United States Patent [19]

Warning, Sr. et al.

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[54] **SPRAYING APPARATUS**

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[52] **U.S. Cl.** **239/411;**

[51] **Int. Cl.²** **B05B 7/12**

[58] **Field of Search** 239/410, 411, 412, 533, 239/583, 584

[56] **References Cited**

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[57] **ABSTRACT**

The needle valve in a spray head is guided by a plurality of bushings spaced apart by a plurality of packing washers for precise alignment with the associated valve seat, and the needle has a conical front end which prevents liquid from collecting thereon.

7 Claims, 4 Drawing Figures

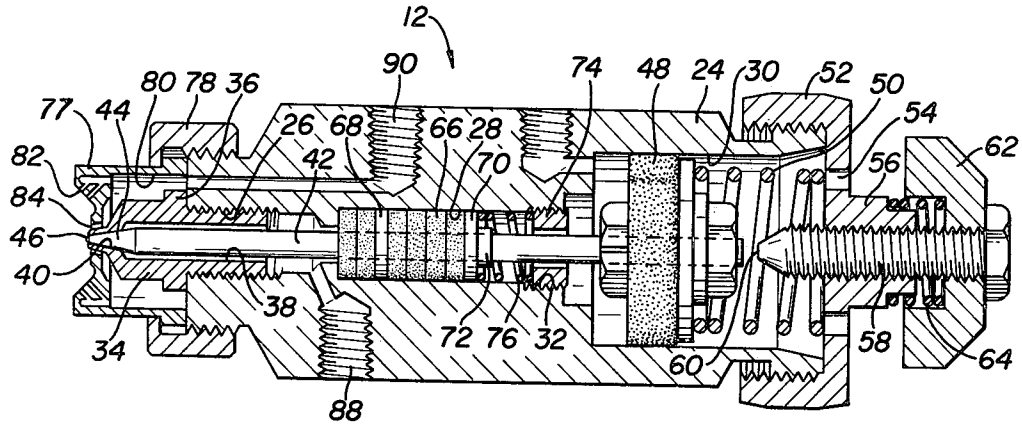


FIG. 1

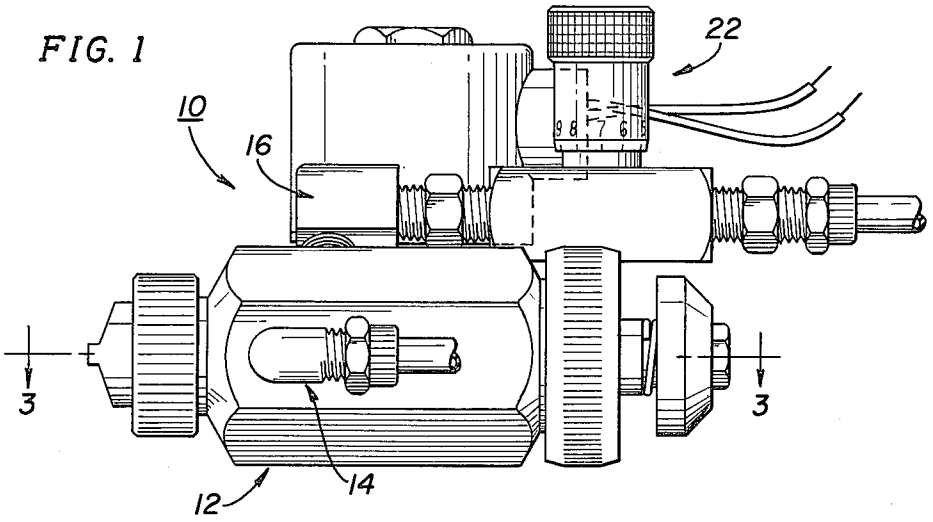


FIG. 4

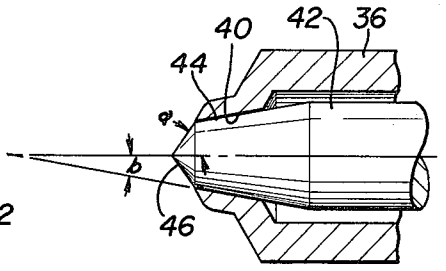


FIG. 2

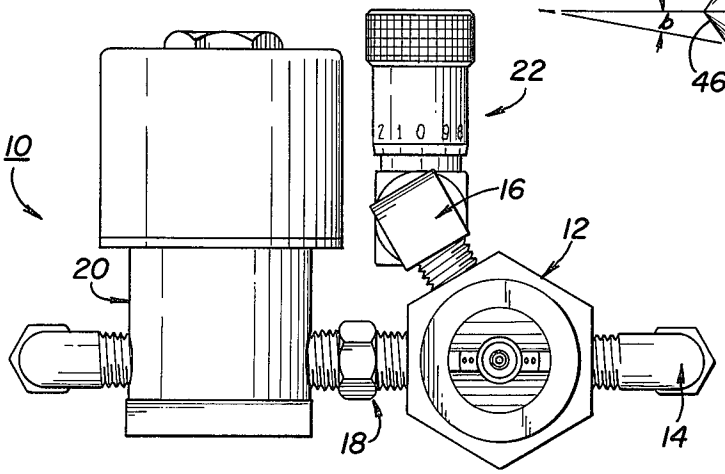
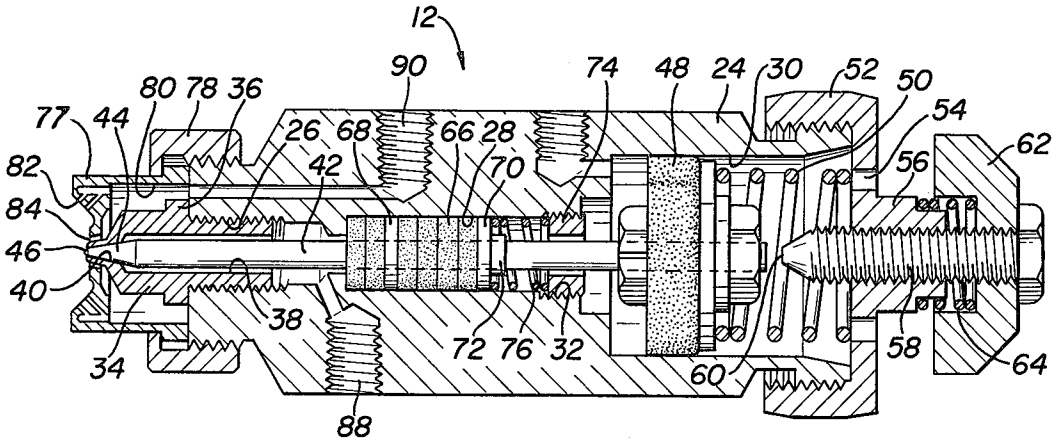


FIG. 3



SPRAYING APPARATUS

The present invention relates to apparatus for atomizing and spraying liquid in a controlled predetermined pattern.

BACKGROUND OF THE INVENTION

The use of spraying apparatus for use in marking and in applying glue has presented several problems which have limited the use of such apparatus to special applications. Whether the apparatus is used for applying a liquid dye or liquid glue it is ordinarily important that the spray pattern remain precisely the same for extended periods of time so that the apparatus may operate unattended. Particularly in the case of glue it is extremely important that the glue not collect at the liquid spray orifice since the collected liquid not only alters the spray pattern but in some cases prevents operation of the apparatus after it has been idle for a period in excess of that required for the glue to set, such, for example, as overnight.

