Dec. 9, 1952 | J. T. EFFORD | 2,621,014

VALVE FOR THE DISTRIBUTION OR DISPERSION OF FLUIDS IN SMALL PARTICLES

Filed Jan. 25, 1949 | 2 SHEETS—SHEET 1

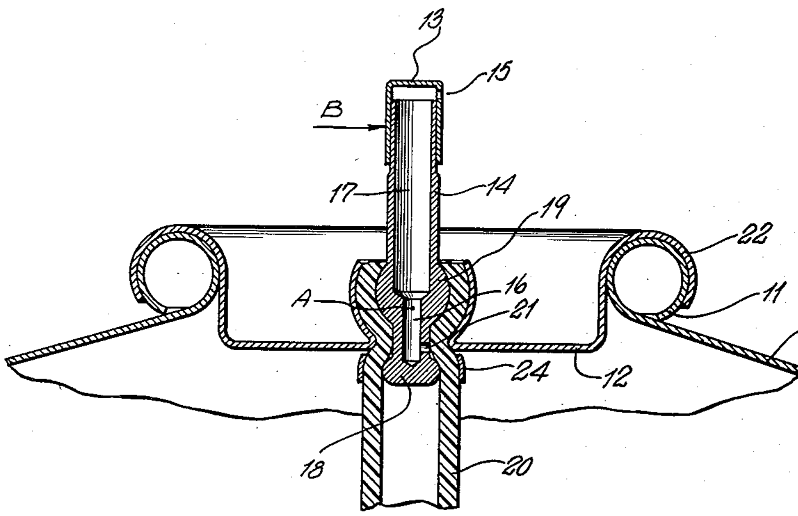

Fig. 1.

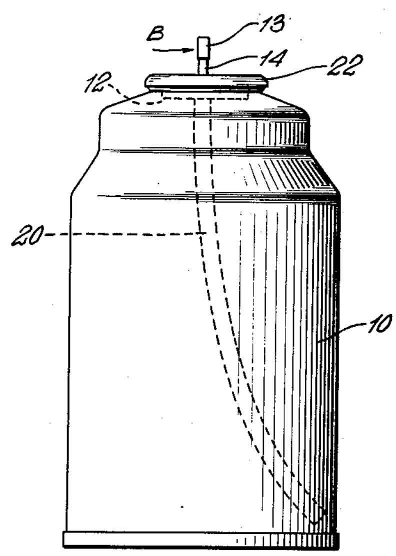

Fig. 2.

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2 SHEETS—SHEET 2

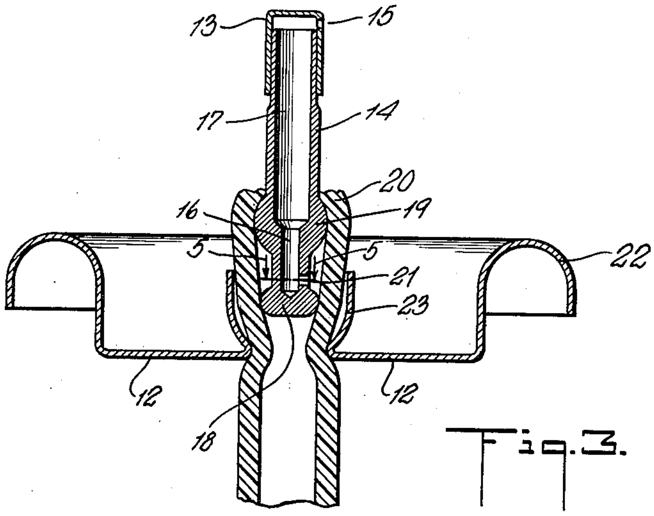

Fig. 3.

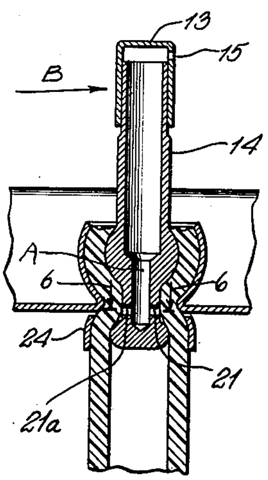

Fig. 4.

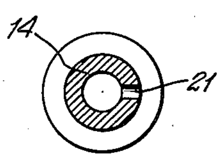

Fig. 5.

