Nov. 2, 1943. E. E. LAUER 2,333,535

WAX IMPREGNATED GLASS FABRIC LINER AND GASKET SEAL

Filed June 2, 1939

Fig. 1.

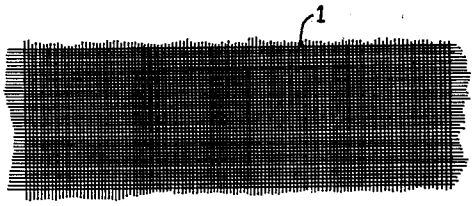



Fig. 2.

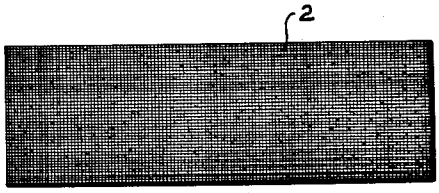



Fig. 3.

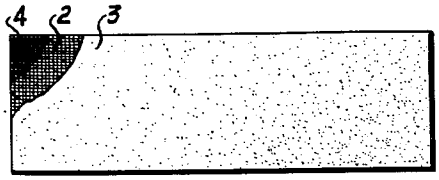



Fig. 4.

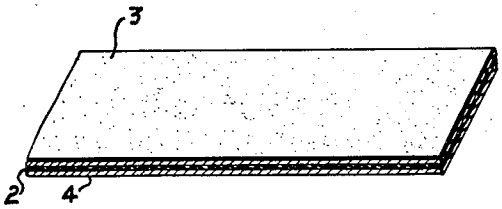



Fig. 6.

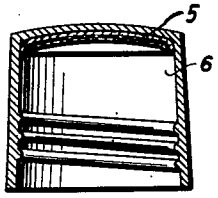



Fig. 5.




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## WAX IMPREGNATED GLASS FABRIC LINER AND GASKET SEAL

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Application June 2, 1939, Serial No. 277,103

3 Claims. (Cl. 288—34)

This invention relates to certain new and useful improvements in a composition of glass cloth and wax, the purpose of which is to provide seals or gaskets between elements of containers, apparatus, equipment and the like which are used for containing and/or transporting concentrated acids and other corrosive liquids and substances, especially those which should be maintained in a high state of purity such as acetic, formic, hydrochloric, nitric and sulfuric acids.

Owing to the corrosive nature of strong mineral acids, such as hydrochloric, nitric and sulfuric, a practically insurmountable difficulty has been experienced in effecting a satisfactory sealing of their containers. A common means hitherto employed has been through the use of glass or ceramic stoppers, the sides of which have been ground down so as to cause the stoppers to fit within the container necks to form liquid-tight joints. Even with such ground stoppers, it has been necessary to smear the ground surface of the stoppers with a grease in order to effect a liquid-tight and yet removable seal. The cost of grinding the stoppers, the frequency of leakage resulting from imperfectly ground stoppers, the contamination of the container contents with grease from the stopper, the necessity of using some lute to hold such stoppers rigidly in position during the transit of containers, and the frequent "freezing" of ungreased or insufficiently greased stoppers within the container necks, have been serious disadvantages.

In the course of extensive experiments it has been found that asbestos, a natural, mined substance, usually contains undesirable reactive impurities, such as compounds of iron. Though these impurities are not acted upon by many chemicals and may be without adverse effects in the utilization of the products of the art where slight or even more appreciable contamination is of no technical or commercial consequence, such impurities in asbestos are highly objectionable if the latter should be applied as a constituent of a closure liner for containers of concentrated chemically pure acids.

Coating of asbestos with an acid-resistant substance, in an attempt to preclude the action of acids and other chemicals on the reactive impurities in the asbestos, is an unreliable expedient, because in every-day practice a complete coating is not always attainable.

