

the high temperatures experienced in the severe usage of such friction elements, while still possessing a substantial degree or amount of resiliency and even after prolonged and severe usage and exposure to the high temperatures incidental thereto. Moreover, resiliency in such finely divided and dispersed particles is of particular significance in that it enables the finely divided particles which are employed as friction-controlling agents in friction elements to compensate for such loss of friction stability and decrease in coefficient of friction which might otherwise occur if it were not for the resiliency which is inherent in the finely divided or dust particles composed essentially of one or more synthetic vulcanizable rubbery elastoprenes of the butadiene-acrylonitrile copolymer type which are employed as friction controlling agents in friction elements in the practice of the present invention.

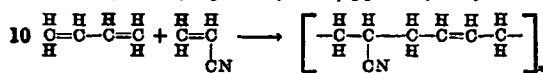
While a certain degree or amount of resiliency is inherent in the finely divided particles of soft scrap rubber, and in the finely divided particles of heat polymerized drying oils and, to a somewhat greater degree in the particles of cashew nut shell liquid polymer, which have been employed heretofore in friction elements as friction-controlling agents, such resiliency as is possessed by these materials is present therein only in the earlier stages of the use of such materials in friction elements and the resiliency of such materials is substantially lost or decreased either by heat decomposition or carbonization of such materials incidental to the use thereof as friction-controlling agents in friction elements, as referred to hereinbefore.

Other types of synthetic elastoprenes or so-called synthetic rubbers are, of course, known, and among these are those of the butadiene-styrene copolymer type which are exemplified by the disclosure of United States Letters Patent No. 1,938,731, granted December 12, 1933, and the non-vulcanizable chloro-butadiene or chloroprene type of polymers, which have been referred to above, and which are known as "Neoprene," "Duprene," and the like.

We have found, however, that finely divided or dust-like particles composed essentially of synthetic elastoprenes of the butadiene-styrene copolymer type, as well as those of the chloro-butadiene type, do not possess or impart to friction elements the desirable characteristics, including friction stability, and resistance to heat decomposition and carbonization, which are imparted to friction elements by finely divided particles composed essentially of synthetic elastoprenes of the butadiene-acrylonitrile copolymer type compounded with a relatively low sulphur content, as in the practice of the present invention. The present invention is, therefore, primarily concerned with friction elements embodying as friction-controlling or friction-stabilizing agents therein finely divided dust-like materials or so-called dispersed discrete particles composed essentially of vulcanizable synthetic rubber-like elastoprenes or so-called synthetic rubbers of the butadiene-acrylonitrile copolymer type, compounded with preferably from about five percent to about ten percent, by weight, of sulphur, and to which more specific reference will now be made.

The relationship of the monomer components and the general type of synthesis of the copolymer nuclei of the group or class of vulcanizable synthetic elastoprenes or so-called synthetic rubbers

which are referred to above and which I have found to be useful as friction-controlling or friction-stabilizing agents in friction elements, in the practice of the present invention, may be illustrated as follows (J. I. E. C., vol. 34, No. 2, pp. 245-251, and News edition, Am. Chem. Soc., 19, 750 (1941), and revision, Chem. and Eng. News, vol. 20, No. 8, April 25, 1942, pp. 536, 537, 538):



Butadiene + acrylonitrile
or vinyl cyanide

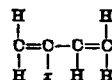
Product:

"Perbunan"
"Buna N"
"Hycar OR" or
"Hycar Ninona B" (Goodrich)
"Chemigum" ("X" or "T") (Goodyear)
"Stanco" (Standard Oil of New Jersey)

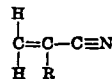
It will be understood in connection with the general type of synthesis or copolymerization illustrated above that certain of the materials which are employed in or are necessary in such syntheses, including the emulsifying, wetting, modifying and catalytic agents which are employed in the synthesis of the above mentioned butadiene-acrylonitrile copolymer type synthetic rubber-like elastoprenes, are trade secrets, although all of these materials are known to be essentially copolymers of the butadiene-acrylonitrile type.

All of the synthetic elastoprenes or so-called synthetic rubbers referred to above, and which are known to be useful as friction-controlling or friction-stabilizing materials, in the practice of the present invention, are currently available upon the market in commercial quantities, under the trade names referred to.

It will be seen, therefore, from the foregoing description, and from the disclosures referred to therein, that the present invention is primarily concerned with friction elements containing organic bonding agents and which friction elements contain as an ingredient thereof a friction-controlling agent in the form of dust-like materials or so-called finely divided dispersed discrete particles composed essentially of one or more vulcanizable synthetic rubber-like elastoprenes or so-called synthetic rubbers of the character obtained by copolymerization (under conditions and in the presence of other materials, such, for example, as those which are disclosed in Patent No. 1,973,000) of an unsaturated diolefinic or butadiene hydrocarbon of the type



where x represents either hydrogen or an alkyl group, and a compound (an acrylonitrile) of the type



where R represents either hydrogen, as in acrylic acid nitrile, per se, or an alkyl group, as in methacrylic acid nitrile, to form a synthetic rubber-like high molecular weight elastoprene of the butadiene-acrylonitrile copolymer type, followed by compounding the product thus obtained with a relatively low percentage of sulphur and which is preferably not substantially less than five percent nor substantially more than ten percent, by weight, of the copolymer, and then finely