Jan. 15, 1952 J. J. EBERL 2,582,242

CAST FOR ORTHOPEDIC USE

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Fig. 1.

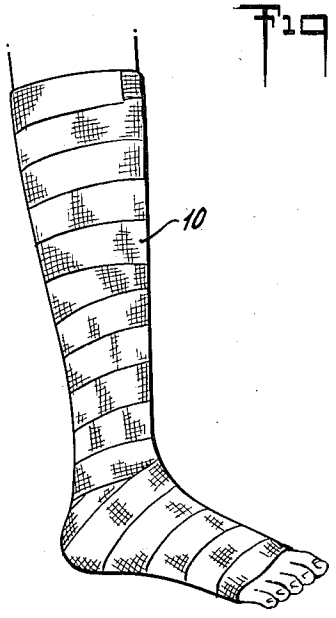


Fig. 2.

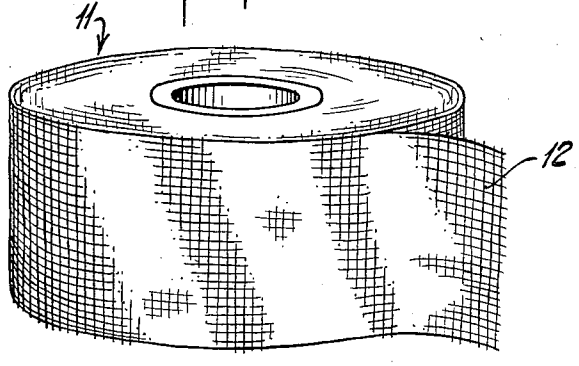
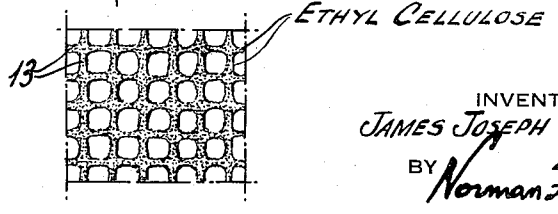


Fig. 3.



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CAST FOR ORTHOPEDIC USE

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6 Claims. (Cl. 128—90)

1

This invention relates to improved resin casts for orthopedic use and to a process of forming the same and is concerned particularly with casts that are applied from solvent.

In the past, orthopedic casts were usually based on plaster of Paris which was mixed with water in the form of a heavy paste, applied to a body member and allowed to set, but more recently a type of bandage has become available wherein a porous web, e. g. crinoline, impregnated with particles of plaster of Paris, is dipped in water for a few seconds, then wrapped around the body member and allowed to set. Although plaster of Paris bandages are used extensively they have certain important disadvantages such as undue weight and high bulk, a high degree of X-ray opacity, and imporousness The heavy weight and high bulk of plaster of Paris bandages are disadvantages in casts that are worn by ambulatory patients, the X-ray opacity prevents observation by the physician of callus formation and the imporousness of plaster of Paris casts prevents "breathing" of the wound or elimination of perspiration and is accordingly responsible for some of the disagreeable odor that is so often associated with casts that have been worn for long periods of time. Moreover, plaster of Paris does not reach its maximum strength during its setting process until one or two days after application and the amount of heat that is given off by the cast during its initial setting makes the cast uncomfortable to the patient.

In view of the above-mentioned disadvantages of plaster of Paris casts, bandages based on synthetic or natural resins have been under development for some time. Their use requires application by wetting of the bandage with solvent, bandaging of the patient, and evaporation of the solvent as the cast dries out and gains its strength. In the past development of this type of cast, the resins used and the type of cast desired necessitated the use of highly toxic or inflammable organic solvents. To many patients and physicians the disadvantages inherent in the use of these solvents outweighed the advantages to be gained by using casts based on materials other than plaster of Paris. In one case, death of a patient was reportedly due to the action of the solvent used in application of the cast. Prior to the invention, surgical casts based on resins or polymers that would not require use of toxic or inflammable solvents were not used.

