

Nov. 17, 1959

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2,913,187

SPRAY GUN FOR VISCOUS LIQUIDS

Filed June 20, 1957

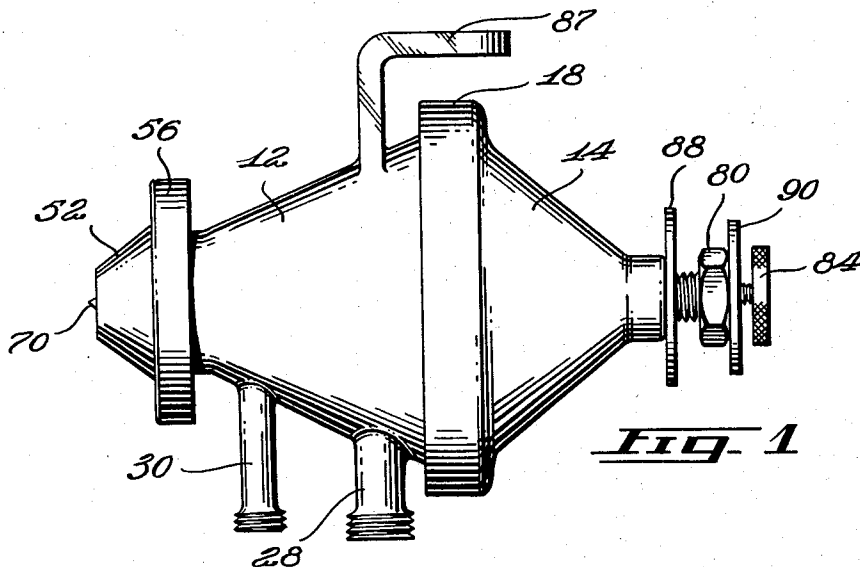


Fig. 1

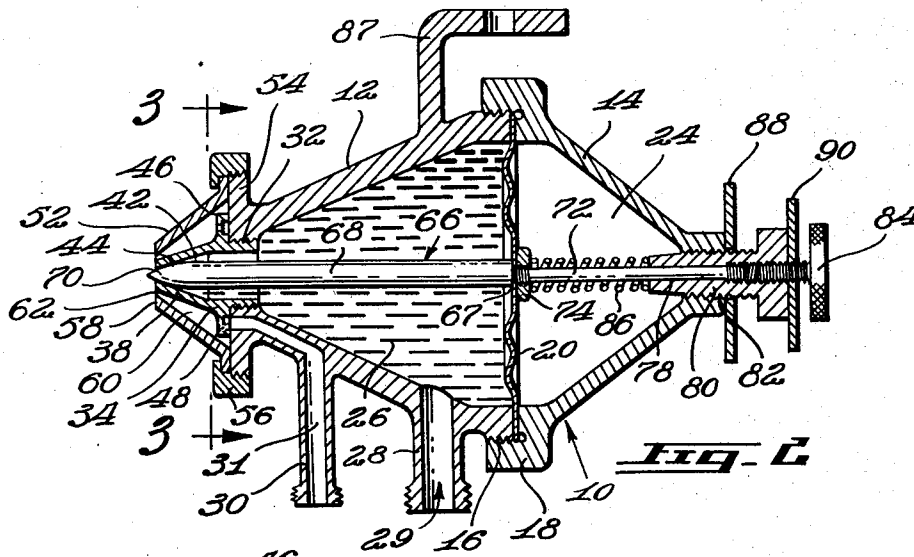


Fig. 2

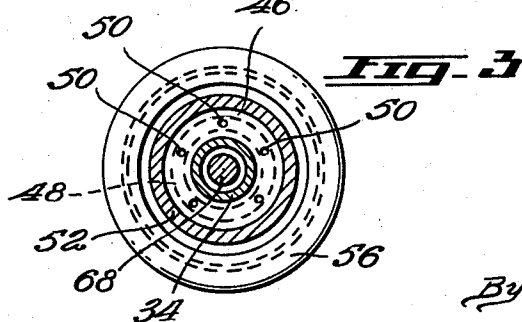


Fig. 3

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SPRAY GUN FOR VISCOUS LIQUIDS

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Application June 20, 1957, Serial No. 666,823

3 Claims. (Cl. 239-412)

The present invention relates to improvements in the construction of spray guns and more particularly to improvements in spray guns used for viscous liquids.

