United States Patent

[11] 3,589,610

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[73] Assignee **Spraying Systems Co.**

[54] **VARIABLE FLOW RATE SPRAY GUN WITH PRESSURE RELIEF**
9 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **239/125,** 239/583
[51] **Int. Cl.** **B05b 9/00**
[50] **Field of Search** 239/124, 125, 126, 127, 526, 527, 528, 583, 412

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ABSTRACT: A variable pressure spray gun with an unloader valve built into the gun so that when the spray pressure is turned off fluid circulated to the gun is returned to the fluid system. Movable valves in the gun selectively direct all of the fluid developed in the pressure system through the outlet of the gun or through a bypass return line to the system and are arranged to selectively vary the pressure of the fluid delivered by diverting selected amounts of the pressurized fluid to the return line. The gun is arranged with counterbalancing fluid forces aiding a gun closing spring and with stop means for selectively limiting pressures delivered by the gun.

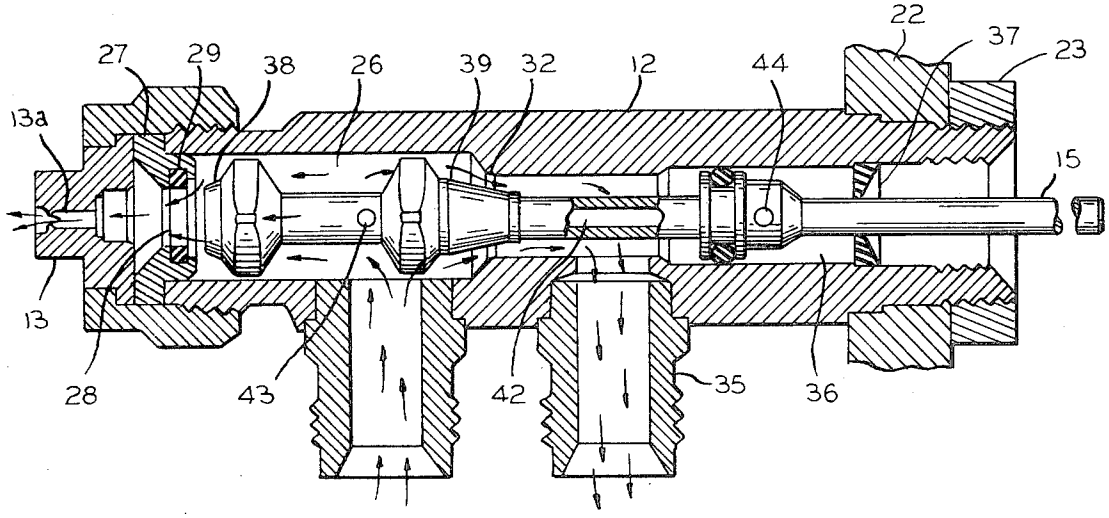
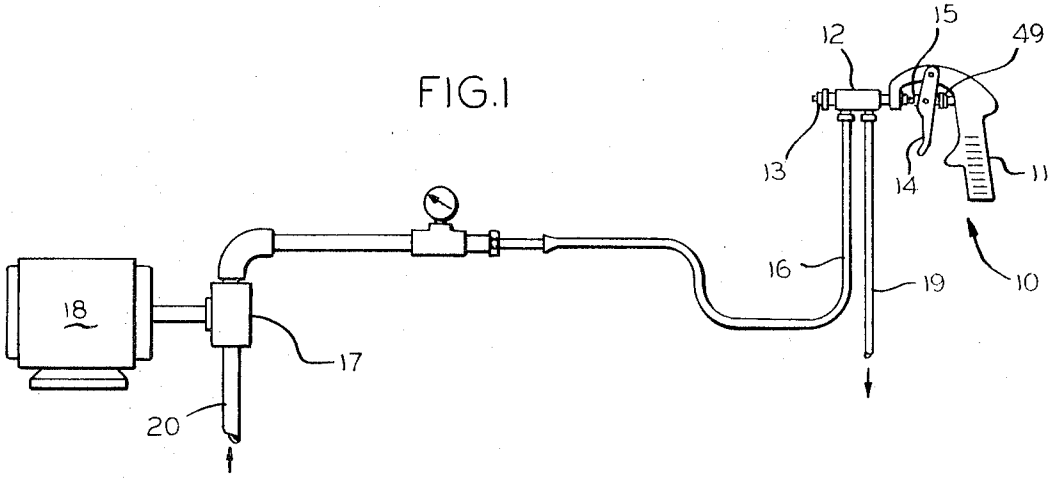


