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LIQUID SPRAY APPARATUS

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Fig. 1.

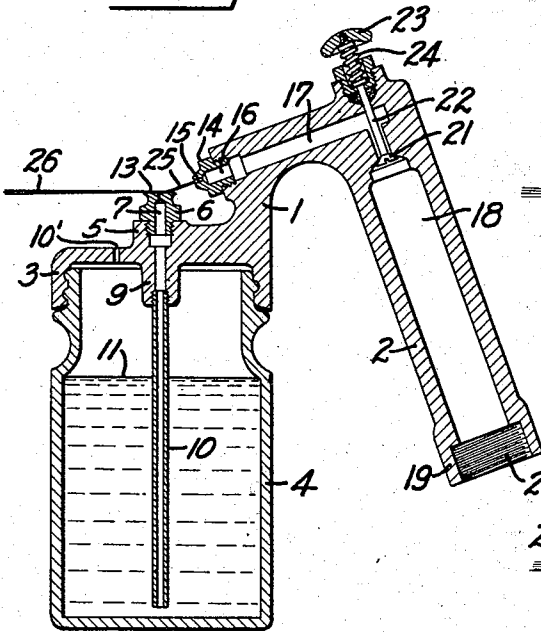


Fig. 3.

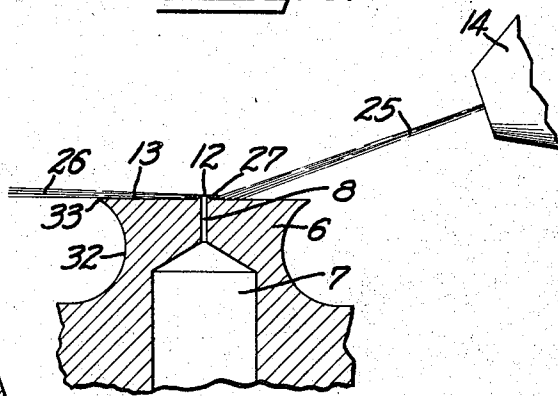


Fig. 4.

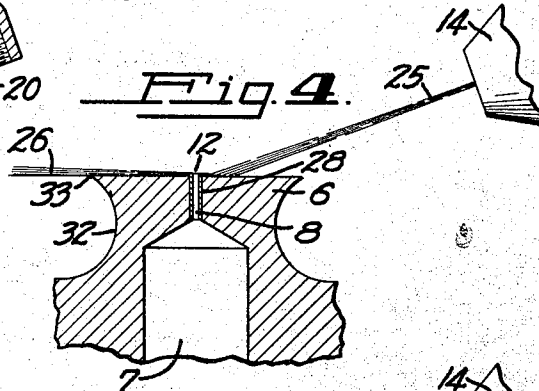


Fig. 7.

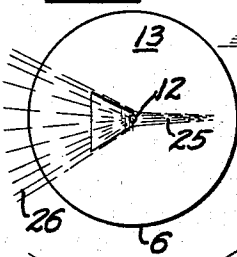


Fig. 8.

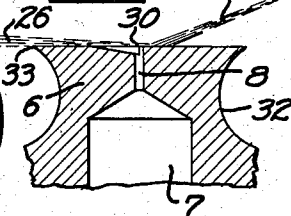


Fig. 5.

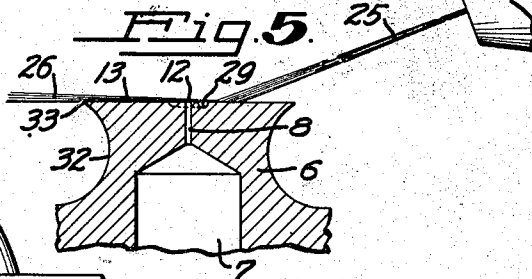


Fig. 6.

