

Jan. 7, 1941.

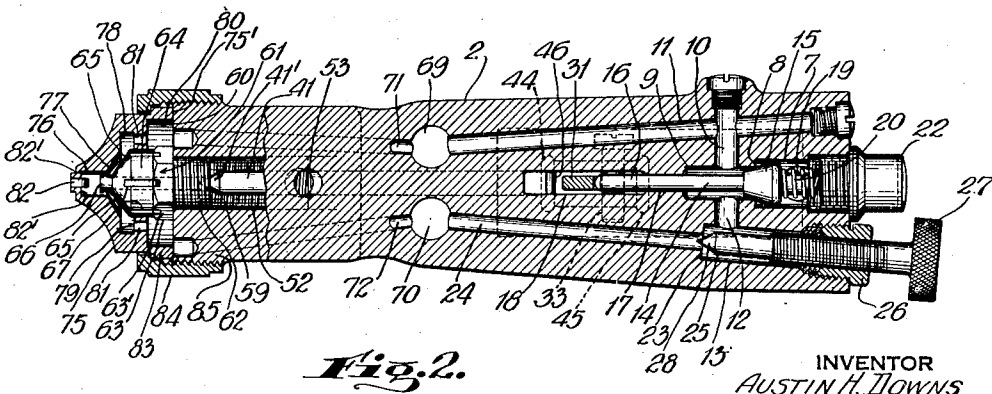
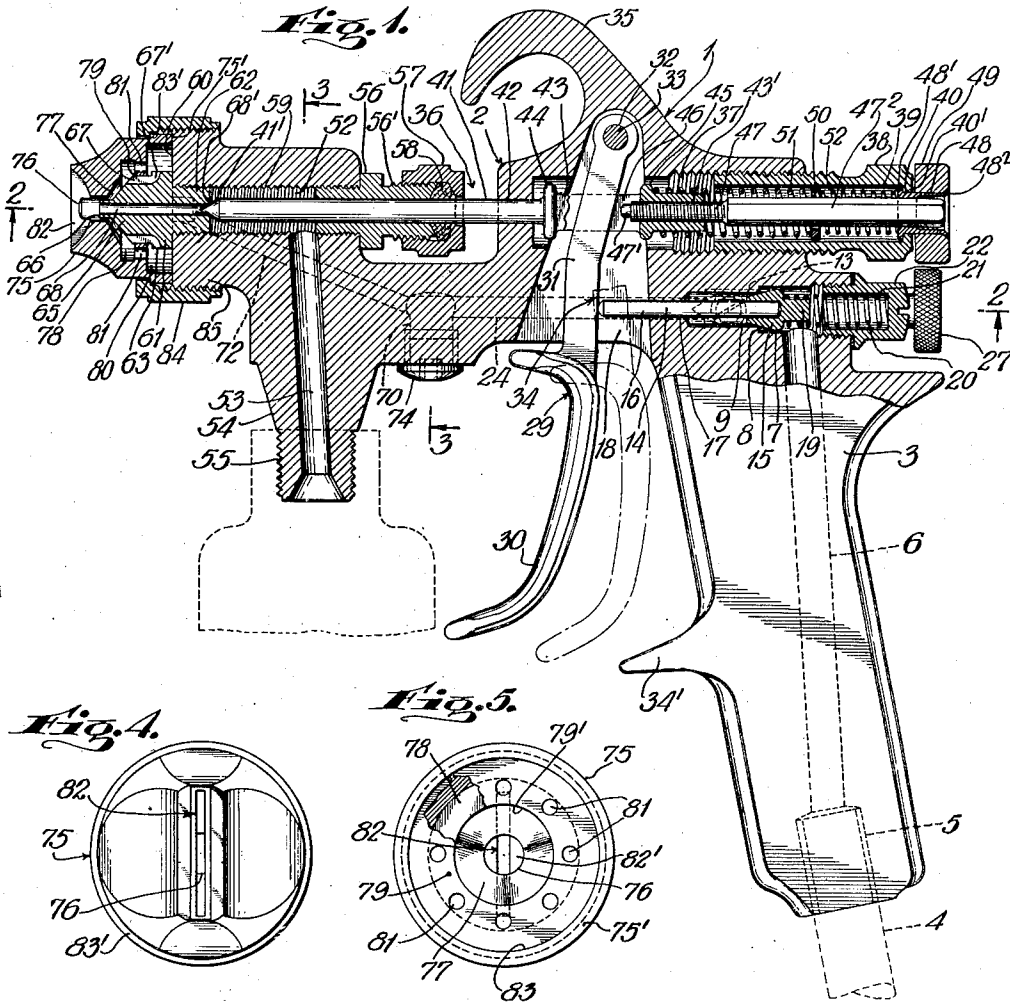
A. H. DOWNS

