June 14, 1960 G. G. BUDWIG 2,940,673

LIQUID MIXING AND SPRAYING DEVICE

Original Filed April 10, 1953 2 Sheets-Sheet 1

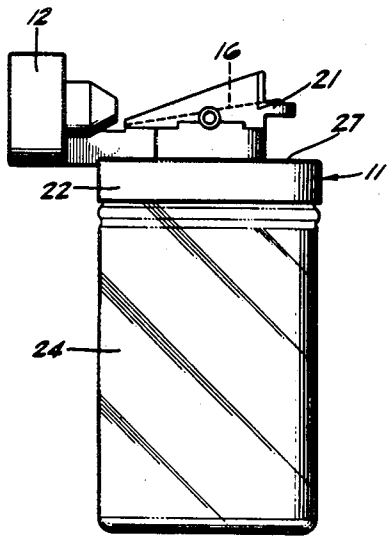

FIG. 1.

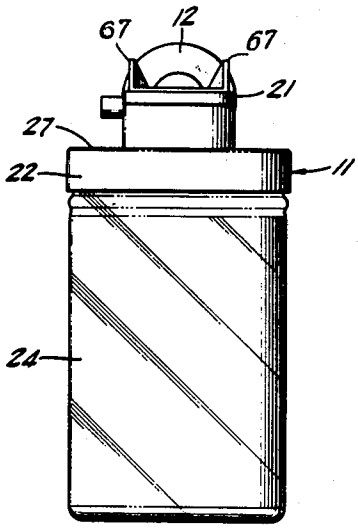

FIG. 2.

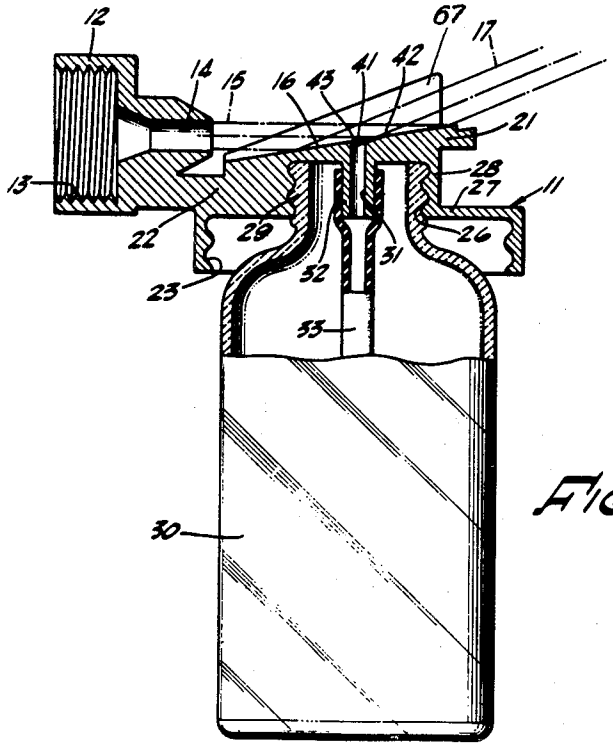

FIG. 3.

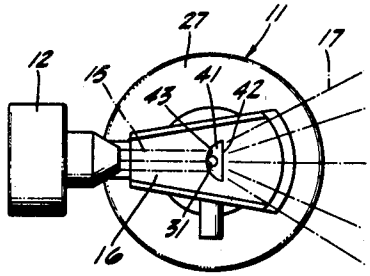

FIG. 4.

GILBERT G. BUDWIG
INVENTOR.

BY Lyon & Lyon

ATTORNEY

June 14, 1960 G. G. BUDWIG 2,940,673

LIQUID MIXING AND SPRAYING DEVICE

Original Filed April 10, 1953 2 Sheets-Sheet 2

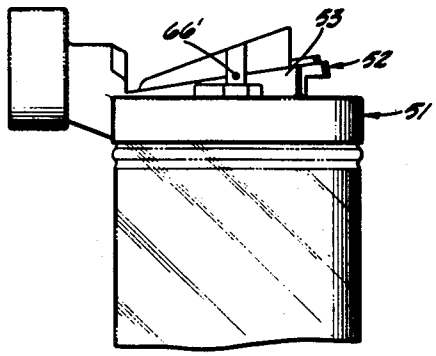

FIG. 5.

