July 29, 1924. 1,503,337

W. R. SEIGLE

INSULATION FABRIC

Filed Jan. 6, 1920

Fig. 1

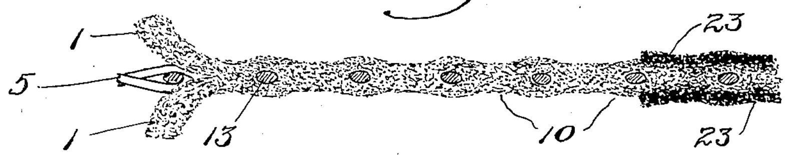


Fig. 2

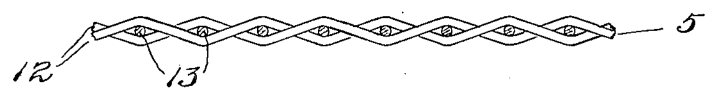


Fig. 3

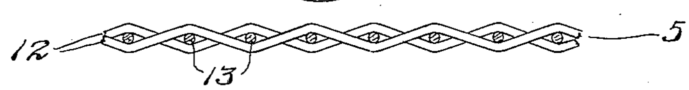


Fig. 4

Fig. 5

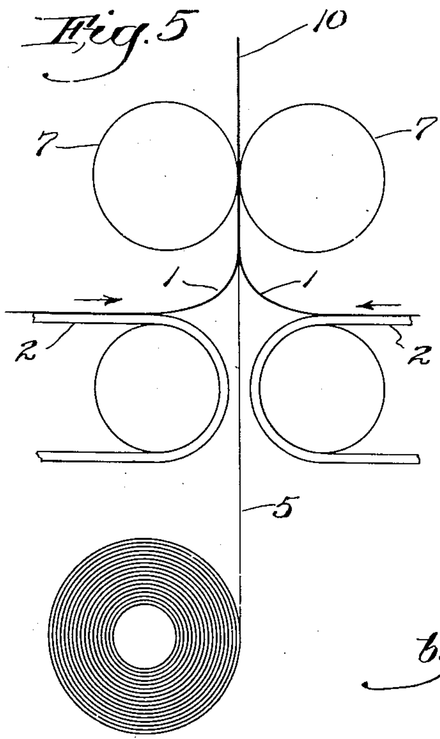
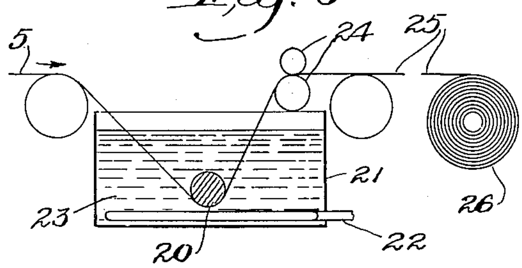


Fig. 6



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UNITED STATES PATENT OFFICE.

WILLIAM R. SEIGLE, OF NEW YORK, N. Y.

INSULATION FABRIC.

Application filed January 6, 1920. Serial No. 349,734.

To all whom it may concern:

Be it known that I, WILLIAM R. SEIGLE, a citizen of the United States, and resident of New York, in the county of New York and State of New York, have invented new and useful Improvements in Insulation Fabrics, of which the following is a specification.

This invention relates to insulation fabrics of the kind including a non-conductor of heat or electricity, or both, such as a mineral or asbestos fibre, and adapted for use as a protection to conduction, transmission or penetration through the fabric of heat or an electric discharge.

The invention is more particularly concerned with a fabric of this nature including a strengthening component for resisting tensile or tearing strains. Fabrics of the class referred to have many important uses ranging from roofing and the heat insulation of hot or cold bodies, such as boilers or brine tanks, to the insulation or separation of electrical conductors or electrified bodies, or of closely adjacent parts of electrical apparatus exposed to high potential differences, such as the plates of condensers, the windings of the coils of alternating-current machines, the parts of transformers and other induction apparatus.

