

Aug. 11, 1936.

G. L. NEELY

2,050,368

SPRAY NOZZLE

Filed Feb. 26, 1934

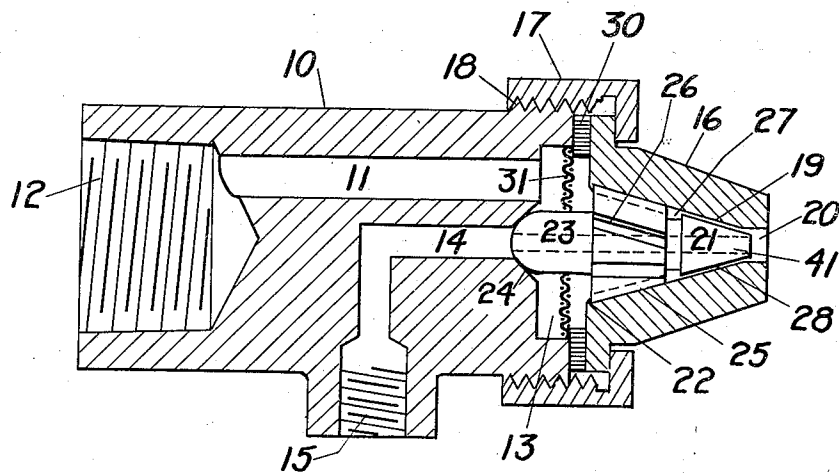


FIG. 1.

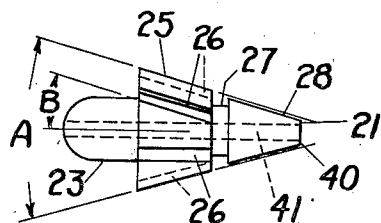


FIG. 2

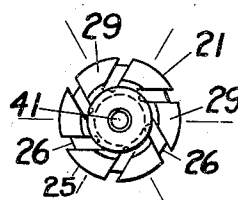


FIG. 3

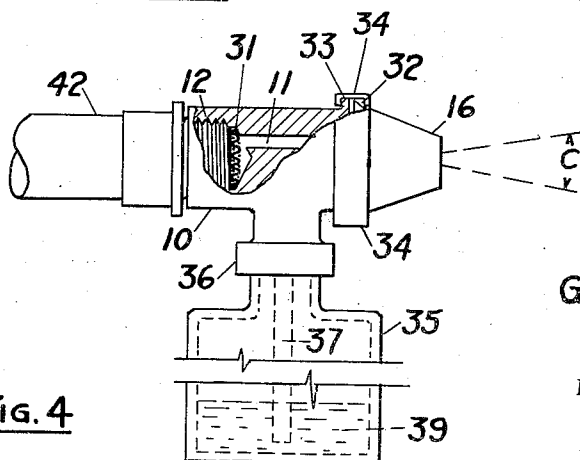


FIG. 4

George Leonard Neely  
INVENTOR.

BY *Walter G. Miller.*

ATTORNEY.

## UNITED STATES PATENT OFFICE

2,050,368

## SPRAY NOZZLE

George Leonard Neely, Berkeley, Calif.

Application February 26, 1934, Serial No. 712,873

4 Claims. (Cl. 229—115)

This invention relates to spray nozzles and particularly but not necessarily to those in which a fluid under pressure is utilized to aspirate a liquid from a container and then atomize it to form a finely divided spray or mist. Such a one is disclosed in my copending application Serial Number 348,164, filed March 19, 1929, and on which Patent No. 1,948,533 issued February 27, 1934 and of which this application is a continuation in part.

In small spray devices, particularly those used for atomizing liquid insecticides by means of a pressure fluid such as water from the usual piped supply, it is particularly difficult to provide a simple and cheaply manufactured construction which will maintain the continued accurate and close alignment of the various parts forming the nozzle. It has been found by extensive tests that an annular converging conoidal jet of water, for example, if directed through suitable passages so as to give it a vortical motion, will cause a reduction of pressure at its apex or converging point. If a suitable axial passage is provided from this apex or converging point to a liquid supply, the said liquid will be aspirated and thoroughly mixed with the water, and the resulting mixture will be dispersed into a finely divided cone shaped spray or mist. Under some circumstances, however, it is possible to feed the liquid under a positive head, so that the aspirating action may be subsidiary to the diluting, atomizing and dispersing actions.

