

H. F. KENWORTHY.
POROUS SUBSTITUTE FOR LEATHER AND THE LIKE.
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1,310,703.

Patented July 22, 1919.

Fig. 1.



Fig. 2.



Fig. 3.



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UNITED STATES PATENT OFFICE.

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POROUS SUBSTITUTE FOR LEATHER AND THE LIKE.

1,310,703.

Specification of Letters Patent.

Patented July 22, 1919.

Application filed September 26, 1916. Serial No. 122,308.

To all whom it may concern:

Be it known that I, HERBERT F. KENWORTHY, a citizen of the United States, residing at Scituate, in the county of Plymouth and State of Massachusetts, have invented new and useful Improvements in Porous Substitutes for Leather and the like, of which the following is a specification.

- 10 This invention relates to processes and products for porous leather substitutes. It is an object of the invention to provide a material which will have utility similar to that of leather, with additional advantages.
- 15 In particular, the objects of the invention are to produce a material which may be workable like leather, with customary tools, methods and machinery for working leather; be flexible, and retain this flexibility throughout its life at all ordinary atmospheric temperatures; be durable; be a non-conductor of heat; be resilient; have non-slip characteristics, and in general be cheaper than leather, as well as more useful
- 20 than leather in various other respects. It is another object that this material shall be free from some of the disagreeable features that are associated with rubber.

- Notwithstanding numerous efforts heretofore made, no one, so far as I am aware, has hitherto mastered the problem of compounding materials for the above purposes. Important features of the process which I have found successful are to provide a
- 35 tough, thick, porous substance, of a filmy nature, in which are fibers, preferably of animal origin, such as wool, which supplement the strength and elasticity of the film, and to a degree determine and maintain its interior structural aspect. This said substance, which has many characteristics of the film produced by what are known as "drying oils", incases and clings tightly to the fibers, binding them flexibly together.
- 40 At the same time the fibers are entangled with and cling to each other; and the smaller spaces between them are more or less filled, either with said film or with small solid mineral particles embedded therein. Film and fibers reinforce each other as regards strength, and are stiffened by the solid portion of the filling, and yet have among them

pores or spaces which permit a considerable degree of flexibility of the mass as a whole,—a flexibility which results from the presence of these spaces coupled with the elastic nature of the fibers and of the film, and of the attachments of the fibers to each other and to the film. If the said pores are unfilled, air can pass in and out and through the product thus described, nevertheless the openings are so small and the oily characteristic of the material surrounding the orifices is such, that water does not readily enter. This may be because the surface is not wetted by the water and the skin tension of water globules is not broken. However, as the product thus described is in fact porous, water can be made to penetrate it; and water will do so under suitable conditions of repeated flexure or of pressure, so that this product may be commercially described as being only partly waterproof, or merely "moisture proof".

For the porous, fibrous, filmy structure it is preferred to use blown oil, japan, and turpentine coupled with wool felt and comminuted mineral solids such as oxid of zinc or carbonate of lead. The structure may be made by mechanically combining the fibers with the other materials, liquids being first thinned with a volatile diluent such as naphtha, herein called "fugitive oil" and by raising their temperature so that as a thin liquid they penetrate among the fibers, carrying also the pulverized solids in among them. The subsequent evaporation of the naphtha leaves a porous structure in which air is accessible to the remaining liquids all through the mass, so that they dry into the elastic filmy condition. Color can be added either in the filling or in the initial liquid; and the product can be finished mechanically by sand papering, by embossing or by other suitable methods.

The structure of the finished product is shown more or less diagrammatically in the accompanying drawing, in which,

Figure 1 is a cross section through a preferred and ordinary form of the product;

Fig. 2 shows a similar section through a modification having a central web; and

Fig. 3 is a similar section through a modification having both the central web and an

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embossed coating, the thickness of the coating being exaggerated.

