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[73] Assignee **Ampoules, Inc.**
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FOREIGN PATENTS

585,862 10/1959 Canada 128/218.2
177,888 2/1962 Sweden 128/218(A)

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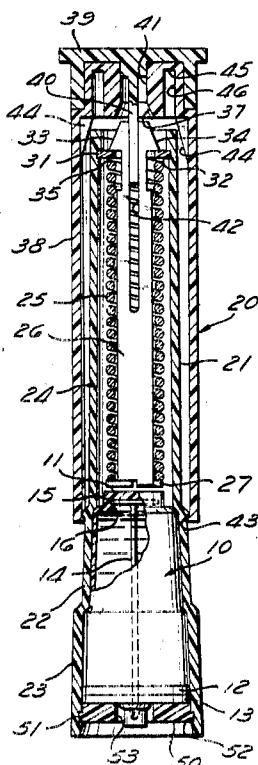
[54] AMPOULE APPLICATOR 9 Claims, 4 Drawing Figs.

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A61m 05/28
[50] Field of Search 128/218,
218A, 218.1, 218.1P, 218.2, 218.1PA; 131/243,
247; 128/215

[56] References Cited UNITED STATES PATENTS

1,770,633	7/1930	Smith	128/218.1
2,832,339	4/1958	Sarnoff et al.	128/218.2
2,888,924	6/1959	Dunmire	128/218.1
3,094,987	6/1963	Dunmire	128/216
3,320,955	5/1967	Sarnoff	128/218.2
3,368,559	2/1968	Sarnoff et al.	128/218.2
2,536,852	1/1951	Middleton	131/247X

ABSTRACT: An applicator for hypodermic ampoules having one end for receiving a hypodermic ampoule and another end for housing and retaining a spring-biased plunger in a cocked or ready-to-fire position. An outer sleeve is provided with a camming surface which releases the cocked plunger upon axial movement of the outer sleeve relative to the inner housing. Interference surfaces are provided between the overlapping outer and inner sleeves so that a predetermined force must be applied to the outer sleeve to perform the firing operation. The camming surface and interference surfaces provide means spacing the major portion of the outer housing from the inner housing. The major portion of the inner housing which is overlapped by the outer housing is substantially free of surface-to-surface sliding contact with the outer housing. A removable snap-in washer is provided at the lower end of the applicator to retain the hypodermic ampoule therein and to permit the ampoule to be removed for periodic inspection or replacement. The spring-biased plunger is stamped from a flat sheet and has a bent end portion for applying force to the ampoule.