The dimensional factors governing these actions, however, are quite critical, particularly the thickness of the annular converging conoidal jet, the degree of vortical motion or whirling and the resulting angle of divergence of spray from the nozzle tip.

The devices heretofore utilized for maintaining these shapes and clearances have been made with two separately threaded members, the outer member or shell being provided with a conical recess, and the inner member fitting into the recess and separately threaded into the base or support member, as in my application above cited. Thus the concentricity of the two elements, which determines the parallelism of the fluid passage walls, has been dependent upon two sets of threads, which have been found entirely inadequate to maintain the close tolerances, on the order of two or three one-thousandths of an inch, which are essential to proper operation.

Another feature which has been both difficult and expensive to provide is the means for giving the conoidal fluid jet a whirling or vortical motion. Cutting helical passages or grooves in a cylindrical element is easily and quickly done, but a simul-

taneously helical and conical machining operation requires elaborate and expensive equipment.

It is an object of this invention to provide a spray nozzle in which the elements defining the conoidal converging passage may be permanently and accurately fixed together during the manufacture of the nozzle.

Another object is to provide a tip for a spray nozzle in which the spacing and aligning means defining the fluid passages are entirely independent of the means for holding the nozzle in assembled relation, and which spacing means are not subject to change in shape or clearance during assembling operation, or cleaning.

Another object is to provide a spray nozzle assembly which may be fabricated with a minimum of machining operations and in which those machining operations required are easily and simply made.

Another object is to provide a spray nozzle tip in which the means for providing a vortical or whirling motion in the fluid passages are formed by straight cuts or shaping operations, thereby avoiding the expense of conical helix generation.

Another object is to provide a tip for a spray nozzle that is separable as a unit from the body of said device, and which may be accurately and cheaply duplicated for quantity production.

These and other objects and advantages will be more fully apparent from the following description of a preferred embodiment of this invention, and from the accompanying drawing, which supplement the description and form a part of this specification. In the drawing:

Figure 1 is a longitudinal sectional view, to an enlarged scale, of a spray nozzle embodying this invention, and in which the tapered plug member is crimped into place within the closure member.

Figure 2 is a side elevation of the tapered plug member shown in Figure 1.

Figure 3 is an end elevation of the tapered plug member shown in Figure 2, illustrating the angularly directed slots which give a vortical motion to the conoidal fluid jet.

Figure 4 is an approximately full scale side elevation, partly in section, showing an alternative method of assembling the nozzle tip to the body, and also illustrating the nozzle assembly in place upon a receptacle from which liquid is to be withdrawn, mixed or diluted and atomized.

Referring to the drawing and particularly to Figures 1 and 4, the body of the nozzle is generally designated 10, and in this example is provided with an offset pressure fluid passage 11, extending longitudinally from a threaded inlet 12, to a re-

cess or chamber 13. A second passage 14 extends axially partly through the body 10 and communicates with a threaded liquid inlet connection 15, which is illustrated as being on the side of the body 10. Bore 12 may be connected to any fluid pressure supply, in this example a garden hose, and liquid inlet 15 may be connected by any suitable conduit to a liquid source such as a receptacle for a concentrated spray material, as will be more fully explained and described below.

A closure or cap 16 is secured to the outlet end of body 10 by means of a threaded union nut 17 cooperating with corresponding threads 18 on body 10. Closure 16 is provided with a tapered bore 19, which communicates with a cylindrical outlet passage 20. The included angle of the bore 19 at the outlet and the angularity of grooves 26 have been found to be governing factors, and, when using water as a pressure fluid and aspirating and atomizing liquids, the included angle "A" of the tapered plug is preferably about 35° and the angle "B" between an axial line and each groove 26 is preferably about 15°. With these dimensions the resultant angle "C" of the spray will be between 15 and 20 degrees. A greater angle of spray will result from an increased value of either of the above angles "A" or "B" and will give poor aspiration. A smaller angle of spray gives poor atomization. Bore 19 is preferably finished by the use of a tapered reamer, which permits accurate duplication with smooth bore finish.

