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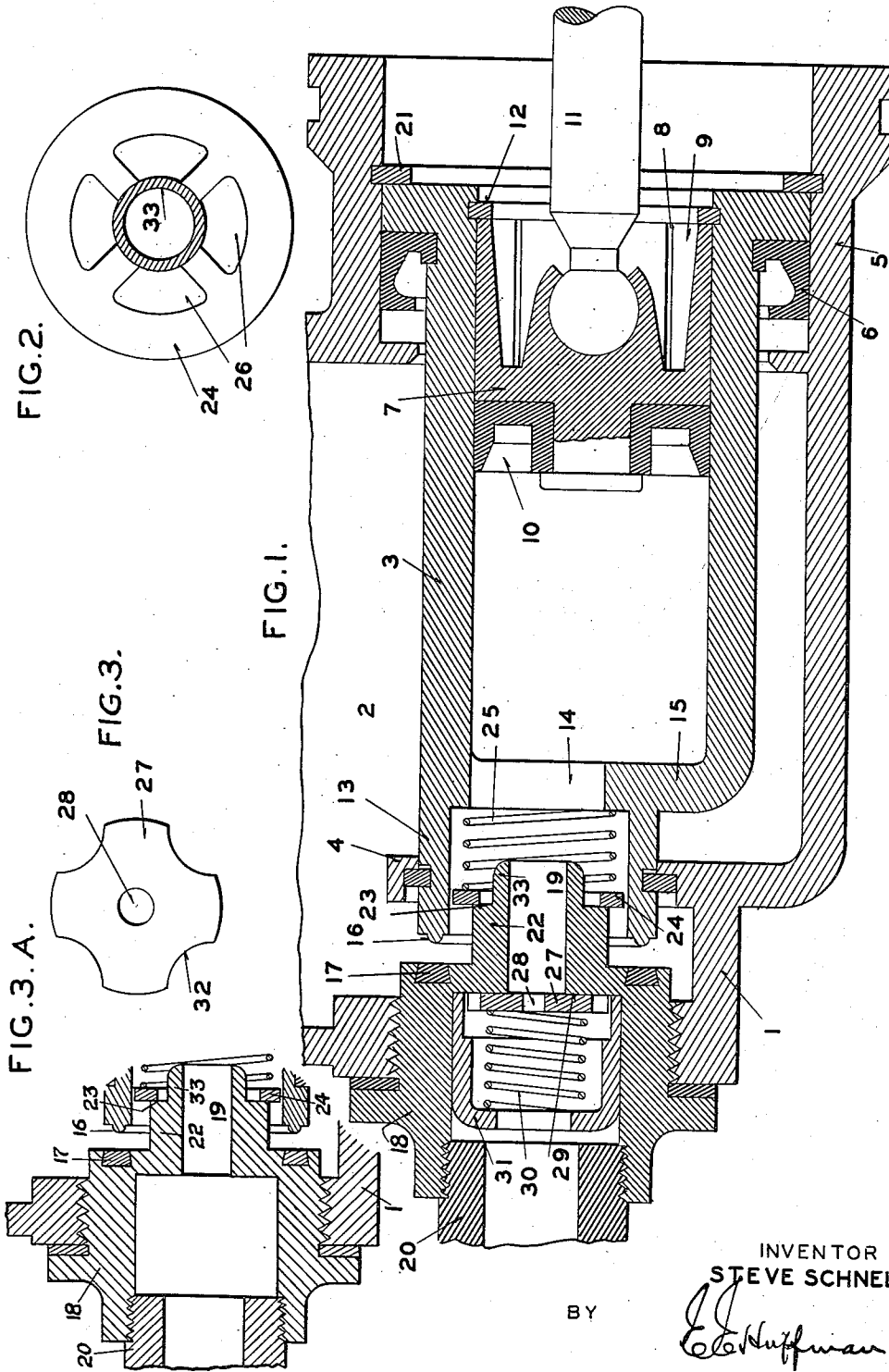
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2,307,642