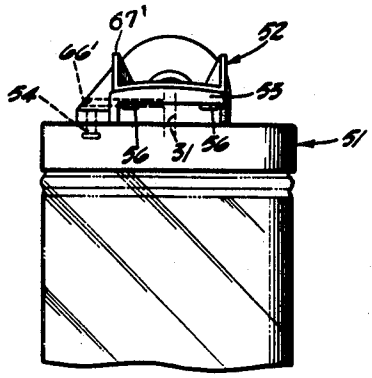

FIG. 6.

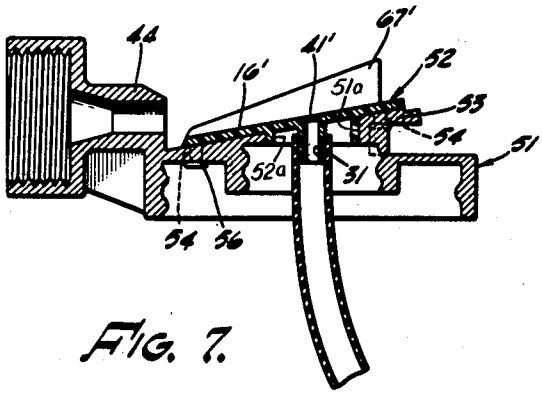

FIG. 7.

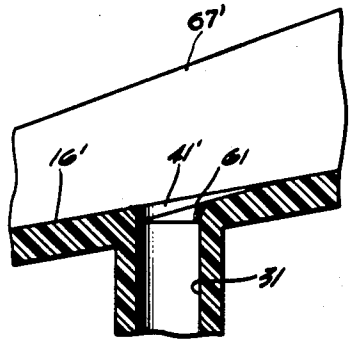

FIG. 8.

GILBERT G. BUDWIG
INVENTOR.

BY Lyon & Lyon
ATTORNEY

United States Patent Office 2,940,673 Patented June 14, 1960

2,940,673

LIQUID MIXING AND SPRAYING DEVICE

Gilbert G. Budwig, 3400 Bayside Walk, Mission Beach, Calif.

Continuation of application Ser. No. 347,961, Apr. 10, 1953. This application Feb. 21, 1957, Ser. No. 641,699

2 Claims. (Cl. 239—314)

This invention relates to fluid sprinkling, spraying, and diffusion, and more particularly to an apparatus for mixing characteristically differentiated liquids and spraying them, after mixing, onto external objects. The present invention is a continuation of my copending application, Serial No. 347,961 filed April 10, 1953, now abandoned, for Liquid Mixing and Spraying Device and also constitutes an improvement over those forming the respective subjects matter of Patents No. 2,030,853, issued to me on February 18, 1936, and No. 2,061,932, issued to me on November 24, 1936.

The liquid mixing and spraying device disclosed in each of my two hereinabove identified patents comprises a spray gun adapted to be attached to a hose carrying liquid under pressure and whereby another liquid, such as concentrated insecticide or liquid fertilizer may be mixed with the first-mentioned liquid and thereafter applied to external objects in the form of a spray. An object of the present invention is to provide improvements and refinements in the devices of my said prior patents whereby the apparatus is adapted to be used for diluting and applying concentrated liquids, such as liquid fertilizers, in which particles of solid or semi-solid matter occur, which particles would be apt to clog the relatively small suction apertures or meter orifices which were required to be used in the devices of my said prior patents in order to restrict the flow of concentrate and thereby maintain the desired degree of dilution of the concentrated fertilizer or insecticide.

Another object of my present invention is to provide improvements for adapting the liquid mixing and spraying apparatus to use liquid concentrate containing solid or semi-solid particles as indicated and, in co-operation therewith, means for compensating for the increased flow of concentrate which otherwise would result, and thereby maintain the degree of dilution desired within adequately close limits, in spite of the fact that the orifice through which the concentrate is aspirated is of many times the cross-section as compared with the corresponding orifice in either of the two said prior devices.