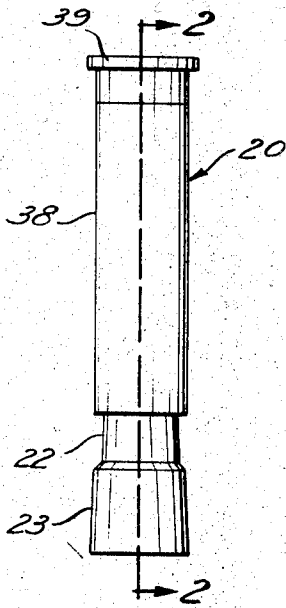


Fig. 1

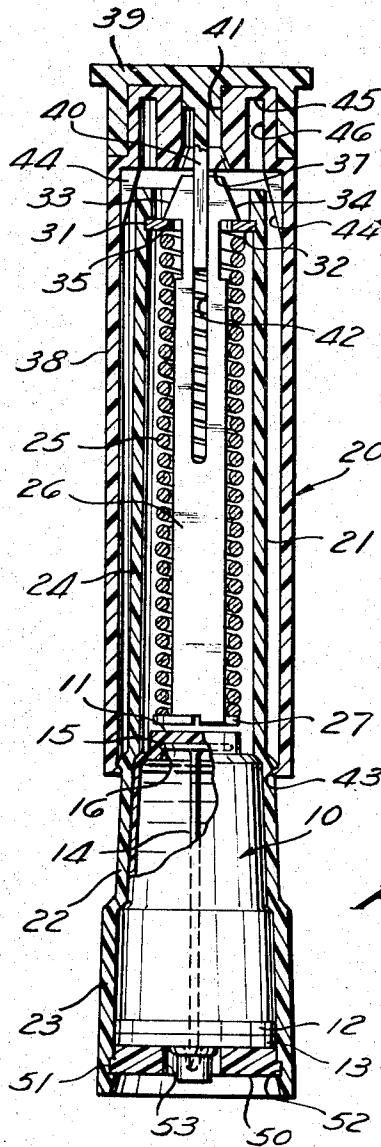


Fig. 2

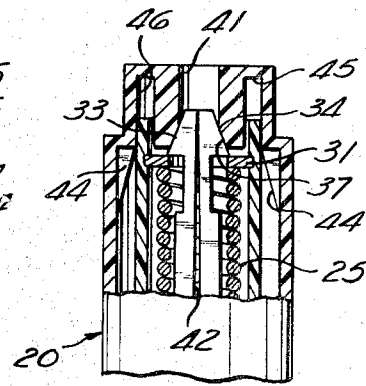


Fig. 3

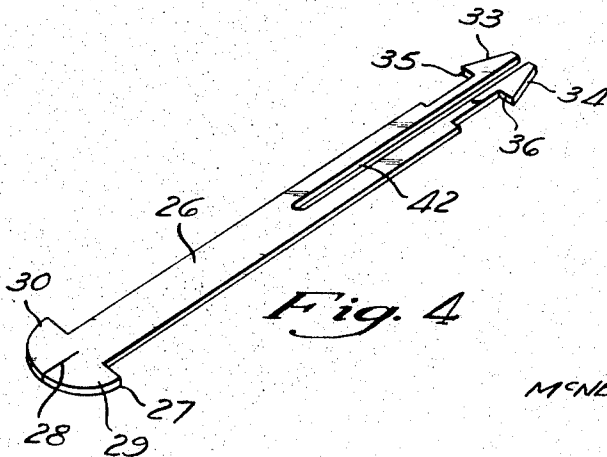


Fig. 4

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AMPOULE APPLICATOR

BACKGROUND OF THE INVENTION

Hypodermic ampuls for which the applicators of this invention are designed are characterized by a shell defining a liquid reservoir having a generally flat and easily punctured end wall. The other end of the shell is relatively rigid and supports the butt end of a hypodermic needle that is enclosed within the shell, the butt end being in liquid communication with the reservoir and the shank of the cannula extending substantially perpendicularly to the end wall to be punctured. The ampul is actuated by collapsing it to force the needle cannula through the generally flat end wall of the shell and into the patient, while expelling liquid from the shell through the needle.

Hypodermic ampuls of the type referred to are shown in U.S. Pat. Nos. 3,094,987 and 3,094,988, granted to Russell P. Dumire (now deceased) as the inventor.

Such hypodermic ampuls are used by placing the generally flat end wall against or closely adjacent the skin of the patient and simply collapsing the ampul shell by externally applied force. During the initial collapsing movement, while the liquid medicament is confined within the shell, the pointed end of the needle cannula punctures the generally flat end wall of the shell. During the remainder of the collapsing action, the needle is forced into the patient and the medicament in the ampul is exhausted through the needle as the interior volume of the ampul is reduced by the collapsing of the shell. These hypodermic ampuls were originally intended to be collapsed manually, as by thumb pressure.

Since the advent of disposable hypodermic ampuls of the type described, a considerable amount of effort has been devoted to the development of mechanical devices for actuating the ampuls to inject medicaments from the ampuls into persons or other animals. This is due to the fact that, for psychological reasons, and also to minimize the element of human error, hospitals have indicated a preference for using mechanical applicators to effect injections with such ampuls even though, with reasonable care, the ampuls may be manually used without an applicator. Furthermore, if such hypodermic ampuls are to be used by the armed forces, it is necessary to provide a mechanical device for actuating the ampul, since, in the field, the injection must be made by the individual and the elimination of the element of human error is mandatory.

Numerous attempts have been made to develop mechanical applicators for ampuls of the type set forth in the above-mentioned patents and conventional ampuls of the type comprising a vial and needle piston slidable within the vial. One such mechanical applicator is shown in Pat. No. 2,832,339 to Sarnoff et al. Mechanical applicators such as that shown in Sarnoff et al. include a spring-biased driving piston which is released by a camming action between one end of the driving piston and an outer sleeve. The outer sleeve surrounds an inner sleeve and is intended to be axially movable relative to the inner sleeve to accomplish the camming and release operation set forth above. Close tolerances are required between the inner and outer sleeves so that the outer sleeve will slide relative to the inner sleeve but will not be easily removed from the inner sleeve. Such close tolerances, however, result in the possibility of jamming if dirt or other foreign particles become lodged between the inner and outer sleeves. The problem of jamming is aggravated by the relatively large surface-to-surface contact between the inner and outer sleeves of such applicators.

