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PLAINTIFF'S EXHIBIT
RFP-3

April 17, 1997

Direct Dial
575-2740

Robert E. Paul, Esquire
PAUL, REICH & MYERS, P.C.
1411 Walnut Street, Ste. 500
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RE: Interrogatory Answers of Railroad Friction Product Corporation in the Derrick Case

Dear Bob:

In reviewing the Interrogatory Answers filed on behalf of Railroad Friction Product Corporation on or about July 30, 1981 which were signed by Ed David who was then counsel for Railroad Friction Product Corporation we have discovered a few mistakes. Although I believe that I may have provided you with accurate information with respect to Cobra brake shoes in the past, I enclose for your review two patents wherein it is clear that although composition brake shoes were first patented in 1958, those particular shoes did not contain asbestos as an ingredient. The second patent dated June 25, 1968 demonstrates that this was the first date in which asbestos was used as an ingredient in Cobra brake shoes.

Thus to the extent that the interrogatory answers state that asbestos was used as an ingredient in Cobra brake shoes from 1955 to 1980 this should be corrected to 1968 to 1980.

If you would like a formal amendment to the answers, I will be more than happy to do so.

You will be receiving shortly an Affidavit attached to Summary Judgments filed on behalf of Westinghouse Air Brake in your May Group which makes reference to the fact that asbestos was not an ingredient in Cobra brake shoes or to our knowledge any brake shoes until 1968.

Although the Federal Register refers to Cobra brakes shoes made by Manville from 1892 to 1989 it is mistaken to our knowledge that asbestos was in the Cobra brake shoe before 1968.

Therefore I believe that my client should be dismissed in the upcoming mesothelioma cases because there is no evidence that any of these plaintiffs worked with or around any asbestos containing products made by my clients.

We will call Dave Kerr and possibly others as fact witnesses in these cases if necessary.

Very truly yours,

DANIEL J. RYAN, JR.

DJR/smw
Enclosures

phila19/doc#209676

United States Patent Office

2,861,964

Patented Nov. 25, 1958

1 W-89

2,861,964

COMPOSITION BRAKE BLOCK

Charles L. E. de Gaugue, Jr., Cokesbury, and Ralph T. Halstead, Somerville, N. J., assignors to Johns-Manville Corporation, New York, N. Y., a corporation of New York

Application November 17, 1953, Serial No. 392,764

27 Claims. (Cl. 260—17.4)

This invention relates to composition brake blocks and more particularly to a molded brake block of novel composition adapted particularly for braking heavy railway equipment.

This application contains subject matter in common with copending U. S. patent application, Charles L. E. de Gaugue, Jr., Serial No. 279,417, filed March 29, 1952, issued August 10, 1954, as Patent No. 2,686,140, which is a continuation-in-part of U. S. patent application Serial No. 217,790, filed March 27, 1951, and now abandoned, which in turn was a continuation-in-part of U. S. patent application Serial No. 127,884, filed November 17, 1949, and now abandoned.

One of the conventional means of braking railway equipment is by brake shoes of cast iron applied against the steel treads of the wheels, whereby a metal-to metal engagement is effected under sufficient applied force to effect deceleration. Compressed air actuated mechanism is usually employed to force the brake shoe into braking engagement with the wheel tread.

An alternative form of railway brake employs engageable rotor and stator discs, the rotor discs being connected to the wheels to rotate therewith, and the stator discs being connected to the stationary frame of the equipment. Brake blocks may be affixed to the face of the stator and applied to the rotor to effect deceleration.

The braking of heavy railway equipment using cast iron shoes requires application of high braking force to hold the shoes in braking contact with the wheels or rotor discs, and efficient and effective deceleration develops a high rate of wear for cast iron brake shoes. While the friction coefficient of a cast iron brake shoe is relatively low and the service life short, it is notable that the friction coefficient of such shoe remains substantially constant in either dry or wet weather. In other words, the presence of moisture does not have a serious adverse effect on the braking efficiency of cast iron shoes.

In copending application Serial No. 279,417, there is disclosed a molded composition brake block having properties adapting it for braking heavy railway equipment. As specifically disclosed therein, the molded brake block has characteristics of high friction level and low rate of wear with a wet-to-dry friction coefficient ratio approximating that of cast iron. The block claimed in that application preferably contains fixed proportions of cast iron particles, long-wearing organic friction particles, and staple reinforcing fiber, preferably asbestos, all in a binder matrix comprising an in situ vulcanized elastomer matrix. While the preferred friction element disclosed therein exhibited excellent characteristics adapting it for use as a railway brakeblock, it also exhibited one adverse characteristic in that it had a tendency towards uneven wearing of the tread of the car wheel.

It is an object of this invention to provide a molded brake block having all of the outstanding characteristics of the preferred friction element described and claimed in application Serial No. 279,417, but which does not exhibit the undesirable characteristic of uneven wear on the wheel tread.

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With this object in view, the invention consists of the improved molded composition brake block which is hereinafter described and more particularly defined in the appended claims.

In the accompanying drawings, in which preferred embodiments of the invention are illustrated, and wherein like reference characters designate like parts:

Fig. 1 shows in cross-section a molded composition brake block shaped for mounting on an arcuate brake shoe;

Fig. 2 is an enlarged cross-sectional view taken along the line 2—2 of the embodiment of the invention shown in Fig. 1;

Fig. 3 is a fragmental perspective view of a modified metal lath reinforced brake block, with part of the face broken away to show a metal lath reinforcing element in position; and,

Fig. 4 is an attempted plan view portrayal of a wearing face of the brake block portrayed in Fig. 3, showing worn portions of an embedded reinforcing lath exposed.

In that embodiment of the invention which is illustrated in Figs. 1 and 2, the numeral 10 designates a molded composition brake block of arcuate shape firmly affixed to, or molded integral with, a metal shoe 12 which is adapted for operation by compressed air actuating mechanism (not shown). It will be understood that the invention is not limited as to the shape of the shoe or block, or as to the means for affixing or anchoring the block facing to the shoe.

As in the aforementioned application, the present invention is directed to a molded brake block of novel composition having a high friction coefficient level preferably approximating 0.300, as compared to 0.080 for cast iron under comparable railway braking conditions. Another important feature of the present brake block composition is that it exhibits a frictional coefficient when wet which is not substantially less than its dry friction coefficient. Thus, for molded brake blocks formed in accordance with this invention the ratio of wet to dry stopping distance under the same initial speed and braking effectiveness does not usually exceed 1.25. Molded brake blocks within the widest composition range herein disclosed have a friction coefficient level at least triple that of cast iron under high speed braking conditions, and have a friction coefficient when wet which is not less than 75% of the dry friction coefficient.

It is also a particular feature of the present brake block composition that the coefficient of friction of these blocks is relatively constant over the entire range of wheel speeds during the braking activity; whereas the coefficient of friction of cast iron brake shoes increases greatly as the wheel speed decreases. Accordingly, a much smoother braking action is obtained when utilizing brake blocks fabricated according to this invention than is obtained when conventional cast iron shoes are employed; that is brake blocks formed in accordance with this invention do not cause the typical jerky stops commonly experienced with railway equipment using cast iron shoes.

While possessing the aforementioned characteristics in common with the preferred molded friction elements described in application Serial No. 279,417, brake blocks formed in accordance with this invention possess the further advantageous characteristic of more even wearing of the wheel tread against which they coact. The prevention of uneven tread wear is, of course, a most desirable characteristic in the blocks hereinafter described, and they also possess a totally unexpected characteristic of longer wear life than blocks containing asbestos fiber as exemplified in application Serial No. 279,417. This characteristic would be unexpected since elimination of

PLAINTIFF'S 2

some wear on the wheel tread would be expected to result in increased wear on the other coacting body, the brake block.