2,228,226

DEVICE FOR SPRAYING PAINTS, LACQUERS, OR OTHER LIQUIDS

Filed April 27, 1938

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

**Fig. 3.**

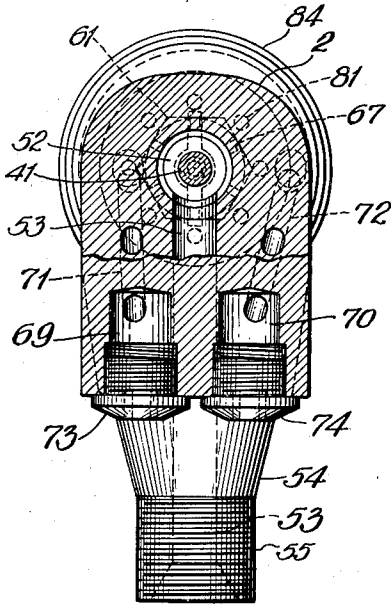


**Fig. 6.**

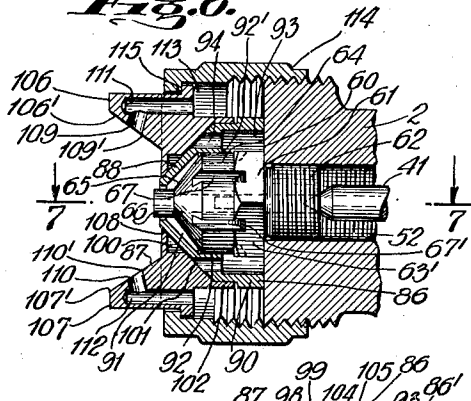


**Fig. 7.**

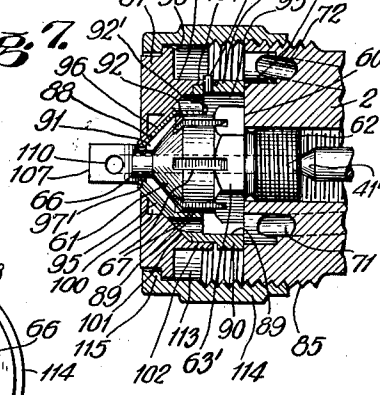
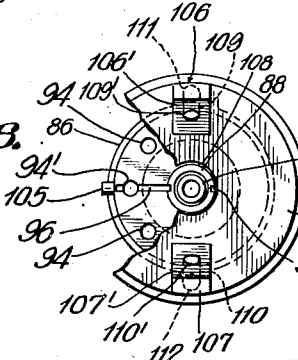


**Fig. 8.**



## UNITED STATES PATENT OFFICE

2,228,226

DEVICE FOR SPRAYING PAINTS, LACQUERS,  
OR OTHER LIQUIDS

Austin H. Downs, Glen Ridge, N. J., assignor to  
Eclipse Air Brush Company, Inc., Newark, N. J.,  
a corporation of New Jersey

Application April 27, 1938, Serial No. 204,550

9 Claims. (Cl. 299—140.1)

This invention relates to improvements in devices for spraying light bodied or low specific gravity materials such as lacquers and varnishes, as well as heavier liquids such as paints, or semi-pastes, etc., and the principal object is the provision of such a device which is highly efficient in operation, simple and readily controlled to use a minimum amount of material and a minimum amount of air or gas pressure to accomplish the best atomizing results.

Further objects include the provision of such a device in which the trigger control is very accurate and simple, which operates at low air pressures and volumes and with a low consumption of materials, thereby reducing the amount of mists and fumes to a minimum and still affording perfect atomization of the material and application thereof to the surface being coated.

Another object of the invention is the provision of a new and improved system of air distribution within the device, the air leads to the nozzle of the device from a single valve controlling the air supply being branched into two independent leads, one of which is adapted to be separately regulated whereby when a slot type nozzle, to be hereinafter described, is used, the volume of air can be cut down for the proper application of light bodied or low specific gravity materials, and when an external nozzle, also to be hereinafter described, is used the air supply can be changed to vary the width of the fan spray and/or produce a conical spray.

Another object of the invention is the provision of a new and improved form of nozzle construction whereby the liquid is completely atomized therein and delivered therefrom in the form of a fan-shaped sheet of finely divided spray of substantially uniform density throughout its entire extent. By "fan-shaped," I mean flaring or divergent in width, but preferably of small depth or thickness.

A further object is the provision of an improved form of fluid tip construction for my device to insure even air distribution through slots or grooves arranged in novel manner on said tip and thus to co-operate with my new and improved nozzle construction to effect proper and complete break-up or atomization of the coating material.

Still another object of my invention is the provision of a new and improved form of external-type nozzle to be used with my device, comprising essentially an outer and an inner part or piece; the inner piece having two milled slots or grooves which cause two jets of air to strike

against the sides of the fan-spray resulting in a more even distribution of material and a better break-up or atomization. Another object of this invention is the provision of such a device in which the entire body and handle are made of one piece, preferably by die-casting or forging, whereby the manufacture of the same is simplified and cheapened and at the same time a more attractive appearing and substantial device is provided.

A further object of this invention is the provision of slot type nozzles having slots of varying widths and lengths of slots to produce effective and desirable results under different conditions and with different types of coating materials.

And yet another object of this invention is the provision of nozzles which may be machined to have sharp outside edges which prevent the accumulation of coating material about the nozzle or in the passageways of the device whereby clogging is avoided and in effect the device is to a large measure self-cleaning.

Further objects include improvements in details of construction and are hereinafter set forth in full.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, the invention consists in the novel construction, combination and arrangement of elements or parts hereinafter described and then sought to be defined in the appended claims, reference being had to the accompanying drawings forming a part hereof and which show, merely for the purpose of illustrative disclosure, preferred embodiments of my invention, it being expressly understood, however, that various changes may be made in practice within the scope of the claims without digressing from my inventive idea.