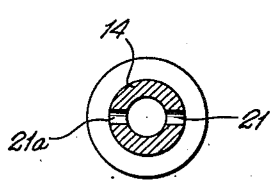

Fig. 6.

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Patented Dec. 9, 1952 2,621,014

UNITED STATES PATENT OFFICE

2,621,014

VALVE FOR THE DISTRIBUTION OR DISPERSION OF FLUIDS IN SMALL PARTICLES

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Application January 25, 1949, Serial No. 72,577

4 Claims. (Cl. 251—115)

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This invention is for apparatus for the distribution or dispersion of fluids in small particles. It is more specifically addressed to the provision of a valve for the formation of aerosols from liquids under super-atmospheric pressure. While my new valve is particularly suited to the formation of aerosols, it is also adapted to the release of sprays where the desired particles are larger than aerosol size. Thus, my valve is suitable for the application of insecticides, fumigants, coatings, suntan preparations, deodorants, medicinal sprays and the like; in short, wherever dispersion is extremely small substantially uniform particles is desired.

In the application of insecticides, fumigants or the like, it is essential for maximum effectiveness that the active agent be suspended in the space to be treated for as long a period as possible. It is well known that the period of suspension is an inverse function of particle size, and that extremely fine particles, of colloidal magnitude, may be distributed in the air and remain suspended for long periods without settling. Similarly, in the production of fine films of coating or treating material, uniformity and economy require that the material be supplied to the surface being coated or treated in extremely small particles of substantially uniform size. Desirable colloidal dispersions of finely divided solids or liquids in air are known as aerosols. A method suggested for effecting such a dispersion is to maintain a solution of the active agent or agents in a liquefied gas confined under high pressure in a container and to release it into the atmosphere through an orifice, thereby obtaining rapid evaporation of the solvent and dispersion of the solution into small particles. The problems involved in the formation of the desired small particles, and especially of aerosols, are increased when the dispersion is to be effected from a liquid maintained at a relatively low degree of super-atmospheric pressure—for example, in the neighborhood of 50 lbs. per square inch (gauge) or lower. At such pressures, orifice design, multiple stage expansion, and the provision of appropriate expansion chambers between orifices, become of critical importance. It will be understood, in addition, that a proper dispersion device must be capable of low cost manufacture, lest the advantages of safety and low container costs be nullified by high cost dispersion means. An improved valve for aerosol and similar dispersions was disclosed and claimed in application Serial Number 785,158, now Patent No. 2,582,262, filed jointly by me and N. O. Loven

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on November 10, 1947. The valve which was the subject of that invention represents an improvement as regards both low manufacturing costs and increased operating efficiency over previously known valves.

The present invention is for a further improved valve for dispensing or dispersing insecticides or other substances and has the advantage of additional ease of manufacture, including a decrease in the number of steps required and the number of parts. An object of my present invention is an improved valve device for dispersing insecticides or other substances, by which device the substance in question can be dispersed in aerosol form from its relatively low pressure solutions in a liquefied gas, or from solution under pressure in other readily volatile liquids. A further object is to provide such a device in a form which can be inexpensively and readily manufactured, and is easily manipulated to dispense any desired part of the contents of the container to which it is affixed, at other times serving as a seal to prevent leakage and loss. Moreover, the device is suitable for permanent attachment to a container holding under pressure the fluid to be dispersed, so that the orifice and chamber sizes can be fixed by the manufacturer to correspond with the properties of the fluid and the particle size required, thus assuring uniformity of operation throughout the charge, with no adjustments to be made by the user.

Other objects, novel features and advantages of this invention will become apparent from the following specification and accompanying drawings, wherein:

Fig. 1 is a sectional view of one form of my valve device affixed in the cap of a container.

Fig. 2 is a side elevation of a suitable container with the valve in place.

Fig. 3 is a sectional view showing one step in the method of assembling my valve in the container cap.

Fig. 4 shows a modified form of the valve.

Fig. 5 is a sectional view along the line 5—5 of Fig. 3.

Fig. 6 is a sectional view along the line 6—6 of Fig. 4.

