B-8

PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improvements in the Manufacture of Fibrous Materials

We, BRITISH BELTING & ASBESTOS LIMITED, a British Company, of Scandinavia Mills, Cleckheaton, in the County of York, and RAYMOND DRAKE, A.M.I.MECH.E., of Grangefield, Westgale Hill, Bradford, in the County of York, of British Nationality, do hereby declare the nature of this invention to be as follows:—

This invention relates to the manufacture of fibrous materials, and is particularly concerned with the production of a coherent fibrous web or fleece.

According to the invention, textile fibres are formed into a coherent web or fleece, treated with a bonding agent, and consolidated into a felted film or billet capable of being moulded.

The fibres are preferably teased or carded into the form of the coherent fleece since the nature of the teasing or carding operation separates and opens out bunches of fibres and makes possible the production of a fleece of substantially regular density and thickness. The fleece may be impregnated with a liquid bonding agent, or the bonding agent may be applied to the fleece in solid, comminuted or powder form. If desired, the fleece may be treated with both forms of bonding agent, the comminuted form preferably being applied to the fleece before impregnation with the liquid form. When the fleece is treated with the liquid bonding agent, such agent may be sprayed along the length of the fleece, or the fleece may be immersed in a bath of the liquid.

Consolidation of the treated fleece may be effected by blocking or pressing lengths of the fleece, or the fleece may be conducted through the nip of one or more co-operating pairs of squeeze rollers. The blocking, pressing or nipping surfaces may be heated in order to induce suitable reaction in respect of substances contained in the fleece, e.g. when a thermoplastic, comminuted bonding agent is employed which requires the application of heat to become adhesive.

Fibrous materials such as asbestos, cotton, wool, silk, artificial silk, fibrous glass, flax, hemp, jute, sisal and like bast fibres, separately or in combination, may be treated according to the invention.

Threads, strips or wires of materials adapted to modify the characteristics of the fleece, or to reinforce the fleece, may be introduced into the structure of the fleece either before or after the treatment of the fleece with the bonding agent.

The invention is particularly applicable to the treatment of asbestos fibres in the manufacture of films, webs, wads or like structures convertible by a moulding or pressing operation into strips, sheets or blocks having substantial mechanical strength and resistance to abrasion. For example, the process may be applied in the manufacture of friction elements to be employed as friction pads, clutch facings, brake linings, brake blocks, and like products which in use are subjected to substantial abrasion and mechanical stresses. According to one method of carrying out the invention, asbestos fibres are carded and formed into a coherent web or fleece which is conducted continuously through an impregnating bath of liquid phenolic resin. The resin-impregnated fleece is taken from the bath and passed through the nip of a co-operating pair of squeeze rollers arranged to consolidate the fleece into a felted film or billet. Such film or billet is cut into convenient lengths which are dried and subsequently moulded under the combined influences of heat and pressure into shapes appropriate for use as friction-elements, e.g. of the types referred to above.

Conveniently, the fleece of asbestos fibres delivered from the card is carried on a gauze conveyor adapted to conduct the fleece into and out of a bath of liquid phenolic resin. The fleece is preferably held in contact with the conveyor during the dipping or impregnating process by any suitable means, e.g. a roller, paddle or second gauze conveyor co-operating with the first. The amount of liquid resin absorbed by the fleece may be controlled by a nip roller bearing against the fleece as it emerges from the bath, and arranged in a manner such that excess liquid is squeezed out of the fleece. The pressure applied to

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in the apparatus illustrated in Fig. 1; and

Fig. 5 is a section, on an enlarged scale, on the line 5-5, Fig. 4.

In the following description with reference to the accompanying diagrammatic drawings, the invention is described more particularly in its application to the production of friction elements.

Referring to Fig. 1, fibrous asbestos is fed from the supply hopper 6 to weighing mechanism 7 which deposits measured quantities of fibre 8 on the lattice 9 where the fibre is spread into a layer by the rocker-bar 10. The lattice 9 travels in the direction shown by the associated arrow and delivers the layer of fibre 8 to a pair of nip rollers 11 which feed the layer to the surface of the rotating toothed cylinder 12. The cylinder 12 and co-operating toothed rollers 13, 14 tease and comb the fibres 8 into a continuous thin substantially homogeneous fleece 15 which is stripped from the rollers 14 by doffing-combs 16 and delivered by lattices 17 to a lattice 18.

