United States Patent

[11] 3,633,828

[72] Inventor **James H. Larson**
Amoka, Minn.

[21] Appl. No. **3,889**
[22] Filed **Jan. 19, 1970**
[45] Patented **Jan. 11, 1972**

[73] Assignee **Graco Inc.**
Minneapolis, Minn.

[54] **SPRAY GUN**
18 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **239/412,** 239/526, 239/600, 251/DIG. 4
[51] **Int. Cl.** **B05b 7/12**
[50] **Field of Search** 239/526, 600, 525, 412, 583, 127, 581; 251/DIG. 4

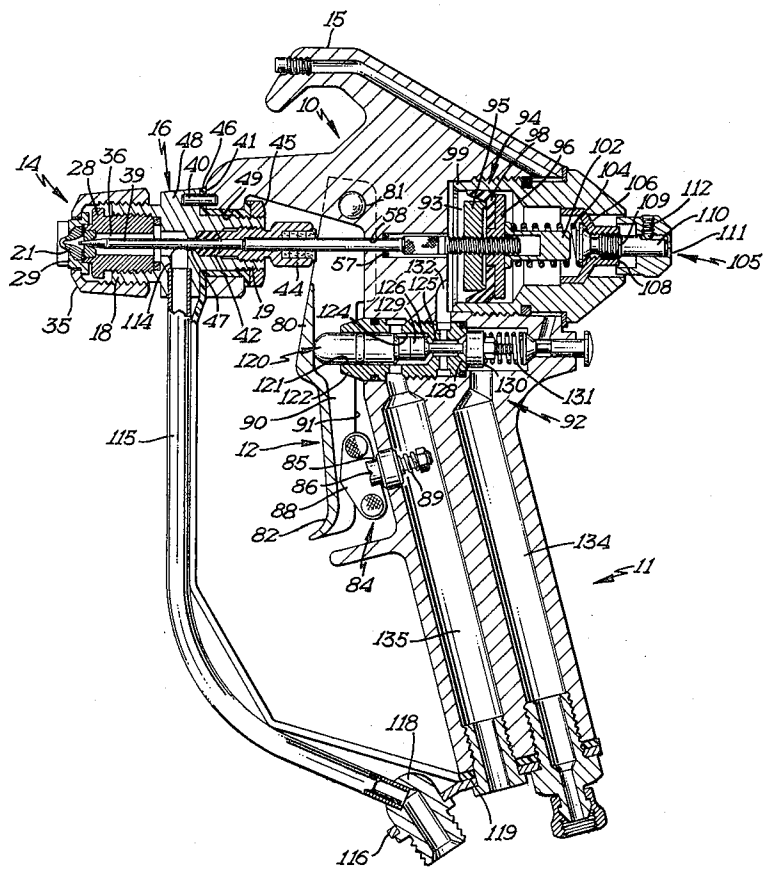
[56] **References Cited**

UNITED STATES PATENTS

2,936,959	5/1960	Nord et al.	239/127
3,556,411	1/1971	Nord	239/581
1,287,756	12/1918	Rork	251/DIG. 4
2,569,251	9/1951	Nieburg	239/526 X
2,829,006	4/1958	Johansson	239/526 X
2,880,940	4/1959	Briggs	239/526 X
2,904,262	9/1959	Peeps	239/526 X
3,022,955	2/1962	Riddell	239/583 X
3,515,355	6/1970	Wagner	239/526

Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—Thomas C. Culp, Jr.
Attorneys—Frederick E. Lange, William C. Babcock and John J. Held, Jr.

ABSTRACT: An improved airless spray gun suitable for fine finish spraying. The spray gun includes a body with a spray nozzle assembly secured to its forward end. The nozzle assembly houses a valve assembly and more particularly a valve seat of special shape and location and a needle designed to cooperate with the seat. Contact between the valve seat and the needle defines a closed position, whereas the needle and seat may be moved relatively apart to an adjustably controlled open position, permitting paint or other fluid under pressure to flow at an adjustable controlled flow rate through an annular passageway between the valve seat and the needle, to be formed by the shape and location of the parts into a thin annular cone-shaped sheet, with its vertex impinging at a spray nozzle opening, and to be forced through the nozzle and atomized thereby producing a spray pattern suitable for fine finish spraying.