The molded railway brake blocks formed in accordance with the present invention essentially comprise hard ferrous metal particles, preferably granulated or chipped cast iron; long-wearing organic friction particles, such as common heavily filled hard vulcanized rubber friction particles or conventional resinous friction particles such as granules of cured thermosetting resins as exemplified by polymerized cashew nut shell oil; a vulcanized in situ hard rubber matrix formed from an elastomer composition containing a relatively large amount of conventional fillers and vulcanizing ingredients; and, as distinguished from the preferred blocks claimed in application Serial No. 279,417, a substantial proportion of a staple organic reinforcing fiber. Examples of staple organic reinforcing fibers which may be used in accordance with this invention are cellulose fibers such as wood fiber, cellulose flock (exemplified by the commercial product Solka-floc), viscose and acetate rayon fiber, cotton fiber, etc.; protein fibers such as wool, silk, etc; regenerated protein fibers (e. g. Vicara); alginate fibers; and synthetic polymeric fibers such as polyamide fibers (e. g. nylon), polyethylene and polyhaloethylene fibers (e. g. Polythene, Velon, etc.), polyester fibers (e. g. Dacron), polytetrahaloethylene fibers (e. g. Teflon), polyacrylonitrile fibers (e. g. Orlon) including thermally modified acrylonitrile fibers as, for example, those obtained from the procedure disclosed in the copending application of Irvin Barnett, Serial No. 345,682, filed March 30, 1953, etc.

It is apparent from test results that the excellent frictional characteristics and long service life of the railway brake blocks formed in accordance with this invention are due to a pronounced cooperation between the cast iron particles forming a substantial proportion thereof and the hard, tough elastomer matrix and non-ferrous inorganic and organic filler materials incorporated therein, considering the organic fiber and resinous or rubber friction particles as such fillers. The cooperation of these ingredients lends the block characteristics of long life and frictional efficiency, both wet and dry, not attained in any molded friction materials heretofore proposed or fabricated, nor exhibited by conventional cast iron railway brake blocks.

The staple organic reinforcing fiber cooperates with the organic and inorganic fillers and elastomer matrix to result in the extremely desirable characteristic in the block of less wear on the wheel tread and yet a longer life when compared to the prior blocks in a manner which is most noticeable when employing a cellulosic reinforcing fiber and particularly when using a cellulosic fiber of the chemically modified wood fiber type, such as that marketed under the name Solka-floc. That such staple organic reinforcing fibers could be used in such molded brake blocks and would lend the bodies such desirable characteristics is totally unexpected, since investigations have shown that temperatures as high as 1450° F., well above the destructive temperatures for such fibers, are generated at the friction surfaces under service conditions.

Preferably, the railway brake block 10 (Figs. 1 and 2) formed in accordance with this invention will comprise approximately 25–75% by weight of hard ferrous metal, at least 50% of which is in the form of cast iron chips or granules 14; 10–60% by weight of long wear friction particles 16 comprising either particles of hard vulcanized rubber containing, for example, 50–70% by weight of inorganic fillers and vulcanizing ingredients, or conventional resinous particles as exemplified by granules of cured theromsetting resins such as polymerized cashew nut shell oil; up to 30%, preferably 2 to 10%, staple organic reinforcing fiber 18; from 8–32% of a vulcanized in situ rubber matrix 20 formed from a composition comprising 2–12% by weight of the block of a natural or synthetic rubber such as a butadiene-styrene copolymer

(Buna GR–S), together with 4–20% by weight of the block of inorganic and organic fillers and vulcanizing ingredients such as sulfur, litharge, ZnO, carbon black, barytes, etc., which rubber matrix may be stiffened with up to 6% by weight of the block of a thermosetting resin such as phenolaldehyde or cashew nut shell oil resins, etc.

The characteristics of the composition brake blocks for railway service formed in accordance with this invention primarily result from the presence in the composition of high proportions of hard cast iron granules or chips and of the hard vulcanized rubber matrix and its non-ferrous fillers, and organic fiber reinforcement, which matrix has good resistance to heat-softening. The presence of 25–75% by weight of hard ferrous metal chiefly in the form of cast iron particles, and at least 50% by volume (75–25% by weight) of non-ferrous inorganic and organic filler and organic binder materials including the organic reinforcing fiber and a binder matrix of relatively heat-stable vulcanized rubber, is necessary to develop a suitably high friction coefficient, a satisfactory ratio between the wet and dry braking performance for heavy duty railroad service, good resistance to generated heat, even tread wearing characteristics and a long service life. Preferably, the total ferrous metal content is in the form of cast iron chips, and, when so used, the iron content will usually not exceed 65% by weight. While a greater percentage may be employed, an increase in iron chip content over 65% does not result in any significant improvement of wet/dry ratio, and slightly decreases the desirable long wear life of the block. The cast iron particles used in this invention should have the characteristics of those defined in Serial No. 279,417.

In order that the present molded composition brake block have a high coefficient of friction and long wear characteristics, it is preferred that it contain a comparatively high percentage of long wear friction particles of the types described in the aforementioned application.

An alternative form of molded composition brake block may be formed, as illustrated in Figs. 3 and 4 wherein several layers of expanded steel grid lath 22 or equivalent hard ferrous metal reinforcing fabric are incorporated in the block. While these reinforcing grids obviously comprise a part of the total ferrous metal content of these blocks in which they are incorporated, by far the greatest part of the ferrous metal will be present in the form of cast iron chips. The ferrous metal content due to the grids alone should comprise no more than about 15% by weight of the total block composition.

When the hard ferrous metal chips comprise up to 50% by weight of the block, it will be noted that this metal content does not exceed on the average 25% by volume at the exposed wear face of the block, with the result that the block develops a much higher coefficient of friction than, and exhibits a wear life substantially greater than, that of a standard cast iron shoe. In the molded and cured block the cast iron particles, staple organic reinforcing fibers and long wear friction particles are distributed uniformly throughout the hard rubber binder matrix. In other words, the oganic fiber and long wear friction particles may be considered to make up a part of the filler content of the hard rubber, supplementing the content of conventional filler and vulcanizing materials.

Brake blocks of the type illustrated may be manufactured substantially as follows: A suitable molding composition for the block is first prepared in accordance with the formulas heretofore set forth. After thoroughly mixing the particulate ingredients, the mixture is charged into a mold of suitable shape. In the event that expanded metal lath or equivalent metal reinforcing fabric is to be used, layers of such reinforcing fabric are introduced into the mold at spaced intervals paralleling the block face during the operation of charging the mold with the

composition material. After filling the mold to predetermined depth with the plastic molding mixture, with or without metal reinforcing fabric, the uncured and plastic block is densified, hardened, and cured within the mold by simultaneous application of high temperature and pressure. Such curing may, for example, take place under a pressure of 2000–5000 (preferably 2500–3000) lbs. per square inch at a temperature equivalent to the temperature of steam at 90 lbs. pressure. In this manner the block is molded to final dimensions and shape, and the various ingredients of the composition are strongly bonded to each other to form a strong unitary block.

The following are examples of various molded composition brake blocks for use in railway brake systems, and their general method of preparation. It is understood, of course, that the compositions of, and methods for producing, these blocks are exemplary and are not to be considered to limit the invention to the particular compositions and operating conditions outlined. All percentages indicated in the examples are by weight.

