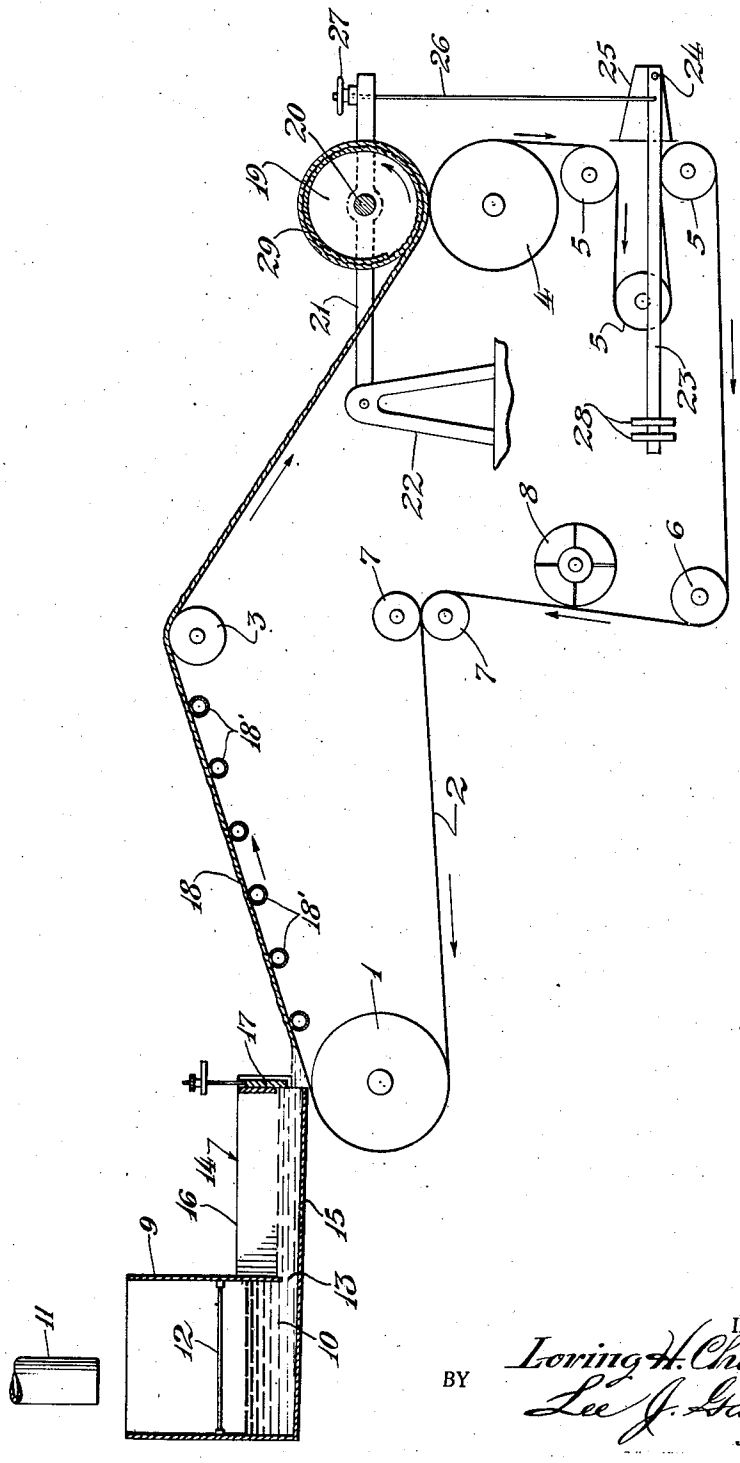
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METHOD FOR MAKING FRICTION MATERIALS

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METHOD FOR MAKING FRICTION MATERIALS

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This invention relates to improvements in the manufacture of friction materials, and refers particularly to a method for felting the ingredients of the friction material comprising fibers, such as asbestos fibers, fillers with or without a binder into a sheet from which desired shapes, that is, clutch facings or brake linings, may be formed.

