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FIRE EXTINGUISHING COMPOSITION AND THE MANUFACTURE THEREOF

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This invention relates to fire extinguishing compositions and relates especially to fire extinguishing compositions of the type composed of subdivided solid material which can be distributed over material that is undergoing combustion for the purpose of extinguishing the combustion.

It is one of the principal purposes of the present invention to provide a fire extinguishing composition of the character referred to which is effective for extinguishing fires involving extremely high temperatures and for which ordinary fire extinguishing materials such as water, carbon tetrachloride, and the like, are unsuitable. Fires of this character result from the burning of pure magnesium metal and of magnesium alloys containing a high percentage of magnesium, e. g., about ninety per cent. or more, and from the burning of aluminum and sodium.

Fires resulting from the combustion of metallic magnesium can be extinguished very quickly using the fire extinguishing composition of this invention due to the shutting off of oxygen from the burning metal.

If the fire occurs on a support which is combustible, for example, a floor made of wood, the fire extinguishing composition of the present invention is very effective in preventing the intense heat of burning magnesium from striking through to and burning the combustible support. This is because the fire extinguishing composition of the present invention not only is very effective in smothering the fire, but also is very effective in providing a heat insulating mat which protects adjacent materials from the heat of the burning material.

It is also an advantageous feature of the fire extinguishing composition of the present invention that it tends to remain in position even when subjected to the intense temperature of burning metallic magnesium.

It is a further advantage of the fire extinguishing composition of the present invention that, when exposed to flame, it does not have objectionable characteristics, such as gassing, violent disintegration tendency, or the like, and is inexpensive.

While this invention is especially suitable for extinguishing fires which are caused by burning magnesium or magnesium alloys, the fire extinguishing composition of the present invention is also useful in extinguishing any type of fire that can be covered with a protective blanket of finely-divided material. However, fires which are difficult to extinguish with water, such as fires due to burning oil and gasoline in machine shops, burning sulphur, burning metals, including magnesium, aluminum and sodium, and the like, are types of fire for which the fire extinguishing composition of the present invention is especially suited.

It is another purpose of this invention to provide a fire extinguishing composition which is not adversely affected by exposure to varying atmospheric conditions, namely, which is not affected by such things as oxidation, mild heat, subatmospheric temperatures, moisture, etc. Moreover, while in storage or during shipment the material is not susceptible to injury, but can be packed in inexpensive containers such as paper or cloth bags without special precautions.

It is a feature of this invention that the fire extinguishing composition occurs in granular form and that a thermoplastic bitumen which is solid at ordinary atmospheric temperatures, but which is meltable at flame temperature, is combined with a finely-divided solid material which is substantially unmeltable and which is preferably also heat-resistant at approximately 1200° F., i. e., within the range of flame temperatures. By "heat-resistant" it is meant that when 7 grams of the finely-divided solid material in the form of a conical pile is subjected to a temperature of approximately 1200° F. on a metal hot plate for a period of five minutes, the material or some substantial residue thereof will remain in solid or semi-solid form. By "unmeltable" it is meant that, when 7 grams of the finely-divided solid material in the form of a conical pile is subjected to a temperature of approximately 1200° F. on a hot plate for a period of five minutes, it is not reduced to a liquid state. A material such as sand or asbestos is both unmeltable and heat-resistant, while a material such as wood or animal fiber which carbonizes and burns without melting is unmeltable but is not heat-resistant. The bitumen by itself, being meltable at flame temperatures, is capable of being reduced to a liquid condition at 1200° F., but, by incorporating with the bituminous material a substance which is unmeltable and heat-resistant at 1200° F., a composition is afforded which, when reduced to granular form, has remarkable effectiveness in extinguishing fires. While the bitumen in the granules tends to soften and melt at the surfaces of the granules when the composition is exposed to fire, this has the effect of sealing the fire from access of air. The unmeltable and heat-resistant material in the granular composition serves to stabilize the bitumen, however, so that the granules tend to remain in place and the granu-

lar material affords a continuous protective sealing blanket of substantial thickness and resistance to displacement about the burning material. Even when the finely-divided solid material is merely unmeltable without being heat-resistant, as defined above, some advantage according to this invention is afforded due to the fact that the combustion can be extinguished so quickly that much of an unmeltable material remains unconsumed, even though it is not heat-resistant, and serves to stabilize the bitumen.

