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W. V. STROKALITIS

2,492,405

ATOMIZER HEAD

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Fig. 1.

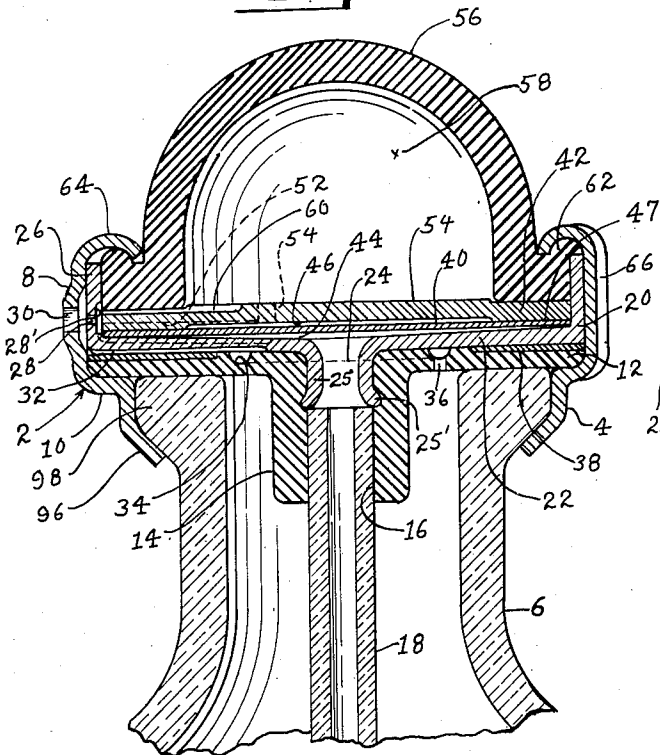


Fig. 2.

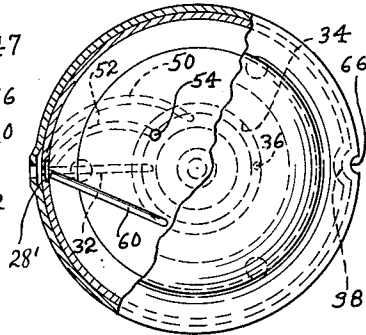


Fig. 3.

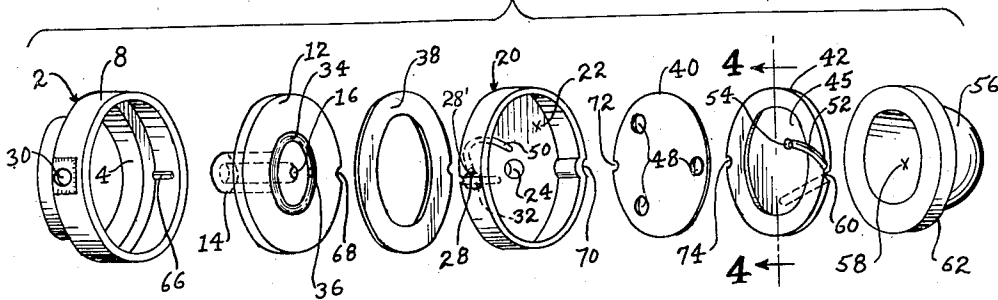
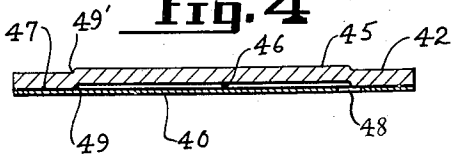


Fig. 4



INVENTOR
William V. Strokalitis

BY *Albert Sperry*

ATTORNEY

UNITED STATES PATENT OFFICE

2,492,405

ATOMIZER HEAD

William V. Strokalitis, Waterbury, Conn., assignor to Scovill Manufacturing Company, Waterbury, Conn., a corporation of Connecticut

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3 Claims. (Cl. 299—88)

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This invention relates to atomizer heads adapted to be applied to containers for discharging liquid therefrom in the form of a mist or fine spray. The present invention is directed particularly to improvements in atomizers of the general type shown and described in the patent to Spender et al. No. 2,427,932.

The atomizer head shown in the Spender patent embodies an outer shell or retaining member adapted to be applied to the neck of a container. Within the retaining member are located atomizing elements consisting of a cup and a supporting disc which cooperate to form a liquid receiving chamber and between which a diaphragm is movable. The cup communicates with the liquid in the container through a tube, whereas the disc is covered by a compressible member such as a hemispherical rubber bulb adapted to be depressed to force air through an opening in the disc and to force air and liquid through a passage leading to a discharge orifice in the retaining member.

