April 26, 1966 R. D. WISE ETAL 3,247,849

PUMP-TYPE SPRAYER FOR LIQUIDS HAVING A DUAL-PURPOSE PROTECTIVE CAP FOR PUMP SEALING AND DIRECTIONAL SPRAY CONTROL

Filed March 28, 1963 3 Sheets-Sheet 1

FIG. 1

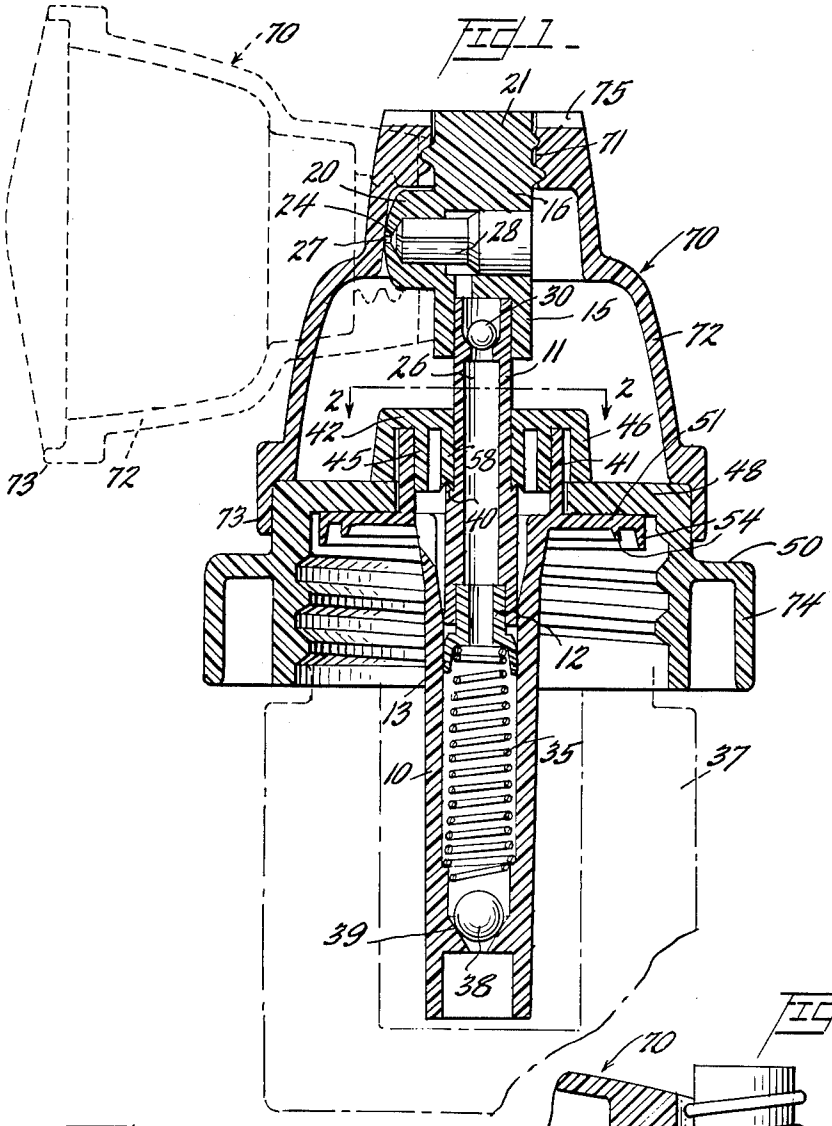


FIG. 2

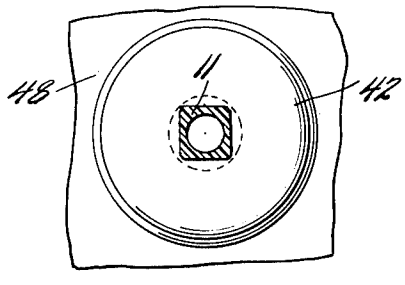
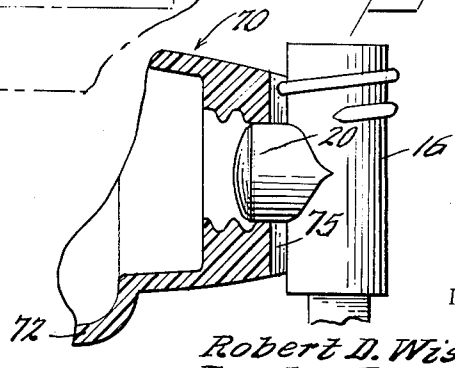


FIG. 2A



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FIG. 3.