For explanation, of the process and product more in detail, the following illustrative example is given: Take 250 pounds of fluffy oxid of zinc, made by the so-called French or German process; 85 pounds of carbonate of lead; 30 gallons of blown oil; 10 gallons of japan; and 10 gallons of turpentine; and mix them thoroughly so that the solids are suspended and uniformly distributed through the liquid. Pigment may be introduced to give desired color. When ready to use, naphtha is added, varying in amount according to weather conditions. The amounts may be in the vicinity of about 50 per cent. by volume, making the liquid of a specific gravity of about 1.100. The precise proportions of ingredients above described may be varied. And in fact it has been found well in some cases to add about 10 per cent. of blown oil and about 30 per cent. of drier, and the whole being well stirred in a tank. The sheets of fibrous fabric which may be wool felt are then put in, and left immersed until the liquid and its suspended solids have entered thoroughly into them. The completeness with which the liquid passes into the spaces between the fibers is noticeable, for a large quantity of the felt can be immersed without raising the level of the liquid mixture in the tank more than a trifle. If the felt be $\frac{1}{2}$ of an inch thick, several hours of such immersion has been found sufficient, the liquid being well stirred. If the felt be moved through the liquid in strip form, moving around rollers, with bends and angles therein, a few minutes suffices. If the felt be thicker, a longer time is requisite. The combined liquid, solid and fibrous material then is dried, preferably in a room having a temperature in the vicinity of 160° Fahrenheit, through which room air is blown, passing over and around the sheet material with its liquid contents. During this the naphtha is withdrawn by evaporation, and so is recovered; and the liquid material dries by a process of oxidation into tough, filmy form, incasing and gripping in its film the fibers and the solid particles, and leaving pores. Thereafter the material is cooled, with the drying process still continuing slowly to a more perfect stage, which is conveniently done by simply turning off the heat and allowing the blowing of air to continue at atmospheric temperature. The sheet material then passes through apparatus for giving its surface any desired finish, as for example, sand papering and embossing machines.

The material thus finished has many of the characteristics of leather as regards utilities, and has many that are superior or additional to those of leather. When used in connection with the manufacture of shoes,

as for example for Goodyear welting, it may be white, if white felt be used, and is cheaper than white leather welting. When used as an innersole it has the following characteristics, none of which are true of leather: it can be worked dry, without mulling in water; it neither shrinks nor swells, as leather does under changes of moisture from the wearer's foot; it is fast in color, whereas leather stains white hosiery; it is of uniform flexibility, whereas the flexibility of leather varies in different hides and in different parts of the same hide; it will not check or crack as leather does; it is cheaper than leather; and there are further economies resulting incidentally such as the saving of time and labor of mulling, involving a saving of expense; the elimination of the sorting operation, and the freedom of the stock from culls. Among still other advantages are, that it is porous permitting passage of air, that while not absolutely waterproof, it is moisture proof; and that it is a non-conductor of heat; and that it retains its resiliency well. It can be made exceedingly flexible by the use of hot water.

An important feature in the attainment of the desired qualities is the omission of rosin from among the ingredients, this being a material that has often been proposed for use for leather substitutes, and also the omission of other stiff ingredients such as a shellac and glue, which either will stiffen permanently, or will not penetrate properly before they set, or which unless protected by other chemicals are liable to soften under exposure to water. Without saying that these ingredients must be absolutely excluded, experience has shown that a better product is produced without them.

The particular material which is employed for the fibrous fabric may depend in part on the use to which the product is to be put, strong and coarse woolen fibers being selected for uses such as shoe soles, and particularly for cases where the product is to be further impregnated for use for out-soles as is disclosed and claimed in my co-pending application for patent Serial No. 122,307. For other uses, such as for power transmission belts, the felt sheet may contain a central web of fabric as indicated in Fig. 2 to which the material on each side is attached by felting. Such a web eliminates stretching and contributes to the strength, while the felt and web are found in practice to be so thoroughly joined together that the web is not noticeable upon cutting the material. For such a purpose, where flexibility is important, a larger proportion of blown oil and a smaller proportion of the drier may be used. The material has the advantage, compared with other fabrics, that it can remain on a flanged pulley without becoming frayed; that it

