Dec. 11, 1951 R. M. STEPHENSON ET AL 2,578,102

ANTISURGE MECHANISM FOR FLUID SPRAY APPARATUS

Filed Aug. 4, 1949 2 SHEETS--SHEET 1

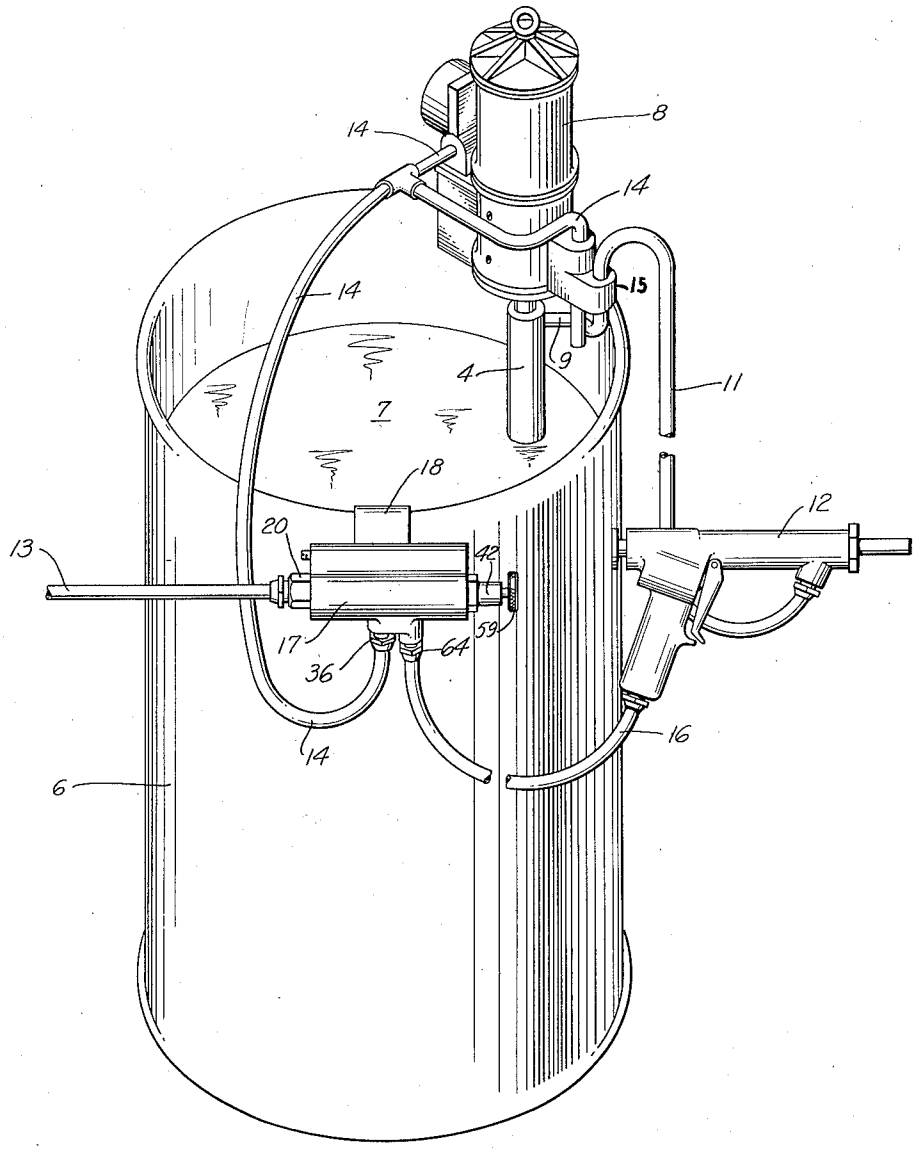



FIG. 1

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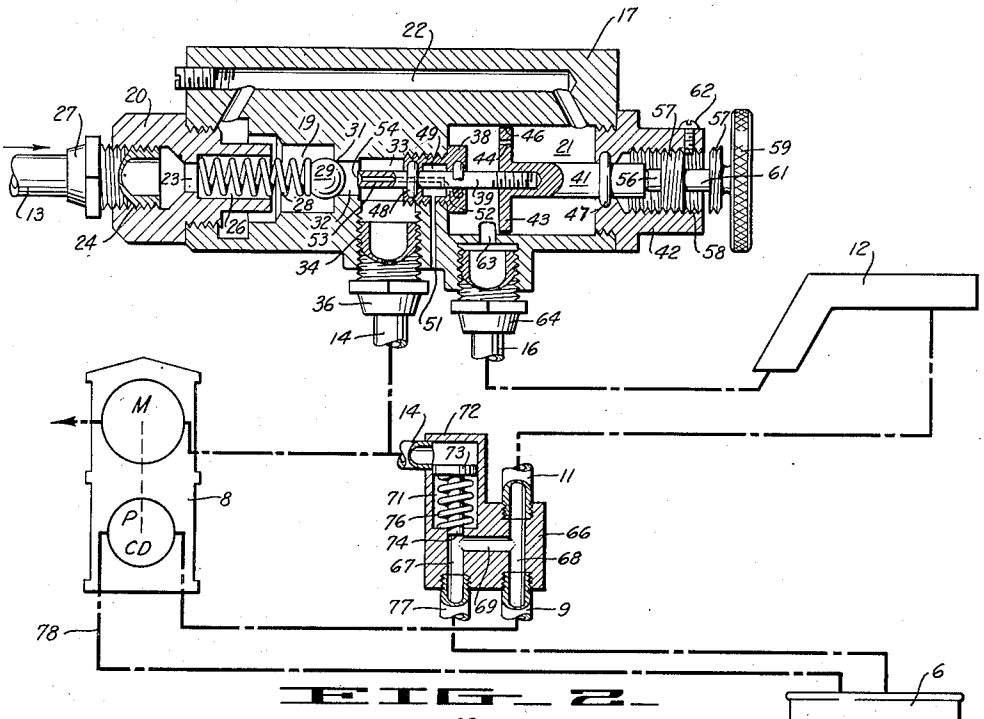



