June 21, 1955 L. BRICKMAN ET AL 2,711,168

FABRIC WITH SETTABLE COATING FOR MAKING ORTHOPEDIC CASTS

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Fig. 1.

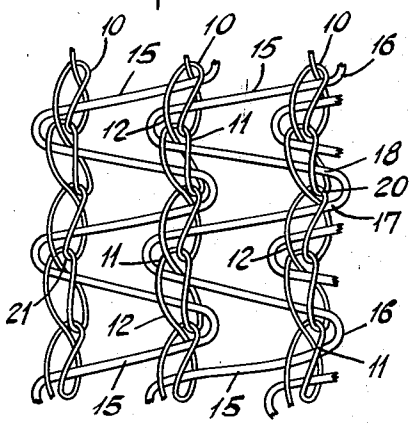


Fig. 2.

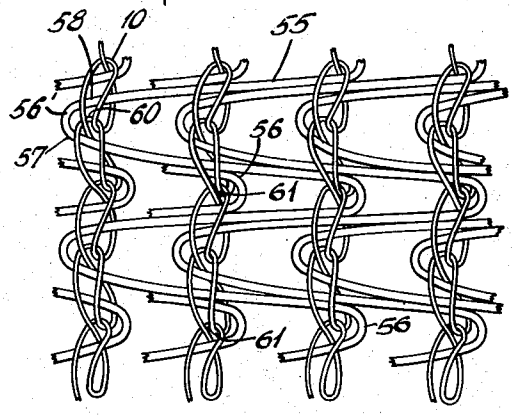


Fig. 3.

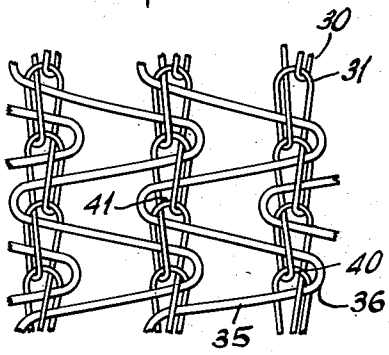


Fig. 4.

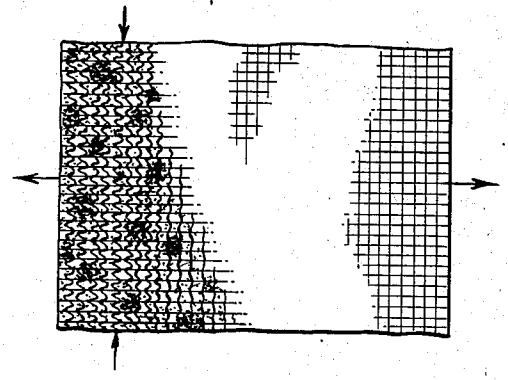


Fig. 5.

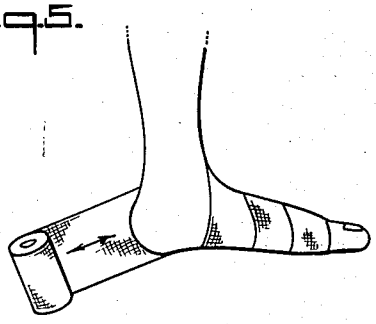
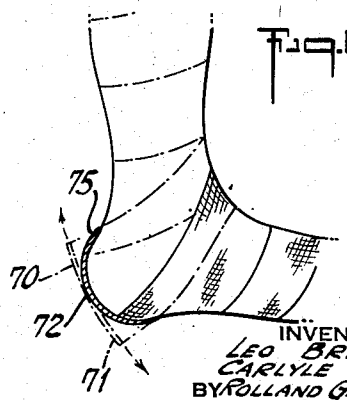


Fig. 6.



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FABRIC WITH SETTABLE COATING FOR MAKING ORTHOPEDIC CASTS

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6 Claims. (Cl. 128—89)

This invention relates to cast-forming elements and, more specifically, to plaster of Paris bandages suitable for formation of casts on the human body.