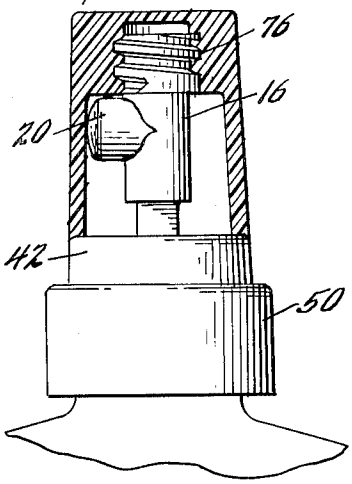


FIG. 4.

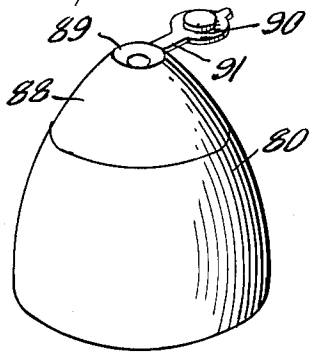


FIG. 5.

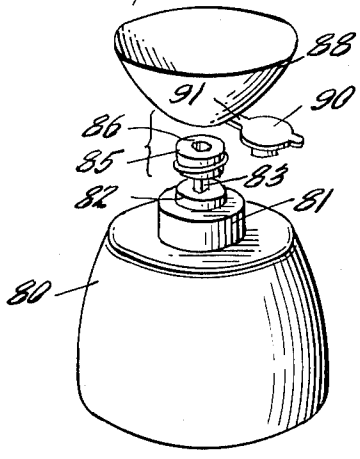


FIG. 6.

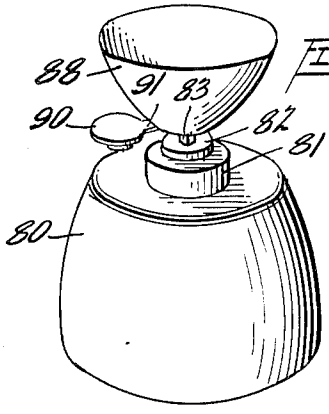


FIG. 7.

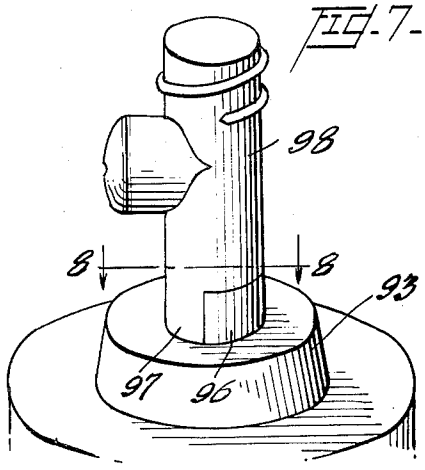
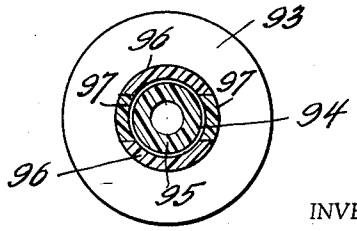


FIG. 8.



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PUMP-TYPE SPRAYER FOR LIQUIDS HAVING A DUAL-PURPOSE PROTECTIVE CAP FOR PUMP SEALING AND DIRECTIONAL SPRAY CONTROL