The nature of fire extinguishing compositions embodying this invention may be illustrated by reference to a preferred method of manufacture. A normally solid bitumen is first heated until it is in a heat-liquefied condition and finely-divided solid material is then uniformly incorporated therein so as to be covered by the bitumen. The mass of bitumen and filler is then cooled until it is sufficiently hard to be subjected to a comminuting action as by crushing or grinding in a suitable mill of which many types are known. The hardened mass is then crushed or ground until it is reduced to a granular condition and preferably any fines, e. g., passing a 100-mesh screen are screened out. The resulting granular product is then ready for use.

The maximum size of the particles of finely-divided material in a fire extinguishing composition according to this invention is determined by the size of the granules in the composition, namely, the particles of finely-divided solid material may approach the size of the granules, although preferably the finely-divided solid material is normally considerably finer than the bituminous granules and is incorporated in the granules and acts as a reinforcing filler for the bitumen. Ordinarily, the finely-divided solid material passes a 14-mesh testing sieve. On the other extreme, the finely-divided solid material may be of any fineness of subdivision, e. g., passing a 325-mesh testing sieve.

When the word "bitumen" is used herein, reference is made to asphalt, pitch, tar, etc., per se and without admixture therewith of a substantial quantity of finely-divided solid material. When the expression "bituminous material" is used, reference is made to bitumen per se or bitumen containing therein some non-bituminous material such as the finely-divided solid materials referred to above.

The bitumen that is used in the fire extinguishing composition of the present invention may be any type of bitumen that is solid at ordinary atmospheric temperatures. The bitumens which are preferred are asphaltic bitumens or natural bitumens. Asphaltic bitumens such as air blown (oxidized) "cracking coil tar" residue from the high temperature pressure cracking process of petroleum refining are especially suitable. While bitumens such as coal tar pitch and the like may be used, coal tar pitch is not as satisfactory as asphaltic bitumen, due to the fact that coal tar pitch contains a higher percentage of volatile matter which tends to smoke when the material is applied to a fire and tends to be excessively brittle, the brittleness resulting in the formation of dust during handling and shipment of the material.

Heretofore it has been proposed to use powdered bitumen per se or mixed with a pulverulent material such as slate flour for extinguishing burning magnesium fires. Such a composition is, however, subject to the great disadvantage that the powdered bitumen tends to form combustible or explosive mixtures with air and therefore the composition is difficult and unsafe to apply to fires. Such a composition is also less effective as a fire extinguisher than the composition of the present invention, due to the fact that the bitumen has to first melt down to a quite fluid state before it becomes effective and then tends to smoke or even burst vigorously into flame. Moreover, if and when the fire is extinguished and the mass cooled, the bitumen hardens down to a continuous and very hard cementitious mass that is very difficult to dispose of. It is likewise a disadvantage of a mixture of this character that it is difficult to maintain uniform. The powdered bitumen and powdered mineral upon handling and during shipment tend to separate, so that the mixture is nonhomogeneous, the mineral accumulating at one portion of the mass with resultant deficiency of bitumen, and the bitumen tending to accumulate in another portion of the mass with resultant deficiency of mineral and tendency of the bitumen to cake. Furthermore, a mixture of powdered bitumen and powdered mineral is very offensive from the standpoint of its dustiness and dirtiness when handled and used and in cleaning up the residue after the fire.