does not slip, thus always giving full efficiency; that it does not stretch; and that it is not hurt by water falling upon it. To adapt the material for upholstery or for trunks and bags, the felt with web center may be used, and the product may be finished with an enamel coating and by embossing as indicated in Fig. 3, as so called "artificial leather" is now finished; and the product thus finished has the advantage over leather substitutes which are made on woven fabric bases that it does not fray when cut. The product may also be used for many other purposes for which leather and other fabrics are now used. It will be understood that the invention is not limited to the precise steps and materials above indicated. Naphtha, for example, is a type of what is referred to in the claims as "fugitive oil", meaning a liquid which is introduced and remains only temporarily, being readily evaporative at ordinary temperatures or at the temperature to which the mixture is subsequently subjected. The naphtha may be aided in its function of reducing the viscosity of the liquid by adding heat to the mixture, although if this increases the wastage of naphtha it may be preferred to omit the heating at this stage, unless this step is carried out in a closed space. In the drying which immediately follows, it is preferable to arrange the sheets in parallelism in a closed space, and then to force a blast of heated air through the passages between the sheets, as by power fans. By suitably confining the air, which thus becomes laden with naphtha, the naphtha may be recovered for repeated use. A temperature of 100° more or less above the atmosphere increases the speed of evaporation and also increases the speed and completeness with which the process of oxidation of the drying oils goes forward. When the drying oil composition is made of the particular ingredients and proportions mentioned, its elasticity after the oxidation process is noticeable, resembling that of rubber. This coupled with the inherent elasticity of the fibers makes the completed product both flexible and elastic.

The specific material, which is preferred for use as the principal basis for the filmy characteristic of the completed product, is blown oil, which has in practice been found advantageous; but it appears that other fatty bodies capable of drying into a hard and tough state might be substituted. In the claims, the phrase "intensely-drying" is used as a convenient term for signifying bodies capable of quickly drying into this state when standing in thick layers as hereinbefore described. Linseed oil as commonly used in paints is not suitable for this. Still less is it desirable that the liquid be so pervasive as to penetrate the cellular

structure of the fibers. Only a superficial attachment to and incasing of them is desired. Ordinarily the wool fibers of the felt commonly used are already saturated more or less with their own oil. This prevents such penetration by other oil, so that the oil used as herein described merely fills the spaces between fibers binding them together and filling the mass.

What is claimed is:—

1. The art of making resistant sheet material comprising the immersing of a thick fibrous fabric having a felted surface in a mixture including intensely drying oil, which at atmospheric temperature is a relatively thick liquid, fugitive oil, and a powder, thereby impregnating the said fabric throughout its body and substantially filling its pores; and afterward exposing the whole to air, while the interfibrous spaces are substantially filled with said mixture, whereby the said filling becomes a binder stiffly supporting the fibrous fabric.

2. The art of making resistant sheet material comprising the immersing of a thick fibrous fabric having a felted surface in a mixture including blown oil, japan, turpentine, fugitive oil, and a powder, thereby impregnating the said fabric throughout its body and substantially filling its pores; and afterward exposing the whole to air, while the interfibrous spaces are substantially filled with said mixture, whereby the said filling becomes a binder stiffly supporting the fibrous fabric.

3. The art of making resistant sheet material comprising the immersing of a thick fibrous fabric having a felted surface in a mixture including blown oil, japan, turpentine, a readily evaporative mineral solvent, fluffy oxid of zinc and carbonate of lead, thereby impregnating the said fabric throughout its body and substantially filling its pores; and afterward exposing the whole to air, while the interfibrous spaces are substantially filled with said mixture, whereby the said filling becomes a binder stiffly supporting the fibrous fabric.

4. The art of making resistant sheet material comprising the immersing of a thick fibrous fabric having a felted surface in a mixture, which at atmospheric temperature is a relatively thick liquid, including about five parts, by weight, of an intensely-drying oil mixture and four parts, by weight, of a powder, thinned by addition of fugitive oil, thereby impregnating the said fabric throughout its body and substantially filling its pores; and afterward exposing the whole to air, while the interfibrous spaces are substantially filled with said mixture, whereby the said filling becomes a binder stiffly supporting the fibrous fabric.