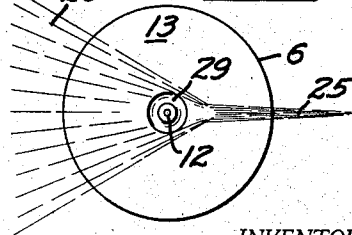
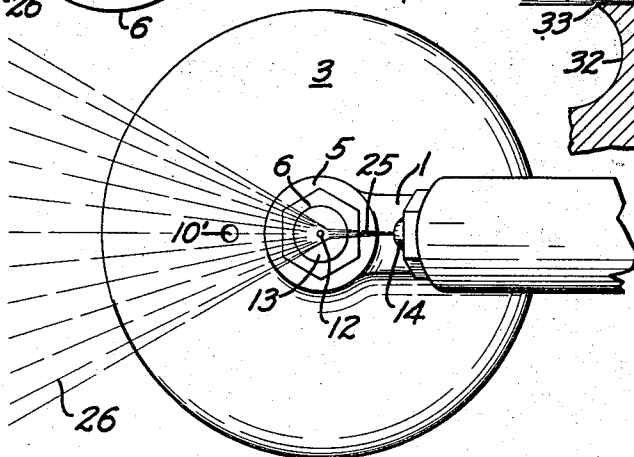


Fig. 2.



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## UNITED STATES PATENT OFFICE

2,030,853

## LIQUID SPRAY APPARATUS

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Application January 24, 1934, Serial No. 708,031

9 Claims. (Cl. 299-84)

My invention relates to liquid spray apparatus, and more particularly to an apparatus by which liquids having differing characteristics may be mixed in preferred percentages and applied to external objects in the form of a spray.

The principal object of my invention is to provide a spray gun, or similar device, adapted to aspirate and mix various liquids.

Other objects of my invention are: to provide a spray gun operated by liquid under pressure; to provide a means for mixing liquids of differing characteristics; to provide means for mixing different liquids having different pressures; to provide means for mixing liquids having different pressures, the percentage of combination being largely independent of these pressures; to provide a means for mixing fertilizing chemicals with a stream of water; to provide a means for mixing insecticides with a stream of water; to provide a spray gun adapted to be attached to a hose carrying liquid under pressure, whereby other liquids may be mixed in definite proportions with the first mentioned liquid and thereafter applied to external objects; to provide a simple means of diluting concentrated chemicals, and thereafter applying them to external objects; and to provide a means and method for forming a water spray, and in certain cases to provide means for mixing a different liquid into the spray.

Other objects of my invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but I do not limit myself to the embodiment of the invention herein described, as various forms may be adopted within the scope of the claims.

In the drawing which is attached hereto and forms a part of this specification, I have shown one particular embodiment of my invention as applied to a device adapted to be attached to the ordinary garden hose, several types of mixer tables being shown.

Figure 1 is a longitudinal sectional view of the preferred embodiment of my invention.

Figure 2 is a top view, in plan, of the device illustrated in Figure 1.

Figures 3, 4, and 5 are longitudinal sectional views of the spray surface nozzle and feed conduit, illustrating various modifications of the surface adjacent the conduit opening.

Figure 6 is a plan view of the spray table shown in Figure 5, illustrating the path of the liquid.

Figure 7 is a plan view of a modified form for the surface adjacent the conduit.

Figure 8 is a vertical sectional view of the device illustrated in Figure 7.

There have, in the past, been placed on the market, and made available to the public, various devices for mixing chemicals with water, utilizing the action of water in a garden hose. The chemicals have generally been of two distinct types. First, fertilizing chemicals, so that lawns, shrubs and like growing plants may be sprinkled and simultaneously fertilized. It is quite customary, however, to utilize the identical devices for applying insecticides, mildew preventing substances and like materials to plants. As most of the prior devices have handled either class of materials without modification, the instant invention is likewise adapted for all these types of materials. Furthermore, in this specification I do not wish to be limited to such chemicals as may be actually in solution, as certain desirable materials may be carried in liquids by suspension. An example of this latter type is colloidal sulphur and some of the lime sprays, both of which can be readily handled by my devices.

My device is adapted to handle any form of liquid, preferably in concentrated form, mixed with a stream of water and then sprayed on the desired external object.

In broad terms, my invention comprises a flat mixing surface, preferably having an aperture therein which aperture is connected with a supply of concentrated liquid material. A jet of water, or other fluid under pressure, is directed against the flat surface, thereby causing the fluid to spread out and leave the surface in the form of a spray. During its passage over the surface, it passes over the aperture. The reduced pressure, caused by the passage of the jet fluid over the aperture, causes the concentrated liquid to be sucked through the aperture and mixed with the spray. I prefer to provide means adjacent the aperture for increasing the amount of suction developed.