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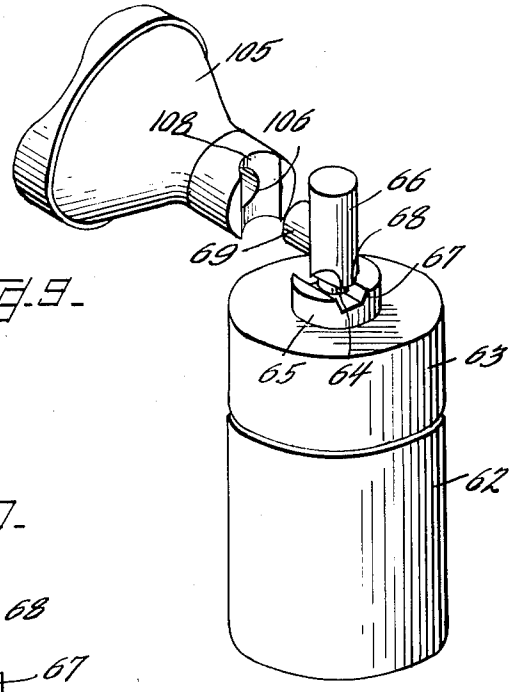


FIG. 9.

FIG. 10.

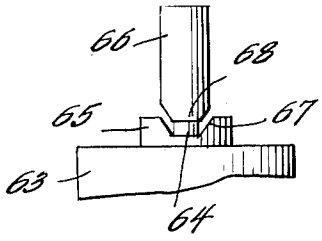


FIG. 11.

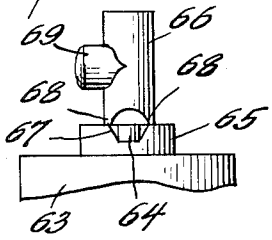
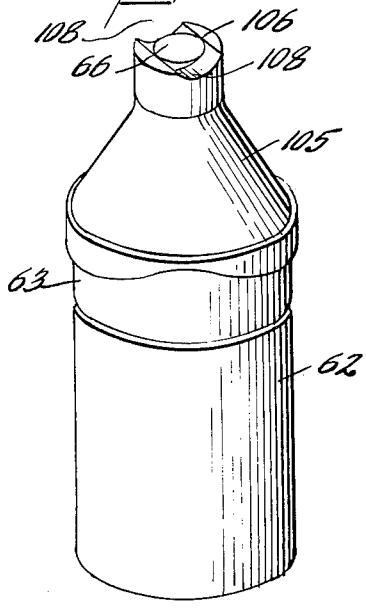


FIG. 12.



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PUMP-TYPE SPRAYER FOR LIQUIDS HAVING A DUAL-PURPOSE PROTECTIVE CAP FOR PUMP SEALING AND DIRECTIONAL SPRAY CONTROL

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Filed Mar. 28, 1963, Ser. No. 268,756
9 Claims. (Cl. 128—173)

This invention relates to molded plastic sprayers of the manually-operated pump type for dispensing liquids from small containers, held in the hand, and has for an object the provision of improved sealing means for preventing leakage of liquid from the pump unit when the container with which it is assembled is laid on its side or is inverted.

Specifically, it is an object of the invention to provide, in a pump type sprayer of the kind described, sealing means which are rendered operative by displacement of the pump plunger to its outer or uppermost position.

It has been proposed, for instance in the patent to Cooprider and Corsette, No. 2,956,509, granted October 18, 1960, to provide sealing means for pump units, but such sealing means have heretofore been rendered operative in a depressed position of the pump plunger. Consequently, in depressing the pump plunger toward and into the sealing position, liquid is discharged by the normal functioning of the pump parts, which effect discharge of liquid on the downward stroke of the plunger. Such unintentional discharge is especially undesirable in pumps in which the plunger is retained in the depressed position by a protective cap, as in the aforesaid patent, since the liquid discharges into the cap and runs down onto the container, marring its appearance.

It is therefore an important feature of the instant invention that closing of the sealing means to prevent leakage from the pump at the exterior surface of the pump plunger requires no depression of the plunger, sealing being achieved by exerting an upward thrust on the plunger.

It is also an object of the invention to provide, in a pump sprayer of the type described, cam means acting between fixed and movable components of the pump to raise the plunger and spray head to the upper sealed position. In a preferred form of the invention, the cam means comprises a protective cap having a threaded connection with the spray head and abutting axially a fixed part of the pump unit, such as the container cap or the collar, whereby the pump plunger is raised when the cap is threaded on the spray head to seal the unit as hereinafter more fully described.

