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(54) IMPROVEMENTS IN OR RELATING TO FRICTION MATERIALS

(71) We, FERODO LIMITED, a Company organised under the laws of Great Britain, of 20 St. Mary's Parsonage, Manchester M3 2NL, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to friction materials, and more preferably to friction materials of the kind used for brake pads, brake linings, clutch facings and similar uses.

Friction Materials of this kind are generally composed of a thermoset binder, in inorganic fibrous reinforcement and various fillers and other additives. These compositions are required to withstand severe operating temperatures and pressures under repeated application without failure or deterioration in friction properties and the fibrous reinforcement generally used is asbestos. Numerous proposals have been made of compositions containing other inorganic fibrous reinforcement but such materials have so far found limited commercial acceptance.

According to the present invention a friction material comprises a thermostat binder, a fibre-based reinforcement and other fillers and additives, the thermoset binder comprising a phenol-formaldehyde resin and making up 20% to 60% by volume of the material of which more than 50% by volume of the binder is said phenol-formaldehyde resin, and the fibre base reinforcement making up between 10 and 35 per cent by volume of the material, and consisting of a mixture of steel fibres having a length in the range 1 mm to 5 mm with glass fibres or with one or more non-asbestos inorganic reinforcing fillers. When the fibre-based reinforcement contains glass fibres the glass fibres preferably have a length of the order of 2 to 5 mm. The glass

may be a conventional glass such as E-glass and will preferably have a surface dressing, as well known in the glass fibre art, to promote its adhesion to the binder. The fibre-based reinforcement contains steel fibres and the fibres are preferably fine, e.g. 0.125 mm diam. The steel may be mild steel.

The fibre-based reinforcement is a mixture of materials, one of which is steel fibre. If desired a mixture of steel fibres and glass fibres may be used. Other inorganic reinforcing materials which may be included in the mixture include inorganic reinforcing fillers such as mica and wollastonite.

The thermoset binder includes a thermoset resin based on a phenol-formaldehyde resin but may also include a heat and chemical resistant vulcanized rubber, such as a nitrile rubber. Preferably a mixture of such materials is used. When a rubber is used it may be incorporated into the friction material in the form of a powder but is preferably incorporated in the form of a solution in a suitable organic solvent and a vulcanizing agent such as sulphur is also used.

In the manufacture of the friction materials various other materials may be included such as fillers and friction and wear modifiers the proportions of which can be varied to adjust the friction and other properties of the materials.

In the present case the preferred additives are particulate fillers, more preferably a mixture of such materials and friction and wear modifying materials.

The particulate fillers are not reinforcing fillers and will generally be present in an amount between 10 and 50 per cent by volume and may include such fillers as barytes, whiting and silica.

Examples of friction and wear modifiers are carbon black, graphite, antimony trisulphide and molybdenum disulphide and metals, in a finely divided form. Examples of

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suitable metals are copper and tin. A mixture of such materials may be used, and the total amount of such materials may be up to 40 per cent by volume.

- 5 The friction materials of the present invention are particularly suited to be manufactured by a press-moulding technique in which all the ingredients of the material are compounded together, the
10 compounded mix disintegrated and (optionally dried) and then moulded into a component such as a brake pad in a die under pressure. The moulded component is then removed from the die and baked to
15 cure the binder.

The invention provides friction materials which are free of asbestos, and yet have comparable properties to asbestos-based friction materials.

- 20 The invention will now be illustrated, by way of example only, by means of the following example.

EXAMPLE

- 25 Sample disc-brake pads were manufactured according to the formulation given below in Table I. The ingredients were initially compounded together, the nitrile rubber being introduced into the mixture as
30 a powder and the compound was disintegrated and dried. The material was then moulded into pads under pressure in a die and the mouldings baked in an oven to cure the binder.

TABLE I

35	Nitrile rubber	11.40
		parts by
		volume per
		100 parts
		of material
40	Sulphur	3.00
	Phenol-formaldehyde resin	20.00
	Steel Fibres	10.00
	Mica	5.00
	Carbon Black	5.39
45	Silica	6.08
	Barytes	19.89
	Graphite	8.48
	Antimony trisulphide	2.39
	Molybdenum disulphide	1.79
50	Copper (powdered)	5.38
	Tin (powdered)	1.20

- 55 Samples were also made using the formulation given in Table I. except that the mixture of steel fibres (10 parts) and mica (5 parts) was replaced by a mixture of steel fibres (10 parts) and glass fibres (5 parts). The sample pads produced were tested and

found to have friction properties comparable to asbestos-containing materials.

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WHAT WE CLAIM IS:—

1. A friction material comprising a thermoset binder, a fibre-based reinforcement and other fillers and additives wherein the thermoset binder
65 comprises a phenol formaldehyde resin makes up 20% to 60% by volume of the material of which more than 50% by volume of the binder is said phenol formaldehyde resin and the fibre-based reinforcement
70 makes up between 10 and 35% by volume of the material and consists of a mixture of steel fibres having a length in the range 1 mm to 5 mm with glass fibres or with one or more non-asbestos inorganic reinforcing
75 fillers.

2. A friction material according to Claim 1 comprising glass fibres having a length in the range 2 to 5 mm.

3. A friction material according to Claim 1 or 2 in which the steel is mild steel.

4. A friction material according to any one of Claims 1 and 3 in which the reinforcement consists of a mixture of steel fibres and glass fibres.

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5. A friction material according to any one of Claims 1 and 3 comprising a reinforcing filler which includes mica.

6. A friction material according to claim 5 in which the reinforcing filler is mica.

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7. A friction material according to Claim 1 or 3 in which said reinforcing filler is wollastonite.

8. A friction material according to any one of the preceding claims wherein the binder also includes a heat and chemical resistant vulcanized rubber.

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9. A friction material according to Claim 8 in which said rubber is a nitrile rubber.

10. A friction material according to any one of the preceding claims which includes one or more non-reinforcing particulate fillers in an amount between 10 and 50 percent by volume.

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11. A friction material according to Claim 10 in which said particulate filler comprises barytes, whiting or silica.

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12. A friction material according to any one of the preceding claims comprising one or more friction or wear modifiers in an amount up to 40 percent by volume.

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13. A friction material according to Claim 12 in which said friction and wear modifiers are selected from carbon black, graphite, antimony trisulphide and molybdenum
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disulphide and brass, copper and tin in finely divided form.

14. A friction material substantially as described in the foregoing example.

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