A further object of this invention is to improve the design and general construction of the mixing and spraying device so that the suction aperture, the distributing surface, and the recess for increasing the suction and enhancing evenness of distribution of the concentrate throughout the diluent liquid, are formed in and upon a head formed separately from the main body of the device and adapted to be attached thereto after the machining operations required for the formation of the above enumerated operative portions have been completed, thus permitting use of a material more adapted to facile and accurate machining in the portion of the apparatus requiring the greatest care and precision in their production, which thereafter can be attached to the main body of the device which is produced in quantities by a less expensive die-casting process.

The invention possesses other objects and advantageous features, some of which, with those enumerated, will be

set forth in the following description of the preferred forms illustrated in the drawing accompanying and forming part of the specification. It is to be understood that I do not limit myself to the showing made by the said drawing and description, but that I may adopt variations of the preferred forms within the scope of the invention as defined by the claims.

Referring to the drawings:

Figure 1 is a view in side elevation of one form of apparatus incorporating the principles of the present invention.

Figure 2 is a front elevation.

Figure 3 is a view similar to Fig. 1, but drawn to an enlarged scale and with the upper, operative portion of the apparatus broken away and shown in longitudinal medial vertical section.

Figure 4 is a top plan view.

Figure 5 is a view similar to Figure 1, but showing a slightly modified form of construction and with a portion of the figure broken away to reduce its size.

Figure 6 is a view in front elevation of the apparatus of Figure 5.

Figure 7 is a longitudinal vertical medial sectional view of the apparatus of Figures 5 and 6, but with the reservoir jar removed.

Figure 8 is a detailed view drawn to an enlarged scale and in the same plane as that of Figure 7, showing the detailed construction of the distributing surface, the aspiration or suction aperture, and the recess in the distribution surface which enhances the evenness of distribution of the concentrated liquid throughout the diluent liquid and which also functions to increase the suction or aspirating effort exerted by the sheet of diluent liquid over the suction aperture.

In terms of broad inclusion, the present invention comprises means defining a flat mixing or distribution surface, preferably having an aperture therein which aperture is connected with a supply of concentrated liquid material such as liquid fertilizer or liquid insecticide. A jet of water or other diluent liquid under pressure is directed against the flat surface at an oblique angle thereby causing the diluent liquid to spread out and leave the surface in the form of a spray. During its passage over the surface it passes over the aperture. Reduced perssure caused by the passage of the spread-out jet of diluent liquid over the aperture, causes the concentrated liquid to be sucked, or aspirated through the aperture and mixed with the spray. The present invention comprises refinements of detailed construction and improvements which adapt the apparatus for satisfactory use in connection with concentrated liquids which contain solid or semi-solid particles which, in previously developed forms of my liquid mixing and spraying apparatus would seriously interfere with their operation by clogging the relatively small metering orifice which those earlier forms of the apparatus employed to regulate the degree of concentration of the ultimate, mixed and sprayed liquid. Certain of these novel details of construction characterizing the present invention also contribute to the efficiency with which the concentrate is mixed with the diluent by enhancing the evenness with which the former is distributed through the latter prior to the actual spraying operation.

Referring first to that modification of my invention which is illustrated in Figures 1 to 4, inclusive, there is provided a body portion or supporting element, indicated generally at 11, and preferably in the form of a single die casting. An extension 12 formed integrally with the body portion 11 at one side thereof, is of tubular form, having an internally threaded socket 13 to which the male threads of a conventional garden host coupling can be secured and a jet hole, or nozzle, 14 the bore of which

communicates with the socket 13. This nozzle 14 is adapted to direct its jet, preferably in round, pencil-like form onto a substantially flat distributing surface 16 at an oblique angle thereto so that after the pencil-like jet 15 has impinged upon the distributing surface 16 it spreads out into a water fan or sheet, as indicated at 17 in Figure 4.

The distributing surface 16 is provided upon the upper surface of a platform 21 which projects upwards a suitable distance above the main portion 22 of the body 11; and the main portion 22 is provided in its under surface with a circular recess 23 the circumferential wall of which is interiorally threaded for the reception of a reservoir jar 24 preferably of conventional type, such as that commonly employed in the marketing of mayonnaise and similar products. However, in order to enlarge the range of adaptability of the device, I also prefer to provide a second, smaller socket 26 concentric with the socket 23 but projecting upwards beyond the top wall 27 thereof, as clearly shown in Figure 3. The circumferential wall 28 of this smaller socket 26 is also provided with interior or female threads so that the threaded neck 29 of a bottle 30, also preferably of conventional and commonly occurring form, can be attached to the under surface of the body 11, as is also clearly shown in Figure 3. This double socket feature of the body 11 permits either a bottle or a jar to be employed as a reservoir for the concentrated liquid which the device is intended to dilute and spray.

