside of pilot valve 2 through port 10. The movement of pilot valve 2 gradually cuts off port 11 and simultaneously opens port 12. This builds up pressure behind piston 6 and drops the pressure in front of piston 6, thus developing a closing force which is applied to plunger 1.

It will be observed that the size and location of ports 11 and 12 are such that by the time port 11 is completely closed port 12 is completely open, and at the same time pilot valve 2 has advanced only approximately half of its stroke towards its seat 26. As a result of the latter condition the port 27 is

still fully open, providing free communication from the waterway to chamber 24 through ports 28; and consequently the static pressures behind and in front of plunger 1 are substantially equalized. The equalization of static pressures leaves the forces developed on piston 6 free to overcome only the dynamic reaction of the flowing water on the nose of the plunger and the friction of the moving parts. It is obvious, however, that if, as in the case of a valve discharging into the atmosphere at high velocity, the reaction developed against the nose of the plunger should be greater than the propelling force which could be applied to piston 6, then the pilot valve 2 will move still further forward relative to the plunger, gradually approaching its seat 26 and cutting off the passage 27. This will prevent the exhaust of pressure from chamber 24 and will permit pressure therein to build up, thus adding to the closing force developed on piston 6. Pilot valve 2 will continue to cut off passage 27 until the plunger starts to move. Thus it will be seen that the action of pilot valve 2 is cumulative. It first develops all of the force which it is possible to apply to piston 6 and if this is insufficient to move the plunger it goes further and develops a supplementary force in chamber 24 until the plunger moves. The pressure in chamber 24 is automatically supplied either by leakage around plunger 1 or else by an independent source of pressure supply, which, however, is of restricted size as compared with the exhaust port 27 so that chamber 24 may be exhausted regardless of the incoming pressure supply.

After plunger 1 has been seated at 33 as shown in Figure 2, pilot valve 2 continues its motion until it seats at 26, thus cutting off all flow through the valve. If it is desirable to stop leakage through pipe 19, valve 20 is then closed.

In opening the valve, pilot valve 2 is moved in the opposite direction. Its first effect is to open port 27, thus equalizing the pressures upstream and downstream of the plunger seat. If the diameter of plunger 1 is the same as seat 28 no immediate movement of plunger 1 will occur, but if the plunger is larger than its seat as shown by the drawing, then the pressure of the pipe line on the shoulder 29 will tend to open the plunger. Further movement of pilot valve 2 towards the left will build up pressure in front of piston 6 and exhaust pressure from behind it, thus developing a force to open plunger 1. Any tendency of plunger 1 to drift relative to pilot valve 2 will be automatically corrected by the resultant opening or closing of ports 11, 12 and 27. It therefore results that plunger 1 will follow automatically the movement of pilot valve 2 until the plunger is completely open, after which a

further movement of the pilot valve closes port 17 and stops all leakage out of the operating chambers. It is desirable that this leakage should be cut off when the plunger is open without closing valve 20 because if valve 20 were closed the entire control mechanism would be inoperative and the valve would not be in condition for emergency closing by remote control.

Piston 6 is provided with an extension or shoulder 30, having a close fit with a similar shoulder 31 on the cylinder head. When plunger 1 is closing these two shoulders lap at a point in the stroke of the plunger some distance from seat 28. The effect of this is to cut off from the portion of cylinder 5 which is being exhausted through port 23, a chamber 32, which, having no outlet, acts as a dashpot to slow down the closing stroke of plunger 1. The water trapped in chamber 32 must be expelled entirely by leakage and this can only occur very slowly.

In the modification diagrammatically shown in Fig. 3 the pilot valve is left within the plunger while the remaining valve control is disposed outside. The elements of the outer control are given prime numbers corresponding to the numbers of the same elements in the preferred form. The rear exhaust passage feature of pilot valve 2 is formed in a member 2' which is actuated by any suitable means through a rack and pinion 13' and 14' respectively. Ports 11' and 12' have communication respectively with the rear and front ends of cylinder 5 as through pipes 11a and 12a, ports in the sleeve 7' and chambers connecting said ports and pipes. The sleeves 7' is connected to plunger 1 by any usual rods or linkages so that all plunger movements will be copied by the sleeve. A stationary valve controlled port 17' is provided by a telescopic connection between a hollow sleeve and the rear of rod 2'.