Example I

A railway brake block was prepared by thoroughly mixing a composition comprising:

	Percent
Cast iron chips	32
Hard rubber friction particles	46
Cellulose fiber (Solka-Floc)	6
Hard rubber matrix	16
Butadiene-styrene (Buna GR-S), 3%	
Polymerizable cashew nut shell oil resin, 2%	
Sulfur 1.4%	10%
Litharge 4.3%	
Zinc oxide 3.6%	
Carbon black 0.5%	
Hexamethylenetetramine 0.2%	

and molding said composition to the desired dimensions with a pressure of approximately 3000 lbs./sq. in. and at a temperature of approximately 300° F. The block exhibited a coefficient of friction of 0.300 as compared to 0.180 for a cast iron shoe under the same braking conditions, had a wet/dry stopping distance ratio of substantially 1.0 at high speeds, and had a wear life approximately 3.5 to 4 times that of a standard cast iron railway block.

Example II

A railway block was prepared in the same manner as that in Example I from a composition containing:

	Percent
Cast iron chips	33
Hard rubber friction particles	47
Thermally modified acrylonitrile fiber	5
Hard rubber matrix	15
Butadiene-styrene (Buna GR-S), 3%	
Polymerizable cashew nut shell oil resin, 2%	
Sulfur 1.4%	10%
Litharge 4.3%	
Zinc oxide 3.6%	
Carbon black 0.5%	
Hexamethylenetetramine 0.2%	

The resultant block exhibited frictional characteristics substantially similar to those exhibited by the block formed in accordance with the preceding example.

The invention disclosed herein is not limited to the use of the butadiene-styrene rubber defined in the above examples for the heat resistant vulcanized elastomer matrix. A satisfactory matrix may comprise in place of butadiene-styrene, natural rubber or a synthetic rubber of the Buna N type, i. e., butadiene-acrylonitrile. An alternative, but somewhat less satisfactory, matrix may comprise a polychloroprene such as chlorbutadiene, or any other heat resistant vulcanized rubber which will not pass through an inversion or softening point during heat hardening cure or in use. It is preferred to reinforce the vulcanized rubber matrix with up to 6% by weight of the block of a thermosetting resin of the phenolicaldehyde or cashew nut shell oil type.

It will be understood that the details given are for the purpose of illustration, not restriction, and that variations within the spirit of the invention are intended to be included in the scope of the appended claims.

What I claim is:

1. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, staple organic reinforcing fiber in amount from 2 to 30% by weight, and at least 50% by volume of non-ferrous inorganic and organic filler and organic binder materials including a binder matrix comprising a heat resistant hard vulcanized in situ rubber selected from the group consisting of natural rubber, polychlorbutadiene, and butadiene-styrene and butadiene-acrylonitrile copolymers.

2. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and at least 50% by volume of non-ferrous inorganic and organic filler and organic binder materials including a binder matrix comprising a heat resistant hard vulcanized in situ rubber selected from the group consisting of natural rubber, polychlorbutadiene, and butadiene-styrene and butadiene-acrylonitrile copolymers.

3. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and at least 50% by volume of non-ferrous inorganic and organic filler and organic binder materials including a binder matrix comprising a heat resistant hard vulcanized in situ butadiene-styrene copolymer synthetic rubber.

4. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and at least 50% by volume of non-ferrous inorganic and organic filler and organic binder materials including a binder matrix comprising a heat resistant hard vulcanized in situ natural rubber.

5. A molded composition brake block having good wet and dry friction characteristics and a long service life comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, staple organic reinforcing fiber in amount from 2 to 30% by weight, and at least 50% by volume of non-ferrous inorganic and organic filler and organic binder materials including a binder matrix comprising a heat resistant vulcanized in situ rubber selected from the group consisting of natural rubber, polychlorbutadiene and butadiene-styrene and butadiene-acrylonitrile copolymers, said binder matrix containing up to 6% by weight of the block of a thermosetting resin stiffener.

6. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and at least 50% by volume of non-ferrous inorganic and organic filler and organic binder materials including a binder matrix comprising a heat resistant vulcanized in situ rubber selected from the group

consisting of natural rubber, polychlorbutadiene and butadiene styrene and butadiene-acrylonitrile copolymers, said binder matrix containing up to 6% by weight of the block of a thermosetting resin stiffener.

7. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and at least 50% by volume of non-ferrous inorganic and organic filler and organic binder materials including a binder matrix comprising a heat resistant hard vulcanized in situ butadiene-styrene copolymer synthetic rubber, said binder matrix containing up to 6% by weight of the block of a thermosetting resin stiffener.

8. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and at least 50% by volume of non-ferrous inorganic and organic filler and organic binder materials including a binder matrix comprising a heat resistant hard vulcanized in situ natural rubber, said binder matrix containing up to 6% by weight of the block of a thermosetting resin stiffener.

9. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, staple organic reinforcing fiber in amount from 2 to 30% by weight, and from 8–32% of a binder matrix comprising the in situ vulcanization product of a composition comprising a rubber selected from the group consisting of a natural rubber, polychlorbutadiene and butadiene-styrene and butadiene-acrylonitrile copolymers and a high proportion of inorganic fillers and vulcanizing ingredients.

10. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and from 8–32% of a binder matrix comprising the in situ vulcanization product of a composition comprising a rubber selected from the group consisting of a natural rubber, polychlorbutadiene and butadiene-styrene and butadiene-acrylonitrile copolymers and a high proportion of inorganic fillers and vulcanizing ingredients.

11. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of a hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, thermally modified acrylonitrile reinforcing fiber in amount from 2 to 30% by weight, and from 8–32% of a binder matrix comprising the in situ vulcanization product of a composition comprising a rubber selected from the group consisting of a natural rubber, polychlorbutadiene and butadiene-styrene and butadiene-acrylonitrile copolymers and a high proportion of inorganic fillers and vulcanizing ingredients.

12. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and from 8–32% of a binder matrix comprising the in situ vulcanization product of a composition comprising a butadiene-styrene copolymer and a high proportion of inorganic fillers and vulcanizing ingredients.

13. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and from 8–32% of a binder matrix comprising the in situ vulcanization product of a composition comprising a natural rubber and a high proportion of inorganic fillers and vulcanizing ingredients.

14. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, staple organic reinforcing fiber in amount from 2 to 30% by weight, and from 8–32% of a binder matrix comprising the in situ vulcanization product of a composition comprising a rubber selected from the group consisting of a natural rubber, polychlorbutadiene and butadiene-styrene and butadiene-acrylonitrile copolymers and a high proportion of inorganic fillers and vulcanizing ingredients, said binder matrix containing up to 6% by weight of the block of a thermosetting resin stiffener.

15. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and from 8–32% of a binder matrix comprising the in situ vulcanization product of a composition comprising a rubber selected from the group consisting of a natural rubber, polychlorbutadiene and butadiene-styrene and butadiene-acrylonitrile copolymers and a high proportion of inorganic fillers and vulcanizing ingredients, said binder matrix containing up to 6% by weight of the block of a thermosetting resin stiffener.

16. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, thermally modified acrylonitrile reinforcing fiber in amount from 2 to 30% by weight, and from 8–32% of a binder matrix comprising the in situ vulcanization product of a composition comprising a rubber selected from the group consisting of a natural rubber, polychlorbutadiene and butadiene-styrene and butadiene-acrylonitrile copolymers and a high proportion of inorganic fillers and vulcanizing ingredients, said binder matrix containing up to 6% by weight of the block of a thermosetting resin stiffener.

17. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and from 8–32% of a binder matrix comprising the in situ vulcanization product of a composition comprising a butadiene-styrene copolymer and a high proportion of inorganic fillers and vulcanizing ingredients, said binder matrix containing up to 6% by weight of the block of a thermosetting resin stiffener.

18. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, cellulosic reinforcing fiber in amount

from 2 to 30% by weight, and from 8–32% of a binder matrix comprising the in situ vulcanization product of a composition comprising a natural rubber and a high proportion of inorganic fillers and vulcanizing ingredients, said binder matrix containing up to 6% by weight of the block of a thermosetting resin stiffener.

19. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, staple organic reinforcing fiber in amount from 2 to 30% by weight, and from 8–32% of a binder matrix comprising the in situ vulcanization product of a composition comprising a rubber selected from the group consisting of a natural rubber, polychlorbutadiene and butadiene-styrene and butadiene-acrylonitrile copolymers and a high proportion of inorganic fillers and vulcanizing ingredients, said block being reinforced with a hard ferrous metal grid sheet disposed in spaced relation substantially parallel to the friction face of the element.

20. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and from 8–32% of a binder matrix comprising the in situ vulcanization product of a composition comprising a rubber selected from the group consisting of a natural rubber, polychlorbutadiene and butadiene-styrene and butadiene-acrylonitrile copolymers and a high proportion of inorganic fillers and vulcanizing ingredients, said binder matrix containing up to 6% by weight of the block of a thermosetting resin stiffener, and said block being reinforced with a hard ferrous metal grid sheet disposed in spaced relation substantially parallel to the friction face of the element.

21. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and at least 50% by volume of non-ferrous inorganic and organic filler and organic binder materials including a binder matrix comprising a heat resistant hard vulcanized in situ butadiene-acrylonitrile copolymer synthetic rubber.

22. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and at least 50% by volume of non-ferrous inorganic and organic filler and organic binder materials including a binder matrix comprising a heat resistant hard vulcanized in situ butadiene-acrylonitrile copolymer synthetic rubber, said binder matrix containing up to 6% by weight of the block of a thermosetting resin stiffener.

23. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and from 8–32% by weight of a binder matrix comprising the in situ vulcanization product of a composition comprising a butadiene-acrylonitrile copolymer and a high proportion of inorganic fillers and vulcanizing ingredients.

24. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising 25–75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from 10–60% by weight of long wearing organic friction particles, cellulosic reinforcing fiber in amount from 2 to 30% by weight, and from 8–21% of a binder matrix comprising the in situ vulcanization product of a composition comprising butadiene-acrylonitrile copolymer and a high proportion of inorganic fillers and vulcanizing ingredients, said binder matrix containing up to 6% by weight of the block of a thermosetting resin stiffener.

25. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising approximately 32% by weight of cast iron chips, approximately 46% by weight of hard rubber friction particles, approximately 6% of cellulosic reinforcing fiber, and approximately 16% of a binder matrix comprising the in situ vulcanization product of a composition comprising rubber selected from the group consisting of a natural rubber, polychlorbutadiene, butadiene-styrene and butadiene-acrylonitrile copolymers, and a high proportion of inorganic fillers and vulcanizing ingredients.

26. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising approximately 32% by weight of cast iron chips, approximately 46% by weight of hard rubber friction particles, approximately 6% of cellulosic reinforcing fiber, and approximately 16% of a binder matrix comprising the in situ vulcanization product of a composition comprising natural rubber and a high proportion of inorganic fillers and vulcanization ingredients.

27. A molded composition brake block having good wet and dry friction characteristics and a long service life, comprising approximately 32% by weight of cast iron chips, approximately 46% by weight of hard rubber friction particles, approximately 6% of cellulosic reinforcing fiber, and approximately 16% of a binder matrix comprising the in situ vulcanization product of a composition comprising a butadiene-styrene copolymer and a high proportion of inorganic fillers and vulcanization ingredients, said binder matrix containing approximately 2% by weight of the block of thermosetting resin stiffener.

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2-5

2,861,964 W-89 Mattuni

Composition Friction Material for Brake Shoes, Brake Bonds, Disc. Brakes, etc.

Nov. 25, 1958 C. L. E. DE GAUGUE, JR., ET AL 2,861,964

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COMPOSITION BRAKE BLOCK

Filed Nov. 17, 1953

Covers Jan's. W-89 comp. friction matl

Fig. 1.

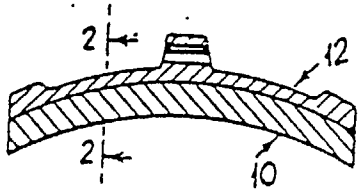


Fig. 2.

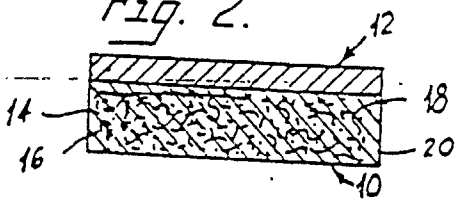


Fig. 3.

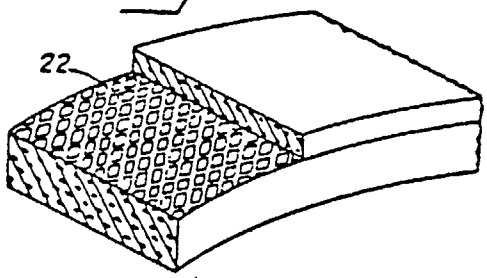
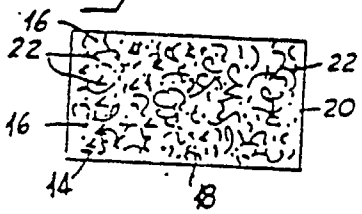


Fig. 4.



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2-6

United States Patent Office

3,390,113
Patented June 25, 1968

3,390,113

BRAKE BLOCK COMPOSITIONS COMPRISING VULCANIZED HALOGENATED BUTYL RUBBER

Charles Louis Ernest de Gaugue, Califon, N.J., assignor to Johns-Manville Corporation, New York, N.Y., a corporation of New York

Continuation-in-part of application Ser. No. 198,156, May 28, 1962. This application Jan. 27, 1967, Ser. No. 632,120

12 Claims. (Cl. 260—23.7)

ABSTRACT OF THE DISCLOSURE

A heavy duty brake block composition containing hard ferrous metal particles, non-ferrous inorganic and organic fillers, and an organic binder matrix comprising a heat resistant, vulcanized halogenated butyl rubber.

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part application of my copending U.S. patent application Ser. No. 198,156, filed May 28, 1962, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to improved composition brake blocks, and more particularly to enhanced molded brake block compositions of the general type disclosed and claimed in U.S. Letters Patent No. 2,686,140 and No. 2,861,964 which are peculiarly adaptable for braking heavy equipment such as railroad rolling stock.

Patents No. 2,686,140 and No. 2,861,964 are concerned with a new concept in railroad brake blocks, a unique combination of cast iron particles and organic constituents bonded with highly filled, hard, rubbers of the given compositions which provide decidedly improved advantages including enhanced braking and friction properties with both longer block or friction element and wheel tread or drum wear over the long utilized solid cast iron brake blocks for railroad application.

This invention comprises the discovery of a new composition for railroad brake blocks of the general type and/or general components described in Patents No. 2,686,140 and/or 2,861,964, which results in further marked enhancements and improvements of certain basic properties of the former composition brake blocks of either of the said patents. In particular, the modified and improved composition brake blocks of this invention, primarily attributable to and constituting a new and enhancing binder phase or matrix, exhibit general overall properties at least equivalent to those of the prior art as represented by the aforementioned patents and decidedly improved properties comprising a substantially increased wear life, more uniform and greater friction characteristics, and the reduction of loud and/or disagreeable noises during or resulting from braking which is of considerable importance in passenger service, particularly in subway or interurban passenger service wherein stops are frequent and the noise of braking confined or concentrated by the ambient conditions.

