Aug. 31, 1954 A. SHELBURNE ET AL 2,687,739

CONTROL MECHANISM FOR SPRAYING APPARATUS

Filed Oct. 5, 1950

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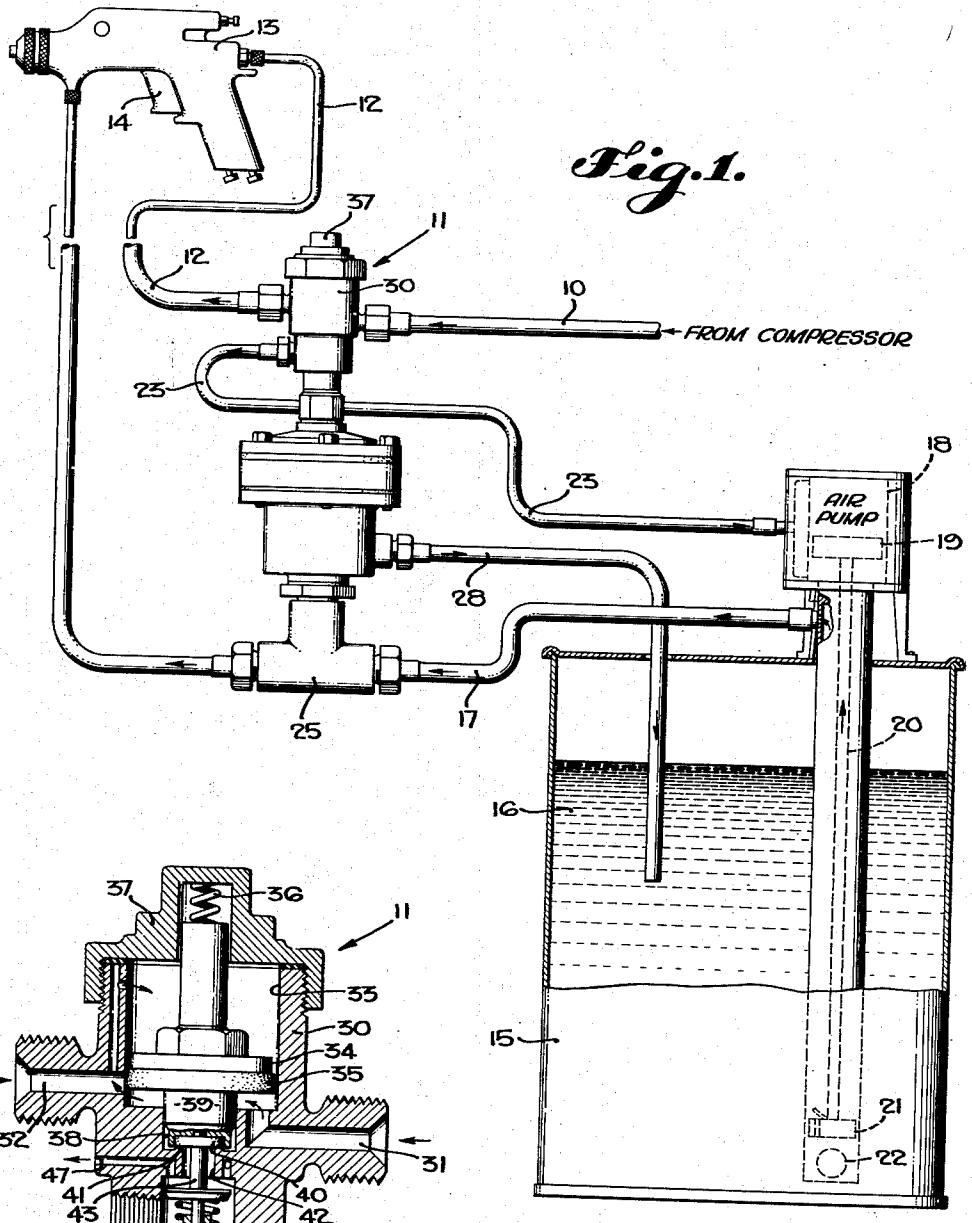


Fig. 1.

Fig. 4.