VALUE MECHANISM FOR MASTER CYLINDERS

Filed Dec. 18, 1939

2 Sheets-Sheet 1



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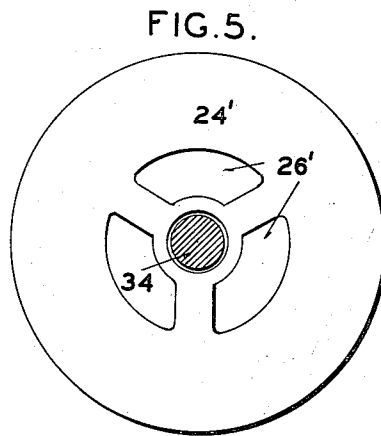
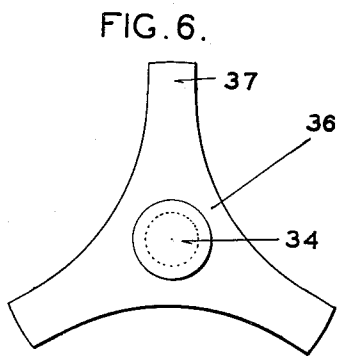
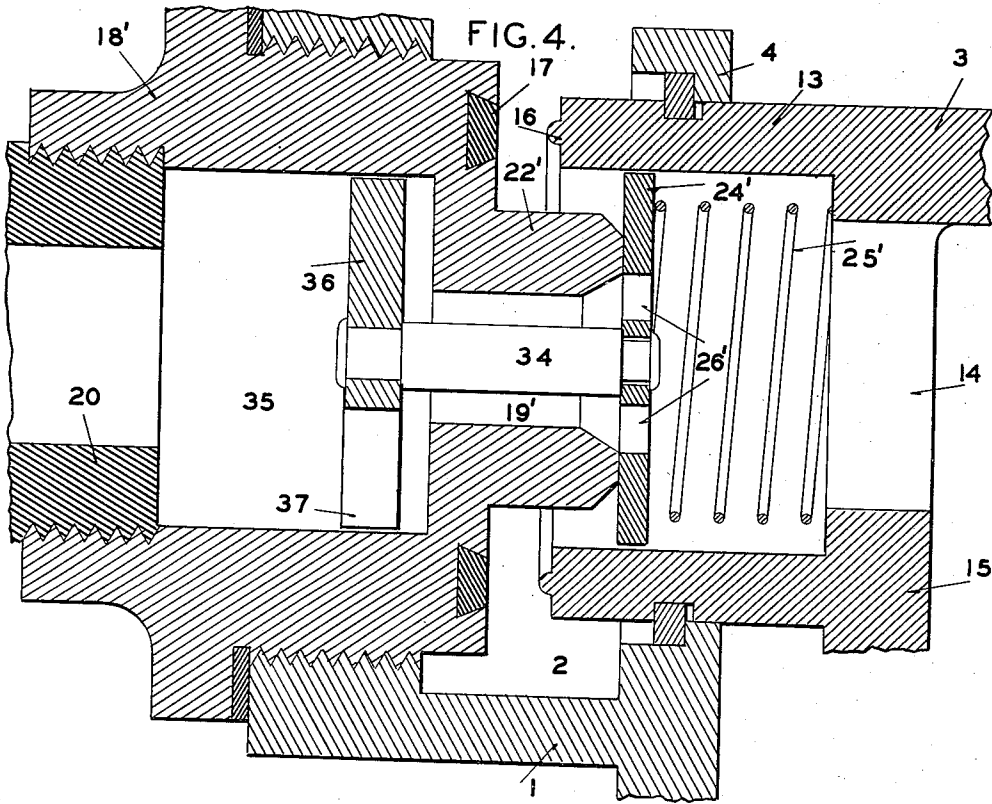
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VALUE MECHANISM FOR MASTER CYLINDERS

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2 Sheets-Sheet 2



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VALVE MECHANISM FOR MASTER CYLINDERS

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Application December 18, 1939, Serial No. 309,709

13 Claims. (Cl. 60—54.6)

My invention relates to master cylinders and more particularly to improved valve mechanism for master cylinders of the type disclosed in my co-pending application Serial No. 274,540, filed May 19, 1939, for Master cylinder, since issued as Patent No. 2,258,034.

One of the objects of my invention is to provide improved valve mechanism for association with a master cylinder device of the type referred to which will insure efficient operation of the master cylinder under all conditions.