The lattice 18 is progressively lengthened and shortened by reciprocation of the roller 19 towards and away from the roller 20 in a manner such that the fleece 15 is deposited in superposed layers 21 on the cross-lattice 22 (see also Fig. 4). The cross-lattice 22 travels in a direction transverse to that of the lattice 18 and carries the superposed layers 21 of the fleece to the nip of a co-operating pair of vertical lattices 23 (Figs. 1 and 4) which together press the layers 21 into a continuous web 24 of increased thickness. The width of the web 24 is controlled by the extent of the reciprocation of the roller 19, while the thickness of the web depends on the number of layers of which it consists. Such number is a function of the rate of travel of the lattice 22 relatively to the rate at which the fleece 15 is deposited thereon.

From the co-operating vertical lattices 23 the continuous web 24 is conducted by a guiding surface 25, formed as a side of a tank 26 to the nip of a co-operating pair of wire mesh lattices 27, 28 which travel at the same surface speed as the lattices 23. Such lattices are caused by their guide rollers 29 to conduct the web 24 beneath the level of a liquid bonding agent such as liquid phenol-formaldehyde resin 30 contained in the tank 26, the open structure of the wire mesh permitting the liquid freely to reach the fibres comprising the web. The web 24 is thus saturated with the liquid and conducted to the nip of a pair of rollers 31, 32 which rotate at a surface speed equal to that of the lattices 27, 28. The rollers 31, 32 consolidate the web 24 into a continuous coherent web or billet 33, and squeeze excess liquid therefrom. The excess liquid is collected in a trough 34 from which it is conducted back to the tank 26 by a drain pipe 35.

Alternatively, the consolidation of the web or billet 33 may be effected by blocking or pressing lengths thereof between suitable pressure members.

The quantity of liquid bonding agent applied to the web 24 may be varied in accordance with the ultimate use of the product. Thus, asbestos fibres, or asbestos fibres blended with cotton or rayon staple fibres, treated according to the invention and intended for conversion into friction elements may have applied thereto liquid phenol-formaldehyde resin in quantities such as will give from 20% to 30% or even 40% of resin by weight in the consolidated web 33 when in the dry state.

The degree of pressure applied to the impregnated web 24 by the nip rollers 31, 32, can be varied by adjusting screws 44 which bear on blocks 4 freely mounted on the shaft 5 of the upper roller 31 (see Fig. 5). As will be apparent, the quantity of liquid remaining in the web 24 varies substantially inversely as the pressure to which the web is subjected. The lower roller 32 is flanged to receive the upper roller 31, the flange supporting the edge of the web 24 during its consolidation into the billet 33.

One or both of the pressure rollers or other pressure-applying members may be heated for the purpose of inducing suitable reaction in the bonding agent.

A conveyor belt 36 supported and driven by rollers 37 at the same surface speed as the rollers 31, 32 carries the continuous billet 33 to a guillotine, the blade 38 of which is caused to descend against a pad 39 by a rotating cam 40, and cut the billet into predetermined lengths 41. The cut lengths 41 fall on a conveyor belt 42 supported and driven by rollers 43, and are collected from such belt for drying and subsequently moulding under the combined influences of heat and pressure, e.g. into shapes appropriate for use as friction elements.

If desired, fibres of materials other than asbestos may be blended with the asbestos fibres fed from the supply hopper 6. Thus, cotton or rayon staple fibres may be blended with the asbestos fibres within the hopper, or such fibres may be formed into a scutcher lap 45 (Fig. 1) and fed in predetermined amount by nip rollers 46 to the nip rollers 11 for presentation with the layer 8 of asbestos fibre to the toothed cylinder 12. Where short-fibre asbestos is employed, an admixture of cotton or rayon staple fibre of from 5% to 30% by weight of the asbestos fibres may be effected.

Powders or substances in comminuted form, e.g. a powdered bonding agent, may be added to the fleece 15 from a supply

hopper 47 (Figs. 1, 2 and 3). The hopper comprises a trough 48 carrying in its base a rotatable roller 49, the surface of which is formed with longitudinal grooves 50. The roller 49 is mounted on a shaft 51 which is rotated by a pulley 52 driven by a chain 53. Powder 64 placed in the trough 48 lodges in the grooves 50 of the roller 49. Stationary pads 54 fitting closely against the face of the roller 49 prevent the powder falling freely from the trough.

Rotation of the roller 49 causes the powder lodging in the grooves 50 to scatter beneath the trough. The supply hopper 47 is mounted across the width of the carding machine in a manner such that the powder 64 is caused to scatter over the fleece 15 shortly after such fleece leaves the rollers 14. At this stage the fibres comprising the fleece are in open form and permit the grains of powder to enter intimately into the structure of the fleece. The amount of powder applied to the fleece may be increased or decreased by increasing or decreasing the rate of rotation of the roller 49. The depositing of the fleece 15 in superposed layers 21 on the cross-lattice 22 assists in blending the powder 64 with the component fibres of the fleece.