In fire extinguishing compositions according to the present invention, it is regarded as desirable that the bitumen have a softening point of at least about 125° F., so that it will be solid at ordinary atmospheric temperature. Preferably, the softening point of the bitumen is above 175° F. A bitumen having relatively high softening point may be used; but, if the softening point is too high, it is difficult to mix the finely-divided solid material therewith and the resulting mass may be undesirably brittle. Therefore, in making up the composition, it is desirable that the softening point of the bitumen not be above about 325° F., and it is preferable that the softening point of the bitumen be below about 300° F.

In order to afford a better understanding of the practice of this invention, there will be described certain typical examples of the practice thereof. One suitable type of fire extinguishing composition can be prepared using equal proportions of asphalt and finely-divided asbestos which may be referred to as asbestos dust. The asphalt used may be air blown refined cracking coil tar having a softening point (ring and ball method of the American Society for Testing Materials, designation D36–26, published in A. S. T. M. Standards, vol. II, 1942, pages 488–490 inclusive) of about 260° F. Typical of the asbestos dust used is fine Chrysotile asbestos of which about eighty-five per cent. by weight passes a 48-mesh standard testing sieve, about sixty-five per cent. passes a 100-mesh testing sieve, about fifty per cent. passes a 200-mesh testing sieve, and about thirty-five per cent. passes a 325-mesh testing sieve. The material is prepared by heating the asphalt to about 450° F. until it is in a heat-liquefied condition. The asbestos dust is then mixed therewith to form a doughlike mass. The mass is then extruded using any suitable type of extrusion machine and cooled to ordinary temperature. The use of an extrusion machine in the manufacture of the fire extinguishing composition of this invention is especially advantageous. At ordinary temperature, the mass is hard and tough and can be easily ground to a granular condition. The mass is ground until the granules pass a one-eighth inch testing sieve and the material is screened so as to uti-

lize only those granules which are retained on a 65-mesh testing screen. The resulting material is suitable for use according to this invention. It has the advantages both for use in extinguishing fires and for shipment, handling and storage that have been mentioned hereinabove.

The fire extinguishing composition of the foregoing example also has been satisfactorily prepared, using about fifty-five per cent. of the asbestos dust above referred to, together with twenty-five per cent. of air blown refined cracking coil tar having a softening point of about 260° F. and forty per cent. of asphalt having a softening point of 230° F., namely, air-blown heat- and vacuum-refined pipe still bottoms produced as a residuum from the distillation of petroleum.

The following are additional examples of fire extinguishing compositions according to this invention:

	Per cent
Asphalt (air blown cracking coil tar having a softening point of about 200° F.)	27
No. 16 asbestos fiber (Q. A. P. A. 7T grade)	30
Sand passing a 20-mesh sieve and retained on a 150-mesh sieve	43

(Q. A. P. A. above is an abbreviation of Quebec Asbestos Producers Association, the reference being to the asbestos fiber classification system adopted by the Committee on Uniform Classification and Grading of Asbestos Mines Products of the asbestos producers of Quebec, Canada.)

	Per cent
Asphalt (air blown cracking coil tar having a softening point of about 200° F.)	40
Organic fiber (rag)	10
No. 16 asbestos fiber (Q. A. P. A. 7T grade)	25
Sand passing a 20-mesh sieve and retained on a 150-mesh sieve	15
Ferric oxide	10

	Per cent
Asphalt (air blown cracking coil tar having a softening point of about 200° F.)	25
No. 16 asbestos (Q. A. P. A. 7T grade)	35
Ferric oxide	10
Sand passing a 20-mesh sieve and retained on a 150-mesh sieve	30

The No. 16 asbestos fiber referred to above is a fine asbestos that is somewhat coarser than the asbestos dust above mentioned, but is very much shorter than the asbestos classified as "fiber" by the Quebec Asbestos Producers Association and has approximately the following sieve analysis by weight:

	Per cent
Passing a 48-mesh sieve	65
Passing a 100-mesh sieve	45
Passing a 200-mesh sieve	30
Passing a 325-mesh sieve	15

While short asbestos fiber that is customarily regarded as waste material may be used in the manufacture of fire extinguishing compositions according to present invention, it is not necessary to use such finely-divided asbestos, inasmuch as longer fibers may also be used. The longer fibers are, however, broken up during the grinding operation, and for this reason it is ordinarily advantageous commercially not to use the long fiber asbestos which is much in demand for use in reinforcing heat insulations, in the manufacture of asbestos paper, etc., and to use the short dust-like material which is ordinarily regarded as waste.