A further object of the invention is to provide a pump sprayer of the type generally described which can be used effectively to spray liquid, such as a lotion or other medicated liquid, against a part of the body. In a preferred form of the invention, the sprayer is provided with a protective cap which may be fitted onto the spray head in either of two positions. In one of these positions, the cap serves to house and protect the head and plunger, which constitute the moving parts of the pump, and at the same time to exclude from the inside of the cap dust and other foreign objects. In the second position, the protective cap is fitted on a part of the spray head which serves as a nozzle through which the atomized liquid is discharged, the open enlarged side of the cap facing away from the nozzle, whereby application of the sprayed liquid may be localized.

Further objects and features of the invention will be apparent from the following description taken in connection with the accompanying drawings, in which

FIGURE 1 is a vertical section of a pump type sprayer employing the principles of the invention;

FIGURE 2 is a transverse section on the line 2—2 of FIGURE 1;

FIGURE 2*a* is a detailed section showing the protective cap of FIGURE 1 in operative position for confining the sprayed liquid to a selected area;

FIGURE 3 is a partial sectional view illustrating a modified form of the invention;

FIGURES 4, 5 and 6 are perspective views of still another form of the invention;

FIGURE 7 is a perspective view of a modified detail of the pump unit shown in FIGURE 1;

FIGURE 8 is a section on the line 8—8 of FIGURE 7;

FIGURES 9 and 12 are perspective views of still another embodiment of the invention; and

FIGURES 10 and 11 are fragmentary views in elevation of the modified structure shown in FIGURE 9.

In describing sprayers of the character to which the invention relates, it is convenient to assume that the sprayer occupies an upright position, thus permitting reference to upper and lower parts of elements and components of the sprayer. It will be appreciated, of course, that these sprayers are frequently held in a position other than vertical when in use.

Referring first to FIGURE 1, which illustrates one preferred embodiment of the invention, it will be observed that the pump unit therein shown is largely conventional. Thus the unit comprises a barrel **10** having a plunger **11** reciprocally disposed in the barrel. At its lower end, the plunger is provided with a piston **12** having a downwardly directed cup-shaped skirt **13** for reception with a snug fit within the barrel. At its upper end the plunger is received in a socket **15** formed at the lower side of a spray head **16**, and is bonded therein by a suitable solvent, the spray head having a laterally projecting nozzle **20** and an upwardly directed, externally threaded portion **21**. Plunger **11** is hollow, its interior providing a discharge passage **26** extending therethrough and communicating with the interior of the spray head **16**; liquid is discharged from the spray head through an orifice **27**. In passing through the spray head and into the orifice **24**, the liquid is caused to rotate about the orifice axis, this rotation resulting from the configuration at one end of a plug **28**, the other end of which serves to close the internal bore in which the plug is received. The construction may be that shown in U.S. Patent 2,974,880, granted March 14, 1961, to Stewart and Cooprider.

A valve ball **30**, resting on a seat **31** provided at either end of the plunger **11**, in this case the upper end, serves to prevent downward movement of liquid through the discharge passage, the ball **30** being gravity seated. A coil spring **35** acting between the lower end of the barrel and the lower end of the plunger, and engaging within the skirt **13** of the piston **12**, serves normally to hold the plunger in its upper position, and to return the plunger to that position when it is depressed, as on a pumping stroke. The lower end of the barrel extends into close proximity with the bottom of a container **37** and is itself provided with a ball valve **38** resting on a seat **39** to prevent downward movement of liquid in the barrel.

It will be appreciated that the elements of the device and its function and mode of operation, as thus far described, are quite conventional.

In the embodiment shown in FIGURE 1, the pump plunger **11** is formed intermediate its ends to provide an annular, upwardly directed sealing flange **40**. That portion of plunger **11** above the sealing flange **40** is noncircular in transverse section, and is preferably square as shown in FIGURE 2. That portion of the plunger below the sealing flange **40** is preferably cylindrical. At its upper end the pump barrel **10** is provided with a cylindrical

extension 41 on which is received a collar 42, the collar being cemented by a suitable solvent to the barrel extension 41. Preferably bonding is effected between barrel extension 41 and an intermediate depending annular flange 45 on the collar, but bonding may also be effected at the internal surface of outer depending annular flange 46; in that event the intermediate flange 45 may be eliminated. Collar 42 is also formed with an inner depending annular flange 58 which is noncircular in transverse section, and receives the upper noncircular portion of plunger 11 with a sliding fit, serving as a guide for the plunger, the purpose of the noncircular contour being the prevention of relative rotation between the collar and barrel and the pump plunger 11.

