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R. B. WAITE

2,393,578

CLOSURE

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Fig. 1.

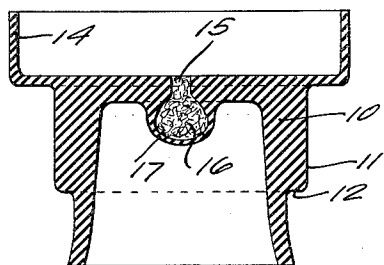


Fig. 2.

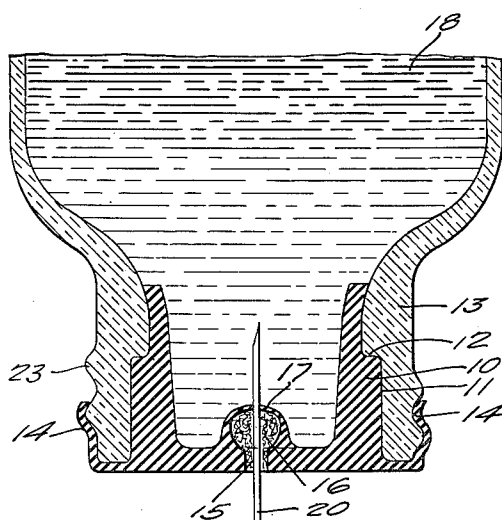
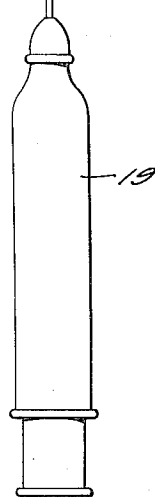
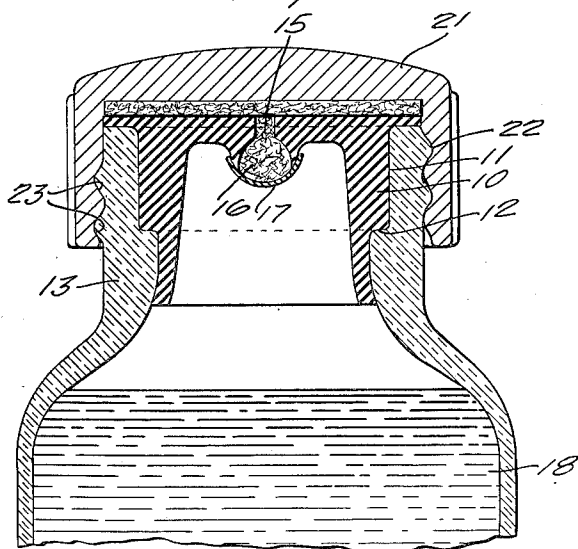


Fig. 3.



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UNITED STATES PATENT OFFICE

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CLOSURE

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Application January 9, 1942, Serial No. 426,116

5 Claims. (Cl. 215—38)

My invention relates to a new closure for bot-
tles, vials and the like adapted to contain medic-
inal and other liquid preparations.

My new closure is of the type used when medic-
inal preparations are withdrawn from stoppered
bottles by means of a hypodermic syringe, the
needle of which is introduced into the bottle
through the stopper material. It is characterized
particularly by the ease with which the medicinal
preparation can be withdrawn and by the ease
with which the needle of the hypodermic syringe
can be inserted as well as by the extreme simplic-
ity of its construction.

The first closures of this type developed by the
art were constructed with the sole purpose of
making them capable of being pierced by the needle
of a hypodermic syringe. Stoppers of some-
what later construction featured the idea of main-
taining the pierceable material in the stopper
under compression so as to avoid contamination
of the medicinal solution by contact with air seep-
ing through the perforations made by the needle.
This was accomplished by making the pierceable
material resilient and making the outer dimen-
sions of the stopper slightly larger than the neck
of the bottle with which it was intended to be used.
Although this device had the desired result, it
created other problems. The compressive stress
on the resilient material makes the stopper rela-
tively difficult to pierce with a needle. Further-
more, when a medicinal solution is withdrawn
from a bottle provided with such a closure, the
pressure within the bottle progressively decreases
until it finally becomes so much lower than at-
mospheric that further withdrawal is difficult or
impossible. A considerable waste of medicament
inevitably results. More recently the problem has
been attacked by providing pierceable stoppers
with air valves and chambers filled with sterilizing
cotton. These, however, are difficult to manufac-
ture and therefore expensive, and are prone to
leak.