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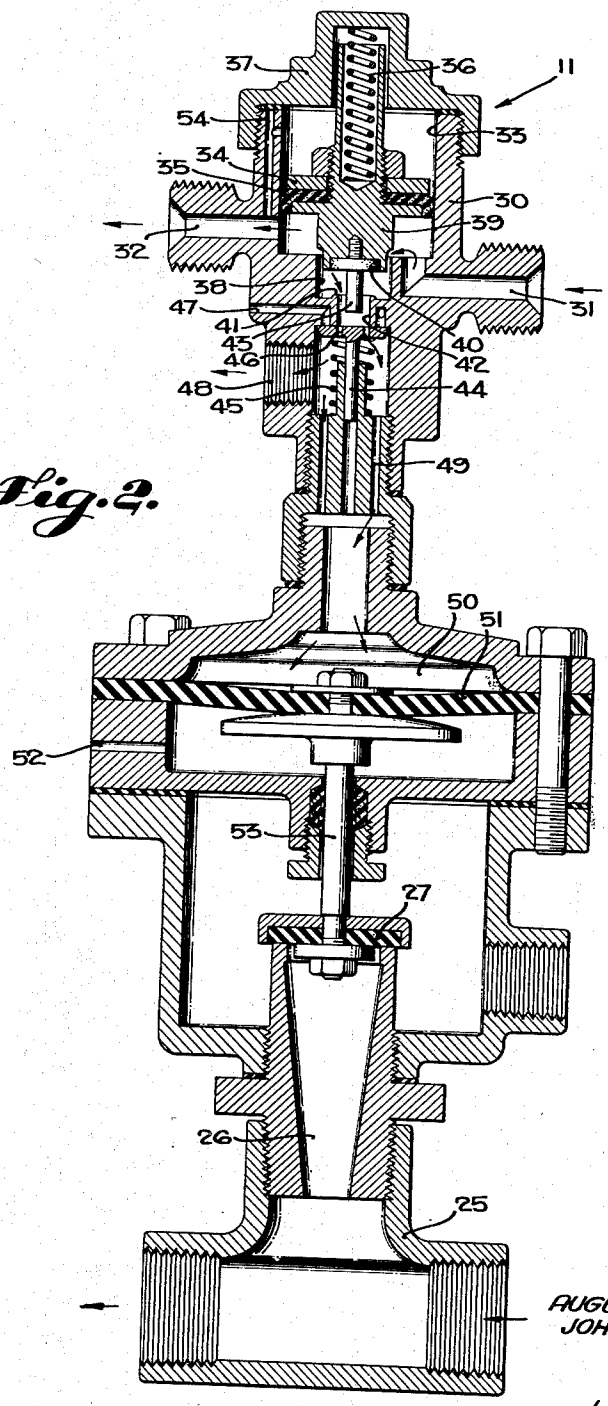


Fig. 2.

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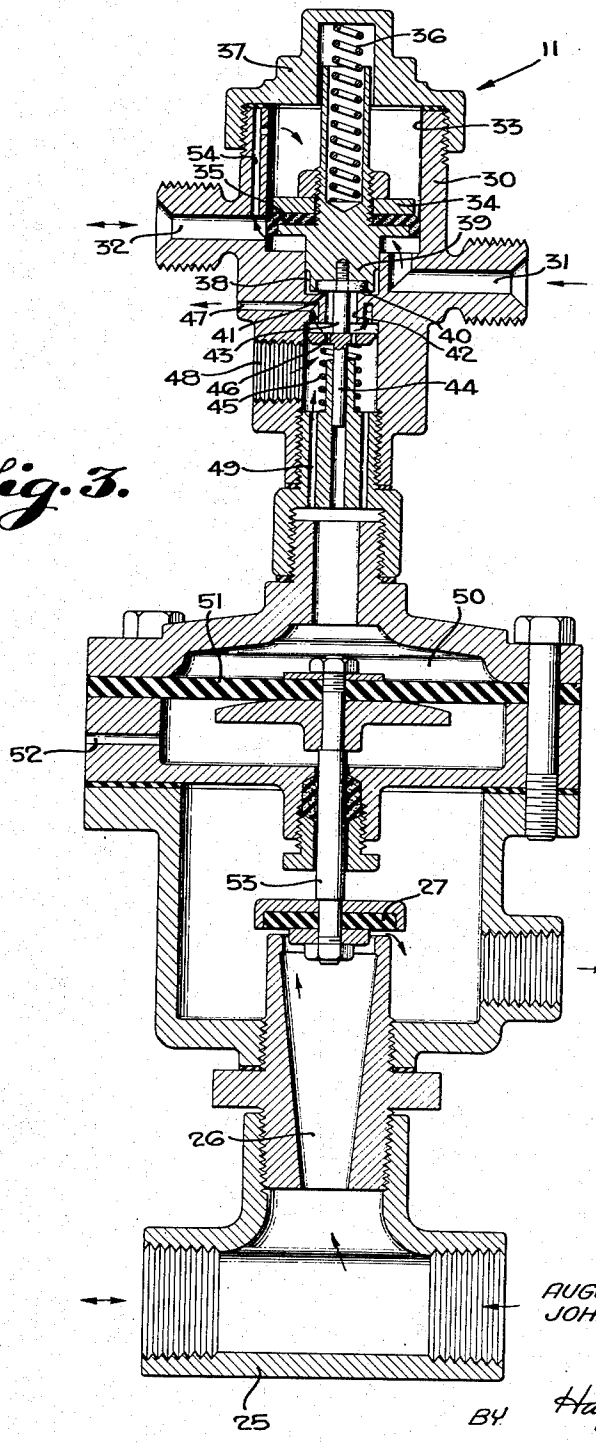