The parts are so proportioned and arranged that the pencil-like jet 15 from the nozzle 14, impinges upon the distribution surface 16 just before it reaches an aspiration or suction aperture 31, the upper end of which opens through the distribution surface 16 and which extends downwards therefrom through a tubular projection 32 which preferably is coaxially arranged within the smaller socket 28. A preferably flexible tube 33, secured at its upper end by being slipped over this projection 32 thus establishes communication between the suction aperture 31 and the reservoir attached to the under surface of the body 11, regardless of whether that reservoir be in the form of the jar 24 or the bottle 30. This suction tube 33 preferably extends to a position closely adjacent the bottom of the reservoir jar or bottle, as the case might be, so that substantially the entire contents of the reservoir can be aspirated before the supply of concentrated liquid needs replenishing.

Impingement of the jet 15 against the surface 16 just before it reaches the upper end of the suction aperture 31, causes the fan-shaped sheet 17 to pass, at considerable velocity, over the upper end of the suction aperture 31. This causes a partial vacuum to be developed within the suction aperture 31 so that fluid within the bore of the projection 32 and within that of the tube 33, will be drawn upwards through the suction aperture 31 to mix with and consequently to be diluted by the liquid jetted onto the surface 16 from the nozzle 14.

In the type of mixing and spraying apparatus previously produced, it has been necessary to restrict the size of the suction orifice, or else to provide a metering orifice below and relative closely adjacent the aspiration aperture in order to limit the quantity of concentrated liquid and thereby regulate the degree of concentration of the ultimate spray. In fact a No. 60 drill has to be used in forming a suction aperture small enough to function properly in this connection in the previously existing devices. A drill of this extremely small size is necessarily and inevitably relatively delicate with the result that it is a somewhat difficult machining operation to drill the suction apertures therewith without breakage of the drill. Moreover, the extremely small suction aperture is possessed of the disadvantage that the concentrated liquid to be aspirated therethrough must be substantially free of solid or semi-solid particles of matter of diameter greater than that of the aperture itself. This, it has been found, constitutes an important disadvantage of the previously existing liquid-mixing and spraying devices inasmuch as a large number of commercial liquid fertilizers presently available upon the market contain a relatively high proportion of solids and semi-solid particles, the diameter of which greatly exceeds that of an aperture produced by a 60-gauge drill. When constructed in accordance with the principles of the present invention, the device has incorporated thereinto two refinements and details of construction which have been found to overcome this disadvantage of earlier devices with a high degree of efficiency. The first of these improvements involves the size of the suction aperture 31 itself. Instead of being of only .035 to .045 of an inch in diameter as when constructed with the No. 60 drill, suction aperture 31 of the present apparatus is of substantially ⅛ of an inch in diameter, i.e., approximately .125 or many times the size of the previously used suction orifices. Seldom, if ever, are solid or semi-solid particles of greater diameter than those that can pass freely through a suction aperture of such increased size encountered in commercial liquid concentrated fertilizers.