While there are many and varied types of spray guns at present available which function satisfactorily for the spraying of relatively thin fluids, for example, thin paints, lacquers or the like, they are not too satisfactory when utilized for the spraying of viscous, sticky liquids, such as synthetic resins or the like.

In general these spray guns all include a liquid chamber into which the fluid is delivered under pressure and from which it is discharged through a nozzle in combination with a stream of pressurized air to achieve the desired spray effect. Except where induced vacuum by the pressurized air is adequate for liquid supply, which is certainly not the case for viscous liquids, it is necessary to provide some means of positively controlling and shutting off the flow of liquid at the discharge nozzle. This is normally done by means of a needle valve which is operated either manually or by air pressure under the control of the operator. In some multiple spray gun arrangements for production purposes, the needle valves are operated in sequence by mechanical means.

When seated in the discharge nozzle the needle valve retains the liquid under pressure in the liquid chamber of the gun. To prevent the liquid under pressure from leaking back up the valve stem and fouling the operating mechanism, the needle valves are usually glanded or provided with sealing washers which are forced against the stem of the valve to seal off the valve stem accommodating boring or sleeve in the gun. Friction between these washers and/or packing and the valve stem is a constant source of trouble, even in the spraying of relatively thin liquids, either by retarding or completely preventing movement of the needle valve or by permitting the liquid to leak back and clog the operating mechanism. This is particularly true when spray guns are used with viscous liquids which tend to solidify in a relatively short time.

Up to the present time no really satisfactory material has been found from which to make these sealing washers. Leather appears to be the best available but leather absorbs the liquid being sprayed and if this is viscous or sticky, the frictional drag between washers and needle valve stem gradually increases to the point where the needle valve will not operate.

The present invention aims to provide a solution for these problems by furnishing a spray gun construction which is capable of handling all types of fluids and particularly sticky, viscous liquids such as the synthetic resins. In accordance with the invention this is accomplished by eliminating the need for packing washers and glands entirely with respect to the needle valve by providing a sealed flexible diaphragm at the rear or top of the liquid chamber. This diaphragm is constructed and disposed within the gun body so that it not only seals off the liquid to the interior of the chamber but also operates the needle valve which is secured to its center.

Accordingly, the invention is a spray gun adapted for controlled spraying of viscous liquids which comprises essentially of a main body having an internal recess constituting an internal fluid chamber and having a sealing wall constituted by a flexible diaphragm, preferably of metal, extending across the internal body recess. Liquid inlet and outlet passages are provided in the body leading into and out of the liquid chamber and a valve seat

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is provided in the outlet passage in axial alignment with the center of the flexible diaphragm. A valve stem having one end shaped to conform with the outlet passage valve seat is mounted for restricted axial movement on the center of the flexible diaphragm and in axial alignment with the liquid outlet passage. Means are provided for adjustably restricting the amount of axial travel of the valve stem relative to the valve seat and consequently the degree of flexure of the flexible diaphragm under varying liquid pressures delivered to the fluid chamber. Means are provided to disperse the flow of liquid from the needle valve controlled outlet passage. In a preferred construction an extension is provided on the body which includes an atomizing air chamber having an annular discharge outlet surrounding the fluid outlet passage and there is an air inlet passage leading to the atomizing air chamber for attachment to a source of air under pressure in the usual manner.

With this arrangement operation of the needle valve is effected by movement of the flexible diaphragm and the diaphragm is moved by varying the pressure applied to the actual liquid being sprayed as it is delivered to the liquid chamber.

Having thus generally described the nature of the invention particular reference will be made to the accompanying drawings showing a preferred embodiment by way of illustration, and in which:

Figure 1 is a side elevation of a spray gun embodying the controlling means of the invention;

Figure 2 is a longitudinal cross-sectional view of the construction of Figure 1;

Figure 3 is a sectional view of Figure 2 along the line 3-3.

