July 25, 1967 L. BRICKMAN ETAL 3,332,416

CAST FORMING ELEMENTS AND METHOD OF MAKING THE SAME

Filed April 8, 1963

Fig. 1.

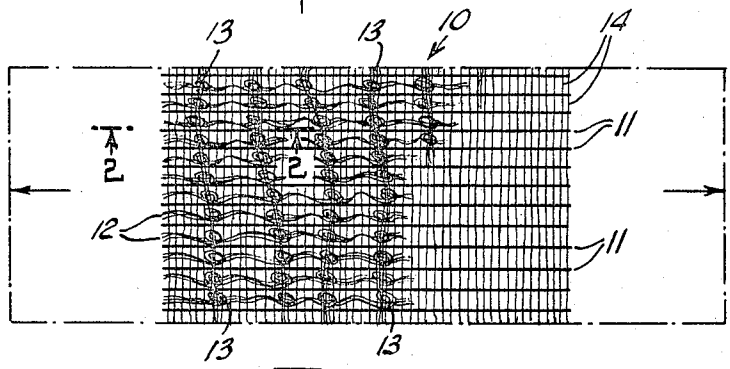


Fig. 3.

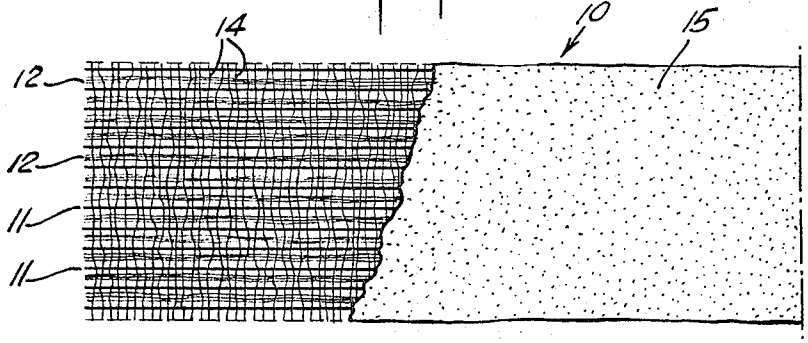


Fig. 2.

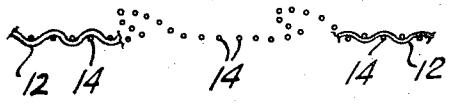
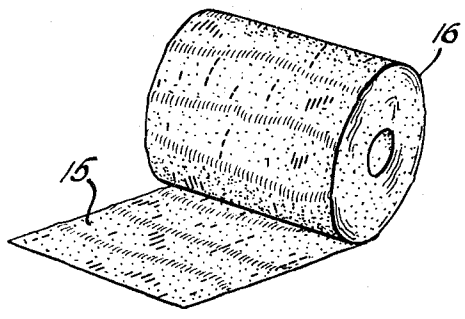


Fig. 4.



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CAST FORMING ELEMENTS AND METHOD OF MAKING THE SAME

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8 Claims. (Cl. 128—91)

This invention relates to cast forming elements designed to be used for immobilizing or supporting parts of the body, and more particularly to cast forming elements that are elastic or extensible at the time of their application.

Cast forming elements have heretofore been made by coating or impregnating a flexible carrier or backing with plaster of Paris or other suitable activatable cast forming materials. These cast forming elements are utilized in making casts that fit closely to the part of the body requiring immobilization or support. They are usually in strip form, wound into a roll, or suitably precut to the desired shape as, for instance, in the manufacture of arm splints. The backing material generally heretofore used has been of woven gauze or crinoline of suitable mesh. In use, the cast forming element, such as a bandage, is treated with an activating liquid, generally by immersion, and the excess liquid then squeezed out by hand pressure. The bandage is then applied to the body in spiral form until enough thickness has been built up to provide the cast strength needed.

It has been observed that a tighter and more conforming wrap can be obtained by using, as the backing or base fabric material, an extensible fabric that is elastic in nature. Such a fabric can, for example, be treated with plaster of Paris, in the form of fine powder, by dusting or otherwise coating the fabric. The bandage thus prepared can then be immersed in water to activate the plaster of Paris and the bandage then applied. The loose plaster bandage, however, has marked disadvantages. The plaster is not firmly secured to the backing and tends to drop off in dry handling and wash off during immersion of the bandage prior to application by the physician. This loss of plaster results in the production of casts of non-uniformity and generally low strength. When attempts are made to wet-coat the elastic fabric backing as by coating with a slurry of the cast forming material and then drying, any tension that the dried coated fabric encounters, after the plaster of Paris or other cast forming material has dried stretches the fabric, thus loosening the plaster coating with the result that many of the disadvantages occurring with the dry coating are still encountered. As the bandage material cannot be handled in later operations, such as slitting of the coated fabric and rolling of the coated fabric into small individual rolls without tension, much of the cast forming material is loosened from the backing during manufacture of the bandage with the result that the loose plaster of Paris or other cast forming materials drop off or are washed off as with loose plaster bandages that have not been wet coated.