The powder 64 may comprise a single substance or a blend of two or more substances adapted to vary the character or colour of the fleece 15. When the product according to the invention is intended for use as a friction element, friction-modifying or enhancing materials may be added to the fleece. For example, particles of metal, rubber, iron oxide, rottenstone, wood-flour or like substances may be scattered on the fleece 15 from the hopper 47. In the manufacture of brake lining or clutch facing materials fibrous glass or powdered or comminuted brass or zinc may, with advantage, be added to the fleece.

Friction materials according to the invention may be reinforced for heavy-duty applications by the introduction into the web 24 of threads or strips of materials such as steel threads or wires. Similarly, metallic fabric or woven steel, brass, zinc or aluminium wire mesh may be introduced as a backing or reinforcing means.

A method of incorporating a mesh backing into the web 24 is illustrated in Figs. 4 and 5, in which a roll 60 of woven steel mesh 61 of width equal to that of the web 24 is mounted on a shaft 62 rotatably supported in open bearings 63. The mesh 61 is led from the roll 60 to the nip of the rollers 31, 32, where the mesh is gripped and caused to unwind from its roll at the peripheral speed of the rollers. The pressure between the rollers 31, 32 while consolidating the web 24 into the continuous billet 33, squeezes the web intimately into contact with the mesh 61 in a manner such that the mesh becomes an integral part of the billet 33 which is cut into lengths 41 by the blade 38 in the manner described above.

It will be understood that the invention is not limited to the particular embodiment hereinbefore described. For example, the apparatus for carrying out the various steps involved in the process may be modified in various ways. Furthermore, it will be understood that the process and apparatus hereinbefore described with reference to the accompanying diagrammatic drawings is generally applicable for the production of a coherent web or billet from various fibrous materials or combination thereof with or without the introduction of fillers, such web or billet being capable of being moulded or pressed to produce strips, sheets or blocks of any suitable shape having substantial mechanical strength and applicable for various purposes according to the nature of the fibres utilised and the substances incorporated therewith.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is :—

1. A process for producing fibrous materials of the kind referred to, comprising forming fibrous material into a continuous fleece which is, in a manner known *per se*, cross-folded to form a multi-layer continuous web, impregnating said multi-layer web with a liquid hardenable bonding medium, such as an artificial resin, and thereafter consolidating the impregnated web by the application of pressure.

2. A process according to Claim 1, wherein the application of pressure to the multi-layer web for the purpose of consolidation also serves to expel excess liquid bonding medium.

3. A process according to Claim 2, wherein the consolidating pressure is adjusted so that the percentage of bonding medium retained in the multi-layer web after consolidation and in the dry state is between 20% and 40% by weight of the bonding medium.

4. A process according to any of the preceding claims, wherein the consolidated multi-layer web is cut into lengths to form suitable blanks for subsequent moulding operations with the application of heat and pressure to produce substantially rigid elements.

5. A process according to any of the preceding claims, for the production of friction elements, wherein the fibrous material consists of asbestos.

6. A process according to Claim 5, wherein additional fibrous material, such as cotton or rayon, is combined with the asbestos fibres.

7. A process according to Claim 6, wherein the cotton or rayon staple fibres are added in the proportion of 5% to 30% by weight of the asbestos fibres.

8. A process according to Claim 6 or Claim 7, wherein the admixture of cotton or rayon fibres with the asbestos fibres takes place before the fleece-forming operation.

9. A process according to any of the preceding claims, wherein fillers, such as friction-modifying materials in powdered or comminuted form, are introduced into the fleece prior to the folding operation.

10. A process according to Claim 9, wherein the fillers comprise fibrous glass, zinc or brass.

11. A process according to any of the preceding claims, wherein, for the purpose of mechanical reinforcement, metallic elements in the form of threads, strips, wires or mesh are embedded in the impregnated multi-layer web in the course of consolidating the same.

12. A process of producing friction elements which comprises subjecting asbestos fibres, with or without additional fibres, to treatment for the production of a fleece in the form of a continuous layer, applying to said layer solid friction-modifying materials in powdered or comminuted form, cross-folding the treated fleece upon itself in a manner known *per se* to form a continuous multi-layer web, impregnating the said web with a liquid phenol-formaldehyde resin or like bonding medium, subjecting the impregnated web to a consolidating pressure to expel surplus liquid and to produce a coherent web or billet, cutting the web or billet into suitable lengths, and from such lengths producing such friction elements by a moulding or pressing operation involving the application of heat and pressure.