However, as an added precaution against possible clogging of the suction aperture 31 by solid or semi-solid particles of unusually large size, I have provided means for increasing the suction, or partial vacuum, developed in the suction aperture 31 by passage of the fan-shaped sheet 17 over the upper end thereof. For this purpose, I have provided a recess 41 of peculiar form and arrangement in the distribution surface 16. In general configuration this recess 41 is in the form of a segment of a circle, and wedge shaped, having an arcuate side 43 and a straight side or chord 42, and so arranged within the distribution surface 16 that the chord thereof which represents its straight side 42 extends perpendicularly with respect to the axis of the jet 15, as is clearly shown in Figure 4. The transverse axis of the segment, corresponding to a diameter passing through the middle of the chord 42 and the middle of the arcuate side 43, lies parallel to the axis of the nozzle 14 and the jet which issues therefrom, and in the same vertical plane. From the straight side 42, the recess 41 extends with its curved or arcuate side 43 rearwards, i.e., towards the nozzle 14, the recess gradually increasing in depth toward the nozzle 14. On either side of the transverse axis of the recess, the walls forming the arcuate side 43 diverge, at constantly decreasing angles, with reference to said transverse axis, but such angles of divergence are always greater than the angle of divergence of the walls provided by the flanges 67. Consequently, the fan-shaped sheet 17 of diluent liquid first encounters the arcuate side 43 of the recess 41, and, subsequently thereto, passes over the recess 41 and lastly over the straight edge or chord 42. As seen in Fig. 3, the axis of the nozzle 14 is substantially normal to the axis of the suction aperture 31, and is arranged so that the nozzle axis intersects the distribution surface 16 substantially at the edge 42. Because of the angle formed by the axis of the jet 15 and the surface 16, the jet 15 initially contacts the surface 16 a short distance upstream of the aperture 31, so that the stream of water is flattened and forms a film travelling at high velocity over the leading edge of the arcuate side or wall 43. Substantially no, or very little, spreading occurs until the stream crosses the recess 41. As shown in Fig. 4, the recess 41 produces an abrupt fanning out of the jet, and forms an edge over which the high velocity flattened jet produces a high degree of vacuum, effective to draw the concentrate from the bottle 30 through the suction orifice 31, mix said concentrate with the water from the jet, and form a flat discharge stream or spray.

The delivery end of the suction aperture 31 preferably is located entirely within the recess 41 and is disposed tangentially with respect to the arcuate side 43 thereof. Moreover, the upper end of the suction aperture 31 is

located in that portion of the recess 41 which is first encountered by the sheet 17 of diluent liquid passing over the recess 41. That is to say, the point of tangency between the upper end of the aperture 31 and the recess 41 is at the outer end of a radius of the arcuate recess 41 which is perpendicular to the straight edge 42 of the latter. The bottom of the recess 41 is disposed angularly with respect to the plane of the distribution surface 16. The straight edge 42 of the arcuate recess is preferably within the mentioned plane with the result that at this portion of the recess it is of zero depth; but from the straight edge the recess is of gradually increasing depth in the direction toward the nozzle 14, with the result that the suction aperture 31 is located in the deepest portion of the recess. Extensive experimentation has demonstrated that the exact angularity of the bottom of the recess 41 with respect to the plane of the distribution surface 16 is a matter of considerable importance in so far as the efficiency of the recess 41 in increasing the vacuum developed by the fan-shaped sheet 17 in passage over the aperture 31 and the recess 41 is concerned. If the recess 41 is of uniform depth throughout its entire area with respect to the plane of the surface 16, it seems to have no effect whatsoever upon the amount of vacuum developed within the suction aperture 31, but its influence in increasing the vacuum increases as the pitch of the bottom of the recess with respect to the plane of the surface 16 increases to approximately 5° to 6°; and then if the pitch is increased beyond that point its efficiency in increasing the vacuum again decreases. Accordingly, the optimum angularity of the bottom of the recess 41 with respect to the plane of the surface 16 seems to be of the order of 5° or 6° with the deepest portion of the recess at that side thereof which is proximal to the nozzle 14 and with the opposite, or straight side of the recess actually lying within the plane of the surface 16.

As has been pointed out hereinabove, the relatively large cross-sectional area of the suction aperture 31, as well as the precise shape and arrangement of the recess 41 both operate to increase the vacuum or suction exerted by the fan-shaped sheet 17 upon the column of liquid within the projection 32 and suction tube 33, and thereby ensure that the flow of concentrate through the suction aperture 31 will be maintained in spite of the presence therein of relatively large particles of solid or semi-solid matter. However, so efficient is this combination of increased diameter of suction aperture 31 and the described shape and arrangement of the recess 41, that too great a quantity of concentrated liquid will be aspirated to combine with the diluent liquid for most purposes, unless additional means be provided to restrict the flow of concentrate through the suction aperture 31. Here again it has been necessary to conduct a long and extensive series of experiments to find means for so restricting the flow through the suction aperture without decreasing the effective size thereof; and the flow-restricting means which I have developed and adapted to the present device constitute another of the important details of the present invention. Due to the limitations of drafting, this detailed structure is difficult to illustrate otherwise than in a highly enlarged view; consequently, in describing this feature reference will be had to Figure 8 of the drawing with the understanding, however, that the same feature is present, not only in the model illustrated in Figures 5 to 8, inclusive, but also in the modification illustrated in Figures 1 to 4, inclusive.

