(12) UK Patent Application (19) GB (11) 2 059 401 A

(21) Application No 8023123
(22) Date of filing 15 Jul 1980
(30) Priority data
(31) 69748
107334
151000
(32) 27 Aug 1979
26 Dec 1979
15 May 1980
(33) United States of America (US)
(43) Application published 23 Apr 1981
(51) INT CL³ B65D 47/18
(52) Domestic classification B8T 13A DAX
(56) Documents cited
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GB 1112715
GB 1023028
GB 521237
(58) Field of search
B8N
B8T
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(54) **Dropper for adhesives**

(57) A dropper (14) press fitted into the neck (16) of a cyanoacrylate adhesive dispensing container (12) includes an elongated nozzle (22) having a passageway (24) of which at least a section is of constant diameter. The inlet (44) to the nozzle (22), which is in fluid communication with an outlet (46), is defined by a sharp edged orifice. The sharp edged orifice tends to discourage depending retention of any droplets of cyanoacrylate adhesive on righting of the container (12) to maintain the inlet (44) free of residual cyanoacrylate adhesive and free of the crusting and clogging thereof which might otherwise occur. To further discourage retention of any droplets of cyanoacrylate adhesive, the inlet (44) to the passageway may be formed within a downwardly depending hollow boss (48), Fig. 4 (not shown), having a narrow annular terminal surface defined by a sharp edged perimeter and the sharp edged orifice.

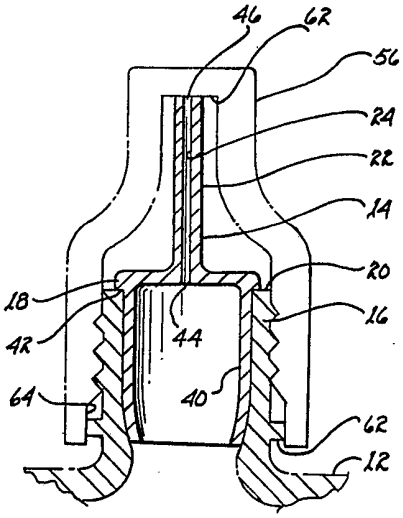


Fig. 3

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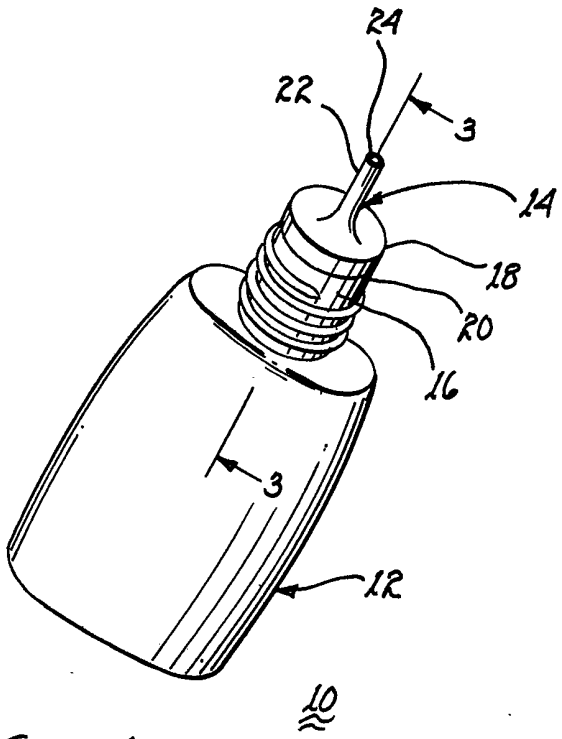