FIG. 1



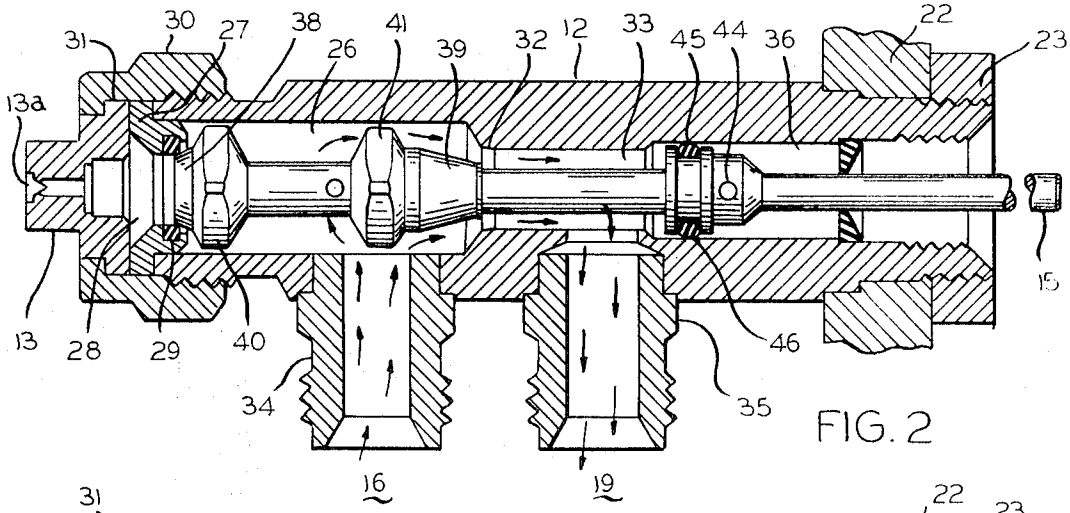


FIG. 2

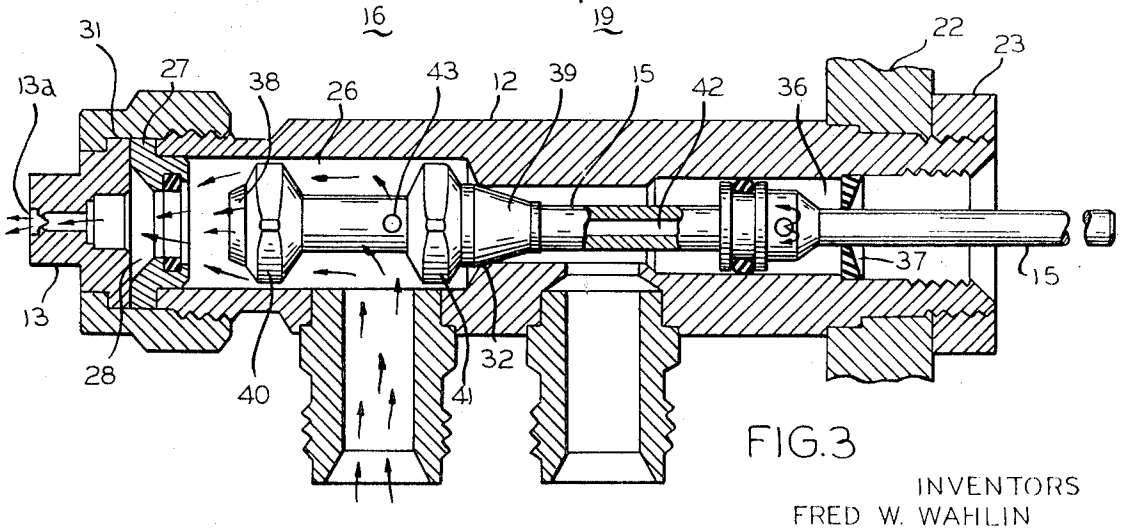


FIG. 3

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