SUMMARY OF THE INVENTION

In general, this invention comprises improved composition brake blocks of the same general construction and compositions as those of Patents No. 2,686,140 and No. 2,861,964 containing a binder phase or matrix comprising halogenated butyl rubber, or more precisely a halogenated elastomer produced by copolymerization of isobutylene with relatively small amounts of isoprene at low temperatures. The balance of the friction composition of this invention like those of the Patents No. 2,686,140 and No. 2,861,964, typically comprise approximately 25 to 75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles together with at least 50% by volume of non-ferrous inorganic and organic filler and the organic binder. The effective binder systems of this invention consist of halogenated butyl rubber elastomers containing a halogen comprising chlorine and/or bromine such as chlorobutyl rubber and bromobutyl rubber. The preferred rubber material, primarily due to its superior molding characteristics, consists of a chlorobutyl rubber or elastomeric isobutylene isoprene copolymer containing about 1.1 to 1.3% of reactive chlorine and produced pursuant to the disclosure of U.S. Letters Patent No. 2,944,578.

Objects and advantages of this improved composition for brake blocks or elements of this invention comprise greater block or element wear life of up to about three times greater than prior compositions without an increase in wear of the cooperating braking surface of the wheel tread or brake drum, and improved higher and more uniform friction properties along with good wet and dry frictional characteristics comparable to prior brake blocks. Although these attributes are present when braking from any speed, they are most pronounced under high speed conditions of up to 150 m.p.h. Moreover the new composition brake blocks or elements of this invention do not emit or produce typical or characteristic braking squeals or the like disagreeable noise and vibrations when contacting and/or compressed upon the cooperating wheel tread or brake drum surface.

The above and other objects and advantages of the improved composition or new binder system of this invention will become more apparent in the hereinafter detailed description and drawing wherein the FIGS. 1 and 2 illustrate comparable retardation rates or characteristics upon braking from speeds of 100 miles per hour and 40 miles per hour with brake blocks of this invention and with the preferred and commercial composition brake blocks of the prior art consisting of the product of Example I of Patent No. 2,861,964. FIG. 3 comprises a graph illustrating the relative wear rates of the composition of Example I of this invention with that of Example I of Patent No. 2,861,964 constituting a preferred, commercial product of the prior art. All braking conditions were the same and the abscissa axis denotes speed and the ordinate axis the rate of wear in cubic inches in logarithmic scale.

DESCRIPTION OF PREFERRED EMBODIMENTS

The composition brake block products of this invention are produced by utilizing halogenated butyl rubbers of the types specified in amount of about 5 to 12% and preferably about 6 to 10% by weight of the overall block which are vulcanized or cured in situ with curing agents, fillers, etc. to form the bonding phase or system constituting an encompassing matrix for other components. The overall binder systems or phases include along with the rubber approximately 2 to 20% by weight of the block of inorganic and organic fillers and vulcanizing ingredients such as sulfur, or tetramethylthiuram disulfide or polymethylol phenol resin or other apt curing agents, magnesium oxide, zinc oxide, carbon black, barytes etc. [illegible] a bonding and encompassing matrix or mass 8 to 35% by weight of the total block. And in addition to the fundamental halogenated butyl rubber in the specified amounts, these brake blocks may also include other rubber compositions in the binder system such as butyl or other compatible butadiene-styrene rubber and other compatible elastomers. When combined with other rubber or elastomers, the halogenated butyl rubber of the [illegible] of this invention must consist of at least 20% by

weight of the overall block, and the total rubber binder component should not exceed about 15% by weight of the block.

The method or means of producing and/or molding the subject brake blocks of this invention are not unlike those of the foregoing mentioned patents and are pursuant to established rubber compounding and brake block manufacturing procedures and techniques. For example, the rubber component with the fillers and/or vulcanizers and the like are blended on a rubber mill and cut back with a suitable solvent such as gasoline to form a uniform and workable fluid-like consistency whereupon the other constituents are combined and blended therewith. The admixture of the complete formulation is then formed into small particles or pellets which are dried at a relatively low temperature if necessary to provide a convenient and handleable particulate furnish for molding. The material is then molded at high pressures and elevated temperatures, e.g., about 2000–5000 p.s.i. and 300–400° F., to shape and integrate the brake block article whereupon it is baked at an appropriate temperature, e.g., about 250–400° F., to complete the cure or vulcanization.

Molded composition brake blocks of a formulation in accordance with this invention, viz., composition brake blocks such as generally disclosed in Patent No. 2,686,140 and/or No. 2,861,964, but comprising therein a vulcanized in situ halogenated butyl rubber in amount of at least about 2 up to about 12% by weight of the product selected from the group consisting of chlorobutyl rubber, and bromobutyl rubber, or mixtures thereof, exhibit improved higher and more uniform frictional characteristics, significantly greater wear resistance or service life without a commensurate increased rate of wear or reduced service life on the cooperating or brake contacting wheel tread, brake drum or other contacting brake surface, and exceptionally quiet braking properties without incurring adverse qualities or materially diminishing other essential properties of comparable prior art products. As is apparent these improved properties render such a brake block particularly advantageous and useful in high speed passenger service and on subway and interurban service systems.

The organic friction particles and thermosetting resin stiffener referred to throughout this specification comprise conventional frictional material constituents such as described and illustrated in Patents Nos. 2,868,140 and 2,861,964, and related prior art. For example, the organic friction particles may comprise common heavily filled, hard, prevulcanized rubber friction particles, or conventional resinous friction particles such as granules of cured thermosetting resins as exemplified by polymerized cashew nut shell oil. Such organic friction particles are preferably included in amounts of from approximately 10 to 60% by weight of the composition and typically in amount of about 40 to 50%. And the rubber matrix or binder phase can be stiffened with up to about 6% by weight of the overall block with a thermosetting resin such as phenolic resins, polymethylol phenol resins or halogenated butyl compatible resins. The friction particles of the hereinafter specific examples consist of the heavily filled hard vulcanized rubber variety of a composition approximating that illustrated in Patent No. 2,686,140. The compositions also preferably include reinforcing fiber in amounts up to approximately 30% by weight of the composition.

The following examples illustrate suitable and preferred railroad brake block compositions including various halogenated butyl rubbers in accordance with this invention. It is to be understood that the manufacturing or processing means and techniques, and the particular constituents of the illustrated brake blocks, other than the novel halogenated butyl elastomer binders, are exemplary and are not to be considered to limit this invention to any specific product, formulation, or composition recited in the hereinafter examples.

Exemplary brake blocks comprising the hereinafter given formulations were prepared as follows: The appropriate identified halogenated butyl rubber components were combined on a rubber mill with the given proportions of a conventional curing agent comprising either sulfur or tetramethylthiuram disulfide or polymethylolphenol resin accelerators, stearic acid, zinc oxide or the like appropriate rubber compounding constituents given. The resultant compounded rubber sheet was chopped and tumbled with gasoline until a smooth, consistent cement was formed which was placed in a sigma-blade mixer and combined with the balance of the constituents of the particular formulation producing a dough-like extrudable mass. Upon pelleting the mixture, or chopping or slicing the material into small bodies, the particles thereof were thoroughly dried at a temperature just under about 130° F. to provide a convenient particulate furnish for charging and molding in compression type molds such as are frequently utilized in the production of composition blocks. The dried pellets were compression molded for a period of about 1 hour at mold temperatures of approximately 300° F. and unit compressive loads of approximately 3000 pounds per square inch. Upon removal from the mold, the resulting shaped and consolidated brake blocks were subjected to an after-bake of about 12 hours at approximately 300° F. to complete the vulcanization or cure.