One object of my invention, therefore, is to
provide a closure not having the aforementioned
disadvantages.

Another object of my invention is to provide a
closure of simple construction which permits easy
withdrawal of the medicinal solution from the
container.

Still another object is to provide a closure of
simple construction provided with means for ster-
ilizing any air entering the container upon with-
drawal of the medicinal solution.

A concomitant object is to provide a closure
that will permit easy withdrawal, but does not
allow leakage of the medicinal solution from the
container.

Another concomitant object of my invention is
to provide a closure that can be pierced easily with
the needle of a hypodermic syringe.

These and other objects and advantages will be
understood by those skilled in the art or will be
apparent or pointed out hereinafter.

I have found that these objects can be accom-
plished by equipping a closure provided with a
channel, with a thin diaphragm of resilient, or-
ganic material that is normally under neither
tension nor compression.

In the accompanying drawing which illustrates
preferred embodiments of my invention:

Fig. 1 is a cross-sectional elevation of one form
of closure responding to the present invention,

Fig. 2 is a cross-sectional elevation of the clo-
sure of Fig. 1 showing it in place on a medicinal
container and also the manner in which a charge
of the liquid preparation is withdrawn from the
container by means of a hypodermic syringe; and

Fig. 3 is a section through a container equipped
with a modified form of my new closure and a cap
therefor.

Like numerals designate corresponding parts
throughout the various views of the drawing.

It is to be understood, of course, that the illus-
trated embodiments of my invention are intended
as examples and not as restrictive or limitative
and that the different embodiments may be used
interchangeably.

Closure 10 may be made of any resilient or
non-resilient material and is preferably made of
an elastic, thermoplastic material such as natural
or synthetic rubber. The cylindrical side wall
portion 11 may have a shoulder 12 to engage a
complementary shoulder in the neck of the con-
tainer 13. If desired, the closure may be equipped
with a skirt 14 that can be folded down over the
exterior surface adjacent the mouth of con-
tainer 13.

The closure 10 is provided with a channel 15
leading to a chamber 16 preferably filled with a
loosely packed air-filtering material, such as cot-
ton, which may be sterilized. Chamber 16 is
formed partly by the end wall of closure 10 and
partly by a sealing diaphragm 17. This dia-
phragm 17 is made of a tough, resilient thermo-
plastic material such as natural rubber, synthetic
rubber or a rubber substitute. I prefer to use pure
Para rubber. As synthetic rubber I may use, for
example, synthetic rubbers such as those derived
from butadiene, chloroprene and the like. Rubber
substitutes include elastic polymerization prod-
ucts of aliphatic unsaturated compounds such as
polymerized acrylic acid esters, dienes and inter-
polymers thereof, elastic vinyl compounds and
polyisobutylenes and interpolymers thereof. In
the specification and claims I hereinafter refer
to these materials, including natural rubber, as
rubberlike materials.

Diaphragm 17 is preferably an integral part or
elongation of the material forming channel 15
and chamber 16, shown as unitary in Figs. 1 and

2, but it may be a separate piece of rubber-like material with its edges securely attached to the main body of the closure 10 as shown, for example, in Fig. 3. When the diaphragm 17 is a separate piece, its union with the main body of the closure 10 must, of course, be capable of resisting repeatedly the tendency of the diaphragm to tear away when it is subjected to stress as, for example, when the diaphragm is pierced by the needle of a hypodermic syringe. In either case, it is particularly important that diaphragm 17 be fixedly secured without strain, i. e., the main body of closure 10 should exert no compressive or tensile force on the diaphragm. In other words, the diaphragm material, although fixedly secured to the closure proper, should hang loosely as a thread, for instance, would hang if its two ends were secured at points spaced from one another by a distance less than the free length of the thread. It is preferable to give diaphragm 17 a bulb-like shape as shown in the drawing. The thickness of diaphragm 17 should be as small as possible without, of course, causing it to rip or tear, or allowing filtering material to be pushed into the container when the diaphragm is pierced by a hypodermic needle. The lower limit of thickness, therefore, varies with, and depends upon, the quality of the material. I have found that when diaphragm 17 is made of pure Para rubber, its optimum thickness is about 0.04 inch. In no event, however, should the thickness of the diaphragm material be so great that when it is pierced by the needle of a hypodermic syringe and a differential pressure is created, it will prevent air from flowing past the needle.