Glass can be made by specification to be resistant to the action of most mineral acids, and hence it might appear that the ideal liner for a closure would consist wholly of such glass. However, glass is normally a brittle material, and no means have been previously known by which to endow a closure lining with the acid-resistant properties of glass and at the same time to produce a soft resilient, liquid-proof lining material which will be devoid of all contaminating effects upon concentrated pure mineral acids.

Glass fibers can be made long, round, smooth, and altogether suitable for the construction of a closely-woven, tight fabric, without reinforcements of cotton or metallic wires, or other such materials.

However, applicant has found that neither a glass fabric nor a felted or matted agglomeration of glass fibers is alone capable of providing a non-porous lining material. Applicant has extensively experimented with glass fabrics and felted or matted glass fibers, without adding thereto any lubricating and sealing agent, and it has been found impossible to produce a liquid-proof lining material from any of them because of their inescapable porosity, however tightly woven the glass fabric, or however closely felted or matted the glass fibers may have been. He has found, further, that this porosity cannot be overcome by the exertion of closure pressure upon the glass fibers of a piece of glass fabric or upon a layer of felted or matted glass fibers placed upon the rim of the mouth of a liquid container. The art has so far failed to produce a liquid-tight lining material consisting solely of glass fibers capable of withstanding such pressure, for the latter inevitably destroys the structure of the unprotected glass fibers.

This applicant has discovered that glass fibers, in order to aid in the provision of a perfect seal under screw-cap closure pressure at the rims of the mouths of containers, for instance, need to receive an inter-lubricating agent which must have the function of perfectly filling spaces between or among the glass fibers and, in addition, must preserve the purity or the original state of the acids or other corrosive substances with which that agent may come in contact.

It is therefore a primary object of this invention to provide the combination of a lubricating and sealing agent and a fabric made from pure glass which will be generally acid-resistant and devoid of discoloring and other contaminating effects on acids, and which at the same time will provide a liquid-tight closure material.

Another object of the invention is to produce a lining material consisting essentially of tightly woven glass fabric impregnated with a wax having definite properties, in order to provide a lin-

ing or gasket material which will be impervious to the contents of containers; resistant to the corrosive action of concentrated mineral acids or of dry or moist chemical substances or compounds; devoid of discoloring effects upon such acids or substances or compounds; sufficiently resilient to effect a positive seal when placed within, and tightened by pressure of, a suitable closure; and capable of repeated application by virtue of its physical properties, structure, and sealing capacity.

It is a further particular object of this invention to utilize a certain type of construction of tightly woven glass cloth which will satisfactorily provide a supporting structure for certain acid-resistant waxes in certain proportions, so that the product will be serviceable as a liquid-tight lining material of strong pure acid containers.

With the above and other objects in view that will become apparent as the nature of the invention is better understood, the same consists in the novel form, combination and arrangement of parts hereinafter more fully described, shown in the accompanying drawing and claimed.

In the drawing, of which the figures are merely diagrammatically and illustratively represented:

Figure 1 represents the untreated woven glass fabric itself;

Figure 2 represents that woven glass fabric having a wax content of about 40 percent by weight;

Figures 3 and 4 are different views of the more fully impregnated and externally coated glass fabric;

Figure 5 represents a cross-section, considerably diagrammatically enlarged, to show the upper and lower layers of wax and the wax impregnated glass fabric within these layers;

Figure 6 is a cross-section of a screw-cap through a median line, showing with some enlargement the up-turned edge of the liner along the internal periphery of the cap.

In further reference to the drawing, in Fig. 1, 1 illustrates a specimen of the mesh of the untreated woven glass fabric. In Fig. 2, 2 illustrates a specimen of the wax-impregnated glass fabric. In Fig. 3, 3 illustrates the general overall smoothly waxed upper surface; 2, in the fragmented corner illustrates the wax-impregnated glass fabric represented in Fig. 2; 4 illustrates the inner aspect of the nether overall smoothly waxed surface. In Fig. 4, representing a disproportionately perspective view, 2, 3 and 4 indicate the corresponding parts in Fig. 3. In Fig. 5, 2, 3 and 4 are indicated in enlarged sectional view. In Fig. 6, 5 shows the liner composed of the material of Fig. 5 positioned within the screw-cap 6.