fig. 1

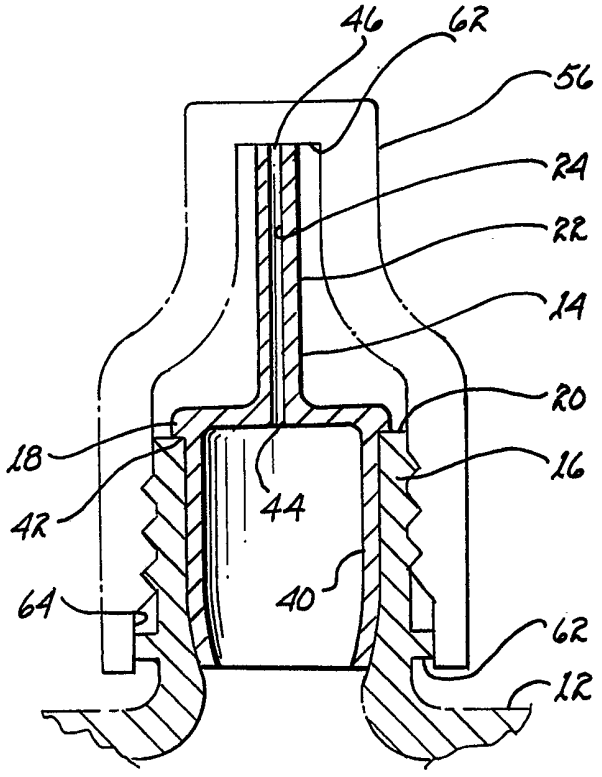


fig. 3

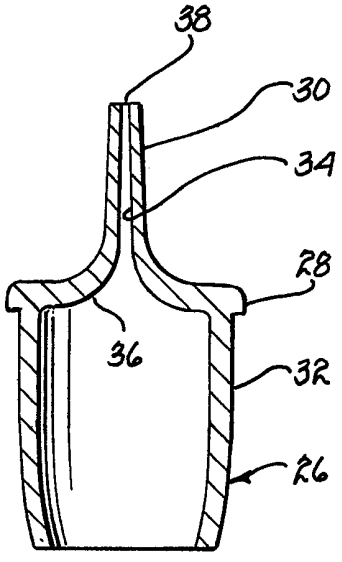


fig. 2

PROIR ART

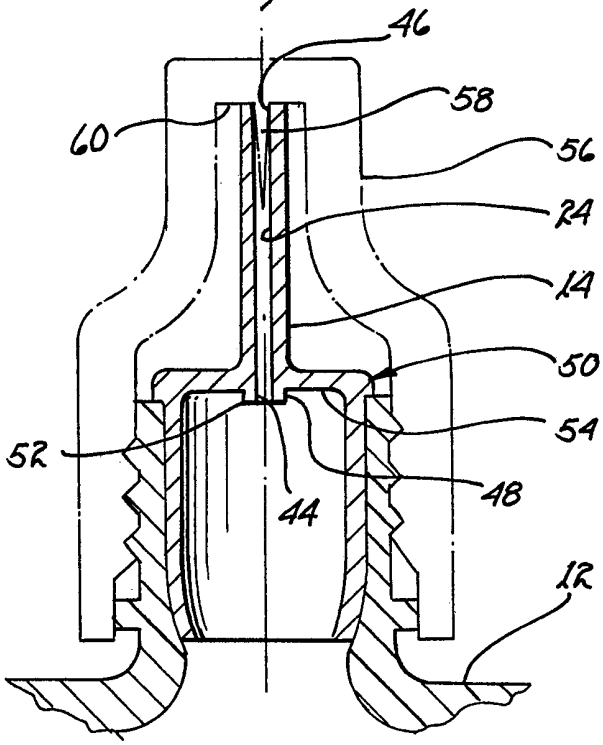


fig. 4

SPECIFICATION

**Dropper for adhesives**

The present invention relates to containers for adhesives and more particularly relates to droppers for cyanoacrylate adhesives.

Droppers for various types of adhesives are well known. Primarly, these droppers include a tip having a tapered internal passageway terminating at a reduced diameter outlet. Should the tip or the passageway become clogged by the drying or curing of the adhesive, dislodgement of the dried or cured adhesive is generally effected by ramming the dried or cured adhesive with a pin or the like. In other prior art droppers, the tip is sufficiently flexible to cause dislodgement by flexing of the nozzle with or without the introduction of a ram into the passageway.

For a very small diameter nozzle which serially dispenses small quantities of adhesives, the internal passageway is too minute to employ a ram to clear it. Moreover, flexing of the nozzle may be ineffective to dislodge particles of dried or cured adhesives.

Generally, little consideration has been given to the configuration of the inlet to the dropper passageway which will avoid retention of residual adhesive that might clog the inlet. The configuration of the inlet, to effectively prevent retention of a cyanoacrylate adhesive, must be matched with both the viscosity and surface tension of each particular cyanoacrylate adhesive commensurate with the size of the passageway.

It has now been found that the dispenser of the present invention enables the provision of a dropper which is self-clearing, particularly for adhesives which cure by polymerization and which discourages retention of a cyanoacrylate adhesive at the inlet of the dropper by the use of a sharp edged inlet orifice to preclude depending attachment of a drop of cyanoacrylate adhesive. Thus, the dropper has insufficient contact area at the inlet of a passageway at least a part of which has a constant diameter extending through the dropper to support by surface tension a drop of cyanoacrylate adhesive.