Felted sheets comprising asbestos fibers have heretofore been made upon so-called wet machines from which friction materials, such as clutch facings, brake linings and the like, have been formed. In some instances fillers and binders have been admixed with the fibers to form the felting stock, but inasmuch as so great a quantity of such fillers and binders have been lost during the removal of the aqueous carrier from the sheet, the general practice is to add the binder after the sheet has been felted. However, loss of fillers cannot be prevented and the operation is therefore quite expensive. Moreover, to conserve the binder, the same is added after formation of the web. This involves an additional manufacturing step which, of course, is undesirable and further the after-incorporation of the binder in the sheet is imperfect due to the character of the sheet produced in the wet machine process, and uniform saturation is unattainable.

In felting such sheets on the conventional wet machine, the stock flowed upon the forming wire is in a relatively dilute state, comprising in the neighborhood of 1% fiber and other solids. As a consequence, a relatively thin (rarely thicker than .020 inch), dense sheet is formed which is wound upon the make-up roll to the desired thickness and thereafter stripped therefrom. The resulting composite sheet appears to be antagonistic to subsequent saturation operations and in general is a more or less undesirable product for the formation of friction elements.

In addition, due to the fine grained character of the sheet made upon the conventional wet machine, and also due to the fact that the sheet has a considerable portion of its aqueous carrier removed before it reaches the make-up roll, the resulting composite sheet is characterized by being built up of definite, sharply identified lamina and definite, comparatively weakly bonded planes exist in the thickness of the final product.

It has long been known that the type of fibrous arrangement in friction materials is a very important factor in the production of desirable friction elements. One of the best structures is produced by the so-called wet slurry casting method which consists of making a wet slurry containing from 6% to 15% solids and pouring the slurry into a box with a perforated bottom over which a felt or burlap is placed, through which the water in the slurry is exhausted. Either suction or pressure is usually applied to speed up the process. This process produces a relatively uniform felted mass with no trace of laminations. Filler losses are reduced to a minimum since the initial material drawn against the filter blanket acts in such a manner as to be the equivalent of increasing the thickness of the filtering medium. In other words, the water is drawn initially from the stock nearest the blanket and subsequent water must be drawn through the mat already deposited on the blanket. Friction materials made in this manner have long been known to have good strength and exceptional uniformity. The method of making friction materials in this manner, however, has been very costly because it is a batch process requiring considerable floor space, since a good many suction boxes are necessary due to the time element in filtering. There is considerable difficulty in removing the sheets from the box if the sheets have any appreciable size. In spite of the costly process, considerable friction material is being made by this process because of the desirable product produced.

In my invention, I contemplate employing a stock comprising fibers, essentially asbestos fibers and fillers with or without a binder in an aqueous carrier, the solids content of the stock ranging from about 4 per cent to 8 per cent or even as high as 14 per cent. The stock is agitated, but not beaten in the sense that the term is used in conjunction with conventional wet machine or cylinder machine practice. The agitated stock is flowed upon the upper surface of an endlessly traveling felt or blanket which travels over a plurality of suction devices where a predetermined controlled amount of liquid carrier is removed from the stock carried upon the blanket. With no previous pressing of the web, it is stripped from the blanket and wound upon a make-up roll to a desired thickness and thereafter stripped from said roll.

Due to the fact that the percentage solids of the stock is relatively high and that the stock is carried upon a blanket instead of a screen, and further, due to the fact that the suction upon the blanket is very closely controlled, little or none of the fillers or binder are lost in removing the aqueous carrier, and, hence a resultant sheet hav-

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ing the fillers and binder uniformly and efficiently incorporated therein can be economically made.

