



United States Patent [19]

[11] Patent Number: **5,163,919**

Thijs et al.

[45] Date of Patent: **Nov. 17, 1992**

[54] **OBTURATING MEANS FOR CONTAINER FOR PHARMACEUTICAL AND MEDICAL PREPARATION**

[75] Inventors: **Anita Thijs, Alken; Willy Van De Poel, Herk-De-Stad, both of Belgium**

[73] Assignee: **Helvoet Pharma N.V., Alken, Belgium**

[21] Appl. No.: **490,587**

[22] PCT Filed: **Aug. 25, 1989**

[86] PCT No.: **PCT/BE89/00040**

§ 371 Date: **Feb. 22, 1990**

§ 102(e) Date: **Feb. 22, 1990**

[87] PCT Pub. No.: **WO90/02150**

PCT Pub. Date: **Mar. 8, 1990**

[30] **Foreign Application Priority Data**

Aug. 25, 1988 [BE] Belgium 08800966

[51] Int. Cl.⁵ **A61M 5/32**

[52] U.S. Cl. **604/199; 604/218; 525/332.3; 218/DIG. 4**

[58] Field of Search **604/199, 218; 525/332.3; 215/DIG. 3, DIG. 4, 247**

[56] **References Cited**

U.S. PATENT DOCUMENTS

- 3,198,368 8/1965 Kirkland et al. 215/DIG. 3
- 3,760,969 9/1973 Shimamoto et al. 215/37 R
- 4,187,149 2/1980 Tolbert et al. 195/104
- 4,316,941 2/1982 Eguchi et al. 428/421
- 4,321,306 3/1982 Eguchi 428/421
- 4,366,912 1/1983 Matukura et al. 215/247
- 4,381,779 5/1983 Margulies 604/202
- 4,397,903 8/1983 Allen et al. 428/156

- 4,491,653 1/1985 McGinniss et al. 525/356
- 4,500,685 2/1985 Ogawa et al. 525/343
- 4,600,651 7/1986 Aufdermarsh et al. 428/422
- 4,614,276 9/1986 Ihara et al. 215/364
- 4,997,423 3/1991 Okuda et al. 604/230

FOREIGN PATENT DOCUMENTS

- 0205312 12/1986 European Pat. Off. .
- 0264273 4/1988 European Pat. Off. .
- 0338671 10/1989 European Pat. Off. 604/199
- 3415381 11/1985 Fed. Rep. of Germany .
- 3506766 12/1985 Fed. Rep. of Germany .
- 0200649 11/1984 Japan 215/DIG. 2

OTHER PUBLICATIONS

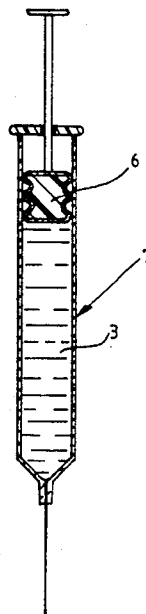
Encyclopedia of Polymer Science and Technology, vol. 5, Herman F. Mark, pp. 414-421.
Polymer Science Dictionary, Mark. S. M. Alger, pp. 71 and 331.

Primary Examiner—C. Fred Rosenbaum
Assistant Examiner—Mark O. Polutta
Attorney, Agent, or Firm—Pennie & Edmonds

[57] **ABSTRACT**

An obturating structure and a container provided with such an obturating structure and a syringe comprising a slidable obturating structure acting as a stopper; and a process for treating an obturating structure prepared at least from one elastomeric material and intended for a static or dynamic seal of a container holding a pharmaceutical or medical preparation, in which process at least the elastomeric part of the obturating structure is at least partially subjected to a treatment with elementary halogen or chemical compound(s) containing reactive halogen.

