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METHOD OF MANUFACTURING FRICTION FACING AND LIKE MATERIALS

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1 Claim. (Cl. 92—55)

This invention relates to the manufacture of friction and like materials, and a principal object of the invention is to provide an improved method of manufacture capable of yielding a material of improved characteristics on an economically favorable production basis.

The rapid development of transport industries entailing the use of heavier vehicles operating at higher speeds imposes an increasing responsibility on the friction materials used in the braking systems. The factors of industrial competition and mass production, however, substantially preclude an advance in the cost of friction materials commensurate with the advance in quality, and it is necessary, therefore, that quality advances shall be obtained primarily through improved methods of manufacture, preferably utilizing the conventional ingredients, which shall permit maintenance of manufacturing costs at either the current or lower levels. It is a principal object of the present invention, therefore, as previously set forth, to provide a method of manufacture which shall afford the required improvement in the quality of the materials without increase of, or even at reduced, production cost.

In proceeding in accordance with the invention, I may employ the ingredients commonly used in the manufacture of friction materials, which basically are as follows:

Asbestos fibre
Organic fibre
Inert filling materials
Metal chips or powders
Some suitable bonding agent, preferably of the thermosetting plastic type.

These ingredients are first compounded, on a ball mill, for example, or by other suitable means, in a manner preferably to thoroughly open out the asbestos fibres and to intermix them with the organic fibres with a high degree of uniformity. The inert filling materials, metal chips or powders, and the bonding material are in this operation broken up to fine condition and evenly distributed throughout the fibre mass.

This compound is then suspended in water to form a slurry of fair fluidity, such a slurry being obtainable by addition of say eight parts by weight of water to one part of the compound. It has been found that the relative distribution of the various elements or ingredients in the compound remains substantialy unchanged in the slurry. This slurry is then poured onto suitable filter frames and the excess water permitted to drain out by gravitation. After the gravity drainage has been completed, or has reached an advanced stage, high vacuum is applied under the filter and is maintained until all the water, except a certain amount not susceptible to removal by this method, is withdrawn. Instead of the high vacuum for removal of the major portion of the residual water, pressure may be used, in which case the said water is expressed from the mass; or pressure and vacuum may be used in conjunction to obtain the desired effect.

In the initial drainage by gravitation, the slow running out of the excess water from the mass has a tendency to orient the fibres in a manner facilitating the flow of fluid through the mass, but the movement of the excess water in this step is insufficiently energetic to disturb the distribution throughout the fibres either of the filling materials, the metal particles, or the bonding plastic. Nor is the aforesaid orienting tendency sufficiently great to effect a complete orientation of the fibres in one direction, but on the other hand has the effect of correcting any such orientation that may have occurred when the slurry is fed to the filter. In the deposited fibrous mass left after drainage is finished, therefore, there is a substantially complete absence of definite orientation, the fibres extending in all directions and being distributed and interlaced in a manner calculated to afford a highly homogeneous body displaying great strength in all directions and high resistance to rupture.

After gravity drainage is completed, the high vacuum or pressure, or both, is imposed upon the filter as described, and a shock effect is thereby produced which causes the fibres to jam themselves together into a highly homogeneous mass which, nevertheless, presents no unduly high resistance to fluid flow therethrough, so that the forced drainage is effective to remove a major percentage, say in the neighborhood of 70%, of the water originally employed in making up the slurry.

The sheet remaining after forced drainage, although including no direct bonding material effective in the cold, is yet sufficiently solid to permit handling without exercise of any extraordinary precautions against breaking or tearing. This solidity results from the thorough interfelting of the fibres in the sheet, which in its turn results from the pretreatment given the fibres in the initial compounding operation, in the gravity drainage, and subsequently in the high vacuum and/or pressure drainage. The sheet may now be placed between wire or other suitable screens and cold-pressed under a pressure of, preferably, at

least 300 pounds per square inch of the surface area, the purpose of this pressure being to squeeze out as much as possible of the remaining water. The higher the pressure used in this operation, the better, although preferably the pressure should not materially exceed 1000 pounds per square inch. After the cold-pressing operation, there ordinarily remains in the neighborhood of 8% to 10% of water in the sheets over and above the water content of a normally dry sheet which must be removed by drying, and for this drying operation any temperature may be used below that required to polymerize or finally set the bonding plastic.

After drying, the sheets are placed either in molds or frames and hot-pressed at a temperature and for a period of time necessary to polymerize or to finally set the bonding plastic. The pressure used in this operation should be sufficient to obtain maximum density and homogeneity of the finally resulting friction material, and should, therefore, be at least 1600 pounds per square inch of the effective molding area.

A further advantage of the method of manufacture described above is that it permits the production of composite sheets in which, for example, the effective frictional surface portion may contain all the ingredients required to afford the desired friction characteristics, whereas the supporting body of the sheet is made of a less expensive compound having sufficient solidity to hold the friction facing in place. This result may be obtained by first pouring the high-friction-compound slurry onto the filter frames and allowing it to drain by gravity as fully as this drainage method will permit and as described above. A relatively cheap body-mix slurry is then poured gently over the gravity drained high-friction-mix, and further gravity drainage of both compounds is permitted to proceed to its final point. High vacuum and/or pressure is then applied and all the operations proceeded with as previously described.

This method of superimposing one compound upon another after gravity drainage of the first insures complete cohesion between the two compounds. The method also makes possible the interposing between the said facing and backing sections, or anywhere within the mass of the formed sheet, of various reinforcing means, such, for example, as textile fabrics, wire screens and the like.

It will be apparent that a practice of the aforedescribed invention does not depend on the use of particular ingredients. The nature of the fibres, of the fillers and frictioning elements, and of the bonding agent may vary widely. While for the latter thermosetting plastics are preferred, it is possible to use a wide variety of bonding agents either of thermosetting or thermoplastic character, and the pressures and temperatures employed will vary according to the nature of the said agent and the characteristics required in the finished product.

It will be apparent, also, that by the aforedescribed method, the friction material may be made directly to the thickness and shape required in the finished friction element, such, for example, as a brake lining or clutch facing; or the material may be produced in sheets of required thickness and the individual friction elements dyed or otherwise cut from this sheet as a blank.

I claim:

The method of manufacturing friction facing and like materials of the class compounded of fibres, solid particles of a frictioning or other agent and a normally non-cementitious heat-reactive binding substance, said method comprising first compounding said ingredients in dry state to the form of a substantially uniformly disseminated mix, suspending said mix in water to form a flowable slurry in which the uniform dissemination of the ingredients is substantially preserved, flowing said slurry onto a filter bed and filtering the water through said bed by gravity to form an interfelted fibrous mass in which the fibres extend in all directions, thereafter applying heavy suction to said filter with consequent withdrawal of further water from the interfelted mass, subjecting said mass in the cold to pressure expressing still further moisture, drying the compressed mass at low temperature without materially affecting the said binding substance, and subsequently applying heavy pressure and heat to the mass to densify the latter and to convert the binding substance to cementitious state.

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