Nov. 27, 1934. A. F. JENKINS 1,982,056

SPRAY GUN

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FIG. 1.

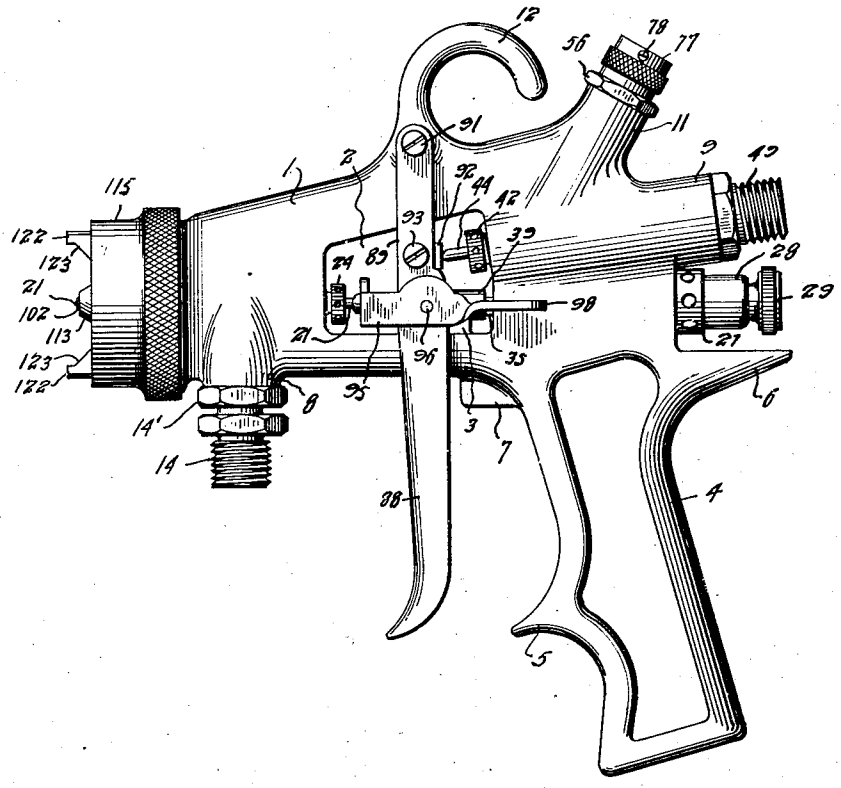


FIG. 2.

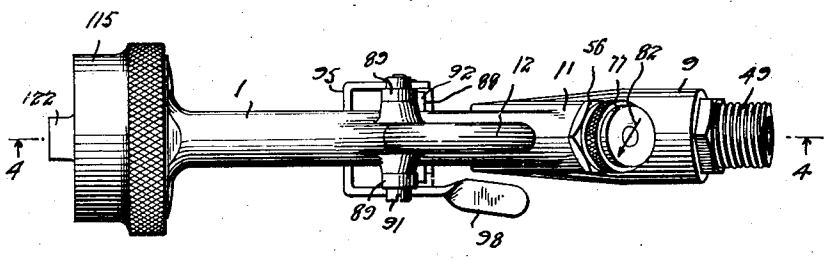
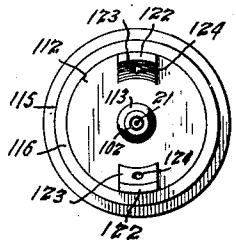


FIG. 3.



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SPRAY GUN

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FIG 4.

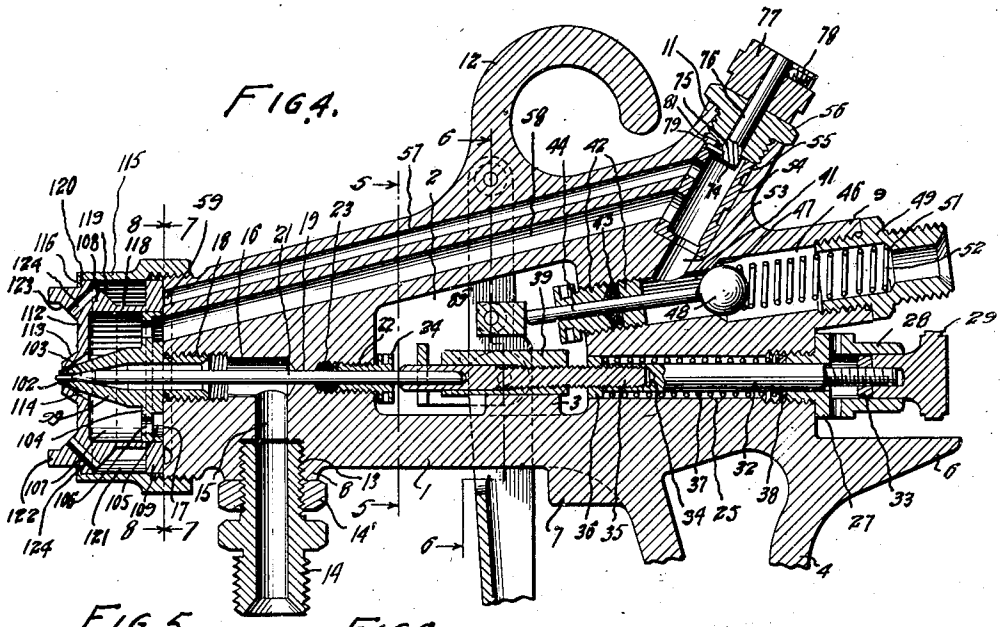


FIG 5

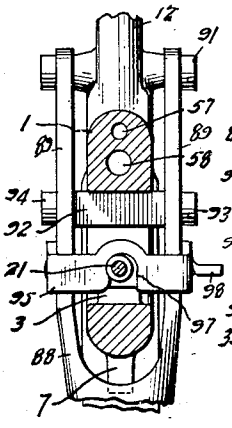


FIG 6.

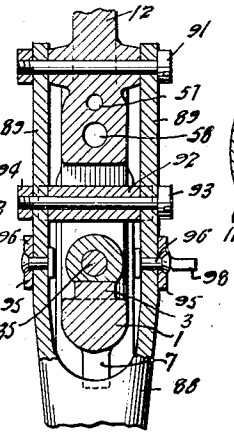


FIG 7.

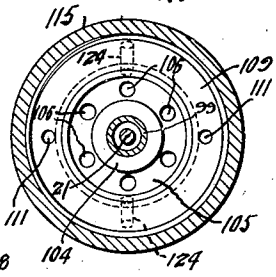


FIG 8.

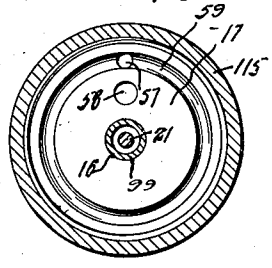


FIG 9.

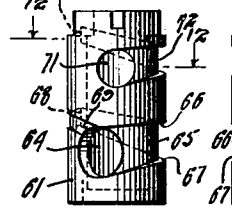


FIG 10.

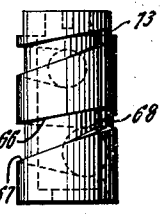


FIG 13.

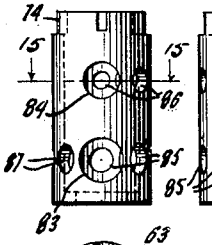


FIG 14.

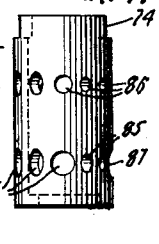


FIG 15.