16 Claims, 2 Drawing Sheets



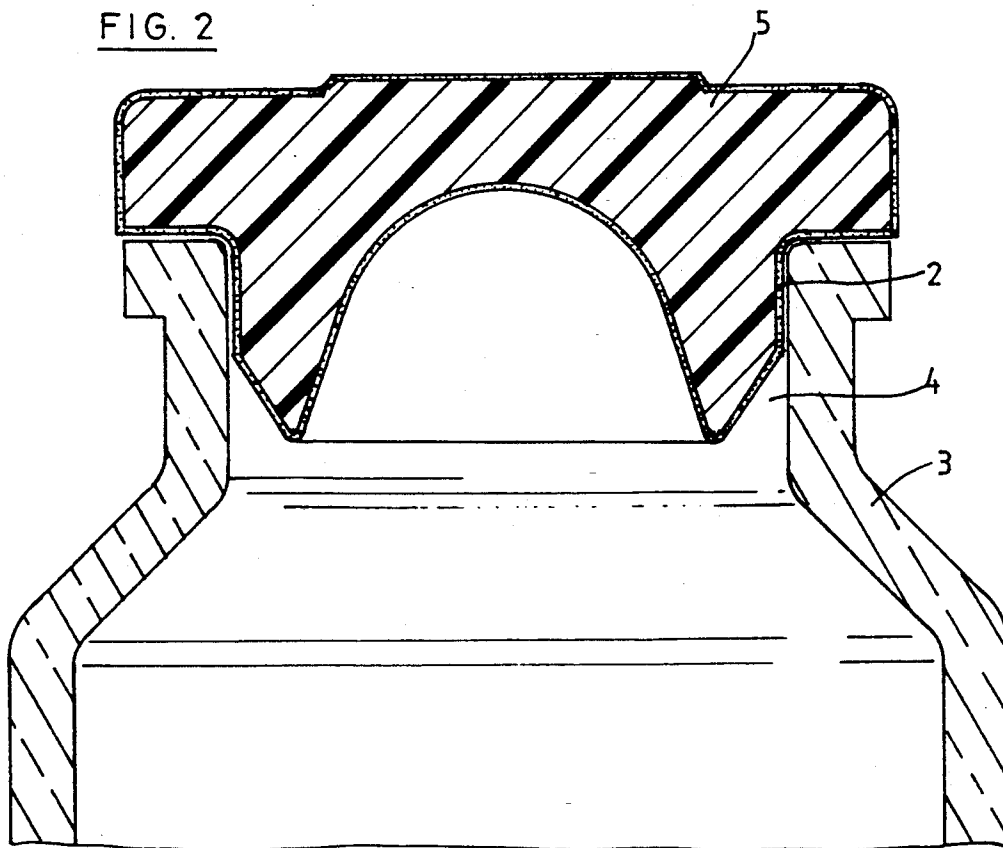
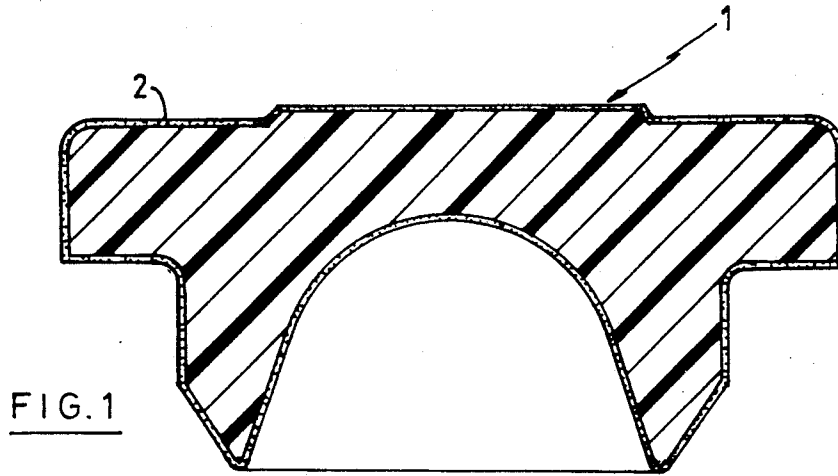
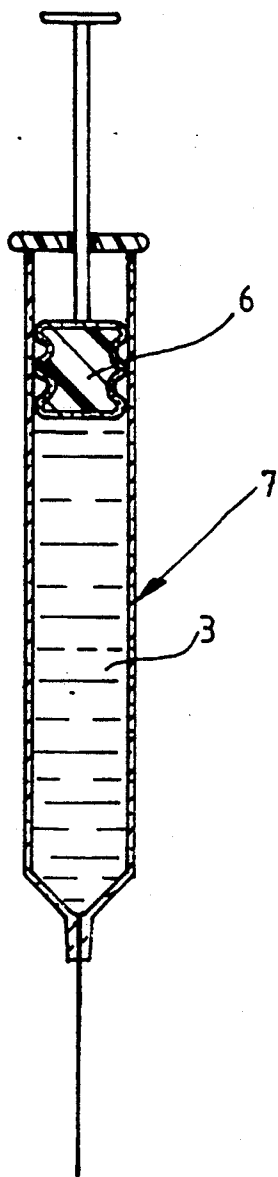


FIG. 3



OBTURATING MEANS FOR CONTAINER FOR PHARMACEUTICAL AND MEDICAL PREPARATION

BACKGROUND OF THE INVENTION

The preparation of materials for pharmaceutical and medical use requires the utmost care. Such materials may be used for medication of humans or animals, as well as for various related purposes, such as the diagnosis of disorders of humans and animals.