This type of atomizer has been produced and used extensively but it is found in practice that the amount of liquid discharge varies considerably in different atomizer heads made in a single manufacturing run. Thus, for example, tests on atomizers that were designed to have a 4 gram tolerance in dispersion per hundred strokes of the compressible bulb and which appeared to be identical have shown that the amount of liquid discharged may vary from 2 grams to 10 grams per hundred strokes. This variation is due to the fact that the elements forming the liquid receiving chamber are sometimes distorted slightly during the operation of assembling the atomizer and securing it to a container whereby the area of the diaphragm which is flexed and the tension to which the diaphragm is subjected are varied. Moreover, very slight differences in the temper or thickness of the metal or in the action of the forming dies by which the elements are produced are inevitable in any commercial operation. Therefore it has been practically impossible in a commercial operation to maintain the desired uniformity of discharge with constructions of the prior art. Furthermore, when it is desired to change the volume of discharge of the atomizers it is necessary to provide a new set of forming dies for each volume required.

It is also found that certain of the atomizers heretofore produced have a tendency to form bubbles that appear in the fluid of the container upon compression of the bulb. This is presumably due to the difficulty in eliminating all possi-

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ble minute channels or openings between the parts which could allow air to be forced downward through the liquid supply tube and into the container on operation of the bulb.

When the atomizer head is removed from a container it is also difficult to drive out the liquid remaining in the atomizer head by operation of the bulb. These objectionable features are believed to be due to the tapered form of the marginal portions of the liquid receiving chamber and perhaps also to some slight cramping, distortion or roughness along the edges of the diaphragm or supporting disc at their line of contact. The presence of capillary areas that exist in prior constructions create an undesired reservoir of fluid within the atomizer with the result that an abnormal number of strokes of the compressible bulb are required to effect the removal of retained liquid from the atomizer upon removal from a container.

It has now been discovered that these difficulties can be largely overcome and a much greater degree of uniformity can be maintained by forming the elements between which the diaphragm is secured and the space within which it is movable in such a way that the volume of the liquid receiving chamber and the area of the diaphragm which is flexed during operation are of fixed and unvarying dimensions and are substantially unaffected by the assembling operations. The diaphragm is engaged by retaining means which extend over a relatively wide portion adjacent its periphery and the capillary spaces and pin hole openings are thus reduced or eliminated so that leakage, bubbling and the retention of liquid in the atomizer head is reduced to a minimum.

One of the objects of the present invention is to provide an improved type of atomizer head which will serve to produce a more nearly uniform discharge of liquid upon operation thereof.

Another object of the invention is to eliminate the formation of bubbles in the liquid when the atomizer is operated.

A further object of the present invention is to reduce the difficulty presented in removing liquid from the atomizer head on the removal of the head from a container.

A specific object of the present invention is to provide a novel type of assembly for forming the liquid receiving chamber and for supporting a diaphragm in an atomizer.

These and other objects and features of the present invention will appear from the following

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description thereof in which reference is made to the figures of the accompanying drawing.

In the drawing:

Fig. 1 is a vertical sectional view of a typical form of atomizer head embodying the present invention;

Fig. 2 is a top plan view of the construction illustrated in Fig. 1 with a portion of the compressible bulb removed;

Fig. 3 is an exploded view illustrating the various elements forming the assembly shown in Fig. 1; and

Fig. 4 is a vertical sectional view through the plate and diaphragm employed in the construction shown in Fig. 1.

In that form of the invention illustrated in the drawing the atomizer head is formed with a retaining member 2 having a lower attaching portion 4 of suitable form for securing the head to a container such as the container 6. The upper wall portion 8 of the retaining member is connected to the attaching portion 4 thereof by a shoulder 10, against which bears the marginal portion of a gasket 12. The gasket 12 is formed of rubber or other suitable material for sealing the space between the retaining member and the neck of the container. The lower face of the gasket is formed with a centrally located, downwardly extending neck 14 having an opening 16 therethrough for receiving and frictionally holding a supply tube 18 formed of glass, metal or the like. The supply tube projects downward from the gasket into the container 6 for conducting liquid from the container to the atomizing elements located above the gasket.

The atomizing elements of the head are surrounded by the wall portion 8 of the retaining member 2. The elements preferred and illustrated in the drawing include a cup 20 which is formed with a base 22 having a central opening 24 therein which communicates with the opening 16 in the neck of the gasket. In order to retain the central part of the gasket 12 against the underside of the cup base 22, that portion of the cup about the opening 24 is drifted downwardly as shown at 25 so as to project a substantial distance into the opening 16 of the neck. The lower extremity is flared outwardly at 25' and is adapted to be embedded in the rubber material of the neck as a form of anchorage.