A dispensing device embodying my invention includes a receptacle or container for maintaining under pressure a liquefied gas or other readily vaporizable liquid containing in solution insecticides, fumigants, coating materials or the like, which it is desired to disperse in finely divided or aerosol form. The generally cylindrical container or receptacle 10 may be approximately 6 inches long and 3 inches in diameter so that it may be readily manipulated as desired, but these dimensions are not critical and the container may be as large or as small as is appropriate to the service required. The container may be made of metal, glass, or plastic materials, provided that it can safely withstand the pressure of the contents and that it will not be corroded by or otherwise enter into chemical reaction with the contents. Where a metal container is used, it may be provided with a plastic or other lining to improve its resistivity to the solution with which it is charged. The container is preferably drawn to a relatively narrow diameter opening, the top which is provided with a bead 11 to which a cap 12, into which has been inserted my new valve, may be affixed in the manner known in the art. However, other means of applying the valve to the container can be used without departing from my invention. The valve itself comprises two rigid members, 13 and 14, and a flexible elastic member 20. Member 13, which may conveniently be made of brass, although other materials may be used if desired, is what is known in the art as an eyelet, approximately 0.1 inch inside diameter and approximately 0.01 inch thick. Through the wall of the eyelet, adjacent its closed end, is drilled an orifice 15 approximately .020" in diameter. The size of this orifice is determined by the service required of the valve. Thus, if it is desired to use the valve to produce an aerosol dispersion of an insecticide dissolved in Freon-12 or in mixtures of Freon-12 with Freon-11 or with methylene chloride, where the internal pressure may range from 10 to 90 lbs. per square inch, the orifice should be .020 inch in diameter. Where sprays of fine particles for coatings are required, it will ordinarily be preferred that the particles be somewhat larger than aerosol size, and in such event the orifice will be made larger. On the other hand, when operating in the lower range of pressures a smaller orifice may be provided. Member 14 may be made of brass, zinc or other material. As shown, it has a hollow core, the diameter of the portion of the hollow core 16 near the closed end of the member being approximately .04 inch and the diameter of the portion of the hollow core at 17 adjacent the open end of member 14 being approximately .08 inch. Each section of the hollow core may be straight or slightly tapered, depending upon the method of construction of member 14, which may be made either by drilling or by die casting. The closed end of member 14 is enlarged into a rounded protuberance 18, and there is a second substantially spherical protuberance 19 provided near the closed end, but spaced from protuberance 18. Near its open end, member 14 is cylindrical in form and is of such outside diameter that member 13 can be applied thereto as shown in the drawings with the achievement of a pressed fit. When orifice 15 is approximately .02 inch in diameter, member 14 may be approximately ½ inch long. In such case the protuberance 18 will be approximately 0.15 inch in diameter, and the greatest diameter of member 14, which will be the diameter of protuberance 19, will be approximately 0.19 inch. The external diameter of the cylindrical portion of member 14 which connects the two protuberances will be approximately $\frac{3}{32}$ inch. While these exact dimensions may be departed from, the general relationship of the size of the various parts of member 14 must be approximately as given in order that my valve will operate most effectively. As shown in Figure 1, the valve assembly is positioned in cap 12 and held firmly in place by a heavy walled rubber tube 20. The nominal inner diameter of this tube should preferably be about 0.01 inch less than the diameter of the protuberance 18, and the walls of the tubing should be approximately .075 inch thick. The central portion of cap 12 is preferably depressed as shown so that when the cap is affixed to the container 10 the central portion of the cap is below the top of the bead and the dished cap affords some protection to the valve. The rubber tubing surrounding the spherical protuberance is firmly held in place by the central portion of the cap as shown in Figures 1 and 4 and is also pressed firmly against the cylindrical section of member 14 between the 2 protuberances. Due to the fact that the diameter of protuberance 18 is greater than the inside diameter of the rubber tubing there is a close frictional contact between the tubing and the latter protuberance as well. In the form of valve shown in Figures 1, 3 and 5, hole 21 is drilled through the cylindrical portion of member 14 at such a location that when the valve is installed as shown in Figure 1, hole 21 will be substantially horizontal and substantially in line with the depressed horizontal portion of cap 12. Where my valve is intended to produce aerosols from liquids at a pressure in the range of from 10 to approximately 90 lbs. per square inch, hole 21 will preferably have a diameter in the range of 0.15 inch, although for some uses it may be larger, and in some cases I make hole 21 the same diameter as hole 15.