Fig. 3.

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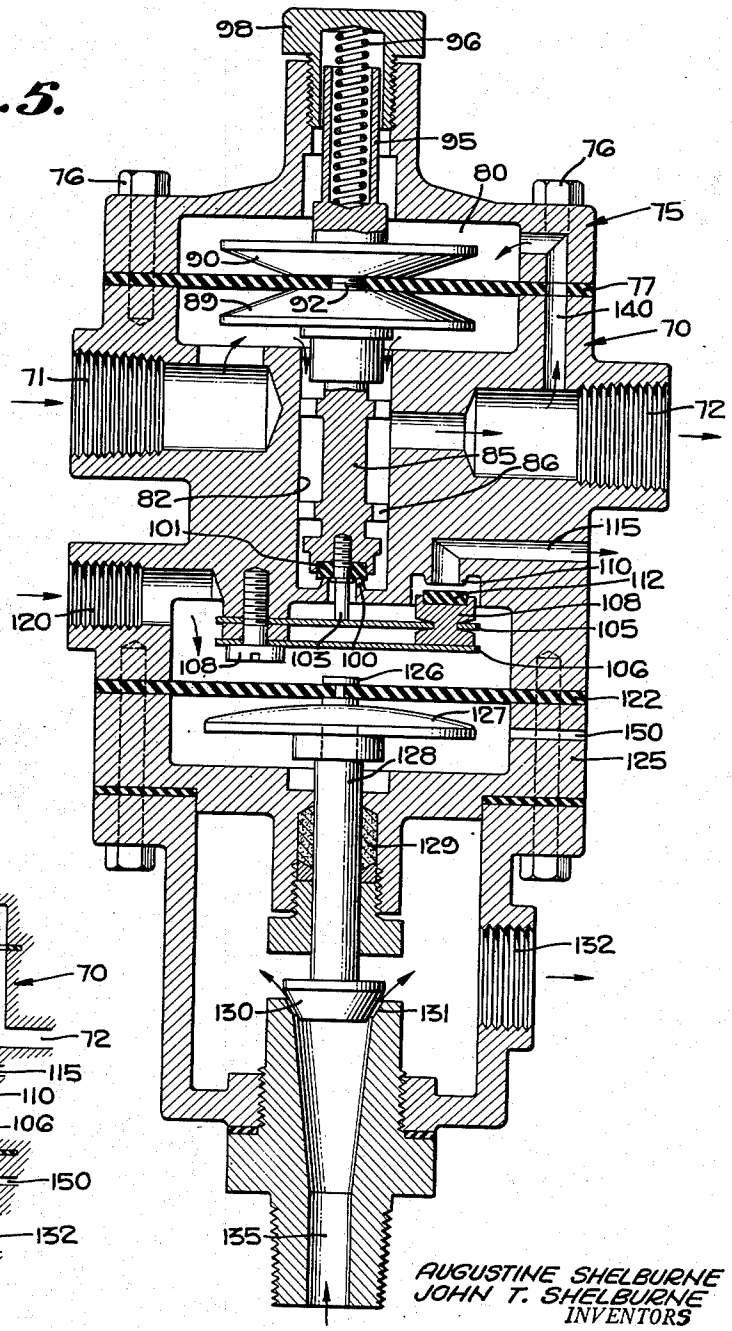
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CONTROL MECHANISM FOR SPRAYING APPARATUS

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Fig. 5.