The side wall 26 of the cup is formed with an atomizing aperture 28 which is located in alignment with a discharge port 30 in the wall portion 8 of the retaining member 2. The lower face of the cup 20 is formed with a vent groove 32 therein which extends inward from the marginal portion of the cup and communicates with an annular groove 34 in the upper face of the gasket 12. The gasket, in turn, is formed with a small opening 36 which passes from the annular groove 34 to the lower face of the gasket. In this way a vent opening is provided which extends from the interior of the container through the opening 36 and annular groove 34 to the groove 32 in the lower face of the cup and thence to the discharge port 30 in the wall portion of the retaining member.

In order to prevent the relatively soft rubber gasket 12 from being pressed into the groove 32 in the cup, so as to close the vent when the head is attached to the container, it is preferable to insert a thin annular metal washer 38 between the gasket 12 and the cup 20 as shown in Figs. 1 and 3.

Within the cup 20 is located a thin flexible

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diaphragm 40 formed of metal and confined at its edges between the base of the cup and an upper supporting disc 42. As shown to an exaggerated extent in Fig. 1, the base 22 of the cup 20 is bowed downward or the parts are otherwise formed to provide a space 44 between the upper surface of the base of the cup 20 and the lower surface of the diaphragm 40.

In accordance with the present invention the upper supporting disc 42 is formed in a suitable manner, as by striking up the central portion of the disc as shown at 45. As shown in Fig. 4 the supporting disc has a central downwardly facing cavity 46 which is substantially rectangular in vertical cross section so that the side walls of the cavity extend substantially at right angles to the diaphragm and the upper face of the cavity is flat and planished.

In order to assure that the central portion 45 be offset relative to the disc 42 and remain as flat as possible, it is necessary to give the central portion a definite set relative to the rim. This may be accomplished by having the break on the opposite sides of the disc 42 disposed in a common cylindrical plane so that the indented shoulder 49 on the lower face of disc 42 as seen in Fig. 4 is coincident with the projecting shoulder 49' on the upper face of said disc. In other words, there is a tendency to actually shear the central portion 45 bodily out of the disc 42 that is effective in eliminating strains in the disc that would otherwise tend to create an uncontrollable doming effect in said central portion 45. By this construction it is possible to maintain effective control of volume of the chamber portion 46 and to assure more accurate control of the amount of liquid discharged per hundred strokes of the compressible bulb.

Moreover, the depth and volume of the cavity 40 can be varied while using the same forming dies by introducing shims to alter the relative positions of the dies in producing the supporting disc. The disc 42 when thus formed may have the cavity depressed or drifted into the lower face of the disc to any desired depth to secure the necessary volume of the cavity while maintaining the same area in horizontal cross section of the cavity. The space 44 between the cup and the lower surface of the diaphragm and the space 46 between the supporting plate and the upper surface of the diaphragm thus cooperate to form a liquid receiving chamber of fixed and predetermined dimensions to which liquid is supplied from the container through the opening 24 in the base of the cup.

The supporting disc 42 is further characterized by the relatively wide flat annular surface 47 which engages the upper surface of the diaphragm and cooperates with the base 22 of the cup to clamp the diaphragm 40 securely in place over an extended area about the periphery of the diaphragm. The disc thus serves to reduce and substantially eliminate narrow tapering spaces about the edge of the diaphragm whereby the retention of liquid by capillary attraction is prevented and any minute passages or channels which might be due to slight roughness or cramping of the diaphragm are effectively blocked off or smoothed out. In this way operation of the atomizer does not cause the formation of bubbles in the liquid in the container.

The central portion of the metal diaphragm 40 is freely movable toward and away from the upper surface of the base 22 of the cup and the downwardly facing surface of the cavity 46,

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However, the inner edge of the annular bearing surface 47 of the supporting plate serves to provide a shoulder 49 which acts as a bridge or marginal nodal line which accurately defines the area of the diaphragm which is movable during the operation of the device. In this way the volume of the liquid receiving chamber and the active area of the diaphragm are effectively established so that their action is in no way dependent upon or variable with differences in the assembling operation or the pressure under which the disc, diaphragm and cup are secured together and held in place.

The diaphragm is formed with openings 48 which are spaced from the central portion thereof so that when the diaphragm is depressed the central portion may move into engagement with the upper face of the cup to close and seal the opening 24 through which liquid passes into the cup while at the same time liquid in the liquid receiving chamber 44 may pass readily from the lower to the upper surface of the diaphragm and will not be forced back into the container. As shown in Fig. 4 the openings 48 in the diaphragm are preferably positioned so that they will be located adjacent the shoulder 49 of the supporting disc 42 and may be partially closed by the flat bearing surface 47.