According to the present invention therefore, there is provided a dispenser for dispensing a fluid which comprises an apertured container for housing the fluid to be dispensed, a one piece self-evacuating dropper for dispensing the fluid, said dropper comprising:

(1) a nozzle including:

(i) an inlet in fluid communication with the container, the inlet having a sharp edged orifice and a planar surface circumscribing said inlet, the planar surface being oriented normal to the major axis of said inlet;

(ii) an outlet for discharging the fluid from the container, the outlet having a sharp edged orifice;

(iii) a passageway interconnecting said inlet and said outlet, said passageway including at least a section which has a constant diameter; and

(2) a skirt depending from said nozzle;

said container including a neck for receiving the skirt of the dropper; and sealing means for maintaining the skirt in sealed relationship with the neck.

In one embodiment of the present invention the dropper has a hollow boss defining an inlet to a constant diameter passageway extending through the dropper and which boss includes a sharp edged orifice and a sharp edged perimeter to minimize support for retention by the effect of surface tension of droplets of a cyanoacrylate adhesive.

In a particularly preferred embodiment the dropper has a passageway extending therethrough which passageway defines a multiple of the volume of a drop to be dispensed and which passageway includes a sharp edged inlet orifice of insufficient surface contact area to dependingly retain a drop of adhesive.

The present invention will now be further illustrated with reference to the accompanying drawings, in which:

Figure 1 illustrates a dropper attached to a container for a liquid adhesive;

Figure 2 is a cross-sectional view of a prior art dropper;

Figure 3 is a partial cross-sectional view taken along the line 3—3 of Figure 1; and

Figure 4 is a partial cross-sectional view of a variant of the present invention.

Referring to Figure 1, there is shown a dispenser 10 having a container 12 for containing an adhesive, such as a cyanoacrylate adhesive, which is to be dispensed through a dropper 14. In a preferred embodiment, the dropper 14 is retainingly lodged within the neck 16 of the container 12, but it may be externally fitted to the neck.

The dropper includes an annular flange 18 for matingly contacting the annular end surface 20 of the neck 16 and thereby positionally locate the dropper with respect to the neck 16. A nozzle 22 extends outwardly from the flange 18 and includes an internal passageway 24 for dispensing the adhesive contained within container 12. Retention of the dropper 14 within the neck 16 may be accomplished by a cylindrical skirt depending from the annular flange 18, which skirt is fitted into the neck. Retention of the skirt within the neck may be by a mechanical interlock, friction fit or welding of the skirt to the neck by a known process.

Referring now to Figure 2, prior art droppers 26, may be externally quite similar to the dropper 14 shown in Figure 1. That is, they may include an annular flange 28 supporting a nozzle 30 and a depending cylindrical skirt 32. Such prior art nozzles are characterized by a passageway 34 internal to the nozzle which has a wide mouthed inlet 36. The passageway itself is generally tapered geometrically from the inlet to the outlet 38.

A tapered passageway 34 presents several problems in maintaining the passageway cleared. After the adhesive container, to which the nozzle is secured, is placed in an upright position, the adhesive within the passageway will tend to

gravitate downwardly and flow along the internal surface of the passageway. The substantial surface contact which is available for the flowing adhesive provides sufficient purchase to allow the surface tension attendant the flowing adhesive to support puddles or drops of adhesive proximate to the inlet to the passageway and also along the passageway. Such puddles or drops may bridge across the passageway at any point therealong.

If the size of passageway 34 and outlet 38 is sufficiently large, any bridging can be dislodged by ramming an appropriately sized diameter rod through the passageway. Alternatively, if the adhesive, on drying or curing, forms a crystalline structure (crusting), and assuming that the nozzle is flexible, dislodgement of the adhesive may be effected by flexing the nozzle. However, nozzles having very small diameter passageways which cannot be rammed and which are too small to allow clearing of crusted adhesive by flexing are essentially useless. Such crusting will often occur with anaerobic and cyanoacrylate adhesives.

Moreover, the configuration of the inlet 36 to the passageway 34 may tend to promote retention of drops or droplets of adhesive on righting of the container. These drops or droplets, when fully or partially cured, have a tendency immediately to clog the inlet or provide a rapid build up of adhesive which build up will clog the inlet.