In the accompanying drawings, in which similar reference characters denote corresponding parts:

Figure 1 represents a vertical longitudinal cross-section through a device constructed to embody my invention shown in inoperative or closed condition in full lines, the open position of the trigger being indicated in dotted lines, said figure also showing a slot type nozzle applied to the device and illustrating the relative position of the fluid tip with respect to said nozzle;

Figure 2 is a horizontal longitudinal section taken along line 2—2 of Figure 1 and viewed in the direction of the arrows, illustrating in detail the new and improved system of air distribution from the air control valve to the nozzle;

Figure 3 is a partial vertical cross-section taken

along line 3—3 of Figure 1 and viewed in the direction of the arrows illustrating details of the air and fluid passageways to the nozzle of the device;

5 Figure 4 is a front elevation of one form of slot type nozzle;

Figure 5 is a rear elevation of the said nozzle, partially broken away to illustrate internal structure thereof;

10 Figure 6 is a partial enlarged longitudinal section of the nozzle end of the device of Figure 1 with an external type nozzle applied thereto in place of the slot type nozzle of Figure 1 and showing the relative position of the fluid tip with respect to said nozzle;

Figure 7 is a cross-section along line 7—7 of Figure 6 viewed in the direction of the arrows;

Figure 8 is a front elevation of the said external type nozzle partially broken away to illustrate the internal part of the said nozzle structure;

Figure 9 is a perspective view of the said internal part;

Figure 10 is a front elevation of a modified form of external type nozzle, broken away in part to illustrate details of its internal structure; and

Figure 11 is a cross-section along line 11—11 of Figure 10 showing the relative position of the fluid tip with respect to said nozzle.

Referring now to the drawings, and first to Figures 1 to 7 inclusive, the numeral 1 designates the body of the device as a whole, this body including the barrel portion 2 and the handle portion 3, the handle portion extending downwardly from the barrel portion and inclined slightly to the rear so that the device has somewhat the appearance of an automatic revolver.

Devices of this kind are employed to spray material principally for coating purposes, the material being atomized by air under pressure. The material is fed to the point of atomization by pressure and consequently this device has parts, passages and valves for controlling the admission and passage of the pressure fluid as well as the liquid material and the atomization of the same. A connection 4 to a suitable source of air or other fluid under pressure is made in the internally threaded opening 5 on the lower end of the handle portion 3. Usually this pressure is automatically maintained by suitable regulating means, as is well understood. This opening 5 leads to the passage 6 which extends upwardly through the interior of the handle 3 to the air inlet valve chamber 7 in the barrel portion of the device (Figs. 1 and 2). This valve chamber is provided with a valve seat 8 leading to the distributing chamber 9. A passageway 10 leads from this chamber directly to passageway 11, which latter extends along the barrel interior toward the nozzle end of the device. A second passageway 12 leads from distributing chamber 9 to a valve chamber 13 to be presently described.

Mounted in the valve chamber 7 is a suitable valve member 14 having the valve proper 15 adapted to engage the seat 8 and having the operating stem 16 extending forwardly therefrom and through a suitable bearing opening 17 in the barrel body into an open slot 18 in said barrel body, as shown, to bear against a trigger to be presently described. The rear end of the valve member 14 is provided with the stud or projection 19 to receive one end of the coil spring 20, the other end of which is positioned in a

socket 21 in the securing and tensioning adjusting nut 22 which is screwed into the rear end of the valve chamber 7. By this means, the valve 15 is normally held in tight engagement with its seat 8 so that no air pressure is admitted 5 through the passages 6, 7, 10, 11, 12 and 13 unless the valve is opened.

The valve chamber 13 is provided with a valve seat 23 leading to a passageway 24 which extends in the same direction as passageway 11 10 along the barrel interior toward the nozzle end of the device. A needle valve 25 is mounted in the valve chamber 13 through the internally threaded portion of the mounting nut 26. At its outer end the valve terminates in a manipulating knob 27 by which the inner or valve end 28 may be adjusted relative to the valve seat 23 to regulate the flow of air into passageway 24 as desired and to cut it off completely if required, all for a purpose to be hereinafter described. 20

The trigger above referred to is designated by the reference character 29 and has the downwardly extending portion 30, adapted to be engaged by certain fingers of the hand of the operator, the upper portion 31 of the trigger extending into the triangular slot 18 of the device and being pivotally supported at 32 in the said slot by means of a suitable pivot or bolt 33 (see Fig. 1). The rear face of the trigger is provided with a bearing face 34 on the rear side which 30 engages the front end of the valve stem 16, and when the trigger is forced rearwardly the valve stem and its attached valve 15 are forced rearwardly and the valve forced off its seat to permit the admission of air through passages previously mentioned. The rearward movement of the trigger is limited by means of the abutment of the portion 30 against the external face of the handle 3. Spring 20 is of sufficient strength to normally hold the valve 15 closed and the trigger 40 in its extended open position shown in full lines in Figure 1 of the drawings, and to cause these parts to assume these positions when the pressure is released from the trigger and to cause these parts to move from these positions when 45 the pressure on the trigger is reduced. Thereby a very simple and delicate control is provided for controlling the admission of air into the device and it is very easily regulated by an operator and without the necessity of long training and experience. For further ease of manipulation and to insure a firm grip, the handle 3 is provided with a finger lug or guard 34' projecting from said handle directly below and adjacent the lower end of the trigger. 55

The barrel portion 2 extends in a horizontal direction forwardly from the handle portion 3 and is provided with a curved lug or hook or flange 35 to provide a convenient hanging means for the device when not in use. On its upper part and slightly forwardly of the mid point of the barrel, a substantial cut out portion 36 is provided for a purpose to be presently described. The barrel is bored centrally to provide the valve operating chamber 37 in its rear end portion, 65 which chamber 37 interconnects with the slot 18 in said barrel. This chamber receives a hollow nut 38 screwed into its rear end. The nut has a spring chamber 39 and a central axially aligned opening 40 therewith at its rear end. 70