The upper surface of the base of the cup is formed with an arcuate groove 50 which extends from a point near the center of the cup (but spaced from the opening 24) to the side wall 26 of the cup along this wall to the atomizing aperture 28. The lower face of the supporting disc 42 is also formed with an arcuate groove 52 which extends from an opening 54 near the center of the disc to the edge of the disc at a point adjacent the atomizing aperture 28. These grooves serve to conduct liquid and air from both sides of the diaphragm 40 to the atomizing aperture so that liquid may pass thereto from the liquid receiving chambers 44 and 46.

Above the supporting disc 42 is located a compressible member, such as the rubber bulb 56. The bulb is formed with an air space 58 therein which communicates with the cavity 46 of the liquid receiving chamber 44 through an opening 54 in the supporting disc 42 in registry with the inner end of disc groove 52. The openings 48 in the diaphragm 40 also serve to provide limited communication between the air space in the bulb and the portion 44 of the liquid receiving chamber beneath the diaphragm.

The upper surface of the disc 42 is formed with an air groove 60 which extends from the air space 58 in the bulb to the atomizing aperture 28 in the cup 20. Thus the construction provides both an air channel and liquid channels which extend to the atomizing aperture for mixing air and liquid and ejecting the same through the atomizing aperture 28 and the discharge port 30 in the head. As shown in Figs. 1, 2 and 3 the cup 20 is preferably provided with a depression or cavity 28' formed on the inner surface of the wall portion of the cup adjacent the atomizing aperture 28. This cavity serves as a common mixing chamber to which the air and liquid channels extend and in which the jets of air and liquid are subjected to vigorous agitation or swirling as they meet before being forced through the aperture 28.

The marginal portion of the bulb 56 is formed with a bead 62 which is engaged by the intumed upper edge 64 of the wall portion 8 of the retaining member. In this way the atomizing elements are clamped together within the upper wall por-

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tion of the head, and the head may be shipped or handled as a unit without danger of displacing the elements or loss thereof. Similarly the liquid supply tube 18 may be shipped separately from the head and inserted into the downwardly extending neck 14 on the gasket at the time of applying the head to the container.

In order to aid in the assembly of the atomizing elements and to avoid relative movement thereof after they are assembled the wall portion 8 of the retaining member 2 is formed with an inwardly extending projection or rib 66 and the gasket 12 is formed with a complementary recess 68, while the cup is formed with an indexing recess 70 which insures registry of the atomizing aperture 28 in the cup with the discharge port 30 in the retaining member. Similarly the flexible metal diaphragm 40 is formed with a notch 72 and the supporting disc 42 is provided with a recess 74 so that the grooves 52 and 60 in the disc will be accurately positioned to terminate adjacent the atomizing aperture 28.

The operation of the device illustrated in Figs. 1 to 4 is as follows:

The bottle or container to which the head is applied is grasped in one hand and the thumb or one finger is used to depress the bulb 56. Upon the first depression of the bulb air is forced from the air space 58 through the air discharge groove 60 to the mixing chamber 28' and the atomizing aperture 28 in the cup. At the same time air is forced through the opening 54 in the supporting disc 42 and across cavity 46 against the flexible metal diaphragm 40 so that the central portion of the diaphragm is forced downward into engagement with the base 22 of the cup 20 and serves to seal the opening 24 therein. The air thus forced into cavity 46 and the liquid receiving chamber 44 passes out through the groove 52 in the lower surface of the supporting disc 42 to the atomizing aperture and discharge port. Any air passing through openings 48 in the diaphragm also will serve to force liquid from the portion 44 of the liquid receiving chamber through the channel 50 to the mixing chamber 28'. In this chamber the jets or streams of air and liquid meet and blend as they are forced through the atomizing aperture 28 thus assuring effective dispersion of the liquid as it is discharged from the aperture through the discharge port 30 in the retaining member.

When the bulb 56 is released it expands due to the inherent elasticity, drawing air inward through the atomizing aperture 28 and groove 60. Air is also drawn into the air space within the bulb from the liquid chamber 44 through the opening 54 in the supporting disc 42 whereby the pressure of air within the liquid receiving chamber is reduced and the central portion of the diaphragm 40 is flexed upwardly to uncover the opening 24 in the base of the cup.

Continued expansion of the bulb 56 serves to draw liquid upward through the supply tube 18 into the liquid receiving chamber 44 between the base of the cup 20 and the supporting disc 42. Some of the liquid usually flows upward through the openings 48 in the diaphragm so as to lie in cavity 46 above the diaphragm and it may even pass through the opening 54 into the bulb air space itself.