My invention may be more thoroughly and completely understood by reference to the figures. A gun body 1 is provided with a handle 2 and a threaded cap portion 3. I prefer to make the shape and size of this threaded cap portion 3 such that it will receive the threads of a common pint jar 4, and I utilize this jar as a receptacle to carry the material which I may desire to mix with a water stream. The top surface 5 of the cap 3 is provided with a mixing table 6, which is screwed or otherwise fastened to the cap surface. I prefer to make this table in the form of a nut so that it may be easily removed from

the cap, as I may desire to provide this table with suction bores 7 and connecting suction conduits 8, of varying sizes. The bore 7 of the table 6 is continued through the cap 3 into an internally projecting boss 9, and from there the bore is further continued to a point in the neighborhood of the bottom of the pint jar by a liquid suction pipe 10. An air vent 10', communicating with the interior of the jar 4, is provided in the cap 3.

When there is liquid in the pint jar, as indicated by a level line 11, there is a complete open passage way from beneath the surface of the liquid to an aperture 12, opening directly on a top spray surface 13 of the spray table 6, and if suction were to be applied to the aperture 12, liquid contained in the jar 4 would pass up through the composite bore and emerge through aperture 12.

I then prefer to project a jet of water on the top spray surface of the table from a jet nozzle 14, secured or otherwise fastened into the gun frame 1. This nozzle is provided with a jet bore 15 and a continuing counter bore 16 which opens into a frame chamber 17. This frame chamber 17 connects with a valve chamber 18 in the handle 2, and the end 19 of the handle 2 is preferably provided with internal hose threads 20, of suitable pitch to receive the male coupling member 30 of an ordinary garden hose.

In order to control the action of the gun, I prefer to position a thumb operated valve 21 between the valve chamber 18 and the frame chamber 17. This valve is operated through a valve stem 22 connected with a thumb pad 23 and held closed by a spring 24. It is obvious that pressure on the thumb pad 23 will open the chamber 18 into the chamber 17, and if water under pressure is in the hose, such water will then pass through to the jet nozzle 14. I prefer to direct the jet thus produced, illustrated by broken lines 25 in all the figures, onto the spray surface 13 of the spray table 6, and so position the jet nozzle 14 that the jet 25 will contact the surface 13 at a slight angle, thereby causing the jet to fan out into a substantially planar spray, as indicated by the numeral 26 in the figures. I also prefer to position the nozzle so that the jet 25 will contact the surface 13 just in front of the aperture 12, whereby the water, just as it starts to diverge, will pass over the aperture 12 and cause, by that passage, a suction therein sufficient to draw up through the suction bore 7 and associated pipes, liquid from the pint jar 4. This liquid will be carried on in the spray and will be thoroughly mixed therewith, so that when the spray lands on external objects there will be a percentage therein of the liquid from the pint jar. This percentage may be controlled by the size of the jet bore 15 and the size of the suction bore 8.

In the normal operation of the device, I have found it preferable to make additional arrangements adjacent the aperture 12, on the spray surface 13, which will greatly increase the suction produced, thus enabling aspiration of relatively thick and heavy liquids. There are a number of means by which this suction may be increased. All of them, however, appear to have the same general underlying idea, which may be stated, in broad terms, to be the formation of a ridge or ring in front of the aperture which is slightly higher than the next adjacent surface. Figures 3 and 4 illustrate embodiments where the material surrounding the aperture is raised above the general level of the surface 13,

while Figures 5, 6, and 7 show different forms wherein the material immediately surrounding the aperture is at the same level as most of the surrounding surface; a portion, however, of that surface spaced back a short distance from the aperture being cut away below the surface. As far as I have been able to tell, there is no essential difference in the operation of the means shown in Figures 3 and 4 and that shown in Figures 5, 6, and 7.

While I am not at this time prepared to give the exact theory which is involved in the suction producing means above referred to, I am of the opinion at present that the stream, in the devices shown in Figures 3 to 6, as it passes over the aperture, is thrown slightly upward away from the surface by the raised edge adjacent the aperture 12, hit by the jet, and causing a reduced pressure to be produced behind the lip. This upward movement probably causes the stream to miss entirely the far edge of the aperture, thus preventing any of the projected liquid from shooting down into the suction bore 7, and allowing the material from the jar to flow freely into the stream.

In any event, I have found, by repeated experimentation, that a very slight upward projection of the edges of the aperture causes a relatively large increase in suction.