The valve rod 41, which controls the supply of liquid material, extends into chamber 37 through its front end and is movably mounted within the forward bearing part 42 of the central barrel bore. Inside the chamber 37 said rod 41 is en- 75

larged in diameter at 43 and provided with two spaced shoulders 44 and 45. A vertical slot 46 is provided in the rod between the shoulders 44 and 45 and the upper portion 31 of the trigger passes therethrough and is movable therein. The rear end of rod 41 is provided with an internally threaded bore 43' extending from the said end through the rear end of the slot 46. Threadedly engaged in said bore is an operating rod 47 whose forward nose 47' projects into said slot and is adapted to be engaged by the trigger 29 when the latter is moved into operative position as hereinbefore described. Operating rod 47 at its rear portion is hexagonally shaped in section as at 47<sup>2</sup> or may be any other polygonal shape. A riveting collar 48 is slidably borne to the rear end of the rod. The inner flange 48' of this collar is adapted to engage an inner shoulder 48<sup>2</sup> formed on the nut 38. A rotatable knob 49 is mounted on the collar 48 and the outer edge of the latter flanged over at 48<sup>2</sup> to rivet said knob in place whereby rotation of the knob will rotate said collar and in turn the rod 47 through engagement of said collar with the hexagonally shaped portion thereof.

Intermediate its ends, the rod 47 is provided with a slidable ring member 50. A spring 51 mounted about the rod 47 is provided, one of its ends bearing against shoulder 45 and its other end against one face of the ring member 50. A second spring 52 is also provided, one end of which engages the opposite face of the ring member 50 and whose opposite end engages the flange 48'. The springs 51 and 52 normally urge the rod 47 and consequently valve rod 41 forwardly to close the valve controlling the inflow of fluid material.

The adjustable positioning of the nose 47' through knob 49 by the parts above described nearer to or further away from the trigger permits a fine variation of the relative movement of the valve rod 41 when the trigger is actuated, as well as a fine control of the relative time of opening of the air valve 15 and the fluid valve when the trigger is moved. In fact, the timing may be thus controlled to effect simultaneous operation of the air and fluid valves or later opening of the fluid valve with respect to the air valve. In Figure 1 the position of the nose 47' is such that the trigger 31 will first engage the valve rod 16, open the air valve 15 and then engage the nose 47' to open the fluid valve. This timing feature is of great importance as will presently be shown.

The forward end of the barrel is provided with a longitudinal bore forming a liquid receiving chamber 52 which in turn communicates with the material supply passage 53 which extends downwardly through the downward extension 54, this downward extension having its lower portion screw-threaded as at 55 to afford a connection leading from a suitable pressure fluid container shown diagrammatically in dotted lines, and which, for example, may be a device such as that described in the Austin H. Downs Patent No. 1,706,875, issued March 26, 1929.

Receiving chamber 52 is in axial alignment with valve operating chamber 37 and valve rod 41 projects into said chamber and is slidably movable toward and away from the front end of the chamber, being slidably borne and guided in a packing nut 56 screwed to the rear end of said chamber. The rearwardly extending portion 56' of the nut 56 is externally threaded and a hollow clamping nut 57 is screwed thereon serving to

force and clamp packing material 58 tightly about the valve rod 41 and seal the rear end of said receiving chamber 52 against leakage while permitting sliding movement of the said rod. The front end of chamber 52 is internally screw-threaded at 59 and terminates in the flat front face 60 of the barrel 2, and the fluid tip 61 is adapted to be received in said screw-threaded portion 59.

This fluid tip is shown in detail in Figs. 1 and 2 and also illustrated in Figs. 6, 7 and 11, and is provided with the screw-threaded extension 62, whereby it is secured in position engaging the forward screw thread 59 of the receiving chamber 52. It has a hexagonally or polygonally shaped flange 63 directly adjacent the extension 62, a cylindrical portion 64 equal in diameter to the perpendicular distance between opposite flat faces of the hexagon or polygon, adjacent said flange, a conical portion 65 adjacent said cylindrical portion 64 and a small diametered cylindrical nose 66 at its forward end located at the apex of said conical portion.

Longitudinal slots 67 are provided in the tip 61, being centrally located with respect to each of the hexagonal faces 63' of the flange 63 and extending from substantially the forward half of each hexagonal face and through the entire length of cylindrical portion 64. These slots are uniformly deep throughout their length except at their rear ends where their bottoms curve outwardly at 67' to terminate in the respective faces of said flange 63. The fluid tip 61 is bored entirely through as at 68 along its longitudinal center line from the nose 66 to the rear face of extension 62, forming at its rear face a valve seat 68' on which the tapered valve 41' on valve rod 41 is normally adjusted to rest in closed position and to seal the fluid receiving chamber 52. When said valve 41' is opened by pressure on the trigger as before described, fluid passes from the chamber 52 and out through the forward end of the bore in the nose 66.

The air passages 11 and 24 extend horizontally along the barrel toward its forward end, to the respective chambers 69 and 70 (Fig. 2) converging slightly in their approach thereto. A passageway 71 extends upwardly and outwardly in the barrel 2 from the chamber 69 terminating in the flat face 60 of said barrel directly adjacent the flange 63 for a purpose to be presently described. A passageway 72 leads upwardly and outwardly in the barrel 2 from the chamber 70 also terminating in the flat face 60 of such barrel at a diametrically opposite point to said passageway 71 and at substantially adjacent the outer edge of said face. The chambers 69 and 70 are provided to facilitate the boring of the respective passageways 71 and 72 and each is suitably sealed by the respective sealing plugs 73 and 74. In this manner, two continuous air passages from the air distributing chamber 9 to the tip end of the barrel are provided, one of which is independently valve controlled through the valve 28 whereby air through passageways 24 and 72 may be adjustably restricted or cut off entirely as desired.