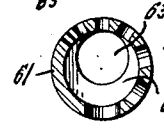


FIG 11.

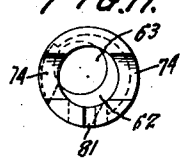
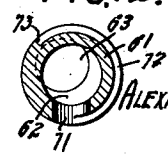


FIG 12.



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SPRAY GUN

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FIG. 16.

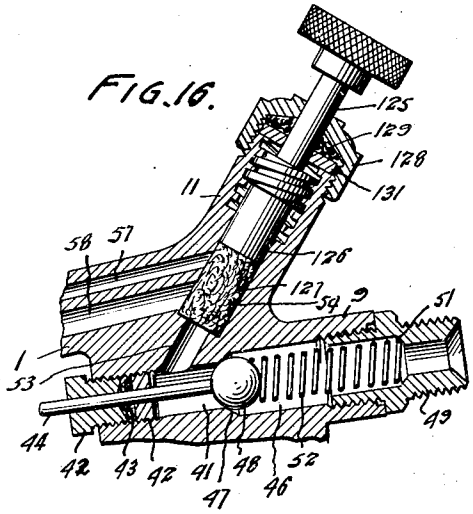


FIG. 17.

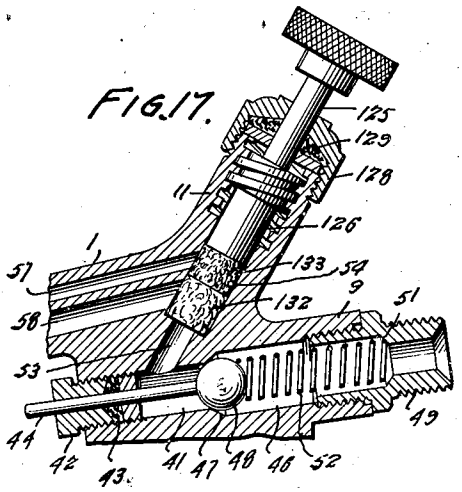


FIG. 18.

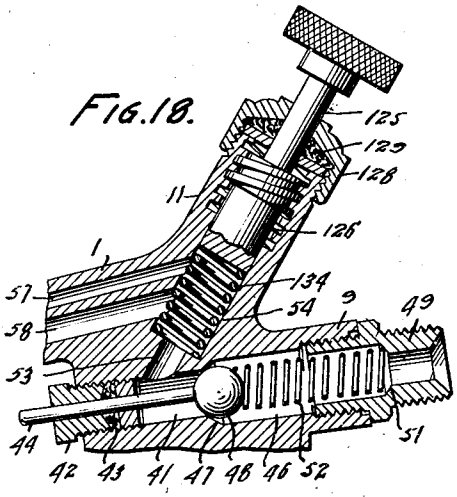


FIG. 19.

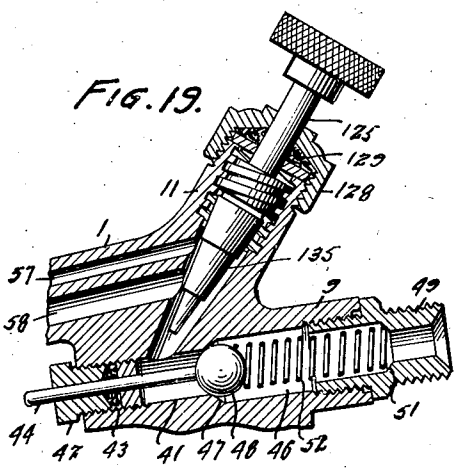


FIG. 20.

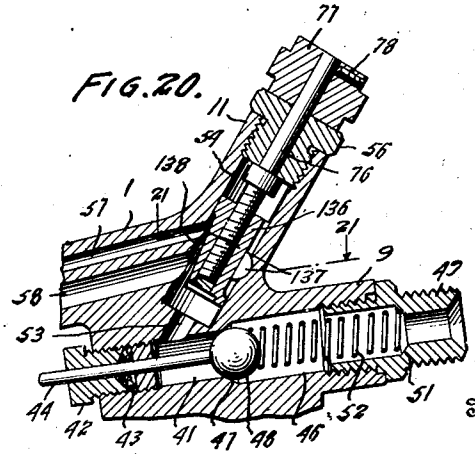
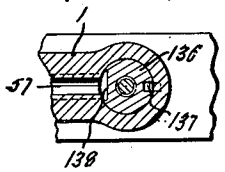


FIG. 21.



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Patented Nov. 27, 1934 1,982,056

UNITED STATES PATENT OFFICE

1,982,056

SPRAY GUN

Alexander F. Jenkins, Baltimore, Md.

Application May 31, 1932, Serial No. 614,584

9 Claims. (Cl. 299—140.1)

This invention relates to spray guns or air brushes, and more particularly to a type adapted for the application of paint or similar coating material, in which the shape of the paint spray may be modified by the operator.

In former devices of this character, there have inhered certain disadvantages. These prior guns have generally been of bulky construction and heavy in weight, and have been of a design in which the operation thereof has in certain instances been awkward. The difficulties in the manipulation of these guns have largely resided in the positioning of the various elements, particularly the inlets and various controlling mechanisms.

Also, no adequate means have been provided for the regulation of the paint spray, both with reference to the volume of the spray and its shape. Generally speaking, the coating material is drawn from the gun by a jet of air designated an "impelling jet", or a so-called "forced feed" system may be employed, which may, or may not, be supplemented by an impelling jet. The shape of the spray is modified by the use of auxiliary jets of air adapted particularly to flatten the emitted jet of paint, and the regulation of these auxiliary jets controls the shape of the spray, from a round spray to a substantially flat spray. Prior guns have failed to adequately control the relative ratios of the air which impels the coating fluid and the jet which modifies the shape of such fluid.

Furthermore, the various passages in such prior guns for the conducting of the air and coating liquid have been such as to render difficult the drilling, tapping, machining, and general manufacture of the device. These passages have, for instance, been crooked or angular, and so positioned as to frequently necessitate the steps of blocking and other operations when such passages are drilled, all of which are obviated by my invention.

The positioning and shape of these passages have also rendered extremely difficult, if not impossible, the cleaning of the device after use, because of the difficulty of reaching certain parts of the various conduits and chambers. The failure to remove the accumulated dirt and residual paint from the passages obviously results in deterioration of the device and necessitates frequent replacements.

And again, the shape of such passages in prior devices has been such as to result in a loss of pressure by virtue of friction, and also the unequal distribution of the air discharged from the gun. Consequently, there is a non-uniform application of paint, and the treated object frequently presents a splotchy or smeared appearance.

To overcome the above mentioned difficulties in prior structures of this general class is one of the objects of my invention.

Another object is to provide a spray gun which is economical of manufacture and sturdy in construction.

Yet another object of my invention is to provide a device in which paint may be sprayed upon a surface to be coated and in which the volume, shape, and velocity of such spray may be closely controlled.

A still further object of my invention is to provide a spray gun of such construction that the various parts may be readily dismantled, cleaned, and reassembled, in which friction of the air with the passage surfaces is reduced to a minimum, and whereby the device may be easily manipulated by the operator.

To accomplish the above, and other important objects as will more fully hereinafter appear, my invention in general comprises the construction of a relatively light spray gun body and associated means to control the discharge of paint therefrom with respect to shape, volume and velocity. My invention also contemplates the elimination of all unnecessary angles in the fluid passageways, and the reduction of friction in such passageways to a minimum.

To facilitate the comprehension of my invention, there is depicted in the accompanying drawings one embodiment thereof, it being of course understood that various modifications may be made therein without exceeding the true scope of my invention as defined in the accompanying claims.