This invention provides a means of applying bandages comprising high polymers wherein there are used solvents that are substantially free

2

of toxicity and is based upon the discovery that chlorofluoroparaffins that are liquid at normal room temperatures and that boil at temperatures between 35 and 85° C. in admixture with mutual solvents for ethyl celulose and chlorofluoroparaffins, form satisfactory solvents for ethyl cellulose.

Other objects and advantages of the invention will be apparent from the following description of practical embodiments thereof, furnished by way of example only and not in order to limit the invention, particularly when considered in connection with the drawing wherein:

Fig. 1 is a view in perspective of a resin cast in accordance with the invention made from an orthopedic bandage as described herein;

Fig. 2 is a view in perspective of a roll of orthopedic bandage made in accordance with the invention;

Fig. 3 is an enlarged plan view showing a small part of an orthopedic bandage made in accordance with the invention.

In carrying the invention into practice, fibrous material 12 of great porosity (e. g. crinoline of wide mesh) is impregnated with ethyl cellulose 13 so as to provide a bandage composed of a major proportion, by weight, of ethyl cellulose. The bandage is activated by wetting with a non-toxic, non-irritant solvent mixture therefor comprising a major proportion by weight of a liquid chlorofluoroparaffin and a minor proportion of a mutual solvent for ethyl cellulose and chlorofluoroparaffin. At least 3% mutual solvent, based on the total weight of the solvent mixture, is necessary to provide sufficient solubility for the ethyl cellulose in the solvent. The wetted bandage is applied by wrapping it around the body member and on evaporation of the solvent a rigid, well-laminated cast results. This cast is of light weight and low bulk and exceeds in strength a cast of comparable weight made from plaster of Paris. The orthopedic bandage made according to the invention may be coiled into a roll 11 as illustrated in Fig. 2 and is applied normally to form an orthopedic cast 10 as illustrated in Fig. 1.

While any of the various available types of ethyl cellulose may be used in executing the invention, ethyl cellulose having an ethoxyl content of between 45 and 50% by weight and a viscosity of 10 centipoises or less in a solution comprising 5% ethyl cellulose in 80 parts by weight of toluene and 20 parts by weight of ethyl alcohol is preferred because this type of ethyl cellulose is most readily wetted by the solvent and requires

less solvent for application. The amount of ethyl cellulose present may vary substantially but is usually in the range of 50 to 75% of the total weight of the bandage. Bandages having percentages of ethyl cellulose substantially less than 50% of the total weight produce a weak cast while those having amounts in excess of 75% produce a cast that dries too slowly. At an ethyl cellulose content near 65% bandages are obtained that have desirable high strength and a satisfactory drying time.

The fibrous material base may comprise any of the well-known web-forming fibrous materials such as cotton, rayon, linen, etc. It is preferable that the fibrous material be in the form of a fairly open woven gauze, of cheese cloth, or of tobacco cloth. The ethyl cellulose may be applied to the web in the form of an emulsion, or ethyl cellulose fibers may be interwoven with the other fibrous material. The mesh of the bandage is adjusted so that substantial strength and good porosity are obtained.

