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FRICTION ELEMENTS

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The present invention relates generally to friction elements and more particularly the present invention relates to linings for brakes and clutches made of compositions comprising granulated particles of polymerized furane compounds.

Heretofore the friction fortifying dusts for friction elements generally have been phenol-aldehyde condensation products or such condensation products which have been modified by addition of materials such as drying oils before condensation has been completed.

I have found that the furane compounds can be polymerized to a state in which they are infusible yet can be softened slightly at 500°–600° F. to a rubbery condition and that powders or dusts made of such polymerized furanes or modifications thereof are adapted for dusts in friction elements.

Modifications of polymerized furanes can be made by mixing in other materials with the furane compound before polymerizing so that the furane dust particle has incorporated with it a greater or smaller amount of the added material. These other materials are added, for example, for obtaining certain frictional characteristics at temperatures below those at which the polyfurane becomes slightly softened, the added material being adapted to soften at temperatures lower than those at which the polyfuranes soften so that, in the finished article such as a brake lining, for example, a slight softening which is less than actual fusing is obtained over a wide range of temperature or at different ranges. Examples of materials adapted for adding to the polyfurane are vegetable oils such as perilla, linseed and china wood oils, fatty acids such as stearic, oleic and linoleic acids, hardwood pitch, fatty acid still residues such as cottonseed oil pitch, rubber and so on.

Illustrative examples of the furane compounds suitable for use in the practice of the present invention are furane, C_4H_4O; furfuraldehyde, $C_4H_3O—CHO$; furfuryl alcohol,

$$(C_4H_3O—CH_2OH)$$

ethyl furoate ($C_4H_3O—COOC_2H_5$); coumarone (benzofurane, C_8H_6O) and hydrofuramide,

$$(C_4H_3O—CH)_3N_2$$

and other furane compounds which can be polymerized by the methods disclosed or referred to herein.

Illustrative examples of polymerizing agents are acid polymerizing agents such as ferric chloride, aluminum chloride, phosphoric acid, hydrochloric acid, sulphuric acid, alkyl sulphates and alkyl phosphates and mixtures of any two or more of these, for example a mixture of four parts of diethyl sulphate and one part of concentrated sulphuric acid. The alkyl radicles on the alkyl phosphates and alkyl sulphates can be methyl, ethyl, propyl, butyl or amyl, for illustrative examples, and the alkyl compounds used can be mono alkyl or dialkyl sulphate or the mono, di or tri-alkyl phosphate. Reference is hereby made to patents numbers 1,665,233 to 1,665,237, inclusive, for illustrative methods of polymerizing furane compounds.

Illustrative examples of methods for making the frictional granulated powders or dust of the present invention are given as follows:

Example 1.—About one hundred parts by weight of furfuraldehyde and ten parts of concentrated hydrochloric acid are mixed together and heated to about 100° C. for from about five to ten minutes or until a gelatinous product is obtained. The gelatinous product is then cured in pans at about 110° C. to 115° C. for about eighteen to about twenty-four hours to obtain a hard tough solid which can be comminuted or granulated.

Example 2.—About one hundred parts by weight of cottonseed oil pitch and one hundred parts of furfuraldehyde are heated together at 50°–80° C. until solution occurs and twenty parts of diethyl sulphate are added and the mixture held at this temperature for about four to sixteen hours until solidification occurs. The product is a dense tight mass and is cooled and ground to the size required. At higher temperature, e. g. 100° C. frothing occurs and the granular structure is not obtained.

Example 3.—About three hundred parts by weight of cottonseed oil pitch, one hundred parts of furfuralcohol and forty parts of diethyl sulphate are mixed together and heated to from about 25° C. to about 70° C. until there is produced a hard, solid product which can be granulated. The polymerization reaction is faster than when furfuraldehyde is used and can be brought about in from about twelve to about three hours, depending on the temperature at which the reaction is conducted.

Example 4.—About one hundred parts by weight of furfuralcohol and twenty parts of diethyl sulphate are mixed together and left to stand at about 25° C. to about 30° C. for several days. Condensation reaction occurs and the

product is a hard, tough mass which can be ground or granulated.

Example 5.—About one hundred parts by weight of cottonseed oil pitch and one hundred parts of furfuraldehyde are heated together at from 50° C. to 80° C. until solution occurs when there is added a solution of two parts of sulphuric acid in fifteen parts of diethyl sulphate and the mixture held at the stated temperature until solidification occurs to form a dense, tight mass which is cooled and ground or granulated to the required size.

