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FRICTION ELEMENT AND METHOD OF MAKING THE SAME

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This invention relates to an impregnated article of manufacture, particularly a friction element, and to the method of making the same.

A conventional friction material or element adapted for use as brake lining or clutch facing of automobiles, for example, comprises asbestos fibers and a friction compound. The friction compound may be one containing a large proportion of rubber, pitch, or other semiplastic binder of suitable properties.

It is an object of the present invention to provide a friction material that has an increased coefficient of friction, increased resistance to wear, or increased resistance to change in properties at moderately elevated temperatures, as compared to conventional brake lining.

The invention comprises the novel features hereinafter claimed or described and, especially, a product comprising reenforcing fibers, a water-insoluble, heat-resistant, inorganic substance precipitated in intimate association with the said fibers, and a friction compound adhering the whole into an article adapted for use as a friction element. The invention comprises also the method of manufacturing the improved product which includes precipitating in situ a heat-resistant, inorganic substance, in intimate association with reenforcing fibers, then applying friction compound to the thus treated fibers, and forming a unitary product.

The invention is illustrated by the following specific example of the making of a product in which asbestos yarn is intimately associated with calcium silicate, precipitated within and between the several units of yarn and enmeshed in the fibers therein, the thus treated yarn is provided with a coating or impregnation of a rubber friction compound, the coated or impregnated yarn is compressed and densified into an article of desired shape, and the rubber therein is hardened by vulcanization.

There is provided a supply of asbestos yarn that is preferably wire-inserted, that is, wire-reenforced. A yarn that has been used to advantage is scrap asbestos yarn that has been cut and/or shredded into short lengths averaging, say, approximately 1 to 3 inches long. The short lengths of asbestos yarn are then immersed in or thoroughly wetted by an aqueous mixture, actually a suspension, of hydrated lime containing suitably 10 to 50 parts by weight of lime, say, 25 parts, to 75 parts by weight of water. The mixture is made intimate, as by agitation, so that the fine particles of hydrated lime become incorporated between the units of yarn and also between the various fibers comprising the individual strands of yarn. The yarn is an especially desirable form of unit of asbestos in this treatment, since the yarn does not collapse into large masses when wet.

The yarn thus associated with the lime, either after drying at an elevated temperature, as, for example, at approximately 200° F., or, without drying, is treated with a soluble silicate. For the treatment there has been used to advantage a commercial solution of sodium silicate in water, of a density of approximately 20° Baumé. This treatment causes the conversion of lime into a precipitate of calcium silicate. Because the lime was initially lodged within and around the fibers in the yarn, the precipitate formed is intimately associated with and distributed throughout the fibers composing the yarn. The precipitated material is in finely divided form.

The silicated yarn thus formed may be subjected to washing with water, in any convenient and satisfactory manner, to remove soluble materials present. This washing is designed to remove unused sodium silicate, if any is present, as well as the soluble by-product of the interaction of the lime with the silicate.

The washed product is then subjected to drying, suitably at an elevated temperature, say, at approximately 200° F. The thus treated yarn is then impregnated with rubber friction or binder compound. The rubber compound may consist of ingredients which are conventional in brake linings, including a high proportion of rubber, a vulcanizing agent, fillers, and, if desired, anti-oxidation material and other ingredients. A rubber compound that may be used has the following composition:

	Parts by weight
Rubber (crude)	24
Sulfur	8
Litharge	8
Zinc oxide	12
Carbon black	12
Barium sulphate	36
Total	100

The compound is applied, advantageously, in the form of a rubber cement, that is, in solution in a volatile solvent. The rubber compound is distributed thoroughly over the various units of dry silicated yarn and the volatile solvent is evaporated. The thus rubberized yarn is placed, in suitable quantity, into a shaping and vulcanizing die and is compressed and densified in the die, to

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establish the shape desired in the finished article. The rubber binder in this shaped article is vulcanized, as, for example, by steam heat applied to the shaping die, supplemented, suitably, by additional vulcanization in a steam-heated oven after the shaped and partly vulcanized material is removed from the die.

The product so made, as compared to brake lining including asbestos yarn and rubber binder compound but not including the insoluble silicate associated with the fibers, has a greatly increased coefficient of friction, decreased rate of wear, and is adapted for use at higher temperatures, that is, under more severe conditions of braking.

In order to minimize the tendency of the brake lining to score the brake drum against which it is applied, there may be incorporated with the rubber binder compound, in a process of manufacture that is otherwise similar to the one described above, an anti-scoring agent, that is, a material adapted to modify slightly the hardness of the product. Thus, there has been used to advantage a resinous polychlordiphenyl that melts at about 158° F. to a viscous liquor and is known as arachlor, in the proportion of about 2 parts of the anti-scoring agent for 100 parts by weight of rubber in the compound. In general, the anti-scoring agent should be a latent softener which becomes an effective lubricant only when the temperature exceeds a certain point, as under conditions which make the brake drum relatively susceptible to scoring. High melting, lubricating, relatively non-volatile, inert substances may be used.

Various alternatives may be used in place of the materials described above.

In general, the material used as the friction compound or binder may be one that is commonly used in friction materials and is, advantageously, semiplastic or plastic initially and semirigid in the final product. It may also be resilient. Preferably, the binder is one that is adapted to be hardened after being incorporated into the fibrous material. Thus, there may be used a drying oil, that is, one adapted to be hardened by polymerization and/or oxidation, such as China-wood oil, linseed, or perilla oil. Such an oil, when used, is hardened in the shaped article by being maintained at an elevated temperature in the presence of air. Another binder that may be used is a resinous material, say, a phenol-aldehyde condensation product. Another that may be used when the asbestos is fabricated, into a woven fabric, for example, is asphalt or other bituminous material.