FIG. 2

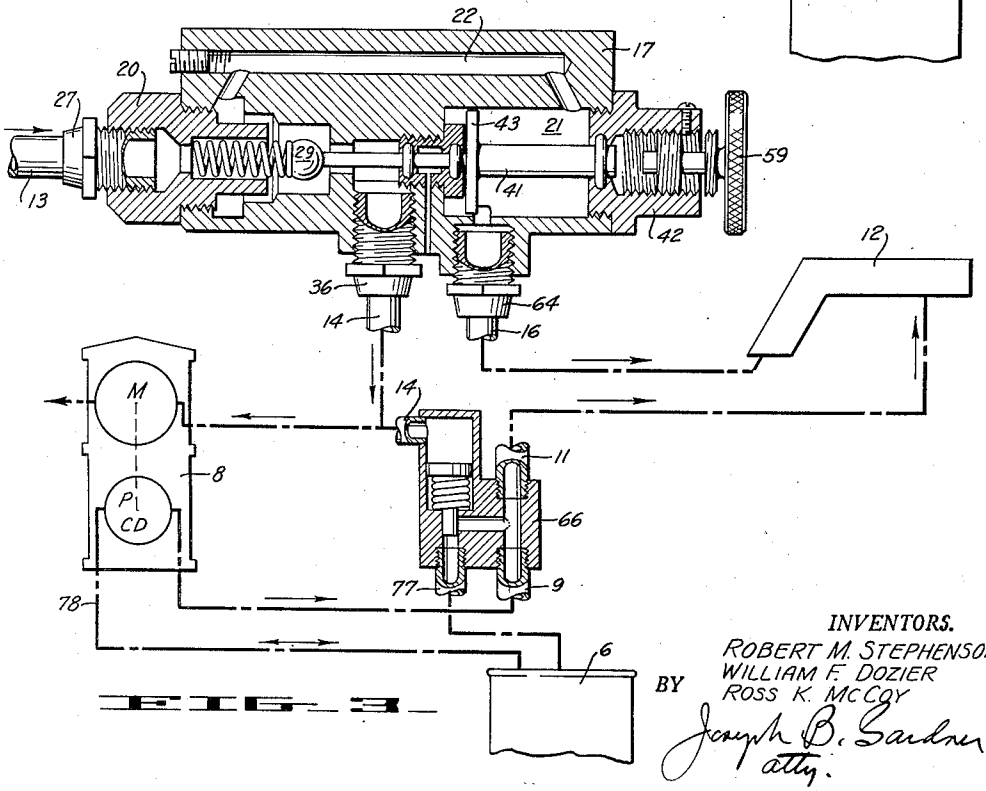



FIG. 3

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2,578,102

## ANTISURGE MECHANISM FOR FLUID SPRAY APPARATUS

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Application August 4, 1949, Serial No. 108,592

