Nov. 23, 1926. 1,608,165

S. BROWN ET AL

IMPREGNATED FABRIC AND PROCESS OF PRODUCING SAME

Filed May 26, 1925 2 Sheets-Sheet 1

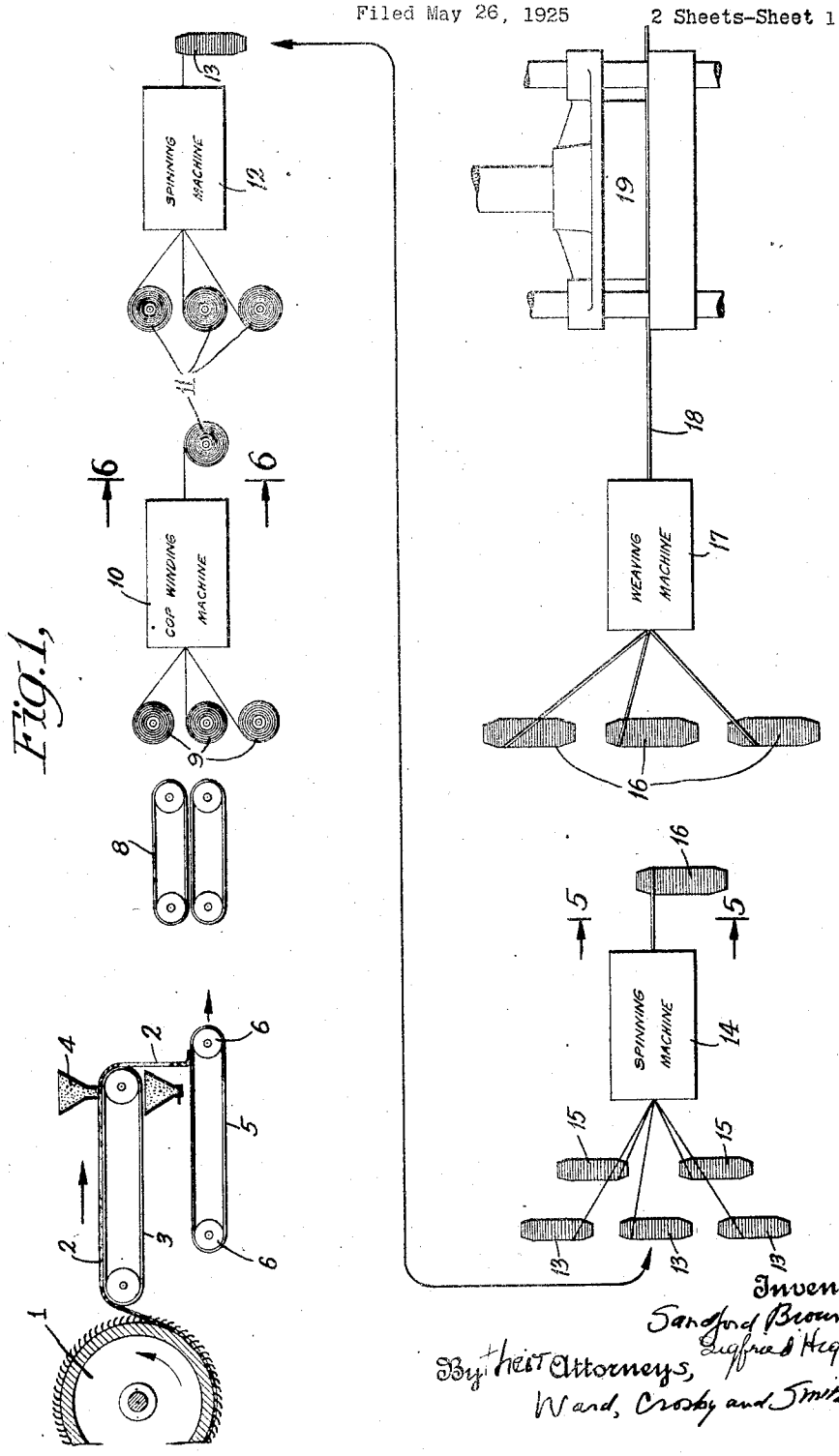


Fig. 1.