The conventional cast-forming material consists of a rolled-up bandage such as gauze or crinoline which serves as a carrier for plaster of Paris or other settable composition. Bandages having a carrier of gauze (crinoline), which has constituted the only economically feasible carrier for plaster of Paris bandages, have long been known to suffer from many disadvantages. In the first place, they have no appreciable elasticity in either direction. It has been found difficult to apply crinoline bandages to joints or other irregulariteis of the body around which the cast is to be formed.

To offset non-stretchability or non-elasticity it has been found necessary to make tucks in the bandage at joints in order to permit the bandage to go around the joint at all. These tucks make lumps or points of non-uniform thickness in the cast, and increase the hazard of areas of excessive irritation or pressure.

However, stretchability alone is not the complete answer to the problem. Stretchy backings for plaster of Paris bandages have been proposed which are too unmanageable for broad use. The carrier material must permit a degree of stretch and still not be difficult for the physician to handle. It should also be non-fraying, even when cut at an angle.

One object of the invention is to prepare a cast-forming bandage material which is elastic enough to make smooth casts on joints without being so stretchy as to be unmanageable.

A further object of the invention is to prepare such a cast-forming bandage material which has a settable composition such as plaster of Paris thereon.

In addition to the foregoing objects, it is a further object of the invention to prepare a material formed of a carrier having threads which possess the desired requisites of mechanical strength, adhesion to the plaster of Paris or other setting composition, and ability to be fabricated into the desired construction.

The cast-forming bandages of the invention comprise a backing fabric which is warp knit, the wales being individual chains formed by needle loops and floats connecting adjacent needle loops of the same chain, and filling threads having sinuous form interconnecting adjacent wales, the fill threads being bound into the chains between the legs of the needle loops and the floats. The fabric meets the objects of the invention by providing substantial rigidity, i. e. non-stretchability, in the walewise direction (which is the lengthwise direction of the bandage), but permitting stretch transversely to the wales due to the tendency of the warp chains to be distorted by the sinuous fill threads under tension.

The invention may be conveniently understood by reference to the attached drawings.

Fig. 1 is a detailed view of the carrier material of the cast-forming bandage according to the invention.

Fig. 2 is a modified form of carrier material.

Fig. 3 is another modified form of carrier material.

Fig. 4 shows the cast-forming material impregnated with settable composition such as plaster of Paris, the bandage being stretched widthwise.

Fig. 5 illustrates application of the invention cast to a bony prominence, i. e. an ankle of the human body.

Fig. 6 illustrates the adaptability of the invention bandage to an irregular contour, i. e. heel, of the human body.

Reference numbers **10** indicate a series of parallel chains formed on conventional warp knitting equipment. Each chain **10** is formed of a series of needle loops **11** drawn one through the other in succession. Floats or ties **12** connect the end of one needle loop with the beginning of the next. Each row of simultaneously formed and oppositely disposed needle loops in the cross direction of the fabric is designated by the term "course." That is, in Fig. 1 there are shown five courses of needle loops. It will be noted that each of the needle loops of Fig. 1 is formed in the same direction, that is, by movement of the thread from left to right over the needle.

Sinuous fill threads are indicated at **15**. The fill threads **15** are looped between different chains in the fabric, the loops being formed around a link of one of the chains, and then around a link of another of the chains, each loop **16** of each fill thread **15** being in a course different from the course in which the other loopings thereof occur. In the Fig. 1 construction, the fill thread, after looping itself around a link in one chain, moves over to the link in the next course of the adjoining chain, and then back to the first chain two courses removed from the previous link in the first chain. It will be noted further that, moving from bottom to top of the drawing, the leading part **17** of each thread loop **16** is bound in between a thread loop and a float of that course. Following part **18** of the same thread loop is bound in between the thread loop of the following course in the same chain. The focal point of action of thread loop **16** on a chain is, therefore, the point **20** at which two chain loops meet.