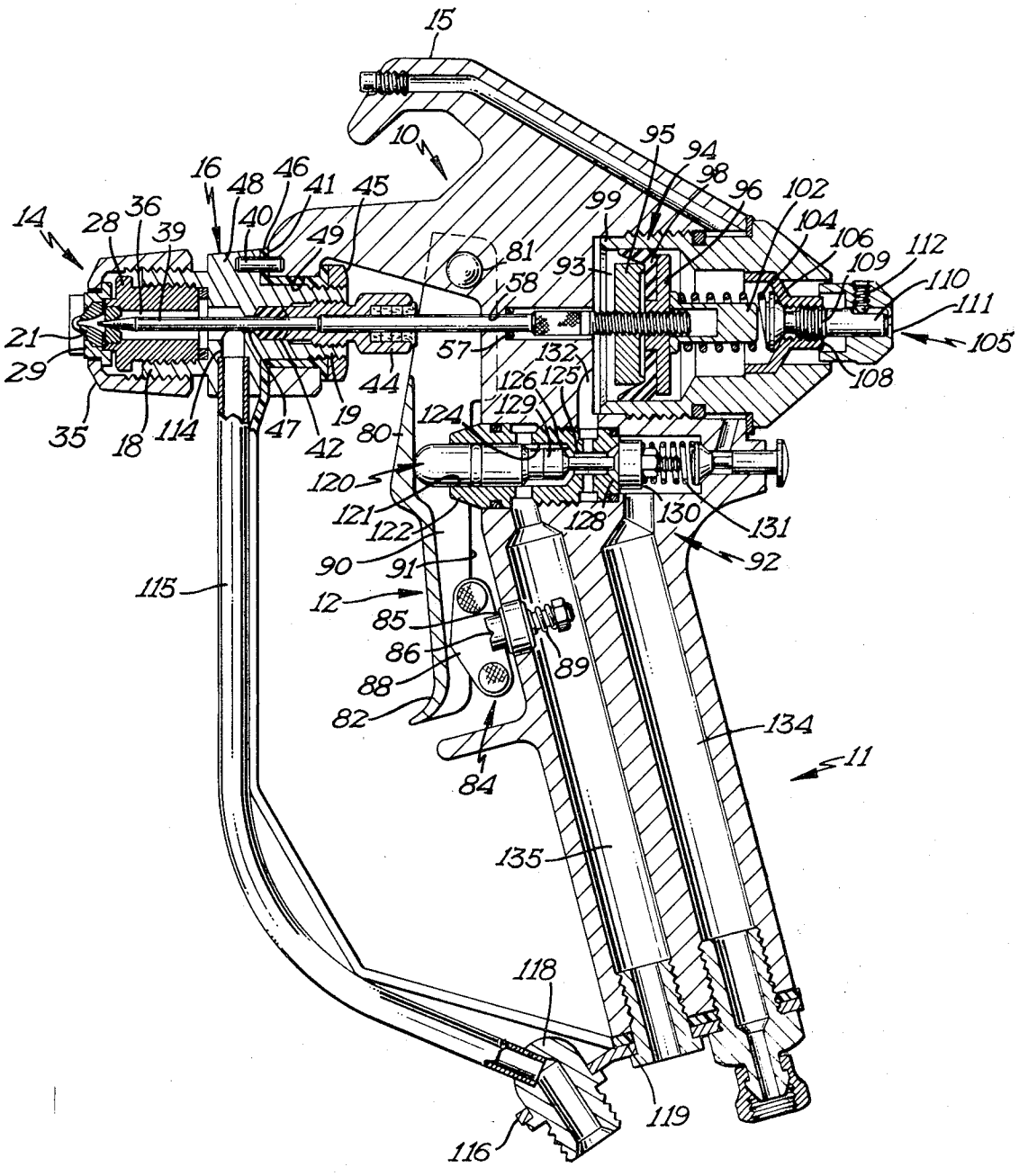


FIG 1

INVENTOR.
JAMES H. LARSON

BY William C. Babcock
and John J. Held Jr.
ATTORNEYS

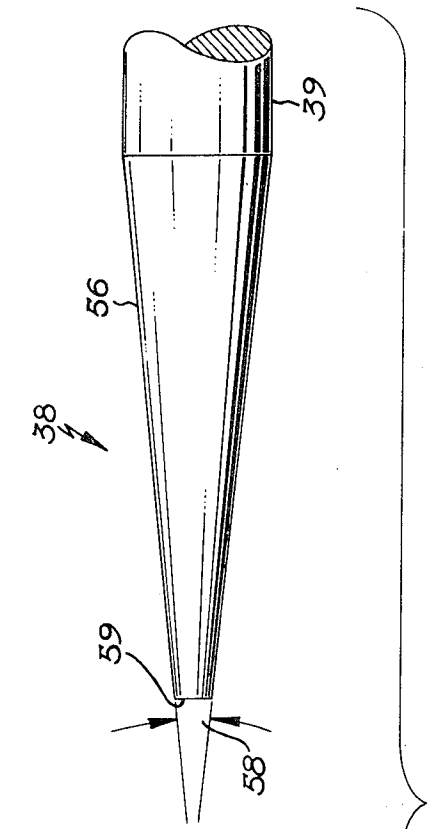
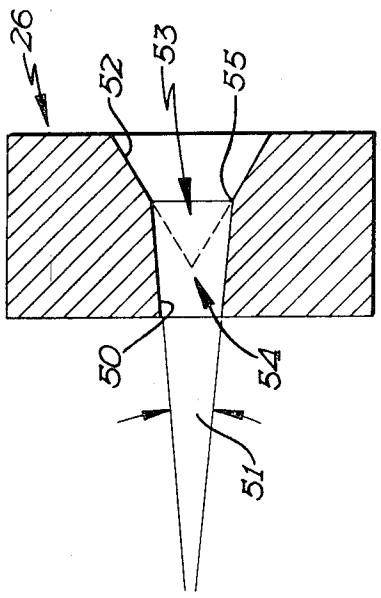