The top 48 of a container cap 50 rests on and is supported by the usual radial barrel flange 51 and is retained against upward displacement by the outer annular depending flange 46 of collar 42. Radial barrel flange 51 is provided with concentric annular sealing flanges 54 positioned for engagement with the upper end of the neck of a container or bottle. The barrel, barrel flange and sealing flanges are preferably integrally molded from polyethylene or other relatively soft plastic material, so that sealing flanges 54 yield and flex when pressed against the container neck when the container cap 50 is threaded down on the neck, so as to form an effective seal and thus prevent leakage of liquid at the periphery of the container cap. It will also be appreciated that friction exerted against the bottle neck by sealing flanges 54 tends to resist rotation of the barrel and other elements of the pump unit with respect to the container.

A protective cap indicated generally at 70 is provided at its upper end with a portion of reduced diameter having an internally threaded bore 71 for coaction with the threaded upper portion 21 of the spray head 16, and a skirt portion 72 which, when the cap 70 is threaded down on the spray head 16, is formed to engage and axially abut a stationary part of the pump unit, in this instance the container cap 50. Thus, as the protective cap 70 is threaded down, the spray head 16 and the plunger 11 are pulled upwardly to engage flange 40 on the plunger with the lower edge of the inner flange 58 of the collar 42, which is grooved to receive the flange 40 in sealing engagement, thereby preventing leakage of liquid between the plunger 11 and the collar 42 when the container is laid on its side or inverted. During the operation of threading the protective cap 70 on and off the spray head 16, rotation of the head is prevented by the noncircular contour of the upper portion of the plunger and the coacting noncircular guide opening in the collar 42, and rotation of the collar with respect to the container is resisted by the frictional contact of the sealing flanges 54 with the rim of the container neck.

The fluid discharge passage affords a second leakage path (although one of less significance because of the small size of orifice 27) which is preferably closed to prevent leakage from the pump unit when the container is laid on its side. In the preferred embodiment of the invention this is achieved by engagement of the inner surface of cap 70 with the surface of the nozzle 20 immediately adjacent the orifice 27. To insure application of adequate pressure when the protective cap 70 is threaded down on the spray head 16, the internal surface of the cap 70 is flared slightly in a downward direction and the surface of the nozzle adjacent the orifice 27 is formed with a slight convexity, it being appreciated that if the cap 70 is molded of a soft plastic, such as polyethylene, sufficient pressure will be applied as the protective cap is forced downwardly to deform the cap slightly and thereby insure an effective seal at the orifice. To facilitate the application of torque to the protective cap 70, the container cap 50 may be provided with an outer depending flange 74 to permit the grasping in one hand of both the container 37 and the container cap 50 while the protective cap 70 is grasped with the other hand, to minimize the possibility that the container cap 50 will be threaded off the container 37 during the operation of removing the protective cap. Also, flange 74 facilitates removal of the container cap when desired, for instance for the purpose of refilling the container. The flange 74 is also helpful in insuring the application of adequate torque to the container cap 50 when the latter is threaded down on the container 37, an operation normally performed initially on an automatic machine.

The internal diameter of the threaded bore 71 at the end of cap 70 is such that the bore may be received on the laterally projecting nozzle 20, perferably with a snap fit, and a groove 75 in the end of the cap 70 engages the generally cylindrical external surface of spray head 16 to orient the cap in its operative position. Thus the protective cap 70 may be removed from the spray head and fitted on the nozzle 24 with the open side of the cap facing outwardly of the nozzle as shown in dotted lines in FIGURE 1. In this position, the plunger may be reciprocated in the barrel while the open side is held against a selected portion of the body to confine the liquid spray. Since the quantity of liquid to be sprayed in each application is usually small, the pump stroke may be short. On completion of the spraying operation, the protective cap 70 may be removed from the nozzle and again threaded down on the spray head to lock the plunger 11 in its upper position and thereby seal the two leakage paths as hereinbefore described. When the protective cap is thus assembled, damage to the head and plunger is precluded and dust and foreign objects are excluded from the interior of the cap.

