

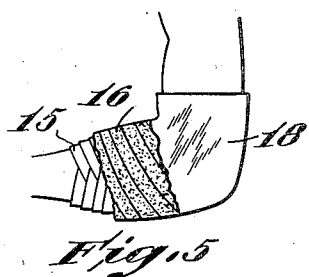
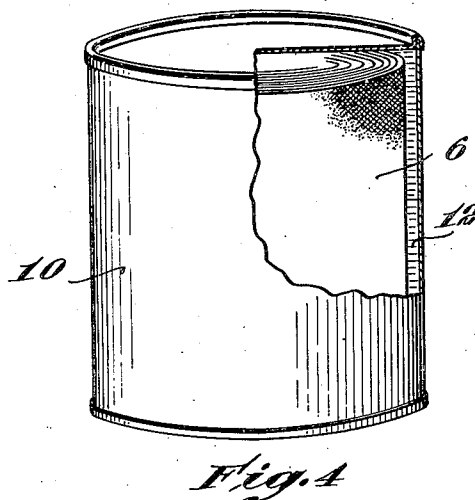
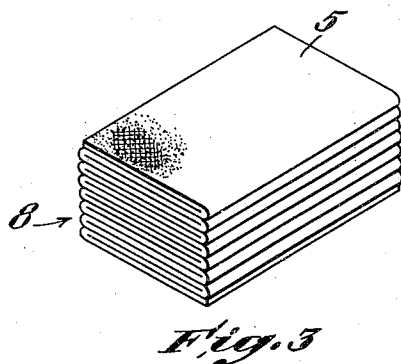
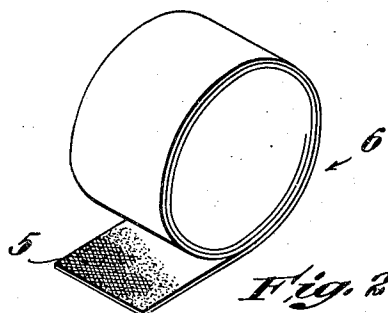
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SPLINT-FORMING MATERIAL

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SPLINT-FORMING MATERIAL

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In treating fractures it is the usual practice to form a cast or encasement about the site of the fracture so as to render immobile the injured bone and muscles, etc., adjacent thereto, the usual technique consisting essentially in the application of the so-called "plaster of Paris" (dehydrated calcium sulphate) bandages which have been previously soaked in water. Although this practice has been in vogue for centuries, it has several disadvantages which have been recognized by the medical profession and also by the patient. For example, the weight of the plaster cast frequently causes the bones to knit in maladjusted relationship, and, due to the opacity of the plaster of Paris, the use of Roentgen ray photography to detect defective setting is rendered practically impossible.

Another difficulty is due to the fact that plaster of Paris sets rather quickly, and as the efficacy of the encasement depends upon the accuracy of the fit, it is often difficult to form an accurately fitting cast within the limited time during which setting takes place. Furthermore, in order to attain the necessary degree of immobility of the injured parts, it is often necessary to apply a new encasement after detumescence, particularly when using circular encasements, where it is advisable, if not necessary, to split them after application in order to accommodate the increase in size due to the swelling which frequently takes place. Moreover, a plaster cast induces, by its occlusive nature, a stimulation of the sweat glands, and due to its relative impermeability, is apt to result in the development of edema and a detrimental dermatitis.

In order to avoid the use of plaster casts and the attendant disadvantages, the use of fibrous material impregnated with various types of binders has been suggested. However, such suggestions usually involve one of two procedures, viz., either first preparing a form or model conforming to the contour of the injured parts, then applying the cast-forming material about the form, removing the cast, after setting, from the form, and then applying it to the site of the fracture; or applying a bandage or other suitable wrapping about the site of the fracture, and during the application applying a coating of binder so as to cement the various layers together, the operation being continued until a cast of the required weight has been built up.

The former procedure is highly objectionable in that it necessitates the use of a form or model. In all such cases a variation in the contour of the form would produce a cast which would not

fit about the injured parts with sufficient accuracy to insure proper fixation, and the difficulty of securing a form or model having substantially the same contour as the injured parts, is increased due to the fact that the contour of the injured parts is apt to undergo an appreciable change after the fracture has been set. Moreover, in order to remove a pre-formed cast from the model on which it was made, and apply it about the injured parts of the patient, it is necessary to split it, and when applied about the injured parts it would be practically impossible to maintain the adjacent edges in precise registry or abutting relationship. Hence, either a gap between the adjacent edges or an overlap would be produced, either of which would cause the development of a pressure sore, and any attempt to overcome this difficulty, as by the use of padding, would tend to reduce the rigidity of the cast and hence interfere with proper fixation.

The latter procedure is objectionable in that the time required and the difficulty encountered in building up a cast in such a manner is such as to render the entire procedure impractical. Moreover, the time required for such a cast to become semi-rigid would exceed the time during which it would be possible to hold a set fracture.