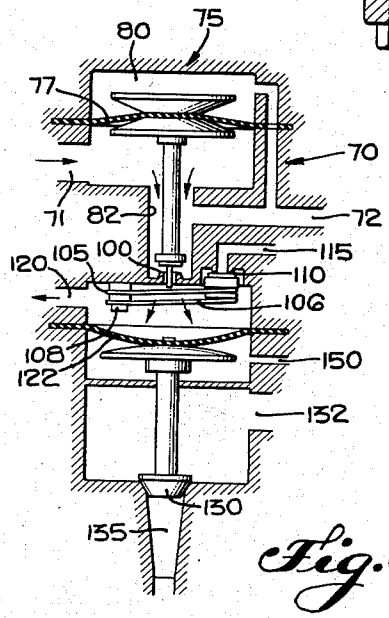


Fig. 6.

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CONTROL MECHANISM FOR SPRAYING APPARATUS

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Application October 5, 1950, Serial No. 188,556

4 Claims. (Cl. 137—87)

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This invention relates to a valve or to a device adapted to be inserted in a fluid conducting conduit and which when the conduit is closed will be effective to actuate auxiliary apparatus. A valve of this character can be employed under a wide variety of different circumstances including spraying apparatus for spraying liquid and like coatings.

This application is a continuation-in-part of our previous application entitled "Control Mechanism for Spraying Apparatus," Serial No. 81,192, filed March 12, 1949, and incorporates all of the subject matter of said application. Said prior application Serial No. 81,192 is now abandoned.

In the usual apparatus for spraying liquid coatings a supply of compressed air is delivered through a conduit or hose to the air outlet of a spray gun. The liquid coating material is pumped from a reservoir or container through another conduit to the liquid outlet from the spray gun. The pump in the reservoir that pumps the liquid therefrom to the spray gun is operated by compressed air from the air source that supplies the spray gun. When the spray gun is shut off it is desirable to have the mere closing of the air valve at the spray gun become effective to shut off the supply of compressed air to the air pump. It is also desirable to relieve the pressure that may be in the air pump and to also open the liquid conducting conduit that conducts the liquid to the spray gun so as to relieve the pressure therein. If the pressure in the liquid conducting conduit is allowed to remain when the spray gun is shut off the subsequent opening of the valves in the spray gun will cause a surge of liquid to take place through the gun and a solid stream of liquid is frequently discharged before there is an opportunity for the released air to convert it into a spray. Relieving the pressure in the liquid conducting conduit and allowing the escaping liquid to drain back to the reservoir is therefore desirable and can be readily accomplished by use of the improved valve.

It is therefore an object of the present invention to provide an improved spraying apparatus or similar apparatus and particularly to provide a valve used therein which is so designed that when the trigger of the spray gun is released this operation is automatically effective to cause the valve to operate and thus perform operations such as turning off the air supply to the air pump, releasing the air pressure in the air pump and opening the liquid conduit to the spray gun to relieve the pressure therein. These operations can be performed even though the spray gun

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is remotely located with relation to the valve, the reservoir, or the air pump.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1 is a diagrammatical view of a spraying apparatus embodying the present invention;

Fig. 2 is a vertical section through the valve used therein illustrating the valve in its normal position wherein compressed air and liquid coating material are being supplied to the spray gun;

Fig. 3 is a view similar to Fig. 2 but illustrating the valve in that position which it assumes when the supply of compressed air is turned off at the spray gun;

Fig. 4 is a sectional view through a modified or alternative form of construction;

Fig. 5 is a sectional view through another modified form or alternative form of construction; and