Heretofore, so far as I am aware, fabrics for the above purposes made of asbestos fibre have been laid together on the principle of paper-making, a film or mat of interlaced fibres deposited from a mixture of the fibrous substance with a relatively large quantity of water being the basic material of the ultimate fabric. Such papers, sometimes called felts by analogy to true felts of animal fibre, necessarily lack tensile strength and necessarily are difficult to prepare of uniform thickness. The lack of tensile strength of such a paper or felt of mineral fibres, such as asbestos, is so pronounced that it has heretofore been regarded as impossible to provide a fabric of the thickness of ordinary vegetable-fibre papers, for instance, of this material, the usual procedure being to make so thick a mat or deposit of the asbestos as to enable the great number of points of contact of many inherently non-cohering fibres found in this thickness to compensate for the lack of coherence characteristic of the particular fibre in question. I am aware, however, of attempts to use binding fillers of various kinds, of the general nature of cements such as plaster and the like, to reinforce the feeble felting or cohering powers of the asbestos fibres.

The usual procedure in the prior art to attain a sufficient tensile strength has been to mix with the asbestos fibre a certain proportion of a true textile fibre having high powers of coherence, such as cotton or wool, this admixture being relied upon to give enough tensile strength to the whole fabric. The usual inclusion is cotton, and the usual practice is to mingle the cotton fibres with the asbestos in the wet mixture or pulp from which a paper maker's wet film of mingled asbestos and cotton is strained and couched by the usual means.

But for any such uses for the fabric as suggested above this material, the best heretofore known, is subject to serious disadvantages. It is practically impossible to maintain an even mixture of the asbestos with the cotton or other strong organic fibre relied upon. Inevitably the textile fibre inclusion is found in the product distributed more thickly in some places than in others; or in lumps and patches not accompanied by sufficient of the asbestos fibre to perform the functions intended for the asbestos fibre. Reliance on admixture of cotton or the like with the asbestos for increase of tensile strength is also often in vain, uniformity of distribution of the cotton or other strong fibre implying the separation of so many of the cotton fibres by the feebly-uniting asbestos fibres as to deprive the fabric of much of the strengthening effect possible if the included textile fibres could have been mutually interengaged in matted or felting relation. A characteristic still more detrimental to the final utility of the fabric is the tendency of the included fibre to carbonize under heat. When carbonized, the textile fibre loses its tensile strength, becomes relatively inflammable, and becomes electrically conducting.

If lying crosswise of or through the thickness of the fabric, a carbonized fibre or bundle of fibres, such as cotton or wool, may lead actual flame from one face of the fabric to the other, or become incandescent from electrical flow, or lead a spark discharge through the fabric. Even when the carbonization is slight, the electrical resistance is seriously impaired, so that the composite fabric is no longer an efficient insulating medium at high potentials.

For many of the uses for fabrics of this nature it is preferred and often required that the fabric be impregnated with an oily, gummy or bituminous agent. The most valuable of these agents are fluid at high temperatures only, and I have found by experiment that the cotton-fibre inclusions of asbestos fabric containing such cotton inclusions are carbonized and rendered electrically conducting at the minimum desirable temperatures of the best types of impregnating or coating baths. Under these circumstances, every such fibre lying across the fabric is potentially a place at which the fabric may be penetrated by an electric spark, or an arc formed. This would not be the case if there were no fibres extending from surface to surface of the material capable of being carbonized, and would not be the case if the textile fibre inclusion were protected from the heat of the impregnation substance or mixture, or heat applied to the finished fabric in use.

Objects of the present invention are to avoid the difficulties suggested above by the provision of a composite fabric having a relatively high tensile strength in relatively very thin sheets, and having at all parts of the fabric a continuously non-conducting texture free from holes or possible paths for electrical discharges, such as afforded by the transverse carbonized fibres of the prior art.

When I refer to a relatively thin fabric I am to be understood as referring to fabrics from 0.003 to 0.175 of an inch in thickness, but my invention may be embodied in fabrics of any desired thickness. My invention also contemplates an improved and efficient method of producing a fabric of the desired qualities.

I shall now refer to particular instances of the fabric and a particular way of making it in explanation of the genus of such fabrics and of the methods or arts of making such fabrics comprised in my invention. In the accompanying drawings,—

Figure 1 is a longitudinal section through a typical fabric;

Figure 2 is a longitudinal section through a cross-woven or netted textile fabric hereinafter referred to;

Figure 3 is a similar section through a plain or basket woven textile fabric;

Figure 4 is a section in the direction of the warps of a textile fabric formed of warp and weft strands respectively laid together in parallel relation but not interwoven;

Figure 5 is a diagrammatic section of apparatus showing a step of the method of making the product; and

Figure 6 is a diagrammatic section of apparatus showing another step in making the fabric.