In this connection applicant has tested many weaves of glass fabric, and he has found certain weaves particularly suitable to the accomplishment of his purpose. For instance, a desirable weave of glass fabric is composed of fibers of which about 87 percent vary less than 20 percent from the average diameter of 0.00025 inch. This glass fiber permits tight weaving and provides a strong all-glass fabric which has the following characteristics, subject to reasonable variations:

Air porosity: Air velocity of 30 cubic feet, per minute, per square foot of fabric, under one inch water pressure, for a fabric weighing 1.4 lbs. per square yard.

Water porosity: Rate of flow of 286 gallons, per minute, per square foot, under pressure across the fabric of 10 lbs. of water per square inch.

Ordinary paraffin wax, such as the prior art used in indefinite proportions with asbestos, contaminates pure mineral acids by discoloring them. So-called purified paraffin has the disadvantages that it is not wholly free from substances carbonizable by sulfuric acid; that it is slightly oxidized by prolonged contact with concentrated nitric acid at ordinary temperatures; and that it exhibits such a well-defined crystalline structure that, when solidified in thin layers, it fractures and chips off under slight stress. Paraffin that is soft and unctuous at ordinary temperatures is unserviceable and in fact objectionable in or upon screw-cap stopper seals because it detaches itself by mere contact with container contents and contaminates them.

After testing many waxes, particularly with respect to their melting points, fluidity, chemical inertness, odor, taste, tenacity, etc., it has been found, for example, that a wax which meets the following specifications is especially suitable for this purpose:

| | |
|---|---|
| Viscosity at 210° F.—seconds— | 62.7 |
| A. S. T. M. melting point—°F— | 170 |
| Penetration (needle) at 77° F.—cm— | 0.12 |
| Sulfuric acid discoloration test | None |
| Acid value | None |
| Saponification value | None |
| Odor | None |
| Taste | None |

A wax having approximately the foregoing characteristics is sufficiently fluid at elevated temperatures, so that it can readily penetrate between the fibers of the glass fabric, thus effectively wetting their inter-faces and eventually affording the desired lubricating effect and closure of the pores in the glass structure. When this wax cools, the individual fibers of the glass, which normally lack in sufficiently serviceable flexibility, are buttressed by this inter-lubrication, so that they cannot abrade one another, and upon the application of screw-cap pressure the wax protects the glass fibers from fracture by distributing the stress throughout the lining material. At ordinary temperatures this wax is tenacious, but not sticky, and is moderately compressible. As its particles do not break away during closure pressure, there is no physical contamination by wax of the contents of containers. It is non-reactive to all the strong mineral acids. It does not discolor these acids. It has no deleterious effect on the material of screw-cap closures. Its temperature range of utility, namely, —30° F. to 130° F., permits of the efficient and safe use of applicant's lining material under widely varying climatic conditions. Hence, the attainment of the objective is critically dependent on the existence of the special chemical and physical properties of the wax described and on its several coacting functions.

In the utilization of a wax having substantially these specified qualities, the success of its association with the described glass fabric has been found to depend on the adaption of certain optimum proportions of wax to glass, according to purpose. The determination of these proportions depends on the content of the wax essential for the lubrication and the buttressing of the glass fibers and for the sealing of the pores of the glass structure; the diameter of the glass fibers and the closeness of their weave; the size and thickness of the liner or gasket; the degree of corrosiveness and the volatility of the liquid or substance to be sealed; and, in the die-punch-

ing for producing the seals, the need of lubrication by the wax to prevent fracture and rugged contour of the liners or gaskets.