All of the parts of the pump unit, with the exception of the ball valves and the coil spring, may be formed of moldable plastic materials in injection molding machines, as has been common practice for many years.

The sealing of the leakage path between the plunger and its collar-guide while the plunger is in its upper rather than its lowermost position has utility, of course, whether or not the protective cap is employed as a localizing or confining device during spraying. For the purpose of forcing the plunger upwardly into its sealing position, the protective cap may abut stationary elements other than the container cap. This is illustrated in FIGURE 3, in which the protective cap is closed at its upper end, and is provided with an internal socket 76, threaded to receive the externally threaded portion of spray head 16, which may be formed and assembled on the plunger as in FIGURE 1. The skirt of the protective cap abuts the collar 42 to exert upward thrust on the spray head and plunger, thereby sealing the unit externally of the plunger as in the modification shown in FIGURE 1. As in the earlier described structure, the portion of the protective cap which engages the nozzle 20 of the spray head is flared slightly in a downward direction, and the area of the nozzle exterior immediately adjacent the orifice is slightly convex, so that when the protective cap is threaded downwardly on the spray head, pressure is applied between the cap and the nozzle to close the orifice and prevent leakage from the unit through the discharge passage. The internal structure of the pump shown in FIGURE 3 may conform with that of FIGURE 1 and need not be reproduced in detail.

In FIGURES 4, 5 and 6 are shown further modifications. In these figures the pump unit is mounted in a container 80 of generally oval shape by means of a container cap 81, threaded on the container neck. The collar 82 is provided with an opening in which the plunger 83 is guided in its reciprocal movement, the plunger and opening being noncircular in transverse section to prevent relative rotation between the plunger and the collar. The spray head 85 is provided with an orifice 86 in its upper face, and is threaded on its peripheral surface. Protective cap 88 is provided with an opening 89 threaded internally for reception on the spray head in

either of two inverse positions. In FIGURE 4 the cap 88 is positioned with its open end in abutting relation with the flat upper portion of the container 80, in which position the spray head and plunger are protected, and are held in the upper sealed position as described more particularly with reference to FIGURE 1. A closure cap 90, molded integrally with protective cap 88 and connected therewith by a flexible strap 91, is dimensioned for reception in the outer end of the opening 89 to close the orifice 86.

In FIGURE 6 the protective cap is threaded on the spray head 85 in inverse position for application to the body as previously described. This arrangement is essentially similar to that of FIGURE 1, differing therefrom by the formation of the nozzle at the upper end of the spray head rather than at one side thereof. The oval shape of the container 80 and the protective cap 88 contribute a pleasing appearance in conformity with its utility in the cosmetic and therapeutic fields.

FIGURES 7 and 8 illustrate an alternative arrangement for preventing relative rotation of the head and plunger and the collar of a pump unit of the type shown in FIGURES 1 and 2, permitting the use of a plunger which is cylindrical throughout its length. Thus collar 93 is provided with a cylindrical opening 94 for receiving and guiding the plunger 95. Upstanding lugs 96 formed integrally with the collar mate with lugs 97 at opposite sides of the spray head 98, as shown in FIGURE 7, and in the sectioned view, FIGURE 8. The structure of the pump unit in other respects may be that shown in FIGURE 1.

It will be appreciated that the protective cap of FIGURE 1, having a threaded connection with the spray head, constitutes an axial cam means, rotatable about the sprayer axis, to exert axial thrust between the stationary and movable components of the pump unit to raise the latter and apply pressure at the plunger seal. A further embodiment exhibiting essentially the same functional relationship, but not requiring a protective cap to raise the plunger, is shown in FIGURES 9 to 12 inclusive, in which the spray head itself is provided with an axial cam engaging the collar to raise the spray head and plunger into sealing position. Thus FIGURE 9 shows in perspective a pump type of sprayer assembled on a container 62 by a container cap 63. A pump plunger 64, preferably cylindrical throughout its length, is received with a sliding fit in a cylindrical opening in guide collar 65, and a spray head 66 is bonded to the upper end of the plunger 64. Excepting for the fact that the noncircular upper portion of the plunger shown in FIGURE 1 is eliminated, leaving the plunger free to rotate on its axis, the internal construction of the embodiment shown in FIGURES 9 to 12 may conform with that shown in FIGURE 1, and need not be reproduced here. As in FIGURE 1, the pump plunger 64 is preferably provided with an upwardly directed sealing flange (not shown) which is engaged with the lower edge of the collar 65 in the uppermost position of the plunger to seal the leakage path between the plunger and the collar.