In the modification diagrammatically shown in Fig. 4 the control valve mechanism including the pilot valve, is simply entirely removed to the exterior instead of being disposed within the plunger valve mechanism and the various chambers and ports are connected by pipes leading through the inner and outer casings. In this modified form the elements thereof corresponding to the elements in the preferred form are given corresponding double primed numbers. The hollow rod 7'' which has a close sliding fit with the hollow pilot valve 2'' is actuated by a pinion 14b mounted upon the shaft 15 outside of the casing 3. This insures the member 7'' to follow all movements of the plunger 1 just the same as does the piston rod 7. A port 7b is adapted to have communication with the port 12'' to allow discharge of fluid from the front end of cylinder 5 to atmosphere as through ports 10'' and 17''. The ports 27'' and 28'' allow communica-

tion between the chamber 24 and the conduit just below the plunger seat as by the pipes 27b and 28b. Pipe 11b allows discharge of fluid from the rear end of cylinder 5 as by ports 11'', 10'' and 17''. To actuate the pilot valve 2'' for effecting closing or opening plunger movement there is provided a pinion 15'' meshing with a rack 13'', the pinion being rotated by any usual means. In either modification, however, the length of stroke of the external valve elements may be reduced by suitable linkages or reduction gearing, thereby allowing the control valve mechanism to be made shorter and without altering its operation.

The mode of operation and flow of fluid relative to the ports and chambers in these modified forms being identical to the preferred form, description of the operation will not again be given.

It will thus be seen that in any of the above forms the effect of ports 27, 27', or 27'' is merely supplementary to the effect of the auxiliary cylinder 5. The control of ports 27, 27' or 27'' does not as heretofore produce the primary moving force for actuating the plunger and when the pilot valve does approach its seat or actually seats the supplementary force is not of a pure mechanical nature but rather hydraulic. Hence, any slight movement or tendency of the plunger to jump so as to cause relative movements between the pilot valve and the plunger will cause a substantially instantaneous reduction of the supplementary hydraulic moving force. Such a mode of operation is particularly important in those installations involving, for instance a hydraulic turbine, wherein when the turbine gates are closed the only flow in the penstock will be due to gate leakage. When the turbine gates are thus closed the plunger valve will be closed in practically still water. Due to the small flow, pressure in the downstream side of the plunger will not drop until the latter is very close to its seat. This sudden reduction of pressure will if the ports 27, 27' or 27'' are not already open cause the plunger to jump forward and possibly suddenly engage its seat. However, with the construction herein disclosed the ports 27, 27', or 27'' will not be entirely closed and hence when the plunger approaches its seat and the downstream pressure drop occurs, such pressure drop will be instantly communicated to the plunger chamber 24 and reduce the supplementary closing force. There is no necessity for the plunger to move relative to the pilot valve to allow this communication of decreased pressure, hence plunger movement may be controlled to a nicety.

It is also to be noted that the ports 17, 17', or 17'' close automatically when the plunger valve is wide open, thus cutting off exhaust leakage, and which is accomplished in such

a way as not to put the valve out of operation as would be the case if valve 20 were closed. Valve 20 is closed when the main valve is closed, and the main valve is out of commission at that time, but this is not objectionable inasmuch as there is never any occasion to open a valve by remote control. In fact, it is desirable that the valve should be arranged so that it cannot be opened from a distance. Otherwise, it might be opened too rapidly into an empty line or opened at a time when men were working in the pipe.

I claim:

1. In combination with a valve mechanism
15 having inner and outer casings and a plunger cooperating with the inner casing to form an internal plunger fluid chamber, of means for moving said plunger comprising a piston and cylinder one of which is rigidly
20 secured to said plunger for movement therewith, a movable control valve mechanism for controlling fluid flow relative to said cylinder whereby said plunger will substantially follow movements of said control valve, and
25 means whereby said internal chamber is adapted, automatically in accordance with flow conditions through said casings, to have variable communication with the downstream side of said plunger during movement thereof by varying the flow area of the communicating passage.

2. In combination with a valve mechanism of the plunger type having inner and outer casings and a plunger cooperating with the
35 inner casing to form an internal chamber, of means for controlling the plunger including a piston and cylinder, one of which is normally immovably secured to said plunger so as to be movable therewith, and a pilot valve normally movable during movement of the
40 plunger for controlling communication between said internal chamber and the downstream side of the plunger.

3. In combination with a valve mechanism
45 of the plunger type having inner and outer casings and a plunger cooperating with the inner casing to form an internal chamber, of means for controlling the plunger including a piston and cylinder, one of which is normally immovably secured to said plunger so as to be movable therewith, and pilot valve mechanism for controlling communication
50 between said internal chamber and the downstream side of the plunger and for also controlling fluid flow relative to said operating cylinder.