FIG 3



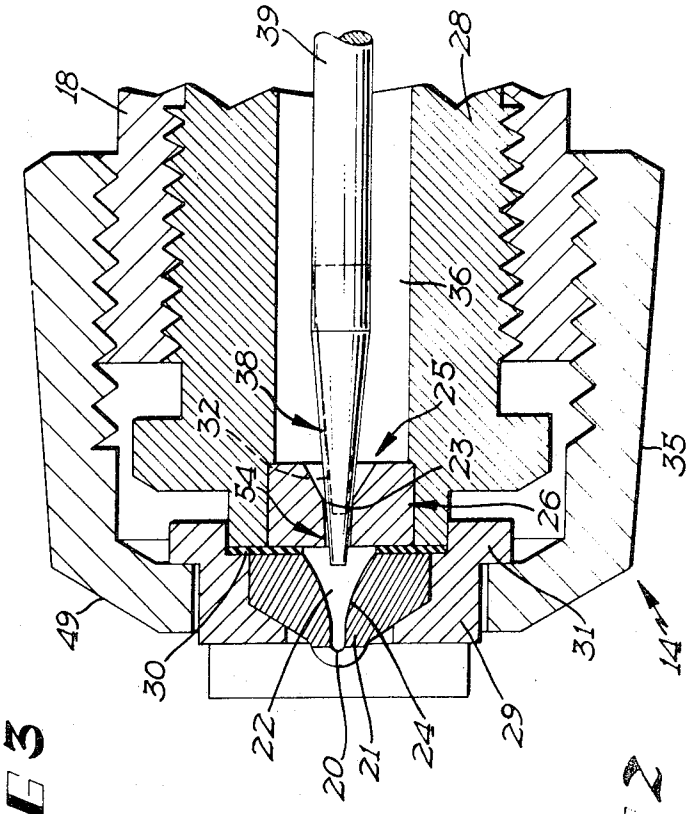


FIG 2

INVENTOR.
JAMES H. LARSON

BY William C. Babcock
and John J. Kelly Jr.
ATTORNEYS

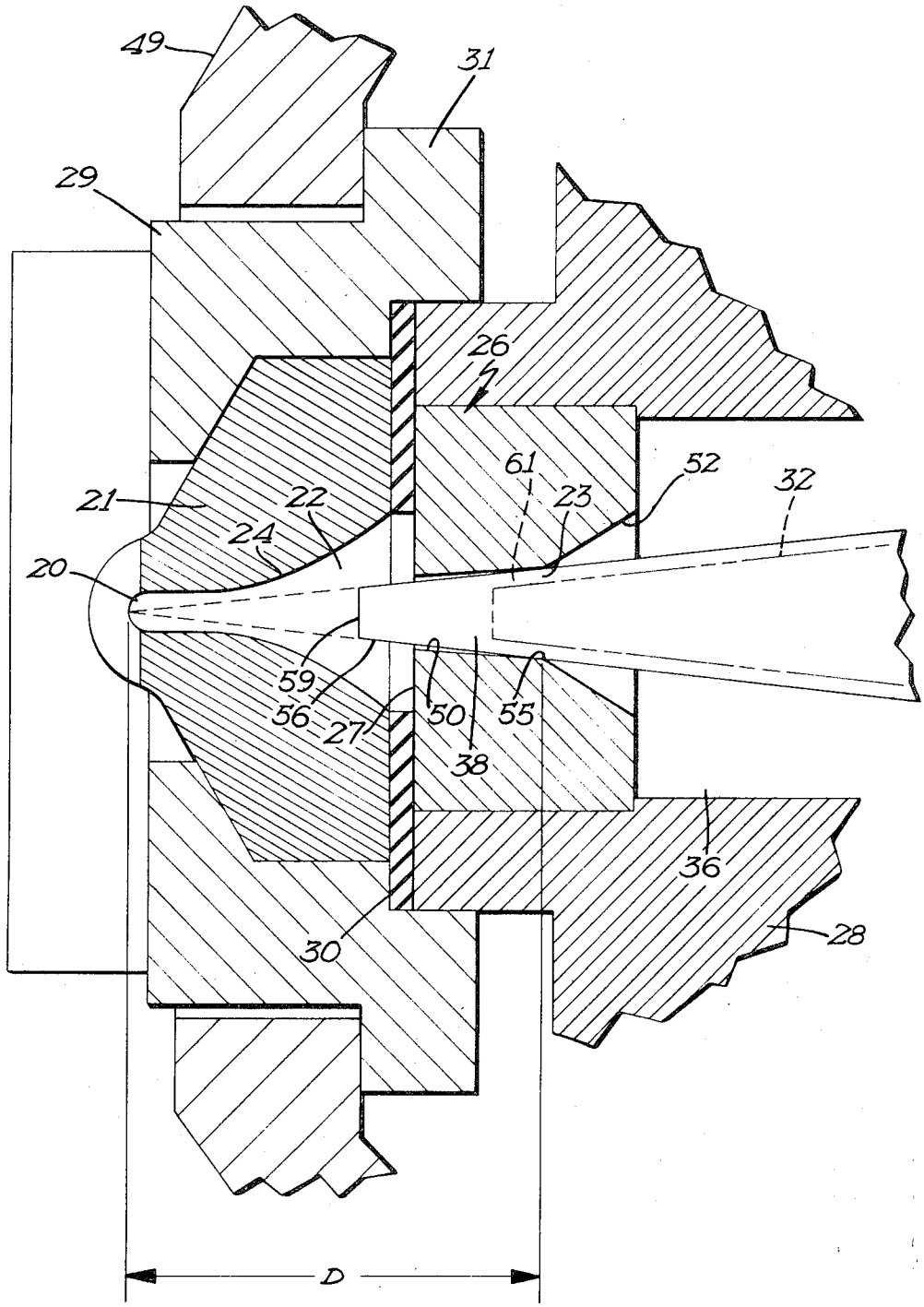


FIG 4

INVENTOR.
JAMES H. LARSON
BY William C. Babcock
and John J. Field Jr.
ATTORNEYS

SPRAY GUN

BACKGROUND OF THE INVENTION

This invention relates to an airless spray gun and more specifically to an improved airless spray gun suitable for the fine finish spraying required by many articles of manufacture.