As another feature of my invention, due to the relatively high percentage of solids in the stock and also due to the fact that the stock is merely agitated, as opposed to being beaten in the commonly accepted sense of the term, the stock when flowed upon the blanket is "lumpy," the fibres being in a substantially clotted condition and the web has an irregular, uneven surface, the irregularities or lumps not being disturbed by excessive suction nor by pressing the web prior to winding the same upon the make-up roll. Therefore, in view of the controlled moisture condition of the web coupled with its irregular, lumpy surface at the time of winding the web upon the make-up roll, the composite sheet stripped from the make-up roll is substantially homogeneous in structure, being substantially devoid of clearly demarked laminations and, hence, is ideal for the production of friction clutch facings, brake linings and the like.

Other objects and advantages of my invention will be apparent from the accompanying drawing and following detailed description.

The single figure comprising the drawing illustrates, diagrammatically, suitable apparatus for carrying out my invention.

In the drawing, 1 indicates a breast roll around which a felt or blanket 2 is trained. The blanket 2 is carried in the direction of the arrow and from the breast roll 1 travels upwardly at an angle to guide roll 3, and thence downwardly over lower couch roll 4. Upon leaving the lower couch roll 4, the blanket passes around conventional web-tightener rolls 5, over guide roll 6 and between squeeze rolls 7 wherein moisture is removed from the blanket. Between guide roll 6 and squeeze rolls 7, the blanket passes adjacent "whipper" 8, of conventional construction, which functions to loosen and remove solid materials which tend to cling to the blanket. From squeeze rolls 7 the blanket completes its endless passage around breast roll 1.

A head box 9 is positioned adjacent the breast roll 1, said head box being adapted to receive stock 10 from conduit 11 which transports said stock from a stock chest (not shown). A coarse grating 12 is positioned in head box 9 and tends to uniformly distribute the stock from the conduit within the lower portion of the head box. The lower portion of the head box 9 is provided with an elongated opening 13 which affords communication between the lower portion of the head box and a trough 14. The trough 14 comprises an apron-board 15 and sides 16. The trough 14 is adapted to conduct stock 10 from the head box 9 to the blanket 2 and said trough terminates over breast roll 1. An adjustable gate 17 serves to control the passage of stock 10 from the trough to the upper portion of the blanket 2.

As a feature of my invention careful control of the stock 10 is exercised. The stock comprises fibers, preferably asbestos fibers or a mixture of asbestos fibers and other fibers, substantially insoluble fillers such as litharge, barytes, graphite, carbon black or the like with or without a binder. If a binder is added to the stock such insoluble binders as rubber, synthetic resins, oils, asphalts or the like are contemplated.

In preparing the stock the fibers, fillers, and if a binder is used, the binder are mixed with water to give a solids content of from about 4 percent to 8 percent or even as high as 14 percent. The stock is agitated, but not beaten in the sense that the term is used in the paper making art or wet machine or cylinder machine practice. The fibers are not "opened up." The function of the agitating step is merely to secure a fair degree of dispersion of the solids (fibers, fillers and binder if used) in the aqueous carrier. Of course, the stock 10 is not permitted to stand for a sufficient length of time unagitated to permit settling of the solid ingredients.

The stock is passed beneath the gate 17 and carried forwardly upon the blanket 2 in the form of a web 18. Conventional deckles (not shown) are preferably used to prevent the stock from flowing over the edge of the blanket.

The blanket, carrying the stock upon its upper surface in passing from breast roll 1 to guide roll 3 moves over a plurality of suction pipes 18' which are provided with slots or holes whereby a portion of the aqueous carrier is removed through the blanket. The stock 10, having a relatively high solids content and not being vigorously beaten is in a more or less lumpy state although generally in web-like formation. It is a feature of my invention to maintain the web 18 in this state, that is, with a relatively lumpy upper surface, and hence a relatively mild degree of suction is exerted by the suction pipes 18', the suction being so controlled as not to unduly flatten the upper surface of the web 18. The importance of this feature of my invention will be hereinafter more fully described.