A further problem involved in mechanical applicators is the problem of shelf life. Many medicaments must be used within a prescribed period after their manufacture. If the medicament is not used prior to expiration of the shelf life date, it is necessary to discard not only the medicament-containing ampul but also the applicator, since prior art applicators are not designed for replacement of the ampul portion after assembly.

A still further problem involved in mechanical applicators is the problem of cost. Although some prior art applicators may be reloaded after firing, the majority of such applicators are intended to be one-shot, disposable applicators. Each component part of the applicator must, therefore, be a low cost, easily manufactured item. However, prior art applicators include plungers which are relatively expensive, thus increasing the total cost of the applicator.

SUMMARY OF THE INVENTION

According to one aspect of the present invention, a mechanical applicator is provided which includes a plunger having a detent which holds the plunger in a cocked or ready-to-fire position against the bias of a compressed spring. The plunger is stamped from a flat sheet and has a bent end portion for applying force to an ampul. The plunger, spring, and an ampul are contained in an inner housing and an outer housing is telescoped over the inner housing. The outer housing has a cam surface which releases the detent portion of the plunger when the outer housing is moved axially downwardly relative to the inner housing so that the spring forces the plunger down onto the upper end of the ampul, whereby the ampul is axially compressed and the liquid medicament is ejected therefrom as the needle is projected into the patient.

During this downward movement of the outer housing, the outer housing bears against the inner housing at preselected zones which, although relatively small in area, cause considerable sliding friction between the inner and outer sleeves, thus requiring between 3 and 6 pounds pressure to release the detent on the plunger. This affords a safety factor which prevents premature firing after a safety release pin is removed. Furthermore, the relatively small surface-to-surface contact between the inner and outer housings minimizes jamming, since foreign particles do not tend to collect at those small bearing areas. The zones of surface-to-surface contact according to this aspect of the invention are substantially less than the area of the inner housing which is overlapped by the outer housing.

According to a further aspect of this invention, a bottom snap ring is provided to retain the ampul within the inner housing. This snap ring may be removed for periodic inspection of the ampul, or for replacement of the ampul with one containing fresh medicament.

It is therefore an object of the present invention to provide a mechanical applicator for an ampul which eliminates jamming problems inherent in many of the prior art devices.

It is a further object of the present invention to provide a mechanical applicator for an ampul which facilitates the removal of an ampul from the applicator for inspection and/or replacement thereof.

It is a still further object of the present invention to provide a low-cost, easily manufactured, yet reliable, plunger.

These and other objects, features, and advantages of the invention will be better understood from the following detailed description of an illustrative embodiment and from the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of a mechanical applicator in accordance with the present invention.

FIG. 2 is an enlarged, cross-sectional view of the applicator, the plane of the section being indicated by the line 2-2 in FIG. 1.

FIG. 3 is a fragmentary view of the applicator showing the inner and outer sleeves in a position wherein the plunger is about to be released.

FIG. 4 is a perspective view of the plunger showing the plunger in an intermediate stage in its manufacture.

DETAILED DESCRIPTION OF THE DRAWINGS

Before describing in detail the applicator improvements of the present invention, reference is first made to FIG. 2, which

illustrates the particular type of hypodermic ampul for which the present invention was devised. It is to be understood at the outset that the specific construction of this ampul forms no part of the present invention, and will be described only for the purpose of facilitating an understanding of the applicator and its mode of operation.

The hypodermic ampul has a main body 10, in the general form of an inverted cup-shaped shell defined by an upper end wall 11 and a circumferentially extending sidewall. A peripherally outwardly extending flange 12 integrally extends around the open end or mouth of the body 10, and a dislike diaphragm 13 is sealed to the flange 12 so as to close the mouth of the body and form a fluid reservoir for containing the hypodermic liquid.