The method of assembly of my valve and the container cap is shown in Figure 3. The cap is provided in the form of a cup having a circumferential shoulder 22 and a central opening defined by a cup-shaped rim 23. The diameter of the opening in the plane of the depressed horizontal central portion of cup 12 is greater than the diameter of the cylindrical portion of member 14 and only slightly smaller than the nominal outside diameter of rubber tubing 20. The top diameter of cup or rim 23 is, for the corresponding dimensions already given, approximately 0.3 inch. After eyelet 13 has been formed and hole 15 drilled in it and after member 14 has been formed with hole 21 therein, member 13 is pressed onto 14 in a manner known in the art, thereby completing the valve assembly. The rubber tube 20 is then affixed to the valve assembly by thrusting the latter into the former until protuberances 18 and 19 are inside the rubber tube. The tube, which is preferably of sufficient length so that it will reach to the bottom of the container after the cap is applied thereto, as shown in Fig. 2, so as to act as an eductor, is then pulled through the opening in cap 12 as shown in Fig. 3. The tube bearing the valve assembly at its upper end is pulled down until the assembly reaches the position shown in Fig. 1, whereupon rim or cup 23 is upset so as to firmly grip the rubber tubing and secure it in relation to protuberance 19. The cap is then placed on container 10, which has previously been filled with the desired volatile solution of the active agent, and shoulder 22 is upset so as to firmly grasp the bead 11, thereby sealing the container. It will be noted that although fluid contents of the container are in communication with the valve assembly through eductor tube 20, protuberance 18 is seated against the rubber tubing and does not permit any of the contents to flow from the container. It will be observed that by this method of construction the internal pressure of 10 to 90 lbs. within the container tends to maintain rubber tubing 20 and the upper portion of protuberance 18 in sealing relationship.

To operate my valve, it is only necessary to displace it manually, as for example by finger-tip pressure, in the direction shown by arrow B. This causes displacement of the valve assembly substantially around the point designated as A. Such displacement of the assembly will result in breaking the seal between tube 20 and protuberance 18, so that the internal pressure of the contents of the container will force them up through eductor tube 20 into orifice 21 thence through openings 16 and 17 and finally through orifice 15 into the atmosphere. I have found that the changes of direction and the relatively short abrupt orifices combined with the expansion chamber provided by the hollow core sections 16 and 17 results in an effective aerosol formation. While the diameters of the orifices and the other parts may depart somewhat from those given, it is essential that the orifices be cleanly drilled and that the openings in member 14 be fairly uniform and relatively smooth throughout their bore.

Figures 4 and 6 show a modified form of my valve which has two openings, 21 and 21*a* drilled in the cylindrical portion of No. 44. I use this modified form where I desire to have an effectively larger diameter into the interior of member 14 without departing from the small orifice size. More than two openings can, of course, be used where desirable.

Instead of using a rubber eductor tube 20, any similarly flexible elastic material may be used which is not deleteriously acted on by the contents of the vessel. Various grades of synthetic rubber, neoprene and the like may be used. Moreover, where a rubber or similar tube is used in order to secure the valve assembly in the cap, I may make this tube relatively short and use a plastic tube of polyethylene or the like affixed to the lower portion thereof, the polyethylene or plastic tube extending to a point adjacent to the bottom of the container. I have found that satisfactory results can be obtained even where the composition of the material in the container causes appreciable swelling of the rubber tube. In such cases I add an annular retaining band 24, made of metal or plastic, which has an interior diameter of such magnitude that it will afford a friction grasp on the rubber tubing. When I use such a retaining band I pull the rubber tubing through it, after the valve assembly is in place on the cap, and force the retaining band upwardly until it is substantially in contact with the inner surface of the cap. However, the retaining band is not attached to the cap. The band provides enough rigidity so that any substantial swelling of the rubber is forced into a downward direction and consequently does not result in breaking the seal between the rubber tubing and the protuberance 18.

For effective operation, the container 10 is charged with a solution of insecticide, or other desired active agent, in a solvent comprising a liquefied gas, or in a readily vaporizable liquid which may if desired have a vapor pressure between 10 and 90 lbs. gauge, or lower, at normal temperatures, the preferred pressure being 50 lbs. or less. Among such solvents are low-boiling hydrocarbons, halogenated hydrocarbons and the like. In some cases, the pressure may be increased by the addition of small amounts of an auxiliary propellant, such as carbon dioxide or other compressed gases. When an insecticide aerosol is desired, pyrethrum is a desirable active agent. Other solvents and modifiers may be added to the solution, which of itself does not form part of my invention. The valve assembly seals the liquid due to the sealing contact between the rubber tubing and protuberance 18. When the valve is unseated, as described above, the pressure of the vapor in equilibrium with the liquid in container 10 forces the liquid up through eductor tube 20 and orifice 21 (or, in the form of device shown in Figures 4 and 6, through orifices 21 and 21*a*) into opening 16 where partial expansion and a change of direction, both conductive to turbulence occurs. Vaporization of the fluid will begin in openings 16 and 17. The position of orifice 15 causes another abrupt change in direction of flow, and this, coupled with the completion of vaporization of the volatile constituents of the mixtures which occurs when the fluid passes through orifice 15 into the atmosphere, produces a finely divided aerosol with optimum or long time settling qualities. When the inward or radial pressure which has caused the displacement of the valve assembly is released, the sealing contact between tube 20 and protuberance 18 will be reinstated, and the fluid remaining in the container will be maintained under pressure for further use as desired.