The method of this example is similar to that of Example 2 above with the difference that a solution of sulphuric acid in diethyl sulphate is used in place of the diethyl sulphate alone of said Example 2. With the solution of sulphuric acid in diethyl sulphate (or other alkyl sulphate) the polymerization reaction is initiated sooner and the speed of polymerization is increased, and the solid, pulverizable polymerization product is obtained in less time than with the diethyl (alkyl) sulphate alone.

Example 6.—About one hundred parts by weight of furfuraldehyde and ten parts of concentrated hydrochloric acid are mixed together and heated at 100° C. for about five to ten minutes or until a gelatinous mass is obtained after which the temperature is raised to about 110° C. to 115° C. for about eighteen to twenty-four hours or until a hard, tough solid material is obtained which can be ground or pulverized.

Example 7.—About one hundred parts by weight of furfuramide and forty parts of diethyl sulphate are mixed together and heated to from about 50° C. to about 100° C. A vigorous reaction is obtained which in a short time produces an infusible mass which is solid and which can be ground or granulated.

Example 8.—About one hundred parts by weight of furfuraldehyde, one hundred parts of linseed oil and twenty parts of diethyl sulphate are mixed together and heated to from about 50° C. to about 80° C. until a gelatinous mass is produced when the temperature is raised to about 110° C. to 115° C. until a hard brittle product is obtained, which product can be ground or granulated.

Example 9.—About one hundred parts by weight of a fraction of gas house drip boiling between 150° C. and 200° C., and containing indene and coumarone (benzofurane), and five parts of diethyl sulphate were mixed together and heated for three hours at 140° C. and then for three hours at 120° C. or until a hard brittle resin is obtained which can be ground or granulated.

Reference is hereby made to patents numbers, 2,164,326 and 2,165,140 for examples of friction elements in which granulated particles are used for frictional characteristics. The polymerized furane composition in the granulated form as described herein can be substituted for any part or all of the infusible phenolic resin in the pulverized form of Examples 1, 2 and 3 of said patent 2,164,326.

A further illustrative example of friction elements which can be made up with granulated polymerized furanes, is as follows:

Example A.—About sixty parts by weight of asbestos fiber, fifteen parts of dry, finely powdered heat reactive phenol-aldehyde resin (for binder), fifteen parts of a granulated, hard, infusible furane polymer (polymerized furfuraldehyde or polymerized furfuryl alcohol, for illustrative examples) and ten parts of barium sulphate are mixed together, dry in a tumbling barrel. When thoroughly mixed the mixture is pressed into sheets with the application of heat and pressure sufficient to cause the binder to flow and to give it a preliminary set, but not sufficient for the binder to reach a final state of curing. The sheets are then cut to size and cured in molds to the final state of the binder to form curved brake linings.

For clutch facing the heat and pressure, when desired, can be sufficient on the first pressing to set the binder to the final state, the shapes being formed after the final setting. In other cases the shapes of the clutch facing can be formed before the final setting.

Generally the furane compounds used in the practice of the present invention are produced by polymerization under acid conditions, the dialkyl sulphate and trialkyl phosphates of the examples being slightly acidic but it is intended that furane compounds that are first subjected to alkaline conditions and finally to acidic polymerizing conditions are products suitable for making the hard particles of polymerized furane compounds used in the practice of the present invention.

While only diethyl sulphate is recited in the examples as the alkyl sulphate polymerizing agent it is pointed out that any of the other polymerizing agents recited above can be substituted in said examples for the diethyl sulphate, and generally in substantially equal amounts. Also, while cottonseed oil pitch in the examples is the only material used with a furane compound and that only in amounts equal to the amount of furane compound used, it is to be understood any one or more of the other compounds or materials can be used in place of all or any part of the cottonseed oil pitch. Further, the proportion cottonseed oil pitch (or its equivalent) to furane compound can be varied, for example, from four parts of cottonseed oil pitch (or its equivalent) to one of furfuraldehyde (or its equivalent) down to the other extreme where only a furane compound (or compounds) is used.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. A brake lining comprising asbestos, organic friction material and a phenol-aldehyde resin binder, said organic friction material comprising comminuted particles of a product selected from the group consisting of solid infusible condensation products of furfuryl alcohol in the presence of an acidic agent and solid infusible condensation products of furfuraldehyde in the presence of an acidic catalyst.

2. A brake lining comprising asbestos, organic friction material and a phenol-aldehyde resin binder, said organic friction material comprising comminuted particles of a solid infusible condensation product of furfuryl alcohol in the presence of an acidic agent.

3. A brake lining comprising asbestos, organic friction material and a phenol-aldehyde resin binder, said organic friction material comprising comminuted particles of a solid infusible condensation product of furfuraldehyde in the presence of an acidic agent.

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