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METHOD OF MAKING A SURGICAL CAST

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This invention relates to a method of preparing rigid supporting means and the main aspect of the invention is concerned with the preparation of surgical casts or splints.

Hitherto, the most widely used method of immobilising and supporting parts of the human body, has been to employ casts formed with plaster of Paris. This method involves the preparation of bandages in the form of plaster coated strips of cotton fabric, dipping these strips in water, applying the moistened bandages around the appropriate part of the body and allowing the plaster to dry and set after which it will act as a rigid supporting means. Casts formed by this method, however, have certain disadvantages in that they are absorbent to fluids including liquids secreted from the body, they are comparatively heavy, they take a long time to set during which time adverse therapeutic conditions are liable to be established, they are substantially impervious to electrical rays, and, in the course of absorbing fluid, they are weakened.

In an effort to overcome the disadvantages inherent in the plaster of Paris type of cast, it has been proposed to form an entirely different kind of support by the method of applying to the part of the body to be immobilised, layers of fabric having threads which comprise soluble plastic material, treating the fabric with a solution which exerts a weak solvent action on the material and has a saturation value therefor of less than 300 milligrams per 100 cubic centimeters of treating solution at 70 degrees Fahrenheit, and allowing the fabric to form into the shape desired and, upon removal of the solvent, to become set and rigid.

Though a surgical cast formed in this manner possesses many advantages over the conventional plaster of Paris cast, the threads of the fabric when treated with solution of the kind specified contract to an extent sufficient in many cases to occasion severe discomfort to the patient. It has been proposed, in order to overcome this difficulty, to include in the method set forth, the step of shrinking the fabric prior to treatment with the specified weak solvent solution. Alternatively, it has been proposed to utilise fabrics which, in addition to threads formed with soluble plastic material, contain threads which are inert to the action of the solvent solution.

The difficulty has, however, arisen that, in the case of a fabric consisting of threads of soluble plastic material, irrespective of the manner in which the fabric has been shrunk, subsequent treatment of the fabric with weak solvent solution of the kind specified has resulted in casts having inadequate rigidity. Furthermore, the use of fabrics having inert threads does not resolve the difficulty in an entirely satisfactory manner and involves a considerable increase in cost as such fabrics are relatively very expensive to produce.

It is an object of the present invention to provide a method of forming improved supporting means from fabrics consisting of threads comprising soluble plastic

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material. A further object of the invention is to provide rigid supporting means at relatively low cost.

The features of novelty characterising our invention are pointed out in the claims annexed to and forming part of the present specification. The above and further objects and advantages of the invention will be apparent from the following description in which we have described preferred embodiments of our invention.

The invention finds its widest application in the sphere of medicine where it is used in the formation of rigid surgical supports. Preferably, in the formation of such supports, on the part of the body to be supported, are wound a couple of layers of the fabric consisting of threads containing over 90 percent of cellulose acetate. The layers of fabric so mounted are treated with a solvent solution which has a saturation value for cellulose acetate of less than 300 milligrams per 100 cubic centimeters of solution. The analyses by weight of three suitable solutions which fall within this range are as follows:

Example (a):

	Percent
Methanol	35.50
Isopropyl alcohol	35.43
Dimethyl ketone	28.55
Formaldehyde	0.25
Diacetone alcohol	0.15
Benzaldehyde	0.10
the balance being colour and perfume.	

Example (b):

Methanol	33.43
Ethanol	15.50
Methyl ethyl ketone	35.20
Benzyl alcohol	10.55
Acetaldehyde	3.20
Benzaldehyde	2.07
the balance being colour and perfume.	

Example (c):

Ethanol	61.04
Isoamyl alcohol	7.27
Formaldehyde	1.15
Dimethyl ketone	25.50
Methyl isobutyl ketone	4.55
Diacetone alcohol	0.33
Acetophenone	0.12
the balance being colour and perfume.	