A tapered plug generally designated 21 is mounted within the bore 19 of cap 16, and the larger end of bore 19 may be crimped or beaded over as at 22 to hold the plug in place and aligned with the bore. This is a particularly desirable construction if the nozzle tip is to be used in a garden sprayer, for example, where relatively unskilled operators may dismantle the whole device for cleaning. In case of oil burners and the like, however, where skilled mechanics would ordinarily do this work, the crimping or beading is not required.

Plug 21 is illustrated in Figures 1, 2 and 3, and preferably comprises a stem 23, of generally spherical shape adapted to seat into the bevelled outlet 24 of liquid passage 14 in body 10. The major portion of plug 21, however, is enclosed within bore 19 in cap 16. The base or skirt portion 25 is of the same taper as bore 19 and fits it closely, thereby constituting the aligning means between the plug 21 and the bore 19. Angularly directed grooves 26, best illustrated in Figure 3, and preferably not less than six in number, are cut in the skirt 25 and serve to give the essential vortical or whirling motion to the pressure fluid passing around plug 21. These grooves may be truly helical but it has been determined that, if they are disposed as illustrated in Figure 3, slightly displaced circumferentially from axial planes through plug 21, they may be made by a simple straight shaping operation, substantially parallel to the tapered outer surface of skirt 25, thereby effecting considerable savings in machining costs.

Intermediate the ends of plug 21 may be located a circumferential groove 27, which appears to act as an equalizing chamber, so that the fluid passing outwardly between bore 19 and the tapered and inwardly spaced surface of the plug tip 28 will be spread out as a smoothly flowing sheet instead of, for example, six independent streams from the six grooves 26 of the skirt. As just described, the tapered tip 28 of plug 21 is spaced inwardly by the lands 29 between

grooves 26 from bore 19, preferably about 0.007 inch, plus or minus 0.002 inch, when using water as a pressure fluid, and when aspirating and atomizing concentrated commercial liquid insecticides.

The closure or cap 16 illustrated in Figure 1, is secured to the body 10 by means of the threaded nut 17, as stated above, and the joint is made liquid tight by a resilient composition or rubber gasket 30. The force exerted by screwing nut 17 onto threads 18 first compresses gasket 30 and then seats stem 23 tightly into the bevelled outlet 24 of liquid passage 14. This latter action forces plug 21 tightly into bore 19, if it has not already been crimped therein as at 22, and the lands 29, contacting with bore 19 over their full faces and for a considerable axial length, serve to perfectly align and space the tapered tip 28 in the smaller end of bore 19. This arrangement completely eliminates any possibility of misalignment of those parts, the threaded nut 17 serving only to make tight the two fluid joints, at 30 and at 23, and to urge the plug 21 and cap 16 into still more perfect union.

A strainer 31 may be inserted in chamber 13, or, as illustrated in Figure 4, may be placed in the bottom of threaded inlet 12, to prevent dirt and debris from being carried into the grooves and passages of the nozzle tip.

As an alternative to the removable joining together of the nozzle tip and body by a union nut 17, as in Figure 1, the construction diagrammatically illustrated in Figure 4 may be employed, in which the closure or cap 16 is flanged outwardly as at 32, and a corresponding flange 33 is formed on body 10. These flanges are preferably spaced apart slightly, as illustrated, by the stem 23 of the tapered plug seating in bore 24 (Fig. 1) and are enclosed and sealed by a circumferential ring 34, which is crimped or formed over the outer faces of the flanges 31 and 32. This obviously forms a tight and permanent union between the body 10 and cap 16, so that the desirable location of wire mesh or perforated metal strainer 31 is at the bottom of threaded inlet bore 12.

Figure 4 also illustrates a convenient arrangement of a receptacle 35 as for a liquid insecticide, detachably secured to body 10 by a threaded cap 36, and into which a conduit 37 depends. The upper end of conduit 37 communicates with the axial liquid inlet passage 14 of body 10 (Figure 1) and allows liquid 39 to be aspirated from the receptacle 35, or, if the receptacle were to be inverted, permits the liquid to flow to the axial liquid inlet 14, under a positive gravity head through axial bore 41 in plug 21 so that it passes into the converging jet of pressure fluid and is atomized into spray. My copending application above cited discloses means for obtaining a constant flow of liquid 39 from receptacle 35 in the position shown, regardless of the depth of liquid therein, thereby providing a constant mixture-ratio with the pressure fluid admitted through hose 38 to the conoidal jet.