Figure 1 is a side elevational view of my invention.

Figure 2 is a top plan view of the device shown in Figure 1.

Figure 3 is an elevational view of the face of the spray gun head.

Figure 4 is a longitudinal sectional view of the device shown in Figure 1, taken along the line 4—4 of Figure 2, looking in the direction of the arrows.

Figure 5 is a cross sectional view, taken along the line 5—5 of Figure 4, looking in the direction of the arrows.

Figure 6 is a similar view, but taken along the line 6—6 of Figure 4, looking in the direction of the arrows.

Figure 7 is a view in partial cross section of the spray gun head, taken along the line 7—7 of Figure 4, looking in the direction of the arrows.

Figure 8 is a view of the gun body face taken along the same line, but looking in the opposite direction, as indicated by the arrows 8, 8.

Figure 9 is an elevational view of one form of air control valve by which the impelling and modifying air jets are regulated.

Figure 10 is a view of the same valve turned around 180°.

Figure 11 is a top plan view of the valve shown in Figure 9.

Figure 12 is a sectional view of the same valve, taken along the line 12—12 of Figure 9, which follows roughly the tapering of the slot therein depicted.

Figure 13 shows a modified form of valve from that shown in Figures 9 through 12.

Figure 14 is a view of the valve shown in Figure 13, when turned about 180°.

Figure 15 is a sectional view of the valve shown in Figures 13 and 14, along the line 15—15 of Figure 13, looking in the direction of the arrows.

Figures 16 through 20 show examples of various modifications that may be made in the valve arrangement.

Figure 21 is a sectional view of the valve depicted in Figure 20, taken along the line 21—21 of that figure.

Referring more particularly to the drawings, in which similar numerals indicate the same part, it will be observed from Figure 1 that my invention embraces a general body member 1, with a centrally cutaway portion 2, for purposes which will hereinafter be described. The lower edge of the cutaway portion is provided with a lug or boss 3 cast integrally with the body member, or suitably affixed thereto. The upper surface of this lug is flat and smooth.

A hollow handle 4 is provided, which has a protuberance 5 on its forward portion to serve as a guard. A lip 6 at the upper rear portion of the handle projects rearwardly and guards the paint valve knob and air connection. At the upper front side of the handle, a stop 7 is cast onto the body and handle of the gun to limit the extent of movement of the trigger. It will be observed that the construction shown makes for a strong yet light handle, and the hollow feature not only decreases the weight of the handle, but also renders it cool during an operation. The guard 5 and lip 6 also serve to afford a better grip and prevent slipping of the gun when in the hand of the operator.

The body member 1 is provided at its lower forward end with a boss 8 adapted to receive suitable fittings for connection with the supply of paint or other coating material. At the rear end of the body portion is another boss 9, likewise drilled to receive suitable fittings for connection with the air supply source. And a boss 11, slanting upwardly and rearwardly, is provided immediately in front of the boss 9. This boss is interiorly drilled to receive an air valve mechanism, all as will be more fully pointed out hereinafter.

A hook 12 is provided at the top of the body portion by which the gun may be suspended when not in use.

I prefer that the body portion and handle, together with the associated parts just described, be cast in a single piece, and have found that an aluminum alloy makes a particularly desirable material, although the gun may be composed of other suitable material, if desired. It is also of course obvious that the various parts of the device may be formed in some other suitable manner, such for instance as by forging, and it will also be understood that the several elements hereinbefore referred to might be separately formed and assembled.

There are drilled in the body portion of the gun various passages and chambers, as best shown in Figure 4, and it will be noted that these drillings are all straight and in general in the same direction. This obviates the necessity of blocking at the time of the drilling operations, and also very materially reduces the resistance offered to the air and liquid traversing the several passages. As a result, the air and fluid are delivered at high and uniform pressures with a minimum loss resulting from friction.

The boss 8, for instance, as best shown in Figure 4, is interiorly threaded as at 13 to receive a union member 14, and beyond the threaded recess 13 there is drilled a passage 15 preferably of the same diameter as the interior of the union 14. The union 14 is exteriorly threaded at both ends and a lock nut 14' is employed to securely maintain the union in the boss 8. To the opposite end of the union 14 there may be attached a conduit leading to the paint supply, or, if an appropriate container for the paint is employed, such container may be threaded directly upon the union 14.

At the upper end of the passage 15 there is provided a passage 16, which is in direct communication with the face 17 of the body member. The channel 16 is located at the center of the face 17, as shown in Figure 8. It will also be noted from Figure 4 that the forward end of channel 16 is threaded, as at 18.

Rearwardly from the passage 16 there is drilled a hole of smaller size, 19, adapted to receive a valve stem 21. The hole 19 communicates with a threaded recess 22 which opens into the forward wall of the cutaway portion 2 of the body member. Into this recess 22 there is inserted packing 23 and a packing nut 24, serving to form a fluid tight gland for reciprocation of the valve stem 21.

In the rear portion of the body member, and in direct alignment with the passage 16, hole 19 and recess 22, there is drilled a bore 25 extending from the rear wall of the cutaway portion 2 to the rear of the body member. The bore 25 is adapted to receive the associated parts of the valve stem 21.

The rear end of the bore 25 is threaded, and there is screwed into this threaded end a nut 27. The nut 27 is provided with a sleeve flange 28 within which there is adapted to slide a knurled knob 29. The knob 29 is screwed upon a reduced threaded end of a rod 32. A lock nut 33 serves to hold the knob 29 and the rod 32 in non-rotatable relation when the knob 29 is turned.

The rod 32 at its opposite end is provided with a threaded recess 34, into which is screwed a shaft 35. Into the other end of the shaft 35 there is pressed the valve stem 21. The shaft 35 is held in the rod 32 by means of lock nut 36, which is also adapted to serve as an abutment for a spring 37. The opposite end of the spring abuts against washer 38, which is inserted over the shaft 32 and is held against the forward end of the threaded portion of the nut 27. It will be observed that the nut 27 serves as a sleeve for the rod 32, which may be reciprocated within the nut against the tension of spring 37.

As shown in Figure 4, the thread upon shaft 35 extends well forward of the lock nut 36, and there is threaded upon this shaft a block 39. The block 39 is provided with one flat surface which slides on the boss 3, but is held against rotation by that boss. It will therefore be observed that rotation of the knob 29 results in longitudinal displacement of the block 39 along the length of the shaft 35. The purpose of this displacement will be discussed hereinafter.

It is also to be noted that reciprocation of block 39, without any rotation of shaft 35, results in a corresponding reciprocation of valve stem 21. Such reciprocation is of course against the tension of spring 37, and this spring serves to return the several members to their forward positions.

Immediately above the passage 25, and at a slight angle thereto, is drilled a bore 41, the forward end of which is threaded to receive packing nuts 42 and packing 43. Both of the packing nuts are centrally bored to receive a valve stem 44, and the forward packing nut is provided with engaging means whereby the same may be readily turned. A recess 46 is drilled in boss 9 which is aligned and communicates with the bore 41 by way of tapered walls 47 which form a seat for a ball valve 48. The rear end of chamber 46 is threaded to receive a union 49 which is provided with interior shoulders 51 to form an abutment for a helical spring 52. The opposite end of the spring 52 engages the ball valve 48 and serves to resiliently maintain the valve seated. To the union 49 there may be threaded a conduit from a source of air under the required pressure.