The finely-divided solid materials that may be used according to this invention are by no means limited to those materials which are mentioned in the foregoing examples. The finely-divided solid materials which are ordinarily used in the practice of this invention are inorganic fillers, many of them being mineral fillers. Examples of such materials which may be used in finely-divided form are serpentine rock, hydrated Portland cement, precipitated calcium carbonate, limestone, chalk, dolomitic rock, slate, other sedimentary rocks, brick and other ceramic materials, slag, fly ash, household ash, ash concrete, pumice, clays, dead burned calcium sulphate, marble, sandstone, granite and other igneous rocks, micas, mica schist, quartz, non-alkali metal oxides, etc. Ground asbestos-cement scrap, e. g., from asbestos cement shingles containing about 20 per cent. by weight of asbestos fiber and 80 per cent. of hydrated Portland cement, is also suitable. Some of the filler materials mentioned above, such as the clays, hydrated Portland cement, asbestos-cement, and certain varieties of asbestos such as Chrysotile asbestos, contain water of constitution that is liberatable when the filler material is subjected to elevated temperatures such as, for example, 1200° F. Thus Chrysotile asbestos contains upwards of 13 per cent. water of constitution, while materials such as hydrated Portland cement contains about 15 to 20 per cent. water of constitution. Materials such as chalk, precipitated calcium carbonate, dolomitic rock, etc., are decomposed when subjected to temperatures such as 1200° F. so as to liberate carbon dioxide which may constitute 50 per cent. by weight or even more of the finely-divided solid material. Material such as dead burned calcium sulphate is decomposed when subjected to such temperatures so as to give off sulphur dioxide. Such materials are referred to generally herein as finely-divided solid materials containing matter that is volatilizable at 1200° F. The employment of filler materials of this character is preferable according to this invention. When bituminous granules contain finely-divided filler material encased in the bitumen and are subjected to flame temperature, the filler, if it contains volatilizable matter, will be decomposed with production of gaseous material that acts to expand the granules. This expansion of the granules assists in causing the granules to pack together to form an air-tight seal that prevents access of oxygen to the burning material. The formation of the gaseous material in the granules also makes the granules porous and tends to make the mass as a whole of an increased porosity which serves to greatly increase the heat insulating effectiveness of the composition.

As a substantial part of the finely-divided solid material that is used, it is preferred to use mineral fiber. Use of asbestos fiber has been mentioned above and has been illustrated in connection with the foregoing examples. In addition to or in lieu of asbestos fibers, other mineral fibers may be used, such as glass fiber, mineral wool, e. g., rock wool, and the like. The Chrysotile asbestos fiber, due to the fact that it contains water of constitution, is preferable; but other types of asbestiform mineral fiber, such as actinolite, Amosite, crocidolite, etc., may be used. The mineral fiber is peculiarly effective in making the bituminous granules tough, so that they will not crumble in handling, and also are very effective in increasing the viscosity and stability of the bituminous material. They also have the advantage of being both non-meltable and heat-resistant. It is desirable that the bituminous gran-

ules contain at least about ten per cent. by weight of mineral fiber and preferably at least about twenty per cent. by weight of mineral fiber.