If the materials deviate from the required quality standard, they may exert obnoxious or even fatal influence on the treated being or lead to equally dangerous wrong conclusions in for instance a diagnosis.

The preparation of such materials is entrusted to qualified pharmacists. They generate the materials in the required quality by using appropriate equipment and procedures in carefully constructed premises.

The materials, once prepared, must however be stored in containers in order to allow their transport to the application site. Between preparation and application, a considerable time interval may elapse. It is clear that the container must be such that no appreciable deterioration of the materials takes place.

Container systems for the purpose of storage of the materials have been elaborated in the past three or four decades for a very large number of applications. In many cases, the container system not only preserves the good quality of the packed material but additionally facilitates or even makes possible its actual application.

Many systems employ elastomeric (rubber) components, functioning practically always as a sealing means between the container content and the environment, and additionally also in many cases as a means for easy and/or safe application.

Two typical examples from a very large body are the following

1. A glass vial containing a fluid intended for parenteral medication is closed with a soft elastomeric stopper. The stopper allows penetration with a hypodermic needle or a spike. The sterile fluid may then be withdrawn from the vial without actually opening it, thus avoiding the danger of contamination with microorganisms or other undesirable matter.

2. A glass tube is used as a parenteral fluid cartridge by closing one end with an elastomeric stopper in the shape of a plunger. The other end is connected to a hypodermic needle. The fluid content of the cartridge can be pushed out through the needle by pushing the elastomeric plunger with a suitable plunger rod. In this application, the elastomeric part must form a static seal during shelf life of the cartridge and a dynamic seal during the actual application. In the latter stage, it must slide very smoothly in order to allow correct medical action.

From the above, it will be clear that elastomeric seals in this area may have a very wide variety of shapes and dimensions. In the following text they will be addressed as "elastomeric seals" for short.

In the course of the last three decades, much work has been devoted to the development of suitable materials for elastomeric seals in this field. The work was complex because elastomeric materials for the production of seals are composed themselves over a number of starting materials. Such starting materials must be most carefully selected as well as combined in accurately

balanced ratios in order to obtain seals possessing a complex of properties required for the application.

Said seals having

the ability to form a static, and if required, dynamic gas- and liquidtight seal for a container containing pharmaceutical or medical preparation (1),

very low, and indeed pharmaceutically acceptable, release of extraneous material to the pharmaceutical or medical preparation (2), and

durability or persistence of the required properties during the storage time of the container with a pharmaceutical or medical preparation (3),

must additionally have, in order to be suitable to be used in equipment for filling or closing containers, the following properties

ability to support currently practiced technical treatments for surface cleaning and sterilization (4), and

ability to be processed in current technical container filling and closing equipment (5).

By selecting suitable elastomeric base materials and further components, compounds may be obtained which, after curing in an appropriate shaping treatment, have a good balance of properties (1), (2) and (3). Such compounds are proprietary to the pharmaceutical rubber industry.

It has been observed that their final processing, especially on a large scale, in fast running modern machines, requires a certain adaptation of their surface state. By their nature, elastomeric objects have a relatively high coefficient of friction, for instance 2.4. This hampers their ability to be transported in filling equipment and similar machinery and, as a consequence, such equipment must be adapted in complicated and mostly costly ways.

In order to overcome this problem, the elastomeric seals in many cases are coated with some lubricant, for instance silicone oil. Such treatment is additionally favorable in preventing the seals from sticking to one another, which also is a frequently observed phenomenon in uncoated seals, especially after treatment in cleaning, cleansing, sterilization and drying equipment.

However, the silicone oil or other lubricant spoils some desirable properties of the seals as an extraneous material, it contaminates the pharmaceutical or medical material stored in the container. In the case of silicone oil, for instance, it has been observed that a water-based medical preparation after contact with the silicone oil treated elastomeric seal, contains a relatively large quantity of silicone oil droplets in emulsified state.

Coatings with various materials have been proposed, but they generally involve the already mentioned or other drawbacks, for instance a decreased sealing capacity or a high application cost.

The present invention purports to resolve the problem by applying a relatively simple and at the same time cost-efficient treatment, consisting of introducing in a carefully controlled way an amount of halogen atoms into the seal surface. The treated seals acquire the necessary low friction coefficient and lose their aggregation tendency, even upon stringent cleaning, cleansing, sterilizing and drying treatment. They do not lose the desirable properties they already possess before the treatment and release a very low amount of extraneous material to a pharmaceutical or medical preparation.