The nozzles to be applied over the fluid tip may as heretofore mentioned be either of the slot or the external type or of other types. Nozzle 75 which is shown in Figures 1, 2, 4 and 5 is of the slot type. This nozzle, which I term a "fan slot" nozzle is of general cylindrical form being substantially hollow and adapted to be applied over the fluid tip 61 with its inner or bottom edge 75

75' abutting the flat face 60 of the barrel. The nozzle has a cylindrical passage 76 near its forward end into which the cylindrical nose part 66 of the fluid tip projects, the diameter of said passage being larger than that of said part 66 for the passage of air and forming an atomizing chamber. Behind the cylindrical passage or chamber 76 is a conical passage 77 which is spaced from the conical portion 65 of the fluid tip. This conical passage joins a cylindrical chamber or passage 78 whose diameter is substantially larger than the diameter of the cylindrical portion 64 of the fluid tip. A partition 79 is provided in the nozzle immediately behind the chamber 78 and has a central bore 79' through which the said cylindrical portion 64 of the tip projects, fitting snugly against the walls of said bore. An enlarged cylindrical chamber 80 is provided behind the partition, its diameter being large enough to permit free passage into it of air from the air passages 71 and 72. The partition 79 is provided with a plurality of equally spaced passages or holes 81 permitting air to pass therethrough to the forward passages of the nozzle heretofore described and serving to distribute said air uniformly. The forward end of cylindrical passage 76 leads into a flat fan shaped or arcuate slot 82. It is to be noted that the cylindrical passage 76 in the nozzle extends in the nozzle body beyond the innermost edge of the fan slot and as the slot is less in width than the diameter of the passage or atomizing chamber 76, shoulders 82' are formed and these shoulders assist in breaking up the liquid by diverting the direction of flow of the air and causing the air to undergo a sharp change of direction and to pass into and across the stream of liquid as it emerges from the portion 66 of the fluid tip in said atomizing chamber. This chamber 76 is located centrally with respect to the slot. Furthermore, the air stream itself is broken up by the numerous abrupt changes of direction it undergoes in passing from the chamber 80 through the various holes and passages hitherto described before it reaches the atomizing chamber 76. This breaking up of the air and the abrupt changing of direction of flow of the air across the stream of fluid as it emerges from the fluid tip results in complete breaking up and atomization of the liquid and its discharge in the form of a finely divided spray of uniform density. This action also retards the direct flow of liquid from the nozzle which would result in an uneven spray of non-uniform density. In other words, the liquid is forced through the fluid tip under pressure and would pass through the nozzle in the form of a thick narrow stream, but for the air being directed by the shoulders 82' across the stream of liquid which retards the flow of the same through the nozzle, breaks it up into small particles and prevents its passage through the nozzle as a stream of liquid. This retarding action resulting from what might be termed eddy currents of air, is very important and gives the advantageous results hereinbefore referred to. It makes the use of a pressure feed cup possible in a device of this character and still gives efficient results in the application of these materials. Such a pressure feed cup is described in the hereinbefore mentioned Downs patent.

Externally the nozzle is provided with an annular flange 83 providing an annular shoulder 83' for securing the nozzle to the barrel 2 by means of a clamping nut 84 which screw threadedly engages an external threaded portion 85 on the tip end of the barrel 2. With the clamping nut loos-

ened, the nozzle may be rotated to provide any desired angular positioning of the fan slot 82, and thereafter locked in this position upon re-tightening of said nut.

In operation, it being understood that a fluid pressure cup illustrated in dotted lines in Figure 1 is connected to the extension 54, and that a source of air pressure is connected to the connection 4, the operator presses the trigger 29 which immediately opens air valve 15 whereby a supply of air under pressure is admitted into the air distributing chamber 9 and from there to the passages 10, 11 and 71 into the chamber 80 of the nozzle directly adjacent the fluid tip 61. Likewise, air is thus admitted to the needle valve chamber 13 and, if the needle valve 25 is open, into the passages 24 and 72 and thence into chamber 80 adjacent the periphery thereof. The air in chamber 80, under pressure passes through the slots 67 in the nozzle tip and also through the holes or passages 81 in partition 79 through the conical passage 77 between the nozzle and the fluid tip and strikes the shoulders 82' of said nozzle in the atomizing chamber 76, being thereby deflected across the open end of the fluid tip, and then out through the fan slot. Since the valve rod 41 has not yet been moved, there is no passage of paint or other liquid, and this does not occur until air under pressure is flowing through and emerging from the nozzle slot 82. Further movement of the trigger results in movement of the rod 47 and consequently valve rod 41 attached thereto, which moves the valve 41' from its seat in the rear end of the fluid tip bore 68 and permits the liquid, which because of the air pressure thereon has been forced up through passage 53 into chamber 52, to pass through the bore 68 in the fluid tip into the atomizing cylindrical chamber 76 in the nozzle. There, the fluid meets the out-rushing current of air under pressure and is completely broken up and atomized and forced out of the fan slot passage 82 in the form of a sheet of misty fluid material in proper shape to coat a surface. When the pressure is relieved from the trigger the fluid valve 41' first seats, closing the fluid passages and preventing the material from dripping or otherwise discharging from the nozzle. After this valve has seated the air valve 15 seats, closing off the parts of the apparatus from the source of air pressure. This action of closing off the air after the fluid has been cut-off or air cut-off lag results in a cleaning action of the air upon the machined parts of the fluid tip and nozzle, the continued air flow under pressure after fluid cut off serving to whip or blow off residual fluid material on said tip and nozzle. The time between the respective cut-offs of fluid and air can be varied to suit any existing conditions by manipulation of the knob 49 to bring the nose 47' of rod 47 nearer to or further away from the trigger 29. Furthermore, the provision of the two separate air passages 11 and 24 in the barrel is a distinct advantage. With heavier liquid spray material, both passages are wide open and permit a large volume of air under pressure and properly distributed to atomize the fluid emerging from the fluid tip. With thinner fluids, on the other hand, a smaller volume of air is required for complete atomization of the said fluid, and in such instances the air from passage 24 can be restricted independently by the needle valve 25, or cut off entirely when very thin fluids are used. This results in a saving of the operating air stored under pressure, and becomes particularly important if the sources of air sup-