8 Claims. (Cl. 299—58)

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This invention relates to pressure operated apparatus for controlling the flow of fluids.

An object of the invention is to provide, in apparatus wherein flowable material is supplied under pressure to an intermittently operable spray projection device, means associated with the apparatus for maintaining substantially constant pressure of the material at the spray projection device so that, upon operation of the latter after a rest period, undesirable spurts of material in abnormally increased volume and at excessive velocity will not occur prior to subsequent self-adjustment of the apparatus to produce the prescribed normal spray pressure and rate of discharge.

Another object of the invention is to provide, in apparatus of the character described and including a force pump for effecting pressure conveyance of material from a supply container, through a supply conduit to a remote spray projector, means operative upon stoppage of the force pump for instantly relieving the fluid pressure in the supply by bleeding off of a portion of the contents of the latter.

A further object of the invention is to provide, in apparatus of the nature of the nature referred to, means for facilitating intermixing or blending of materials prior to instituting spraying operations and for effecting ready cleaning of the force pump and its associated fluid supply conduits subsequent to completion of periods of use of the spray projector.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of the specification. It is to be understood, however, that variations in the showing made by the said drawings and description may be adopted within the scope of the invention as set forth in the claims.

Referring to the drawings:

Figure 1 is a perspective view of a complete apparatus for spraying fluent materials showing the improved anti-surge mechanism of my invention embodied therein.

Figure 2 is a view, for the most part diagrammatic in character and showing the anti-surge and bypass valve units in vertical section, illustrating the operative relationship of the units to the entire spray apparatus prior to institution of a spraying operation.

Figure 3 is a view similar to Figure 2 showing

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the operative relationship of the parts during a spraying operation.

In the art of spray coating, particularly in those systems wherein fluent material to be sprayed is forced by a pump through long, flexible hoses from a supply source, usually a tank or other container, to a spray gun or equivalent applicator, it has been an inherent disadvantage in existing apparatus that upon resumption of spraying operations after a pause, an abnormally heavy spurt of coating material issues from the gun immediately upon depression of the trigger of the latter with the result that a localized area of the object being sprayed would receive an excessively thick and prominently noticeable overcoating. The governing factor responsible for this condition is that the force pump in not being stopped immediately upon interruption of the spraying operation builds up considerable pressure in the material supply hose to the gun with the result that the hose is stressed radially to a considerable degree. Upon resumption of spraying operations, the normal operation of the gun is upset to the extent that the first coating material to be projected by the gun will not flow at a prescribed rate as the result of the injector action of the compressed air released through the gun but rather will spurt out of the gun in greatly excessive volume under the impetus of the pressure generated by the radially contracting material supply hose. On a wide expanse of wall surface, for instance, overcoated localized areas caused by such spurting of material from the gun are quite noticeable and greatly detract from the neat and eye-pleasing appearance of the finished work.

We have provided attachment mechanism capable of ready inclusion in spray or other pressure feed systems, by means of which the aforesaid highly undesirable spurting of coating material from the applicator gun is eliminated resulting in the production of work of uniform quality and greatly extending the useful life of supply hoses by reason of the removal therefrom of abnormally high internal pressures in the coating material contained therein. Figure 1 shows a conventional pressure spray system, of the type with which the improved mechanism of our invention is adapted to be associated, including a force pump 4 capable of immersion in a container 6 of the fluid material 7 to be sprayed and actuated by suitable means, usually by a double acting reciprocating motor 8 powered by air under pressure from an adjacent portable compressor or derived from any other convenient source. In conven-

tional practice the output duct 9 of the pump is connected directly to the elongated material supply hose 11 connected to the manually handled spray gun 12 and the compressed air supply line 13 leads, respectively, to the air motor 8 through a feeder line 14 and suitable check valve 15 to the spray gun and through a feeder conduit 16 to effect atomization of the fluid coating material 7 as the latter flows through the gun 12. The pump unit is conveniently supported by a hanger bracket, not shown, on the rim of the container 6, the latter usually consisting of an open top metal drum of conventional design.