Fig. 6 is a schematic view of th device in Fig. 5 showing the parts in that position which the parts will assume when the supply of compressed air is turned on at the spray gun.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, 10 indicates a conduit such as a hose leading from a source of compressed air such as, for example, an air compressor. This conduit is connected to a valve mechanism generally indicated at 11 from which a compressed air conduit 12 leads to a spray gun 13 the valves of which are controlled by a trigger 14. 15 indicates a container or reservoir adapted to contain a liquid 16 which is to be sprayed by the spray gun 13. This liquid is pumped from the reservoir into a liquid conduit 17 by means of an air pump. The air pump employed may conform to any conventional type of pump used for this purpose but is illustrated as having a cylinder 18 within which is recirocable a piston 19. The piston 19 reciprocates a sucker rod 20 connected to a pump piston 21 that is reciprocable over a standing valve 22. A valve mechanism (not shown) controls the supply of compressed air to the opposite ends of the cylinder 18 from a conduit 23 so that when compressed air is supplied to the pump through conduit 23 from the valve mechanism at 11 the pistons 19 and 21 will be vertically reciprocated to pump the liquid 16 from the reservoir 15 into the liquid conduit 17.

This liquid is conducted by the conduit 17 to the spray gun 13. The conduit 17 has a T 25 incorporated therein the lateral outlet of which has an upwardly divergent throat 26 terminating in a valve seat on which a pressure relief valve 27 is adapted to seat. When this valve is in unseated or open position, pressure in the liquid conduit 17 will be relieved and excess liquid can drain therefrom back into the reservoir 15 through a drain conduit 28.

The valve mechanism 11 which forms an important part of the present invention consists of a body 30 having an inlet 31 to which the compressed air conduit 10 is connected. The primary outlet from this body is indicated at 32 and is connected to the conduit 12 which leads to the spray gun 13. The body provides a cylinder 33 within which there is reciprocable a piston 34 equipped with a cup leather or equivalent sealing means indicated at 35. This piston is normally urged downwardly by means of a compression spring 36 that is compressed between the top of the piston and a cap 37 screwed onto the body. In the bottom of the cylinder 33 there is a recess or well 38 into which a cylindrical extension or valve closure 39 on the bottom of the piston is receivable. This valve closure carries a yieldable seating material 40 adapted to engage with a valve seat 41 at the bottom of the well and which surrounds an outlet 42. The piston and cylindrical valve closure carries a tappet 43 engageable with a poppet valve 44 that is slidably mounted in the body 30 and which is urged into its uppermost or seating position by means of a compression spring 45. The head of the poppet valve 44 has one or more apertures 46 formed therein opposite the outlet 42 but outwardly of these apertures the head of the poppet valve is adapted to seat on a seating surface surrounding the outlet and the poppet valve thus controls egress through one or more exhaust ports 47. To this extent the poppet valve 44 may be regarded as an exhaust valve in that it controls the exhaust ports 47. Below the head of the poppet valve 44 a second outlet 48 is formed in the body 30 to which the conduit 23 that leads to the air pump is connected. Below this outlet there may be additional passages 49 which lead to the top of a diaphragm chamber 50. A diaphragm 51 extends across this chamber so that its upper surface is exposed to air pressure that passes downwardly to the diaphragm chamber 50 through the passages 49. The underside of the diaphragm 51 is exposed to atmospheric pressure through one or more breather ports 52. The diaphragm is connected to the relief valve closure 27 such as by a stem 53. A bypass 54 connects the outlet 32 with the top of the cylinder 33.

The operation of the above described apparatus is, briefly, as follows: When the trigger 14 on the spray gun is depressed, opening the valves of the spray gun, pressure in the conduit 12 is reduced. The pressure of the compressed air conducted through the conduit 10 to cylinder 33 is effective against the underside of the piston to lift the piston 34 against the action of the compression spring 36. This is so because there is a pressure drop between the space on the underside of the piston and the entrance to the outlet 32 and also because there is a pressure gradient from the exit of the inlet 31 across the bottom of the piston to the entrance to the outlet 32. It will also be noted that the volume of air above the piston is fixed so that the pressure above the piston will always be substantially that existing in port 32 and when the pressure in port 32 drops there will

be a very immediate drop in pressure above the piston. This action causes the valve mechanism to assume a position as illustrated in Fig. 2 wherein compressed air can readily pass from conduit 10 and through conduit 12 to and through the spray gun. When the piston 34 is in its upper position, as shown in Fig. 2, the cylindrical valve 39 is withdrawn from the well 38 so that the outlet 42 is opened to receive compressed air from the compressed air source. This air passes downwardly through the ports 46 through the outlet 48 and conduit 23 to the air pump causing liquid to be pumped from the reservoir through the liquid conduit 17 to the spray gun. The pressure of the air released through the ports 46 is also effective through the passages 49 to depress the diaphragm 51 causing the pressure relief valve 27 to be firmly maintained on its seat.