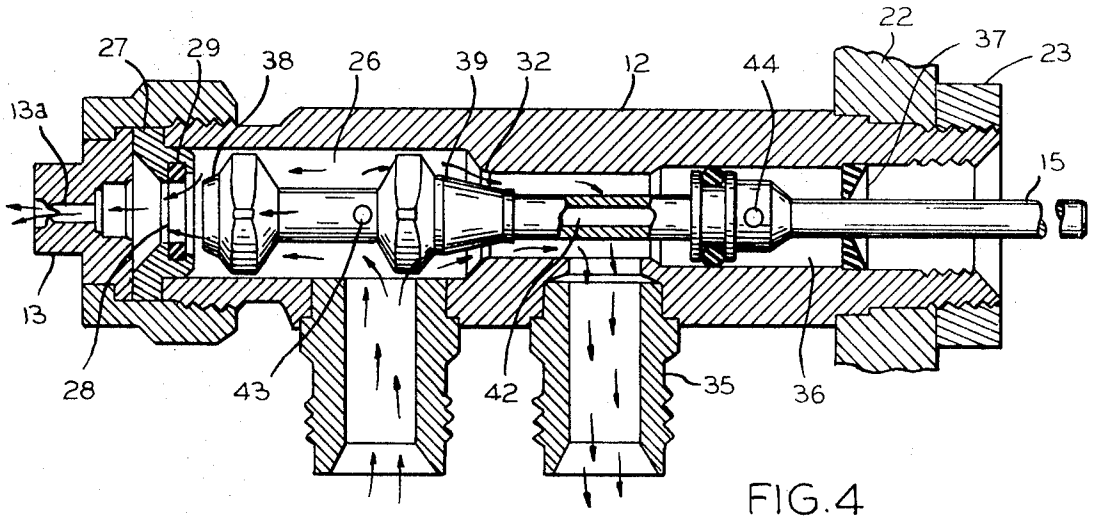


FIG.4

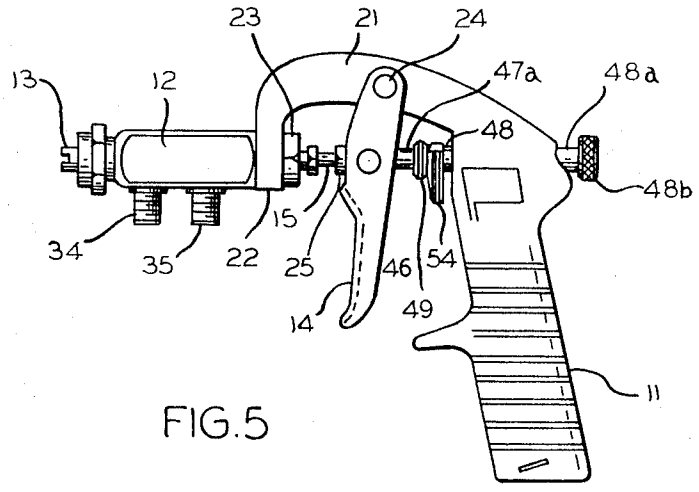


FIG.5

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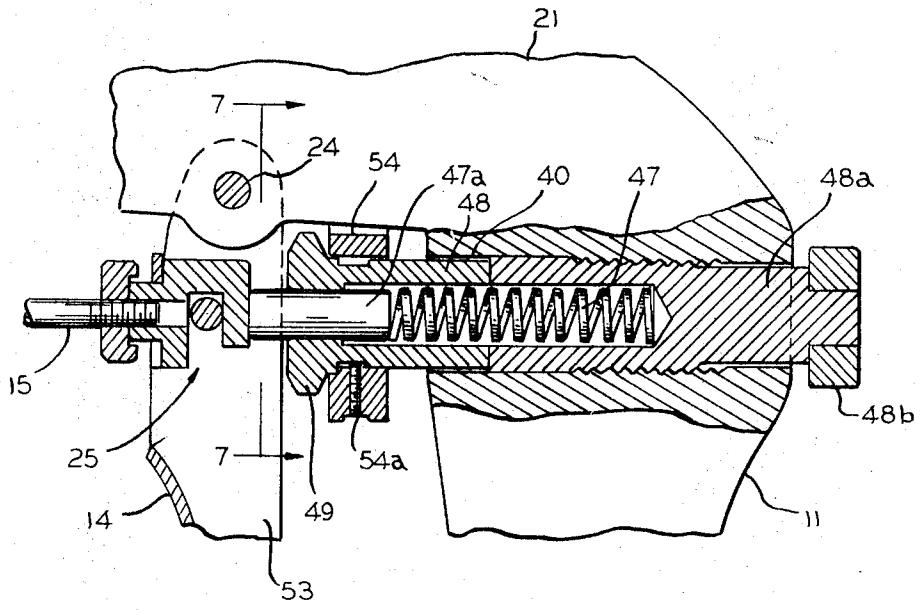