We have determined that it is these two problems inherent in the prior art spraying heads, which have deterred the widespread use of spraying apparatus for marking and gluing applications. The present invention as described hereinafter has enabled the application of glue spraying equipment to high speed packaging lines. When so used, the spray head is sequentially operated at high repitition rates over long periods of time and maintains the density of glue in the spray and the pattern itself constant throughout such periods.

SUMMARY OF THE INVENTION

Briefly, the spraying apparatus of the present invention utilizes a reciprocable needle valve having a conical tip adjacent the frusto-conical valve portion, the latter portion sealably engaging a complimentary shaped seat when the needle is in the forward sealing position. When the needle is retracted the glue exits the head through the annular space surrounding the forward end of the needle. The angle of the conical tip at the distal end of the needle is critical if the liquid being sprayed is not to collect thereon. We have found, for example, that if the taper at the tip is the same as that of the frusto-conical valve portion, or if the tip is flat or semi-spherical, liquid will collect thereon and drastically impair the operation of the unit. Moreover, we have found that the frusto-conical valve portion of the needle and the associated valve seat must be held withiin extremely close tolerances or else irregular patterns and irregular liquid density distributions will result. Nevertheless, simply controlling these tolerances has not solved the problem and we have further found that only by precisely maintaining the needle on the axis of the valve seat with spaced guide bushings will a precise, repetitive spray pattern be provided and will the tip remain free from liquid.