It has long been recognized that there are two basic methods of paint spraying, air spraying and airless spraying. In air spraying, small particles of paint are entrained in a high velocity flow of air through a spray nozzle with the air helping to atomize and propel the paint against the surface to be painted. With air spraying, a spray pattern of uniform density having a feathered edge can be obtained on almost any type of surface. The uniform density makes air spraying desirable for fine finish spraying while the feathered edge permits a uniform coating to be applied to the entire surface to be painted by overlapping the feathered edge portions on subsequent parallel sweeps of the spray gun. The principal disadvantage in air spraying is a result of the escape of the air used to entrain and atomize the paint. This air carries with it a substantial amount of paint and paint solvents resulting in excessive waste and dangerous conditions due to the presence of the inflammable particles remaining in the air. Thus, although the desired spray pattern is obtainable from air spraying, the cost is high in terms of waste and the need for adequate ventilation.

In airless spraying, paint is delivered under high pressure to an atomizing nozzle where it is accelerated to a high velocity and propelled toward the surface to be painted. The main advantage of airless spraying is the absence of the "over spray" (loss due to the escape of paint-saturated air) present in air spraying. This substantially reduces the waste and minimizes the need for ventilation of the air away from the area where the paint is being applied. Although the disadvantages of air spraying are overcome by airless spraying, the resulting spray pattern has been inferior, being of nonuniform density having thickened areas or "pigtails" and lacking the desired feathered edge. These qualities have made the airless spray pattern unsuitable for fine finish spraying.

One prior proposal to eliminate the undesirable spray pattern in airless spraying involves positioning a preorifice upstream from the final spray nozzle, with an expanded chamber between the orifice and nozzle. It was suggested that such an orifice have substantially the same cross-sectional area as the final nozzle opening, and that it should be a circular bore of uniform cross section positioned between the pressurized paint source and the final spray nozzle. A major limitation of such a preorifice was the suggestion that it must be changed to accommodate different sizes of nozzle openings. Even then optimum conditions are difficult to realize since variables other than the preorifice—spray nozzle ratio are present, e.g., paint viscosity and density, temperature and the flow pattern downstream from the preorifice. Thus, such a structure requires many different sizes of preorifice inserts to provide optimum conditions for different sized nozzle openings having varying operating conditions.

Needle valves heretofore have been used to control the fluid flow in airless spray guns but have not been acceptable for fine finish spraying. This is apparently a result of the prior art not recognizing the structure and dimensions necessary to produce the proper fluid phenomena at the nozzle opening. In fact, it has been observed that needle valves, as they exist in the prior art airless spray guns, have not been used effectively for fine finishing even with the addition of a preorifice and expanded chamber as suggested above.

SUMMARY OF THE INVENTION

In contrast to prior airless spray guns of the type suitable for fine finish spraying, the improved gun of the present invention makes it possible to adjustably control the rate and type of flow entering the spray nozzle opening, so as to accommodate any size of nozzle opening at optimum conditions. Moreover, unlike prior spray guns, it eliminates the need for a preorifice and an on-off valve upstream from the preorifice since the improved needle valve of the present invention serves as both an on-off control and as a means of generating an improved fluid flow pattern prior to passage through the nozzle opening. One result of such a flow pattern is the formation of a soft spray having a uniform density with the desired feathered edge.

More particularly, the improved spray gun of the present invention includes a spray nozzle assembly which is adapted to be secured to the forward portion of a body. The spray nozzle assembly includes a spray tip housing a nozzle opening, a pressurized pain chamber and a valve assembly positioned therebetween. The valve assembly is arranged so that the seat portion containing a tapered valve port and the needle portion designed to cooperate with the tapered valve port are in coaxial relation to the nozzle opening. The needle, when in contact with the valve seat, prevents the passage of fluid through the valve port thereby defining a closed position. When the needle is retracted by means located in the body of the gun, an annular cone-shaped passageway is formed between the valve seat and the needle through which the paint from the pressurized chamber flows. The size of the cone-shaped annular opening is adjustably controlled by a threaded stop associated with the needle retraction means thereby allowing the annular opening and thus the flow rate to be "tuned in" to optimum flow conditions for each size of nozzle opening.

As the paint flows through the annular passageway, it is formed into an annular cone-shaped sheet. Applicant has discovered that the distance between the nozzle opening and the valve assembly when properly related to the angles which the tapered orifice and the needle side make with the spray nozzle axis causes the annular cone-shaped sheet to impinge at the nozzle opening. This impingement creates the flow phenomena necessary to generate a soft spray having a uniform spray pattern with feathered edges.

Accordingly, it is an object of this invention to provide an improved spray gun with a needle valve assembly having a structure and corresponding dimensions capable of forming an annular cone-shaped sheet which impinges at the nozzle opening.

It is also an object of this invention to provide such an assembly with an annular cone-forming opening whose cross-sectional area is adjustable thereby capable of accommodating any size of nozzle opening at optimum spray conditions.

A further object is to eliminate the need for a valve upstream from the annular opening by accomplishing the functions of both the valve and the annular opening with an improved needle valve arrangement.

A further object is to provide a convenient means of controlling the flow rate of the fluid, while still maintaining the critical flow pattern thus assuring the soft spray.

These and other objects and advantages of the present invention will become apparent upon reference to the following specifications, drawings and appended claims.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of the improved spray gun.

FIG. 2 is an enlarged cross-sectional view of the spray nozzle assembly.

FIG. 3 is an expanded cross-sectional view of the seat member 10 and the tapered needle showing their axial orientation to each other.