Disposed in the compressed air distributing system interconnecting the air source and the pump motor and spray gun, is an automatic control valve including a housing 17 fitted, as shown in Figure 1, with a hook-shaped bracket 18 providing convenient attachment of the housing to the container. Extending into the housing from one end thereof is an air receiving chamber 19 and preferably axially aligned with the latter at the opposite end of the housing is a cylinder recess 21, a duct 22 drilled in the housing being provided to directly interconnect the chamber 19 and the cylinder 21. A plug member 20 threadedly engaged in the housing and closing the outer end of the recess 19, is provided with an axial bore 23 and with opposed counterbores 24 and 26 the former of which is threaded to receive a coupling unit 27 connected to the air line 13 leading to the compressor or other compressed air source while the latter encloses a coil spring 28. The spring 28 engages at one end, a suitable valve here shown as a ball 29 and holding the latter engaged with a valve seat 31 formed at the junction with the bottom of the recess 19 of an axially continuing bore 32 opening into a chamber 33 comprising a continuation of the bore 32. A branch passage 34, drilled into the housing 17 and radially intersecting the chamber 33, is fitted with a threaded coupling unit 36 to which the conduit 14 is attached. Threadedly engaged in the chamber 33 is a plug member 38 axially bored to receive a slidable plunger 39, one end of the latter extending into the chamber 33 and terminating adjacent the seated ball valve 29 and the other end thereof being engaged, preferably threadedly as shown, with an axially aligned stem 41 concentrically disposed in the cylinder 21 and slidably engaged in a plug member 42 which threadedly engages the housing and closes the outer end of the cylinder. The stem 41 also carries a piston 43 which divides the cylinder 21 into a pair of sections each of which is in communication with the other through a bleeder passage 44, drilled axially through the piston, and also through a narrow gap 46 provided between relatively confronting peripheries of the piston and the cylinder 21. A preferably toroidal sealing ring 47 embracing the stem 41 and confined in a suitable groove provided in the plug member 42 and bounding the stem, serves to seal the stem against leakage therepast of fluid from the cylinder 21, and similar sealing rings 48 provided in the plug member 38 and embracing the plunger 39 prevent fluid leakage from the cylinder 21 into the chamber 33. The sealing rings 48 also serve to render fluid-tight a chamber 49 formed in the plug member 38 and coaxial with the plunger 39, the latter chamber being vented to the atmosphere through a radially extending duct 51 and being also in communication, through a radial passage 52, with an axially extending duct 53 formed in the plunger and terminating, at the end of the latter facing the ball valve 29, in a conically recessed valve seat 54. Axial movement of the connected unit comprising the plunger 39, the piston 43 and the stem 41 is controlled, in one direction, by a stop element 56 engageable with an end of the stem and having threaded portions 57 engaged in a correspondingly threaded recess 58 provided in the plug member 42, a handwheel 59 being associated with the stop element for axially advancing or retracting the latter so as to govern the degree of movement of the aforesaid unit in one direction. A circumferentially extending groove 61 formed in the stop element between the threaded portions 57 thereof receives the inner end of a stop screw 62 threaded radially into the plug member 42 and entering the groove. An outlet port 63 provided in the housing 17 intermediate the ends of the cylinder 21 is in communication, through a coupling unit 64 threadedly engaged in the housing, with the conduit 16. In the normal inoperative condition of the mechanism described, the stop element 56 is fully retracted so as to stop the piston 43 in a position medially of the length of the cylinder 21 and relatively retracted from the end thereof adjacent the chamber 33, the plunger 39 being then also retracted so that its end is drawn away from the ball valve 29 which cooperates with and is capable of engaging the valve seat 54 provided at the end of the plunger. The outlet port 63, it will be noted, is arranged to lie in the cylinder section closest to the chamber 33 when the piston 43 is in its retracted position, all of which is shown in Figure 2.