5. The art of making resistant sheet material comprising the immersing of a thick

fibrous fabric having a felted surface in a mixture including about three parts, by weight, of blown oil, one part of japan, one part of turpentine, three parts of fluffy oxid of zinc and one part of carbonate of lead, the said oxid and carbonate being in the form of powder and the whole mixture being thinned by addition of fugitive oil and by rise of temperature above the atmospheric; thereby impregnating the said fabric throughout its body and substantially filling its pores; and afterward exposing the whole to air, while the interfibrous spaces are substantially filled with said mixture, whereby the said filling becomes a binder stiffly supporting the fibrous fabric.

6. The art of making resistant sheet material comprising the immersing of a thick fibrous fabric having a felted surface in a mixture including intensely-drying oil, which at atmospheric temperature is a relatively thick liquid, fugitive oil, and a powder, thereby impregnating the said fabric throughout its body and substantially filling its pores; and afterward exposing the whole to air, at a temperature of about 160° F., while the interfibrous spaces are substantially filled with said mixture whereby the said filling becomes a binder stiffly supporting the fibrous fabric.

7. A felted, fibrous, filmy, slightly porous, thick fabric, having pulverized solids in its midst, its filmy parts extending throughout its body, surrounding and binding together its fibrous and pulverized parts, and being composed of oxidized drying oils.

8. A felted, fibrous, filmy, slightly porous, thick fabric, having pulverized solids in its midst, its filmy parts extending throughout its body, surrounding and binding together its fibrous and pulverized parts, and consisting substantially of oxidized drying oils.

9. A felted, fibrous, filmy, slightly porous, thick fabric, having pulverized solids in its midst, its filmy parts extending throughout its body, surrounding and binding together its fibrous and pulverized parts, and being composed of oxidized drying oils including blown oil.

10. A felted, fibrous, filmy, slightly porous, thick fabric, having pulverized solids in its midst, its filmy parts extending throughout its body, surrounding and binding together its fibrous and pulverized parts, and being composed of oxidized drying oils,

the said filmy and fibrous portions being elastic.

11. A slightly porous, thick fabric having a fibrous web with a body of fibrous material on each side of it, attached to it by felting, having pulverized solids in its midst, the whole being held together by a filmy product composed of oxidized drying oils extending throughout its body, surrounding and binding together its fibrous and pulverized parts.

12. The art of making a resistant mass which consists in thoroughly impregnating a fibrous thick body having a felted portion with a liquid of a character to dry to a thick hard and tough state, and disseminating a powder throughout the whole, with its particles among the fibers and embedded in said liquid, and then permitting said liquid to dry while the interfibrous spaces are substantially filled with said liquid, thereby binding flexibly together the incased fibers with greatly reduced porosity of the fabric.

13. The art of making a resistant mass which consists in thoroughly impregnating a thick body of fibrous absorbent material having a felted portion with a mixture which is thick at atmospheric temperature and includes blown oil and a removable diluent therefor and a powder, thus causing said oil, diluent and powder to penetrate and lodge within the interstices and pores of said fibrous body whereby the liquid incases the fibers, and then causing the removal of said diluent and the setting of said blown oil while so positioned to a hard and tough state, binding individual fibers.

14. As a new article of manufacture, a felted, fibrous, filmy, slightly porous, thick composite sheet in the form of a shoe sole, and adapted for use as an inner sole of a shoe; said sheet being composed of an elastic fibrous body, a powder disseminated through it, and an elastic, filmy material extending throughout its body, surrounding and binding together its fibrous and pulverulent parts and composed substantially of oxidized drying oils, including blown oil.

Signed by me at Boston, Mass., this twenty-fifth day of September, 1916.

HERBERT F. KENWORTHY.

Witnesses:

EVERETT E. KENT,
CHARLES A. DE COURCEY.