FIG. 4 is an enlarged cross-sectional view of the forward end of the spray nozzle assembly with the tapered needle in its closed position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, the improved airless spray gun comprises a main body 10, a handle 11, a trigger 12 and a spray nozzle assembly 14. A hook portion 15 is located at the top of the main body 10 to hang the gun when it is not in use.

Spray nozzle assembly 14 is attached to the front end of the spray gun and includes a tubular member 16 having internally and externally threaded end portions 18 and 19 and central

portion 48 having a diameter substantially greater than the end portions 18 and 19. As shown, the end 19 extends through an aperture 49 so that the central portion 48 of the tubular member 16 tightly abuts the front end 41 of the main body 10 with a gasket 46 positioned therebetween. Lock nut 45 cooperates with the external threads of the end 19 to secure the spray nozzle assembly 14 to the main body 10. Also, locator pin 40 extends between the central portion 48 of the tubular member 16 and the front end of the stock 41 to align the spray nozzle assembly 14 in its proper position.

Referring now to FIG. 2, the spray tip 21 located at the forward end of the spray nozzle assembly 14 is characterized by the nozzle opening 20 and the prenozzle chamber 22. Nozzle opening 20, being elongated in cross section, and passing through the forward end of the spray tip 21, is in communication with the prenozzle chamber 22, chamber 22 having the end with a cross-sectional area substantially greater than that of the nozzle opening 20 and a tapered side 24 converging in the direction of the nozzle opening 20 and conforming to the shape thereof to guide the paint flowing through a valve assembly 25 to the nozzle opening 20. The rearward end of spray tip 21 abuts a portion of the seat member 26 and the cylindrical member 28 with a sealing gasket 30 positioned therebetween, all of which are secured tightly by the tip body 29. The tip body 29 is in turn held secure by the annular cap 35 having internal threads in cooperation with the external threads of the end portion 18, and a flanged portion 49 engaging a shoulder portion 31 of the tip body 29. The annular cap 35, and thus the spray tip 21, are easily removed when it is necessary to change to a spray tip 21 with a different size of nozzle opening 20. Generally cylindrical member 28 positioned immediately to the rear of the spray tip 21 has its forward end abutting the spray tip 21 with a gasket 30 positioned therebetween, an externally threaded rearward end being received into the end portion 18, and an inner surface defining an axial cavity 36 housing a valve assembly 25.

The valve assembly 25 includes a seat member 26 held about its periphery in a coaxial relation to the nozzle opening 20 by a portion of the inner surface of the cylindrical member 28. A tapered, coaxial valve port 54 is contained in the seat member 26 and a needle or conical member 38 is carried by the front end of an axially extending valve stem 39. Member 38 has a tapered side 56 (FIG. 3) converging in the direction of the nozzle opening 20 and terminating in one direction at a forward end 59 and in the other direction at a point where the tapered side 56 intersects with the outer surface of the valve stem 39. The forward end 59 of the needle 38 does not converge to a point but rather is terminated to form a substantially flat surface. As seen in FIG. 4, the forward end 59 extends slightly past the forward end 27 of the seat member 26 when the needle 38 is in a closed position and to the rear of forward end 27 when in an open position. Although the length of the needle 38 from the shutoff point 55 to the forward end 59 is not critical, it must be of sufficient length to form the fluid into an annular cone shaped sheet. The valve stem 39 is guided by a counterbore 47 in the central portion 48 of the tubular member 16 and extends through a seal 42 (FIG. 1) and a gland nut 44 which is threaded at one end and secured to the tubular member 16 at the other end 19. The valve stem 39 then continues past the trigger 12, through a bore 58, and into contact with the sealing ring 57 where it extends into a fluid motor chamber 93 which along with the trigger 12, controls the movement of the valve stem 39 as hereinafter more fully described.

The valve assembly 25 in FIG. 2 is arranged so that when the trigger 12 is in its relaxed position, the needle member 38 is in contact with the shutoff point 55 of the seat member 26. This defines a closed portion of the needle member 38, thereby preventing the paint, under pressure, in the axial cavity 36 from flowing through the valve port 54. When the trigger 12 is moved rearwardly, the valve stem 39 and the needle member 38 are likewise moved rearwardly defining an open position, as designated by dotted line 32, in FIG. 2 thereby permitting the paint, under high pressure, to flow at a high velocity from the axial cavity 36, through the conical passageway 61 between the seat member 26 and the needle member 38, and through the nozzle opening 20 whereby the paint is atomized and sprayed onto the surface to be painted.

Valve port 54, as shown in FIG. 3, includes a tapered seating surface 50, a tapered entrance surface 52, and a shutoff point 55 located at the intersection of surfaces 50 and 52, surfaces 50 and 52 further defining two valve port portions each having a shape similar to the frustum of a cone. As shown, the seating surface 50 converges in the direction of the nozzle opening 20 with the projected extension converging to a point and defining a seat angle 51. Applicant has discovered that the seat angle 51 is important in producing the desired spray pattern for fine finishes having a maximum value of about 20°, a minimum value of about 9°, and an optimum operating value of about 10°. Likewise, the projected extension of the entrance surface 52 converges and defines an entrance angle 53 being substantially greater than the seat angle 51. It is noted that the valve port portion defined by surface 52 is not critical to the operation of the valve assembly 25 in an effective airless paint sprayer, since the paint sprayer will operate adequately with no entrance surface 52 at all. However, the presence of the surface 52 does improve the efficiency of the spray gun by channeling the high pressure liquid in the axial cavity 36 (FIG. 2) into the annular cone-shaped passageway 61 (FIG. 4) and by allowing for better flow control at the shutoff point 55.