In operation, the pressure fluid, which may be water in the case of an insecticide sprayer, or a gas such as air or steam in a burner nozzle, is admitted to body 10 through hose 42 threaded into inlet 12 and passes through bore 11 into chamber 13, from which it is admitted into the plurality of helical or angularly directed passages formed by the cooperation of grooves 26 and the bore 19 of cap 16. Thus the pressure

fluid is given a whirling or vortical motion, which is preferably smoothed out or made into a uniformly flowing sheet by circumferential groove 27 and finally passes out of the nozzle over the smoothly tapered surface of tip 28. It will be found that the converging jet thus formed does not follow the cylindrical bore or outlet passage 20 of the cap 16, but leaves it cleanly at the juncture of 20 with the tapered bore 19. This action is facilitated by the projection of the end of tip 28 into the cylindrical bore or outlet 20. After leaving the nozzle the stream or jet reaches a minimum diameter and then diverges again, forming the angle "C" (Fig. 4). It has been found by many tests that the angle "C" of the spray should be between 10 and 25 degrees, and, for best operation is substantially 15 degrees. This may be determined by several factors, the principal ones being (1) the included angle of the tapered tip 28 and (2) the vortical whirl produced by grooves 26 in skirt 25. If the angle of tip 28 is substantially 35 degrees, the angle of grooves 26 with an axial line along the face of the skirt may lie between 13 and 16 degrees for satisfactory operation. The extreme tip or end 40 of plug 21 is preferably flat or at least blunt, to facilitate the formation of a reduced pressure in the axial bore 41 in said tip, through which latter the liquid 39 from receptacle 35 or its equivalent may pass into the converging conoidal jet of pressure fluid and be mixed and atomized in the resulting spray.

Once determined, the clearances, concentricity and divergence of the spray are readily duplicated by the construction disclosed, and, what is more important, these factors are not disturbed, as the plug 21 may be securely crimped into bore 19, as disclosed above at 22, or, if not permanently fastened therein, will be so accurately guided by the lands of base or skirt 25 contacting the bore 19 that misalignment is hardly possible.

Although a specific example embodying this invention has been described and illustrated, it is to be understood that the invention is not limited to the particular features disclosed, and all such modifications and changes as come within the scope of the following claims are embraced thereby.

#### I claim:

1. A spray nozzle comprising a body, a fluid chamber in said body, a closure member for said chamber provided with a uniformly tapered bore, a tapered plug disposed within said bore, the base of said plug fitting said bore closely and provided with substantially helical grooves and lands constituting fluid passages, a circumferential groove intermediate the ends of said plug, the remainder of said plug being spaced inwardly from said bore solely by said lands, and an axial liquid passage in said plug.

2. A spray nozzle comprising a body, a fluid chamber in said body, a closure member for said chamber provided with a tapered bore, a tapered plug disposed within said bore, the base of said plug fitting said bore closely and provided with substantially helical grooves and lands constituting fluid passages, a circumferential groove intermediate the ends of said plug, the remainder of the tapered portion of said plug being of smooth configuration and spaced from said bore solely by said lands, and an axial liquid passage in said plug.

3. A spray nozzle assembly comprising a body provided with a recess, a fluid passage in said body communicating with said recess at one side thereof, a liquid passage in said body coaxial with said recess and communicating therewith through a beveled seat, a tip for said nozzle constituting complementary means for producing an annular uniformly converging conical passage communicating with said fluid passage, said tip provided with an axially projecting member received in said beveled seat, said member and tip being provided with a passage coaxial with said conical passage, and means for securing said nozzle tip to said body.

4. In a spray nozzle including a closure cap provided with a converging tapered bore and means for admitting a pressure fluid to said bore, a tapered plug provided with a grooved base at its larger end, a circumferential groove intermediate its ends, and a smoothly tapered tip, said tip conforming to the taper of said bore and spaced therefrom solely by said base, and an axial bore in said plug.

GEORGE LEONARD NEELY.