ply are tanks of compressed air used in localities where pumping equipment is not available. Furthermore, excess air particularly with thin materials would result in objectionable blowing and sputtering at the nozzle tip. This is also avoided by regulating the flow of air in passage 24 by adjustment of the said needle valve.

My device is not restricted to the use of slot "fan type" nozzles. In Figures 6-9 inclusive I have illustrated an external or "outside mix" type of nozzle which may be applied to the barrel 2 in place of the slot nozzle hitherto described. Except for the external nozzle now to be described all the other elements of the device remain the same, and corresponding numbers on the said figures are identical parts with those of the earlier figures. The external nozzle illustrated consists of an inner part 86 and an outer part 87.

Externally, the inner part 86 consists of a substantially conical forward portion 88 superposed upon and integrally formed with a cylindrical portion 89 having an annular shoulder or flange 90 at its rear end. The inner part is hollowed or bored out to have an internal conical chamber 91 in the conical portion 88, and a cylindrical chamber 92 contiguous therewith, and a second cylindrical chamber 93 contiguous with chamber 92 whose internal diameter is so admeasured as to permit entry of air thereto from the outlet of the passage 71 only in the barrel 2. The diameter of chamber 92 is so admeasured as to snugly receive the cylindrical portion 64 of the fluid tip so that air may not pass between the walls of said chamber 92 and said portion 64 except through the slots 67, and through holes or perforations 94 provided in and extending in longitudinal direction through the walls about said chamber 92 from the annular shoulder 92' at the junction of the chambers 92 and 93 to the outer wall of the conical portion 88. Externally, the conical portion is provided with two milled slots or grooves 95 and 96 extending from two diametrically opposite openings 94' of holes 94 toward the central opening 97 at the apex of said conical portion. In position of use, the member 86 is mounted over the fluid tip and its rear edge 86' abuts the flat face 60 of the barrel 2; the nose 66 of the said tip projecting through and somewhat beyond the outer face of said conical portion 88. The diameter of opening 97 is somewhat larger than that of nose 66 to form an air passage 97' therebetween.

The outer part 87 comprises a substantially cylindrical member having an annular shoulder 98 and a portion 99 of reduced diameter behind said shoulder. Internally the part 87 is bored out to provide a cylindrical chamber 100; a conical portion 101, those walls abut the walls of the conical portion 88 of the inner part; and a second cylindrical portion 102 whose walls fit snugly over the walls of the cylindrical portion 89 of said inner part. A guide slot 104 in the walls of chamber 102 is adapted to receive a guide pin 105 on the part 86 to prevent relative rotation of the inner and outer parts. The front face of the outer part 87 is provided with two integrally formed longitudinally projecting air jet outlet members 106 and 107 which are diametrically arranged at opposite sides of the central hole 108 therein through which latter the conical portion 88 of the inner part and the nose 66 of the fluid tip project. These members are arranged at right angles to the direction of the slots 95 and

96 for a purpose to be presently described. The facing sides 106' and 107' slant outwardly in opposite directions from the bases of the respective members at a suitable angle and are provided with passage outlets 109' and 110' respectively of passages 109 and 110, which latter are perpendicular to the respective slanting faces. Longitudinally extending air passages 111 and 112 connect the respective passages 109 and 110 with the chamber space 113 behind the annular shoulder 98. A suitable clamping nut 114 having an internal annular flange 115 to engage the said annular shoulder 98, and adapted to be screw-threaded onto the barrel 2 at 85, serves to position the external nozzle on the barrel and to completely surround air space 113 between the annular shoulder 98 and the front face 60 of the barrel whereby air from passageway 72 is admitted thereto and directed from the said chamber through the passages 111 and 112 to outlets 109' and 110' for a purpose to be presently described.

The assembled inner and outer parts 86 and 87 when mounted on the nozzle end of the barrel serve to form an external type nozzle whereby a fan spray as hitherto described of varying fan spread can be produced. When the trigger 29 is actuated as heretofore described, air is first admitted to the nozzle end of the barrel through the passages 11 and 24, 71 and 72, exactly as previously described in connection with the first modification. The air from passageway 71 under pressure passes from the outlet of the latter passageway into the chamber 93, partially through the slots 67 to the chamber 91 and out through passageway 97' about the nose 66. Air also passes from the chamber 93 through the holes 94 and through the milled slots 95 and 96, causing a pair of oppositely directed jets of air to cross the fluid opening in the nose 66. These cross-currents intersect the tubular jet of air emerging from the passageway 97' and set up an eddy current effect at the liquid outlet of the nose 66 which serves to atomize completely the fluid which now emerges from the fluid tip as the trigger is further pressed by the operator into full operative position. The cross streams of oppositely-directed air from the slots 95 and 96 also flatten the atomized liquid into a fan-shaped spray whose plane is perpendicular to the axial direction of the said slots.