As shown in FIG. 3, the tapered side 56 of the needle 38, if extended, converges in the direction of the spray nozzle 20 to define a needle angle 58 having a maximum value of about 30°, a minimum value of about 10° and an optimum value of about 12°. The value of the needle angle 58 in FIG. 3 as compared to the seat angle 51 is important in that the two angles cannot be equal. This angle difference is necessary to shape the flow between the axial cavity 36 (FIG. 2) and the prenozzle chamber 22 and to prevent the locking of the needle valve member 38 when the needle valve member 38 is in its closed position. In addition, greater needle angle allows for the cross-sectional area of the annular cone-shaped passageway 61, located between the sealing surface 50 and the tapered side 56, to remain relatively constant along its length, when the valve assembly 25 is in a selected open position. Thus, the paint flowing through the passageway 61 is maintained at a relatively constant velocity even though the outer diameter of the annular cone-shaped passageway 61 is decreasing in the direction of the nozzle opening 20.

In FIG. 4, the distance D is shown to be that distance from the nozzle opening 20 to the shutoff point 55. Applicant has found the relation between the distance D and the needle angle 58 (FIG. 3) to be of critical importance in creating the proper spray pattern for fine finish spraying. He has discovered that the projected extension of the tapered needle side 56 must converge to a point at or near the nozzle opening 20 when the needle member 38 is in its closed position, as shown in FIG. 4. This relationship allows the liquid under high pressure in the axial cavity 36 to be accelerated through the annular opening 23 between the tapered needle side 56 and the shutoff point 55 and to pass through the annular cone-shaped passageway 61 causing the fluid to be formed into a thin annular cone-shaped sheet which impinges at the nozzle opening 20. This impingement, in combination with the increased surface area of the annular cone-shaped passageway 61, as compared to the surface area of the circular bore in the prior art, creates the desired fluid phenomena at the nozzle opening 20 to generate a soft spray having a uniform spray pattern with feathered edges. In addition, the adjustable valve assembly 25 makes it possible for the fluid passing through the annular opening 23 to be accelerated to the velocity at which it will pass through the nozzle opening 20. Applicant has found these conditions to be met when the cross-sectional area of the annular opening 23 can be readily adjusted to approximately equal the cross-sectional area of any selected nozzle opening 20. The length of the annular cone-shaped

passageway 61 between shutoff point 55 and the front end of the seat member 26 must also be sufficient in length to form the fluid into a thin hollow cone-shaped sheet. Applicant has found a length at least twice the diameter of the orifice opening to be sufficient.

Note that in the preferred embodiment the annular opening 23 extends completely around the needle member 38. When liquid flows through the opening 23, certain portions of the liquid intersect with other portions so that the impinging force of each portion is equally balanced by the impinging force of one or more other portions. Thus, the preferred embodiment may be viewed as having at least two portions of the liquid converging so that they intersect at the nozzle opening 20.

Referring again to FIG. 1, the trigger 12 consists of a curved metal casting 80 pivotally mounted at a point 81 and having a lower portion 82 which can be swung toward and away from the handle 11, thereby defining an open and closed position of the valve assembly 25. The trigger 12 can be moved freely except when the stop 84, located on the forward edge of the handle 11, prevents such movement. The stop 84 includes a neck member 85 containing triangular teeth 86 which receive the member 88 and hold it in an operating position, as shown in FIG. 1, or in a stop position, not shown, where the member 88 is rotated 90° from that shown in FIG. 1. Coil spring 89 positioned on the inner side of the handle 11 biases the member 88 in cooperation with the teeth 86 and prevents the member 88 from freely rotating about the neck member 85. In its operating position, member 88 fits between the side portions 90 of the trigger 12 thereby allowing the trigger 12 to be depressed. In its stop position, member 88 contacts the inside edge 91 of the trigger 12, preventing the trigger 12 from being inadvertently depressed. The stop position allows the operator to render the trigger 12 immobile when it is feasible to do so, for example while cleaning the gun or replacing the spray tip 21, thereby preventing possible injury to the operator.

As noted above, movement of the trigger 12 controls the flow of paint through the valve assembly 25. In fact, the trigger 12 directly controls a pilot valve assembly 92 which in turn controls the movement of the piston 94 located in the fluid motor and thus controls the movement of the needle member 38. The piston 94 is actually comprised of two disc members 95 and 96 threadedly mounted on the rearward end of the valve stem 39 and a cup-shaped flexible member 98 positioned therebetween, member 98 tightly abutting the inner surface of a thin sidewall 99 thereby sealing the fluid motor chamber 93. Secured to the rear side of the disc 96 is the sleeve member 102 surrounded by a coil compression spring 104 having its forward end abutting the rear side of the disc 96 with its other end disposed against stop member 105. The compression spring 104 urges the piston 94 and thus the valve stem 39 in a forward or valve closing direction (to the left as viewed in FIG. 1). When the trigger 12 is depressed, the spring 104 is opposed by the pressure of compressed air in chamber 93 to the left-hand side of piston 94.

Pilot valve assembly 92 noted above includes a valving element 120 within an axial bore 121 in an annular sleeve 122. Axial bore 121 has two diameters, one at 124 and one at 125, connected by a sloping shoulder portion 126, and which is chamfered at 128 adjacent its inner end. When the operator releases the trigger 12, coil spring 131 urges land 130 against the portion 128 thereby preventing any compressed air from passing out of chamber 134 through passageway 132 and into fluid motor chamber 93. When the trigger 12 is pulled back toward the handle 11, valving element 120 and thus land 129 is moved into contact with the sloping shoulder portion 126 cutting off chamber 93 from the atmospheric air through chamber 135. In turn, land 130 is moved away from the chamfered portion 128 thereby permitting compressed air to pass from chamber 134, through passageway 132 and into chamber 93, urging the piston 94 and thus valve stem 39 toward an open position.