Another difficulty encountered with elastic cast forming bandage materials is that if the materials are stretched to too great an extent, undesirable overconstriction of the wrapped member can result due to the build-up of too much elastic pressure in the wrapping.

It is an object of the present invention to prepare elastic cast wrappings which are limited in their degree of stretch so that they will not be overly stretched during application of the bandage. A further object of the present invention is to prepare elastic cast wrapping materials that are inelastic while dry so that the same will not stretch during dry handling and loosen the settable, cast forming material from the backing. A still further object is to prepare dry, inelastic strips of cast forming material that become elastic on wetting with an activating liquid just prior to use. Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein are set forth by way of illustration and example certain embodiments of this invention.

It has been found that the above difficulties with respect to elastic cast forming elements can be obviated and the above and other objects obtained by using as the backing or base fabric a loose weave fabric that contains both elastic and inelastic warp threads, wet-coating the fabric with a settable cast forming composition while fully extended and then, while still extended, drying the same. The base fabric in its relaxed state should have a length which is substantially less than the length of the inelastic warp threads. The best results are obtained by using as a backing fabric, a fabric having a stretch of about 40–200% of its relaxed length. The stretch of the fabric is limited by the inelastic warp threads which are fully extended when the fabric is fully stretched. Also, preferably the base fabric should exert a pull of about 60–200 grams for a section 6 inches long and 1 inch wide when extended to the point of removing wrinkles. When applying the plaster of Paris or other cast forming material, the extensible fabric is first stretched to its full limit as controlled by the inelastic warp threads and while held in this stretched condition is coated with a slurry or paste of the plaster of Paris or other cast forming material. The coated fabric is then, without relaxing the stretch, dried in its fully extended state. After drying, the impregnated or coated fabric remains in its fully extended state, it being held in this state by the dried, adhering cast forming material. The dried, coated fabric is cut into the desired widths, formed into rolls, and packaged. In cutting the dry, coated fabric, the bandage strips are cut so that the elastic and inelastic warp threads run lengthwise of the same. The bandage material so formed remains in an inextensible, i.e., an inelastic state until wetted just prior to use. On wetting, the coating material again assumes a pasty consistency whereupon the fabric contracts, becoming again elastic so that it is in a relaxed elastic state during application of the bandage wrap to the injured member while forming the cast.

Although various cast forming materials which are activated by wetting are known and can be used in making the cast forming elements of the present invention, the material most commonly used is plaster of Paris, the same generally either being used alone or with small amounts of various modifying resins, such, for example, as described in U.S. Patent Nos. 2,557,083, 2,842,121 and 2,842,138. Accordingly, in describing the practice of the present invention, plaster of Paris cast forming material will be used, the same being applied in the manner described in Patent No. 2,557,083 in the form of an aqueous slurry with a retarder such as ammonium borate.

In practicing the present invention, any fabric may be used which contain both inelastic and elastic warp threads, the inelastic warp threads being from about 1.4 to 3 times the length of the elastic warp threads when the elastic warp threads are in their relaxed state. The fabrics used are open mesh fabrics preferably having an open mesh of about 30 to 36 threads per inch with inelastic warp threads preferably positioned in between the elastic warp threads.

In order to further illustrate the present invention, reference is made to the drawings in which:

FIG. 1 is an elastic backing fabric shown in its relaxed state;

FIG. 2 is a cross-sectional view of the backing fabric taken along lines 2—2 of FIG. 1;

FIG. 3 illustrates the same elastic backing fabric of FIG. 1 under tension and partially coated with an aqueous slurry of plaster of Paris; and

FIG. 4 is a bandage roll of the coated and dried product of FIG. 3 with part of the plaster bandage unrolled.