It will be observed that when the valve stem 44 is forced rearwardly, it unseats the ball valve 48, against the tension of spring 52, thereby affording communication between the chamber 46 and bore 41. Upon release of pressure from the stem 44, the spring 52 returns the ball 48 to its seated position, thus closing communication between the chamber 46 and bore 41.

Into the top of bore 41 there is drilled a channel 53, which communicates with a chamber 54 located in the boss 11, and adapted to receive a valve casing 55. The valve 55 will be described in more detail hereinafter, but at this point it may be noted that the valve is maintained in the chamber 54 by means of a nut 56 which is threaded into the upper portion of the valve chamber 54.

There are drilled in the upper portion of the body member 1 two passageways 57 and 58, passageway 57 being of somewhat smaller diameter than 58, and located above the latter. Channel 58 conducts the impelling fluid, while channel 57 conducts the spray-modifying fluid. As shown in Figure 4, the rear ends of these passages open into valve chamber 54, and they extend forwardly in a straight course to the face 17 of the body member. As shown in Figure 8, the passage 57 terminates at its forward end in an annular groove 59 which is formed on the face 17 of the body member, for a purpose which will be described hereinafter.

It will therefore be seen that upon proper manipulation of the valves 48 and 55, communication between the union 49 and the face 17 of the body member 1 is afforded by way of the valve chamber 46, bore 41, bore 53, valve 55, and the two passages 57 and 58. Control of the amount of air introduced to the passages 57 and 58 is effected by valve 55. Various types of valve casings are shown in the drawings, the preferable forms being those of Figures 9 through 12, and Figures 13 through 15.

In the first mentioned form of valve, I have provided a cylindrical body 61, which is partially closed at the bottom by base 62. Into the base 62 there is drilled a hole 63, but it is to be noted that the hole 63 is located off center. Also, referring to Figure 4, it will be noted that bore 53 is drilled off center from valve chamber 54.

In the side wall of the body 61 of the valve there is drilled a circular hole 64, at a sufficient distance above the base to register with the rear end of passage 58. Extending helically about the body from the hole 64 is a groove 65, which, adjacent the hole 64, is of substantially the same width as the diameter of the hole and tapers in a decreasing width away from the hole. The upper wall 66 of the groove as disclosed in Figure 9 describes a partial helix and the lower wall 67 also describes a partial helix, but of greater pitch. This groove is disclosed as of uniform depth in Figures 9 and 10, but it is of course to be understood that it may vary in depth if desired.

The groove 65 does not extend entirely around the circumference of the body, but terminates about three quarters of the way around, as indicated at the dotted line 68 of Figure 9. From the termination 68 there extends a groove 69, of considerably less depth and width than any part of the groove 65, which joins the termination of the groove with the hole 64. The groove 69, although of smaller size than groove 65, nevertheless insures that there is always a discharge of impelling fluid into channel 58 when valve 48 is unseated.

The valve is also provided with a second hole 71, which is adapted to register with the spray-modifying passageway 57 when the valve is in the open position. A helical groove 72 also extends from this hole about the circumference of the valve body 61, terminating at 73. The groove 72 is of suitable depth, and tapers in width toward its termination 73. As in the case of groove 65, the lower wall of groove 72 is of steeper pitch than its upper wall. It is to be noted, however, that there is no groove, corresponding to groove 69, which connects the termination of groove 72 with hole 71.

The top of the valve is notched as at 74 and is adapted to receive a key 75 which is integral with, or at least non-rotatably secured to, a shaft 76 which rotates within the nut 56. The upper end of shaft 76 is pressed into a knurled knob 77, and maintained in non-rotatable relation thereto by means of set screw 78. Rotation of knob 77 therefore results in corresponding rotation of the valve 55.

The key 75 is also provided with a pin 79 which fits within a slot 81 at right angles to the slot 74 of the valve. This insures that the relative positioning of the valve 55 in the valve chamber may be ascertained prior to operation of the gun, for it will be observed in Figure 2 that the top of the knob 77 is provided with an arrow 82. When the arrow points upwardly, hole 64 is in complete registry with passageway 58, and hole 63 in the base of the valve completely registers with the bore 53. It will be observed, however, that the hole 71 is slightly offset from hole 64, being positioned slightly to the right of the axis as shown in Figure 9, for the reason that will be pointed out.

It is of course apparent that the positioning and sizes of the holes and grooves on these valves may be altered. As a matter of fact, a set of valves may be provided with various modifications in these respects, the holes and grooves in the several forms being such as to render each valve especially valuable for a particular kind of work. The ease with which the valves may be removed and replaced facilitates the use of such sets.

The operation of the valve shown in Figures 9 and 10 is believed to be apparent. When the arrow 82 is pointed up, the air pressure within the valve casing 54 is equal to that existing in chamber 46, provided the valve 48 is unseated. There is an unimpeded discharge of air into im-

pelling channel 58, but the passage of air through channel 57 is not at the maximum, for it is to be noted that opening 71 is not in complete registry with that channel.

As the knob 77 is turned clockwise, the hole 63 begins to overlap the base of valve chamber 54, thus serving to cut down the amount of air passing from bore 53 to the interior of the valve casing 55. However, it is to be noted that at no time is this passage of air completely cut off because, notwithstanding the fact that hole 63 is off center, the size of the hole is such as to insure that there is always a registry of part of the hole 63 with the mouth of the bore 53. Also, as the knob 77 is turned clockwise, the hole 64 is moved out of complete registry with passage 58, thus cutting down the amount of impelling air. After a slight clockwise movement from the initial positioning of the knob 77, hole 71 is thrown into full registry with passage 57.

I find it preferable that there be an initial discharge of the impelling air, which is carried by passage 58, prior to the initial discharge of the modifying jet which is carried through passage 57. This is insured by drilling hole 71 slightly to the right of hole 64. In general, I find it also desirable that the pressure of the impelling air be always in excess of the modifying air. In this connection, it is to be noted that, while the hole 71 may be in complete registry with its corresponding passage when the registry of hole 64 is decreased, nevertheless even this partial registry of hole 64 insures a greater supply and pressure in passage 58 than is obtained in passage 57 upon complete registry of hole 71. It will also be observed that hole 71 is of smaller diameter than hole 64, and that passage 57 is smaller than passage 58.

Upon further clockwise rotation of knob 77, hole 71 is first thrown out of complete registry with passageway 57 and there is a decrease in the amount of air admitted to the passages 57 and 58. After the holes 64 and 71 have been thrown out of even partial registry with the passages 57 and 58, there nevertheless continues, for a predetermined further movement of the valve, a passage of air to such channels 57 and 58. This is accomplished by virtue of the grooves 65 and 72. Even though the amount of air introduced into the interior of the valve 55 is decreased by rotation, in view of the decrease in the effective size of hole 63 in the base, there nevertheless is always present in the valve 55 an amount of air under pressure. This air passes through the holes 64 and 71, and thence into the grooves 65 and 72.

It will be observed that, notwithstanding the grooves 65 and 72 decrease in width, thus restricting the passage of air therethrough, they nevertheless do permit the air to pass through such grooves and into the passages 57 and 58. It will be noted also that the pitch of the grooves 65 and 72 is such as to insure that they will at all times be in registry with passages 57 and 58 to varying extents, depending upon the position of the valve, and thereby affording communication between the interior of the valve and those passages. As is the case with the holes 64 and 71, groove 65 is always larger than groove 72, for any given position of the valve, and, therefore, as heretofore pointed out, the air in passage 58 is always in excess of that existing in passage 57.