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Fig. 3.

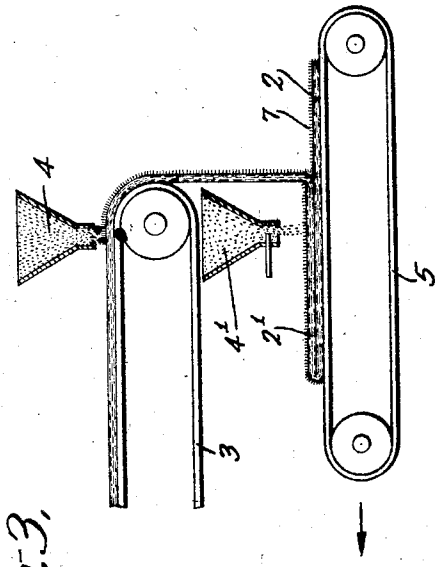


Fig. 6.



Fig. 5.

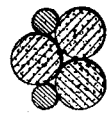


Fig. 2.

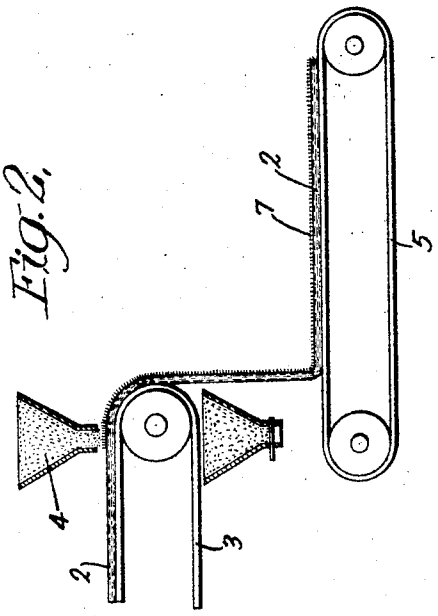
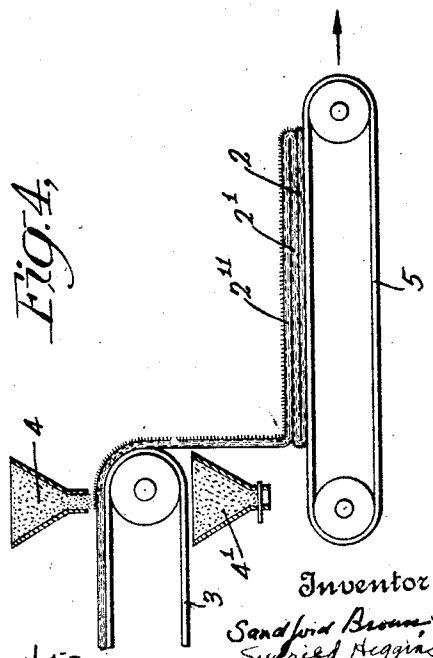


Fig. 4.



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UNITED STATES PATENT OFFICE.

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IMPREGNATED FABRIC AND PROCESS OF PRODUCING SAME.

Application filed May 26, 1925. Serial No. 33,069.

The invention relates to impregnated fabric and process of producing same. It is particularly adapted to the production of fabric which is to be utilized in the manufacture of brake linings although it is not so limited, impregnated fabric being useful additionally for many purposes such as gaskets, packing, and other uses. The fabric produced if intended for brake linings may comprise material commonly employed for such purposes such as asbestos mixed with cotton with which brass wire may be included if desired.