Enclosed entirely within the ampul is a hypodermic needle 14. The needle 14 has a circular, dislike base 15 that is clamped adjacent the upper end wall 11 of the body 10 by a radially inwardly extending rib 16 so that the cannula of the needle, which extends axially from the base of the needle, is in substantial alignment with the axis of the ampul body and has its pointed end projecting downwardly in position to be forced through the diaphragm 13. A cannula opening (not shown) through the base 15 of the needle and into the adjacent butt end of the cannula permits the hypodermic liquid to be evacuated from the ampul through the cannula after it has pierced the diaphragm.

As is more specifically described in Pat. No. 3,094,987 to Dunmire, the body portion 10 is constructed so that at least 90 percent of the hypodermic liquid can be discharged from the ampul when it is subjected to an axially directed collapsing force of not more than 10 or 12 pounds. Provision is also made to prevent the ampul body from elastically expanding back toward its original shape after it has once been collapsed, thereby avoiding the creation of a vacuum tending to suck or aspirate the hypodermic liquid back into the ampul body.

In accordance with this invention, there is provided an ampul applicator 20 which provides the axial pressure required to drive the needle 14 through the diaphragm 13 and into the patient, thereby injecting the patient with the medication contained in the ampul. The ampul applicator 20 includes an inner housing 21 which contains the ampul body 10 within its lower end. The lower end of the housing 21 has an enlarged conical intermediate portion 22 which receives the upper portion of the ampul body 10 and a lower enlarged end portion 23 which receives the lower portion of the ampul body 10. The remainder of the housing 21 comprises a tapered or conical plunger housing 24 within which a coil spring 25 and a plunger 26 are mounted.

As may be seen in FIG. 4, the plunger 26 is stamped from a flat sheet of metal. The plunger 26 in its as-stamped condition has an enlarged lower end portion 27 which is provided with a slit 28 so that a spring-retaining flange is formed by bending a first half 29 of the portion 27 in a first direction so that it is at right angles to the plane of the plunger and by bending a second portion 30 in a second direction so that it is substantially coplanar with the bent portion 29 and is also at right angles relative to the plane of the plunger 26. After the portions 29 and 30 are bent in this manner, they provide a spring-retaining surface which holds one end of the compressed coil spring 25. The other end of the coil spring 25 is retained by a washer 31 which is snapped into an annular groove 32 provided in the upper end of the housing 21. The upper end of the plunger 26 is provided with a tapered and slotted end portion which has a pair of sloping cam surfaces 33 and 34 and a pair of detent surfaces 35 and 36 which are hooked over the washer 31. The plunger 26 is released from its ready-to-fire position illustrated in FIG. 2 by forcing the surfaces 33 and 34 radially inwardly until the detents 35 and 36 clear the washer 31. This is accomplished by providing a conical surface 37 at one end of an outer housing 38. As may be seen in FIG. 3, the conical surface 37 forces the surfaces 33 and 34 radially inwardly when the outer housing 38 is driven axially downwardly relative to the housing 21.

In order to prevent accidental firing of the plunger 26, there is provided a safety cap 39. The cap 39 has an axially extending pin 40 which extends through an aperture 41 in the housing 38 and then into a slot 42 in the head of the plunger. The pin 40 prevents the surfaces 33 and 34 from being cammed together by the surface 37 until the cap 39 is removed.

Even after the cap is removed, however, it is desirable to prevent accidental firing until the applicator 20 is pressed against the patient's skin to effect an injection. To this end, there is provided an interference fit between the outer housing 38 and the inner housing 21 at spaced locations. The lower end of the housing 38 has a lip 43 which extends radially inwardly and bears against the tapered surface 22 so that increasing axial pressure is required to drive the housing 38 downwardly relative to the inner housing 21. Similarly, there is provided a plurality of tapered ribs 44 which are engaged by the upper end of the housing 24 as the outer housing 38 is moved axially downwardly to fire the plunger 26. Engagement of the ribs 44 by the upper end of the housing 24 also provides an area of frictional resistance between the inner housing 21 and the outer housing 38 so that the plunger 26 may not be accidentally fired even after the cap 39 is removed. This frictional resistance obtains even after the upper end of the housing 24 rides over the full extent of the ribs 44, since an annular recess 45 in the upper end of the outer housing 38 has a bearing sidewall 46 of a smaller diameter than the diameter of the upper end of the housing 24.