4. In combination with a valve mechanism of the plunger type having inner and outer casings and a plunger cooperating with the
60 inner casing to form an internal chamber, of means for controlling the plunger including a piston and cylinder, one of which is normally immovably secured to said plunger so as to be movable therewith, and a movable pilot valve for controlling communication

between said internal chamber and the downstream side of the plunger and having means for also controlling actuating fluid for said cylinder, whereby movement of said valve is adapted to be substantially copied by
70 the plunger, while communication between the internal chamber and the downstream side of the plunger is maintained.

5. The combination with a valve mechanism having inner and outer casings and a
75 plunger cooperating with the inner casing to form an internal fluid chamber, said plunger being of the type having a sleeve portion of uniform diameter, of means for controlling said plunger including fluid operated means, a movable control valve adapted to control
80 actuating fluid for said operating means and to have the control valve movements copied substantially by the plunger, and means automatically controlled in accordance with
85 plunger movement for permitting communication between the downstream side of said plunger and said internal chamber throughout the closing stroke of said plunger.

6. The combination with a valve mechanism having inner and outer casings and a
90 plunger cooperating with the inner chamber to form an internal fluid chamber, of means for controlling said plunger including fluid operated means, a movable control valve
95 adapted to control fluid to said operating means and to have its movements copied substantially by the plunger, means for permitting communication between the downstream side of said plunger and said internal
100 chamber throughout the closing stroke of said plunger, and means including said control valve for closing said latter communication when said plunger is seated.

7. The combination with a valve mechanism having inner and outer casings, a plunger cooperating with the inner casing to form
105 an internal fluid chamber, of means for controlling plunger movement including a piston and cylinder, one of which is movable and connected to the plunger, and a combined pilot and control valve whereby actuating
110 fluid for said cylinder and piston and communication between said internal chamber and the downstream side of the plunger are controlled.

8. The combination with a valve mechanism having inner and outer casings and a
120 plunger cooperating with the inner casing to form an internal fluid chamber, of means for controlling plunger movement including a piston and cylinder, one of which is movable and operatively connected to the plunger, and a combined pilot and control valve
125 whereby actuating fluid for said cylinder and piston and communication between said internal chamber and the downstream side of the plunger are controlled, said combined valve being so arranged that said chamber
130

communication may be continually had during the closing plunger stroke.

9. The combination with a valve mechanism having inner and outer casings and a plunger cooperating with the inner casing to form an internal chamber, of means for controlling said plunger including a piston and cylinder, one of which is normally immovably connected to the plunger for movement therewith, means for controlling actuating fluid for said cylinder including a movable control valve adapted to have positive mechanical connection with said plunger for movement therewith and to effect opposite controlling characteristics of the fluid in the opposite ends of said cylinder whereby said plunger will be moved so long as said control valve is moving, and means permitting equalization of pressure between said chamber and the outer side of said plunger including a valve adapted to move with the plunger.

10. The combination with a valve mechanism having inner and outer casings and a plunger cooperating with one of said casings to form an internal fluid chamber, of means for controlling the plunger including a piston and cylinder, means permitting a continual supply of operating fluid to opposite ends of said cylinder, and means for controlling exhaust of fluid from either of said cylinder ends including a movable control valve whereby said plunger will copy movements of said control valve.

11. The combination with a valve mechanism having inner and outer casings and a plunger cooperating with one of said casings to form an internal fluid chamber, of means for controlling the plunger including a piston and cylinder, means permitting a continual supply of operating fluid to opposite ends of said cylinder, means for controlling exhaust of fluid from either of said cylinder ends including a movable control valve whereby said plunger will copy movements of said control valve, and means for permitting constant communication between said internal chamber and the downstream side of said plunger during the closing movement thereof until said plunger is seated.

12. The combination with a valve mechanism having inner and outer casings and a plunger cooperating with one of said casings to form an internal fluid chamber, of means for controlling the plunger including a piston and cylinder, means permitting a continual supply of operating fluid to opposite ends of said cylinder, means for controlling exhaust of fluid from either of said cylinder ends including a movable control valve whereby said plunger will copy movements of said control valve, and means for preventing exhaust of fluid from said cylinder when the plunger is in open position.