Another object of my invention is to provide a valve mechanism which will properly control the flow of fluid to and from the reservoir when the reservoir is permitted to be in communication with the fluid pressure system.

Other objects of my invention will become apparent from the following description taken in connection with the accompanying drawings in which Figure 1 is a cross-sectional view of a master cylinder device having associated therewith a valve mechanism embodying my invention; Figures 2 and 3 are views of parts of the valve mechanism; Figure 3A is a showing of a slight modification of the structure of Figure 1; Figure 4 is a cross-sectional view showing a modified valve mechanism; and Figures 5 and 6 are views of parts of the valve mechanism shown in Figure 4.

Referring to Figures 1 to 3 in detail, numeral 1 indicates a casing forming a liquid containing reservoir 2 for maintaining the fluid pressure system filled and to compensate for contraction and expansion of the liquid in the said system. Within the lower portion of the casing is mounted a cylinder 3 for limited reciprocable movement, the forward end of the cylinder being supported on a guide 4 and the rear end of the cylinder supported by a cylindrical extension 5 of the casing. A packing cup 6 is carried by the rear end of the cylinder to prevent leakage. Within the cylinder is a piston 7 the skirt of which is provided with longitudinal slots 8 to provide resilient portions 9 to frictionally engage the cylinder wall. The forward end of the piston carries a packing cup 10 to provide a seal between the piston and cylinder. The piston is actuated by a piston rod 11 and when in retracted inoperative position it engages a stop 12 carried by the rear end of the cylinder. The piston is returned to its retracted position by a spring (not shown) cooperating in a well known manner with the actuator such as a foot pedal.

The forward end of the cylinder 3 which is supported by the guide 4 is in the form of a

cylindrical extension 13 having an inner diameter considerably less than the main cylinder portion in which the piston is reciprocable. The chamber in the cylindrical extension and the main cylinder portion communicate with each other by a passage 14 in the end wall 15 of the cylinder. The forward end surface of the extension is provided with an annular rib 16 for cooperation with an annular rubber seat 17 carried by a plug 18 threaded into the end of the casing 1. The plug is provided with an outlet passage 19 which is connected to a conduit 20 for conducting fluid under pressure to actuate a fluid motor such as the fluid motor of a vehicle brake assembly.

When the master cylinder device is inoperative the parts are in the position shown in Figure 1. The cylinder 3 which has limited reciprocable movement is at its rearmost position against a stop 21 carried by extension 5 and the rib 16 on the extension 13 is disengaged from the valve seat 17. Under these conditions the cylinder 3 and the system connected to the outlet are in free communication with the reservoir 2, thus permitting contraction and expansion of the liquid due to temperature changes. When it is desired to develop pressure the piston 7 is moved forwardly by the rod 11. The friction between the skirt of the piston and the cylinder wall and also the friction between the cup 10 and the cylinder wall will cause the cylinder to move with the piston. Slight fluid pressure will also be developed ahead of the piston as it is moved and this will increase the friction between the cup and cylinder wall thus aiding in insuring the movement of the cylinder with the piston when the cylinder has moved to a position to cause rib 16 to engage seat 17 whereby communication with the reservoir will be cut off. The piston will now move relatively to the cylinder and place the fluid in the cylinder under pressure and cause fluid under pressure to flow out the outlet 19 and operate the fluid motor connected to conduit 20. The greater the fluid pressure developed by the piston the greater the force present holding the rib 16 on its seat 17. This is caused by the fluid pressure acting on one side only of end wall 15.

When the piston is retracted the cylinder will move therewith due to the friction between the piston and the cylinder wall and the friction between cup and cylinder wall. Also the retracting of the piston will cause a drop in pressure in the cylinder ahead of the piston and thus eliminate the pressure action on end wall 15

tending to keep the rib 16 seated. When the rib is unseated fluid can return from the fluid motor.

In the type of master cylinder device just described it is desirable for efficient operation to restrict the flow of fluid from the cylinder and the extension 13 to the reservoir during the initial movement of the piston but not restrict the flow in the opposite direction. If the flow of fluid is not restricted it may sometimes happen that the piston will have considerable initial movement relative to the cylinder before the rib 16 is seated due to a rapid movement of the piston or a low friction between the cup and cylinder wall or between the piston and cylinder wall. If this occurs there will be loss of piston travel for pressure producing purposes. It is also desirable to prevent too rapid a return of fluid under pressure from the fluid motor and permit too rapid a release of the mechanism actuated by the motor but at the same time not restrict the flow of fluid under pressure from the master cylinder to the fluid motor.