Instead of providing for an inclusion in the fabric of loose textile fibres mixed with the asbestos fibre, I prefer to provide an asbestos or other mineral fibre pulp in a pure state, that is, containing no fibre except the asbestos fibre; but I may provide a cementitious binder of a non-conducting nature if the inclusion of such a binder in the fabric is desired for any particular purpose.

Two separate wet films 1, 1, which may be substantially of the same consistency and substantially of the same thickness, are taken from this pulp and may be transported toward each other, as shown in Fig. 5, by the endless blankets 2, 2. Traveling at the same speed as the films 1, 1, a strengthening inclusion 5 is delivered between the films 1, 1, which are laid upon it, compressed into it, dried and set by usual operations as typified by the couching rolls 7, 7, illustrated in Fig. 5. When dried the product 10 is that illustrated in Fig. 1, comprising a homogeneous asbestos paper formed on either side of, in the interstices of, and through any spaces in the included fabric 5. The fabric 5 is of a particular nature permitting this result.

The preferred forms of fabric 5 are shown in Figs. 2, 3 and 4. Fig. 2 illustrates a textile fabric formed preferably of cotton, linen, ramie, silk or other strong free-spinning textile fibre spun into yarns 12, 13, preferably characterized by absence of projecting fibres (such as may be produced within the skill of any spinner, or provided by singeing or other clearing operations performed upon the yarns after spinning). Such yarns are preferably of a fineness connoting a diameter of something less than half of the finished fabric; for a very thin fabric such yarns may exceed in fineness 60's or even 100's gauge. The fabric formed of these yarns may be of any known woven, braided, knitted, netted or laid texture having when finished numerous interstices.

For instance, as shown in Fig. 2, the ordinary net weave formed by cross-woven warps 12 and spaced wefts 13 provides such a fabric; or as shown in Fig. 3, an ordinary open basket or muslin weave of plain-shed warps 12 and wefts 13 may be employed. In some cases, as shown in Fig. 4, the component yarns may be assembled without interweaving by laying spaced parallel strands of the warps 12 and laying across them spaced parallel strands of the wefts 13, temporary association in this arrangement being provided for by any suitable sizing or adhesive 14 applied to one or both sets of yarns.

The spacings of the warps and the wefts in the included fabric 5 may vary with the desired effect to be gained. For a finished fabric about 0.010 of an inch in thickness, a preferred spacing may run from 10 to 25 warps or wefts of 40's to 50's gauge to the inch, thus leaving rectangular spaces for the inter-engagement of the asbestos films of one-tenth to one-twenty-fifth of an inch in dimension on each side.

So far as described the fabric consists entirely of the textile inclusion and the asbestos covering for this inclusion (which, it will be observed, is entirely free from any textile fibre which could carbonize) in which state the fabric is a complete product having a relatively high insulating power for its relatively slight thickness. Such fabric, moreover has a high tensile strength in every direction and a high resistance to heat; it may be used in any place where a heat or electrical insulation is desirable; a typical use is for the electrical and heat insulation of the elements of domestic electrical heating apparatus, or as a separator for the core frames and the windings of transformers or of the field and armature cores and windings of dynamo-electric machines.

For electrical and other uses, especially where the fabric is exposed to very high potential differences, it is desirable to increase the resistance to penetration by sparks by impregnating the fabric with a bituminous, gummy or other dielectric substance. A preferred procedure to this end is illustrated in Fig. 6, in which the material 5 is shown passing at a predetermined speed about a submerged roll 20 in a dipping tank 21 heated by a steam coil 22 and containing a sufficient quantity of a coating or impregnating substance 23 kept in a melted state by the heating coil. The fabric after dipping in the tank 21 may be squeezed by squeeze rolls 24 and subjected to cooling at a comparatively long run 25 before being wound into a roll 26.

The preferred coating material 23 is asphaltum of a relatively high melting point and therefore adapted to remain in a comparatively solid but flexible state in the fabric, although subjected to high temperatures. The asphaltum may be either refined Trinidad Lake asphalt, or a refined residue from an asphaltic petroleum, but in some cases rubber, gutta-percha or other gums may be employed.