There must always be a sufficiency of the wax on the surface of the finished product in order to ensure a tight sealing surface in contact with the lip of the container without risk to the glass structure during repeated application of pressure of the screw-cap closure upon the rim of the container's neck. If the product contains insufficient wax the glass fibers become exposed upon repeated loosening and tightening of the closure. Such deficiency of wax results in a glass to glass contact, which is not liquid-tight. On the other hand, an excess of wax upon the finished product must be avoided because a liner that is unduly thick through the presence of excessive wax may lead to an excessive stress upon the screw-cap and to the breakage of the latter during its application to the container.

The wax has multiple functions, which depend on a minimum and a maximum ratio of wax to glass. This ratio, in turn, is directly governed by the surface area of the given fineness of the glass fibers in the glass structure, by their thickness, by the type of weaving of the glass fibers, by the fabric's mesh, by the nature of the wax, and by the dimensions of the screw-cap. This ratio controls a critical limit above or below which the lining material will not efficiently serve as a liquid-tight seal of screw-cap closures.

It has been found that the requisite range of proportions of the specified wax to the described glass fabric is approximately 40 to 75 percent of wax to 60 to 25 percent of glass, by weight. The optimum of wax and glass contents for the particular use can readily be determined by those skilled in the art, having in mind the limitations and considerations as disclosed.

In the manufacture of applicant's lining material from the given tightly woven glass fabric and the wax as described, the first step involves the careful de-oiling or the de-greasing of the glass fabric. The wax will not adhere firmly to an oily or greasy glass surface, or satisfactorily sheathe oily or greasy glass fibers. Moreover, the removal of such contamination is an important precaution wherever the discoloration of pure acids is to be avoided. Next, the cleansed rolls of glass fabric are impregnated and coated with the described wax, and finally the finished product is die-punched into liners of gaskets of any desired dimensions. These liners of gaskets are then ready for application to closures.

The completed lining material of this invention has ample mechanical strength and excellent sealing properties, which remain perfect over a wide range of atmospheric temperatures and successfully withstand the pronounced pressure which the liquid-tight closing of the screw-caps entails.

It is obvious that certain modifications may be made in the steps of the process, and in the kind and proportions of the materials employed, without departing from the scope and spirit of the invention and the purview of the claims.

I claim:

1. A lining and sealing material comprising tightly woven glass fabric consisting of fibers substantially averaging 0.00025 inch in diameter and affording resistance to air-flow and water-flow as indicated respectively by an air porosity characterized by an air velocity of about thirty cubic feet per minute, per square foot of fabric, under one inch water pressure, for a fabric weighing about 1.4 lbs. per square yard, and by a water porosity characterized by a rate of flow of about two hundred and eighty-six gallons per minute, per square foot, under pressure across the fabric of about ten pounds of water per square inch, said fabric being substantially uniformly impregnated with about 40 to 75 per cent by weight of a wax having substantially the following specifications: viscosity at 210° F., 62.7''; A. S. T. M. melting point, 170° F.; penetration (needle) at 77° F., 0.12 cm.; freedom from carbonizable matter, free fatty acids, esters, odor and taste.

2. An acid-proof and liquid-proof lining material comprising a tightly woven fabric composed of fine glass fibers substantially uniformly impregnated throughout with a wax having substantially the physical and chemical specifications as defined in claim 1, the wax filler being present in sufficient amount in relation to the glass fabric to coat all the interfaces of the glass fibers with a lubricant cushion and to fill the mesh spaces of the fabric.

3. An acid-proof and liquid-proof lining material comprising a tightly woven fabric composed of fine glass fibers substantially uniformly impregnated throughout with a wax having substantially the physical and chemical specifications as defined in claim 1, the wax filler being present in sufficient amount in relation to the glass fabric to coat all the interfaces of the glass fibers with a lubricant cushion, to fill the mesh spaces of the fabric, and to form a thin film thereof as an over-all coverage of the outer face of the thus wax-impregnated glass fabric.

ETHAN E. LAUER.