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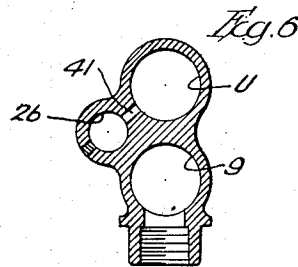
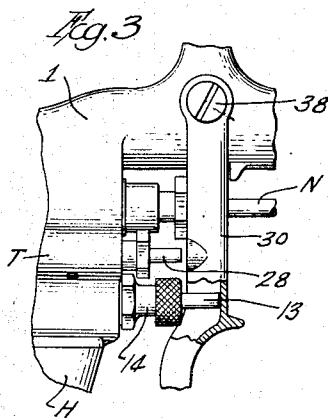
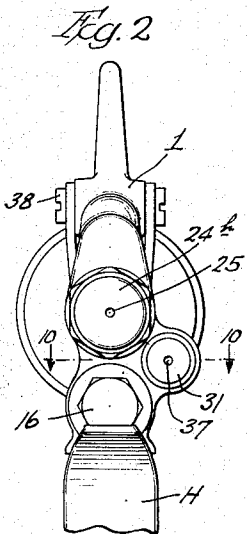
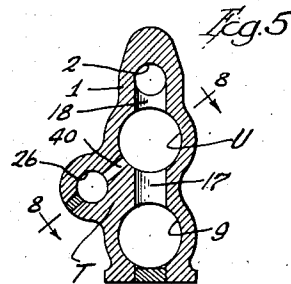
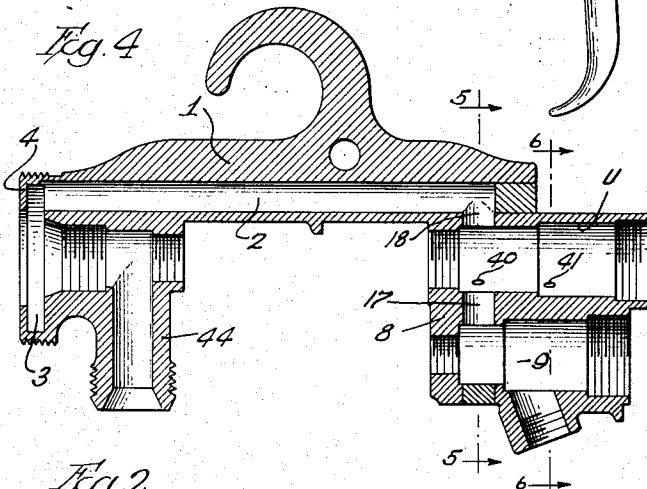
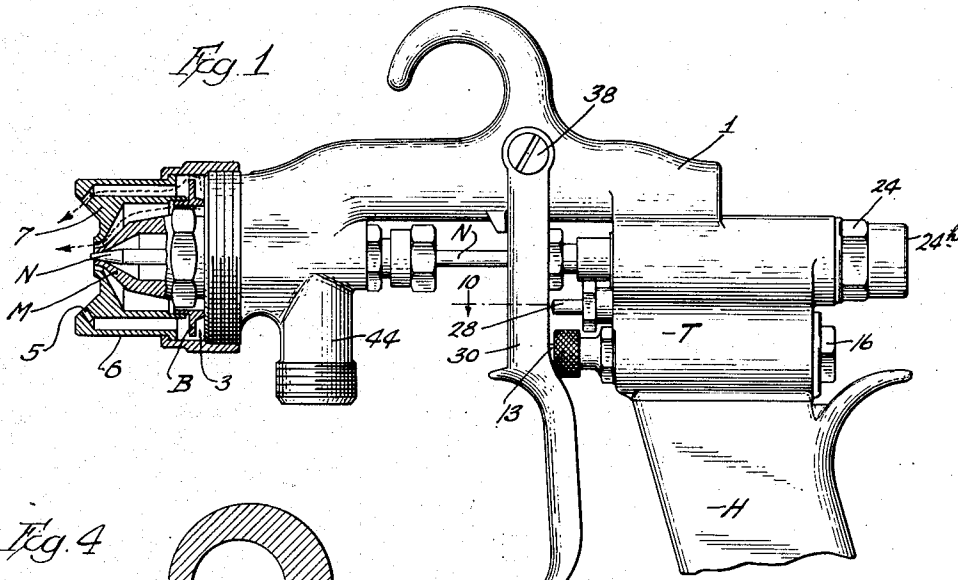
E. GUSTAFSSON ET AL