As stated, groove 72 terminates abruptly, as at 73. A short distance beyond the termination of groove 72, groove 65 also terminates. This slight difference in the termination of the two grooves is in keeping with my discovery that it is preferable to maintain the pressure and air in the impelling passage 58 always in excess of the modifying passage 57. Therefore, in the clockwise rotation of the valve, the modifying jet is the first to be cut off and a short time thereafter the impelling jet is substantially cut off.

The impelling jet is never completely cut off, however, because, as heretofore pointed out, there is a groove 69 which extends from the termination 68 of groove 65 to hole 64. This groove 69, of considerably less depth and width than any part of groove 65, insures that there is always at least a slight passage of air from the interior of the valve 55 to passage 58.

The operation of valve 55, as just described, is of course on the assumption that ball valve 48 has been unseated to permit passage of air from chamber 46 to bore 41.

Substantially the same principle is applied in the form of valve disclosed in Figures 13 through 15, but in lieu of the grooves just described, I have provided a series of holes of varying sizes. In this form of valve, the body portion 61 is substantially similar to the body portion of the first described valve, and is provided with notch 74 and slot 81 for engagement with the key 75 and pin 79 of the knob. Likewise, there is a base member 62 and hole 63.

There is a relatively large hole 83, corresponding to hole 64 of the first form of valve, which is adapted to completely register with passage 58 when the arrow 82 is perpendicular. A hole 84 also corresponds with hole 71, and here again it is to be noted that hole 84 is disposed slightly to the right of hole 83, so that it does not completely register with passage 57 until after limited clockwise movement of knob 77.

Extending to the right of hole 83, there is a series of holes 85 of progressively decreasing size; and a similar set of progressively decreasing holes 86 extend rightwardly from hole 84. It will be observed from Figures 13 and 14 that the holes 86 cease, at a point on the circumference of the valve body which corresponds generally to the termination 73 of groove 72. While the decreasing in the size of holes 85 stops at a point slightly to the right of the smallest hole 86, at a point which corresponds roughly with the termination 68 of groove 65, from such smallest hole 85 there are two holes 87 of progressively increasing size to initial hole 83.

Here again, it is to be noted that I provide for an initial passage of air into channel 58 prior to any passage of air into channel 57. It will also be observed that the hole 83 is larger than hole 84, and holes 85 are larger than corresponding holes 86. And also, it will be noted that the smallest hole 85 is displaced a slight distance to the right of smallest hole 86. While there are no openings for a slight distance between smallest hole 86 and hole 84; in the case of the lower line of holes I provide in the space corresponding to the blank in the upper line, holes of gradually increasing size.

The operation of this valve is substantially the same as the valve shown in Figures 9 through 12, the hole 83 being in registry with passage 58 when the arrow 82 is perpendicular. Clockwise rotation of knob 77 throws hole 83 out of communication with passage 58, and hole 84 first into communication with passage 57 and then also out of registry with that passage. Successively smaller holes are thrown into communication with the passages 57 and 58, until the smallest hole 86

has been passed. Further rotation of the valve maintains the passage 57 cut off from the interior of the valve, but successively larger holes 87 register with passage 58, until the valve is returned to its initial position, in which hole 83 opens passage 58.

During this same rotation, hole 63 in the base of the valve is first partially cut out of register with bore 53 and thence is thrown back toward complete registration. As in the case of the grooved valve, there is always, however, air within the valve, which passes into the passages 57 and 58 according to the position of the valve. It will be observed that in the case of this form of valve, both jets are decreased with rotation of knob 77, but in the necessary ratio, which insures that the pressure in passage 58 will always be in excess of that in passage 57.

I have provided a trigger for the actuation of valve stems 21 and 44. As shown in Figures 5 and 6, the trigger 88 is bifurcated to straddle the body portion 1, having arms 89 which extend from immediately below the body portion to a point of pivot 91 near the hook 12.

At a point substantially opposite the forward end of valve stem 44, a block 92 is provided which extends through the opening 2 and is secured to the arms by means of bolt 93 and nut 94. This block 92 is adapted to contact with the forward end of the valve stem 44.

Immediately below the block 92 I provide a stirrup 95 which is pivoted to the arms 89 by means of bolts or rivets 96. The forward end of this stirrup is recessed as at 97, permitting the sides of the stirrup to assume a position substantially parallel to the valve stem 21 and shaft 35. The notched portion fits over the shaft 35, and upon rearward movement of the pivot the forward portion of the stirrup abuts against the block 39. Further movement of the trigger causes a corresponding movement of the block, which in turn retracts valve stem 21, shaft 35 to which the block is threaded, rod 32, and knob 29. As will be pointed out hereinafter, this movement admits paint or other coating material to the discharge orifice.

The exact time, and extent, to which the needle valve 21 is opened is determined by the relative position of block 29 on shaft 35. As heretofore stated, the under surface of block 39 is flat and rests upon abutment 3. This engagement of block 39 and abutment 3 prevents rotation of the block, although permitting reciprocation of the block on the abutment. Also, rotation of knob 29 effects a corresponding rotation of rod 32 to which it is locked, shaft 35 and valve stem 19. However, inasmuch as block 39 is held against rotation by abutment 3, and is threaded onto shaft 35, the rotation just described results in the relative displacement of block 39 along the length of shaft 35. And this relative displacement on the shaft 35, in turn, determines the time at which the stirrup 95 abuts against the block 39, and also the extent to which the needle valve opens the paint-discharge orifice.

It will be observed that in the case of ball valve 48, the forward portion of valve stem 44 is fixed. The ball valve 48 can extend no farther forwardly in the chamber than seat 47. Therefore, the block 92 will abut against the valve stem 44 at a fixed point in the oscillation of the trigger 88, and the valve 48 will always be opened at a given time. In the usual operation, this time is always prior to the opening of needle valve 21, so that no paint is discharged from the gun until there is sufficient air at its point of discharge to effect thorough atomization. This prevents any dripping of the paint from the nozzle.

It will be noted that one arm of the stirrup 95 extends well to the rear of pivot 96 and is turned to form a thumb piece 98. The stirrup, therefore, may be lifted as a safety measure so that when the trigger is pulled, no engagement with the block 39 is effected. When the stirrup is so lifted, no paint can be discharged, and the trigger tends merely to actuate the valve 48 to discharge air alone. The stirrup 95 may also be lifted to facilitate the insertion and removal of the valve stem 19, and its associated parts, into the gun.

The gun is provided with an atomizer head, composed of several elements whereby it may be readily removed and reassembled. As heretofore pointed out, the forward end of chamber 16 is threaded, and is adapted to receive a screw threaded shank of a nozzle 99. As will be seen in Figure 4, the nozzle is provided with a central bore, which is tapered at its forward end to form a discharge orifice 102. The forward end of valve stem 21 is correspondingly tapered to form a needle valve 103, which in its normal and forward position finds a seat in the tapered wall and serves effectively to close the discharge orifice 102. Retraction of the valve stem 21 by actuation of its associated mechanism, as heretofore pointed out, unseats the needle valve 103 to open orifice 102 and thereby permit the discharge of paint or other coating material.

Nozzle member 99 is provided with a radial flange 104, the rear face of which is adapted to fit firmly against the face 17 of the spray gun. The rear wall of the flange 104 has cut into it an annular groove or recess 105, which is so positioned as to register with the forward or discharge end of impelling channel 58. Spaced along this groove 105 are holes 106 which extend from the groove 105 to the forward face of flange 104.