FIG.6

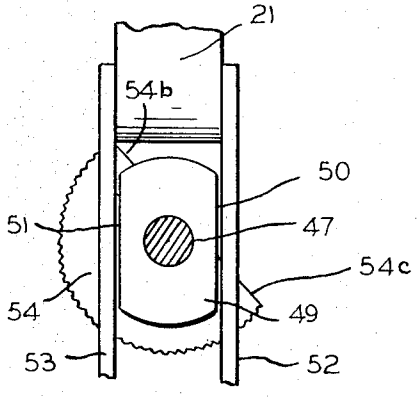


FIG.7

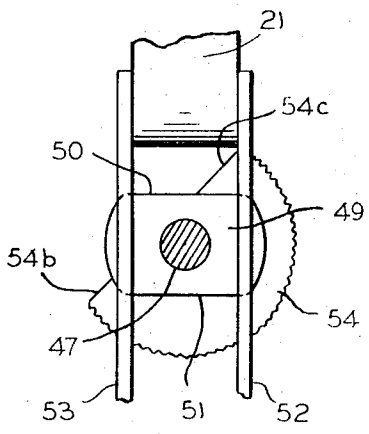


FIG.8

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VARIABLE FLOW RATE SPRAY GUN WITH PRESSURE RELIEF

The present invention is directed to new and useful improvements in spray guns.

A number of spray gun arrangements are known to the art. When using spray guns with relatively high pressure pump systems the overall fluid system is usually sensitive to the specific components utilized. For example, the pump supplying the pressure usually has a particular rated flow rate at a particular pressure and the nozzle orifices used with the guns have particular ratings in terms of pressures and flow rates. Previous spray gun systems have been more or less sensitive to the specific components in the system in that for particular pumps particular nozzle orifice ratings must be utilized. If the nozzle orifice and pump are not properly matched, as, for example if a nozzle orifice is too small for the rating of its supply pump, the nozzle may cause a buildup in pump pressure with a resultant overloading of the pump and a possible "burnout" of the pump motor and/or bearings. Also, in previous spray gun systems it has been customary in many installations to utilize some form of bypass or unloader valve in the system and arranged so that, when the spray gun is turned off, the valve opens and diverts fluid from the pressure side of the pump supplying the fluid to the gun to the return side of the system so as to avoid pump damage. This has required use of a separate valve in the fluid system. When such valves are utilized, they must be matched in terms of pressure and flow rate with the other components in the system so that they operate properly to divert fluid from the high pressure side of the system to the return line when the gun is turned off.

With the foregoing in mind, the major purposes of the present invention are to so arrange a spray gun that the fluid system is far less sensitive to specific pressure and flow ratings of nozzles and pumps, to so arrange a spray gun that the outlet pressure and flow rate of the gun are variable and easily controllable between zero pressure and a preselected maximum pressure which may be selected by the operator of the gun to be the same as the rated pressure of the pump or a lesser pressure which is within the capabilities of the pump, to so arrange a spray gun that shock forces on the gun are minimized when the spray gun is turned off, to so arrange a spray gun that pressure forces acting on a valve controlling member within the gun are essentially balanced, and to so arrange a spray gun that the valve elements which are used to control pressure are also used to return fluid from the pressure side of the system to the return side when the spray gun is turned off.

These and other objects and purposes will become more apparent in the course of the ensuing specification and claims when taken with the accompanying drawings, in which:

FIG. 1 is a diagrammatic view of a typical spraying system with which the present invention is concerned;

FIG. 2 is a sectional view through the barrel of the gun illustrated in FIG. 1 and illustrating the gun in a closed position;

FIG. 3 is a sectional view similar to FIG. 2 and illustrating the barrel of the spray gun in the fully open position;

FIG. 4 is a sectional view similar to FIGS. 2 and 3 but illustrating a valve controlling member of the gun in a partially open position;

FIG. 5 is an enlarged elevation of the spray gun of FIGS. 1—4;

FIG. 6 is a sectional view of a portion of the spray gun;

FIG. 7 is a detailed view of a trigger stop assembly utilized in the invention; and

FIG. 8 is another view of the trigger stop utilized in the present invention.

Like elements are designated by like characters throughout the specification and drawings.

With specific reference now to the drawings and in the first instance to FIG. 1, the numeral 10 generally designates a spray gun defined by an operating handle 11, a gun barrel 12, a nozzle orifice member 13 at the outlet end of the gun barrel, and an operating trigger 14. The trigger is pivotally mounted on the gun for reciprocating an actuating or control rod 15 to open and close the gun for flow through the nozzle orifice 13. A fluid supply line 16 is connected to the gun barrel and supplies fluid under high pressure from a pump 17 which is driven by a motor 18. A fluid return line 19 is also connected to the barrel 12 and leads to a suitable reservoir or drain in the fluid system. The pump 17 has an intake line 20 supplied with fluid from a suitable source.

