Dec. 9, 1952 A. W. BROWN 2,620,851

INORGANIC SHEET MATERIAL

Filed July 9, 1949

Fig. 1.

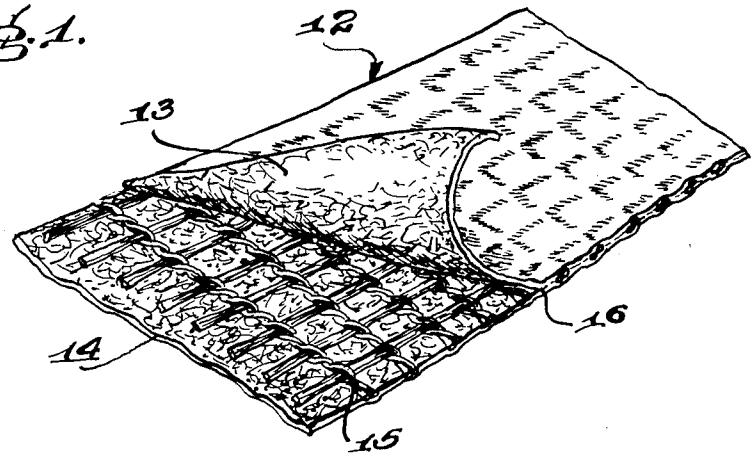
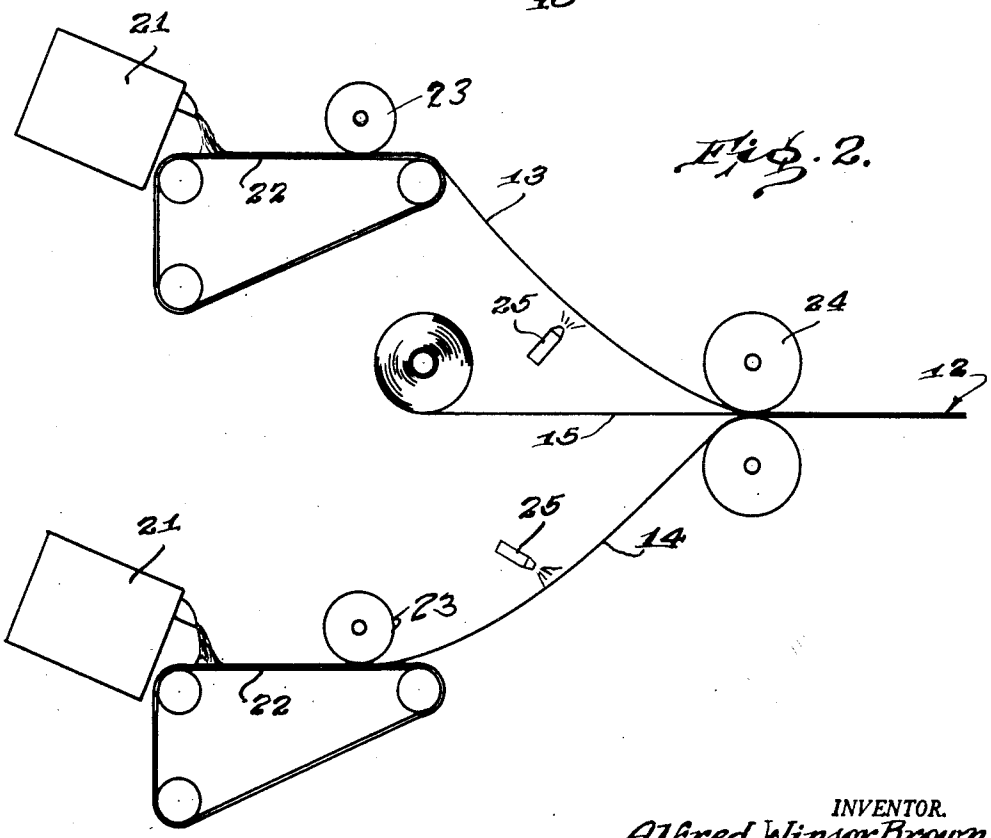



Fig. 2.