The holes 106 open into a chamber 107 formed by an atomizer head 108. The atomizer head 108 is adapted to fit firmly about the radial flange 104 of the nozzle, and is in turn provided with a radial flange 109, the circumference of which extends to substantially the circumference of face 17, and the rear edge of which fits firmly against that portion of the face 17 of the gun outside of flange 104. As heretofore pointed out, an annular groove 59 is cut in the face 17 to register with the discharge end of passage 57. The flange 109 covers this groove, and forms an annular channel into which passage 57 discharges. Flange 109 is provided with two openings 111 which are drilled diametrically opposite each other and register with channel 59. The atomizer head 108 is positioned on the nozzle so that these openings are spaced 90° from passage 57, thus insuring an equal discharge through such openings of air received from passage 57.

The atomizer head 108 is provided with a forward face 112, at the center of which there is a frusto-conical opening 113. The walls forming this opening are so shaped as to provide between their inner surfaces and the outside of the tapered portion of the nozzle 99, a discharge orifice 114 for the impelling air. As shown in Figure 4, this passage 114 opens into chamber 107 formed about the nozzle, and air passes through the channel 114 and is discharged in the form of an annular jet. This jet is adapted to draw paint through the paint orifice 102, when the needle valve 103 has been unseated.

As heretofore pointed out, actuation of the trigger 88 serves to open valve 48, thereby permitting the passage of air through bore 58, and at the same time opens the needle valve 103 to an extent determined by the relative position of block 39 on shaft 35. The paint is therefore discharged from the nozzle 99 in the form of a stream or spray. The extent to which needle valve 103 is withdrawn from the seat 101 determines the relative density of this spray.

The pressure of the impelling air discharged through orifice 114 of course depends upon the amount of air passing through bore 58, which in turn is determined by the position of valve 55. As heretofore stated, the extent to which ball valve 48 is opened is fixed for any given movement of the trigger 88. In the absence of other provisions, the paint discharged from the orifice 102 will always be in the form of a round spray or stream.

It is usually desirable that this spray be applied in the form of a relatively flat sheet, rather than in the form of a round stream or spray. I secure this modification in the form of the spray by means of my improved atomizer head 108. The head 108 is held in position by means of a collar 115, which is provided with an inwardly extending radial flange 116 at its forward end, and at its rear end with interior threads whereby it may be enthreaded upon the forward end of the gun body. The head 108 is provided with a cylindrical portion 118. At the forward end of cylindrical portion 118, the exterior of the nozzle head is inclined at an angle, as at 119. At the forward end of the inclined portion 119, the nozzle head is provided with a surface 120 which is perpendicular to the face 112, and is of sufficient extent to afford a seat for the collar 115. The flange 116 engages the front face of the nozzle head 108. It will also be noted that a chamber 121 is formed between the nozzle head and the collar member 119, and it is into this chamber that apertures 111 open.

The various engaging surfaces of my spray gun head are so machined as to afford an air-tight fit between the several surfaces. This machining serves to align and properly position the nozzle with respect to the atomizer head, and these elements are maintained in alignment by collar 115.

Two projections 122 are formed on the face 112 of the nozzle head, being diametrically opposed and spaced sufficiently inwardly from the circumference of the face to clear flange 116 of the collar. Projections 122 are provided with converging faces 123, which it will be noticed are parallel to inclined surface 119 of the head. There is drilled through each projection a channel 124, which is perpendicularly disposed to the converging face 123 and consequently to the inclined surface 115. These passages therefore open into chamber 121, and communication is therefore effected between the converging surfaces 123 and valve 55.

In normal operation, the projections 123 are vertically aligned, and inasmuch as apertures 111 are spaced 90° from passage 57, channels 124 are in turn thereby spaced 90° from these apertures. It will be noted that this relative spacing of passages and apertures insures an equal distribution of the air in chamber 121, and consequently an even distribution of air discharged from channels 124. This is of extreme importance, for slight discrepancies between the discharge pressures in the channels 124 result in appreciable distortion and inaccuracies in the spray. To further insure against such inaccuracies, it will be noted that the channels 124 are equal in length, and the walls of these channels are of equal length throughout. Therefore, the air discharged from the mouths of the channels is of uniform velocity and pressure, and travels in a straight line from the channels.

It will be noted that the channels 124 are so disposed as to direct the air discharged therefrom onto the stream or spray of fluid discharged from orifice 102. This serves to flatten out the spray, so that at the time of its application to the surface which is to be coated, it is in the form of a relatively flat sheet. The extent to which the spray is flattened is of course dependent upon the relative velocity of these modifying air jets and the impelled fluid, which can be so controlled as to secure any shape from round to substantially flat. The velocity of the paint in turn is governed by the pressure of the impelling air discharged through orifice 114. However, as heretofore pointed out, the construction of valve 55 is such as to always insure the proper ratio between the impelling and modifying air jets. In other words, when the velocity of the impelling air jets is decreased, there is obtained the necessary decrease in the modifying jet to secure a spray in the properly flattened form. It is to be remembered that it is possible, by manipulation of valve 55, to entirely cut off the modifying air at the same time that there is maintained a sufficient amount of impelling air to draw paint through the orifice 102. When the valve is in such a position, the paint is of course discharged in the form of a round spray.

While I have shown one form of spray gun head which is particularly well adapted for use with my invention, it is of course obvious that other types of head may be employed.

From the foregoing, it is believed that the operation of my spray gun is readily apparent. A proper supply of paint is provided, and communication with such supply is effected through union 14. This paint may, of course be under pressure if a forced feed is desired. Air under pressure is also provided, and a conduit is secured to such compressed air and union 49. The several valves are then manipulated to secure the desired form of spray. As heretofore pointed out, ball valve 48 is relatively fixed in operation. By manipulation of valves 55 and 39, however, the quantity and pressure of the paint and air are controlled. There are various combinations that can be worked out between the several valves to secure different effects.

For instance, block 39 governs the flow of paint from the maximum down to the minimum, in fact to zero. If the block 39 is moved to its most forward location, the maximum amount of paint will be available. Forward movement of the block 39 is accomplished by rotating knob 29 in a counterclockwise direction. Upon actuation of the trigger, and consequent engagement of stirrup 95 with the forward end of the block 39, a maximum movement to the rear of the shaft 35 is effected, and consequently a corresponding maximum displacement of needle valve 103 from its seat. If it is desired to curtail the amount of available paint, the knob 29 may be turned in a clockwise direction, which retracts the block 39 relative to shaft 35. The movement of block 39 when in this retracted position as a consequence of actuation of the trigger, therefore results in a more limited opening of the needle valve. As

above pointed out, block 39 may be so far retracted that it is never engaged by the stirrup 95.

Also, as heretofore stated, when the trigger is pulled, block 92 engages the forward end of valve stem 44, and the resulting movement of that stem unseats the ball valve 48. Inasmuch as the opening of valve 48 is fixed, the control of the amount of air discharged from the nozzle head is governed by valve 55. If it is desired to secure a maximum impelling jet, at the same time having the resultant spray flattened out, the knob 77 is positioned so that the arrow 82 points upwardly. In this position, the hole 63 in the base exactly coincides with bore 53, and hole 64, or 83, in the side of the valve is in complete registry with channel 58. Holes 71 or 84 are in substantial, although not complete, registry with passage 57. When the valve 55 is in this position, and if block 39 is in its most forward position on shaft 35, a heavy, dense, but flattened spray is obtained. If the block 39 is rearwardly displaced relative to the shaft 35, a powerful and flattened spray is obtained, although the quantity of paint is not as much as if the block 39 were in its more forward position.