2,107,732

SPRAY GUN WITH PNEUMATIC MATERIAL CONTROL

Filed July 31, 1935

3 Sheets-Sheet 1



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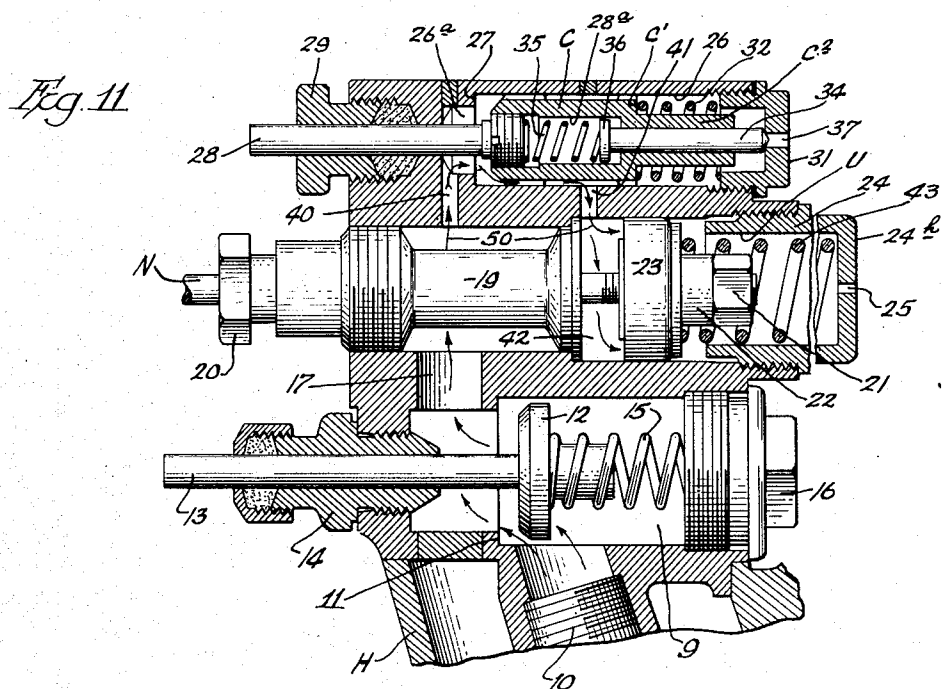
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## UNITED STATES PATENT OFFICE

2,107,732

## SPRAY GUN WITH PNEUMATIC MATERIAL CONTROL

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Application July 31, 1935, Serial No. 34,066

8 Claims. (Cl. 299-140.1)

Our invention relates to spray appliances of the class generally constructed in the form of spray guns, and in its general objects aims to provide a spray gun which will prevent a splashing of inadequately atomized material at the beginning and end of the spraying, and which will insure a continuous spray (even by an inexperienced user) at the maximum rate corresponding to the pressure at which the material and air are supplied to the gun.

In the spray-coating of automobile parts, furniture, bath-tubs and the like it has heretofore been customary to employ spray guns constructed for enabling the user to vary both the spraying rate, namely the time required for spray-coating a given surface area, the degree of atomization of the sprayed material, and the pattern momentarily produced by the spray on the surface against which the spray is directed.

For example, with the material and the compressed air maintained at given pressures by the usual pressure regulators, the user of a conventional flat-spraying gun is free to effect the following departures from the continuous spraying of the material at the maximum spraying rate corresponding to the said fluid supply pressures and with the spray pattern of the predetermined shape corresponding to an undiminished supply of air to all air ports of the air nozzle of the spray gun:

(1) By only lightly retracting the trigger of the gun, which consecutively opens the air valve and the material valve, the user can halt this trigger at points intermediate of its full-opening movement, thereby reducing the rate at which both material and air are emitted, so that the spraying rate is only a fraction of that for which the gun was constructed.