After treatment with one of the abovementioned solutions the layers are allowed to dry for about half a minute and a further couple of layers are wound over the layers first applied and the process of treatment with the solution is repeated. In this way an appropriate number of layers of processed fabric is applied to the part of the body which is to be immobilised. In the case of minor casts utilised, for example, for immobilising fingers or toes, six layers of fabric will normally provide a cast of adequate strength. However, for major casts utilised, for example, to immobilise arms or legs, between eight and twelve layers of fabric are usually required. The solutions quoted in Examples a, b or c are applied so as to effect shortening of the threads of the fabric and in the interests of economy, can, advantageously, be applied by means of a sponge or brush. When a sufficient number of layers of material have been applied and treated as described above with one of the relatively weak solvent solutions of Examples a, b or c, the material is then subjected to treatment with a relatively strong solution having a saturation value for cellulose acetate of between 400 and 100,000 milligrams per 100 cubic centimeters of solution at 70 degrees Fahrenheit. The analyses by weight of three relatively strong solvent solu-

tions falling within the desired solubility range are as follows:

Example 1:

	Percent
Ethanol -----	5.40
Isoamyl alcohol -----	0.75
Formaldehyde -----	1.15
Dimethyl ketone -----	87.50
Methyl isobutyl ketone -----	4.75
Diacetone alcohol -----	0.33
Acetophenone -----	0.12
the balance being colour and perfume.	

Example 2:

Methanol -----	5.50
Isopropanol -----	5.45
Dimethyl ketone -----	88.55
Formaldehyde -----	0.25
Diacetone alcohol -----	0.15
Benzaldehyde -----	0.10
the balance being colour and perfume.	

Example 3:

Methanol -----	3.50
Ethanol -----	1.55
Methyl ethyl ketone -----	92.15
Benzyl alcohol -----	1.55
Acetaldehyde -----	0.35
Benzaldehyde -----	0.90
the balance being colour and perfume.	

After the fabric layers have been treated with one of the relatively strong solvent solutions enumerated above, they are allowed to dry whereupon they form a cast which is sufficiently rigid, comparatively light in weight, permeable to electrical rays and waterproof.

Both in Examples *a*, *b* and *c*, and Examples 1, 2 and 3, it is the ketone component which acts as the main solvent for the cellulose acetate in the threads of the fabric whilst the remaining components serve principally as diluents.

The action on a fabric consisting of threads comprising soluble plastic material of a solvent solution which in respect of such material has a saturation value at 70 degrees Fahrenheit of between 400 and 100,000 milligrams per 100 cubic centimeters of solution, results, in the case of a fabric which has not been processed so as to shorten its threads, in at least a partial breakdown of the fabric which arises from the tendency of its threads, under the influence of the solution, to flow. However, in the method according to the present invention the action of solvents having relatively higher saturation values than those employed hitherto on fabrics processed so as to shorten the threads thereof does not occasion any appreciable breakdown of the said threads. The explanation of this phenomenon is thought to reside both in the fact that the increased density of the soluble plastic material of the threads which is evident after contraction thereof, reduces the availability to the solvent of the soluble plastic material also, and particularly where the desired processing of the threads is brought about by treatment, as hereinbefore set forth, with solvent solution having a relatively low saturation value, one of the physical changes wrought in the fabric during the processing thereof is such as to produce a reduced capillary attraction of the fabric for the solvent solution, which, in view of the volatility of the solvent solution, makes for reduced action by the solvent and suggests that effective further plasticising of the fabric will require the use of solvents having relatively higher saturation values. Another factor to be taken into account is that the contraction effected in the threads is accompanied by a certain thickening thereof which renders the threads able to withstand subsequent application of solvents having relatively high saturation values without appreciably breaking down.

Though, the processing of the fabric for the purpose of shortening its threads may be carried out by heat treatment under controlled conditions, the processing is effected, preferably, by treatment with a solvent solution which has a saturation value for the soluble plastic material of less than 300 milligrams per 100 cubic centimeters of solution at 70 degrees Fahrenheit.