A very limited clockwise rotation of arrow 82 from the vertical will increase the force of the modifying jet, for the hole 71 or 84 will come into more complete registry with passage 57. However, as above pointed out, even at its maximum the modifying jet never equals the impelling jet. Further clockwise rotation of knob 77 curtails the force of both the impelling and modifying jets. This results both from the fact that decreased amounts of air are admitted to channels 57 and 58 by virtue of the decreasing size of the grooves 65 and 72, or holes 85 and 86; and also by reason of the fact that the effective size of the hole 63 in the base of the valve is diminished by such rotation. While valve 55 is being closed, the same considerations govern the position of block 39 as heretofore discussed—namely, in the most forward position of this block a heavier spray is obtained, while in the more rearward position a lighter or more finely divided spray is obtained.

If it is desired to have a round spray, the knob 77 is turned until the valve 55 completely closes the passage 57. As already indicated, however, even with passage 57 completely shut off, some selection may be obtained in the pressure within the channel 58, by virtue of holes 87 in the valve.

The path of the air through my gun is believed to be also readily apparent from the drawings. It enters the union 49 and passes into chamber 46. When the valve 48 is opened, the air may then enter bore 41 and thence pass into bore 53. From the latter bore, the air passes to the interior of valve 55 and thence by way of the respective openings into channels 57 and 58. The modifying air from channel 57 passes into the groove 59 and around this groove to holes 111. From holes 111 the air enters the chamber 121 and then passes out through channels 124 in the nozzle head, and impinges upon the spray of paint ejected from the nozzle. It will be observed that the path of the air is relatively straight-forward, with a minimum of angles; and it is to be particularly noted that, immediately prior to discharge, the air passes through a channel, all sides of which are of uniform length, and consequently leaves the gun in a straight and uniform stream. The importance of this is appreciated when it is remembered that even slight aberrations from the proper form of modifying jet result in distortions of the paint spray of considerable magnitude.

The impelling air leaves the interior of valve 55 and flows through passage 58 to groove 105 cut in the rear wall of nozzle flange 104. From this groove the air passes through ports 106 which are spaced equi-distant around such grooves. The impelling jet then enters chamber 107, and passes through orifice 114 to draw out and thoroughly atomize the paint, the amount of paint being controlled by the position of needle valve 103.

As heretofore pointed out, the valve 55 may be readily removed from the chamber by merely unscrewing nut 56. While valve casings of the type shown in Figures 9 through 15 are particularly well adapted for use in my gun, it is of course obvious that other types of valves may be employed. For instance, in Figures 16 through 20 I have shown such alternative forms.

In Figures 16 and 17 there are depicted valve arrangements in which felt or other fibrous material is substituted for the valve casing 55. In this instance the valve chamber is interiorly threaded to receive the square threads of a nut 125. As shown, the nut 125 is provided with a knurled knob corresponding to knob 77. The lower portion of this nut is provided with a barrel 126, which is adapted to bear against felt 127 located in the lower portion of the valve chamber. It will be observed that the felt or other fibrous material extends from the base of the chamber to above the modifying passage 57.

The nut 125 is adapted to rotate and reciprocate within nut 128 which is enthreaded upon the boss 11, and which, together with packing 129 and washer 131, effectively closes the valve chamber 54. It will be observed that the turning of nut 125 in a clockwise direction compresses the felt 127 thereby diminishing the passage of air therethrough. The air within the channels 57 and 58 is thereby reduced proportionately, and, in view of the smaller size of channel 57, the modifying jet will always be less than the impelling jet. There is usually sufficient resiliency in the felt 127 to cause its expansion upon retraction of barrel 126, but, if necessary, a spring may be embedded in the felt to insure such expansion.

The arrangement shown in Figure 17 is similar to the form of Figure 16, except I have disclosed felt of different sizes. The lower layer of felt 132 may be of coarser texture than the upper layer 133. Felt 132, it will be observed, lies opposite channel 58, while the finer felt 133 is located adjacent the channel 57. The coarser felt of course cannot be compressed to the same extent as the finer felt, thus permitting better passage of air therethrough. Consequently, the impelling jet will be in excess of the modifying jet at all times, and even when both layers are compressed, this desired ratio obtains. As in the case of the forms shown in Figure 16, a spring may be embedded in felts 132 and 133 to insure expansion, if necessary.

Both of the forms shown in Figures 16 and 17 will serve to adequately control the passage of air through channels 57 and 58, and to maintain the desired ratio of air within those channels. It is also to be noted that the construction shown in these figures is extremely economical to manufacture, and may be operated with the maximum of ease.

In Figure 18 I have shown a form of valve in which a spring 134 may be substituted for the felt of Figures 16 and 17. It will be noted that the associated valve mechanism is similar to the

mechanism discussed above with reference to the valve formed of felt. The spring 134 is adapted to be compressed upon clockwise rotation of nut 125, thereby reducing the space between the several coils of the spring. This reduction of course cuts down the passage of air through the spring, and thereby controls the amount of air entering the channels 57 and 58. The spring 134 may be so far compressed that the contiguous coils contact with one another to substantially prevent the passage of any air to channels 57 and 58. Obviously, upon retraction of bolt 126 the spring 134 expands, thus increasing the spaces between the coils and permitting substantially the unimpeded passage of air into the two channels. While not shown in the drawings, it is of course apparent that the upper coils of the spring opposite channel 57 may be of lighter construction than the lower coils opposite the channel 58. This will insure the closing of channel 57 at a faster rate than channel 58.

Still another modificaiton is shown in Figure 19, in which I have employed a nut provided with stepped portions at its lower end as indicated by the numeral 135. The valve chamber in this case is likewise tapered, but it is to be noted that shoulders are not provided in the chamber to correspond with the shoulders of the nut. The absence of shoulders in the valve chamber insures that there will always be a passage of some air into the channel 58, even after the upper shoulder of the nut engages the valve chamber. After such engagement, there is an annular space between the stepped portion opposite channel 58 and the walls of the casing.

Again, in Figures 20 and 21 there is shown a form of valve, in which there is provided a knob 77 and shaft 76 similar to that shown in Figures 9 through 15, and provided with closure nut 56 for the valve chamber. The lower end of shaft 76 is threaded, and adapted to receive an interiorly threaded block 136. This block 136 is provided with a key 137 adapted to fit within a corresponding groove in the wall of the valve chamber to prevent rotation of the block. The face of the block opposite channels 57 and 58 is angularly cut away as at 138.

It will be observed that as knob 77 is rotated, block 136 rides upon shaft 76. Such reciprocation of course varies the amount of air admitted to channels 57 and 58 by virtue of the tapered section 138 of the block. In this instance also it will be noted that the amount of air admitted to channel 58 is never entirely cut off, for even when block 136 is in its most lowered position, there is still a space between the block and the mouth of channel 58.

In connection with all the valves referred to herein, I wish to point out that the inlet valve 48 is positioned in the air passage prior to the control valve. By this arrangement, there is no possibility of air leaking around the control valve, when the inlet valve is closed. No air is admitted to the control valve until the inlet valve 48 has been opened.

It will be apparent that I have devised an improved spray gun, combining in a novel way various advantages over prior devices of the same general character. As pointed out, the body and handle may be cast of aluminum, and then this casting drilled as required for the necessary passages. Obviously, a gun of this character is extremely light in weight, without sacrificing strength or durability.

Also, it will be noted that the arrangement of my gun is such as to afford convenient operation. For instance, there is no air inlet through the handle of the gun, and in the positioning of my air inlet, the hose may be merely thrown over the shoulder of the operator. The positions of the two control valves are extremely accessible and may be readily manipulated by the free hand of the operator. Furthermore, it will be noted that these valves are so located as to be relatively protected.