(2) By varying the adjustment of the air for the usual side air ports from which the spray-flattening side air jets issue, the user can greatly vary both the spray pattern and the uniformity of atomization of the projected material, thereby producing such streakiness or other variations in the resulting coating as to require additional "touch-up" spraying for increasing the coating at light spots and hand labor for rubbing down unduly thick portions of the coating.

Consequently, the providing of the usual adjustment provisions, although admirable for enabling an experienced user to adapt a given gun to various materials, has left spray gun operators free to vary the gun adjustments made by their supervisors, and the resulting waste of both time and material has been particularly serious in

establishments where operating efficiency demands the maintaining of given adjustments.

Our present invention aims to avoid this shortcoming of the now conventional spray guns by providing a gun construction which will not permit the user to operate the gun at less than a predetermined spraying rate, and by eliminating the usual spray-shape adjusting provisions so as to leave the user unable to change the spray pattern while using a gun which is equipped with a given set of material and air nozzles, to which gun both material and air are supplied under pressures regulated at points out of his reach.

In general, we accomplish all of our above recited purposes by the cooperation of the following provisions:

(a) Instead of having the usual trigger of the gun operate the material-discharge-controlling needle valve directly, we have this trigger actuate a separate control valve controlling the supply to a pneumatic valve which automatically opens the material discharge outlet to its full extent when the trigger is retracted sufficiently to admit air to the gun.

(b) We construct our air valve so that air pressure behind the closed valve will prevent the user from opening it with a light pressure on the trigger, and so that air flowing in front of this valve as soon as it opens will reduce the resistance. By doing this, we insure a quick and complete opening of the air valve as soon as sufficient force has been applied to the trigger to start the opening of the valve.

(c) We provide means for venting the air in front of the said pneumatic valve as soon as the control valve closes in response to the releasing of the trigger, thereby insuring a closing of the material discharge outlet before air ceases to issue from the air nozzle.

(d) We effect this venting through an air vent in the chamber which houses the control valve, and provide means associated with the control valve for automatically closing the said air vent when the gun is in use, so as not to have the vent provision interfere with the normal operation of the gun.

(e) We provide air passage portions of adequate size for storing considerable air, so as to enhance the emission of air from the air ports of the air nozzle of the gun before the material discharge begins and after the material discharge has been halted, thereby avoiding any splashing of inadequately atomized material both at the beginning and at the ending of the spraying.

(f) We construct and dispose the trigger of

the gun so that this trigger will open the air valve before it opens the control valve, thereby augmenting the time during which air issues from the gun both before the beginning and after the end of the discharging of the material.

Illustrative of a suitable spray appliance construction for our above recited purposes.

Fig. 1 is a full sized side elevation of a spray gun embodying our invention, with the spray head shown in section.

Fig. 2 is a fragmentary rear elevation of the same gun.

Fig. 3 is a fragmentary side elevation, taken from the side opposite to that shown in Fig. 1.

Fig. 4 is a central, vertical and longitudinal section through the body of the gun.

Figs. 5 and 6 are sections taken respectively along the correspondingly numbered lines in Fig. 4.

Fig. 7 is an enlarged central, vertical and longitudinal section through rearward parts of the gun, showing the positions of the pneumatically actuated needle valve and of the air valve when the gun is not in use, so that both of these valves are closed.

Fig. 8 is a similarly enlarged section, taken (along the line 8—8 of Fig. 5) through the control valve chamber and the chamber housing the air piston fastened to the material-controlling needle valve, taken when both of these valves are in their closed positions.

Fig. 9 is a fragmentary transverse section taken along the line 9—9 of Fig. 8.

Fig. 10 is a horizontal section taken along the line 10—10 of Fig. 1, showing the idle position of the trigger with respect to the stems of the control valve and the air valve.