In accordance with one feature of my invention, I have provided means in the described master cylinder device which will insure that the above noted disadvantages will not be present under any conditions of operation of the master cylinder. In carrying out my invention I have provided a portion of the plug 18 with an extension 22 which projects into the cylindrical extension 13 on the forward end of the cylinder 3. This extension 22 also forms a part of the outlet passage 19 and is provided with a shoulder 23 spaced from its outer end. Surrounding the extension is a disc 24 biased into engagement with the shoulder by a very light spring 25. The disc, as shown in detail in Figure 2, is of a diameter somewhat less than the internal diameter of the cylindrical extension 13 and is formed with cut out portions 26 which lie within the outer periphery of the shoulder.

With the disc in its normal position, as shown in Figure 1, it restricts the flow of fluid from the interior of the cylinder 3 and the extension 13 to the reservoir. Thus if the piston 17 is moved forward rapidly from its retracted position, there will be no possibility of a great amount of fluid flowing into the reservoir before the cylinder 3 is moved forwardly to engage the rib 16 with seat 17. Any fluid placed under pressure by the piston will thus tend to flow through the outlet 19 and operate the fluid motor instead of being dissipated into the reservoir 2. Also by restricting the flow of fluid to the reservoir any pressure developed in cylinder 3 will cause the lip of the packing cup to engage the cylinder wall with additional pressure and also produce a differential pressure on the end wall 15 both of which will aid in causing the cylinder to move with the piston. If, during the return stroke of the piston, its movement should be so rapid that a sub-atmospheric pressure will be created in cylinder 3 due to the restricted space around the disc permitting fluid to flow in from the reservoir, the disc will readily be unseated from the shoulder 23 and a greater amount of fluid can flow past the disc through the cut-out portions 26, thus preventing sub-atmospheric pressure and maintaining cylinder 3 completely filled with fluid. By preventing sub-atmospheric pressure from being present in the cylinder 3, there will be no possibility of air entering the system by being drawn in past the piston 7 and its packing 10 or past any

sealing cup in the fluid motor connected to conduit 20.

Also as another feature of my invention there is associated with the outlet 19 of plug 18, a disc 27 for restricting the flow of fluid from the conduit 20 through the outlet 19 whenever piston 7 is retracted but not restricting the flow of fluid in the opposite direction during the protractile or pressure producing movement of the piston. This disc 27 is provided with an opening 28 which is of smaller size than the outlet passage 19 and the disc is biased into engagement with shoulder 29 on the plug by means of a very light spring 30 which is interposed between the disc and a cup-shaped member 31 having a press-fit with the plug. The disc 27, as shown in detail in Figure 3, has cut away portions 32 in its periphery which permit fluid to flow around the disc whenever the disc 27 is unseated by flow of fluid through the outlet to the conduit 20. It is thus seen that by use of disc 27 flow of fluid back into the cylinder is restricted but not in the opposite direction and therefore the fluid in the fluid motor connected to conduit 20 will not be released at such a rapid rate that the piston will not have sufficient time to move rearwardly so that a new forward stroke can be made to again place the fluid under pressure if such is desired. In other words, if the piston is at the forward end of cylinder 3 and then is retracted so that rib 16 is unseated, fluid under pressure returning from the fluid motor will not be so rapid that it will escape into the reservoir before the piston has moved rearwardly a sufficient distance that a subsequent forward movement will again place the fluid under pressure.

It is also to be noted in connection with the structure shown in Figure 1 that if it is desired to eliminate the disc 27 and its function the remaining structure will so function as to aid in unseating of the disc 24 from the shoulder 23 during a quick retractile stroke of the piston. With the disc 27 removed as shown in Figure 3A fluid can flow freely and rapidly back through the outlet 19 and into the cylinder 3 as the piston moves rearwardly. This rapid movement of the fluid out of the nose portion 33 of flange 22 which extends beyond the valve disc 24 will produce a limited injector effect thereby producing a force assisting in causing the disc 24 to move away from shoulder 23 and permit fluid to be supplied from the reservoir at a rapid rate to prevent the formation of a sub-atmospheric pressure in cylinder 3 due to the piston returning so rapidly that the volume of the cylinder increases at a greater rate than the volume of fluid returning through the outlet 19.