When the trigger 14 of the spray gun is released, allowing the valves of the spray gun to close, the closing of the conduit 12 causes pressure to be built up therein. This pressure quickly equalizes with the incoming pressure through conduit 10 and is conducted through the bypass 54 to the top of the cylinder 33. The piston 34 consequently commences to descend from the position shown in Fig. 2 to the position shown in Fig. 3 and upon the entry of the cylindrical valve 39 into the well 38 a portion of the underside of the piston 34 is isolated from the upward effect of incoming pressure thereon. Consequently the pressure in the cylinder 33 on top of the piston coupled with the force exerted by the compression spring 36 forces the piston into its lowermost position wherein the resilient material 40 seats on the seat 41 and the outlet 32 is largely closed by the piston. The closing of the outlet 42 stops all further supply of compressed air to the air pump through outlet 48 and conduit 23 so that the air pump is caused to stop operating. However it is desirable to additionally relieve the cylinder of the air pump of pressure and to this end the tappet 43 unseats the poppet valve 44 thus opening the exhaust ports 47 and consequently releasing pressure to the air pump. The opening of the exhaust ports 47 to atmosphere causes the pressure effective on both sides of the diaphragm 51 to quickly equalize and when this takes place the pressure in the liquid conduit 17 can be relieved in that it then can unseat the pressure relief valve 27. Liquid in the liquid conduit that is thus allowed to escape may drain back into the reservoir 15 through the drain conduit 28.

When operation of the spray gun 13 is subsequently resumed by depressing the trigger 14, pressure in the conduit 12 is relieved and incoming pressure from conduit 10 is effective to return the piston 34 to the position shown in Fig. 2. However, as the pressure in the liquid conduit 17 has been relieved as previously explained, there is no danger of a surge of liquid being discharged from the spray gun at the time of opening the valves of the spray gun by the trigger 14.

In Fig. 4 the construction of the valve is substantially the same as previously described and consequently similar reference characters are applied to corresponding parts. In this construction, however, the bottom of the body 30 of the valve is closed below the outlet 48 by means of a plug 55. Such a construction may be employed whenever it is unnecessary to relieve the pressure in the liquid conduit 17. This type of construction may be employed whenever it is desired to automatically shut off the supply of compressed air through the outlet 48 on closing the valves of

the spray gun which may be remotely located from the balance of the apparatus.

It will be appreciated from the above described construction that the piston 34 and its cylindrical valve 39 are in effect a type of differential valve in that when the valve 39 is open incoming pressure is effective over the entire bottom surface of the piston. However, when the spray gun is closed and the valve 39 has entered the well 38 the incoming pressure is effective on only a portion of the bottom surface of the piston and consequently the back pressure in the conduit 12 conducted through bypass 54 and cooperating with the effect of the spring 36 can force the piston downwardly with positive action.

Figs. 5 and 6 show another modified form of the invention wherein there is a valve body 70 having an inlet 71 and a primary outlet 72. There is a cap member 75 which is adapted to be secured to body 70 by screws 76, said cap member securing the edges of a diaphragm 77 between itself and the valve body 70 as shown in Fig. 5. There is a diaphragm chamber 80 provided by cap member 75 and valve body 70 which diaphragm chamber is divided by diaphragm 77.