As will be noted in FIGS. 3 and 5, the spray gun includes a barrel support 21 which projects forwardly from handle 11 and which is formed integrally therewith. The barrel support 21 may have a depending collar 22 formed on the end thereof which collar receives one end portion of the barrel and which is held fixed thereto as by a nut 23. Trigger 14 is pivotally mounted on the barrel support 21 as by a pivot pin 24 and is connected to the actuating rod 15 as by means of a connection generally designated at 25. Spray gun handles for connection with a barrel and with a trigger connected to an actuating rod for the gun are known to the art as, for example, in Wahlin et al. U.S. Pat. No. 3,181,798, issued May 4, 1965, and Williams et al. U.S. Pat. No. 3,379,376, issued Apr. 23, 1968, the disclosures of which are hereby incorporated by reference.

In accordance with the present invention, the barrel 12 is hollow and the actuating and control rod 15 extends within the opening therein and generally coaxially with the barrel. The hollow interior of the barrel at the outlet end portion thereof is formed on a somewhat larger diameter then the remainder of the hollow opening through the barrel and defines a first fluid chamber 26. The outlet end of this chamber includes a first valve seat element 27 disposed across the end of the chamber. The valve seat element may be a screw machine part with a passage 28 formed therethrough and with a ring 29 of nylon or other soft material surrounding the opening 28 and opposed to the chamber. The element 27 may be held in position by a coupling 30 which is threaded onto the outlet end of the barrel and which is used to hold the nozzle element 13 at the end of the barrel. A flange 31 of the nozzle element may abut against the valve seat element 27 so as to hold the valve seat element in abutting relation against the end of the gun barrel. The other end of the chamber 26 is defined by a tapered valve seat 32. A ring of nylon or other soft material may be positioned in this tapered valve seat, although it is not necessary with accurately machined valving surfaces. The valve seat 32 may, if desired, be defined by a separate replaceable insert so that a worn valve seat is easily replaced. The opening within the gun barrel is of a reduced diameter rearwardly of the chamber 26 as designated at 33.

An inlet fitting 34 is connected to the gun barrel intermediate the ends of the chamber 26 and has the inlet pressure fluid supply line 16 coupled thereto by a suitable coupling fitting (not shown in FIGS. 2, 3 and 4) so as to afford communication between the pressure side of the pump and the chamber 26. An outlet fitting 35 is fixed to the gun barrel at a position spaced rearwardly from the inlet fitting 34 and is adapted to afford communication between the passage 33 and the return conduit 19 which may be coupled to the fitting 35 through means of a suitable coupling.

The hollow part of the barrel rearwardly of the passage 33 may have a slightly larger diameter so as to define a second pressure chamber 36 which is axially spaced rearwardly of the first chamber 26 and the passage 33. The rear end of this chamber may be closed by an insert 37 through which actuating rod 15 passes in a sealing relation.

The control rod 15 includes spaced valve closure elements 38 and 39 within chamber 26 and adapted for selective cooperation with the valve seats 29 and 32 at the ends of the chamber 26. For example, the valve element 38 on the forward end of the control rod may be tapered or flat so as to seat against the ring 29 and thus close the opening through the ring. The valve element 39 on the other hand is preferably tapered so as to allow movement of the extreme rearward end of the valve element 39 within the valve seat 32 and progressively restrict flow area between the valve element 39 and the

valve seat as the valve element 39 moves within the seat under influence of movement of the control rod 15 to the right as appears in FIG. 2. The larger diameter of the frustoconical shape of the valve element 39 is sufficiently large so as to seat fully against and fully close the valve seat 32 when the control rod 15 is moved to the extreme right-hand position as is illustrated in FIG. 3. Valve closure element 39 thus meters and varies the flow through the valve seat 32 as it moves within the seat. While it is preferred to use a tapered valve 39, a flat valve surface may be used to abut against seat 32 to close the bypass opening therethrough. A flat valve surface will also perform some metering of the flow as it moves toward and away from the valve seat.

Square or hexagonal guiding portions 40 and 41 are formed on the control rod 15 within the chamber 26 for a sliding and supporting engagement with the cylindrical wall of chamber 26.

It should be understood that the chamber 26, passage 33, chamber 36 and the remainder of the hollow interior of the gun barrel may be formed by boring and counterboring the gun barrel to the appropriate diameters as illustrated, followed by machining the barrel at the inner end of the chamber 26 so as to define the valve seat 32.

The valve elements 38 and 39 are spaced from one another so that when one valve element, as, for example, the gun closing element 38, seats against the ring 29, fluid from the inlet is passed to the chamber and is then diverted through the fluid return seat 32 and passes through passage 33 to the return line 19 through the fitting 35. By pulling trigger 14 towards the handle 11 of the gun, the tapered portion of the valve element 39 gradually moves within valve seat 32 so as to gradually restrict the outlet opening through the valve seat 32. This movement pulls the valve element 38 away from its associated seating ring 29 and opens chamber 26 to the nozzle 13 so that fluid from the chamber 26 may pass through the valve seat 39 and through the nozzle orifice 13*a*. At the same time, since the flow area through valve seat 32 is partially open as is illustrated in FIG. 4, part of the fluid is diverted through passage 33 for flow through the fitting 35 and to the return line 19.