Whatever the composition of the fabric, the invention insures thorough and uniform impregnation of the same with a desired impregnating material, preferably a phenolic condensation product. This is accomplished by impregnating the fibrous material of which the fabric is to be composed at a time previous to the manufacture of the fabric from the fibrous material. Preferably the fibrous material such as asbestos and cotton fiber is treated with the impregnating material while the fiber is in the form of a loose layer, before the same has been twisted to form yarn therefrom. Preferably also the impregnating material is applied to such layer of fibers in the form of a dried powder. In the subseqnent manufacture of yarn therefrom, and of thread from the yarn, this impregnating material will be thoroughly and uniformly distributed throughout the body of the yarn and of the thread so that when the fabric is woven from the thread the impregnating material will be thoroughly and uniformly distributed throughout the body thereof. Preferably the layer of fibrous material is folded over upon itself several times after the impregnating material has been placed thereon, so that the impregnating material will then be distributed between the several plies or layers of the folded material. This folded material is then twisted to form yarn with the fibrous material between the convolutions thereof and the further twisting and condensation of the material in the formation of thread from yarn will of course leave the impregnating material distributed thoroughly therethrough. When the fabric has been formed from such thread, heat treatment or heat and pressure treatment may be applied, which in the case of a phenolic condensation product impregnation will cause the powdered impregnating material to melt and flow and subsequently to harden without disturbing the uniform distribution of the same throughout the mass. The process described results in a more uniform distribution of the impregnating material throughout the mass of the finished product than does any of the commonly known impregnating methods previously used in which the fabric to be impregnated, in its final state, is caused to absorb the impregnating material dissolved in a soluble solvent, which is subsequently evaporated. In such processes the evaporation of the solvent tends to carry some of the impregnating material towards the surface of the fabric, from the center of the mass, by capillary action, so that the distribution of the impregnating material will be less uniform.

Objects of the invention consists in the provision of improved processes of the character referred to and of the process steps utilized therein and in the production of novel articles of manufacture which may be produced by such processes. In order that the invention may be more clearly understood, attention is hereby directed to the accompanying drawings which form part of this specification and illustrate diagrammatically a manner in which the novel process may be carried out. In the drawings Fig. 1 represents diagrammatically a series of operations through which the material may pass from the first application of impregnating material to a layer of fibrous material until the finished fabric is formed. Figs. 2, 3 and 4 are diagrammatic partial side elevations of devices used for folding the fibrous layer and depositing impregnating material thereon. Fig. 5 is an enlarged cross section taken on 5—5 of Fig. 1 and Fig. 6 is an enlarged cross section taken on line 6—6 of Fig. 1.

The process will be described in connection with the impregnation of asbestos and cotton fiber with a phenolic condensation product which is subsequently to be transformed by heat and pressure into the hardened infusible form of phenolic condensation product.

In the manufacture of asbestos fabric, asbestos rock is crushed and formed into a soft mass of long fibers which are then beaten

and carded etc. to produce a rather coarse sheet or layer. The fiber from the first beating machine is commonly fed into a second beater and carder and long staple cotton, which has been previously carded, is mixed with the asbestos by hand in the proportion of about 7/8 asbestos and 1/8 cotton, as the asbestos travels on the feeding chute on its way to the beating machine. This mixture passes into a cylinder where the cotton and asbestos fibers are tumbled together and it is then passed through the carding cylinder and comes from the machine in the form of a fibrous layer.

The impregnating material which preferably is in the form of a dry powder may be deposited upon the asbestos and cotton as they come from the carding cylinder, just mentioned, or as the same are tumbled together, or previous to the tumbling operation. Preferably, however, the impregnating material is deposited on the fibrous layer as the latter is delivered from the fine carding machine to which the layer produced by the carding cylinder, previously mentioned, is fed. The fine carding cylinder further mixes the cotton and asbestos fiber and the fibers are deposited thereby in a thin layer on a moving belt.

Referring now to the drawings, the fine carding cylinder is represented at 1 and the fibers are represented as deposited thereby in a thin layer 2 on the upper surface of the endless belt 3. The impregnating material is diagrammatically represented as being fed from a hopper 4 upon the fibrous layer 2 upon the belt 3. The impregnating material preferably is a phenolic resin, capable of further reaction, or partial condensation product of phenol and formaldehyde or other methylene-containing body which is capable of further reaction upon the application of sufficient heat.

The resin or other powdered impregnating material will adhere to the outer surfaces of the fibers and may be caused to cover the same to a desired extent. The layer of material thus covered is next preferably folded upon itself several times with the impregnating material between the folds.