Fig. 11 is a section through the valve chambers and associated parts of a modified form of our spray gun, namely one in which the control valve chamber is disposed above the pneumatic valve chamber, taken when the gun is in operation.

In the embodiment of Figs. 1 to 10, the body of our spray gun includes a stock 1 having a longitudinal air passage 2 leading to a frontal air chamber 3 in the head 4 of the body. From this chamber the air issues partly alongside and around the tip of a material nozzle M, and partly (past an air equalizing baffle B) through the usual side air ports 5 in the opposed horns 6 of an air nozzle 7.

Depending from the rearward portion of the stock 1 of the gun body is a tail portion T having two superposed longitudinal bores, one being a lower bore 9 (Fig. 7) to which compressed air is admitted from an air supply pipe 10 supported within a gun handle H depending from the said tail portion. This lower bore 9 has a contraction affording a rearwardly facing seat 11 for an air valve 12 which has a stem 13 extending forwardly through a stuffing box 14, this air valve being continually urged forwardly toward its closure position by a compression spring 15 interposed between the said valve and a head 16 which seals the rear end of the said lower bore.

The part of the lower bore 9 forward of the valve seat 11 is connected by an upright port 17 to an upper longitudinal bore U, from which latter bore a port 18 leads to the air passage 2 in the gun barrel 1. Rigidly mounted in the forward part of the upper bore U is a horizontal spool-like stem guide 19, the forward portion of which forms the body of a stuffing box, the part of this stem-guide between the said ports 17 and 18 being of smaller diameter than the correspond-

ing part of the upper bore U to permit air to flow freely past it from the port 17 to the port 18. As here shown, the stuffing box also includes an axially bored cap member 20 threaded to the forward end of the said stem-guide, and an annular packing P clamped between cap member and the stem guide.

Extending slidably through aligned bores in the stuffing box members 19 and 20 and in the packing P is a needle valve N which closes the outlet of the material nozzle M (as in Fig. 1) when the gun is not in use. Threaded upon this needle valve, and latched against unscrewing by a lock-nut 21 is a piston comprising a head 22 carrying an elastic piston ring 23 which fits the said upper bore U. This piston is continuously urged forward by a compression spring 43 interposed between the piston head 22 and the head 24 of a cap 24 which effectively seals the rear end of the upper bore, except for a relatively small vent bore 25 in the said cap head 24 which maintains atmospheric pressure behind the piston.

In addition to the superposed longitudinal bores 9 and U the tail T of the gun body also includes a third longitudinal bore 26 which desirably has its axis at one side of the aligned upright ports 17 and 18 (as shown in Figs. 5, 6 and 9) and which houses the control valve C of our gun as shown in Fig. 8. This third bore 26 has a contracted bore portion affording a rearwardly facing annular seat 27 (Figs. 8 and 11) for engaging the forward end of the tubular body C of a control valve, this valve body having the forward end of its bore 28a closed by a control valve stem 28 which extends slidably through a stuffing box (including a cap 29) toward the usual trigger 30 of the spray gun.

The control valve body C has its forward portion of a polygonal section, as shown in Fig. 9, so as to engage the bore 26 of the said third bore (which, together with a cap 31 at its rear end forms the control valve chamber of our spray gun) only at circumferentially spaced portions while permitting air to flow along intermediate portions of the periphery of this valve body for the hereafter recited purpose.

The rearward portion C<sup>2</sup> of the control valve body C is diametrically contracted to permit a compression spring 32 to surround it, this spring being interposed between the said cap 31 and the rearwardly facing annular portion of the larger diametered valve body part for continuously urging the control valve body toward the said seat 27.

Extending slidably through an axial bore 33 in the said rearward portion C<sup>2</sup> of the control valve body is a plunger 34 which is continually pressed rearwardly by a spring 35 within the forward part of the said valve body. This plunger has a head 36 disposed for engaging the rear end of the bore part housing the spring 35, the plunger being of such a length that its rear end will be freely spaced by a quite short distance from a vent or bleeder outlet 37 in the cap 31 when the control valve body is engaging the valve seat 27 as shown in Fig. 8, in which figure the said spacing has been enlarged to clarify the drawings.