When a desired degree of moisture has been removed from the web 18 the blanket 2 will have reached the guide roll 3 and the blanket carrying the web is then passed into contact with the lower couch roll 4. A make-up roll 19 is positioned immediately above the couch roll 4, said makeup roll being journaled upon shaft 20 carried upon arms 21. The arms at the opposite ends of the shaft 20 are pivotally mounted upon standards 22 which comprise a portion of the frame of the machine. A lever 23 is journaled at its end as at 24 upon support 25 which latter also comprises a portion of the frame of the machine. A rod 26 is connected to an intermediate portion of the lever 23 at one end and at the opposite end is passed through arm 21. The upper end of the rod 26 is threaded and its effective length can be controlled by means of the hand wheel 27 which is threadedly mounted upon said rod. The free end of lever 23 is adapted to carry weights 28.

It can readily be seen that the arrangement is such that by the proper positioning of weights 28 along lever 23 and by the proper manipulation of hand wheel 27, a desired degree of pressure may be established between the make-up roll 19 and the couch roll 4. When blanket 2 carrying the web 18 passes between couch roll 4 and the make-up roll 19, the web which may have a thickness from .015 to .100 inch, adheres to the make-up roll and is stripped from the upper surface of the blanket. As the operation progresses the web 18 winds upon the surface of the make-up roll until a composite layer of stock is formed upon the make-up roll as indicated at 29. When a desired thickness of stock 29 is formed upon the make-up roll 19 the stock is slitted by the operator in a direction parallel to the axis of the shaft 20 and the composite web 29 is removed from the make-up roll. Immediately upon removal of the composite web from the make-up roll the web 18 carried by the blanket continues to form upon the make-up roll. In other words the operation is continuous.

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Due to the fact that the stock 10 has a relatively high solids content, that is, a solids content preferably between 4 percent and 8 percent, and sometimes as high as 14 percent, and also due to the fact that the stock 10 is not beaten, in the sense that the term is used in the paper making art, but is merely agitated, the web 18 is in a more or less coarse state as it forms upon the blanket 2. Further, a mild degree of suction is applied by the pipes 18' so as not to excessively compact the web 18. Consequently, when the web 18 reaches the make-up roll and is stripped from the blanket 2, it is in a more or less coarse condition, the upper surface thereof being relatively lumpy or uneven. In addition, the web at this stage of its travel contains a relatively high percentage of moisture, that is, considerably higher than is conventionally used in wet machine operation. Hence, when the web is wound upon the make-up roll the plane of juncture of adjacent convolutions of the web is extremely shadowy and not clearly demarked. The pressure of the make-up roll upon the couch roll tends to cause a degree of movement of the fibers in the adjacent faces of the convolutions, this movement being accentuated by the coarse and uneven surface of the web and also by the fact that the web is relatively wet. The effect of these cumulative factors is to produce a composite web 29 which very closely approaches the homogeneous state and in no sense resembles the webs taken off the make-up rolls in conventional wet machine operations. It has been found that this type of composite web has exceptional qualities for friction materials such as clutch facings, brake linings and the like. The web 29 when stripped from the make-up roll 14 may be cut or stamped to form endless clutch facings or brake lining strips.

If binders were initially introduced into the stock it is only necessary to cure the cut clutch facings or brake linings under the desired conditions of temperature and pressure and ideal friction elements are thereby produced. If, however, no binders are initially introduced into the stock 10, the friction elements, that is, the clutch facings or brake linings formed from the composite web 29 may be saturated with any of the conventional binders. The usual pressure and cure may follow. It has been found that felted stocks made in accordance with my process wherein no binders have been initially incorporated are ideal for subsequent saturation since the web taken from a make-up roll is relatively coarse and can be readily and quickly saturated with any of the conventional binders.