BRIEF DESCRIPTION OF THE DRAWING

Further objects and advantages and a better understanding of the present invention can be had by reference to the following detailed description, wherein:

FIG. 1 is a side view of liquid spray apparatus embodying the present invention;

FIG. 2 is a front view taken from the left side of FIG. 1;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 1; and

FIG. 4 is a greatly enlarged sectional view of the tip portion of the apparatus of FIG. 1 showing the double tapered tip of the needle valve.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawing and particularly to FIGS. 1 and 2 thereof, there is shown a liquid atomizing and spraying apparatus **10** including a spray head **12**, a liquid inlet connector **14**, a first fluid inlet connector **16**, and a second air inlet connector **18**. An electrically operated solenoid control valve **20** is connected between a source of pressurized air or other fluid (not shown), and a manually adjustable needle valve **22** is connected between the same fluid source and the connector **16**.

With reference to FIG. **3**, the spray and head **12** comprises an integral body member **24** having a longitudinal bore extending therethrough. This bore has a threaded forward portion **26**, an intermediate cylindrical portion **28** separated from an enlarged rear portion **30** by a short threaded portion **32**. A valve tip **34** is threaded into the forward bore portion **26** and has an intermediate annular flange **36** which abuts the foreward end of the body member **24**. The tip member **34** is provided with a longitudinal bore **38** having a frusto-conical foreward portion **40** which forms a valve seat and liquid orifice.

A needle valve **42** is aligned with the longitudinal axis of the seat **40** and has a frusto-conical valve portion **44** near the forward end and an adjacent conical end or tip portion **46**. The tapered valve portion **44** is complimentary to the seat **40** and the portions **40** and **44** are held within close dimensional tolerances. A piston **48** is fixedly attached to the rearward portion of the needle **42** and is pneumatically sealed to the bore portion **30** which functions as a cylinder in which the piston reciprocates. The needle **42** is biased into the forward sealing position closing the orifice in the tip by means of a coil spring **50** compressed between the rear end of the piston **48** and a cap **52** threaded onto the rear end of the body member **24**. The cap **52** is provided with one or more air relief holes **54** and is provided with an elongated tubular central section **56** which is internally threaded to receive a manually adjustable stop screw **58** whose forward end **60** limits the rearward movement of the needle **42** and thus determines the size of the orifice opening in the tip when the piston is retracted to open the valve. An adjusting knob **62** is fixed to the rear end of the stop screw **58** and a coil spring **64** prevents spurious rotation thereof.

In order to seal the piston chamber from the foreward part of the unit, a plurality of leather packing or sealing washers **66** are fitted over the intermediate portion of the needle **42** and sealably engage both the needle and the bore portion **28**. A guide bushing **68** interposed between the washers **66** is formed of a suitable metal such as brass and provides a slip fit to both the needle **42** and to the bore portion **28**. A second guide bushing **70** is also formed of a metal such as brass and provides a slip fit to both the needle **42** and the bore portion **28**. The bushing **70** includes a rearwardly extending sleeve portion **72**. A screw **74** holds the packing washers and the bushings in place and a coil spring **76** compressed between the bushing **70** and the screw **74** holds the packing in compressed sealing relationship against the foreward end of the bore portion **28**. As shown, the bushings **68** and **70** are spaced apart by a

plurality of the resilient sealing washers **66** and maintain the needle in alignment with the tip member **34** so that when the valve is open the orifice surrounding the forward needle portion is truly annular. The bushing **70** also keeps the spring **76** centered on the axis of the needle and provides a flat annular forward surface for uniformly compressing the packing washers.

An air cap **77** is positioned over the tip member **34** and is held in place against the front end of the body member **24** by a collar **78** threaded over the front end thereon. An air chamber **90** is located in the cap **77** surrounding the tip member **34** and is supplied with air from a port **90.** A plurality of orifices **82** in the cap **76** control the shape of the spray pattern in the known manner. Also, an annular orifice **84** surrounds the forward end or nose of the tip member **34** for eductting liquid therefrom when the needle valve is open.

The body member **24** is provided with a port and associated passageway **86** to which the connector **18** is connected for controllably operating the piston **48** to open the needle valve. A port **88** and associated passageway supply liquid from the connector **14** to the foreward side of the packing and thus to the passageway through the tip member **34.** The port **90** and associated passageway receive air or other fluid from the connector **16** and couple it to the chamber **80** at the front of the unit.