BRIEF DESCRIPTION OF THE INVENTION

The invention relates to an obturating means prepared at least from one elastomeric material, said means

being intended for a static and/or dynamic seal of a container intended to contain a pharmaceutical or medical preparation, in which at least the elastomeric part of the obturating means is at least partially subjected to a treatment with elementary halogen or chemical compound(s) containing reactive halogen atoms so that said obturating means has at least the following properties

- ability to form at least a static gas- and liquidtight seal for the container;
- very low release of extraneous material to the pharmaceutical or medical preparation;
- compatibility with the pharmaceutical or medical preparation;
- ability to support currently practiced technical treatments for surface cleaning and sterilization and
- ability to be processed in current technical container filling and closing equipment.

The obturating means according to the invention is preferably treated with fluorine.

In an embodiment of the obturating means according to the invention, the elastomeric part thereof is at least partially treated with a fluorine gas after being washed.

A preferred obturating means according to the invention is obtained by treating the elastomeric part thereof with fluorine gas under a pressure of at least 10^5 Pa, preferably under a pressure comprised between 10^5 and $5 \cdot 10^5$ Pa, during at least 60 seconds, preferably from 60 to 900 seconds, and at a temperature comprised between 15° and 25° C.

The fluorine gas is advantageously mixed with an inert gas and preferably with nitrogen. Such a mixture contains, for example, 1 to 10% fluorine gas and 90 to 99% nitrogen gas.

The invention relates also to

a container intended for pharmaceutical or medical preparation, said container being provided with an obturating means according to the invention, and

a syringe intended for the injection of pharmaceutical or medical preparation, said syringe containing a slidable obturating means according to the invention, said means acting as a stopper.

The invention relates also to a process for treating obturating means prepared from at least one elastomeric material, said means being intended for a static or dynamic seal of a container for pharmaceutical or medical preparation. In said process, at least the elastomeric part of the obturating means is at least partially subjected to a treatment with elementary halogen or chemical compound(s) containing reactive halogen so as to obtain an obturating means according to the invention.

Rubber obturating means according to the invention as well as a process according to the invention will be described hereafter with reference to the attached drawings which show embodiments of obturating means according to the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of a vulcanized obturating means according to the invention;

FIG. 2 is a partial cross-sectional view of a vial provided with a vulcanized obturating stopper; and

FIG. 3 is a cross-sectional side view of a slidable stopper of a syringe, together with the syringe itself.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Obturating means according to the invention are prepared from at least one elastomeric material. Obturating means according to the invention are for example elastomeric stoppers for containers with a pharmaceutical or medical preparation or elastomeric slidable stoppers of syringes intended for injecting pharmaceutical or medical preparation.

Rubber is the generic name for a class of materials composed essentially of one or more elastomeric materials such as polyisoprene, copolymer of isobutene and isoprene, copolymer of butadiene and acrylonitrile, polydimethylsiloxane. Said elastomeric materials may contain functional atoms or molecule groups, introduced before or after the polymerization. Non-elastomeric substances may be added to the elastomer in order to tailor the properties of the material to specific needs. Such substances are for instance finely powdered and purified minerals (example bentonite clay), reactive chemicals intended to enable a crosslinking chemical reaction in the material after it has been converted into the desired shape.

During the manufacturing process (information thereon is given for example in Rubber Technology and Manufacture edited by C. M. BLOW published for the Institution of the Rubber Industry BUTTERWORTHS LONDON—1971), the various components for a given material are mixed to give a malleable compound. This compound is then converted into the desired shape. The material of the final product is characterized by the fact that it is capable of recovering from large deformations quickly and forcibly. It will retract within 1 minute to less than 1.5 times its original length after being stretched at room temperature (18° to 29° C.) to twice its length and held for 1 minute before release.

The following table gives an example of composition of rubber:

	% by weight
chlorobutyl rubber	50 to 55
vulcanizing agent	0.5 to 2
filler (silicate)	40 to 45
zinc oxide	1 to 3
stearine acid	0.5 to 2
paraffine oil	0.5 to 2
colorant (iron-, titane oxide)	0 to 2
polyethylene wax	0.5 to 3

The process according to the invention may be applied to obturating means composed of at least rubber or elastomeric material as described in the following examples, given as examples only.

EXAMPLE 1

Said process comprised the following steps:

1. The obturating means were washed in a rotary drum, first with warm water and a neutral detergent, then with filtered water and finally with pyrogen-free water.

2. The obturating means were then dried by means of hot filtered air.

3. The obturating means were contacted in a rotary drum with fluorine which was mixed with nitrogen. The mixture of gases contained 1% fluorine and 99% volume nitrogen.

The contact time of the obturating means with fluorine was 900 seconds.

The obturating means were contacted with said mixture of gases at a temperature of 25° C. and under a pressure of $5 \cdot 10^5$ Pa.

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.