Valve 70 provides a central bore 82 which connects the inlet 71 to the outlet 72 at all times. Within bore 82 there is a stem 85 having spaced lugs 86 to guide the stem member, said stem member being connected at its upper end to the lower member 89 of two diaphragm-clamping members 89 and 90 which diaphragm-clamping members are clamped onto the central portion of the diaphragm 77 by a threaded central stud 92 which is threaded into the lower member 89. The upper diaphragm-clamping member 70 has a sleeve 95 extending upwardly therefrom, which sleeve contains a compression spring 96 which is contained at its upper end by a threaded cap 98 which threads into the upper end of cap member 75. Valve body 70 is formed to provide a valve seat 100 which is adapted to be closed by a yieldable valve member 101 which is secured to stem 85 by a tappet 103, said tappet being threaded into the lower end of stem member 85, as shown in Fig. 5.

The tappet 103 extends through the lower end of bore 82 and engages the upper of leaf springs 105 and 106 which are secured by screw 108 into the valve body 70. Leaf springs 105 and 106 are initially formed to urge a poppet valve 108 to seat on a seat 110 formed in body 70. Poppet valve 108 is provided with a yieldable pad 112 which engages the seat 110 to close an outlet port 115. 115 is an exhaust port similar to ports 47 in Fig. 4, and serves to relieve pressure to the air pump. There is an outlet 120 provided by valve body 70, outlet 120 being adapted to be connected to an air pump to supply air thereto when valve 101 is in open position. There is a diaphragm 122 secured between body 70 and a diaphragm chamber-forming member 125, said diaphragm chamber-forming member and the lower portion of valve body 70 providing a chamber for diaphragm 122. Diaphragm 122 is clamped between screw 126 and diaphragm clamping member 127, said latter member having a stem 128 extending therefrom through packing 129 and having a valve 130 on the lower end thereof corresponding to valve 27 in Fig. 3, and adapted to allow liquid to pass by the valve seat 131 and through the liquid drain or outlet 132 which is adapted to be connected to a conduit similar to conduit 28 in Fig. 1, to return liquid to the liquid

container. The inlet port 135 is adapted to be connected to a liquid line.

There is a bypass passageway 140 formed in body 70 and cap member 75 which leads from primary outlet 72 to the back of diaphram 77.

The device shown in Fig. 5 operates similarly to the valves shown in Figs. 2 and 3, and when the valve in the spray gun is closed the pressure on opposite sides of diaphragm 77 is equal and therefore, the valve member 101 engages its seat 100 closing the supply of air to the air pump outlet 120 at the same time opening the poppet valve 108 to relieve any pressure to the air pump. The spring 96 aids valve member 101 in seating on its seat. When the valve in the spray gun is open by depressing the trigger there is a drop in pressure in the primary outlet 72 and a corresponding drop in pressure above the diaphragm 77. There is a drop in pressure between the outlet 72 and the chamber on the underside of diaphragm 77 due to the right angle turns and the normal pressure gradient so that the pressure on the underside of the chamber when the trigger on the spray gun is depressed, is higher than the outlet 72 and since the pressure above the diaphragm 77 is equal to the pressure in the outlet 72 the diaphragm will be bowed upwardly to the position shown in Fig. 6, thereby opening valve 101 and allowing the air under pressure to pass through the outlet 120 to the air pump, thereby pumping liquid. At the same time the poppet valve 108 is closed by the leaf springs 105 and 106 since the tappet 103 has moved upwardly as shown in Fig. 6.

The underside of the lower diaphragm 122 is vented by passageway 150 to the atmosphere so that when poppet valve 108 is closed and air under pressure is admitted to the chamber above lower diaphragm 122, diaphragm 122 will be depressed as shown in Fig. 6, thereby closing valve 130 and thereby closing the communication between the liquid line and the drain.

When the valve on the spray gun is closed the pressures on opposite sides of diaphragm 70 will be equalized so that the spring 96 will be effective to close valve 101 opening poppet valve 108, thereby relieving the pressure in the air pump and communicating the upper portion of lower diaphragm 122 with the atmosphere thereby balancing the pressures on opposite sides of this diaphragm so that it returns to its neutral position opening valve 130 and allowing liquid in the liquid line to return through a return line, such as 28, from liquid outlet 132 to the liquid container.

The spring 96 is stronger than the springs 105 and 106 so that spring 96 is sufficient, when diaphragm 77 is balanced to force the valve 101 closed and open poppet valve 108 against the resistance of springs 105 and 106. However, spring 96 is weak enough so that when the diaphragm 77 is unbalanced by the valve in the spray gun being open so that the pressure in outlet 72 drops that the diaphragm will move upwardly against the resistance of spring 96 opening valve 101.