In each of the hereinafter examples the composition is given in percentages based upon weight, and additionally in some cases by parts by weight, or percent by volume.

EXAMPLE I

	Percent by wt.	Parts by wt.	Approx. vol. percent
Chlorobutyl rubber (Enjay HT-1066)	7.62	100	20
Accelerator, tetramethylthiuram disulfide ("Tuads")	0.08	1	1
Accelerator, benzothiazyl disulfide ("Altax")	0.08	1	1
Stearic acid	0.08	1	1
Zinc oxide	0.38	5	1
Carbon black, powdered	4.56	60	6
Cast iron chips (substantially 100–200 mesh)	30.50	400	9½
Friction particles (hard, heavily filled, vulcanized rubber)	45.80	610	50
Cellulose floc	7.90	101	13½
Total	100.00	1,312	

EXAMPLE II

	Percent by weight
Chlorobutyl rubber (Enjay MD-551)	7.57
Sulfur	0.15
Accelerator, tellurium diethyldithiocarbamate ("Tellurac")	0.08
Accelerator, benzothiazyl disulfide ("Altax")	0.08
Stearic acid	0.08
Zinc oxide	0.75
Carbon black, powdered	4.60
Cast iron chips (substantially 100–200 mesh)	30.33
Friction particles (hard, heavily filled, vulcanized rubber)	48.50
Cellulose floc	7.86
Total	100.00

EXAMPLE III

	Percent by weight
Bromobutyl rubber (Hycar 2202)	7.57
Sulfur	0.15
Accelerator, tellurium diethyldithiocarbamate ("Tellurac")	0.08
Accelerator, benzothiazyl disulfide ("Altax")	0.08
Stearic acid	0.08
Zinc oxide	0.75
Carbon black, powdered	4.60
Cast iron chips (substantially 100–200 mesh)	30.33

EXAMPLE III Continued

Friction particles (hard, heavily filled, vulcanized rubber)	48.50
Cellulose flock	7.80
Total	100.00

EXAMPLE IV

	Percent by weight
Chlorobutyl rubber (Enjay MD-551)	8.50
Sulfur	0.20
Accelerator, tellurium diethyldithiocarbamate ("Tellurac")	0.10
Accelerator, benzothiazyl disulfide ("Altax")	0.10
Stearic acid	0.10
Zinc oxide	1.00
Carbon black, powdered	5.00
Cast iron chips (substantially 100–200 mesh)	30.00
Friction particles (hard, heavily filled, vulcanized rubber)	43.00
Asbestos fiber	12.00
Total	100.00

EXAMPLE V

	Percent by wt.	Parts by wt.
Chlorobutyl rubber (Enjay HT-1066)	8.00	100
Accelerator, tetramethylthiuram disulfide ("Tuads")	.16	2
Accelerator, tellurium diethyldithiocarbamate ("Tellurac")	.08	1
Stearic acid	.08	1
Magnesium oxide	.16	2
Zinc oxide	1.60	20
Phenolic resin (Durez 12687)	1.92	24
Carbon black	4.80	60
Cast iron chips	24.00	300
Friction particles (hard, heavily filled, vulcanized rubber)	48.00	600
Asbestos fiber (7-D-02)	6.40	80
Total	100.00	1,250

EXAMPLE VI

	Percent by wt.	Parts by wt.
Chlorobutyl rubber (Enjay HT-1066)	7.55	100
Brominated polymethylol phenol resin (Schenectady SP-1056)	.91	12
Zinc oxide	.60	8
Carbon black	4.53	60
Cast iron grit	30.21	400
Friction particles (hard, heavily filled, vulcanized rubber)	48.34	640
Cellulose floc	7.86	104
Total	100.00	1,324

EXAMPLE VII

	Percent by wt.	Parts by wt.
Chlorobutyl rubber (Enjay HT-1066)	7.50	100
Accelerator, tetramethylthiuram disulfide ("Tuads")	.07	1
Accelerator, tellurium diethyldithiocarbamate ("Tellurac")	.07	1
Accelerator, benzothiazyl disulfide ("Altax")	.07	1
Stearic acid	.07	1
Zinc oxide	.30	3
Carbon black	4.50	60
Cast iron grit	28.70	400
Friction particles (hard, heavily filled, vulcanized rubber)	46.00	640
Asbestos fiber (7-D-02)	13.10	181
Total	100.00	1,350

As stated hereinbefore, the halogenated butyl rubber containing molded composition brake blocks of this invention provide certain decided advantages or improved properties, including such fundamental qualities as enhanced frictional characteristics and markedly greater wear life over like products disclosed by the prior art and/or employed in commerce. For instance, brake blocks of the approximate composition of Example II, an optimum formulation due to its relative ease of producing or molding, when compared with commercial composition brake blocks of the approximate composition of

that given in Example I of Patent No. 2,861,964 on railroad rolling stock under substantially identical service load and braking conditions were of superior wear life, comparable wet-to-dry friction ratios and of improved and more uniform friction or retarding qualities.

A number of dry stops and wet stops made from 40 miles per hour established the wet-to-dry friction ratio of the improved composition brake blocks to be 1.123 which is comparable to the typical ratios of 1.25 for the said prior commercial products.

Characteristic retardation curves for the brake blocks of the composition of Example II above and the brake blocks of the composition of Example I of Patent No. 2,861,964 are given for stops made from speeds of 100 miles per hour and 40 miles per hour in FIG. 1 and FIG. 2 of the drawing, the curves produced by the composition of this invention being presented in heavy solid lines designated A and the curves produced by the prior compositions under comparable railroad car braking conditions being presented in heavy broken lines designated B, superimposed upon each other. Retardation being directly proportional to frictional characteristics, it is apparent from these curves that the improved friction materials comprising halogenated butyl rubber, or brake blocks thereof, exhibit substantially more uniform and consistent friction characteristics over a broad range of speeds.

The pronounced improvement in prolonged wear life of products of the halogenated butyl rubber bonded compositions of this invention is demonstrated by the comparative data illustrated in the graph comprising FIG. 3 of the drawing. The data presented in the graph of FIG. 3 was derived from identical braking conditions extending over a range of initial speeds of from 40 m.p.h. up to 150 m.p.h. applied to like brake shoes composed of each the composition of Example I of this application and of the preferred and a commercial product of the formula of Example 1 of U.S. Patent No. 2,861,964, carried out on a large scale dynamometer with a conventional 36 inch railroad car wheel under the equivalent of one wheel load of a standard passenger car and all conditions comparable to and simulating operational railroad braking. In the graph the abscissa axis sets forth the initial speed in miles per hour at which braking is commenced, and the ordinate axis, in logarithmic scale, gives the shoe wear from braking under like, simulated railroad operating conditions from the initial speeds for each the improved composition of this invention and, to applicant's knowledge, the best and most closely akin composition of the prior art. From the graph and data provided thereby wherein the solid line, identified as A, represents the average wear rate of the preferred composition of Example I of this invention and the broken line, identified as B, represents the average wear rate of the composition of Example 1 of U.S. Patent No. 2,861,964, under identical braking conditions, it is clearly evident that throughout the extended range of speeds of from 40 m.p.h. up to 150 m.p.h., the wear rate from braking of the improved composition of this invention is in the order of 2.5 to 3 times less than that of the prior art and commercial product.