Thereafter, upon again depressing the bulb 56, the air from the air space, and any liquid that may have passed through the opening 54, are forced through the groove 60 to the atomizing aperture and are projected from the discharge

port 30 in the wall portion of the head. The air which is forced from the air space through the opening 54 in the disc is projected against the diaphragm 40 and thereby depresses the central portion thereof into sealing engagement with the opening 24 in the base of the cup 20. As the diaphragm 40 is depressed, at least a part of the liquid in the chamber 44 flows upward through the openings 48 in the diaphragm to cavity 46 and both air and liquid are projected through the groove 52 in the lower face of the supporting disc to the atomizing aperture and discharge port. Since all of the lower surface of the diaphragm 40 does not engage the upper face of the cup 20, additional liquid is forced from the space between the diaphragm and the base of the cup through the groove 50 to the atomizing aperture and discharge port. Some air may also pass through the openings 48 in the diaphragm to the space beneath the diaphragm and thence through groove 50 to the atomizing aperture 28.

In this way air and liquid are forced to the atomizing aperture 28 and discharge port 30 and are co-mingled so as to be projected from the head in the form of a fine mist. Moreover, the construction and operation of the elements are such that deterioration and clogging of the various grooves and openings cannot take place and the device operates consistently and effectively for long periods of time.

It has been determined from actual practice that the quality of atomization can be changed by omitting the openings 48 in the diaphragm 40. By omitting the openings 48 it has been discovered upon operating the device that the quality of atomization is improved but the amount of liquid dispensed is decreased. In other words, in a dispenser having a diaphragm with openings the quality of atomization is lessened but the quantity is increased, and in the case of a diaphragm without openings, the quality is increased but the quantity is decreased. However, when using either form of diaphragm the volume of the cavity 46 and capacity of the liquid receiving chamber is fixed and unaffected by the operations of applying the atomizing head to a container. Moreover, the active area of the diaphragm is also fixed by the engagement of the shoulder 49 about the edge of the cavity 46 where it bears against the diaphragm to establish a marginal nodal line determining the active area of the diaphragm in all assemblies. Movement of the diaphragm is therefore dependent only upon the action of the compressible bulb and the uniformity of operation and discharge of liquid is assured.

The atomizing head may be secured to a container such as the container of Fig. 1 by suitable cooperating elements thereon. As shown the head is secured to the neck of the container 6 by spinning or otherwise inwardly turning the lower extremity 96 of the attaching portion 4 of the retaining member so that it extends beneath the collar 98 on the top of the neck of the container.

Although certain preferred forms of the invention have been shown in the drawing and described above, it will be evident that the invention is capable of numerous changes and modifications in the form, arrangement and construction of the various elements thereof. It should

therefore be understood that the present invention contemplates the use of such alternatives and equivalents and that such constructions are intended to be included within the scope of the following claims.

I claim:

1. In an atomizing head adapted to be applied to a container, upper and lower members located within said head, said upper member having a flat, annular marginal portion surrounding a circular downwardly facing cavity which is substantially rectangular in vertical cross section and presents a flat surface spaced from said lower member and cooperating therewith to define a liquid receiving chamber, a flexible diaphragm located between said members and confined at its edges between said annular marginal portion of the upper member and the upper surface of the lower member and extending across the lower face of said cavity, the side walls of said cavity extending angularly from the inner edge of said flat, annular, marginal portion to said flat surface of the cavity and forming a circular shoulder engaging the diaphragm and bounding a central active area portion of the diaphragm, said lower member having an opening therein and said active portion of the diaphragm being movable to seal said opening, a tube leading to said opening for conducting liquid to said liquid receiving chamber, a compressible member located above said upper member and formed with an air space therein, said upper member having an opening therein communicating with said air space and positioned to direct air from said space against the active portion of said diaphragm to actuate the same, and means extending about said members and diaphragm and formed with an atomizing aperture therein, said members being formed with grooves therein extending from the air space in the compressible member and from the liquid receiving chamber to said aperture for conducting liquid from said liquid receiving chamber and air from said air space to said atomizing aperture.

2. An atomizing device as defined by claim 1 wherein the central portion of the upper member overlying the diaphragm is flat and offset bodily relative to the annular surface of said member.

3. An atomizing device as defined by claim 1 wherein the upper surface of the upper member is formed with a central offset and upwardly projecting portion, the edge of which is coincident with the sides of the downwardly facing cavity in the upper member, as may be produced by the shearing action of forming dies.

WILLIAM V. STROKALITIS.

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