A principal object of the present invention is to avoid the objectionable features of the prior practices and to provide a preconditioned sealed package of splint-forming material which will be preserved indefinitely in ready-to-use conditions and which may be readily formed into an accurately fitting cast, encasement, coaptation splint or the like structure, by the direct application of the material and which when applied is in plastic and flaccid condition and is inherently capable of setting so as to provide an integrated structure which is of light weight, rigid, relatively porous and permeable to X-rays.

Further objects and advantages will be apparent from a consideration of the following description and the accompanying drawing, wherein:

Fig. 1 is an enlarged sectional view illustrating a splint-forming material having a woven fabric base;

Fig. 2 is a perspective view of a roll of splint-forming material;

Fig. 3 is a perspective view of the splint-forming material folded into superposed layers providing a convenient package;

Fig. 4 is a perspective view of a roll of the pre-conditioned material packed in an hermetically sealed container; and

Fig. 5 is a fragmentary view illustrating an encasement constructed in accordance with the present invention and applied about the elbow and forearm of a patient.

In accordance with the present invention, I provide a cast-forming material which is preferably in strip form, comprising a fibrous base loaded with a water-insoluble colloidal binder capable of being rendered plastic and flaccid by a volatile organic solvent so as to be readily moldable, and which, upon the elimination of the solvent, is capable of becoming relatively hard and stiff, thus providing a form-retaining structure of light weight and of sufficient porosity to minimize, if not eliminate, sudorific effects. The fibrous base preferably consists of a woven fabric, such as a cotton print cloth having a thread count of approximately 44 by 40, which I have found is not only capable of holding the requisite amount of loading, but also of providing the proper voids in the mesh to prevent blocking the interstices and thus expediting hardening. For general use the impregnated fabric is cut on the bias into strips of suitable length and width for convenient application and in order to enhance the appearance of a cast made therefrom, the fabric base and/or impregnant may be dyed so as to impart a flesh-colored appearance.

The colloidal loading preferably comprises a water-insoluble resin-like substance readily dispersible in volatile organic solvents, for example, an organic ester, such as compounds of cellulose, dissolved in suitable organic solvents, such as acetone, ethyl acetate, or the like, or mixtures of such compounds. Such resin-like substances are capable of being rendered flaccid and adhesive by an organic solvent, and upon the elimination of the solvent, become relatively hard and stiff, and capable of effecting a strong bond between continuous layers of the fabric base.

In order to produce a cast-forming material which is self-welding and capable of setting within the time during which a fracture can be held, and which possesses an adequate rigidity when set, it is necessary that the proportion of fibrous base to the loading fall within a certain range, depending upon the nature and type of the particular ingredients employed. I have found that a satisfactory cast-forming material may be made from a fibrous base and a colloidal loading of the character above specified when the proportions of these ingredients fall within the following range:

	Parts by weight
Fibrous base (dry basis)	1 to 3
Loading (dry basis)	3 to 4

Referring to Fig. 1, the fabric base, here shown as a woven fabric 1, may be impregnated with a suitable loading material 2, preferably nitrocellulose because of its ability rapidly to form films and readily to give up its solvent content. The impregnating treatment may be carried out in any suitable manner which is effective uniformly to impregnate the fabric base with the colloidal loading so that the proportions of the two ingredients fall within the aforementioned range. After drying or elimination of the major part of the solvent, the impregnated fibrous base may then be cut on the bias into strips of suitable length and width.

The cut strips may then be preconditioned so as to be rendered suitable for use without further treatment, and to this end the strips may be either run through a bath of a suitable solvent,

or sprayed with the solvent, or, if time permits, subjected to an atmosphere saturated with the solvent. When thus conditioned the colloidal loading becomes plastic and adhesive, and the material is rendered flaccid so that it may be easily applied.

The conditioned strips 5 may then be put up into spirally wound rolls 6 (Fig. 2) or folded into bundles 8 (Fig. 3) and such rolls or bundles may be individually packed in a suitable container such as a can 10, as shown in Fig. 4. In order to preserve the material in a properly conditioned state, it is advisable, if not necessary, to confine it in a vapor saturated atmosphere within a vapor-tight container, such atmosphere preferably consisting of a vapor of the same kind of volatile solvent as that in which the impregnating material is dispersed, although it is to be understood that any inert vapor which will not absorb the solvent from the impregnating material or otherwise affect the material may be used. Accordingly, before sealing up the container 10 a predetermined quantity of vapor-forming fluid may be added in an amount sufficient to saturate the atmosphere 12 (Fig. 4) enveloping the pack or roll 6, care being taken to avoid the use of such quantity as might liquefy the impregnating material or cause it to ooze out from the pack or roll.