When the control rod 15 is withdrawn to the maximum under influence of trigger 14, the valve element 39 closes against the seat 32 as is illustrated in FIG. 3. At this time all of the fluid from inlet conduit 16 passes through the chamber 26 and through the opening in the valve seat 27 and through the orifice 13*a* of the nozzle. By setting the control rod at a particular axial position between the extreme positions of FIGS. 2 and 3, the pressure of the fluid delivered through the outlet orifice 13*a* may be selectively varied between zero and the full operating pressure developed by the pump of the system (as when the valve element 39 fully closes against seat 32).

Also, when the gun is turned off and the valve element 39 seats against the seating element 29, all of the liquid from the pump for the system is returned through the return conduit 19 so as to avoid pressure buildup and damage to the pumping system.

In further accordance with the invention, the control rod 15 is hollow through a portion of its length to define a passage 42 therethrough and extending between an inlet opening 43 in the rod between the guiding and supporting elements 40 and 41 and an aperture 44 which is positioned in the actuating rod at a location such that it is within the chamber 36. A piston 45 is defined on the control rod 15 forwardly of the aperture 44. The piston 45 may include an O-ring 46 which is adapted to make good bearing contact with the opposed cylindrical wall of the chamber 36 within the barrel. Pressure in the chamber 26 is thus communicated through the opening 43 and through the hollow portion of the control rod 15 into chamber 36. This pressure works against the piston 45 in a direction tending to force the control rod 15 to the left in FIG. 2 or in a gun closing direction. The pressure developed within the chamber 36 thus counteracts or counterbalances the pressure acting on the control rod when the gun is in an open position as illustrated in FIG. 3. In FIG. 3 it will be noted that the pressure acting on the effective seal area of valve element 39 and the valve seat 32 tends to move the control rod 15 to the right in FIG. 3 or in a gun opening direction.

The cross-sectional areas may be calculated so that the pressure forces within chamber 36 approximately balance the pressure forces in chamber 26. The cross-sectional area of chamber 36 minus the cross-sectional area of control rod 15 where it passes through element 37 should equal the effective cross-sectional seal area of valve element 39 and seat 32. It should be noted here that by providing the area relations as thus stated, operating pressures less than the full operating pressure, as for example when the control rod is in an intermediate position as illustrated in FIG. 4, will still produce opposite forces on the rod in the chambers 26 and 36 which substantially balance one another. The counterbalance thus provided allows use of a light spring to bias the trigger toward the closed position.

In further accordance with the invention, a pring 47 is used to bias the trigger and the control rod 15 toward the closed position. This spring biases an auxiliary rod 47*a* which is axially aligned with the control rod 15. Rod 47*a* is slidably supported in a sleeve 48 which extends into a bore in the gun handle 11. Sleeve 48 is slidably mounted in the bore. A second sleeve 48*a* is axially aligned with sleeve 48 in the bore. Sleeve 48*a* has a threaded exterior portion as does a portion of the bore threadably received within the gun handle. The spring 47 is positioned within aligned bores in the sleeves 48 and 48*a*. The extension of sleeve 48 within the bore is limited by the position of sleeve 48*a*. Sleeve 48*a* has a knurled knob 48*b* on the end thereof to enable rotation of the sleeve and adjustment of the position of sleeve 48.

The end of sleeve 48 adjacent trigger 14 is enlarged to define a stop element 49. As may be appreciated in FIGS. 6, 7 and 8, stop element 49 includes a pair of parallel flats 50 and 51 positioned on opposite sides of rod 47*a* at equal spacings. The flats 50 and 51 are spaced a distance such that flanges or sidewalls 52 and 53 of the trigger 14 may pass over these flats when they are in the relationship shown in FIG. 7. A manipulating element 54 may be a separate part which is held on sleeve 48 by a set screw 54*a*. Element 54 may be knurled to permit the operator to easily rotate it and the stop element 49 together.