As the fabric, for example, in Fig. 1 is stretched walewise, the chain loop knots tend to tighten and are relatively inextensible. However, if the fabric is stretched in the crosswise direction, the thread loops which point to the right will tend to distort the focal points **20** between adjacent chain loops to the left. The thread loops which point to the left, however, will act upon focal chain points **21** one course removed from focal points **20** so as to urge points **21** in the same course the entire width of the fabric toward the right. Any given chain, therefore, will be distorted in a zigzag fashion, first to the left, by the loops pointing to the right, and one course farther on, to the right by the thread loops pointing to the left. The over-all effect will be a stretching of the fabric widthwise and come contraction lengthwise, as shown in Fig. 4.

Fig. 3 illustrates a modified carrier material for invention purposes having parallel chains **30** formed by needle loops **31** and sinuously formed fill threads **35** having thread loops **36** connecting adjacent chains at alternate courses at focal points **40** and **41** where adjacent thread loops meet. Fill threads **35** are laid in in the same fashion as the fill threads **15** of the Fig. 1 structure, the only essential difference between the two fabrics being that the Fig. 3 needle loops are formed by first moving the threads from right to left across the needle in one course and in the opposite direction, i. e. from left to right, in the succeeding course, and so on. The walewise non-stretchability and crosswise stretchability are similar to characteristics just described for Fig. 1.

In Fig. 2 there are shown multiple parallel knitted chains **10** having structure the same as that of Fig. 1. Fill threads **55** having thread loops **56'** pointing to the left, and **56** pointing to the right, are laid in at focal

points 60 and 61, respectively, in a fashion similar to that described for Fig. 1. That is, the leading part 57 of the thread loop is bound in between the needle loop and float of one course, and the following part 58 is bound in between the needle loop and float of the following course. There is one significant difference, however, between the fill threads of Fig. 2 and those of Fig. 1, visible upon inspection. Fill threads 55 of Fig. 2 oscillate between one chain and a parallel chain two chains removed. This configuration is produced by moving the thread bar carrying the fill threads crosswise of the fabric two needles distant in each stitch before reversing direction in the succeeding stitch. In spite of this variation in construction, it will be noted, however, that the Fig. 2 fabric contains needle loops pointing to the right bound in at the focal points between needle loops in one course, while in the following course the thread loops are similarly bound in between needle loops but are pointed to the left. When the Fig. 2 fabric is stretched widthwise, therefore, the zigzag pattern described in connection with Figs. 1 and 3 is produced, resulting in widthwise stretch. On the other hand, if the Fig. 2 fabric is stretched walewise the chain knots tighten and remain substantially inextensible.

One significant advantage of the invention arises by reason of the fact that the fill threads 15, 35 and 55 are bound in by the chains, as described above. When a fabric is cut, whether longitudinally, transversely or diagonally, ravelling, such as is characteristic of woven or usually knitted goods, will be minimized or entirely absent due to this binding-in feature.

From the standpoint of supplying a satisfactory carrier material for a cast-forming element the type of thread utilized in knitting the invention fabric is of considerable importance. The thread should have the proper combination of properties including retention of strength when wet (for use with a water-activatable casting material such as plaster of Paris), good adherence to the setting composition, and ability to be knitted into the structure described. Cotton has been found to be especially satisfactory in furnishing the proper balance of the desired properties.

The openness, that is, number and areas of open spaces per given unit area of fabric, is also important. Cast-forming elements are generally formed by coating or spreading a cast-setting composition upon the carrier fabric. In the case of plaster of Paris this is accomplished by preparing a slurry of the plaster of Paris and coating or spreading the slurry on the carrier fabric, followed by evaporation of the liquid and drying. The spacing of the threads in the fabric will to a large extent determine the degree to which the setting material, such as plaster of Paris, permeates the carrier. If the threads are too close together, insufficient setting composition will permeate, and a weak cast may result. On the other hand, if the fabric is too open, i. e. too wide mesh, there may be an insufficient number of threads per unit area to hold the amount of setting composition desired, and there may result a considerable loss of setting composition, and consequent loss of strength.