13. Apparatus for carrying out the process hereinbefore specified, comprising means for forming fibres into a continuous fleece, means for conveying said fleece to folding apparatus whereby it is cross-folded upon itself on a transversely disposed lattice or the like for the production of a multi-layer web, means for conveying said multi-layer web through a bath of liquid bonding medium, and means, such as nip rollers, for consolidating the impregnated web.

14. Apparatus according to Claim 13, wherein means are provided for adjusting the pressure applied by the said nip rollers, for the purpose described.

15. Apparatus according to Claim 13 or Claim 14, comprising means for introducing on to the fleece, prior to the folding operation, solid substances in powdered or comminuted form.

16. Apparatus according to Claim 15, wherein the means for introducing the solid substances comprises a hopper, a grooved roller forming the base of the hopper, and means for rotating the grooved roller.

17. Fibrous material convertible by a moulding or pressing operation into strips, sheets or blocks having substantial mechanical strength, produced by the process claimed in any of the preceding Claims 1 to 13.

18. Strips, sheets or blocks having substantial mechanical strength, produced by the process claimed in Claim 4.

19. Friction elements, produced by the process claimed in Claim 12.

20. The improved process for the manufacture of fibrous material convertible by a moulding or pressing operation into strips, sheets or blocks having substantial mechanical strength, substantially as described with reference to the accompanying diagrammatic drawings.

21. Apparatus for carrying out the process herein claimed, substantially as described with reference to the accompanying diagrammatic drawings.

Dated this 11th day of March, 1947.

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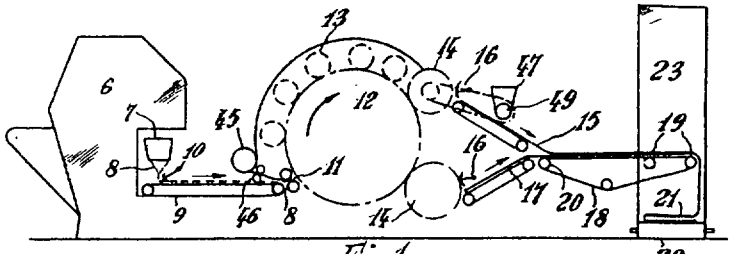

Fig. 1.

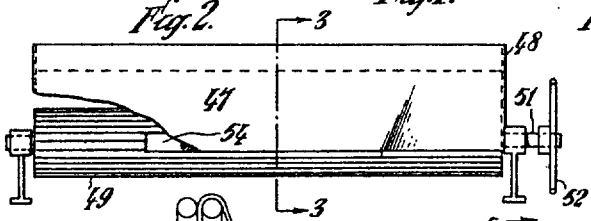

Fig. 2.

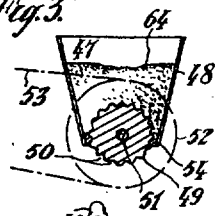

Fig. 3.

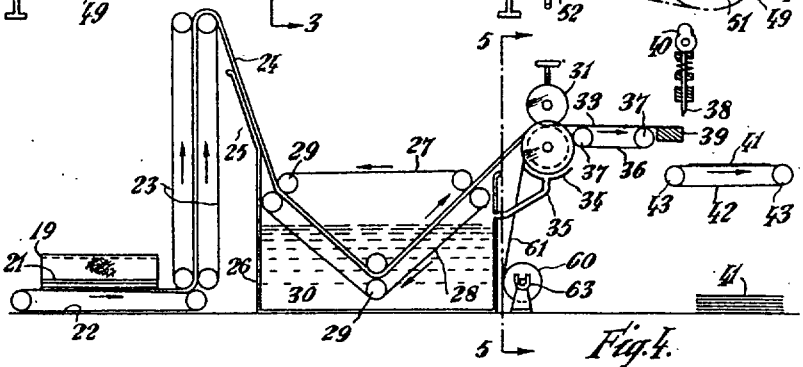

Fig. 4.

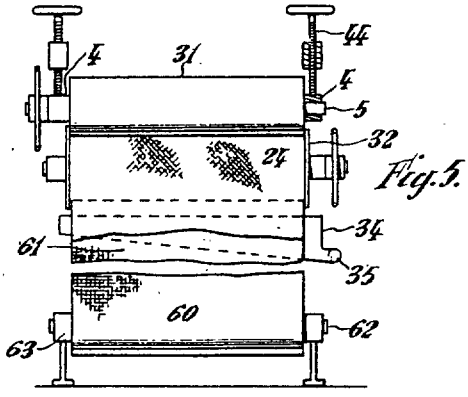

Fig. 5.

H.M.S.O.(Ty.P.)