In making an encasement or coaptation cast in accordance with the present invention, it is advisable first to apply to the surface of the injury, after having set the fracture or dislocation, a protective covering such as a coating of vaseline or, if desired, a stockinet or gauze bandage, and then apply a strip of cast-forming material over the covering to form an encasement, which, if desired, may be reinforced in any suitable manner, as by interposing wood or metal strips between the layers of cast-forming material in a manner suitable for the requirements of the particular case under treatment. As shown, for example, in Fig. 5, a gauze covering 15 may first be applied and strips of the cast-forming material may then be laid so as to form an overlapping spiral wrapping or other suitable encasement 16. After having formed the encasement, any surplus material may be sheared off, and the surface of the encasement may be painted or sprayed with a suitable laquer, such as cellulose acetate, to provide a finishing coat 18. A cellulose acetate finishing coat is particularly advantageous in that it readily bonds with the nitrocellulose impregnant, filling in any crevices and welding the overlapping edges of the strips. Moreover, such a finish provides a washable and durable protective coating which has no tendency to peel off.

Upon drying or setting the encasement becomes hard and rigid, providing an integument which holds the injured parts relatively immovable. Although the evaporation of the solvent or vehicle is accompanied by a slight shrinkage of the encasement, such shrinkage is effective to eliminate objectionable looseness and to cause the encasement to conform more accurately to the contour of the injured parts so they are retained with absolute fidelity. Furthermore, since the voids of the fabric base are not completely filled with the dry colloidal material, the encasement is relatively porous and hence permits a slight diffusion of air and body moisture.

A further feature of an encasement or the like structure formed in accordance with the present invention resides in the fact that the cast-form-

ing material has a substantially lower density than that of the conventional plaster cast and hence does not encumber the patient with objectionable weight which often causes fatigue.

5 Moreover, as the colloidal material is substantially unaffected by moisture, there is no danger of the encasement losing its rigidity because of wetting or of absorption of body moisture, and as the colloidal material and ingredients
10 used in conjunction therewith are more or less antiseptic they do not provide an environment which is conducive to the development of bacteria.

15 Another advantageous feature of encasements or like structures made in accordance with the present invention resides in the fact that where an injured arm or limb, for example, has detumesced or shrunk to such an extent that the encasement has become loose, it may be split so
20 that a narrow strip of the encasement may be removed and the adjoining edges securely welded together either by the application of solvent, or by filling the crevice defined by the split portions with pieces of cast-forming material saturated with solvent, and permitting the joint to
25 harden.

A specific example of a preferred procedure for making a preconditioned cast-forming material is as follows:

30 A sheeting of cotton print cloth, previously dyed with a flesh-colored aniline dye and having a thread count of approximately 44 by 40, is immersed in a bath consisting of 32 ounces of low viscosity nitrocellulose dissolved in one gallon of equal parts of ethyl acetate and acetone.
35 To this solution may be added a fire-retardant, preferably powdered boric acid, which is harmless to the skin and has recognized antiseptic properties. The impregnating treatment is so regulated that the fabric will absorb sufficient
40 colloidal material so that in dry state it contains approximately 1.5 parts by weight of fiber and 3.5 parts by weight of loading, although it is to be understood that these proportions may be
45 varied so long as they come within the range previously specified. After emergence through stripper rolls or the like the fabric is partially dried and then cut on the bias into strips 5 of suitbale length and width. These strips are run

through a bath of acetone or a mixture of acetone and ethyl acetate, after which they may be put up in rolls 5. The rolls 5 may then be individually packed within a hermetically sealed
5 container 10, as shown in Fig. 5, and before sealing up the container a measured quantity of acetone is added so as to ensure a vapor-saturated atmosphere 12 which is effective to preserve the material in a properly conditioned state.
10 When thus packed and sealed, the material may be preserved indefinitely without the slightest deterioration.

While I have shown and described different desirable embodiments of the invention, it is to be understood that this disclosure is for the purpose of illustration, and that various changes and modifications, as well as the substitution of
15 equivalent elements for those herein shown or described, may be made without departing from the spirit and scope of the invention as set forth
20 in the appended claims.

I claim:

1. A splint-forming preparation comprising approximately one to three parts, by weight, of sheeted fibrous material impregnated with three
25 to four parts, by weight, of water insoluble resin-like substance and sufficient volatile organic solvent to render said resin-like substance flaccid, the preparation being adapted to be applied to an injury in layers and the resin-like
30 substance being self-welding during evaporation of the solvent and, when complete evaporation has occurred, forming, with the fibrous material, a rigid porous structure.

2. As an article of manufacture, a package of 35 splint-forming material comprising a strip of fibrous material impregnated with a water-insoluble resin-like substance dispersed in a volatile solvent, said impregnated strip being in a plastic and flaccid condition by reason of its contained solvent, said strip being sealed in a vapor
40 tight container with a charge of said solvent to provide and maintain an atmosphere of the solvent vapor, so that upon opening of the container the strip will be in a flaccid condition and with
45 the resin-like substance sufficiently dispersed to be self-welding upon evaporation of the solvent from the material.

STANLEY P. LOVELL.