A particularly notable and advantageous characteristic of the carrier material of the invention product, which is in marked contrast to other types of fabric, particularly those which have been tried as carrier materials, is that the required degree of openness of the fabric can be maintained while still preserving non-extensibility in a lengthwise direction and extensibility widthwise. According to the invention, the required degree of openness may be defined in terms of the number of wales or chains per inch width of the fabric and the number of grams weight of the base fabric, exclusive of cast-forming material, per square yard. Desired openness is that corresponding with not more than twenty chains or wales per inch width. At the opposite limit, adequate adherence of setting composition according to the principles set forth above may be realized with openness corresponding with at least 8 chains per inch width. These specifications for openness are preferably integrated with a maximum fabric weight of 50 gms. per square yard below which adequate penetration of cast-forming material may be assured, and a minimum fabric weight of 15 gms. per square yard above which acceptable retention of cast-forming material on the carrier will obtain.

The amount of settable material added to the warp knit carrier is of importance from the standpoint of producing sufficient strength in the final cast. According to the invention, therefore, the ratio of plaster of Paris to fabric should be at least about 8:1, and may be as high as 16:1 or more. The preferred range is 10:1 to 14:1. These plaster to fabric ratios may be obtained by use of fabrics having degree of openness and weight per unit area described above.

Fig. 5 illustrates application of invention cast-forming element to the foot, heel and lower leg of a patient. It is wound spirally as shown, being stretched during application according to the dictates of the physician. As the bandage strip is enveloped around the heel the tendency of the strip, apart from the invention material, is to assume a form shown at 70 in Fig. 6, that is, with the edge portion 71 removed from the surface of the skin and the central portion 72 of the bandage stretched tightly against the skin. Using ordinary gauze, about the only way to effect conforming of the bandage to the skin is to make tucks in edge portions 71. The tucks, of course, are hazardous from the standpoint of producing local pressure and irritation. With the invention warp knit carrier, however, the untensioned marginal portions 71 may be pulled by hand outwardly in the widthwise direction, as shown by the arrows in Fig. 6. This sidewise stretching causes the wales in the marginal portions to assume the zigzag configuration shown in Fig. 4, and further to contract. When marginal portions 71 contract they unavoidably conform toward the portions of the bony prominence having smaller radius and finally assume the shape shown at 75, that is, they conform closer to the skin of the wearer without the necessity of using tucks or folds. A major advantage of the invention material is thereby realized.

It will be apparent that there are many variations to the present invention, and many modifications may be made thereto while still within the inventive scope. Other settable compositions, such as plastics, may be substituted for the plaster of Paris. Accordingly, the invention is not limited to the specific disclosure presented.

What is claimed is:

1. A cast-forming element comprising a base warp knit fabric and a settable material coated thereon, said fabric being composed of walewise parallel chains and filling threads having sinous configuration looped between said chains, said fill thread loops being formed around a link of one of said chains and then around a link of another of said chains, each loop of each fill thread being in a course different from the course in which the other loopings thereof occur and the loops of different fill threads in the same course pointing in the same direction, said fabric being substantially unstretchable in the walewise direction, but substantially stretchable in the direction normal thereto, the fabric containing not more than about 20 wales per inch width, the weight of the fabric being not greater than about 50 gms. per square yard.