This may be accomplished, for example, by apparatus indicated in Figs. 1, 2, 3, and 4 in which belt 3 is represented as delivering its layer of fibrous material to a belt or carrier 5, at a somewhat lower level. Belt 5, together with the rollers 6—6 carrying the same, is reciprocated back and forth in its own lengthwise direction and in the lengthwise direction of belt 3 beneath the latter and thence forwardly in front of the latter. Various means may be utilized for thus reciprocating belt 5 and it is thought unnecessary to illustrate any specific form of mechanism. Belt or carrier 5 reciprocates at a speed equal to the linear speed of belt 3. In Fig. 1 belt 5 has started moving forwardly, that is to the right as indicated by the arrow, shortly after the feeding opening of hopper 4 has been opened. The layer of fibrous material 2 will therefore be deposited on the belt 5 as the latter advances under the forward roller of belt 3, and will be deposited upon a suitable length of belt 5 with the condensation product 7 lying thereon. The position of belt 5 at the end of this first forward movement is shown in Fig. 2. The belt 5 now moves in the opposite direction, that is to the left, as shown by the arrow in Fig. 3, so that a second ply 2′ of the fibrous layer will be folded over upon underlying ply 2, the phenol resin 7 being thus interposed between the plies 2 and 2′. If desired, phenol resin may be deposited from a second hopper 4′ upon the upper surface of ply 2′ during this movement.

At the completion of the movement just described, belt 5 again moves to the right, as shown in Fig. 4, so that a third fold or ply 2″ is folded back over the second ply 2′ with the phenol resin deposited on the upper surface of this upper fold from the hopper 4. The hoppers 4 and 4′, if both are used, may of course be provided with suitable valve mechanism, so as to deliver the impregnating material at the proper times.

When a sufficient number of folds of the fibrous material have been made, such as the three folds illustrated, the mechanism may be momentarily stopped and the folded batting or loose sheet removed to apparatus for twisting the same to form something in the nature of yarn. Or, the process may of course be carried on continuously by the provision of suitable devices for folding the batting and thereafter imparting the desired twist thereto.

In the apparatus which is diagrammatically indicated, it is understood that the folded batting is removed in any suitable way to apparatus such as is indicated diagrammatically at 8 where the folded batting is subjected to a slight rolling action so as to form a weak roving. This roving is wound on cylinders 9, a plurality of which are indicated, and from which the rovings are delivered to a cop winding machine indicated diagrammatically at 10. The strands from the various cylinders 9 are twisted together by winding machine 10 and are wound upon cops 11 as yarn. A cross section of this yarn, as indicated by Fig. 6, shows that the original fibrous layers have been twisted to form a plurality of convolutions with the impregnating material interposed between all of them.

A number of loaded cops 11 are now placed in a spinning machine, indicated diagrammatically at 12, where say three strands of the cop yarn are spun into one thread, which is wound on a spool 13. For

the manufacture of brake linings, these spools are then placed on the wire spinning machine, indicated diagrammatically at 14, where threads from a number of the spools 13 are used, together with a number of spools 15 carrying brass wire. The spinning machine 14 will thus form a composite cord consisting of say three strands of asbestos cotton thread and two strands of brass wire, the latter being very ductile. This combined thread is wound on spools 16.

The spools 16 carrying the combination thread are used with a weaving machine, indicated diagrammatically at 17, or other suitable mechanism for forming fabric. The product resulting therefrom may be in the form of a sheet asbestos cloth, 18, produced by a loom or it may be in the form of tape webbing or the like, in accordance with the form of brake lining or other product which is to be produced. In either case, the product is a fabric formed of thread carrying the impregnating material distributed throughout the body of the same in the manner described.

The sheet or tape material in suitable lengths may then be subjected to heat and pressure, and in the case of fabric which has been treated with a phenolic condensation product, is placed in a hydraulic press, indicated at 19, in which it is subjected to heat and pressure sufficient to cause the final hardening reaction of the phenolic condensation product. The first result of the heat treatment is to melt the condensation product which will thereupon flow to greater or less extent through the body of the fabric without, however, losing any of its uniformity of distribution.