The most significant improvement and attribute of this invention, that of reduced wear rate, has been found to be primarily, if not solely attributable to the utilization of halogenated butyl rubber as the principal binder component of the bonding system or phase of the product as is demonstrated by the following relative evaluation of the wear rate of identical compositions, other than that of accepted binders, cures, and proportions therefor. To evaluate a substantial number of compositions a more expeditious test procedure was employed rather than the borderless, costly and time consuming railroad scale dynamometer. The test apparatus consisted of a revolving arm constructed to carry a friction composition sample

be made to contact a flat steel ring of a composition identical to a railroad car wheel. Contact time and speed is variable as desired and can be intermittent or continuous, as given. Contact pressure in all tests was 100 p.s.i. The test conditions and sequence were as follows:

Phase	Rubbing Speed feet per second	Contact Time per Application	Applications per phase
1	17.6	15 sec	30 intermittent.
2	46.6	15 sec	30 intermittent.
Drag	29.4	15 min	1 continuous

Phases 1 and 2 simulate intermittent stopping from different speed levels and the drag phase continuous downhill drag under braking load. All phases are carried out in continuous sequence for each sample tested. Equilibrium temperatures reached during the tests averaged approximately 250° F. for phase 1, approximately 400° F. for phase 2, and 500° F. to 700° F. for the simulated downhill drag phase. It should be appreciated that the continuous downhill drag conditions of uninterrupted braking over a 15 minute period constitutes an unduly demanding test of rigorous terms exceeding the requirements of typical passenger or freight service and is applicable to mountainous terrain.

The composition of Example I, evaluated in simulated railroad scale runs and in the field, served as the standard to determine the relative wear rates of rubber bonds, cures therefor and variable proportions thereof, in products of otherwise identical composition or components. All test friction materials are of the same composition as Example I except as indicated, wherein the given changes consist of the identified variations in the percentage of rubber content of binder phase, cure systems, substitutions of butyl rubbers, and the testing of the compositions of Examples V and VII in the therein stated amount of rubber and the given increased amount. Derived data consist of average coefficient of friction, average rate of wear in cubic inches per horsepower hour. The so-called "standard cure" consists of a thiuram-thiazole sulfurless cure (tetramethylthiuram disulfide, "Tuads" and benzothiazyl disulfide, "Altax") as recommended by the vendor of HT-1066, and as illustrated in Example I. The "resin cure" consists of polymethylolphenol resin as in Example VI.

A further and decided improvement in certain operations such as subway and interurban service is the virtually noiseless operation or braking of the compositions of this invention which eliminate substantially all braking squeals or the like noises other than those produced by the mechanical action of the brake actuating mechanism.

It will be understood that the foregoing details are given for the purpose of illustration, not restriction, and the variations within the spirit of this invention are intended to be included within the scope of the appended claims.

I claim:

1. An improved molded composition brake block having good wet and dry friction characteristics and long service life, comprising approximately 20 to 75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, and at least 50% by volume of the block of non-ferrous inorganic and organic filler and organic binder matrix comprising at least about 2 to up to about 12% by weight of the block of heat resistant vulcanized in situ halogenated butyl rubber which is a halogenated isobutylene-isoprene copolymer.

2. The improved molded composition brake block of claim 1 wherein the binder matrix comprises about 5 to about 12% by weight of the block of heat resistant vulcanized in situ halogenated butyl rubber which is a halogenated isobutylene isoprene copolymer.

3. An improved molded composition brake block having good wet and dry friction characteristics and long service life, comprising approximately 20 to 75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from approximately 10 to 60% by weight of long wearing organic friction particles, and from 8 to 35% by weight of a binder matrix comprising the in situ vulcanization product of a composition comprising at least about 2 to up to about 12% by weight of the block of halogenated butyl rubber which is a halogenated isobutylene-isoprene copolymer.

4. The improved molded composition brake block of claim 3 wherein the binder matrix comprising the in situ vulcanization product comprises about 5 to about 12% by weight of the block of at least one halogenated butyl rubber which is a halogenated isobutylene-isoprene copolymer selected from the group consisting of chloro-

TABLE I

Bond Content, percent		Test Phase	Chlorobutyl Bond						Bromobutyl Bond					
			Standard Cure			Resin Cure			Standard Cure			Resin Cure		
Volumetric	Weight		Avg. Frict.	Avg. Rate Wear	No. Tests	Avg. Frict.	Avg. Rate Wear	No. Tests	Avg. Frict.	Avg. Rate Wear	No. Tests	Avg. Frict.	Avg. Rate Wear	No. Tests
16½	6.2	1	.37	.0040	2									
		2	.32	.0071	2									
		Drag	.22	.0454	1									
			Example I—Standard			Example VI								
20	7.6	1	.33	.0042	7	.39	.0042	1	.36	.0026	2	.32	.0048	2
		2	.30	.0061	7	.32	.0060	1	.32	.0075	2	.31	.0065	2
		Drag	.25	.0450	2	.25	.2570	1	.24	.0774	2	.23	.0436	2
24	9.5	1	.40	.0040	2	.34	.0054	2						
		2	.33	.0090	2	.35	.0052	2						
		Drag	.24	.6620	1	.25	.4120	1						
27	11.3	1	.40	.0120	1									
		2	.36	.0048	1									
		Drag	.25	.7649	1									
16½	6.2	1												
		2												
		Drag												
									Example V			Example VII		
20	7.6	1	Damaged in run-in			Damaged in run-in			.43	.0040	4	.37	.0048	4
		2							.33	.0042	4	.33	.0060	4
		Drag							.20	.0471	2	.25	.0471	2
24	9.5	1	.42	.0040	1									
		2	Destroyed											
		Drag												
27	11.3	1												
		2												
		Drag												

butyl rubber, and bromobutyl rubber, and a high proportion of inorganic fillers and vulcanizing ingredients.

5. The improved molded composition brake block of claim 4 wherein the composition comprises asbestos fiber.

6. The improved molded composition brake block of claim 4 wherein the composition comprises organic fiber.

7. An improved molded composition brake block having good wet and dry friction characteristics and long service life, comprising approximately 20 to 75% by weight of hard ferrous metal at least 50% of which is in the form of cast iron particles, from approximately 10 to 60% by weight of long wearing organic friction particles, up to approximately 30% by weight of fiber, and from approximately 8 to 35% by weight of a binder matrix comprising the in situ vulcanization product of a composition comprising at least about 2 to up to about 12% by weight of the block of halogenated butyl rubber which is a halogenated isobutylene-isoprene copolymer and a high proportion of inorganic fillers and vulcanizing ingredients.

8. The improved molded composition brake block of claim 7 wherein the binder matrix comprising the in situ vulcanization product comprises about 5 to about 12% by weight of the block of at least one halogenated butyl rubber which is a halogenated isobutylene-isoprene copolymer selected from the group consisting of chlorobutyl rubber, and bromobutyl rubber, and a high proportion of inorganic fillers and vulcanizing ingredients.

9. The improved molded composition brake block of claim 8 wherein the binder matrix contains up to approximately 6% by weight of the block of thermosetting resin stiffener.

10. The improved molded composition brake block of claim 8 wherein the fiber comprises asbestos.

11. The improved molded composition brake block of claim 8 wherein the fiber comprises organic fiber.

12. The improved molded composition brake block of claim 8 comprising the following in approximate parts by weight:

Chlorobutyl rubber which is a halogenated isobutylene-isoprene copolymer	7.62
Accelerators	0.16
Stearic acid	0.08
Zinc oxide	0.38
Carbon black	4.56
Cast iron chips	30.50
Organic friction particles	48.80
Reinforcing fiber	7.90

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BRAKE BLOCK COMPOSITIONS COMPRISING VULCANIZED HALOGENATED BUTYL RUBBER

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Fig. 1.