Stop member 105 includes a flanged portion 106 which serves as a stop to prevent the sleeve 102 from being moved past a predetermined position, as a base to contact coil spring 104, and as a stop to prevent the stop member 105 from being removed from its mounting in the wall chamber 108. Stop member 105 also includes an externally threaded neck portion 109 and an end portion 110 designed to receive a control cap 111 housing a set screw 112 to secure the cap 111 to the end portion 110. By turning the cap 111, stop member 105 is moved along the wall member 108, as a result of the threaded neck portion 109, determining the position of the stop member 105. Stop member 105 in turn limits the movement of the sleeve 102 and, likewise, the rearward movement of the valve stem 39 and the needle member 38. Thus, the optimum area of the annular opening 23 is controlled by the position of the control cap 111, thereby accommodating any size of nozzle opening 20.

To supply the paint under pressure to the axial cavity 36, the conduit 115 communicates with the axial cavity 36 through the lateral bore 114. One end of the conduit 115 is press fitted into the outer end of the bore 114 and the other end terminates in a fitting 118 adapted to interconnect the conduit 115 with the source of paint under pressure, not shown. The fitting 118 in turn is secured to the bottom portion of the handle 119 by the bracket 118.

The operation of the spray gun may be summarized by referring to FIGS. 1 and 2. When the spray gun is not being utilized, the trigger 12 is in a nondepressed position thereby allowing the coil spring 104 to move the valve stem 39 and the needle member 38 in the direction of the nozzle opening 20 causing the needle member 38 to contact the seat member 26 preventing paint from flowing through the orifice 54. When the trigger 12 is depressed, the pilot valve assembly 92 causes the piston 94 and the valve stem 39 to be moved away from the nozzle opening 20 a predetermined distance which is controlled by the position of the control cap 111. This movement allows the paint, under high pressure in the axial cavity 36, to flow through the cone-shaped passageway 61 in the form of a thin annular cone-shaped sheet with its vertex impinging at the nozzle opening 20 to generate a uniform airless spray pattern with a feathered edge.

From the foregoing, it is apparent that the improved airless spray gun includes a novel needle valve assembly capable of producing a high velocity annular cone-shaped sheet. The valve assembly can function both as an "on-off" valve and also as a means for adjusting the annular cross section and rate of flow of the thin conical sheet. The novel features allow the improved spray gun to operate effectively as a fine finish sprayer and to eliminate many of the disadvantages present in previous fine finish airless spray guns.

The invention may be embodied in other forms not specifically shown in the preferred embodiment without departing from the spirit or essential characteristics thereof. The preferred embodiment is therefore to be considered as illustrative only, with the scope of the invention being indicated by the appended claims and their equivalents.

What is claimed and desired to be secured by United States Letters Patent is:

1. An improved airless spray gun comprising:
   - a body;
   - a spray nozzle assembly secured to said body wherein said spray nozzle assembly includes;
     - a passageway extending through said spray nozzle assembly having one end in communication with a source of liquid under pressure,
     - a nozzle opening having a center in communication with the other end of said passageway,
     - a needle member having a tapered surface adapted for cooperation and engagement with a tapered surface of a valve port, said tapered surface of said needle member defining a needle angle,
     - a seat member positioned in said passageway between the ends thereof housing said valve port whose tapered surface defines a seat angle, said seat member positioned in said passageway such that the projected extension of

the tapered surface of said needle member converges and intersects at approximately the center of said nozzle opening when said needle member is in contact with the tapered surface of said valve port,

a chamber extending from said seat member to said nozzle opening; and

means for moving said needle member into contact and out of contact with the tapered surface of said valve port thereby defining a closed position and an open position respectively of said needle member.

2. The improved airless spray gun of claim 1 wherein the end of said chamber extending from said seat member is substantially greater in cross-sectional area than said valve port and the other end converging toward and conforming to said nozzle opening.

3. The improved airless spray gun of claim 1 wherein said means for moving said needle member into contact and out of contact with the tapered surface of said valve port includes a stop member for limiting the rearward movement of said needle member out of contact with the tapered surface of said valve port and thereby the size of the opening between said needle member and the tapered surface of said valve port.

4. The improved airless spray gun of claim 3 wherein the longitudinal position of said stop member is adjustable thereby causing the rearward movement of said needle member and the opening between said needle member and the tapered surface of said valve port to be adjustable to thereby accommodate different sizes of nozzle openings at optimum conditions.

5. The improved airless spray gun of claim 4 wherein said means for moving said needle member into contact and out of contact with the tapered surface of said valve port further includes a trigger means operatively connected with said needle member for moving said needle member rearwardly out of contact with the tapered surface of said valve port and against said stop member.

6. An improved airless spray gun comprising:

a body;

a spray nozzle assembly secured to said body wherein said spray nozzle assembly includes;

a passageway extending through said spray nozzle assembly having one end in communication with a source of liquid under pressure,

a nozzle opening in communication with the other end of said passageway,

a seat member positioned in said passageway between the ends thereof housing a tapered valve port whose tapered surface defines a seat angle,

a chamber extending from said seat member to said nozzle opening,

a needle member in cooperation with said tapered valve port whose tapered surface defines a needle angle, said needle angle being greater than said seat angle; and

means for moving said needle member into contact and out of contact with said seat member thereby defining a closed position and an opened position of said needle member, said seat member being positioned such that the projected extension of the tapered surface of said needle member converges to a point as said nozzle opening when said needle member is in said closed position.