The valve stem 13 of the air valve and the stem 28 of the control valve both extend sufficiently forward so as to be near rearwardly facing portions of the usual trigger 30 which is pivoted upon a horizontal screw 38 extending through the stock 1, as shown in Figs. 1 and 7. These trigger portions preferably are arranged, as in Fig. 10, with the trigger spaced farther from the

control valve stem 28 than from the air valve stem 13 when the gun is not in use, so that the retraction of the trigger will open the air valve before the control valve begins to open.

To complete the air passageways, the gun body has a port 40 leading, from a part of the air valve bore 9 opposite the shank portion of the stationary spool-shaped stem guide 19 in that bore, to a portion 26a of the control valve bore which is forward of the valve seat 27 and of the forward end of the control valve body C.

The gun body also has a second port 41 extending from a more rearward portion of the said control valve bore 26 to a space 42 within the lower bore U which is behind the stem guide 19 and in front of the head 22 and the piston ring 23 of the air valve, the area of each of the ports 40 and 41 being a quite small fraction of that of the upright port 17.

With our spray gun thus constructed, the operation, which can conveniently be traced in Fig. 11, is as follows: When compressed air is supplied to the air duct 10, and liquid material to the usual material inlet 44 of the gun, while the trigger depends freely, the three movable valve members are positioned as in Figs. 7, 8 and 10. The compressed air then acts solely and forwardly on the said valve 12 to assist the spring 15 in holding that member in its closure position, while the air in all other portions of the gun, excepting the part of the air valve chamber 9 behind the air valve and in the air supply duct 10, is at atmospheric pressure. Consequently, an opening of the air valve requires an adequate digital pressure for overcoming both the pressure of the spring 15 and the air pressure behind the air valve 12. However, as soon as this air valve begins to open, compressed air flows in front of the said valve head to balance the forward pressure of air behind that head, so that the resistance to the digital movement of the trigger decreases speedily. Owing to these provisions, and particularly when the air valve 12 is of a relatively large diameter (as shown in Fig. 7), the digital pressure on the trigger required for starting the opening of the air valve is such that this pressure instantly moves the air valve head 12 to the full open position shown in Fig. 11, instead of permitting the trigger to be halted in some intermediate position.

As soon as the trigger has been retracted to open the air valve and to slide the control valve rearwardly, the major part of the admitted compressed air flows successively through the upright ports 17 and 18 and the air passage 2 to the air ports of the air nozzle, so that air issues almost instantly both around the tip of the material nozzle and through the side ports 5 of the air nozzle. A much smaller part of the admitted air also passes through the small-diametered port 40 to the portion 26a of the control valve chamber which is in front of the control valve body C, which valve body has been moved from its idle position of Fig. 8 to its operative position of Fig. 11, thereby permitting air to flow along the arrow lines 50 to the space 42 between the rear end of the stationary spindle guide 19 and the head of the piston 23 fastened to the needle valve N, so that the rearward pressure on this piston opens the material valve by sliding the piston to the position shown in Fig. 11.

To reach the said space 42 in front of the needle-valve-actuating piston, the air not only must pass through the small-diametered ports 40 and 41 but also must flow through narrow passage-

way 51 (Fig. 9) alongside the forward portion of the body C of the control valve. This restricted and tortuous path for the air delays the opening of the material valve, and the delay is further augmented by spacing the forward ends of the control valve stem 28 farther from the idle trigger than that of the air valve stem 13. Consequently, air always issues from the air nozzle of our gun considerably earlier than the material begins to issue from the material nozzle, so that there is no splashing of unatomized material at the beginning of the spraying operation.

During the trigger-effected retraction of the control valve the rear end of the rearwardly projecting plunger 34 carried by that member closes the vent bore (or bleeder outlet) 37 in the rear end of the control valve chamber. This plunger preferably is of such a length that the rear plunger end is spaced from the vent, when the gun is not operated (as in Fig. 8) by a minor fraction of the normal travel of the control valve member, this being permitted by the spring in the latter member which is compressed (as in Fig. 11) when the vent is closed. By using such a spring-pressed plunger arrangement instead of a rigid rearward extension on the control valve member for controlling the air vent we enable this spring to compensate for manufacturing variations, and also to cushion the impact of the plunger on the cap 31 so as to reduce wear.