With particular reference to Figures 1 and 2 of the drawings a preferred construction of a spray gun in accordance with the present invention includes a main body 10 made up of interconnected portions 12 and 14. The body portion 12 is provided with a threaded end 16 and the portion 14 is provided with a flanged internally threaded end 18 which fits over and is threadably engaged with the lower portion end 16. A flexible diaphragm 20, preferably of resilient metal, is mounted between the ends 16, 18, of the body portions and is sealed about the outer periphery by their engagement to divide the interior of the gun body transversely of its axis into chambers 24, 26.

The body portion 12 containing the liquid chamber 26 is provided with attachment extensions 28 and 30 the outer ends of which are threaded for connection with suitable sources of fluid and pressurized air. The extension 28 is provided with a central boring 29 constituting a liquid inlet passage leading into the liquid chamber 26 while the extension 30 is provided with an offset boring 31 leading through the body portion 12 to provide an air inlet passage as will be described in more detail later.

An axial boring 32 is provided in the portion 12 and is internally threaded to receive a correspondingly threaded liquid discharging tip or nozzle 34. The nozzle 34 is provided with a tapering end 38 and is centrally bored as indicated at 42, to constitute a liquid outlet passage leading from the liquid chamber 26. The outer end of the outlet passage 42 tapers due to the formation of the nozzle end 38, the inner walls of which at this point form a tapering valve seat 44. The nozzle 34 is also provided with an outstanding flange 46 provided with an annular recess 48 with which the air inlet passage 31 communicates. A plurality of holes 50 lead from the outer surface of the nozzle flange 46 into the annular recess 48 so that pressurized air delivered from the air inlet passage 31 passes into the recess 48 and through the holes 50 is distributed into the interior of an atomizing air cap or fitting 52.

The atomizing air cap 52 is of hollow conical formation and is retained to a threaded flanged extension 54 of the body portion 12 by a threaded locking collar 56. The end 58 of the cap 52 is in substantial alignment with the terminal end of the nozzle end 38 and an air-pressure chamber 60 is thus provided between the outer wall of the nozzle end 38 and the inner tapering wall of the cap 52. The spaced apart concentric ends 38 and 58 of the nozzle and cap respectively provide therebetween an annular air discharge orifice 62 surrounding the liquid outlet passage 42.

In order to control the discharge of liquid from the outlet passage 42, in accordance with the present invention, a valve stem 66 is mounted within and extends axially through the body portions 10, 12, and the flexible diaphragm 20 to which it is secured. The valve stem 66 includes a portion 68 disposed in the liquid chamber 26 and terminating in a tapering end 70 adapted to seat in the liquid outlet passage valve seat 44, and a portion 72 of reduced diameter disposed in the chamber 24. The valve stem 66 is secured to the diaphragm 20 by the abutment of a shoulder 67 at the end of the stem portion 68 on one side of the center of the diaphragm 20 and a retaining nut 74 threadably engaged with the stem portion 72. The valve stem 66 is guided for restricted axial movement under the flexure of the diaphragm 20 by the sliding engagement of the end of the valve stem portion 72 within the boring 78 of a sleeve member 80. The sleeve member 80 is threadably engaged in a tapped opening 82 provided in the top of the body portion 12 and the valve stem receiving bore 78 is tapped for an initial portion of its length to threadably receive an adjusting screw 84. A coil spring 86 is mounted over the stem portion 72 and between the retaining nut 74 and the lower end of the sleeve 80 so as to normally and resiliently urge the valve stem 66 and diaphragm 20 in a closing direction towards the liquid outlet valve seat 44. Locking washers 88, 90, are provided on the sleeve 80 and adjusting screw 84 so as to retain these respective members in the desired adjusted location determining the amount of axial travel of the valve stem 66. An attachment bracket 87 is provided on the body portion 12.