We provide, preferably as a separate unit and arranged in any manner to overlie the coating material container 6, a selector valve unit comprising a housing 66 in which is bored a pair of relatively parallel passages 67 and 68 interconnected by a cross passage 69. The passage 67 is extended at one end into a diametrically enlarged counterbore forming a cylinder 71 closed at its upper end by a wall member 72 of the housing or by a suitable plug, and containing a slidable piston 73 fitted with a valving plunger 74 snugly slidable in the passage 67 and arranged during such sliding movement to traverse and close the junction of the cross passage 69 with the passage 67. A branch of the conduit 14 enters the upper end of the cylinder 71 and a spring 76 interposed between the lower end of the cylinder and the relatively confronting underside of the piston 73 serves to normally urge the latter toward the upper end of the cylinder and thus retain in open condition the bleeder valve consisting of the plunger 74 and the aforesaid junction end of the cross-passage 69 with the passage 67. The lower end of the passage 67 is connected with an open-ended conduit 77 arranged to discharge into the coating material container 6 while the opposite ends of the passage 68 are connected with the duct 9 and with the material supply conduit or hose 11 which conveys the coating material from the pump 4 to the spray gun or applicator 12. Although the pumps usually employed in such systems are of the type capable of immersion in the coating material, the views of the drawing are provided with indicated conduits 78 to show conveyance of material from the container to the pump.

Under operating conditions and prior to institution of spraying, air under pressure from the supply line 13 will occupy the chamber 19 and also the cylinder 21 by virtue of the interconnecting duct 22. However, due to the fact that the trigger actuated air valve of the spray gun re-

mains closed, balanced pressure will exist in the cylinder 21 on opposite faces of the piston 43. In addition, due to the reason that the piston 43, on the face thereof closer to the chamber 33, has a slightly greater surface area exposed to the air pressure than the opposite side of the piston, the latter will be forcibly urged to move away from the end of the cylinder adjacent the chamber 33 until the end of the stem engages and is stopped by the stop element 56. Thus the compressed air is held from escape by the closed ball valve 29 and the previously mentioned trigger air valve of the spray gun. Furthermore, the plunger 39 being held in retracted position effects venting of the upper portion of the cylinder 71 of the automatic bleeder valve, the spring 76 being free to expand axially so as to raise the piston 73 and its associated valving plunger 74 and in so doing forcing any excess air above the piston 73 through the conduit 14 into the chamber 33 to thereafter flow through the ducts 53, 52 and 51 to the atmosphere. Also, since the ball valve 29 is closed, the supply of compressed air to the force pump motor 8 will be shut off.

As soon as the operator depresses the trigger or other control element operating the air valve of the spray gun, the air pressure in the cylinder 21 on the plunger side of the piston 43 will drop considerably and since the released air in the duct 22 cannot flow through the bleeder opening 44 and peripheral gap 46 fast enough to supply the needs of the spray gun, the piston 43 will be forcibly moved toward the plunger end of the cylinder until the port 63 is uncovered sufficiently to permit the incoming air to flow therethrough into the spray gun air line 16. As a direct result of such movement of the piston toward the plunger end of the cylinder the plunger will move to engage the ball valve 29, thereby closing the valve seat 54 and closing the atmospheric vent, and continuing to force the ball valve from its seat so as to admit compressed air from the chamber 19 into the chamber 33 and thence into the conduit 14 thus starting the pump motor 8 and simultaneously admitting air to the upper end of the cylinder 71 thereby depressing the piston 73 and its plunger 74 and closing the cross passage 69. Upon such starting of the pump motor 8 the pump 4 will deliver coating material from the container 6 into the conduit 9, which material will then flow through the valve passage 68 and the supply hose 11 to the spray gun. Such operating conditions will then obtain as long as spraying is continued. Upon release of the trigger to close the spray gun air valve, flow of air through the cylinder 21 and its discharge port 63 will be immediately stopped thus allowing the compressed spring 28 to force the ball valve 29 to seat so as to cut off air flow to the conduit 14 and its branches and, among other things, stopping the pump motor 8, effecting closing of the check valve 15 and halting supply of material to the gun.