The upper surface of collar 65 is provided with a transverse, generally V-shaped cam groove 67 and the lower portion of spray head 66 is provided with axially directed cam lugs 68 which, in the operative position of the pump unit, are aligned with the cam groove 67 in the collar 65, as shown in FIGURES 9 and 10, so that the pump plunger and head may be reciprocated manually to discharge liquid as a spray through an orifice in the laterally projecting nozzle 69 in the usual manner.

When it is desired to render the pump inoperative, and to close the seal, the head 66 and plunger 64 are rotated in either direction from the operative position shown in FIGURES 9 and 10 to the inoperative position shown in FIGURE 11, whereupon the lugs 68 ride upwardly on the walls of the groove 67 and seat on the flat upper surface of the collar 65 to raise the head and plunger slightly, thus applying pressure to close the plunger seal and preventing actuation of the plunger to discharge liquid.

When it is desired to use the sprayer shown in FIGURES 9 to 12 inclusive for spraying on a confined area, a protective cap 105 may be employed. Inasmuch as no threading action is required in this embodiment, the bore 106 in the small end of the cap may, if preferred, be a straight unthreaded bore, dimensioned for reception either on the nozzle 69, as indicated in FIGURE 9, or in inverted position to serve as a protective cap, as shown in FIGURE 12. When the cap 105 is so inverted, the bore 106 is received on the upper end of the spray head 66, and the open end of a cap is seated on the container cap 63, as in FIGURE 1. An orienting groove 108, transverse to the bore 106, engages the body of the spray head and insures proper presentation of the cap 105 to the object to be sprayed when the container and pump unit are held in a vertical position.

While for most purposes of the present invention the spray head is designed to deliver the liquid contents of the container in the form of a fine mist, it will be appreciated that by suitable alteration of the orifice and the internal structure of the spray head, any desired form of liquid discharging ranging from a fine mist to a stream may be attained.

A wide choice of plastic materials may be used in the molding of the pump components, and polyethylene, polypropylene and linear polypropylene are eminently suitable. When flexibility is important, for instance to facilitate engagement with the body surface of the user, polyethylene is preferred. It may be desirable to form the plunger of a harder material, such as polystyrene or nylon plastic, since the harder material affords more effective coaction with the mating sealing surface of the spray head when the latter is formed of softer material, such as polyethylene. Selection of appropriate materials is well within the purview of the skilled artisan and invention is not predicated thereon.

It will be appreciated that when reference is made hereinbefore to the use of a solvent for bonding plastic components, the employment of welding or other procedures appropriate to the materials used is contemplated as equivalent to solvent bonding. Where polyolefin plastics are used, for instance, spin welding will be the normal method of uniting the components. Wherever feasible, separate components which are to be rigidly secured together may be integrally molded.

The various embodiments of the invention illustrated and described in detail herein are illustrative only and the details thereof may be modified substantially within the scope of the invention as hereinafter defined, as will be apparent to those skilled in the art.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A pump type sprayer for liquids, comprising a generally vertical pump barrel, a container cap and a cap-retaining collar at the upper end of said barrel, a plunger reciprocally disposed in said barrel, having a sliding fit in said collar, and having at its upper end and above said collar a spray head having a discharge orifice for liquid, a check valve associated with said barrel to prevent downward movement of liquid therein, said plunger being formed to provide a discharge passage extending therethrough and communicating with said discharge orifice, a protective cap having an upper portion shaped and dimensioned to embrace said spray head, said protective cap and said spray head having coacting threads, said protective cap having a lower skirt portion axially abutting one of said container cap and collar when said protective cap is threaded on said head, whereby said head and plunger are held in an upper position when said protective cap is threaded down on said head, coacting sealing means on said plunger and said collar positioned for sealing engagement in the upper position of the plunger, and means acting between said plunger and collar to resist relative rotation thereof when said protective cap is threaded on said spray head.