For operator convenience the element 54 may have spaced shoulders 54*b* and 54*c* which abut against the gun handle and limit rotation of the element between the two positions illustrated. The portions of the stop element 49 between the flats 50 and 51 are positioned a greater distance from the axis of rod 47*a* than are the flats 50 and 51. When the stop element 49 is rotated through 90° from the position illustrated in FIG. 7 to the FIG. 8 position, the element 49 blocks the rearward movement of the trigger as by abutment of the trigger flanges against the element. In the position of FIG. 7, the trigger may be pulled back until seat 32 is completely closed. Thus, two distinct spraying pressures may be provided through selective axial positioning of the sleeve 48 and element 49. A maximum degree of spraying pressure is provided by positioning the stop element 49 as illustrated in FIG. 7 wherein the trigger 14 and the control rod 15 may be withdrawn toward the handle and thus open the seat 29 and close seat 32 so that all of the flow from the pump must pass through the nozzle 13. A lesser degree of operating pressure is afforded by rotating the stop element to the position illustrated in FIG. 8. In FIG. 8 the trigger flanges abut against the element 49 at a lesser degree of pivotal movement of trigger 14 with an attendant lesser degree of opening movement of control rod 15 which allows seat 29 to open and seat 32 to partially close, thereby allowing part of the flow to pass through the nozzle and part to pass through seat 32. The lower pressure obtainable may be regulated through axial adjustment of the sleeve 48 as by rotating the knurled control knob 48*b* on the end of the sleeve 48*a*. Rotation in opposite directions positions the stop element 49 at varying axial positions toward and away from the handle 11 and the trigger 14, so as to thus allow the user to selectively set

a lower operating pressure for the gun. As the trigger is allowed to move further back, the flow through seat **32** becomes more restricted and the operating pressure increases.

By virtue of the arrangement of the spray gun as disclosed herein, exact matching of the nozzle orifice with the supply pump in terms of flow rates and pressures is not as critical as in the case of prior spray guns. For example, if the nozzle orifice used with the gun is too small for the rated pressure and flow rate of the pumping system, and causes a buildup in pressure which might overload the pumping system (with return valve closed or with a small return valve opening), the maximum pressure may be easily reduced to a safe value as By (a) operator manipulation of the control rod so that it is at a safe pressure position, or (b) by setting the stop **49** in the trigger blocking position of FIG. **8** and setting the stop **49** at an axial position such that valve **39** never fully closes against seat **32** and the bypass through seat **32** is sufficient to provide a safe maximum operating pressure.

If desired, the stop **49** and manipulating element **54** may be arranged so that the trigger flanges abut against the manipulating element **54** when the stop element is in the FIG. **7** position. Then, by proper axial positioning of stop element **49** and manipulating element **54**, two distinct spraying pressures may be provided below the maximum pressure obtainable with the valve seat **32** fully closed. For example, a lower pressure limit is obtainable when the stop element is in the trigger blocking position of FIG. **8** and a higher pressure limit is then obtained when the stop element is in the position of FIG. **7**. When arranged this way, the gun provides three distinct and settable spraying pressures, namely a maximum pressure when the stop element is withdrawn sufficiently as to allow valve element **39** to fully close seat **32**, and two distinct lower pressures by axial positioning of the stop element so that stop element **49** and the manipulating element **54** block and limit trigger movement at two distinct positions corresponding to two distinct and different relief outlet areas through the valve seat **32**.

The spray gun arrangement also provides for a bypass of the pressure fluid when the gun is turned off. In this regard it should be noted that the pressure developed by the spraying system is gradually reduced as the control rod **15** is moved toward a nozzle closed position, because, as this happens, the flow area through valve seat **32** gradually increases. When the gun is fully shut off, the pressure in the pumping system is much lower than the normal spraying pressure.

We claim:

1. A spray gun including a gun barrel having a fluid chamber defined within the barrel and spaced valve seats in the chamber, one of said valve seats defining a nozzle supply seat and being formed and adapted to afford communication with a nozzle on the barrel, the other of said valve seats defining a fluid return seat and being formed and adapted to communicate with a fluid return line opening into said barrel, a fluid pressure supply line connected with said barrel and opening into said chamber, a movable valve operating member in said chamber and having spaced valve portions cooperable with said valve seats, said valve portions being spaced so that when one of said portions is seated against said one valve seat, the other portion is spaced from the other valve seat and so that when said other portion seats against said other valve seat, said first named portion is spaced from said first named valve seat, a second chamber defined within said barrel, said operating member being in the form of a rod extending within said second chamber, a piston on said rod within said second chamber, means communicating the pressure within said first named chamber to said second chamber so as to exert closing forces against the piston within said second chamber and nozzle closing forces on said rod, and actuating means connected with said valve operating member to move the member respectively so that said valve portions move toward and away from said valve seats.

2. The structure of claim **1** wherein the valve portion adapted to seat against the fluid return seat of the chamber is tapered and movable gradually within said seat to provide a metered opening through said seat until said valve portion moves fully against the said seat.

3. The structure of claim **1** characterized by and including spring means for biasing said rod toward the nozzle supply seat.