The principal component of the solvent is a chlorofluoroparaffin preferably one having 5 or less carbon atoms in the molecule and either in itself having a boiling point in the range of 35–85° C. or, in any case, adapted to provide a mixture having a boiling point within that range when combined with a minor portion of a mutual solvent for both the chlorofluoroparaffin and the ethyl cellulose. Various chlorofluoroparaffins may be combined to produce a solvent composition that complies with the above specification and all such solvent compositions are included in the inventive concept. By way of example only, the following chlorofluoroparaffins may be utilized: 1-monochloro-2,2-difluoroethane, any trichlorotrifluoroethane, 1-monochloro-2,2-difluoropropane, 2-monochloro-3,3-difluoropropane, 1-monochloro-3,3-trifluoropropane, 1,2-dichloro-1,1-difluoropropane, 1,1-dichloro-3,3,3-trifluoropropane, 1,2-dichloro-1,1,2-trifluoropropane, 1,2-dichloro-3,3,3-trifluoropropane, 1,2-dichloro-1,1,2,3,3,3-hexafluoropropane, 1,1,2-trichloro-1,2-difluoropropane, 1,1,2-trichloro-1,2,3,3,3-pentafluoropropane, 1,1,2,3-tetrachloro-1,3,3-trifluoropropane, 2-monochloro-2-monofluorobutane, 2-monochloro-3,3-difluorobutane, 2-monochloro-2,3,3-trifluorobutane, and 1,1,1-trichloro-2,2,3,3-tetrafluorobutane. In general, all chlorofluoroparaffins falling within the specifications given earlier in this description, are satisfactory solvents for ethyl cellulose provided they are used in admixture with minor proportions of lower alcohols, esters, ethers or ketones or other mutual solvents. Among the mutual solvents, use is made preferably of ethyl alcohol but methyl or propyl alcohol or butyl alcohol and related alcohols, esters and/or ketones having eight or less carbon atoms in the molecule can be used. The advantage of ethyl alcohol is its relatively low toxicity and the relatively small proportion necessary to effect satisfactory wetting of ethyl cellulose. These two factors combine to provide maximum safety for patient and physician. Examples of esters that work satisfactorily are methyl acetate, ethyl acetate, propyl acetate, butyl acetate, ethyl propionate, butyl propionate; of ethers, ethyl ether and propyl ether; of ketones, acetone, methyl ethyl ketone, methyl isopropyl ketone, di-isopropyl ketone and mesityl oxide. The amount of solvent used is preferably between 200 and 300 parts of solvent per 100 parts of ethyl cellulose, and about 250 parts of solvent per 100 parts of ethyl cellulose is most desirable. To control the amount of solvent, the materials can be accurately measured and may be placed in a sealed container, as for example a tin can in which they may be stored for use by the physician.

In order to disclose the nature of the present invention more clearly, a preferred embodiment thereof will now be described in considerable detail. It is to be understood, however, that this is done merely by way of example and solely for the purpose of illustrating by means of a specific example the basic principles which are broadly applicable to all the embodiments contemplated by the invention. In other words, the invention is not restricted in any way to the specific example hereinafter described.

Example

An open mesh, gauze-type cotton cloth having from five to twenty openings to the inch in each direction was impregnated with an ethyl cellulose emulsion comprising:

	Parts
Ethyl cellulose	50
Xylene	84
Butanol	14
Water	99
Sorbitol mono-oleate wetting agent	2
Dioctyl ester of sodium sulfosuccinic acid	1

In preparing the emulsion the ethyl cellulose was first dissolved in the mixed solvent and the wetting agent then added. This solution was heated on a steam bath and added under rapid stirring to a hot aqueous solution of the sulfosuccinate. The emulsion thickened somewhat on cooling and was applied to the cloth by a spreading action as with a knife spreader. The bandage was then dried in an oven and was found to contain approximately six parts by weight of ethyl cellulose solids and approximately four parts of base cloth.

In use, the bandage was immersed in about 2½ times its weight of a solution of ninety parts of trichlorotrifluoroethane and ten parts of ethyl alcohol. The bandage was then wound around a body member and allowed to set, preferably by directing thereon a warm air blower across the surface thereof. The bandage hardened substantially in less than one-half hour and was completely dried in about three hours.

While in the above example the ethyl cellulose was applied in the form of an emulsion, it may be applied with good results by other methods such as by solvent or hot melt coating. The solvent mixture used may be composed of any chlorofluoroparaffin, and particularly of any of those listed earlier in this specification, and may comprise any lower alcohol, ester or ketone as above defined provided the boiling point of the resulting solvent mixture is in the range of 35–85° C. 3–15% of the mutual solvent and the remainder chlorofluoroparaffin are preferred in the solvent composition. The casts may be canned in the solvent or stored separately from the solvent and wetted thereby immediately prior to application.

In the first few minutes of drying, plaster casts have greater strength than comparable resin casts of the type disclosed in the invention, but as drying proceeds the resin casts of the invention gain strength more rapidly than plaster casts and exceed the latter materially in strength. Tests indicate that after about 3½ hours of drying time, casts prepared according to the invention are highly superior in strength to plaster of Paris casts of the same weight. Resin casts

having three to four times the strength of comparable plaster casts were obtained in accordance with this invention. Much lighter casts attain strength equal to that of the heavier plaster casts. Moreover, the cast of the present invention is not only lighter in weight but also highly permeable to air and its use permits ready escape of perspiration from the body member in the cast.

