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FRICTION MATERIAL

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This invention relates to the production of friction material of novel composition, adapted for use in the presence of an oil spray or in an oil bath, such as in automotive transmission clutches.

It is an object of the present invention to provide a material of the class described which has a high coefficient of friction, one which has good engagement characteristics, such as the ability to provide desirable gradual engagement with a mating member, and one which has resilience and which remains resilient through long periods of use without taking on a permanent set. An additional advantage is a higher torque output due to better contact with a mating member as well as squeegee action on oil films.

In general, the friction material of the present invention comprises a matrix composed of fibrous asbestos and comminuted wood particles as its major constituents by weight, together with relatively minor amounts of reinforcing cellulose fibers, sizing agents and friction modifying agents. The asbestos comprises from about 35 to about 85%, the wood particles from about 10 to about 50%, and the sizing agents, cellulose fibers, and friction modifying agents when included, comprise from about 2% up to about 15%, all by weight.

The foregoing composition is processed into sheet form by conventional paper-making methods, namely, beater or hydrapulper mixing, followed by sheeting on a wet machine. The sheet material is then wet pressed, dried to constant weight, and immersed in a saturant comprising a heat-setting binder. After complete saturation of the matrix sheet, it is removed from the saturant, drained and cured to set the binder. After cure the sheets are cut to shape, such as annular discs or strips, ground to thickness, and bonded to an operatively supporting member, such as a steel plate, by means of an organic cement.

The characterizing wood particles used in the matrix member may vary in particle size from a 20 mesh size sawdust to the grade known in the trade as wood flour. The type of wood may be hard or soft.

A pronounced advantage of friction element compositions containing wood particles over conventional friction materials which may be used in oil is that grooves in the friction material are not necessary in order to gain the apparent coefficient of friction. This feature favors lower processing costs by eliminating the operation of machining grooves. However, the material of the present invention is amenable to the formation of clean, sharp grooves when desired.

A further pronounced advantage in the use of wood particles in an asbestos composition is the marked lowering of the specific gravity of the body. Since the raw material constituents of friction material are purchased by weight and the final composition is sold on a volume basis, the advantage of ground wood particles over other materials is readily apparent, since the specific gravity of ground wood is 1.25. Further, it is a readily available and highly economical material.

The following formulae will serve as typical examples (percent by weight):

Matrix	I	II	III
	Percent	*Percent*	*Percent*
Asbestos	75	44	60
Friction Modifying Agents [1]	10		4
Sulfite pulp	2	3	3
Wood flour	10		15
20-mesh wood		50	15
Boiled starch solids	3	3	3
	100	100	100
Auxiliary Binder [2]	15–40	15–40	15–40

[1] This may be from about 0 to about 13% of a friction modifying powder such as litharge, barytes, clay, silica or graphite; metal particles such as copper, lead or brass chips, etc.
[2] Phenol aldehyde condensation product or drying oil cured residue.

The sulfite pulp or the like cellulose fibers are employed in small amounts such as from about 1 to about 4% by weight and serve to impart fiber strength to the wet sheet.

The boiled starch solids are likewise employed in small amounts, such as from about 1% to about 4% by weight as a sizing material for the dried sheet.

In the normal processing of the matrix material, the sulphite pulp and water are the first constituents to be placed into the beater or hydrapulper. Mechanical action then continues until fiber dispersion in the water is smooth. Asbestos and wood flour or wood particles are then added in turn with more water as needed to provide good beater or pulper action. This solids concentration is approximately 8%. The friction modifying agents are added next, followed by the boiled starch sizing.

The batch, when properly blended, is consigned to a paper machine and sheeted to a predetermined thickness. Wet sheets are placed between felt or burlap and consigned to a press for further extraction of water. Unit pressure on the wet sheets is applied gradually to a peak of 1200 pounds per square inch. Dwell under load is held to cessation of water flow. The wet pressed sheets are separated from the felt or burlap, placed on screens, and dried to constant weight at 225° F.

The auxiliary binder that is used as a saturant for the matrix material is selected on the following basis:

(1) Drying oils yield higher friction values than phenol aldehyde resins, either straight or oil-modified types.

(2) Phenol-aldehyde resins are preferred if the final product is to be grooved.

(3) Using a wood content at the low end or the high end of our range, drying oil is preferred because of better engagement and wear characteristics.

(4) Using a wood content in the median range of this disclosure, either binder type or a mixture may be used.

Having selected the proper binder, the solids content of the saturant is adjusted by dilution with a proper solvent to allow a cured residue of 15 to 40% over the raw dried weight of the matrix paper.

As an example, having selected a phenolic resin binder, a saturant is prepared by dissolving 30 parts of Bakelite #15401 phenol-formaldehyde resin in 70 parts of methyl alcohol. Dried sheets are immersed in the saturant for a time sufficient to completely saturate the interior. Depending on thickness of the paper, this time will run from 30 minutes for 1/16" thickness to 8 hours for 3/8" thickness. Saturated sheets are air-dried on screens for 24 hours to leave a porous structure by evaporation of solvent, followed by a cure as follows:

Rise to 150° F. plus 1 hour at 150°
Rise to 325° F. plus 1 hour at 325°

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The cured residual pickup after processing as above ran about 25% over the raw, dried weight.

In the case of a drying oil binder, the oil is similarly diluted with a compatible solvent such as xylol. The saturation and air dry is similar to that previously indicated; the cure differs, however. A typical drying oil cure is as follows:

Rise to 175° F.
24 hours at 175°
Rise to 250°
2 hours at 250°
Rise to 350°
4 hours at 350°

After cure, the sheets are cut to shape and ground to thickness to complete the process. The product is of a resilient character and has a desirable fuzzy surface feel.

We claim:

1. Automotive transmission friction material for use in oil consisting essentially of a dried, wet felted porous resilient matrix of from about 35% to about 85% by weight of fibrous asbestos, blended with from about 10% to about 50% by weight of wood particles passing a 20 mesh size sieve, from about 1% to about 4% by weight of reinforcing cellulose fibers, from about 1% to about 4% by weight of sizing material, and up to about 10% by weight of friction modifying agents, said matrix including a hardened organic binder in the amount of from about 15% to about 40% by weight of said matrix, said friction material being resilient and resistant to permanent set.

2. The method of making automotive transmission friction material of porous resilient character for use in oil, which comprises wet felting an aqueous slurry consisting essentially by weight of from about 35% to about 85% asbestos fibers, from about 10% to about 50% wood particles passing a 20 mesh size sieve, from about 1% to about 4% of reinforcing cellulose fibers, from about 1% to about 4% by weight of sizing material and up to about 10% friction modifying agents, drying the resultant sheet material until it has a constant weight at 225° F., impregnating it with a volatile solvent solution of heat setting organic binder to incorporate therein from about 15% to about 40% of said binder by weight of the pre-dried sheet, air drying the impregnated sheet to substantially evaporate the solvent content and to leave a porous structure by evaporation of the solvent, and thereafter heat curing said binder content.

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