In use, the liquid to be sprayed is supplied from a gravity head or other pressure source via the connector **14,** and air at a pressure of about **50** psi is supplied to the valves **20** and **22.** Air thus constantly flows from the orifices **82** and **84** across the nose of the tip member. When the solenoid is to be actuated to open the valve **20,** air pressure is supplied to the foreward side of the piston **48** forcing it back against the stop screw **58** to open the liquid orifice at the front a preset amount. Liquid thus exits from the tip and is sprayed in a controlled pattern determined by the angle and location of the orifices **82.** The density of the pattern is adjustable by means of the knob **62** and also by the control valve **22.** The size of the pattern depends on the distance between the unit and the surface to be sprayed.

A problem which has heretofore remained unsolved in spray equipment is the collection of liquid at the front end of the spray device and particularly on the foreward or distal end of the needle. We have found that by selecting the proper angle of taper of the tip portion **46** this problem is solved even with highly viscous and tenacious liquids such as glue. In FIG. **4,** the angle of taper of the valve portion **44** is indicated to be *b* and the angle of taper of the nose portion **46** is indicated to be α. The angle *b* is about **10°** to provide a tip and needle assembly having a long life. The angle α is extremely critical and must be between **47°** and **58°** to prevent adherence of the liquid thereon. We have found the preferred angle to be about **54°.** The included apex angle of the tip must, therefore, be in the range of **94°** to **116°.** Moreover, the tip portion **46** must be adjacent the front end of the seat **40** as shown in FIG. **4** so that when the needle is in the retracted position the nose portion of the needle is within the tip member.

While the present invention has been described in connection with particular embodiments thereof, it will be understood by those skilled in the art that many changes and modifications may be made without departing from the true spirit and scope of the present invention. Therefore, it is intended by the appended claims to cover all such changes and modifications which come within the true spirit and scope of the invention.

What is claimed is:

1. Apparatus for atomizing and spraying a liquid, comprising

a body member having a bore therein,

a tubular tip member mounted in one end of said bore and having a forewardly disposed liquid orifice defined by a conical valve seat,

a needle valve having a frusto-conical valve portion reciprocably mounted in said bore for movement of said valve portion into and out of sealing engagement with said valve seat,

spring means mounted in said bore urging said needle valve into sealing engagement with said valve seat,

fluid operated means mounted in said bore for moving said needle out of sealing engagement with said valve seat,

a plurality of sealing gaskets interposed between an intermediate portion of said needle and said bore for preventing fluid from traveling across said intermediate portion of said needle,

a plurality of bushings slidably disposed on said needle and spaced apart by a plurality of said gaskets for guiding said needle for movement along the central longitudinal axis of said valve seat, and

passageway means for supplying said liquid to said bore forwardly of said sealing gaskets.

2. Apparatus according to claim **1** wherein

the distal end portion of said needle adjacent said valve portion is conical and has an included apex angle within the range of **94°** and **116°,**

said distal end portion being external of and adjacent to said orifice tip when said needle is in the foreward valve sealing position.

3. Apparatus according to claim **2** wherein

said angle is about **108°.**

4. Apparatus according to claim **2** comprising

a nose piece mounted to said body member over said tip,

said nose piece having a plurality of orifices for directing a fluid in a predetermined pattern across the outer end of said tip to draw liquid therethrough when said needle valve is open, and

passageway means in said body member for supplying said fluid to said nose piece.

5. Apparatus according to claim **4** comprising

control means mounted to said body member for adjusting the rate of flow of said fluid to said nose piece.

6. Apparatus for atomizing and spraying a liquid, comprising

a body,

a tubular spray tip disposed at the front end of said body and having a frusto-conical valve seat,

a needle reciprocably mounted in said body and having a frusto-conical intermediate portion adapted to seat against said valve seat when said needle is in a foreward position,

the distal end of said needle adjacent said frusto-conical intermediate portion being conical and having an apex angle within the range of **94°** and **116°,**

said distal end extending forewardly of said seat when said needle is in said forward position,

means for directing an annular stream of air across said tip, and

means for supplying said liquid to said seat interiorly of said tip.

7. Apparatus according to claim **6** wherein said frusto-conical intermediate portion has an angle of taper of about **10°**.

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