When it is desired to withdraw liquid medicinal preparation 18 from container 13 by means of hypodermic syringe 19, the needle 20 of syringe 19 is passed through channel 15 and chamber 16 and made to pierce sealing diaphragm 17. Needle 20 pierces diaphragm 17 very easily because the latter is so thin. As long as the pressure within container 13 remains substantially equal to the atmospheric pressure, the diaphragm 17 forms an effective seal around needle 20 so as to prevent leakage of the medicament into chamber 16 or of air into the container. When the medicament is withdrawn through needle 20, however, the diaphragm 17, apparently for the reason that it is not subjected to compressive stress, allows air from chamber 16 to leak past needle 20 into container 13 until the pressure in the container is made substantially equal to that of the atmosphere. The filtering material within chamber 16 filters the air before it passes into the container. When the needle is withdrawn, the diaphragm will close up and effectively seal the aperture.

The medicinal preparation may, of course, be introduced in any convenient manner. Thus, for example, container 13 may simply be filled with the medicament under sterile conditions and sealed by placing closure 10 in position. Another method is to introduce the medicament into the container by means of hypodermic syringe 19, the needle of which is passed through channel 15 and chamber 16 and made to pierce sealing diaphragm 17. Preferably the filling is accomplished with the aid of a double needle which is made to pierce the flat part of the closure without piercing diaphragm 17. One barrel of the needle introduces the medicament while the other relieves the pressure built up as the container is filled. When the needle is withdrawn, the

rubber-like material of the closure effectively seals the opening.

When container 13 is not in use, it is desirable, although not necessary, to cover closure 10 with a protective cap 21. This may be of any suitable material, such as metal, plastic, glass, hard rubber or the like. Cap 21 is equipped with a screw thread or cam member 22 adapted to engage complementary projections 23 on container 13. The interior of cap 21 is preferably provided with a disinfectant, such as sterilized cotton or the like, which will be pressed down upon the face of closure 10 when cap 21 is tightened so as to protect chamber 16 and channel 15 against contamination.

It is surprising that although air may leak past needle 20, diaphragm 17 will effectively seal the container when the needle is withdrawn and the pressure differential has been equalized. This is due, no doubt, to the elasticity of the diaphragm material and especially to the fact that under normal conditions it is neither under compressive nor tensile stress. Diaphragm 17 also has the function of relieving excess internal pressure when the container is filled.

It is to be clearly understood that various additions, omissions, substitutions and modifications may be made without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. A container closure which comprises a hollow cylindrical body portion open at one end and provided with a transverse end wall portion at the other end, said end wall portion being provided with a channel therethrough and with an enlarged open-ended recess with which said channel communicates, and a thin, resilient, imperforate diaphragm extending across the open end of said recess to define an enlarged chamber, said diaphragm being composed of elastic material which is capable of being easily pierced by a hypodermic needle and which is self-sealing after the removal of the hypodermic needle therefrom, said diaphragm being of such thickness that it is adapted to permit entrance of air between the material of the diaphragm and the needle in response to atmospheric pressure while the contents of the container are being withdrawn through the needle.

2. A container closure in accordance with claim 1 in which the imperforate diaphragm is composed of rubber about 0.04 inch in thickness whereby it is self-sealing when a hypodermic needle pierces and is then withdrawn from the same and is adapted to permit entrance of air between the rubber and the needle as the contents of the container are being withdrawn through the needle.

3. A container closure in accordance with claim 1 in which an air filtering and sterilizing material is disposed in the said enlarged chamber and is maintained in position by the said imperforate diaphragm.

4. A container closure in accordance with claim 1 in which the said diaphragm normally seals from the atmosphere the contents of the container to which the said closure is applied.

5. A container closure in accordance with claim 1 in which the thin, resilient, imperforate diaphragm is concavo-convex in cross section and is in a substantially unstressed condition.

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