2. A cast-forming element comprising a base warp knit fabric and a settable material coated thereon, said fabric being composed of walewise parallel chains, the thread of each chain remaining in the same chain for substantially the entire length of the fabric, each of said chains being connected to the fabric with filling threads having sinuous configuration looped between said chains, said fill thread loops being formed around a link of one

of said chains and then around a link of another of said chains, each loop of each fill thread being in a course different from the course in which the other loopings thereof occur and the loops of different fill threads in the same course pointing in the same direction, said fabric being substantially unstretchable in the walewise direction, but substantially stretchable in the direction normal thereto, the fabric containing not more than about 20 wales per inch width, the weight of the fabric being not greater than about 50 gms. per square yard.

3. A cast-forming element comprising a base warp knit fabric and a settable material coated thereon, said fabric being composed of walewise parallel chains, the thread of each chain remaining in the same chain for substantially the entire length of the fabric, each of said chains being connected to the fabric with filling threads having sinuous configuration looped between said chains, said fill thread loops being formed around a link of one of said chains and then around a link of another of said chains, and then around a link of the chain in which it was first looped, each loop of each fill thread being in a course different from the course in which the other loopings thereof occur and the loops of different fill threads in the same course pointing in the same direction, said fabric being substantially unstretchable in the walewise direction, but substantially stretchable in the direction normal thereto, the fabric containing not more than about 20 wales per inch width, the weight of the fabric being not greater than about 50 gms. per square yard.

4. A cast-forming element comprising a base warp knit fabric and plaster of Paris coated thereon, said fabric being composed of walewise parallel chains, the thread of each chain remaining in the same chain for substantially the entire length of the fabric, each of said chains being connected to the fabric with filling threads having sinuous configuration looped between said chains, said fill thread loops being bound in between floats and adjacent needle loops at a link of one of said chains and then between floats and adjacent needle loops at a link of another of said chains, and then between floats and adjacent needle loops at a link of the chain in which it was first looped, each loop of each fill thread being in a course different from the course in which the other loopings thereof occur and the loops of different fill threads in the same course pointing in the same direction, said fabric being substantially unstretchable in the walewise direction, but substantially stretchable in the direction normal thereto, the fabric containing not more than about 20 wales per inch width, the weight of the fabric being not greater than about 50 gms. per square yard.

5. A cast-forming element comprising a base warp knit fabric and plaster of Paris coated thereon, said fabric being composed of walewise parallel chains, the thread of each chain remaining in the same chain for substantially the entire length of the fabric, each of said chains being connected to the fabric with filling threads having sinuous configuration looped between said chains, said fill thread loops being bound in between floats and adjacent needle loops at a link of one of said chains and then between floats and adjacent needle loops at a link of another of said chains, and then between floats and adjacent needle loops at a link of the chain in which it was first looped, each loop of each fill thread being in a course different from the course in which the other loopings thereof occur and the loops of different fill threads in the same course pointing in the same direction, said fabric being substantially unstretchable in the walewise direction, but substantially stretchable in the direction normal thereto, the fabric containing not more than about 20 wales per inch width, the weight of the fabric being not greater than about 50 gms. per square yard, and the weight ratio of plaster of Paris to fabric being at least about 8:1.

6. A cast-forming element comprising a base warp knit fabric and plaster of Paris coated thereon, said fabric being composed of walewise parallel chains, the thread of each chain remaining in the same chain for substantially the entire length of the fabric, each of said chains being connected to the fabric with filling threads having sinuous configuration looped between said chains, said fill thread loops being bound in between floats and adjacent needle loops at a link of one of said chains and then between floats and adjacent needle loops at a link of another of said chains, and then between floats and adjacent needle loops at a link of the chain in which it was first looped, each loop of each fill thread being in a course different from the course in which the other loopings thereof occur and the loops of different fill threads in the same course pointing in the same direction, said fabric being substantially unstretchable in the walewise direction, but substantially stretchable in the direction normal thereto, the fabric containing about 8 to about 20 wales per inch width, the weight of the fabric being about 15 to 50 gms. per square yard, and the weight ratio of plaster of Paris to fabric being in the approximate range 8:1 to 16:1.

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