The nature of the fabric to be employed depends on the type of support to be formed. For example, in accordance with a feature of the invention a splint can be secured and supported against a part of the body in order to immobilise the part and the supporting means may include a relatively thin and relatively closely knit or woven fabric. A suitable fabric would be one formed with a lock knit stitch and comprising acetate yarn of 75 denier weight. If, on the other hand it is intended that the fabric shall provide the sole support, though a relatively thin fabric of the kind set forth is preferable, a relatively thick and relatively loosely knitted fabric may be used, a suitable example being a fabric comprising yarn of 120 denier weight and formed with a knitted sleeve stitch.

Thus the invention also includes the method of forming a rigid support by locating a splint alongside the part of a body upon which the support is to be formed, and, in desired sequence, binding the splint to the part with a fabric consisting of threads comprising soluble plastic material which are processed so as to shorten said threads, and treating the fabric with a volatile solution which exerts a solvent action on the soluble plastic material of threads of the fabric, which has, in respect of the said material, a saturation value, at 70 degrees Fahrenheit, of between 400 and 100,000 milligrams per 100 cubic centimeters of the treating solution and which is allowed to evaporate whilst the fabric is in position on the part.

It will be appreciated that the processing of the fabric for the purpose of shortening its threads may be carried out prior to the mounting of the fabric on the part to be immobilised since the heating of the fabric or/and the treatment thereof with weak solvent solution does not deprive the fabric, to an appreciable extent, of its flexibility.

It is desirable, when using a relatively thin fabric of the kind specified in the case where the processing of the fabric for the purpose of shortening its threads is carried out prior to the application thereof to the part to be immobilised, to double the thickness thereof prior to the shrinking process during which the adjacent layers of fabric become bonded together.

The measurement of the saturation value of a particular solvent may readily be determined by placing in a known volume of solvent solution contained within an appropriate vessel an excess of the soluble plastic material in finely divided form, preventing the solution from evaporating by keeping the vessel closed and allowing the solvent to act over a period of several hours, the ambient temperature being maintained at 70 degrees Fahrenheit. The saturated solvent solution may then be filtered off and evaporated to dryness. After evaporation the residue is weighed and the saturation value may then be estimated.

Supporting means, according to the present invention, are possessed of adequate rigidity and are relatively cheap to produce since they involve the use of fabrics the threads of which are of the same material. Also they are light in weight and of inconsiderable volume. Furthermore, such supporting means are waterproof and permeable to electrical rays.

Though the invention is principally concerned with the formation of rigid surgical supporting means, the methods set forth above can be utilised, because of the waterproof nature of the casts so formed, for effecting temporary repairs in broken pipes. Accordingly, the supports described can be used to seal a crack in a pipe or to join the broken ends of a pipe together provided the pipe,

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during service, is not subjected to inordinately high temperatures.

What we claim is:

1. The method of forming a rigid supporting means, which includes the steps of processing a fabric consisting of threads comprising cellulose derivative material by treating a fabric with a volatile solution which exerts a solvent action on the soluble plastic material of the fabric and which has in respect of the said material a saturation value at 70 degrees Fahrenheit of less than 300 milligrams per 100 cubic centimetres of the solution, and applying at least one layer of the fabric to the part of a body upon which the supporting means is to be formed, these steps being carried out in desired sequence, and, subsequently, treating the fabrics so processed and mounted in position with a volatile solution which exerts a solvent action on the cellulose derivative material of the threads of the fabric, which has, in respect of the said material a saturation value at 70 degrees Fahrenheit, of between 400 and 100,000 milligrams per 100 cubic centimetres of the treating solution and which is allowed to evaporate whilst the fabric is in position on the part.

2. The method as claimed in claim 1, wherein the processing of the fabric is carried out by treating the fabric with a volatile solution having substantially the following composition by weight:

	Percent
Methanol	35.50
Isopropyl alcohol	35.43
Dimethyl ketone	28.55
Formaldehyde	0.25
Diacetone alcohol	0.15
Benzaldehyde	0.10

the balance being colour and perfume.