When the user releases his retracting grip on the trigger 30 at the close of the spraying operation, the spring 15 promptly moves the air valve 12 forwardly to its closure position. The spring 32 does the same for the control valve C, thereby drawing the vent-controlling plunger 34 away from the air vent 37. The opening of the said vent permits the compressed air within the said space 42 in front of the needle-valve actuating pneumatic piston 23 to expand through the port 41 into the control valve chamber, so that this air exhausts its pressure through the said vent, thereby permitting the spring 43 to move the said piston forward so that the needle valve N closes the material discharge outlet. Since the forward pressure of the spring 32 on the said piston also aids in expelling the air from the said space through the said vent, this spring closes the needle valve at a considerable time interval before the much greater volume of air in the barrel bore 2 and the air passageways between that bore and the air valve ceases blowing out through the air ports of the air nozzle. Consequently, we not only prevent a spattering of inadequately atomized material at the close of the spraying operation, but in practice also enable the suction of the air (which still issues around the tip of the material nozzle after the needle valve has closed) to carry off any particles of material which otherwise might solidify at the mouth of the material nozzle.

With our heretofore described spray gun, both the resulting spray pattern and the degree of atomization of the material can readily be varied (according to the material which is to be sprayed, the surface shapes to be coated, and the desired spraying speed) by a suitable selection of the air nozzle, and a suitable regulation of the pressure on the air and the materials. Such selecting and regulating belongs to the field of the supervisor rather than the ordinary spray gun operator. By eliminating the adjusting features heretofore provided on spray guns, and by constructing our gun so that it can only be used at its full rate, we also eliminate the tampering

which heretofore has caused much waste of time and labor with spray guns used by men of low intelligence.

By providing three adjacent bores (8, 26 and U in Fig. 5) in the tail portion T of the gun body, we permit the control valve provision, the pneumatic needle-valve-retracting provision and the venting provision to be disposed directly above the handle H by which the user holds the spray gun, so that the center of gravity of the gun is farther rearward than the pivot screw from which the trigger depends. Consequently, we avoid the tiring effect of the user which would occur with a previously proposed gun in which the pneumatic piston chamber and the venting provision are both disposed far forward of the trigger. So also, by thus disposing the just recited three provisions in the tail of the gun and close both to each other and to the air passage 17 in the said tail, we allow the compressed air to reach the piston cylinder without the material reduction in its pressure which occurs when the air has to flow through many times longer passages before it can reach the piston, as in the same heretofore proposed construction.

In addition, it will be obvious from Fig. 8 that the residual air, which is in front of the piston 23 when the user releases the trigger to halt the operation of the gun, can reach the vent port 37 through a quite short path, thereby enabling the strong spring 43 behind the piston to close the needle valve while part of the large volume of air stored in the stock passage 2 and the passageways leading thereto is still issuing from the air ports of the air nozzle of the gun. Consequently, we avoid a continued ejecting of material from the gun such as would occur with the same heretofore proposed gun construction owing to the long and repeatedly elbowed passages through which the residual air must flow before it can reach the air vent.

However, while we have heretofore described our invention as embodied in a hand-held spray appliance and as including numerous desirable features of construction and arrangement, it will be obvious that many changes might be made in all of these respects without departing either from the spirit of our invention or from the appended claims.

We claim as our invention:

1. A spray appliance comprising a body member having a material passage and an air passage presenting adjacent forwardly open outlets; a needle valve controlling the discharge of material from the material passage and movable rearwardly for permitting such discharge; the body member also having a piston chamber behind and in axial alinement with the needle valve, and having a branch air-passage leading from the air passageway to the forward portion of the piston chamber; a piston slidable in the said chamber and fast on the needle valve; spring means resisting the rearward movement of the said piston; a control valve controlling the flow of air to the piston chamber through the said branch air-passage; a second spring means resisting the opening movement of the control valve; an air valve controlling the admission of air to the said air passageway; a third spring means resisting an opening movement of the air valve; and a manually operable member pivoted on the said body member and disposed so that movement of the manually operable member in one direction will open both the air valve and the control valve.