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## INORGANIC SHEET MATERIAL

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4 Claims. (Cl. 154—2.6)

1

This invention relates to sheet material and particularly to an inorganic fabric useful as electrical insulating tape but useful also in many other applications.

In the construction of insulated electrical conductors and cables there is need for a high temperature-resistant tape as a wrapping over the conductor to insulate the conductor from objects with which it is in contact, or to insulate the conductors in a multi-conductor cable from each other and from the sheath.

The most commonly used tape for this application is interwoven asbestos yarns, asbestos being used because it has high temperature resistance so that when a short circuit occurs the asbestos will not fuse but remain in place as a spacer to prevent contact of the conductor with other conductors or with adjacent objects such as the sheath.

However asbestos tapes for this application have very exacting specifications and are difficult to manufacture because the tapes must be relatively thin, say .005 to .010 of an inch in thickness, and consequently the yarns must be fine and fine yarns are difficult to produce from any but high quality asbestos fibers. The tapes must also have considerable tensile strength to permit their being tightly wrapped on the conductor and this strength requirement often dictates the inclusion of reinforcing cotton strands. The reinforcement, of course, detracts from the quality of the tape since a tape so reinforced is not completely inorganic and this tape is unsuited for a number of applications.

It is an object of the present invention to provide a tape of other form of sheet material that is substantially completely inorganic and contains sufficient asbestos to have exceedingly high temperature resistance and in other respects partake of the nature of an asbestos tape, but that does not require fine asbestos yarns and that may in fact be made of the much lower grade, shorter asbestos fibers.

It is another object of the invention to provide inorganic sheet material that has high temperature resistance coupled with exceptional tensile strength, much higher strength than can be obtained even with quality asbestos yarns, with the result that the strength of the product may be enhanced while the cost of the product is reduced.

The foregoing as well as other objects will be made more apparent as this description proceeds.

In the accompanying drawing:

2

Figure 1 is a perspective view on an enlarged scale of the invention shown in the form of tape; and

Figure 2 is a diagrammatic view illustrating the process for making the product of the present invention.

The invention provides inorganic sheet material such as a tape in which webs of interfelted asbestos fibers are reinforced with fine yarns disposed in the direction of the tensile stresses to which the tape will be subjected in use. The yarns are preferably in the form of an open weave fabric and the asbestos webs are preferably disposed on opposite sides of the fabric and in contact with each other through the meshes of the fabric so that the webs are tightly held together and the composite product has a high degree of mass integrity.

Referring to Figure 1, the invention is shown in the form of a tape 12 made up of two webs 13 and 14 of interfelted asbestos having interjacent the webs an open weave fabric 15 of interwoven glass fiber yarns. This tape may be quite thin, its overall thickness being as low as .007 to 0.10 inch. A thin tape of this character may be formed with an open weave fabric of approximately .003 to .005 inch thickness covered on opposite sides with asbestos webs of .002 or .003 inch thickness.

The asbestos webs are in contact with each other through the interstices in the open weave fabric as shown at 16 and the webs are adhered together at these points as by being brought into contact while wet or by having an adhesive sprayed onto the adjoining faces before the webs are laminated.

The use of an interwoven fabric of the kind described has considerable advantage over the use of parallel strands or fibers to reinforce the composite product because not only is the fabric reinforced product easier to fabricate but there is also reduced tendency to splitting of the tape lengthwise during application of the tape to a conductor.

The reinforcing fabric is most desirably a leno weave but other conventional weaves are useful.

Figure 2 illustrates the method in which the product of the present invention may be made although, of course, it may be made in any other suitable fashion if desired. The asbestos webs 13 and 14 are represented as being formed on conventional paper making equipment. The station at which each web is formed includes a conventional beater 21 in which the asbestos is highly dispersed in water. From the beater the asbestos

slurry spills onto a continuous paper making belt **22** and the web is then pressed by being passed through rolls **23** for expressing excess water and to press the web to desired density. The webs from the two stations are brought together into superposed relation and passed between a pair of rolls **24** which exert sufficient pressure to cause the wet asbestos webs to adhere together. To increase adherence, a small amount, say 1 or 2 per cent by weight of the dry asbestos, of adhesive such as gum, rosin, starch, gelatin or the like, may be incorporated in the asbestos slurry in the beater. Alternatively the faces of the webs to be brought into contact may have a coating of adhesive applied to them by means of spray guns **25** stationed in advance of the duplexing rolls **24**.