As soon as the valve 29 closes the equalizing air pressure on the faces of the piston 43 will cause the latter to continue movement toward the stem end of the cylinder 21 thus withdrawing the plunger 39 from the ball valve 29 and opening the valve port 52 so as to vent the cylinder 71 as previously explained and thereby withdraw the plunger 74 from across the end of the cross duct 69. This vents the spray material line 11 and any excess pressure which may be present therein, after stoppage of the pump 4 will be relieved, the surplus material creating such pressure being capable of flowing from the line 11 through the cross duct 69 into the passage 67 from whence the material may flow out of the open lower end of the latter passage and be discharged into the supply container 6. Thus at no time after interruption of spraying operations is a pressure above atmospheric allowed to remain in the spray material lines. When the spray gun trigger is again depressed, the above described cycle of operations will repeat itself and the pressure of the coating material will gradually build up as the pump again starts, resulting in a uniformly smooth discharge from the spray gun nozzle rather than in a sudden spurt which would occur if material under pressure was allowed to remain in the supply conduit 11 during shut-off periods of the gun.



The mechanism above described provides for clearing and cleaning of the coating material supply lines, after completion of spraying operations, in a much easier manner than is possible in conventional pressure spray systems. Since, in most instances, the spray gun is being used at a much higher elevation than the supply pump and container the mere act of uncoupling the material supply line 11 from the gun will permit material contained in the line to drain downwardly into the receptacle 6 through the cross passage 69 and the line 77 since the plunger valve 74 remains open during inactive periods of the gun. Also, after draining of the supply line 11, the bleeder valve unit 66 together with the pump may be transferred to a container of solvent or other cleansing material, the detached end of the supply conduit 11 may be immersed in the latter container and the control knob 59 may be rotated so as to advance the stop element 56 and the unit comprising the plunger 39, the piston 43 and the stem 41 toward the plunger end of the cylinder 21 thus causing the plunger to engage and open the ball valve 29. This causes air to flow to the pump motor so that actuation of the pump 4 follows which effects circulation of the solvent or cleansing material through the pump and the various coating material passages and conduits. Using the immediately above-described arrangement wherein the detached end of the material supply line 11 is immersed in the same container from which the pump is drawing coating material, it will be seen that operations such as mixing of the contents of the container or blending therewith of added coloring matter or other ingredients may be satisfactorily and rapidly accomplished, the pump being allowed to run in order to thoroughly mix such contents until the desired condition or consistency of the latter is attained.

We claim:

1. In a distribution apparatus for fluids, a first source of fluid under pressure, a second source of fluid, a utilization device for at least one of said fluids, means including a duct for effecting transfer of fluid from said first source to said utilization device, means for effecting transfer of fluid from said second source to said utilization device through a supply conduit interconnecting said second source and said utilization device, means in said supply conduit for selectively venting fluid therefrom and for retaining fluid therein, means operatively connected with and governing operations of said fluid venting and retaining means so as to selectively vent said conduit and retain fluid therein, and said gov-

erning means being operative in response to movements of fluid through said duct.

2. In a distribution apparatus for fluids, a first source of fluid under pressure, a second source of fluid, a utilization device for at least one of said fluids, means including a duct for effecting transfer of fluid from said first source to said utilization device, a supply conduit interconnecting said second source and said utilization device, means actuated by flow of fluid in said duct under pressure for effecting transfer of fluid from said second source to said utilization device through said supply conduit, means in said supply conduit for selectively venting fluid therefrom and for retaining fluid therein, means operatively connected with and governing operations of said fluid venting and retaining means for effecting said selective venting and retaining, and said governing means being operative in response to movements of fluid between said first source and said utilization means.

3. In a distribution apparatus for fluids, a first source of fluid under pressure, a second source of fluid, a utilization device for said fluids, means including a duct for conveying fluid under pressure from said first source to said utilization device, means for effecting transfer of fluid from said second source to said utilization device through a supply conduit interconnecting the second source and the utilization device, means operative in said supply conduit for selectively venting fluid therefrom and for retaining fluid therein, means operatively connected with and governing operations of said fluid venting and retaining means, and means connected with and operable in said duct and associated with said fluid venting and retaining means for actuating the latter means to retain fluid in said conduit upon movement of fluid under pressure through said duct and for further actuating the latter means to vent said conduit upon cessation of movement of said fluid under pressure in said duct.