2. A spray appliance as per claim 1, in which the manually operable member is disposed for opening the air valve prior to the opening of the control valve; and in which the spring means associated with the air valve are effectively so much stronger than the spring means associated with the control valve, as to prevent the operator of the said manually operable member from halting the movement of the said means in the valve opening direction, after opening the air valve, before also opening the control valve.

3. A spray appliance as per claim 1, including means for venting the said forward portion of the piston chamber when the control valve is closed, and means associated with the control valve for discontinuing the said venting when the control valve is open.

4. A spray appliance as per claim 1, in which the "body member" of the appliance is formed to afford a control valve chamber having a vent port; including also a vent-closure member associated with the control valve, the said closure member being disposed for opening the vent when the control valve is closed, and for closing the vent when the control valve is open.

5. A spray gun of the type including a body member having an air passageway and a material passageway presenting adjacent outlets, a needle valve movable rearwardly against the resistance of a spring for opening the discharge outlet of the material passageway, and an air valve controlling the admission of air to the air passageway; the body member also having a piston chamber, and having a port connecting the air passageway to the forward portion of the piston chamber; a piston fast on the needle valve and slidable in the said chamber between positions rearward of the said port, a control valve controlling the flow of air from the air passageway through the said port; spring means continually urging the control valve toward a position in which the control valve shuts off the said flow of air; and manually operable means movable in one direction for opening the air valve and moving the control valve to permit air to flow from the air passageway through the said port.

6. A spray gun as per claim 5, including means responsive to the position of the control valve for venting the said forward portion of the piston chamber when the said flow of air is shut off, and for discontinuing the said venting when the control valve is open.

7. In a spray gun, a body member including a generally horizontal stock and a tail portion depending from the rearward part of the stock, the body member having an air passage extending upwardly through the said tail portion and thereafter forwardly through the said stock; a spray-head carried by the forward portion of the body and including a forwardly opening material discharge nozzle having its axis substantially parallel to and spaced downwardly from the said stock; the tail portion of the body member including three cylinders axially coparallel with the said barrel, namely a piston cylinder alining axially with the material discharge nozzle, an air valve cylinder, and a control cylinder having its forward portion connected to a part of the said air passage between the air valve cylinder and the said barrel; the body also having a port connecting the forward portion of the piston cylinder with a more rearward portion of the control cylinder; a piston slidably disposed in the piston cylinder; a needle valve fastened to the piston and controlling the material discharge

nozzle; a control valve slidable in the control cylinder and controlling the supply of air from the said air passage to the control cylinder; an air valve slidable in the air cylinder and adapted simultaneously to shut off the supply of air to the control cylinder and the barrel; and three springs respectively urging the air valve, the piston and the control valve forwardly; the air valve and the control valve each having a stem projecting forwardly beyond the said tail portion of the body; and a trigger pivoted to the said barrel and adapted when swung rearwardly, to engage both of the said valve stems so as to force both the air valve and the control valve rearwardly.

8. A spray appliance of the class in which the forward end of the body of the appliance supports an air nozzle and a material nozzle adjacent to the air nozzle, in which the said body has a main air passage and a material passage respectively leading to the air nozzle and the material nozzle and has a piston chamber formed in a rearward

portion of the body and alining axially with the material nozzle, in which a piston slidable in the piston chamber is fastened to a valve controlling the discharge from the material nozzle, and in which an air valve controlling the admission of air to the said main air passage is openable by rearward movement of a trigger movably supported by the said body; characterized by having the body provided also with a control valve chamber adjacent to the said piston chamber, and with a branch air passageway leading from the main air passage through the control valve chamber to the piston chamber; and by including a control valve disposed within the control valve chamber and controlling the flow of air through the said passageway, the control valve being movable in its opening direction by rearward movement of the said trigger.

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