At the time the webs **13** and **14** are brought together the open weave glass cloth **15**, supplied from a roll thereof or from other source, is fed into the bite between the rolls so as to be enclosed between the asbestos webs.

The glass fabric is preferably woven of relatively fine yarns, say yarns of the 450 size, that is, yarns in which there are 45,000 yards to the pounds, and the yarns are preferably of two-ply but may be singles if desired. The woven fabric contains approximately 12 ends per inch in both the warp and fill but it may be more open or more closely woven if desired. 10 ends or even less per inch are sufficient where average tensile strengths are desired but higher tensile strengths dictate the use of as many as 20 or more ends per inch. These fine yarns and this wide spacing of the yarns contributes greatly to a product in which the webs are securely joined to each other.

As the asbestos webs and the glass cloth pass between the rolls **24**, the pressure exerted by the rolls squeezes the asbestos webs into contact with each other through the openings in the cloth with the result that the wet asbestos webs adhere to each other and when dried form a composite fabric having an exceptionally high degree of integrity. After passing the rolls, the composite fabric is dried in suitable fashion and may be further treated in any conventional manner. It may be impregnated or coated with electrical insulating varnishes or resins, it may be laminated with mica, or with other fabrics of the same or different character, and it may be dyed, printed, or otherwise colored.

While webs made wholly of asbestos are desired, the webs may contain small amounts of other fibers. For instance, cotton may be added to the asbestos slurry during the beating operation, especially where short asbestos fibers are used, for the purpose of increasing the interfelting action when the slurry is formed into a web. It has also been found beneficial to add 5 or 10 per cent short glass fibers of about .0002 to .0003 inch in diameter and about ⅛ to ¼ inch long to the asbestos slurry to increase the interfelting action and resultantly the strength of the asbestos web. The conventional adhesives and fillers may, of course, also be added to the asbestos slurry as desired.

The fabric of the present invention is particularly suitable for electrical insulation but may be used wherever a substantially completely inorganic sheet material of exceedingly high temperature resistance is required as in the reinforcing of high temperature resins or plastics. It is also well adapted to be coated or impregnated with resins and varnishes because the increased tensile strength imparted by the reinforcing yarns permits easy handling of the sheet material when wet with resins or varnishes and permits draping or festooning of the wet fabric in drying or curing ovens.



Various modifications may be made within the spirit of the invention and the scope of the appended claims.

I claim:

1. An inorganic sheet material of extreme thinness in the order of .010 inch or less and comprising a plurality of superposed webs of interfelted fibers of which part are glass and part are asbestos, and a reinforcing fabric of glass yarns disposed between said webs, the fabric being of sufficiently open weave to permit the webs of interfelted fibers to engage each other through the interstices in the fabric.

2. An inorganic sheet material of high tensile strength and extreme thinness in the order of .010 inch and comprising a plurality of webs of interfelted asbestos fibers admixed with glass fibers, and a reinforcing interwoven glass fabric disposed between said webs, the fabric being of sufficiently open weave to permit the webs of interfelted fibers to engage each other through the interstices in the fabric.

3. An inorganic sheet material of high tensile strength and extreme thinness in the order of .010 inch and comprising a plurality of webs of interfelted fibers that are predominantly asbestos fibers, and reinforcing glass yarns disposed between said webs, the yarn being in parallel relation and being spaced apart sufficiently to permit the webs of interfelted fibers to engage each other through the spaces between the yarns.

4. An inorganic sheet material of high tensile strength and of a thickness of no more than about .010 inch comprising a plurality of webs of interfelted asbestos fibers, a reinforcing fabric interjacent two of said webs and woven of fine glass yarns of the size in which there are approximately 45,000 yards to a pound and the fabric having about 10 to 20 ends per inch, whereby the fabric is of open weave, and portions of the webs of interfelted fibers at opposite sides of the fabric being in engagement with each other and adhered together through the openings in said fabric.

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