These two modifications of the device of the present invention are of substantially the same form, the principal difference between the two being that the modification thus far described, i.e., that of Figures 1 to 4, inclusive, is all of one piece, preferably a die-casting, whereas the modification of Figures 5 to 8, inclusive, comprises a preferably die-cast body portion 51 with a separately made head 52 rigidly secured thereto upon the upper surface of a platform 53 upstanding from the main part of the body portion 51. The head 52, instead of being made of the same die-cast metal as that of which the body 51 is formed, is preferably a suitable thermo-setting plastic compound. The head 52, after having been suitably machined, is attached rigidly and preferably permanently to the upper surface of the platform 53 as by a plurality of dowels or lugs 54 integral with the head 52 and projecting downwardly from its under surface to be received within complementary and similarly arranged sockets or recesses in the body 51. Some or all of these dowels 54 may extend all the way through the body 51 so that their lower ends can be upset or riveted in contact with the under surface of the head, as indicated at 56. In addition, the body 51 is provided with a central opening 51*a* and the head 52 is provided with a mating depending flange 52*a*.

In this modification of the device, the distribution surface 16', suction aperture 31' and vacuum-increasing recess 41' are formed in the separate head 52; but aside from this, they preferably are of identical shape, size and arrangement with the corresponding portions of the previously described modification. An advantage of forming them in or on the separate, plastic head is that the platsic material is considerably more adapted to the precise and accurate machining which is required for the satisfactory operation of the apparatus than is the die-cast metal of which the previously described modification is constructed.

In both modifications, the feature which operates to restrict the quantity of concentrated liquid flowing upwards through the suction aperture 31 (31') is concerned with the nature of the corner at the intersection of the upper end of suction aperture 31 (31') with the bottom of the recess 41 (41'). Here again, extensive experimentation has proven that if this angle is very sharp the concentrate will be drawn upward through the suction aperture 31 (31') at the maximum rate, as determined by the size of the suction aperture 31 (31') and the size and arrangement and shape of the recess 41 (41'). However, if the angle at the top of the suction aperture 31 (31') is rrounded off, as indicated at 61, into a curved surface gradually merging at its lower end with the wall of the suction aperture 31 (31') and at its upper end into the plane of the bottom of the recess 41 (41') the quantity of liquid drawn upwards through the suction aperture will be materially decreased, the rate of such decrease being substantially proportional to the length of the radius about which the curved surface of the corner or angle 61 extends. Moreover, in order to attain such control of the rate at which concentrate is drawn upwards, this curved or rounded corner need occur only on that side of the suction aperture 31 (31') which is remote from the nozzle through which the diluent liquid is jetted.

A surprising feature of this rounding of the corner as indicated at 61, and one which adapts it pecuriarly to the purposes of the present invention, is that it makes possible the regulation of rate at which concentrate is drawn upward through the suction aperture 31 (31') and consequently upon the degree of concentration of the ultimate, sprayed liquid, without having any effect upon the suction or partial vacuum established within the suction aperture 31 (31'). Consequently, this means of regulating the rate of flow of the aspirated concentrate has no detrimental effect upon the capability of the apparatus for use in diluting and spraying liquid concentrates which contain particles of solid or semi-solid matter. Another detail which should be mentioned in connection with the rounded, flow-regulating corner 61, is that it is principally, if not entirely, effective in regulating rate of flow of the concentrate when it occurs on that side of the suction aperture 31 (31') which is remote from the nozzle 14 (14') through which the diluent liquid is jetted. However, another extremely important advantage is gained by extending the rounded corner 61 throughout as much of the entire extent of the upper end of the suction aperture

31 (31') as is permitted by its being disposed in tangency with the curved, or arcuate side 43 (43') of the recess 41 (41'). If the upper end of the suction aperture 31 (31') is chamfered into the rounded corner 61 throughout the lateral sides as well as at the front (i.e., remote from the nozzle 14 or 14' as the case might be) edge of the suction aperture 31 (31') it contributes to a very substantial and valuable extent to the evenness with which the concenrtate is distributed throughout the enire width of sheet 17 of diluent liquid passing over the suction aperture 31 (31') and recess 41 (41').