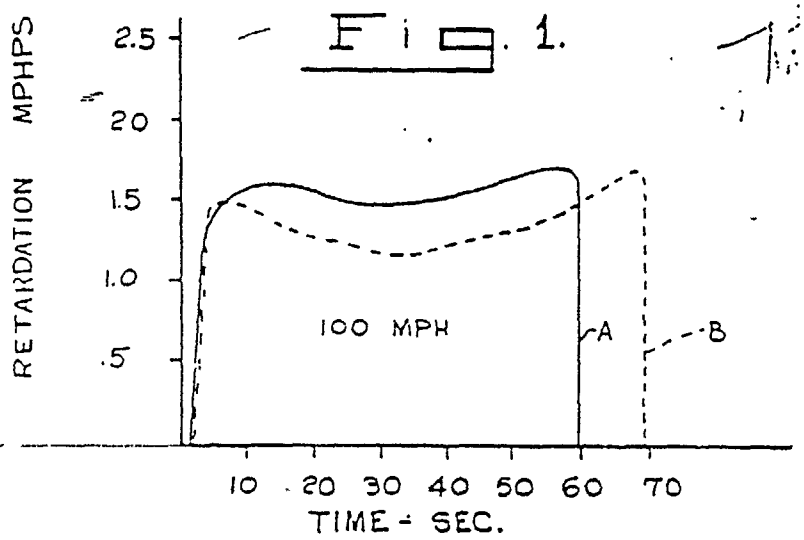
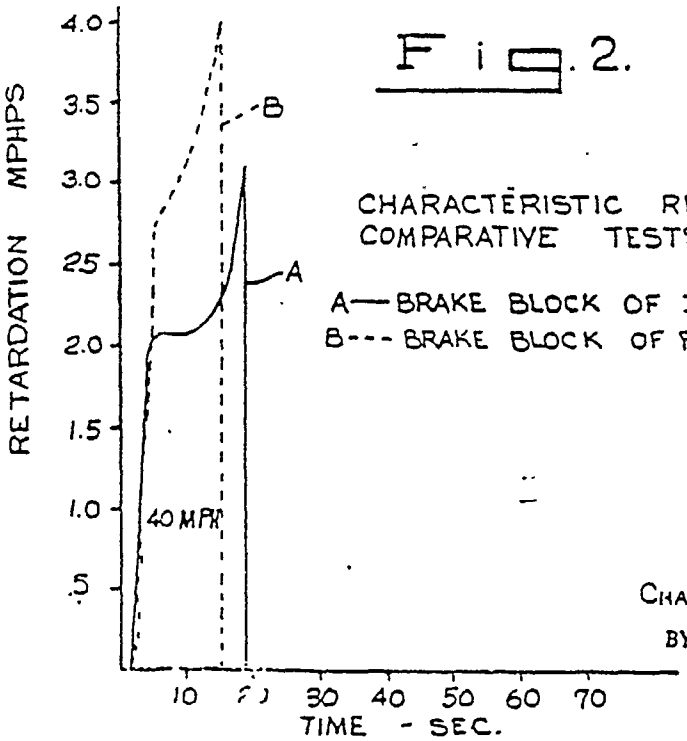


Fig. 2.



CHARACTERISTIC RETARDATION CURVES
COMPARATIVE TESTS

A—BRAKE BLOCK OF IMPROVED COMPOSITION
B---BRAKE BLOCK OF PRIOR COMPOSITION

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BRAKE BLOCK COMPOSITIONS COMPRISING VULCANIZED HALOGENATED BUTYL RUBBER

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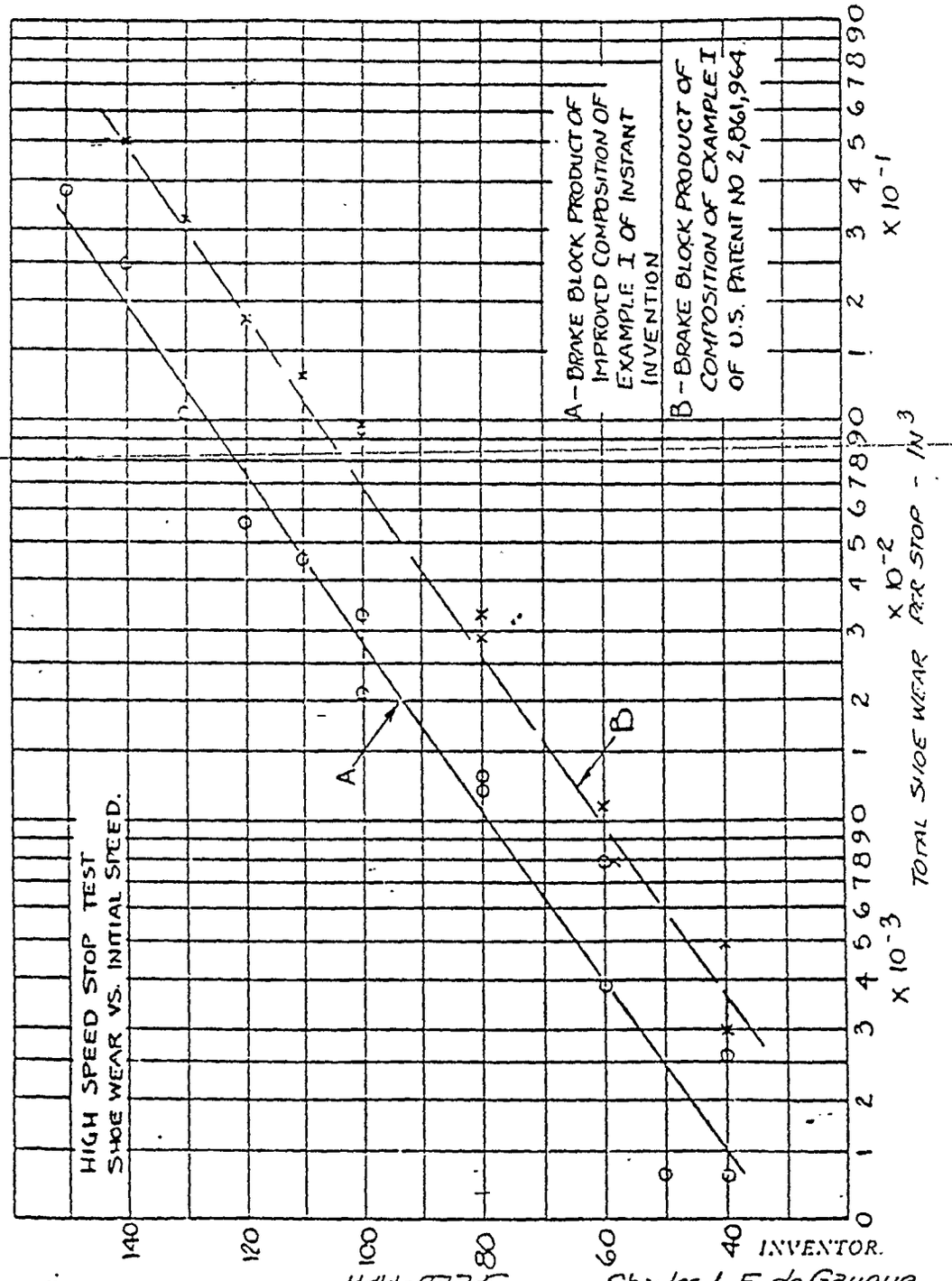

FIG. 3

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