7. The improved airless spray gun of claim 6 wherein said needle member has a maximum value of 30° and a minumum value of 10° and wherein said seat angle has a maximum value of 20° and a minimum value of 9°.

8. The improved airless spray gun of claim 7 wherein said needle angle is about 12° and said seat angle is about 10°.

9. An improved airless spray gun comprising:

a body;

a spray nozzle assembly secured to said body wherein said spray nozzle assembly includes;

a passageway extending through said spray nozzle assembly having one end in communication with a source of liquid under pressure,

a nozzle opening in communication with the other end of said passageway,

a seat member positioned in said passageway between the ends thereof housing a tapered valve port whose tapered surface defines a seat angle,

a chamber extending from said seat member to said nozzle opening,

a needle member in cooperation with said tapered valve port whose tapered surface defines a needle angle;

means for moving said needle member into contact and out of contact with said seat member thereby a closed position and an open position of said needle member, said seat member being positioned such that the projected extension of the tapered surface of said needle member converges to a point at said nozzle opening when said needle member is in said closed position and said seat member and said needle member defining an annular cone-shaped passageway when said needle member is in said open position which is sufficient in length to form the fluid passing therethrough into an annular cone-shaped sheet.

10. The improved airless spray gun of claim 9 wherein said means for moving the needle member into contact and out of contact with the seat member adjustably controls the flow rate of the liquid passing through said annular cone-shaped passageway.

11. The improved airless spray gun of claim 9 wherein the length of said cone-shaped passageway is at least twice the diameter of said valve port.

12. The improved airless spray gun of claim 11 having an annular opening located at the entrance to said annular cone-shaped passageway wherein the cross-sectional area of said annular opening is substantially equal to the cross-sectional area of said nozzle opening.

13. The improved airless spray gun of claim 12 having means to provide for the adjustment and control of the size of the cross-sectional area of said annular opening so as to accommodate any size of nozzle opening.

14. The improved airless spray gun of claim 13 wherein said annular cone-shaped sheet impinges at said nozzle opening to generate a soft spray suitable for fine finish spraying.

15. An improved spray gun suitable for the airless spraying of liquids such as paints comprising:

a body;

a spray nozzle assembly secured to said body including,

a nozzle opening extending through one end of said spray nozzle assembly and being elongated in cross section,

a chamber in communication with said nozzle opening having a cross-sectional area at one end substantially greater than the cross-sectional area of said nozzle opening,

a seat member defining one end of said chamber and containing a tapered valve port having a lateral surface which converges in the direction of said nozzle opening and defines a seat angle, and

a conical member suitable for insertion into said valve port having a tapered side which converges in the direction of said nozzle opening to define a conical angle, said conical angle being greater than said seat angle,

means for moving said conical member into and out of contact with said seat member thereby defining a closed position and an open position of said conical member;

an entrance passageway associated with a source of liquid under pressure and in communication with said valve port;

an annular cone-shaped passageway extending through said entrance passageway within said chamber to allow for the passage of said liquid through said annular cone-shaped passageway in the form of an annular cone-shaped sheet which impinges at the entrance of said nozzle opening;

an annular opening at the entrance of said annular cone-shaped passageway when said conical member is in said open position having an optimum cross-sectional area

substantially equal to the cross-sectional area of said nozzle opening;

means to predetermine and to control the cross-sectional area of said annular opening so as to accommodate any size of said nozzle opening.

16. An improved airless spray gun comprising:

a body;

a spray nozzle assembly secured to said body wherein said spray nozzle assembly includes;

a passageway extending through said spray nozzle assembly having one end in communication with a source of liquid under pressure,

a nozzle opening in communication with the other end of said passageway,

means positioned in said passageway between the ends thereof for directing at least two portions of the liquid along converging paths so that said portions intersect at the entrance of said nozzle opening,

means for adjustably controlling the flow rate of the liquid portions which intersect at said nozzle opening.

17. An improved airless spray gun comprising a body with a passageway therethrough for fluid to be sprayed, means for connecting a high pressure fluid source to one portion of the passageway, a nozzle portion having a spray opening communicating with said passageway, and a valve assembly in said passageway close to said spray opening, said valve assembly comprising a valve body portion having a valve seat opening therein and a needle valve portion movable axially within said valve seat opening between a closed position in which the needle valve portion closes the valve seat opening and passageway and a restricted open position providing for accelerated linear movement of fluid from said passageway through said valve seat opening to said spray opening, at least one of said valve body and needle valve portions having a surface guiding the fluid into a thin annular sheet converging to an apex at said spray opening.

18. A spray gun according to claim 17 in which said valve body portion and needle valve member have cooperating axially extending conical surfaces providing an annular conical passageway therebetween when the valve member is in open position, at least one of said conical surfaces converging toward a vertex at said spray opening and the conical surface of at least said needle valve member terminating at a point spaced axially from said spray opening thereby providing a region of fluid turbulence between the spray opening and the annular conical valve passageway, aid region being located within a conical area defined by the projection of said surface of the valve body toward said spray opening.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,633,828 Dated January 11, 1972

Inventor(s) James H. Larson

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

Column 8, line 11, after "thereby", insert -- defining --

Signed and sealed this 27th day of March 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334