Referring to Figures 4, 5, and 6 there is disclosed a modified construction wherein the disc which restricts flow of fluid to the reservoir is assisted off its seat by the return flow of fluid under pressure when the piston is retracted, thereby insuring that no sub-atmospheric pressure will develop in the system. The plug 18' is provided with an extension 22' and cooperating with the end thereof is the disc 24' for restricting the flow of fluid from the cylinder 3. The disc is of somewhat smaller diameter than the internal diameter of the extension 13 and is held against the end of the extension by a very light spring 25'. The central part of the disc is provided with openings 26'. The hub of the disc is loosely secured to one end of a rod 34 which extends through the outlet passage 19' and into a chamber 35' in the plug. A second disc 36 acting

as an impeller element is positioned in the chamber and secured to the other end of rod 34. As shown in Figure 6 this disc is triangular in shape and the legs 37 thereof guide the disc in the chamber. The body portion of the disc is of such size that when the disc is moved toward the passage 19' it will restrict to a degree the flow of fluid from the conduit through the passage to the cylinder.

When the piston is moved forwardly the operation of the flow restricting disc valve 24' operates in the same manner as the disc 24 in the structure shown in Figure 1. During the retractile movement of the piston and especially if the piston is retracted rapidly the return of fluid under pressure from the conduit 20 to the cylinder will act on the disc or impeller element 36 and thereby unseat disc 24' permitting a free flow of fluid from the reservoir through the opening 26' to the cylinder 3. Thus with this inflow of fluid from the reservoir there is no possibility of a sub-atmospheric pressure developing in the system and the causing of sucking of air past the sealing cups. The relationship of the disc 36 with the passage 19 also insures that the flow of fluid back to the cylinder will be restricted for reasons already set forth with respect to the disc 27 of the construction shown in Figure 1.

Being aware of the possibility of other modifications in the particular structure herein described without departing from the fundamental principles of my invention, I do not intend that its scope be limited except as set forth by the appended claims.

Having fully described my invention, which I claim as new and desire to secure by Letters Patent of the United States is:

1. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means forming an outlet passage for fluid in the cylinder member, a reservoir, cooperating valve means on the fixed member and on the end of the cylinder member for governing the flow of fluid between the reservoir and the interior of the cylinder member and being controlled by the reciprocable movement of said cylinder member, a reciprocable piston in the cylinder member and capable of causing the cylinder member to have limited reciprocable movement therewith to thereby control the valve means, and means independent of the valve means for causing fluid pressure to be created in the cylinder member when the piston is moved relatively to the cylinder member and prior to the valve means being closed, said means being ineffective to cause any appreciable restriction to free flow of fluid from the reservoir to the interior of the cylinder member when the valve means is open.

2. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means forming an outlet passage for the cylinder member, a reservoir, cooperating valve means on the fixed member and on the end of the cylinder member for governing the flow of fluid between the reservoir and the interior of the cylinder member and being controlled by the reciprocable movement of said cylinder member, a reciprocable piston in the cylinder member and capable of causing the cylinder member to have limited reciprocable movement therewith to thereby control the valve means, and means independent of the valve means for restricting the flow of fluid from the cylinder member to the reservoir when the valve means

is open, said means being ineffective to cause any appreciable restriction to the flow of fluid in the opposite direction.

3. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means forming an outlet passage for the cylinder member, a reservoir, valve means associated with the fixed member and the cylinder member for governing the flow of fluid between the reservoir and the interior of the cylinder member and being controlled by the reciprocable movement of the cylinder member, a reciprocable piston in the cylinder member and capable of causing the cylinder member to have limited reciprocable movement therewith, and means associated with the cylinder member for restricting the flow of fluid from the interior thereof to the reservoir when said valve means is open but not appreciably restricting flow of fluid in the opposite direction.

4. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means providing a tubular extension on the fixed member extending into the end of the cylinder member and forming an outlet passage for the cylinder, a reservoir, cooperating valve means on the fixed member and on the end of the cylinder member for governing the flow of fluid between the reservoir and interior of the cylinder member and being controlled by the reciprocable movement of the cylinder member, a reciprocable piston in the cylinder member capable of causing said cylinder member to have limited reciprocable movement therewith to thereby control the valve means, and a member cooperating with the tubular projection and a portion of the cylinder member for restricting the flow of fluid from the interior of the cylinder member to the reservoir when the valve means is open, said member being capable of movement to a position permitting fluid to flow freely from the reservoir to the interior of the cylinder member.

5. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means providing a tubular extension on the fixed member extending into the end of the cylinder member and forming an outlet passage from the cylinder, a reservoir, cooperating valve means on the fixed member and on the end of the cylinder means for governing the flow of fluid between the reservoir and interior of the cylinder member and being controlled by the reciprocable movement of the cylinder member, a reciprocable piston in the cylinder member capable of causing said cylinder member to have limited reciprocable movement therewith to thereby control the valve means, means forming a seat on the tubular extension, a disc cooperating with the seat and of such size in relation to the portion of the cylinder member surrounding it as to restrict the flow of fluid from the cylinder to the reservoir when the valve means is open, and a light spring for biasing the disc on the seat but permitting it to be unseated to allow fluid to flow freely from the reservoir to the interior of the cylinder member when the valve means is open and the fluid pressure in the cylinder member is below that of the fluid in the reservoir.

6. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means providing a tubular extension on the fixed member extending into the end of the cylinder member and

forming an outlet passage from the cylinder, a reservoir, cooperating valve means on the fixed member and on the end of the cylinder means for governing the flow of fluid between the reservoir and interior of the cylinder member and being controlled by the reciprocable movement of the cylinder member, a reciprocable piston in the cylinder member capable of causing said cylinder member to have limited reciprocable movement therewith to thereby control the valve means, a member cooperating with the tubular projection and a portion of the cylinder member for restricting the flow of fluid from the interior of the cylinder member to the reservoir when the valve means is open, said member being capable of movement to a position permitting fluid to flow freely from the reservoir to the interior of the cylinder member and means on the tubular extension for causing an injector action by a rapid flow of fluid back into the interior of the cylinder member through the outlet passage to thereby assist in causing fluid in the reservoir to move the said restricting member to the position where fluid will flow freely from the reservoir to the interior of the cylinder member.

7. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means forming an outlet passage for the cylinder member, a reservoir, cooperating valve means on the fixed member and on the end of the cylinder member for governing the flow of fluid between the reservoir and the interior of the cylinder member and being controlled by the reciprocable movement of said cylinder member, a reciprocable piston in the cylinder member and capable of causing the cylinder member to have limited reciprocable movement therewith to thereby control the valve means, means independent of the valve means for restricting the flow of fluid from the cylinder member to the reservoir when the valve means is open, and means controlled by the flow of fluid back into the interior of the cylinder through the outlet passage for causing said restricting means to be ineffective to appreciably restrict flow of fluid from the reservoir to the interior of the cylinder when the valve means is open.

8. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means forming an outlet passage for the cylinder member, a reservoir, cooperating valve means on the fixed member and in the end of the cylinder member for governing the flow of fluid between the reservoir and the interior of the cylinder and being controlled by the reciprocable movement of said cylinder member, a reciprocable piston in the cylinder member and capable of causing the cylinder member to have limited reciprocable movement therewith to thereby control the valve means, means independent of the valve means for restricting the flow of fluid from the cylinder member to the reservoir when the valve means is open, and means comprising an impeller element associated with the outlet passage and acted on by fluid under pressure flowing back into the interior of the cylinder member through the passage for causing the restricting means to permit free flow of fluid from the reservoir to the interior of the cylinder when the valve means is open.

9. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means providing a tubular extension on the fixed member extend-

ing into the end of the cylinder member and forming an outlet passage from the cylinder, a reservoir, cooperating valve means on the fixed member and on the end of the cylinder member for governing the flow of fluid between the reservoir and interior of the cylinder member and being controlled by the reciprocable movement of the cylinder member, a reciprocable piston in the cylinder member capable of causing said cylinder member to have limited reciprocable movement therewith to thereby control the valve means, means forming a seat on the tubular extension, a disc cooperating with the seat and of such size in relation to the portion of the cylinder member surrounding it as to restrict the flow of fluid from the cylinder to the reservoir when the valve means is open, a light spring for biasing the disc on the seat, and means comprising an impeller element operatively connected to the disc and associated with the outlet passage whereby when acted upon by return flow of fluid through the passage to the interior of the cylinder it will cause the disc to be unseated and allow fluid to flow freely from the reservoir to the interior of the cylinder.

10. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means forming an outlet passage for the cylinder member, a reservoir, cooperating valve means on the fixed member and on the end of the cylinder member for solely governing the flow of fluid between the reservoir and the interior of the cylinder member and being controlled by the reciprocable movement of said cylinder member, a reciprocable piston in the cylinder member, means functioning when the piston moves forwardly for moving the cylinder forwardly to close the valve means and when the piston initially moves rearwardly from a pressure producing position for moving the cylinder rearwardly to open the valve means, said means permitting relative movement between the piston and cylinder after the valve means is closed or after the valve means has been opened, and means associated with the outlet passage for restricting the return flow of fluid under pressure through the passage to the interior of the cylinder but not restricting flow of fluid in the opposite direction when fluid pressure is produced by the piston, said restricting means being incapable of maintaining a positive pressure in the system connected with the outlet when the piston is inoperative and also being so constructed that fluid under pressure returning through the outlet will not vary the size of the restricted opening through which fluid passes.

11. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means forming an outlet passage for the cylinder member, a reservoir, cooperating valve means on the fixed member and on the end of the cylinder member for solely governing the flow of fluid between the reservoir and the interior of the cylinder member and being controlled by the reciprocable movement of said cylinder member, a reciprocable piston in the cylinder member, means functioning when the piston moves forwardly for moving the cylinder forwardly to close the valve means and when the piston initially moves rearwardly from a pressure producing position for moving the cylinder rearwardly to open the valve means, said means permitting relative movement between the piston and cylinder after the valve means is closed or after the valve means has been opened,

and a spring seated disc provided with a restricted opening and associated with the outlet passage to restrict flow of fluid through the passage to the interior of the cylinder, said disc being unseated by flow of fluid through the passage in the opposite direction to thereby permit free flow of fluid in said direction.

12. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means forming an outlet passage for the cylinder member, a reservoir, valve means associated with the fixed member and the cylinder member for governing the flow of fluid between the reservoir and the interior of the cylinder member and being controlled by the reciprocable movement of the cylinder member, a reciprocable piston in the cylinder member and capable of causing the cylinder member to have limited reciprocable movement therewith, means associated with the cylinder member for restricting the flow of fluid from the interior thereof to the reservoir when said valve means is open but not appreciably restricting flow of fluid in the opposite direction, and means comprising a spring seated disc with a restricted opening therein for restricting flow of fluid through the outlet passage to the interior of the cylinder but not in the opposite direction.

13. In fluid pressure producing apparatus, a fixed member, a cylinder member mounted for limited reciprocable movement, means providing a tubular extension on the fixed member ex-

tending into the end of the cylinder member and forming an outlet passage from the cylinder, a reservoir, cooperating valve means on the fixed member and on the end of the cylinder member for governing the flow of fluid between the reservoir and interior of the cylinder member and being controlled by the reciprocable movement of the cylinder member, a reciprocable piston in the cylinder member capable of causing said cylinder member to have limited reciprocable movement therewith to thereby control the valve means, means forming a seat on the tubular extension, a disc cooperating with the seat and of such size in relation to the portion of the cylinder member surrounding it as to restrict the flow of fluid from the cylinder to the reservoir when the valve means is open, a light spring for biasing the disc on the seat, and means comprising an impeller element operatively connected to the disc and associated with the outlet passage whereby when acted upon by return flow of fluid through the passage to the interior of the cylinder it will cause the disc to be unseated and allow fluid to flow freely from the reservoir to the interior of the cylinder, said impeller element being so constructed and associated with the outlet passage as to restrict the return flow of fluid through the outlet passage to the interior of the cylinder when the disc is unseated but not in the opposite direction.

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