There is no need, apparently for this upward projection to be of any great extent. For example, I have found that if the suction bore 7, which in some instances is produced by the action of a No. 60 drill, is drilled from the outside toward the suction conduit 8, that the suction will not be as great as if the drilling is done from the inside out, thus leaving a small burr 27, as indicated in Figure 3. This burr alone is sufficient to create a relatively large suction, much greater than if the burr were not present. The same result can be obtained by the use of an inserted sleeve 28, as shown in Figure 4, where a minute portion of the sleeve is allowed to project above the surface. This method has some advantages as sleeves of this kind may be made removable and replaceable with different inner bores if desired. It should be pointed out here that when an inserted sleeve is used, the edges of the sleeve itself act as the raised edges of the aperture, and that it is not necessary, in this case, to burr or otherwise deform the actual edges of the bore which passes through the sleeve 28 where it emerges from the sleeve. The sleeve wall, therefore, at least where it projects above the surface, may be very thin.

In Figures 5 and 6 I show an embodiment which is preferred by me for certain purposes as it has advantages from the point of view of manufacturing. It is obvious to see that in Figure 3, where a slight burr is used, that the burrs probably will not be uniform in a series of boring operations, therefore the amount of material aspirated will vary somewhat with different spray tables or with spray tables made at different times. Also, and in the device as shown in Figure 4, it is somewhat difficult to insert sleeves which will project a constant amount above the surface. The device shown in Figure 5, however, is readily reproducible in quantity, and a circumferential channel 29 is cut immediately around the aperture 12 and I have found that this embodiment produces the same results as those previously described, with the further advantage that the depth of the channel and positioning thereof can be accurately produced throughout a long series

of machine operations, and furthermore, the production is relatively cheap. Here again, I do not wish to be bound by my explanation of what I believe the action is, that the water, as projected through the jet 25, drops down into the channel before it hits the aperture and is given an upward direction by the side of the channel nearest the aperture, on that side of the aperture first approached by the jet liquid, thus jumping over the aperture and creating the desired suction.

In all of the several embodiments of the suction increasing means that I have shown and described, it will be seen that they are more or less symmetrical and pass completely around the aperture. This feature, however, appears to be valuable only from the point of view of economic production of these means, as I am of the opinion that it is only the edge of the aperture closest to the jet nozzle 14 which is operative to produce the suction, and I do not wish to be limited, within the scope of the claims, to such suction producing means as will pass entirely around the aperture, as I am not convinced that the portions of the suction producing means on the far side of the aperture are operative to aid the suction to any great extent, thus a portion of the edge of the aperture, which is raised higher than the next adjacent surface on the jet side of the aperture, will satisfy the requirements of my invention.

Furthermore, I have provided still another embodiment, as shown in Figures 7 and 8, wherein the spray surface is cut away, back of the aperture, leaving a shelf 30, of the level of the surface, in front of the aperture, the far edge of the aperture being cut away by the cross cut. The water, as it passes over the aperture, creates suction in the chamber formed by the cut and the liquid in the jar is drawn out. No upward movement of the water is needed in this case, as the stream does not need to be deformed to create space for suction generation.

I also prefer, in this latter case, to make the cut at right angles to the direction of travel of the water. The aspirated chemicals are thus spread more fully across the spray section, and, when heavy concentrates are used, are better mixed.

I have found that the rubber hose of the ordinary garden type acts somewhat as a pressure regulator in that it expands under high pressure and absorbs some of the load. I also utilize a fairly small jet bore 15, so that the velocity of the stream 25, as it hits the surface, is fairly constant over a wide range of hose pressures. Thus the suction is maintained fairly constant, and the percentage of liquid mixed with the water remains relatively constant over this range of pressures. As an example, I have found that there is a relatively uniform percentage of mixing taking place when hose pressures vary from 20 to 100 pounds. This feature is important as certain insecticides, if supplied to growing vegetation in too strong a concentration, will burn the leaves of such plants, and yet the maximum possible percentage of insecticide is desired in order to obtain the maximum lethal efficiency. Nicotine solutions are examples of this latter type, and when such insecticides are used in cartridge form in previous devices, water remaining in the cartridge channel, after the hose supply has been shut off, dissolves a large quantity of chemicals out of the cartridge so that when water is passed through the hose the next time, the first material out of the nozzle is excessively concentrated and may, and often does, destroy foliage. This

cannot happen with my device, as the chemicals are kept separate from the water supply until the instant of mixing, and when the water supply is cut off the chemicals are entirely isolated from the hose. Hose deterioration, due to chemicals being sucked back when the pressure is shut off, is entirely impossible in my device.