It should be noted that although the engagement between the lip 43 and the wall 22 and the engagement between the upper end of the housing 24 and the ribs 44 require a downward pressure of, for example, between 3 and 6 pounds, the area of contact between the inner housing 21 and the outer housing 38 is relatively small. This small area of contact insures that the inner and outer housings will not be jammed by foreign particles which may be located between the inner and outer housings.

The ampul body 10 is removably retained in the lower end of the housing 21 by an annular snap ring 50. The snap ring 50 has a radially extending flange 51 which is received in a groove 52 in the wall 23. The ring 50 may be removed by inserting a hooked tool through a central aperture 53 in the ring 50. This permits the ampul body 10 to be removed for inspection and, if required, replacement.

The invention is not restricted to the slavish imitation of each and every detail set forth above. Obviously, ampul applicators may be provided which change, eliminate or add certain specific details without departing from the scope of the invention.

I claim:

1. In an ampul applicator for use with a hypodermic ampul having a needle housed therein and having a diaphragm adapted to be punctured by the needle, said applicator including an inner housing, said ampul being mounted in one end of said inner housing, a plunger mounted within said inner housing and having one end provided with a releasable detent held by a portion of said inner housing, spring means biasing said plunger toward said ampul, an outer housing slidably mounted on and substantially overlapping said inner housing and having means to release said detent upon axial movement of said outer housing toward said one end of said inner housing so that said spring means will drive said plunger axially against said ampul to effect an injection, in combination therewith the improvement comprising means spacing the major portion of said outer housing from said inner housing and defining at least one relatively small zone of surface-to-surface sliding contact between the inner and outer housings, the area of said contact zone being substantially less than the remaining area of the inner housing which is overlapped by the outer housing, and said remaining area being substantially free of surface-to-surface sliding contact with said outer housing.

2. The improvement according to claim 1 wherein there is provided a plurality of relatively small zones of surface-to-surface sliding contact between said inner and outer housings.

3. The improvement according to claim 1 wherein said zone of surfacento-surface contact forms an acute angle outwardly relative to the direction of axial movement of said outer housing toward said one end of said inner housing whereby the amount of pressure required to move said outer housing relative to said inner housing increases in said axial direction.

4. The improvement according to claim 3 wherein the acute angle is of magnitude such that the required pressure is between 3 and 6 pounds.

5. The improvement according to claim 1 wherein said relatively small zone of surface-to-surface sliding contact is formed by a radially inwardly extending lip on said outer housing which engages a portion of said inner housing, and said portion of said inner housing forms an acute angle outwardly relative to the direction of axial movement of said outer housing toward said one end of said inner housing.

6. The improvement according to claim 2 wherein said plurality of zones includes a first zone which comprises a radially inwardly extending lip on said outer housing which engages a portion of said inner housing and a second zone formed by a plurality of ribs extending inwardly within said outer housing which are engaged by one end of said inner housing.

7. The improvement according to claim 6 wherein said portion of said inner housing and said ribs form acute angles outwardly relative to the direction of axial movement of said outer housing toward said one end of said inner housing whereby the amount of pressure required to move said outer housing relative to said inner housing increases in said axial

direction.

8. The improvement according to claim 7 wherein said acute angles are of magnitude such that the required pressure is between 3 and 6 pounds.

9. In an ampul applicator for use with a hypodermic ampul having a needle housed therein and having a diaphragm adapted to be punctured by the needle, said applicator including an inner housing, said ampul being mounted in one end of said inner housing, a plunger mounted within said inner housing and having one end provided with a releasable detent held by a portion of said inner housing, spring means biasing said plunger toward said ampul, an outer housing slidably mounted on said inner housing and having means to release said detent upon axial movement of said outer housing toward said one end of said inner housing so that said spring means will drive said plunger axially against said ampul to effect an injection, in combination therewith the improvement wherein said plunger includes a flat sheet metal body portion disposed in a plane and a flat sheet metal ampul-engaging portion of single piece construction with said body portion, said ampul-engaging portion having an ampul-engaging surface of substantially greater transverse cross-sectional area than the transverse cross-sectional area of said sheet metal body portion, and said ampul-engaging portion including a pair of tabs disposed in opposite directions and forming angles with the plane of the body portion of the plunger.

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