By the described way of treating the fabric and because of the protection of the textile inclusion 5 by the asbestos films 1, 1, the coatings 23 (see Fig. 1) may be deposited by impregnating the outer region of the asbestos at the high melting-point temperatures of the asphalt without carbonizing the textile insert 5. I find this feature of great importance, since it maintains the tensile strength of the fabric 5 while still securing the advantage of a high-melting-point coating or impregnation. Even when the material 23 is so fluid as to penetrate the fabric through and through, I find that this penetration takes place after the fabric has left the hot material 23 in the tank 21 and during its cooling, and I have not been able to detect injury of the textile insert even when the fabric is impregnated through and through by material which in the dipping tank is at a temperature adapted to destroy the textile inclusion when subjected alone to the action of the same material at the same temperature.

A marked saving in the amount of textile fibre used, as compared with the mixed-fibre product of the prior art, is effected. About one-fourth as much textile fibre, as compared with the amount of asbestos, in the form of a spun and woven inclusion, will produce a fabric many times stronger than the prototype fabrics of similar thickness.

I claim:

1. A sheet insulation fabric having therein between and everywhere spaced from its superficial faces a thin and flexible textile strengthening component having interstices therein, and having a thin, homogeneous water-laid, mineral-fibre-paper insulating substance free from organic inclusions occupying all of the remaining space between said superficial faces, including said interstices.

2. An insulation fabric having therein a perforate textile inclusion interpenetrated and wholly covered by a homogeneous paper of intermingled asbestos fibres free from organic fibrous intermixture, and impregnated by a coating of a plastic insulating substance.

3. An insulation fabric having therein a perforate textile inclusion interpenetrated and wholly covered by a homogeneous paper of intermingled asbestos fibres free from organic fibrous intermixture, and impregnated by a coating of a fusible bituminous insulating material.

4. An insulation fabric having therein a perforate textile inclusion interpenetrated and wholly covered by a homogeneous paper of intermingled asbestos fibres free from organic fibrous intermixture, and impregnated by an asphalt having a relatively high melting point.

5. A sheet insulation fabric adapted for heat and electrical insulation purposes comprising an organized fabric of strong textile yarns having recurrent interstices, and a homogeneous layer of intermingled asbestos fibres wholly covering each superficial face of and in commingling contact in and through every interstice of the textile fabric, said fabric having a continuous coating of a gummy substance.

6. Sheet insulation fabric having therein a thin, flexible textile fabric inclusion having interstices between the yarns of which it is composed and a covering and inter-

penetrating homogeneous mineral-fibre-paper component free from organic inclusions on both faces of the textile fabric inclusion, the said mineral fibre covering being conjunct in and through the said interstices and substantially of the same thickness throughout, the fabric having surface ridges and hollows respectively corresponding to the places of the textile inclusions and to the interstices between them.

7. The art of making insulation fabrics comprising the steps, separately preparing a textile fabric inclusion having interstices throughout its extent and a plurality of wet films of asbestos fibre free from organic fibrous intermixture, and assembling the components by including the textile fabric between the wet films and subjecting the aggregate to pressure and drying.

8. The art of making insulation fabrics comprising the steps, separately preparing a textile fabric inclusion having interstices throughout its extent and a plurality of wet films of asbestos fibre free from organic fibrous intermixture, assembling the components by including the textile fabric between the wet films, subjecting the aggregate to pressure and drying, and thereafter applying to the fabric a fusible impregnating and coating agent.

9. The art of making insulation fabrics comprising forming a fabric by including a textile fabric wholly within and between the superficial faces of a homogeneous mass of asbestos fibres free from organic fibrous intermixture, and thereafter immersing the fabric in a melted impregnating agent for a predetermined time, and cooling the treated fabric.

10. The art of making insulation fabrics comprising forming a fabric by including a textile fabric wholly within and between the superficial faces of a homogeneous mass of asbestos fibres free from organic fibrous intermixture, and thereafter running the fabric at a predetermined rate through a bath of melted bituminous impregnating agent at a relatively high temperature, the thickness of the asbestos, temperature of the bath and rate of motion of the fabric being so related as to protect the textile inclusion from charring.

Signed by me at New York, N. Y., this 31st day of December, 1919.

WILLIAM R. SEIGLE.