In view of the fact that the felted stock is made from a relatively highly concentrated stock suspension, very little of the binders, if used, or fillers escape with the extracted water. Although fillers such as litharge, barytes, graphite, carbon black and the like are normally considered to be insoluble in water, they have a small degree of solubility which increases rapidly with temperature conditions. Hence, in conventional wet machine operation wherein the solids content amounts to no more than about 1 per cent, a considerable portion of said fillers are lost in solution in spite of their low degree of solubility. The same holds true for binders ordinarily considered to be water insoluble. Hence, by my process considerable economy is obtained through the preservation of fillers and binders since one-third to one-tenth of the volume of water is used as compared with conventional wet machine operation. In addition, little loss of fillers, binder or fiber exists in my process, inasmuch as substantially all of the solids deposited upon the blanket appear in the final product and a very small quantity is lost in physical extraction of the water.

As opposed to most wet machine operations the web is not subjected, in my process, to any pressure prior to reaching the make-up roll and in view of the fact that a relatively mild degree of suction is applied through the pipes 18' the moisture content of the web 18 when it reaches the make-up roll is relatively high being in the neighborhood of 25 to 50 per cent and preferably 35 per cent. Of course, it is to be understood that I do not wish to be limited to this specific moisture content since it will depend entirely upon the characteristics of the product desired and the degree of pressure applied by the make-up roll. The pressure of the make-up roll and the moisture content of the web must be so correlated as not to crush the web, but are also correlated so as to permit the desired degree of intermingling of the fibers of the adjacent convolutions of the web.

I claim as my invention:

1. A process of making a felted fibrous web adaptable for use in forming friction elements, which comprises, agitating without substantially beating a mixture comprising asbestos fibers, fillers and water to form an aqueous stock suspension having a solids content between about 4 and 14%, the solids content and extent of agitation of said stock being such as to produce a suspension in which the fibers are clotted, flowing the agitated but substantially unbeaten stock suspension onto the top of an endless travelling felt blanket to form a layer of stock thereon, carrying said suspension freely throughout its travel on said blanket and in the absence of surface modification treatment to cause formation of a web having an uneven and lumpy surface, subjecting said web while carried on said blanket to suction to remove a predetermined amount of moisture from the web without materially affecting the uneven or lumpy character of the web surface, winding said web upon a make-up roll and thereat initially applying rolling pressure to said web during the winding operation to form a substantially non-laminar composite web of predetermined thickness, and stripping said composite web from said make-up roll.

2. A process of making a felted fibrous web adaptable for use in forming friction elements, which comprises, agitating without substantially beating a mixture comprising asbestos fibers, a substantially water-insoluble synthetic resin binder, fillers and water to form an aqueous stock suspension having a solids content between about 4 and 14%, the solids content and extent of agitation of said stock being such as to produce a suspension in which the fibers are clotted, flowing the agitated but substantially unbeaten stock suspension onto the top of an endless travelling felt blanket to form a layer of stock thereon, carrying said suspension freely throughout its travel on said blanket and in the absence of surface modification treatment to cause formation of a web having an uneven and lumpy surface, subjecting said web while carried on said blanket to suction to remove moisture from the web to produce a water content therein between approximately 25 and 50% without materially affecting the uneven or lumpy character of the web surface, winding said web upon a make-up roll and thereat initially

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applying rolling pressure to said web during the winding operation to form a substantially non-laminar composite web of predetermined thickness, and stripping said composite web from said make-up roll.

3. A process of making a felted fibrous web adaptable for use in forming friction elements, which comprises, agitating without substantially beating a mixture comprising asbestos fibers, a substantially water-insoluble binder, fillers and water to form an aqueous stock suspension having a solids content between about 4 and 14%, the solids content and extent of agitation of said stock being such as to produce a suspension in which the fibers are clotted, flowing the agitated but substantially unbeaten stock suspension onto the top of an endless travelling felt blanket to form a layer of stock thereon, carrying said suspension freely throughout its travel on said blanket and in the absence of surface modification treatment to cause formation of a web having an uneven and lumpy surface, subjecting said web while carried on said blanket to suction to remove a predetermined amount of moisture from the web without materially affecting the uneven or lumpy character of the web surface, winding said web upon a make-up roll and thereat initially applying rolling pressure to said web during the winding operation to form a substantially non-laminar composite web of predetermined thickness, and stripping said composite web from said make-up roll.

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