Although various elastic fabrics can be used, reference will be made, in describing the practice of the present invention, to the particular fabric illustrated in FIG. 1 of the drawings. Referring to FIG. 1, the fabric **10** is illustrated as it appears in its relaxed state prior to being placed under lengthwise tension. The warp threads of the fabric consist of elastic threads **11** and inelastic threads **12**. The elastic threads **11** are formed of natural rubber or other similarly elastic material. The threads may be either bare or wrapped, as is common practice in the making of elastic fabrics. The inelastic warp threads **12** in the fabric illustrated are placed between the elastic threads, there being several inelastic threads between any pair of elastic threads. The inelastic threads may be made of any suitable material, such, for example, as cotton, rayon, nylon, or other inelastic materials used in making woven fabrics. In the fabric as shown, the inelastic warp threads **12** are quite loose containing many loops **13** caused by the relaxation of the elastic warp threads **11**. As the inelastic warp threads **12** in the fabric illustrated are about twice the length of the elastic warp threads **11** when relaxed, when the fabric is extended to its full length the fabric will be about twice the length that it has in the relaxed state.

The fabric illustrated is a loose weave fabric containing about 30 warp and 30 weft threads to the square inch. In the particular fabric illustrated, all of the weft threads **14** are inelastic. However, if desired, some or all of the weft threads may be elastic. However, little advantage is obtained by having the weft threads elastic since any pull in applying the bandage in the lengthwise direction.

In preparing the plaster wraps, the fabric of FIG. 1 is placed under tension so as to fully extend the same, the loops **13** disappearing as illustrated in FIG. 2. While fully extended, the fabric is coated by spreading with or immersion in a slurry of plaster of Paris in water. The slurry, as in conventional practice, contains a retarder for the plaster of Paris, the plaster of Paris and an adhesive to assure bonding of the plaster of Paris to the fabric being coated. Such plaster of Paris slurries are disclosed, for example, in U.S. Patent No. 2,557,083. After the fabric is coated, and while still fully extended, it is dried. Drying is by any conventional means. However, care should be taken that the drying temperature is not so high as to damage the elastic threads in the backing material. It is generally preferred that the drying temperature not exceed more than about 200° C.

After the fabric with the plaster of Paris thereon has been dried, the dry plaster of Paris coated fabric **15** remains in a fully extended state and is inelastic until again wetted. The inelastic dry plaster of Paris impregnated fabric at this stage resembles, in appearance and dry handling, conventional plaster of Paris impregnated fabric cast forming materials. After drying, the plaster coated fabric is subjected to the conventional slitting and rolling operations used in forming individual rolls of plaster of Paris bandage materials. A roll **16** so formed is illustrated in FIG. 4.

The plaster bandage formed in the manner described is completely inelastic in its dried state, thus avoiding loosening the plaster by stretching the plaster bandage. The elastic warp threads **11**, however, maintain their elastic characteristics even after extended periods of storing and when the bandage roll **16** is immersed in water, as is the conventional procedure for activating the plaster of Paris prior to application of a plaster bandage, the elastic threads **11** again contract as the plaster of Paris becomes thoroughly wetted. However, as the wet plaster of Paris has a paste-like consistency, the relaxing of the fabric backing with the plaster of Paris thereon now does not loosen the plaster of Paris from the fabric backing where it remains adhered. However, the plaster of Paris bandage is now elastic and extensible and is stretched during the wrapping of an injured member. The bandage, due to its elastic nature, can be made to conform better to uneven or protruding surfaces over which it is wrapped. It also gives a tighter wrap than can be obtained with a conventional plaster of Paris bandage. The presence of the inelastic warp threads **12** prevent the bandage from being overly extended during the wrapping process while still permitting substantial tension to be placed on the bandage wrap during wrapping so as to obtain a firm tight cast without causing too much construction of the wrapped member.

The following example, given for purposes of illustration only, further illustrates the practice of the present invention:

Example

A fabric such as that illustrated in FIG. 1 is used. The fabric, when fully stretched in its lengthwise direction, has 36 weft threads to the inch and 30 warp threads to the inch, every 5th warp thread being formed of rubber. The threads other than the rubber warp threads are inelastic in nature and are formed of cotton. The fabric when fully extended under tension to the length of the inelastic warp threads, i.e, to the point where loops or wrinkles are eliminated, has a length of about 170% of its length in a fully relaxed state. Also, when so extended, a 1-inch width strip having a relaxed length of 6 inches, exerts a pull of about 136, plus or minus 20, grams. The rubber elastic threads have a gauge of about 85 and a pull for an individual thread of about 30 grams when extended to twice their length.