By my air control valve, I am able to secure a relatively close control of both the impelling jet and the modifying jet, at all times, however, maintaining the impelling jet in excess of the modifying jet. The regulation may be easily effected by my valve and yet the desired ratio between the several jets is always insured. It is to be noted that in connection with the valves they may be readily removed and any particular form of valve substituted.

I wish to call particular attention to the advantages secured in my gun by reason of the positions and direction of the various passages. The relative arrangement of these passages reduces the bulk of the gun considerably, at no sacrifice of efficiency. It will be noted that all of the passages and chambers are straight line drilling, thus obviating the necessity of plugging. For instance, chambers 16, 21 and 23 are all in line and are secured merely by changing the size of the several drills, again, it will be noted that bore 25 is all in a straight line. It will also be observed that bore 41 and chamber 46 are aligned, as are also bore 53 and valve chamber 54. The same is true of the threaded recess 13 and bore 15; and finally, channels 57 and 58 are straight drilled from the face of the gun to valve chamber 54.

The improvement resulting from such an arrangement not only facilitates manufacture of the gun but is of particular advantage in cleaning or any necessary repair of the gun. All of the passages may be very readily reached, for the purpose of removing any dirt or residual paint that may accumulate. And in this connection, there is to be noted the ease with which the entire gun may be assembled or dismantled. As heretofore pointed out, the knob 29, nut 28, shafts 31, 35, needle valve and valve stem, and block 39, together with the lock nut 36 and spring 37, are all joined together, and may be removed merely by unscrewing nut 28. The various passages occupied by these elements may then be readily cleaned. Also, as pointed out, nozzle 99, nozzle head 108 and collar 115 are separate, and may be readily removed and individually cleaned of any undesirable products. Valve 48 may also be easily reached by removal of union 49, which also permits the removal of spring 52 and valve stem 44. Any one of several different types of valve 55 may be readily substituted for one another by merely unscrewing nut 56.

Furthermore, it is to be noted that the arrangement of the various passages reduces to a minimum the friction encountered by the fluids passing therethrough, thus appreciably conserving the pressure of such fluids. The importance of this has been heretofore emphasized, and the proper distribution and pressures of the fluid is of very real importance.

In summary, I have provided an improved paint spray gun, which facilitates painting or spraying of objects, which is comparatively simple in operation, and which produces a spray which at all times is capable of close and accurate control.

While I have used specific terms in certain

parts of this application, such, for instance, as "paint", "air", "spray" and other terms, it is to be understood that my invention is not to be limited thereby. And although I have shown and described some preferred embodiments of my invention, I wish it to be understood that I do not confine myself to the precise details of construction herein set forth, by way of illustration, as it is apparent that many changes and variations may be made therein, by those skilled in the art, without departing from the spirit of the invention, or exceeding the scope of the appended claims.

I claim:

1. In a spray gun, an impelling fluid passage and a spray-modifying fluid passage, a valve chamber in communication with said passages, a valve casing rotatably mounted within the chamber, means in the base of the casing to admit fluid to its interior, an aperture in the casing adapted to register with the impelling fluid passage and one adapted to register with the spray-modifying fluid passage, spiral grooves in the exterior of the casing extending from the apertures at least partially around the circumference of the casing, whereby upon rotation of said casing the flow from said casing to said fluid passage may be regulated or throttled.

2. In a spray gun, an impelling fluid passage and a spray-modifying fluid passage, a valve chamber in communication with said passages, a valve casing rotatably mounted within the chamber, means to admit fluid to the interior of the casing, a plurality of apertures of varying sizes spaced about the circumference of the casing and adapted to register with the fluid impelling passage, and a plurality of apertures spaced about the circumference and adapted to register with the spray-modifying fluid passage upon rotation of the casing.

3. In a spray gun, an impelling fluid passage and a spray-modifying fluid passage, a valve chamber in communication with said passages, a valve casing rotatably mounted within the chamber, means to admit fluid to the interior of the casing, a hole in the wall of the casing of substantially the size of the impelling fluid passage, and a series of holes circumferentially spaced therefrom and decreasing in size, a hole in the casing of substantially the size of the spray-modifying fluid passage, and a series of holes of decreasing size extending circumferentially therefrom in the same direction as the first mentioned series of holes, the spray-modifying series, however, extending around but a portion of the entire circumference of the casing.

4. In a spray gun, an impelling fluid passage and a spray-modifying fluid passage, a valve chamber in communication with said passages, a valve casing rotatably mounted within the chamber, means in the base of the casing to admit fluid to its interior, an aperture in the casing adapted to register with the impelling fluid passage and one adapted to register with the spray-modifying fluid passage, spiral grooves in the exterior of the casing extending from the apertures at least partially around the circumference of the casing, said grooves provided with converging walls, whereby upon rotation of said casing the flow from said casing to said fluid passage may be regulated or throttled.

5. In a spray gun, a valve chamber, a pressure fluid conduit communicating with said chamber and with the nozzle of said gun, an inlet conduit communicating with one end of said chamber through a port which is eccentric with respect to the axis of said chamber, a valve casing adjustably disposed within said chamber, means in said casing affording a discharge of pressure fluid into said first named conduit, an eccentrically disposed inlet port in the base of said casing and cooperating with the eccentric chamber port to vary the flow through said casing upon adjustment thereof.

6. In a spray gun, a valve chamber therein, a plurality of fluid passages communicating with said chamber, a valve casing adjustably disposed within said chamber, variable flow means affording a discharge of fluid from said casing to said fluid passages at a definite ratio, an eccentric inlet port in the base of said casing arranged to completely register with a fluid duct in said chamber in one position of the casing, and to only partially register with said duct upon adjustment of the casing.

7. In a spray gun, a valve chamber therein, a plurality of fluid passages communicating with said chamber, a valve casing rotatably disposed within said chamber, variable flow means affording a discharge of fluid from said casing to said fluid passages at a definite ratio, during rotation of said casing, means for admitting fluid to the interior of said casing comprising an opening in the base of said casing and an opening in the corresponding wall of said chamber, said openings being eccentric with respect to each other and with respect to the axis of said casing, whereby the amount of fluid admitted to said chamber may also be varied upon rotation of said casing.

8. In a spray gun, an impelling fluid passage and a spray-modifying fluid passage, a valve chamber in communication with said passages, a valve casing rotatably mounted within the chamber, a plurality of apertures of varying sizes spaced about the circumference of the casing and adapted to register successively with the fluid impelling passage, and a plurality of apertures spaced about the circumference and adapted to register successively with the spray-modifying fluid passage upon rotation of the casing, cooperating means in a wall of said chamber and in the base of said casing for varying the amount of fluid admitted through said base into the interior of said casing upon rotation thereof.

9. In a spray gun, an impelling fluid passage and a spray-modifying fluid passage, a valve chamber in communication with said passages, a valve casing rotatably mounted within the chamber, an outlet port in the wall of the casing for variably distributing the fluid to said passages of substantially the size of the impelling fluid passage, and a series of such ports circumferentially spaced therefrom and decreasing in size, another outlet port in the casing of substantially the size of the spray-modifying fluid passage, and a series of similar ports of decreasing size extending circumferentially therefrom in the same direction as the first mentioned series of ports, the spray-modifying series, however, extending around but a portion of the entire circumference of the casing, an opening in the base of said casing, an opening in the corresponding wall of said chamber, said openings being eccentric with respect to each other and with respect to the axis of said casing, whereby the amount of fluid admitted to the interior of said casing may be varied upon rotation thereof.

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