The term "rubber" as used herein is intended to include natural, reclaimed, and/or synthetic rubber. A synthetic rubber that may be used is polymerized chloro-2-butadiene-1,3, of empirical formula, $CH_2{:}CCl.CH{:}CH_2$, and made as described by Carothers and others in the Journal of the American Chemical Society, Vol. 53, pages 4203–6, 1931. In the incompletely polymerized state in which it is initially used, the binder has a consistency approximating that of raw rubber. The hardening or toughening of this binder in a shaped article containing it may be effected by subjecting it to a temperature of about 300° F. for 40 minutes.

The fibers used should be relatively strong, adapted to be adhered together firmly by the binder used, and, for most purposes, heat-resistant. A small proportion of cotton fiber may be used in association with a larger proportion of asbestos fibers, say, approximately 1 part by weight of cotton fibers fabricated with 4 parts of asbestos. In cases where heat-resistance is not required, cotton or wool fibers may be used alone, say in the form of short lengths of yarn. However, asbestos fibers are particularly desirable; because of the structure of the visible fibers which are composed individually of bundles of microscopic, elongated crystals, the fibers are adapted to be penetrated at their frayed portions, at least, in the treatment described above, and, thereby, to become very intimately associated with the precipitate produced.

The fibers may be in the form of short lengths of yarn, as stated, or of a fabric, either felted or woven.

In making a product containing a felted fabric, lime, for example, is suspended with asbestos fibers and water in a beater of paper mill type and the mixture felted into a paper on a paper machine. The resulting paper is then treated with a solution of sodium silicate, washed with water, dried, and impregnated with a solution of a binder, such as a drying oil, a bituminous material, or a resin dissolved in a volatile solvent. Volatile material added in the impregnation is then evaporated and the impregnated product is subjected to conventional treatment for hardening the binder therein and for compressing, if desired.

In making a product containing a woven fabric, reenforced asbestos yarn may be immersed in an aqueous suspension of hydrated lime, for example, and then woven into a fabric, the fabric treated with sodium silicate solution, washed to remove soluble substance present after the treatment or not washed, dried, impregnated with rubber or other binder and the binder therein hardened. Or, the fabric may be woven from untreated yarn and the woven fabric treated with an aqueous suspension of hydrated lime and then with a solution of sodium silicate, and finished as described above.

The water-insoluble, inorganic substance precipitated in intimate association with the fibers, may be one that is heat-resistant, wear-resisting under friction, non-corrodible, finely divided in form, and durable under the conditions to which it is exposed during use. Thus, there may be used a substance meeting these requirements and consisting largely of a metal silicate or phosphate and particularly such a salt of lead, zinc, calcium or other alkaline earth metal. To make the precipitation in situ, preferably there is lodged within the fibers, by means of an aqueous suspension or as a dust, a compound of the type of lime, that is, a relatively insoluble compound of a metal adapted to produce a precipitate with a selected compound of the type of a water-soluble silicate, as, for example, an alkali metal silicate phosphate, and then applying a water solution of the said selected compound. The subsequent operations may be performed as described above.

In order to preserve the semirigidity and/or resiliency of the final product containing rubber binder compound or the like, the proportion of heat-resistant inorganic precipitate in association with the fibers therein should not be so large as to make a stone-like product and should be, for example, less than 100 parts, say approximately 50 parts for each 100 parts of the asbestos units (yarn or fabric).

It will be understood that silicated units of asbestos may be blended with untreated asbestos, in various proportions, before the addition of

the binder compound. Also, the binder compound may be a mixture of two or more conventional binders, such as those described above.

The details that have been given are for the purpose of illustration and not restriction, and many variations therefrom may be made without departing from the spirit and scope of the invention.

What we claim is:

1. A friction element comprising heat-resistant fibers, a water-insoluble, heat-resistant, inorganic substance precipitated in intimate association with the said fibers, and a friction compound, including a binder and an admixed anti-scoring agent, adhering the whole into a unitary product, the anti-scoring agent being a high melting, relatively non-volatile solid adapted, at elevated temperatures of use of the friction element, to modify the hardness thereof and provide lubrication.

2. An article of manufacture comprising heat-resistant fibers, a water-insoluble, heat-resistant, inorganic substance precipitated in intimate association with the said fibers, and a friction compound, including rubber and an anti-scoring agent of the type of polychlordiphenyl, adhering the whole into a unitary product.

3. In making an article of manufacture adapted for use as a friction element, the method which comprises treating asbestos fibers with an aqueous mixture comprising an undissolved and relatively insoluble compound of a metal adapted to form a precipitate in situ when a solution of another selected compound is applied, applying to the treated fibers a solution containing the said selected compound, whereby precipitation is produced, washing to remove soluble materials present after the precipitation, drying the product, and then impregnating with a friction compound.

4. A friction element, adapted for use as automotive brake lining, comprising a fibrous material including the products of the interaction, in the presence of water, of asbestos fibers, a relatively insoluble compound of the type of lime, and a compound of the type of a water-soluble silicate and a friction binder compound adhering the said fibrous material into a unitary product, the product being substantially identical with that produced as described in claim 5.

5. In making an article of manufacture adapted for use as a friction element, the method which comprises incorporating an undissolved and relatively insoluble compound, of the type of lime, within a fibrous asbestos product, causing the said compound to react with a water-soluble substance, of the type of sodium silicate, adapted to form within the said product a precipitate with the said compound, and then applying a friction compound to the said product and precipitate contained therein..

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