While the invention has been described in conjunction with a paint spraying apparatus it will be appreciated that it is not necessarily restricted thereto but may be employed wherever the conduits 10 and 12 conduct a fluid of any character. The purpose of the construction is to cause the closing of conduit 12 and the building up of back pressure therein to become effective to perform other operations such as the shutting off of the supply of compresed air to the air pump, the

opening of the exhaust ports 47, and the release of the pressure relief valve 27. Many other functions could also be performed by the descent of the piston 34 in addition to or substitution for the operations or functions herein described.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claims.

We claim:

1. A valve of the class described comprising a valve housing having a compressed air inlet and outlet adapted to be connected to a source of compressed air and to an air conduit of a spray gun respectively, a second outlet leading from the housing adapted to be connected to an air pump, a drain valve and a seat within the housing adapted to be connected to a liquid conduit leading to a spray gun, a diaphragm connected to the drain valve exposed on one side to atmospheric pressure, a pressure-responsive member in the valve housing exposed on one side to pressure in the inlet and exposed on the other side to pressure in the outlet, a valve carried by pressure-responsive member for controlling flow from the inlet to the second outlet simultaneously with flow from inlet to first outlet being controlled by said member, means for conducting pressure from the second outlet to the other side of the diaphragm whereby on closing egress through the first mentioned outlet flow from the inlet to the second outlet will be discontinued and pressure on the diaphragm urging the drain valve to close will be relieved, and an air exhaust assembly for relieving pressure on the diaphragm resulting in air pressures being made equal.

2. A valve of the class described comprising a body having an inlet adapted to be connected to a compressed air source, an outlet from the body adapted to be connected to a spray gun, a second outlet from the body adapted to be connected to an air pump, a bleeder port adjacent the second outlet, a bleeder valve controlling the bleeder port and urged into closing position, a pressure-responsive member in the body exposed on one side to inlet pressure and exposed on the other side to outlet pressure, a valve closure carried by the pressure-responsive member adapted to close flow from the inlet to the second outlet simultaneously with flow from inlet to first outlet being controlled by said member, a tappet carried by said valve closure engageable with the bleeder valve to open the bleeder valve when the first mentioned valve is closed, a diaphragm housing having a diaphragm therein exposed to pressure in the second outlet on one side and exposed to atmospheric pressure on the other, and a drain valve connected to the diaphragm so as to be operable thereby, said diaphragm and drain valve being responsive to pressures applied to the pressure-responsive member.

3. A valve of the class described comprising a housing having an inlet and an outlet, a pressure-responsive member responsive to pressures therein, a valve associated with the pressure-responsive member adapted to open when the pressure in the outlet is less than the pressure in the inlet and to close when the pressure in the outlet equalizes with the pressure in the inlet, a second outlet in the valve housing on the opposite side of the valve from the inlet, said second outlet being opened and closed by said valve simultaneously with the opening and closing of said inlet and first outlet, one or more bleeder ports adjacent the second outlet, and a bleeder valve controlling the bleeder ports operable by the first mentioned valve to close the bleeder ports when the second outlet is open to the inlet and to open the bleeder ports when the second outlet is closed to the inlet.

4. A valve of the class described comprising a housing having an inlet and an outlet, a pressure-responsive member responsive to pressures therein, a valve associated with the pressure-responsive member adapted to open when the pressure in the outlet is less than the pressure in the inlet and to close when the pressure in the outlet equalizes with the pressure in the inlet, a second outlet in the valve housing on the opposite side of the valve from the inlet, said second outlet being opened and closed by said valve simultaneously with the opening and closing of said inlet and first outlet, one or more bleeder ports adjacent the second outlet, a bleeder valve controlling the bleeder ports operable by the first mentioned valve to close the bleeder ports when the second outlet is open to the inlet and to open the bleeder ports when the second outlet is closed to the inlet, and a diaphragm housing having a diaphragm therein exposed to pressure in the second outlet on one side and to atmospheric pressure on the other and a drain valve connected to the diaphragm arranged to close when pressure is in the second outlet and to be opened when the second outlet is closed to the inlet.

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