Different properties may be imparted to the fabric by different manipulations of the hydraulic press. Thus, it may be subjected to more or less preliminary heating in press 19 before pressure is applied. The coefficient of friction of the finished product may be altered as desired by such treatment. The density of the final product will vary in accordance with the length of preliminary heating, which is followed by the simultaneous application of heat and pressure, as is well known. Various manipulations of the character described will give the product varying abilities to withstand wear and varying coefficients of friction and the preliminary treatment will be governed by the desirability of obtaining greater resistance to wear or greater coefficients of friction in the various cases.

An ideal brake lining may be considered as one having a high coefficient of friction with a thermal conductivity equal to that of the metal of the brake drum with which the brake lining is to be used. It may, therefore in some cases, be desirable to bring up the thermal conductivity of the brake lining to a higher point than it would have by practicing the process which has been described. This may be accomplished by depositing a suitable proportion of a powdered metal, together with the phenol resin, upon the fibrous layer which is subsequently folded and twisted as described. Powdered aluminium is considered a desirable metal for this purpose. Other powdered materials can also be deposited upon the batting or fibrous layer, if desired, where special properties are found desirable. Thus, for example, in certain cases, powdered graphite may be added to the powdered phenol resin which is deposited in the batting so as to make the braking action of the brake more smooth, this being desirable in certain cases only. It should be understood that the invention is not limited strictly to the details of construction and steps of process which have been specifically described, but that the invention is of a considerable breadth, as indicated by the appended claims.

We claim:

1. In a process of producing impregnated fabric, the steps of depositing the impregnating material, in dry powdered condition, on fibrous material, and thereafter folding and twisting the fibrous material to form twisted lengths having the impregnating material between the convolutions thereof.

2. In a process of producing impregnated fabric, the steps of treating a layer of loose fibrous material with a phenolic condensation product in dry powdered condition, and making yarn thereof.

3. A process of producing impregnated fabric, comprising, depositing the impregnating material, in dry powdered condition, on a sheet of loose fibrous material, folding and twisting the same to make yarn, manufacturing fabric therefrom, and applying heat and pressure to cause the impregnating material to flow.

4. A process of producing impregnated fabric, comprising, treating asbestos and cotton fibre with impregnating material, folding and twisting the same to make yarn, making thread thereof, making fabric of the thread, and applying heat and pressure to the fabric.

5. In a process of producing impregnated fabric, the steps of depositing a phenolic condensation product, and a powdered metal, upon fibrous material, and thereafter manufacturing yarn from said material.

6. In a process of producing fabric, which is to have a desired material distributed therethrough, the steps of depositing the said material in dry powdered form upon fibrous material in loose condition, and folding and twisting the fibrous material to form yarn having the first named material between the convolutions thereof.

7. A process of producing impregnated fabric, comprising, treating asbestos and cotton fibre with a phenolic condensation product, adapted to be rendered infusible by heat treatment, twisting the fibrous material to form twisted lengths thereof, making fabric of said twisted lengths, and applying heat and pressure to the fabric.

8. A process of producing impregnated fabric, comprising, treating a layer of loose fibrous material, in untwisted condition, with a phenolic condensation product, adapted to be rendered infusible by heat treatment, twisting the same to make yarn, making thread thereof, making fabric of the thread, and applying heat and pressure to the fabric.

9. A process of producing impregnated fabric, comprising, depositing a phenolic condensation product in dry powdered condition, on fibrous material, thereafter twisting the fibrous material to form twisted lengths having the condensation product powder between the convolutions thereof, making fabric of said twisted lengths, and applying heat treatment to the fabric.

10. As a new article of manufacture, yarn of fibrous material having dry powdered phenolic condensation product material adhering to the surfaces of the twisted fibrous elements thereof.

11. As a new article of manufacture, yarn of fibrous material having dry powdered phenolic condensation product upon the surfaces of substantially all the fibrous elements of which it is formed.

12. As a new article of manufacture, woven fabric having dry powdered phenolic condensation product distributed through the interior of the threads of which it is woven and adhering to the surfaces of substantially all the fibrous elements of which the thread is formed.

13. As a new article of manufacture, twisted lengths of asbestos and cotton fibre having a dry powdered phenolic condensation product adhering to the surfaces of the twisted fibrous elements thereof.

In testimony whereof we have signed our names to this specification.

SANDFORD BROWN.
SIGFRIED HIGGINS.