All embodiments within the scope of this specification and/or the appended claims are comprehended in the invention. Many modifications may be made without departing from the spirit and scope of the invention. All variations and modifications are to be understood as included within the scope of the following claims.

The claims are:

1. The process of applying to a body an orthopedic cast characterized by having a base comprising a porous fabric impregnated with ethyl cellulose, the steps of activating said ethyl cellulose in the fabric by wetting with a solvent composition boiling in the range of 35–85° C. and comprising a major proportion by weight of a chlorofluoroparaffin and a minor proportion, less than fifteen per cent by weight, of a mutual solvent for said chlorofluoroparaffin and said ethyl cellulose and selected from the group consisting of the lower alcohols, esters, ethers, and ketones having eight or less carbon atoms per molecule, and applying said impregnated and activated fabric to a body, permitting the solvent composition to evaporate.

2. The process of applying to a body an orthopedic cast characterized by having a base comprising a light weight porous fabric having from 5 to 20 strands to the inch in each direction impregnated with ethyl cellulose to the extent of 50–75 per cent by weight of the finished product, the steps of activating said ethyl cellulose in the fabric by wetting using a solvent composition boiling in the range of 35–85° C., and comprising a major proportion of trichlorotrifluoroethane and a minor proportion, less than fifteen per cent by weight, of ethyl alcohol, applying said impregnated and activated fabric to a body and permitting said solvent composition to evaporate from said fabric.

3. The process of applying to a body an orthopedic cast characterized by having a base comprising a light weight porous fabric impregnated with ethyl cellulose, the steps of activating said ethyl cellulose in the fabric by wetting with a solvent composition that is liquid at normal room temperatures, boils in the range of 35–85° C., and comprises a major proportion of chlorofluoroparaffin and a minor proportion, less than 15 per cent by weight of said solvent composition, of an alcohol solvent for said chlorofluoroparaffin and said ethyl cellulose and applying said impregnated and activated fabric to a body, permitting said solvent composition to evaporate from said fabric.

4. The process of applying to a body an orthopedic cast characterized by having a base comprising a light weight porous fabric having from 5 to 20 strands to the inch in each direction impregnated with ethyl cellulose to the extent of 50–75 per cent by weight of the finished treated fabric, the steps of activating said ethyl cellulose in the fabric by wetting it with a solvent composition that is liquid at normal room temperatures, boils in the range of 35–85° C., and comprises a major proportion by weight of a chlorofluoroparaffin and a minor proportion, less than fifteen per cent by weight, of a mutual solvent for said chlorofluoroparaffin and said ethyl cellulose and selected from the group consisting of the lower alcohols, esters, ethers, and ketones having eight or less carbon atoms per molecule, and applying said impregnated and activated fabric to a body, permitting said solvent composition to evaporate from said fabric.

5. The process of applying to a body an orthopedic cast characterized by having a base comprising a light weight porous fabric impregnated to the extent of 50–75 per cent by weight of the finished treated fabric with ethyl cellulose having an ethoxyl content between 45 and 50 per cent and a viscosity of not more than 10 centipoises when in solution comprising 5 per cent ethyl cellulose in 80 parts by weight of toluene and 20 parts by weight of ethyl alcohol, the steps of activating said ethyl cellulose in the fabric by wetting it with a solvent composition comprising a major proportion of trichlorotrifluoroethane and a minor proportion, 3–15 per cent of the weight of said solvent composition, of ethyl alcohol, applying said impregnated and activated fabric to a body and permitting said solvent composition to evaporate from said fabric.

6. In the process of applying to a body an orthopedic cast characterized by having a base comprising a light weight porous fabric impregnated with ethyl cellulose, the step of activating said ethyl cellulose in the fabric by wetting with a solvent composition boiling in the range of 35–85° C. and comprising a major proportion by weight of a chlorofluoroparaffin and a minor proportion, less than fifteen per cent by weight, of a mutual solvent from said chlorofluoroparaffin and said ethyl cellulose and selected from the group consisting of the lower alcohols, esters, ethers, and ketones having eight or less carbon atoms per molecule.

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