13. The combination with a valve mechanism having inner and outer casings and a

plunger cooperating with one of said casings to form an internal fluid chamber, of means for controlling the plunger including a piston and cylinder, means permitting a continual supply of operating fluid to opposite ends of said cylinder, means for controlling exhaust of fluid from said cylinder ends including a movable control valve whereby said plunger will copy movements of said control valve, and means for preventing exhaust of fluid from said cylinder when the plunger is in open position and while said control valve is so positioned relative to said cylinder that normally it would permit exhaust of fluid therefrom.

14. The combination with a valve mechanism having inner and outer casings and a plunger cooperating with said inner casing to form a fluid chamber whereby a closing force on the plunger may be created, of means for controlling the plunger including piston and cylinder elements forming a unit spaced from but attached to the plunger and adapted to exert thereon a fluid operating force separate from the pressure in said chamber, a pilot valve controlled by said elements and means for effecting a positive dashpot action adapted when created to be instantly effective on the plunger.

15. The combination with a valve mechanism of the plunger type having an internal chamber formed by the plunger whereby a closing force may be created, of means for controlling the plunger including piston and cylinder elements forming a unit spaced from but attached to the plunger and adapted to exert thereon a fluid operating force separate from but simultaneously with the pressure in said chamber, one of said elements being movable when connected to the plunger, a pilot valve controlled by said elements, means forming a dashpot operative during a certain portion of the plunger movement to create a closed dashpot chamber, and means for constantly applying a fluid force in said cylinder while said dashpot action is effective.

16. The combination with a valve mechanism of the plunger type, of means for controlling the plunger including a piston rod and piston and cylinder elements, one of which is movable and connected to the plunger by said piston rod, said elements having cooperating members spaced from said rod and disposed adjacent the cylinder walls to form a dashpot operative during a certain portion of the plunger stroke, and means permitting exhaust of fluid from said space adjacent said rod while said dashpot action is effective.

17. The combination with a valve mechanism of the plunger type, of means for controlling the plunger including piston and cylinder elements, one of which is movable, and means for connecting said movable element and plunger whereby said plunger and

movable element are adapted to have relative lateral movement, and a controlling valve carried by said connection means.

18. The combination with a valve mechanism having inner and outer casings and a plunger telescoping with said inner casing to form an internal fluid chamber, of means for controlling said plunger including a cylinder and piston disposed within said chamber, a hollow rod connecting said piston and plunger, and a sleeve valve disposed within said hollow rod to control the operating fluid in said cylinder.

19. The combination with a valve mechanism having inner and outer casings and a plunger telescoping with said inner casing to form an internal fluid chamber, of means for controlling said plunger including a cylinder and piston disposed within said chamber, a hollow rod connecting said piston and plunger, a sleeve valve disposed within said hollow rod to control the operating fluid in said cylinder, and a pilot valve including a port formed in the plunger and a closure portion therefor carried on said sleeve valve.

20. The combination with a valve mechanism having inner and outer casings and a plunger telescoping with said inner casing to form an internal fluid chamber, of means for controlling said plunger including a cylinder and piston disposed within said chamber, a hollow rod connecting said piston and plunger, a sleeve valve disposed within said hollow rod to control the operating fluid in said cylinder, and a pilot valve including a port formed in the plunger and a closure portion therefor carried on said sleeve valve, said hollow rod having a passage therein whereby communication may be had between the internal chamber and the outside of said plunger through said plunger port.

21. The combination with a valve mechanism having inner and outer casings and a plunger telescoping with the inner casing to form an internal fluid chamber, of means for controlling the plunger including a cylinder and piston therein, a hollow rod connecting said piston and plunger whereby they are relatively longitudinally immovable, a hollow sleeve valve disposed within said rod and having ports adapted to communicate with opposite ends of said cylinder, and a valve mechanism for sealing the interior of said operating means when the plunger is in open position.

22. The combination with a valve mechanism having inner and outer casings and a plunger telescoping with the inner casing to form an internal fluid chamber, of means for controlling the plunger including a cylinder and piston therein, a hollow rod connecting said piston and plunger whereby said piston and plunger are relatively longitudinally immovable, a hollow sleeve valve

disposed within said rod and having ports adapted to communicate with opposite ends of said cylinder, and a valve mechanism for sealing the interior of said operating means when the plunger is in open position, said latter valve means constituting an exhaust port through which fluid from said cylinder is discharged upon exhaust through said sleeve ports.

23. In combination, a valve mechanism comprising a movable valve member, means forming a fluid operating chamber therefor, and means for controlling said valve member, including a piston and a cylinder, one of which is movable with said valve member and immovable relative thereto, and a pilot valve for controlling communication between said chamber and the downstream side of said valve mechanism and for also controlling fluid flow relative to said operating cylinder.