With this arrangement, operation of the valve stem 66 is effected by movement under the flexure of the diaphragm 20. The diaphragm 20 is moved or flexed by varying the pressure applied to the liquid delivered to the liquid chamber 26. In use, the sleeve member 80 is adjusted to apply the desired pressure to the spring 86 and consequently the diaphragm 20. The adjusting screw 84 is then set to give the desired stroke or movement of the valve stem 66 (approximately $\frac{1}{8}$ ").

Fine adjustment of the pressure control sleeve 80 and adjustment screw 84 is made when spraying commences. Air pressure on the liquid supply is then increased by opening the usual control valve (not illustrated) so that the liquid pressure in the liquid chamber 26 overcomes the adjusted pressure of the spring 86 and moves the diaphragm 20 and valve stem 66 by an amount permitted by the setting of the adjustment screw 84. This permits liquid to flow out of the discharge outlet passage 42. Simultaneously, in the preferred construction illustrated, air under pressure is delivered to the air inlet passage 31 under the control of the usual control valve (not illustrated). Regulation and adjustment of the air pressure required to operate the needle valve arrangement of the invention is preferably effected by a standard air pressure regulator (not illustrated). Once set it should not be necessary for the operator to change the setting. The setting for the atomizing air, as is known, will depend on the degree of atomization desired. For synthetic resins it is an absolute minimum and here again, once set, it should need little further attention. Both the air controlling the liquid pressure and the air for atomization can be conveniently controlled by a single hand or

foot operated valve as is known in arrangements of this nature.

It will be understood that nozzle arrangements other than the preferred construction illustrated might be utilized for the dispersing or breaking up of the liquid stream from the outlet passage. Since the viscous type of liquid, e.g. synthetic resins, which the present apparatus is particularly suited to handle, requires little atomization and is preferably sprayed in fairly large particles or droplets to achieve what is known in the art as a "stippling" effect, a liquid outlet nozzle could be utilized which includes means to break up the liquid flow without pressurized air.

When the operator shuts off the pressure applied to the liquid to stop spraying, a bleed valve in the liquid supply (not illustrated) will operate in a known manner and the force of the spring 86 overcomes the pressure in the liquid chamber 26 and the valve stem 66 travels in the closing direction seating the tapered end 70 into seated position on the liquid outlet passage seat 44 thereby stopping the flow of liquid.

As will be understood by reference to the preceding description and accompanying drawings the frictional retardation and other problems encountered with the known controlling needle valves of spray guns are for all practical purposes eliminated by the spray gun construction of the present invention.

I claim:

1. A spray gun construction adapted for the pressure controlled spraying of viscous liquids comprising a main housing having an internal recess concentric about the axis of said housing, a flexible diaphragm mounted within said housing partitioning said internal recess transversely of the axis of said housing into two chambers, said housing having at one end an axially aligned conical extension terminating in a truncated tip and having an internal tapering recess forming a liquid discharge passage leading from one of said housing chambers to the exterior of said housing, a valve seat in said liquid discharge passage adjacent said housing extension truncated tip, a liquid inlet passage in the wall of said housing leading into said one chamber, a valve stem mounted in said housing so as to extend axially through both of said chambers and including in said one chamber a first portion terminating in a tapered end adapted to seat in said liquid discharge passage valve seat, said valve stem passing through and being secured axially and concentrically to said flexible diaphragm with the other end of said stem slidably guided in a sleeve mounted axially within said housing other chamber, a spring in said housing other chamber surrounding said valve stem and urging said flexible diaphragm and attached valve stem portion having said tapered end towards said liquid outlet passage valve seat, and means to disperse the flow of liquid from said outlet passage into a spray.

2. A spray gun construction, as claimed in claim 1, wherein said means to disperse the flow of liquid from said liquid outlet passage comprises a hollow pressurized gas fitting mounted on said housing conical extension concentrically with and surrounding said extension to terminate flush with said housing extension tip and form with the exterior of said housing extension a pressurized gas chamber having a terminal annular discharge outlet surrounding the terminal outlet of said liquid discharge passage.

3. A spray gun construction, as claimed in claim 1, wherein the said valve stem guiding sleeve extends exteriorly of said housing and a threaded adjustment screw is fitted in said extension sleeve portion so as to engage the end of said valve stem.

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