In this connection, it should also be pointed out that the size of the recess 41 (41') is another detail which has a distinct bearing upon the evenness with which such distribution is attained. If this recess is relatively large, say, for example, that the diameter of this semi-circular recess is from three to five times the diameter of the suction aperture 31 (31'), it will be much more effective in attaining evenness of distribution than if it is proportionately smaller with respect to the diameter of the suction aperture.

Instead of providing a manually operable valve whereby flow of diluent liquid through the jetting orifice or nozzle 14 (14') can be controlled, I have provided an air inlet orifice 66 (66') leading laterally from one side of the device into communication with the suction orifice 31 (31'). This permits the maintenance of atmospheric pressure within the upper end of the suction aperture 31 (31') and consequent breaking of the vacuum therein, when the outer end of the air inlet orifice 66 (66') is open to the atmosphere. Under such conditions, the device can be used as an ordinary garden spray to supply water for the purpose of irrigation when the device is attached to the end of a conventional garden hose. Then, when the operator wishes to apply fertilizer or insecticide, depending of course upon which type of liquid is carried within the reservoir jar or bottle, all he must do is apply his finger to the outer end of the air inlet orifice 66 (66'). This will break the connection between the ambient atmosphere and the interior of the suction aperture 31 (31'), permitting the vacuum to develop therein and consequent aspiration of the concentrated liquid upwards into the fan-shaped spray or sheet 17 of the diluent liquid.

Both of the constructions illustrated include side flanges 67 (67') at opposite sides of the distributing surface 16 (16'). These side flanges diverge from a point immediately adjacent the orifice 14. Also the side flanges increase in height as they diverge. The side flanges confine the spray to the distributing surface 16 (16').

It will be observed that the recess 41 (41') occupies a major portion of the width between the side flanges 67 (67'). As a consequence side streams which would be lacking in entrained chemical are deflected into the main stream. This is important, particularly when spraying plants with chemicals which are intended to remain on the foliage. Otherwise, the chemical free side streams tend to wash the chemical from the foliage.

While particular embodiments of this invention have been shown and described, it is not intended to limit the same to the exact details of the constructions set forth, and it embraces such changes, modifications, and equivalents of the parts and their formation and arrangement as come within the purview of the appended claims.

I claim:

1. A combined hand sprinkler and aspirator for irrigating and applying chemicals to plants, comprising: a metallic body portion adapted for attachment to a container from which a liquid is to be aspirated, said body portion including a platform having a central opening therethrough and an irrigation nozzle arranged for attachment to a hose and having a relatively large discharge orifice; a separately made head of a thermosetting plastic material, mounted on said platform, having a depending flange engaging the wall of said central opening for centering the head on said platform and a depending suction aperture adapted to receive one end of a suction tube, said head having an impingement means for deflecting water issuing from said orifice into a fan-shaped stream, said impingement means including an elongated impingement and deflecting surface, positioned for obtuse engagement by water issuing from said nozzle, and upstanding walls forming with said deflecting surface an upwardly open and open-ended channel receiving a jet of water from said discharge orifice, said walls diverging from said nozzle to confine the jet of water to said deflecting surface and limit the included angle of the fan-shaped stream discharging therefrom; an aspirator depression in said impingement surface having side walls diverging from said discharge orifice at a greater angle than said upstanding side walls; and an aspirator port intersecting the upstream end of said depression.

2. A combined hand sprinkler and aspirator according to claim 1, in which the platform includes a plurality of recesses, and the head includes a corresponding number of integral dowels adapted to be received within said recesses to rigidly secure the head to the body portion.

References Cited in the file of this patent

UNITED STATES PATENTS

470,410	Pangle	Mar. 8, 1892
1,772,426	McConnell	Aug. 5, 1930
2,030,853	Budwig	Feb. 18, 1936
2,061,932	Budwig	Nov. 24, 1936
2,260,603	Budwig	Oct. 28, 1941
2,527,009	Heberlein	Oct. 24, 1950
2,744,791	Budwig	May 8, 1956
2,855,245	Sedlacsik	Oct. 7, 1958