3. The method as claimed in claim 1, wherein the processing of the fabric is carried out by treating the fabric with a volatile solution having substantially the following composition by weight:

	Percent
Methanol	33.43
Ethanol	15.50
Methyl ethyl ketone	35.20
Benzyl alcohol	10.55
Acetaldehyde	3.20
Benzaldehyde	2.07

the balance being colour and perfume.

4. The method as claimed in claim 1, wherein the processing of the fabric is carried out by treating the fabric with a volatile solution having substantially the following composition by weight:

	Percent
Ethanol	61.04
Isoamyl alcohol	7.27
Formaldehyde	1.15
Dimethyl ketone	25.50
Methyl isobutyl ketone	4.55
Diacetone alcohol	0.33
Acetophenone	0.12

the balance being colour and perfume.

5. The method as claimed in claim 1, wherein the processed and mounted fabric is treated with a volatile solution having the following composition by weight:

	Percent
Ethanol	5.40
Isoamyl alcohol	0.75
Formaldehyde	1.15
Dimethyl ketone	87.50
Methyl isobutyl ketone	4.75
Diacetone alcohol	0.33
Acetophenone	0.12

the balance being colour and perfume.

6. The method as claimed in claim 1, wherein the pro-

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cessed and mounted fabric is treated with a volatile solution having the following composition by weight:

	Percent
5 Methanol	5.50
Isopropanol	5.45
Dimethyl ketone	88.55
Formaldehyde	0.25
Diacetone alcohol	0.15
10 Benzaldehyde	0.10

the balance being colour and perfume.

7. The method as claimed in claim 1, wherein the processed and mounted fabric is treated with a volatile solution having the following composition by weight:

	Percent
Methanol	3.50
Ethanol	1.55
Methyl ethyl ketone	92.15
20 Benzyl alcohol	1.55
Acetaldehyde	0.35
Benzaldehyde	0.90

the balance being colour and perfume.

8. The method as claimed in claim 3, wherein the processing of the fabric is carried out by treating the fabric with a volatile solution having substantially the following composition by weight:

	Percent
30 Methanol	35.50
Isopropyl alcohol	35.43
Dimethyl ketone	28.55
Formaldehyde	0.25
Diacetone alcohol	0.15
35 Benzaldehyde	0.10

the balance being colour and perfume, and the processed and mounted fabric is treated with a volatile solution, having the following composition by weight:

	Percent
40 Ethanol	5.40
Isoamyl alcohol	0.75
Formaldehyde	1.15
Dimethyl ketone	87.50
45 Methyl isobutyl ketone	4.75
Diacetone alcohol	0.33
Acetophenone	0.12

the balance being colour and perfume.

9. The method as claimed in claim 1, wherein the processing of the fabric is carried out by treating the fabric with a volatile solution having substantially the following composition by weight:

	Percent
55 Methanol	33.43
Ethanol	15.50
Methyl ethyl ketone	35.20
Benzyl alcohol	10.55
Acetaldehyde	3.20
60 Benzaldehyde	2.07

the balance being colour and perfume, and the processed and mounted fabric is treated with a volatile solution, having the following composition by weight:

	Percent
65 Methanol	5.50
Isopropanol	5.45
Dimethyl ketone	88.55
Formaldehyde	0.25
70 Diacetone alcohol	0.15
Benzaldehyde	0.10

the balance being colour and perfume.

10. The method as claimed in claim 1, wherein the processing of the fabric is carried out by treating the

fabric with a volatile solution having substantially the following composition by weight:

	Percent	
Ethanol -----	61.04	5
Isoamyl alcohol -----	7.27	
Formaldehyde -----	1.15	
Dimethyl ketone -----	25.50	
Methyl isobutyl ketone -----	4.55	
Diacetone alcohol -----	0.33	10
Acetophenone -----	0.12	

the balance being colour and perfume, and the processed and mounted fabric is treated with a volatile solution, 15 having the following composition by weight:

	Percent
Methanol -----	3.50
Ethanol -----	1.55
Methyl ethyl ketone -----	92.15
Benzyl alcohol -----	1.55
Acetaldehyde -----	0.35
Benzaldehyde -----	0.90

the balance being colour and perfume.

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