4. In a distribution apparatus for fluids, a first source of fluid under pressure, a second source of fluid, a utilization device for said fluids, means including a duct for conveying fluid under pressure from said first source to said utilization device, means for effecting transfer of fluid from said second source to said utilization device through a supply conduit interconnecting the second source and the utilization device, means including a valve in said supply conduit capable of being opened to vent fluid therefrom and capable of being closed to retain fluid therein, control mechanism in said duct operatively connected with said valve and including valving means for controlling openings and closings of said valve, and an element in said duct and operatively associated with said control mechanism movable in response to movements of fluid under pressure in said duct for actuating said valving means.

5. In a distribution apparatus for fluids, a first source of fluid under pressure, a second source of fluid, a utilization device for said fluids, means including a duct for conveying fluid under pressure from said first source to said utilization device, means for effecting transfer of fluid from said second source to said utilization device through a supply conduit interconnecting the second source and the utilization device, means including a valve in said supply conduit capable of being opened to vent fluid therefrom and capable of being closed to retain fluid therein, control mechanism in said duct operatively connected with said valve and including valving means for controlling openings and closings of said valve, an element in said control mechanism movable in response to movements of fluid under pressure in said duct for actuating said valving means, and manually controlled means carried by said control mechanism engaged with and for moving said element.

6. In a distribution apparatus for fluid, a first source of fluid under pressure, a second source of fluid, a utilization device for said fluids, means including a duct for conveying fluid under pressure from said first source to said utilization device, means for effecting transfer of fluid from said second source to said utilization device through a supply conduit interconnecting the second source and the utilization device, means including a reciprocable valve in said supply conduit provided with a displaceable actuating element and capable, upon displacement of said element, of being opened to vent fluid from the supply conduit and of being closed to retain fluid in the said conduit, control mechanism in said duct including a control conduit for conveying fluid under pressure from the duct to said actuating element and further including valving means in and for controlling flow of fluid under pressure in the control conduit and to said actuating element, and an element in said control mechanism movable in response to movements of fluid under pressure in said duct for engaging and actuating said valving means.

7. In a distribution apparatus for fluid, a first source of fluid under pressure, a second source of fluid, a utilization device for said fluids, means including a duct for conveying fluid under pressure from said first source to said utilization device, means for effecting transfer of fluid from said second source to said utilization device through a supply conduit interconnecting the second source and the utilization device, means including a reciprocable valve in said supply conduit provided with a displaceable actuating element and capable, upon displacement of said element, of being opened to vent fluid from the supply conduit and of being closed to retain fluid in the said conduit, control mechanism in said duct including a control conduit for conveying fluid under pressure from the duct to said actuating element and further including valving means in and for controlling flow of fluid under pressure in the control conduit and to said actuating element, and a reciprocable piston exposed to fluid under pressure in said control mechanism and movable in response to movements of said latter fluid in the duct, said piston having incorporated therewith a venting valve capable of being opened and closed upon movements of the piston to successively vent said control conduit to the atmosphere, and said piston in a movement thereof engaging and actuating said valving means.

8. In a distribution apparatus for fluid, a first source of fluid under pressure, a second source of fluid, a utilization device for said fluids, means including a duct for conveying fluid under pressure from said first source to said utilization device, means for effecting transfer of fluid from said second source to said utilization device through a supply conduit interconnecting the second source and the utilization device, means including a reciprocable valve in said supply conduit provided with a displaceable actuating element and capable, upon displacement of said

element, of being opened to vent fluid from the supply conduit and of being closed to retain fluid in the said conduit, control mechanism in said duct including a control conduit for conveying fluid under pressure from the duct to said actuating element and further including valving means in and for controlling flow of fluid under pressure in the control conduit and to said actuating element, an element in said control mechanism movable in response to movements of fluid under pressure in said duct for engaging and actuating said valving means, and manually operable means carried by said control mechanism and engageable with said valving means for actuating the latter.



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