24. In combination with a valve mechanism having a movable valve member, means cooperating therewith to form a fluid operating chamber therefor, piston and cylinder elements for controlling the valve member, whereby the unit fluid pressure in said cylinder may be different from the unit pressure in said chamber, and means permitting constant communication between said chamber and the fluid conduit with which said valve mechanism is associated, said means being adapted to control automatically said communication in accordance with flow conditions through said valve, and said cylinder and piston elements being adapted to exert a constant operating force on the plunger during control of the chamber pressure.

25. In combination, a valve mechanism comprising a movable valve member, piston and cylinder elements for controlling operation thereof, a piston rod connecting one of said elements with said valve member and means forming a dashpot for controlling movement of said valve member and being spaced from but surrounding said rod, said dashpot means and piston and cylinder elements being formed in the same structure but operable independently of each other.

26. In combination, a valve mechanism comprising a movable valve member, piston and cylinder elements for effecting movement thereof, a piston rod connecting one of said elements with said valve member, means for supplying fluid to one end of said cylinder, and means disposed within said cylinder end for forming a dashpot, said dashpot being operable independently of the fluid supply to said cylinder end after the dashpot action has once been initiated.

27. The combination in a valve mechanism comprising a conduit casing having a seat, a second casing, a plunger telescopically carried by said casing and adapted for engage-

ment with said conduit seat, said plunger and second casing forming a fluid chamber, an orifice formed in said plunger whereby communication may be had between said chamber and the conduit passage on the downstream side of the conduit seat, piston and cylinder elements disposed within said second casing, a sleeve directly connected to said plunger and one of said elements, a hollow rod slidably disposed within said sleeve and carrying at one end a valve adapted to co-operate with said orifice to control flow there-through and also having spaced from said valve a plurality of ports certain of which are adapted for communication with opposite ends of said cylinder, said sleeve having a port adapted to register with one of said other ports to allow communication with one end of said cylinder and a hollow portion of said rod, a discharge port formed in said second casing, means also carried by said rod to control said discharge port, and means for moving said rod axially.

28. The combination, in a valve mechanism, comprising inner and outer casings spaced to form a fluid passageway therebetween, a plunger telescoping with said inner casing to form an internal chamber therewith, an orifice in the nose of said plunger, a pilot valve for controlling said orifice, and a discharge passage leading from the rear end of said inner casing to the exterior of said outer casing, said inner casing having a valve seat upon which the rear end of said pilot valve is adapted to seat to prevent substantially fluid flow through said discharge passage.

29. The combination, in a valve mechanism, comprising inner and outer casings spaced to form a relatively smooth passageway therebetween, a plunger telescoping with said inner casing, and means for operating said plunger including a piston and cylinder disposed within said inner casing, an orifice in the nose of said plunger, a pilot valve for controlling said orifice, a discharge passage leading from the rear end of said inner casing to the exterior of said outer casing, and including a valve seat, means whereby fluid pressure acting upon at least one side of said piston may be discharged through said discharge passage, and a valve carried by the rear end of said pilot valve for engaging said valve seat to prevent substantially any discharge of fluid through said discharge passage.

30. The combination, in a valve mechanism, comprising inner and outer casings spaced to form a relatively smooth annular fluid passageway, a plunger telescoping with said inner casing to form an inner fluid chamber, and means for operating said plunger including a piston and cylinder disposed within said inner casing, means for discharging the pressure, acting upon at

least one side of said piston, through the rear end of said inner casing, and means for preventing discharge of said fluid including a valve which is adapted to be closed upon rearward movement of said piston.

31. The combination, in a valve mechanism, comprising inner and outer casings spaced to form a relatively smooth annular fluid passageway, a plunger telescoping with said inner casing, and means for operating said plunger including piston and cylinder elements disposed within said inner casing, a discharge passage for the fluid pressure acting upon said piston and leading from the rear end of said inner casing and a valve adapted to close said passage while said plunger is in its open position.

32. The combination, in a valve mechanism, comprising inner and outer casings spaced to form a relatively smooth annular fluid passageway, a plunger telescoping with said inner casing to form an internal fluid chamber, and means for operating said plunger including a piston and cylinder disposed within said inner casing, an orifice in the nose of said plunger, a pilot valve for controlling said orifice, means for discharging fluid from the rear end of said inner casing including a discharge passage, and a valve mechanism associated with the rear end of said pilot valve for controlling said discharge passage whereby fluid flow through said discharge passage is prevented when the pilot valve is in its rearmost position.

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