A water slurry of plaster of Paris is prepared containing the following composition by weight:

	Parts
Plaster of Paris	100
Boric acid	0.4
Conc. ammonia	0.8
Dextrin	1.5
Polyvinyl acetate emulsion	1.2
Potassium sulfate	0.4
Methocel 60 HG (400 cps.)	0.3
Wetting agent (Alkanol B)	0.1
Water	60

The fabric is placed under tension so as to stretch the same to its fully extended state and while so stretched is passed through the water slurry of plaster of Paris. The immersion, while under lengthwise tension, is readily done by passing a continuous strip of the fabric over rolls while keeping the fabric under tension, the surface of the rolls with the fabric thereon being maintained below the surface of the plaster slurry. The impragnated fabric, while still under tension, is then passed through a drying oven and dried at a temperature of 110° C. The coating weight of plaster of Paris composition is about 400 grams per square yard of the fully extended fabric. The impregnated dried fabric is slit into six-inch widths and formed into six-inch rolls, each roll containing about 9 feet of the dried plaster of Paris impregnated fabric.

These rolls of plaster impregnated material, both shortly after preparing the same and after storage at 120° C. for 6 months, show the following characteristics. A roll of the plaster of Paris bandage material in the dry state has substantially the same appearance and the same feel as a conventional plaster of Paris bandage formed by using open 32 to 28 mesh conventional fabric backing. On immersion of the roll in water, however, the plaster impregnated fabric draws up on itself as the fabric backing begins to relax with the wetting and softening of the plaster of Paris coating. Thise relaxation is readily ap-

parent. The plaster bandage which is inextensible before wetting, after soaking for about 5–10 seconds in water, reverts to an extensible bandage wrap. The wet plaster bandage has substantial extensibility and when pulled will extend or stretch to about 80–100% of its length.

In describing the present invention, the invention has been described more particularly with respect to plaster of Paris impragnated bandage wraps, as plaster of Paris is the cast forming material most commonly used. However, the invention is not limited to the use of plaster of Paris but may be practiced with any cast forming material which can be coated onto a fabric backing in a pasty or fluid state, dried, and then treated with an activating liquid so as to again assume a pasty or fluid consistency before setting into its final hard state. Urea-formaldehyde and melamine-formaldehyde resins are examples of such other cast forming materials. These materials may either be used alone or in combination with plaster of Paris to modify the characteristic of the cast obtain.

Having thus described our invention, we claim:

1. A flexible sheet suitable for forming an immobilizing cast comprising a fully extended elastic fabric containing a dry coating of an activatable material which is settable into a hard rigid mass after wetting with an activating liquid, said dry coating maintaining said fabric in its fully extended state until said flexible sheet is wetted with said activating liquid, said sheet when so wetted relaxing so as to be extensible until said coating has set.

2. A flexible sheet of claim 1 in which said activatable material is at least one of the group consisting of formaldehyde prepolymers, plaster of Paris and mixtures of the same.

3. A bandage of claim 2 for producing an immobilizing cast comprising an extended elastic fabric impregnated with a dry, water-activatable plaster of Paris composition, said dry, water-activatable plaster of Paris composition being bonded to said elastic fabric and maintaining the same in its extended state.

4. In a bandage for producing an immobilizing cast, a loose weave fabric having inelastic warp and weft threads and tensioned elastic warp threads, said fabric being impregnated with a dry, water-activatable plaster of Paris composition bonded to said fabric and maintaining said elastic threads in their tensioned state.

5. A bandadge of claim 4 in which said fabric is extended to substantially the full extent permitted by said inelastic warp threads.

6. A bandadge of claim 5 in which said elastic warp threads are separated from each other by said inelastic warp threads.

7. A bandage of claim 5 in which said fabric is extended to about twice its untensioned length.

8. The method of making elastic plaster of Paris bandages comprising taking a loose weave fabric having both elastic and inelastic warp threads, in which said elastic warp threads are substantially shorter when relaxed then said inelastic warp threads, extending said fabric under tension to substantially the full extent permitted by said inelastic warp threads, and while so extended coating said fabric with a liquid slurry of plaster of Paris and then drying said coated fabric without relaxing the same, to hold said fabric in said extended state after said tension is removed and until again wetted.

References Cited

UNITED STATES PATENTS

2,711,168	6/1955	Brickman et al.	128—91
2,842,121	7/1958	Billings et al.	128—91

ADELE M. EAGER, *Primary Examiner.*