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FRICTION ELEMENT AND METHOD OF IMPROVING THE SAME

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This invention relates to friction elements and method of improving same, especially with respect to the removal of certain undesirable constituents in such elements.

In its broad aspects, the invention is directed to woven and unwoven elements, either rigid or flexible, and in one specific aspect, the invention is particularly adapted to improvement of flexible woven brake linings containing oxidized drying oil as a binder.

Of the several types of flexible brake linings on the market up to the present time, one of the most popular and generally serviceable types has been a woven asbestos base containing oxidized drying oils as the principal constituents of the binder. This combination provides brake lining having satisfactory durability and a moderately high coefficient of friction, smooth action, and relative ease of manufacture. For these reasons, a large proportion of service brake linings has consisted of this type of lining. A drawback, however, has been a marked tendency of such oil-treated asbestos brake linings to exhibit an extremely low frictional coefficient when thoroughly wet and a considerably higher than normal frictional coefficient when damp. In regions where precipitation is high, the sales of this type of brake lining, in spite of its normally excellent qualities, have not been comparable with sales of other types.

I have found, after extended investigation, that all brake linings containing any considerable proportion of drying oil in the binder act in a similar manner, especially when used on external brakes where the lining is exposed to dampness and wetness. On analysis, I have found that such brake linings reveal a considerable proportion of free fatty acids and magnesium soaps of these fatty acids. These fatty acids comprise, linolic, linolenic, eleostearic and pyrogenetic on oxidation breakdown products of these such as propionic acid. Cotton tape treated with drying oils and the drying oils dried therein show a free fatty acid content but, of course, no magnesium soaps. It seems, therefore, that the free fatty acids are formed during the drying of the oil and that the magnesia in the asbestos combines therewith to form magnesium soaps.

According to the present invention, I have found that, on extracting a drying oil-treated asbestos base brake lining with solvents as, for example, alcohol or acetone, capable of dissolving magnesium soaps, the extracted brake lining when put into service on an external brake shows very much greater resistance to change from the normal in damp or wet conditions. On further heating of such an extracted brake lining, a small proportion of free fatty acids and magnesium soaps is again formed but in so small a proportion that their effect in service is negligible.

As an indication of the relative proportions of magnesium soaps and free fatty acids present in drying oil-treated asbestos brake linings, a large number of analyses has shown that the usual normal percentage of free fatty acids and magnesium soaps in this type of brake linings is from 12% and 20% of the supposed dried oil, the magnesium soap comprising about three-quarters of the extracted matter. It will be appreciated that a quantity of soapy material of the nature of magnesium soap will exert a pronounced effect on the action of brake lining when wet, all the more aggragated by the fact that while magnesium soap becomes slimy when rubbed out while thoroughly wet, it does not dissolve completely in water and wash away as would, for example, sodium soap. On removal of the soap by suitable solvents, further heating changes less than 2% of the total binder to soaps and acids.

In one preferred form of carrying out the invention, brake lining which has been treated with a saturant containing a drying oil and the drying oil cured therein by oxidation, is placed in an extraction apparatus and exposed to hot methyl alcohol in an apparatus similar in design to the conventional Soxhlet extraction apparatus used in chemical laboratories. After several cycles of solvent replacement have taken place, the lining is removed from the extraction apparatus and the alcohol still remaining therein is dried out in a suitable apparatus which may be equipped for recovery of the solvent. The lining is then ready for use and exhibits a marked improvement over un-extracted material having the same preliminary treatment. As an evidence of this, the extracted material showed on one particular car a deceleration of 14 feet per second per second at 80 pounds pedal pressure, whereas, unextracted material shows an average of only 4 feet per second under the same conditions. Both these tests were made over a period of ten hours during which time the car lined with the brake lining under test was run continuously through driving rain.

Furthermore, dampness results in an undesirable increased friction, especially on cold damp mornings. Under similar conditions, the friction was decidedly better in the case of the extracted tape as against the unextracted tape.

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Some of the solvents which may be used for the removal of free fatty acids and magnesium soaps according to the present invention are methyl alcohol, ethyl alcohol, and alcohol containing moderate proportions of benzol, etc., and in general, any solvent or combination of solvents or reagents may be used which results in the removal of a major proportion or all of the soaps and free fatty acids and any extraction device may be employed which is suitable for effecting such a removal. This operation for the advantages obtained therefrom may also be carried out on unwoven brake linings and clutch facings where it is found that the presence of soaps or free fatty acids is not desirable.

Furthermore, the removal of undesirable fatty or lubricating oily material is valuable in the case of friction materials which ordinarily have a marked tendency to "fade" or drop off in frictional coefficient at high temperatures, or under severe abuse, especially on cast iron drums. It will be appreciated that high temperatures cause such lubricating oils to distil to the friction surface and thus reduce friction at the surface. This is the case with unwoven brake linings containing vegetable oils as modifiers of phenolic resin, for example, the "loose" fatty acid or soap or other decomposition products while generally lower in quantity than in the case of woven brake linings still are present in sufficient proportion to produce such undesirable frictional effects as I have indicated. Extraction of these undesirable lubricants reduces fading and improves the action of the friction material. The extraction may be carried out as in the case of woven brake lining.

Other undesirable lubricating organic matter which may have been introduced as an unavoidable constituent of the saturant, or produced during the hardening of the saturant may be removed by extraction with a suitable solvent in the same manner and for similar purposes to that described above.

I claim as my invention:

1. In the manufacture of friction elements wherein an asbestos base is saturated with a saturant comprising drying oil and cured, the improvement which comprises extracting free fatty acids and magnesium soaps by subjecting said base to the action of a solvent capable of removing such fatty acids and magnesium soaps.

2. A process of improving friction brake lining comprising an asbestos base and a suitable binder whereby the frictional coefficient thereof will be substantially the same in wet or dry weather, which consists in extracting free fatty acids and magnesium soaps normally present in said lining by subjecting the lining to the action of a solvent capable of dissolving said fatty acids and magnesium soaps and then removing the solvent.

3. In the manufacture of friction elements wherein an asbestos base is saturated with a saturant comprising drying oil and cured, the improvement which comprises extracting free fatty acids and magnesium soaps normally present in said cured base by subjecting said base subsequent to curing to the action of a solvent capable of removing such fatty acids and magnesium soaps.

4. Brake lining comprising an asbestos base and a binder comprising the dried residue obtained from the hardening of a vegetable drying oil to a condition suitable for brake lining, wherein the percentage of free fatty acids and magnesium soaps has been reduced by extraction to less than ten percent of the weight of the dried oil.

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