4. The structure of claim **1** characterized by and including guiding and supporting elements on said rod in said first named chamber and supported by the wall of said first named chamber.

5. The structure of claim **1** wherein said valve portion which is cooperable with said return valve seat has a tapered portion adapted to progressively move within said seat and eventually completely close said seat, said tapered portion being effective to gradually close the outlet area through said seat as said portion moves within said seat, and adjustable stop means are associated with said actuating means so as to adjustably limit the travel of said tapered portion within said seat and thus limit the flow of fluid through said return seat and vary the outlet pressure through said nozzle seat.

6. A spray gun including a gun barrel having a fluid chamber defined within the barrel and spaced valve seats in the chamber, one of said valve seats defining a nozzle supply seat and being formed and adapted to afford communication with a nozzle on the barrel, the other of said valve seats defining a fluid return seat and being formed and adapted to communicate with a fluid return line opening into said barrel, a fluid pressure supply line connected with said barrel and opening into said chamber, a movable valve operating member in said chamber and having spaced valve portions cooperable with said valve seats, said valve portions being spaced so that when one of said portions is seated against said one valve seat, the other portion is spaced from the other valve seat and so that when said other portion seats against said other valve seat, said first named portion is spaced from said first named valve seat, a second fluid chamber defined within said gun barrel, said operating member being in the form of a rod passing through said second chamber and having a piston fixed thereto and subject to the pressure forces developed within said second chamber, said rod being hollow and having a first pressure inlet located within said first chamber and a fluid pressure outlet located within said second chamber so that the pressure in said first chamber is communicated through the hollow portions of said actuating rod to said second chamber to exert nozzle closing forces on said actuating rod, and actuating means connected with said valve operating member to move the member respectively so that said valve portions move toward and away from said valve seats.

7. The structure of claim **6** characterized by and including spring means for biasing said rod toward the gun closing position.

8. A spray gun including means defining a manipulating handle and a barrel carried by said handle, an actuating rod reciprocably mounted for movement within said barrel, said barrel having a nozzle outlet at one end thereof, said barrel having a fluid chamber in one end thereof with spaced valve seats at opposite ends of said chamber, seat, of said seats nearest the nozzle outlet defining a nozzle outlet seat and the other seat defining a fluid return seat, a fluid pressure supply line communicating with said chamber between said valve seats, said actuating rod extending within said chamber and having a first valve closure element cooperable with said nozzle outlet seat and a second valve closure element cooperable with said fluid return seat, a fluid return line connected to said barrel and communicating with a passage within said barrel aligned with said fluid return seat, means on said handle for reciprocating said rod, said valve portions being spaced so that when said first element is seated against its nozzle seat, the second valve element is spaced from said return seat so as to allow fluid from said inlet to pass through said fluid return seat, and so that when said second valve element seats against said return seat, said first named valve element is spaced away from said nozzle outlet seat to allow supply of the full inlet pressure through said chamber and through said nozzle, a

second chamber within said barrel and a piston carried by said actuating rod and positioned within said second chamber, and means for communicating said first chamber with said second chamber in a manner such that the pressure within said first chamber operates against said piston to provide forces on said operating rod in a direction tending to close said first valve element against its associated seat, the effective cross-sectional area of said piston being such that the pressure exerted thereaginst essentially balances the opposite pressure forces exerted on said rod when said first valve element is away from its seat.

9. A spray gun including a gun barrel having a fluid chamber defined within the barrel and spaced valve seats in the chamber, one of said valve seats defining a nozzle supply seat and being formed and adapted to afford communication with a nozzle on the barrel, the other of said valve seats defining a fluid return seat and being formed and adapted to communicate with a fluid return line opening into said barrel, a fluid pressure supply line connected with said barrel and opening into said chamber, a movable valve operating member in said chamber and having spaced valve portions cooperable with said valve seats, said valve portions being spaced so that when one of said portions is seated against said one valve seat, the other portion is spaced from the other valve seat and so that when said other portion seats against said other valve seat, said first named portion is spaced from said first named valve seat, the valve portion cooperable with said return valve seat having a tapered portion adapted to progressively move within said return seat and eventually completely close said seat, said tapered portion being effective to gradually close the outlet area through said return seat as said tapered portion moves within said seat, actuating means connected with said valve operating member to move the member respectively so that said valve portions move toward and away from said valve seats, and adjustable stop means associated with said actuating means so as to adjustably limit the travel of said tapered portion within said return seat and thus limit the flow of fluid through said return seat while establishing a maximum pressure in said chamber and through said nozzle seat.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,589,610 Dated June 29, 1971

Inventor(s) Fred W. Wahlin et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 57, for "seat," read -- one --.

Signed and sealed this 4th day of January 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Patents