Turning now to Figure 3, a structure of the dropper 14, which overcomes the problems attendant prior art nozzles, will be described. A nozzle 14 is positionally located within the neck 16 of a container 12 by a cylindrical skirt 40 depending from an annular flange 18 and defining, in combination with the annular flange, an annular shoulder 42 to bear against annular end surface 20. Retention of the nozzle 14 in the neck 16 is accomplished by a mechanical lock, a press fit or by welding.

The passageway 24 is of essentially constant diameter from the inlet 44 to the outlet 46 and is normally in the range of 0.406 mm (~0.016") to 1.35 mm (~0.053"). Contrary to expectations, essentially total drainage of a cyanoacrylate adhesive by the force of gravity will occur in a constant diameter passageway. To the extent presently understood, it is believed that this phenomenon is primarily a function of surface tension. Moreover, surface tension in combination with other parameters and variables such as propensity for rapid polymerization and degree of surface energy of the material defining the configuration of the passageway and the configuration of the draining outlet must be balanced to support continuing drainage. An initial flow through the passageway may be prompted by a plug, plunger or the like.

In one embodiment of the passageway of the dispenser of the present invention, the actual diameter of the passageway may be made dependent, to some extent, upon the length of the passageway or, the length of the passageway may be made dependent upon the diameter of the passageway in order that the volumetric displacement of the passageway be commensurate with a multiple of the volume of a drop of cyanoacrylate adhesive which is of sufficient mass not to be retainingly suspendable from the inlet to the passageway. With this embodiment, the likelihood of total evacuation is promoted as there exists a high probability that all adhesive within the passageway will develop into one or several drops which will disengage from the inlet and not leave any residual adhesive in the passageway or at the inlet.

By maintaining the orifices at both the inlet and the outlet very sharp edged, the surface area in contact with a drop of adhesive is maintained at a minimum. Such minimum contact area tends to minimize the droplet size, or mass, which is supportable by the inherent surface tension of the drop of cyanoacrylate adhesive. Accordingly the drops from the passageway will not have sufficient purchase to be retained in suspension from either the outlet or the inlet.

The operative results arising from the above described structure of the nozzle 22 may be described as follows. After adhesive from within container 12 has been dispensed, the container 12 is generally placed in an upright position. Any residual adhesive within the passageway 24 will gravitate towards inlet 44. Upon collecting at the inlet, the adhesive will form into a drop (or droplet). By maintaining a sharp edge at the orifice of inlet 44, the surface area of the inlet in contact with the drop can be maintained insufficient to permit the inherent surface tension of the drop from exerting a sufficient retentive force to suspend the drop from the inlet. Consequently, each drop will fall back into the container. Thereby passageway 24 is self-clearing each and every time container 12 is placed in the upright position.

By maintaining the orifice of outlet 46 sharp edged, accumulation of the adhesive about the end of nozzle 22 is generally limited because the sharp edge will tend to minimize flow of adhesive onto the end surface of the nozzle. Thus, the possibility of crusting at outlet 46 is reduced. Even if such crusting does occur, it is readily removable as the outlet is readily accessible.

By experimentation, it has been learned that droppers, of the type depicted in Figures 1 and 3 of the accompanying drawings, are particularly useful in conjunction with the dispensation of cyanoacrylate and anaerobic adhesives. These adhesives are generally used to bond two close fitting and mated surfaces. Insertion of the adhesive intermediate the surfaces is effected by wicking, a natural characteristic of the adhesive. Since the wicking is generally extensive and of a thin film, very small drops or droplets are generally employed to make each bond. Such droplets are defined in size by the size of the orifice at the outlet 46 in combination with the supporting surface area in contact with the drop during development of the drop. These rather complex relationships necessarily dictate the cross-sectional area of passageway 24 and the annular

area defining the orifice. Commensurately, these very same relationships make it possible for the passageway to be self-clearing with the use of cyanoacrylate and/or anaerobic adhesives.

There may occur some flow of the cyanoacrylate adhesive lateral to the orifice of the inlet before or during buildup of a drop. Such flow may be restrained through the use of a hollow boss 48 to define the orifice of inet 44, as illustrated by the variant 50 shown in Figure 4. The perimeter 52 of the boss is sharp edged to constrain lateral flow to the annular surface 54 of the dropper. Were any adhesive to flow to the perimeter, retention of any depending droplet thereat would be discouraged by the limited purchase available at the sharp edged perimeter to the forces of the surface tension defining the drop.