If the needle valve 25 is also open, air under pressure from the source enters chamber 113 from the passageway 72 and from there passes through the passages 111 and 112, emerging through outlets 109' and 110' as oppositely directed jets of air in the plane of the fan spray and serving to reduce the fan spread. The degree of reduction effected by these last-named jets of air depends upon the volume and velocity of the air emerging from said jets and these are controlled as desired by regulation of the needle valve 25. If the latter is wide open, minimum fan spray spread is effected and if the needle valve is entirely closed, the fan spray spread is at a maximum.

When the trigger is released by the operator, fluid cut-off occurs prior to air cut-off so that, as previously described in connection with the first modification, the air jets still continue momentarily and serve to blow or whip off residual fluid material about the fluid tip and nozzle. Likewise, the earlier fluid cut-off prevents fluid material

from dripping or otherwise discharging from the fluid tip.

In Figures 10 and 11, I have shown a modified form of external nozzle adapted to be applied to the barrel 2. Herein the external nozzle 116 comprises a single part of substantially cylindrical form having an annular shoulder 117 and a portion 118 of reduced diameter. Externally on its front face are two integrally formed longitudinally projecting air jet outlet members 119 and 120 similar in construction to the members 106 and 107. Members 119 and 120 are diametrically arranged at opposite sides of the central hole or opening 121 and are provided respectively with the outlets 122' and 123' of passageways 122 and 123 at right angles to the slanting faces of these members and which communicate respectively with the longitudinal passageways 124 and 125, which latter lead to the chamber 126 behind the annular shoulder 117.

Internally, nozzle 116 is provided with a large central bore, the wall of whose rearward portion is so admeasured as to snugly fit about the cylindrical portion 64 of the fluid tip, and whose forward portion of the wall forms the chamber 127 in front of the conical portion 65 of the fluid tip. Behind this cylindrical bore is another of enlarged diameter forming the chamber 128 and so admeasured in diameter as to admit air thereto from the passageway 71 in the barrel. This external nozzle is mounted over the fluid tip 61, whose forward nose 66 of smaller diameter than the opening 121, projects through the latter and slightly beyond the front face of said nozzle. A clamping nut 129 having an internal annular flange 130 to engage the annular shoulder 117 is adapted to be screwed on the barrel 2 at 85 and to clamp the nozzle thereto.

Operation of this modified external nozzle is similar to that described above for the first-mentioned external nozzle. When the trigger 29 is operated, air under pressure first flows from passageways 71 and 72 into the respective chambers 128 and 126. From chamber 128, the air passes through the slots 67 into chamber 127 and out through passageway 121' of the nozzle about the nose 66 of the fluid tip. From the chamber 126, air flows through passageways 124 and 125 and out through outlets 122' and 123' as a pair of diametrically oppositely-directed jets. These jets of air cross the jet emerging from the outlet 121' and set up eddy currents which completely atomize the fluid delivered from the nose 66 of the fluid tip and serve to form a fan shaped spray whose plane is perpendicular to the direction of the said air jets from the members 119 and 120. By regulation of the needle valve 25, the volume and velocity of the latter air jets is controlled to vary the thickness of the fan spray as desired without varying its spread. Preferably, it is best to operate the device when this last-described nozzle is employed with the needle valve 25 somewhat open at all times. The self-cleaning features resulting from earlier cut-off of fluid supply in the device as heretofore described are effected with this type of nozzle for the same reasons hitherto presented with the description of the other modifications.

The respective parts of the device and particularly the fluid tip and nozzle parts are made of metal or other suitable substances which may be machined and tooled to precise dimensions and to have sharp outside edges which latter will prevent accumulation of fluid material and assist the self-cleaning actions described.

While I have illustrated and described only one form of "fan slot nozzle," or "inside mix nozzle" and two forms of external or "outside mix" nozzles, it is to be understood that various other forms of nozzles such as "fan slot nozzles" having varying widths of fan slots, conical nozzles and other types of "outside mix" or external nozzles may be used in connection with the device described.

This device results in a number of advantages, a few of which are as follows. The two air lines in the barrel of the device with needle valve control in one permit variation of air volume and velocity when slot type nozzles are used, and fan spread and width control when external type nozzles are used. The increased volume of air led to the nozzle through these double passages effects break-up and complete atomization of the liquid at lower pressures. An even distribution of air is effected by the slots on the fluid tip. In the fan slot nozzle, the series of holes in the partition effect an even supply of air to the atomizing chamber. Likewise, with such slot nozzle, the projection of the nose of the fluid tip inside the forward cylindrical bore or atomizing chamber inside of the nozzle, forces air to strike the fluid material inside the said atomizing chamber to effect proper break-up. With external nozzles, the fan spread may be varied by cutting off or reducing air flow through one of the two main passageways in the barrel, or the fan thickness may be varied. In addition, the device results in the saving of a substantial amount of material used, operation at greater speed, and on less power. Furthermore, the device is composed of few wearing parts, being made strong and substantial and capable of maximum severe service. Mists, fumes, and the chilling of the liquid material is minimized and a smooth even flowing coat free from all blemishes is assured. The flow of liquid material is under perfect trigger control and the device is self-cleaning, balanced, light in weight, and convenient and unusually easy to operate, disassemble and to clean.