I have found that for most efficient spray formation, either with or without chemicals or other extraneous matter mixed with the spray, that the edge of the spray table at the point where the fan of liquid leaves the table should, preferably, be relatively sharp. I prefer to obtain this edge by providing the table with concavity 32, thereby creating a knife edge 33 over which the spray leaves the table. This edge prevents dribbling or loss of liquid from the fan during operation, due to any tendency for the liquid to follow vertical surfaces.

I claim:

1. In combination, a device for mixing and distributing liquids comprising a mixing head having a distributing surface thereon, said head being provided with a conduit having one end terminating in an aperture in said surface, the other end being adapted to be inserted in a body of liquid, means for angularly directing a stream of liquid at a relatively high velocity onto said distributing surface to cause a flat sheet of said latter liquid to pass over a sufficient portion of said surface and said aperture to seal said aperture from the atmosphere, and means associated with the edges of said aperture to create a reduced pressure in said conduit due to the passage of said latter liquid over said aperture.

2. In combination, a device for mixing and distributing liquids comprising a mixing head having a distributing surface thereon, said head being provided with a conduit having one end terminating in an aperture in said surface, the other end being adapted to be inserted in a body of liquid, means for angularly directing a stream of liquid at a relatively high velocity onto said distributing surface to cause a flat sheet of said latter liquid to pass over a portion of said surface and said aperture, and a circumferential ring around said aperture, said ring being raised above the next adjacent portion of said surface.

3. In combination, a device for mixing and distributing liquids comprising a mixing head having a distributing surface thereon, said head being provided with a conduit having one end terminating in an aperture in said surface, the other end being adapted to be inserted in a body of liquid, means for angularly directing a stream of liquid at a relatively high velocity onto said distributing surface to cause a flat sheet of said latter liquid to pass over a portion of said surface and said aperture, and means associated with the edges of said aperture to create a reduced pressure in said conduit due to the passage of said latter liquid over said aperture, said means comprising an irregular burr raised above said surface.

4. In combination, a device for mixing and distributing liquids comprising a mixing head having a distributing surface thereon, said head being provided with a conduit having one end terminating in an aperture in said surface, the other end being adapted to be inserted in a body of liquid, means for angularly directing a stream of liquid at a relatively high velocity onto said distributing surface to cause a flat sheet of said latter liquid to pass over a portion of said surface and said aperture, and means associated with the

edges of said aperture to create a reduced pressure in said conduit due to the passage of said latter liquid over said aperture, said means comprising a circumferential channel cut in said surface around said aperture.

5 5. Apparatus for mixing liquids comprising a flat surface having an aperture therein and a depression therein joining said aperture, said depression extending from a point in the plane of  
10 said surface to a point below the plane thereof at the junction of the depression and the aperture, and means for directing a flow of water at substantial velocity first over said aperture and then over said depression in the plane of said  
15 surface and in contact therewith, said flow being sufficiently wide to seal said aperture and said depression from the atmosphere at said surface.

6. Apparatus for mixing liquids comprising a flat surface having an aperture therein and a  
20 depression therein joining said aperture, said depression extending from a point in the plane of said surface to a point below the plane thereof at the junction of the depression and the aperture, said depression having divergent side walls  
25 joining said surface, and means for directing a flow of water at substantial velocity first over said aperture and then over said depression in the plane of said surface and in contact therewith.

7. Liquid spray apparatus comprising a distributing surface having an aperture therein, said  
30 aperture being located at a level differing from

that of the main area of said distributing surface, means for directing a relatively thin sheet of liquid at substantial velocity over the main area of said distributing surface and over said aperture, said sheet being of sufficient extent to  
5 completely seal said aperture from the atmosphere at said surface.

8. Liquid spray apparatus comprising a distributing surface having an aperture therein, said aperture being located at a level differing from  
10 that of the main area of said distributing surface, and a jet nozzle positioned to direct an angular stream of liquid of relatively small cross section against said surface at substantial velocity in front of said aperture to form a thin  
15 sheet of moving liquid on the main area of said surface diverging from point of impact, said sheet passing over said aperture after it has widened sufficiently to seal said aperture from the atmosphere at said surface by covering the area involved  
20 in the level change.

9. The method of creating suction in a conduit terminating at a distributing surface by the action of a liquid stream which comprises terminating said conduit at a level on said surface differing from that of the main area of said surface,  
25 and flowing said liquid over said main area in a flat sheet to form a liquid seal over said aperture and all areas changed in level from the level of said main area.

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