To prevent leakage from the dropper 14 or the variant 50 during storage and handling of dispenser 10, a cap 56, as shown by phantom lines in Figures 3 and 4, may be employed. A tapered plug 58 (shown in Figure 4) may extend from interior base 60 for penetrating engagement with passageway 24. On initial insertion of the plug within the passageway, it will initiate forced downward flow of any cyanoacrylate adhesive within the passageway. The initial downward flow, on co-mingling with any further cyanoacrylate adhesive in the passageway will, by means of what is believed to be an "avalanche" effect, initiate and maintain essentially complete drainage of the cyanoacrylate from the passageway back into the container. The plug would also serve the purpose of sealing the passageway against leakage.

To prevent possible damage to outlet 46 by repeated insertion and withdrawal of plug 58, the latter may be omitted, as shown in Figure 3. To obtain sealing of the outlet, the length of nozzle 22 may be configured to place the end of the nozzle flush against interior base 62 to effect a seal across outlet 46. A further seal intermediate cap 56 and neck 16 can be obtained by a close tolerance threaded relationship between annular ridge 62 about the neck and groove 64 within the cap.

Because of the propensity for cyanoacrylate to creep, the fit intermediate skirt 32 of the dropper and neck 16 of the container must be in the nature of a seal. Such a fit can be effected by a mechanical lock, such as that described in United States Patent No. 4,138,040 a friction fit or an annular weld disposed therebetween. To aid in development of the weld it is preferable that the dropper be of a high density (0.955 gms/cc) polyethylene homopolymer material generically termed a polyoelfin having a melt index of 18.0 and that the container be of a high density (0.957 gms/cc) polyethylene homopolymer material generically termed polyoelfin having a melt index of 0.24, as described in further detail, including welding method itself, in an application for United States patent entitled "Apparatus and Method for Sealing Thermoplastic Tips to Containers", filed on 1980 May 15.

CLAIMS

1. A dispenser for dispensing a fluid which comprises an apertured container for housing the fluid to be dispensed, a one piece self-evacuating dropper for dispensing the fluid, said dropper comprising:

(1) a nozzle including;

(i) an inlet in fluid communication with the container, the inlet having a sharp edged orifice and a planar surface circumscribing said inlet, the planar surface being oriented normal to the major axis of said inlet;

(ii) an outlet for discharging the fluid from the container, the outlet having a sharp edged orifice;

(iii) a passageway interconnecting said inlet and said outlet, said passageway including at least a section which has a constant diameter; and

(2) a shirt depending from said nozzle; said container including a neck for receiving the skirt of the dropper; and sealing means for maintaining the skirt in sealed relationship with the neck.

2. A dispenser as claimed in Claim 1 wherein the nozzle includes a hollow boss for supporting the inlet, the boss including a sharp edged perimeter defining an annular planar surface circumscribing the sharp edged inlet orifice for minimizing the contact area available to a drop of fluid formed in proximity to the said inlet whereby dispensation of the drop of fluid back into said container on righting of said container is urged.

3. A dispenser as claimed in Claim 1 wherein the planar surface extends to the interior perimeter of the skirt.

4. A dispenser as claimed in any of Claims 1 to 3 wherein the full length of the passageway is of a constant diameter.

5. A dispenser as claimed in Claim 4 wherein the diameter of the passageway is in the range of from 0.406 mm (~0.016″) to 1.34 mm (~0.053″).

6. A dispenser as claimed in any of Claims 1 to 5 wherein the length of the passageway is selected to define a multiple of the volume of the minimum sized drop unretainable at the inlet upon righting of said container.

7. A dispenser as claimed in any of Claims 1 to 6 wherein the dropper is made of a high density polyethylene homopolymer material.

8. A dispenser as claimed in Claim 7 wherein the homopolymer has a melt index of 18.0.

9. A dispenser as claimed in Claim 6 or Claim 8 wherein the homopolymer has a density of 0.955 gms/cc.

10. A dispenser as claimed in any of Claims 1 to 9 wherein the container is made of high density polyethylene homopolymer material.

11. A dispenser as in Claim 10 wherein the homopolymer has a melt index of 0.24.

12. A dispenser as claimed in Claim 11 wherein the density of the homopolymer is 0.957 gms/cc.

13. A dispenser as claimed in any of Claims 1 to 12 wherein the sealing means includes a weld.

14. A dispenser for dispensing a fluid substantially as herein described with reference to, and as shown in, Figures 1, 3 and 4 of the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.