#### I claim:

1. A paint spraying device including a nozzle member having an air passage and a fan shaped slot with which said air passage communicates, a fluid tip member having a material passage mounted within said nozzle with its end spaced from said slot and slots in the side walls of said tip, said device having two air passages terminating one directly adjacent said fluid tip and the other at a substantial distance therefrom, and said nozzle member being partitioned and provided with independent passageways for air through the said partitioning whereby air from the said two air passages is uniformly distributed about the fluid tip member at its outlet end and complete atomization of material flowing from the fluid tip is effected.

2. A paint spraying device including a nozzle member having a discharge passage, and comprising an inner and outer part of which the latter is borne upon the inner part, a fluid tip member having a material passage mounted within said inner part with its outlet end extending through both said parts and spaced from said discharge passage, the spacing between said parts forming a plurality of gas chambers and passageways, said device having two gas supplying passageways, one terminating in one of said chambers and the other in a second of said chambers, said one of said chambers communicating directly with said discharge passage through passage-

ways arranged between said tip member and said inner part, and said inner part having passageways also communicating with said one of said chambers and oppositely directed with respect to said outlet end of said fluid tip member whereby gas supplied from one of said gas supplying passageways to said one of said chambers is both uniformly distributed about the said outlet end of said fluid tip member and directed as streams across the said outlet end to atomize the material flowing from said outlet end and to shape it to a fan spray, and gas jet members on the outer part connected by passageways to said second chamber whereby gas from the second of said two gas supplying passageways in said device is ejected from said gas jet members in oppositely-directed streams to vary the spread of said fan spray.

3. A paint spraying device including a nozzle member having an air passage and consisting of an inner and an outer part, a fluid tip member having a material passage mounted within said inner part with its outlet end extending through both said parts and spaced from said air passage, said outer part having a conically bored-out portion, and said inner part having a conical portion adapted to lie in said conically bored-out portion, said inner part having passageways extending through the walls thereof and oppositely directed slots in the conical portion extending from diametrically opposite passageways therein whereby air is delivered in cross streams over the said fluid tip member.

4. A paint-spraying device including a nozzle member having a central air passage adapted to be mounted on said device, a fluid tip member having a material passage mounted within said nozzle with its end projecting through said air passage and spaced from the walls thereof, said nozzle member being so shaped as to form a plurality of air chambers when mounted over said tip member, air jet members on said nozzle communicating with one of said chambers and two air passageways in said device, one terminating in said last-named air chamber and the other in a second of said air chambers whereby air from the first of said passageways is delivered from said air jet members as jet streams across the fluid tip member and air from the second of said chambers is delivered through the space between said tip member and the said central air passage to atomize completely the material delivered from said fluid tip.

5. A spraying device including a nozzle member having a discharge passageway and an outlet opening with which said discharge passageway communicates, a tip-member having a passage for fluid material arranged within said nozzle with its end spaced from said outlet opening, said tip member having slots in its side walls, said device having two passages terminating one directly adjacent said fluid tip member and the other at a substantial distance therefrom, and said nozzle member being partitioned and provided with independent passageways for gas each extending through the partitioning, whereby gas from the said two passages passing through the said independent passageways and said slots is

uniformly distributed about said tip member at its outlet end and complete atomization of material flowing from said tip is effected.

6. A spraying device including a nozzle member having a gas discharge passage and comprising an inner and an outer part, a tip member having a passage for fluid material arranged within said inner part with its outlet end extending through both said parts and spaced from said discharge passage, said outer part having a bored-out portion, and said inner part having a complementarily shaped portion adapted to lie in said bored-out portion, said inner part having passageways extending through the walls thereof and oppositely directed slots in the complementarily shaped portion extending from diametrically opposite passageways therein whereby gas is delivered in cross streams over the said tip member.

7. A spraying device including a nozzle member having a gas discharge passage adapted to be mounted on said device, a tip member having a passage for fluid material arranged within said nozzle with its outlet end projecting through said gas discharge passage and spaced from the walls thereof, said nozzle member being so shaped as to form a plurality of gas chambers when placed over said tip member, gas jet members on said nozzle communicating with one of said chambers, and two gas passageways in said device, one terminating in said last-named gas chamber and the other in a second of said gas chambers, whereby gas from the first of said passageways is delivered from said gas jet members as jet streams across the tip member and gas from the second of said chambers is delivered through the space between said tip member and said gas discharge passage to atomize completely the fluid material delivered from said tip.

8. A device, as per claim 7, in which means are provided for independently regulating the flow of gas in one of said two gas passageways.

9. A paint-spraying device including a nozzle member having a discharge passage and a slotted outlet opening with which said discharge passage communicates forming shoulders at the junction of said passage and outlet opening, a fluid-tip member having a passage for spraying material arranged within said nozzle with its outlet end spaced away from said slotted outlet opening inwardly of said nozzle and comprising a portion intermediate its inlet and outlet ends of substantially larger over-all dimensions than its said outlet end, a partition in the interior of said nozzle member subdividing the latter into separate chambers, said partition having a central bore through which the said portion of said tip-member extends and also having a plurality of communicating passages interconnecting the chambers, and means in said device for effecting the introduction of gas under pressure into one of said chambers, from which chamber said gas is distributed through the various passageways in said partition into a second chamber and thence about the outlet end of said tip-member in such manner as to effect complete atomization of the material flowing therefrom.

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