It should be understood that in the operation of the valves described above there is no slippage between the inner metallic portion of the valve stem or core and the rubber sheathing. The displacement of the valve about the center of rotation A is made possible because the rubber or similar material surrounding the spherical portion or spherical protuberance of the core is elastic in shear. This elasticity of the rubber in shear assists the automatic restoration of the stem to the normal vertical shut-off position when the rotating force or pressure applied to the valve at B is removed. The elasticity of the rubber below the spherical protuberance also assists the restoration.

I have found that the use of my novel valve assembly makes possible the effective dispersion of aerosols from liquids under pressures as low as 10 lbs. per square inch gauge. Satisfactory results are obtained throughout the whole range of pressures up to as high as 90 lbs. per square inch. Under all of these pressure conditions the valve is easily operated, and self-seating. In fact, the higher internal pressures are maintained free from leakage as effectively as the lower ones by the construction shown.

It is, of course, understood that various modifications may be made in the apparatus above described without in any way departing from the invention as defined in the appended claims, and that my valve may be used wherever it is desired to release a fluid from a container where it is maintained under pressure in finely divided form into the atmosphere or any other relatively low pressure space.

I claim:

1. A valve including an elastically flexible tube having an end, a valve assembly having a portion inserted inside of said tube through said end and a portion extending outside of said tube away from said end, the first-named portion having two protuberances spaced longitudinally therealong with the one closest to said end being of substantially spheroidal shape and with said tube elastically pressing snugly therearound, said

body forming a passage extending from a location open to the inside of said tube between said protuberances to a location open to the outside of the second-named portion beyond said end, and a mounting member encircling said tube and compressing the tube inwardly around said first-named portion between said protuberances.

2. A valve including an elastically flexible tube having an end, a valve assembly having a portion inserted inside of said tube through said end and a portion extending outside of said tube away from said end, the first-named portion having two protuberances spaced longitudinally therealong with the one closest to said end being of substantially spheroidal shape and with said tube elastically pressing snugly therearound, said body forming a passage extending from a location open to the inside of said tube between said protuberances to a location open to the outside of the second-named portion beyond said end, and a mounting member encircling said tube and compressing the tube inwardly around said first-named portion between said protuberances, said mounting member further encircling said tube throughout an area opposite to said protuberance of spheroidal shape and compressing said area against said protuberance of spheroidal shape.

3. A valve including an elastically flexible tube having an end, a valve assembly having a portion inserted inside of said tube through said end and a portion extending outside of said tube away from said end, the first-named portion having two protuberances spaced longitudinally therealong with the one closest to said end being of substantially spheroidal shape and with said tube elastically pressing snugly therearound, said body forming a passage extending from a location open to the inside of said tube between said protuberances to a location open to the outside of the second-named portion beyond said end, and a mounting member encircling said tube and compressing the tube inwardly around said first-named portion between said protuberances, a support encircling said tube around the one of said protuberances most remote from said end.

4. A valve including an elastically flexible tube having an end, a valve assembly having a portion inserted inside of said tube through said end and a portion extending outside of said tube away from said end, the first-named portion having two protuberances spaced longitudinally therealong with the one closest to said end being of substantially spheroidal shape and with said tube elastically pressing snugly therearound, said body forming a passage extending from a location open to the inside of said tube between said protuberances to a location open to the outside of the second-named portion beyond said end, and a mounting member encircling said tube and compressing the tube inwardly around said first-named portion between said protuberances, said mounting member further encircling said tube throughout an area opposite to said protuberance of spheroidal shape and compressing said area against said protuberance of spheroidal shape, a support encircling said tube around the one of said protuberances most remote from said end.

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