2. A pump type sprayer as claimed in claim 1 in which

said orifice opens laterally of said spray head and said protective cap is formed to provide a downwardly flared, annular, internal surface engaging said spray head adjacent said orifice to close the latter in the upper position of said spray head and plunger.

3. A pump type sprayer as claimed in claim 1 in which said coacting sealing means on said plunger and collar comprises an upwardly directed annular flange on said plunger and means on said collar formed to provide a downwardly facing annular groove receiving said flange in sealing engagement in the upper position of said spray head and plunger.

4. A pump type sprayer as claimed in claim 1 in which said spray head is formed to provide a nozzle through which said discharge orifice extends, and said protective cap is provided with an opening extending through its upper portion and dimensioned for reception on said nozzle, and having at its lower skirt portion an open side for application to a portion of the body, whereby said sprayer may be operated to spray liquid against a limited area when said protective cap is seated on said nozzle with its open side facing away from said nozzle.

5. In a pump type sprayer for liquids, the combination with a pump unit comprising a generally vertical pump barrel having at its upper end a container cap and a cap-retaining collar, a plunger reciprocally disposed in said barrel, having a sliding fit in said collar, and having at its upper end and above said collar a spray head having external threads thereon and formed to provide a laterally directed nozzle having a discharge orifice for liquid, spring means acting between said barrel and plunger for urging said plunger upwardly in said barrel, a check valve associated with said barrel to prevent downward movement of liquid therein, said plunger being formed to provide a discharge passage extending therethrough and communicating with said discharge orifice, of a protective cap having an opening through its upper end for threaded reception on said spray head, said opening being dimensioned to fit on said nozzle, said protective cap being formed to provide a downwardly extending protective skirt engaging one of said container cap and collar when threaded on said spray head, said skirt having an open side for application around a surface to be sprayed, when said protective cap is fitted on said nozzle with its open side facing away from said nozzle.

6. A pump type sprayer for liquids, comprising a generally vertical pump barrel having at its upper end a collar, a plunger reciprocally disposed in said barrel, having a sliding fit in said collar, and having at its upper end and above said collar a spray head having a discharge orifice for liquid, spring means acting between said barrel and plunger for urging said plunger upwardly in said barrel, a check valve associated with said barrel to prevent downward movement of liquid therein, said plunger being formed to provide a discharge passage extending therethrough and communicating with said discharge orifice, a protective cap having an upper portion dimensioned to embrace said spray head, said protective cap and said spray head having coacting threads, and a container cap supported on the upper end of said barrel, said protective cap having a skirt portion axially abutting one of said container cap and collar when said protective cap is threaded on said head, said spray head being formed to provide a nozzle through which said discharge orifice extends, said protective cap being provided with an opening extending through its upper end and dimensioned for reception on said nozzle, and having at its skirt portion an open side for application around a surface to be sprayed when said protective cap is seated on said nozzle with its open side facing away from said nozzle.

7. A pump type sprayer for liquids, comprising a stationary structure including a generally vertical hollow cylindrical pump barrel, a container cap and a cap-retaining collar at the upper end of said barrel, and a reciprocable structure including a plunger reciprocally disposed in said barrel to pump liquid out of the barrel, said plunger having a sliding fit in said collar, and having at its upper end and above said collar a spray head having a discharge orifice for liquid, a check valve associated with said barrel to prevent downward movement of liquid therein, said plunger being formed to provide a discharge passage extending therethrough and communicating with said discharge orifice, sealing means acting between said stationary and reciprocable structures and engaged in the upper position only of the latter to prevent leakage of liquid from said barrel externally of said plunger, and manually operable means acting between said stationary and reciprocable structures to exert upward pressure on said reciprocable structure to apply sealing pressure to said sealing means, said manually operable means acting concurrently to engage said orifice to block flow of liquid therefrom.

8. A pump type sprayer as claimed in claim 7, in which said manually operable means is rotatable about the sprayer axis and is provided with an axial cam surface.

9. A pump type sprayer as claimed in claim 8, in which said manually operable means comprises a cap having a threaded connection with one of said structures and an axially abutting relation with the other of said structures.

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