While employment of mineral fiber is preferable, it is not essential that mineral fibers be used. Other fibrous materials are effective in increasing the toughness of the bituminous granules so that they will not disintegrate with formation of dust to an excessive degree during handling and shipment. Any organic fiber may be used, such as paper fiber and other wood fibers, rag fibers, artificial cellulosic fibers, animal fibers and the like. Such fibers, while combustible and not heat-resistant, are not incompatible with the fire extinguishing composition of the present invention. As has been mentioned above, a small amount of material which is volatilizable is desirable in the bituminous granules of the fire extinguishing composition of this invention, due to the fact that the generation of gas or vapor within the granules in contact with a fire tends to expand them, thus causing the granules in the fire extinguishing covering layer to pack together and to develop pores therein. Thus organic fibers in an amount corresponding to ten per cent or more, or even twenty per cent or more, may advantageously be incorporated in the bituminous granules. Such organic fibers may, for example, be used in conjunction with finely-divided solid mineral or other heat-resistant materials in the bituminous granules.

The fact that organic fibers may be used in the fire extinguishing compositions of the present invention makes it apparent that finely-divided solid organic materials other than organic fibers may be present in the fire extinguishing compositions embodying this invention. A number of such materials are suitable when occurring in finely-divided condition. Suitable materials which may be mentioned by way of example are rubberized scrap material, linoleum scrap, ground hardened synthetic resins, e. g., of the phenolaldehyde type, coke, and the like. Since such organic materials as well as organic fibers of the character above-mentioned, when subjected to temperatures such as 1200° F., tend to evolve gaseous material and, in fact, may be substantially entirely gasified and consumed, they are to be regarded as finely-divided solid materials comprising matter that is volatilizable at temperatures of 1200° F.

It is preferable that the finely-divided solid material contained in the bituminous granules contain some matter that is volatilizable at 1200° F. and, when such volatilizable matter constitutes about two per cent. by weight of the bituminous granules, it has some effectiveness in this regard. Preferably, the amount of volatilizable material is somewhat greater, namely, five per cent. by weight, or more, of the bituminous granules. Also preferably, the amount of volatilizable matter that is contained in the finely-divided solid material in the bituminous granules is less than twenty per cent. by weight of the bituminous granules. If the amount of volatilizable matter exceeds about thirty per cent. by weight of the bituminous granules, the amount of gaseous material that is driven off is somewhat excessive when the fire extinguishing composition is used for extinguishing materials such as burning magnesium, which burns at very high temperatures. For extinguishing ordinary fires, such as smoldering rags and the like, the amount of matter volatilizable at 1200° F. may be greater than thirty per cent. without detracting seriously from the effectiveness of the fire extinguishing composition.

When it is said that the finely-divided solid material contains volatilizable matter when subjected to 1200° F., the proportion by weight of matter that is volatilized when a layer of the finely-divided solid material approximately one-eighth inch thick is contacted for five minutes with a plate heated to 1200° F. is referred to. Referring to the fire extinguishing composition as a whole, including both the finely-divided solid material and the bitumen, it is preferable that the composition contain less than forty per cent. by weight of matter volatilizable at 1200° F., namely, the proportion by weight of matter volatilized when a layer of the composition as a whole approximately one-eighth inch thick is contacted for five minutes with a plate maintained at 1200° F.

In addition to finely-divided solid materials above referred to, asphaltites such as gilsonite, grahamite, albertite may be used in finely-divided condition in conjunction with the bitumen. These asphaltites when heated intumesce but do not melt and, therefore, serve to stabilize the bitumen and also expand the bituminous granules containing them. Such materials are both unmeltable and heat-resistant as these terms are used herein.

While organic fibers and other finely-divided solid organic materials may be used, it is preferable that the finely-divided solid material in the bituminous granules consist in major proportion of inorganic unmeltable heat-resistant material.

It is preferable, in the preparation of a fire extinguishing composition according to this invention, that the finely-divided solid material be non-hygroscopic. Hygroscopic material, if present, tends to cause moisture to be absorbed by the fire extinguishing composition. This is not detrimental when the fire extinguishing composition is used for extinguishing ordinary fires such as burning wood, rags, paper, and the like. However, when the fire extinguishing composition is used for extinguishing burning magnesium, any water that is present in the composition serves to accelerate the combustion and detracts from the effectiveness of the bituminous granules. The effect of a hygroscopic filler can be counteracted by manufacturing the fire extinguishing composition in a dry condition and then packaging it while dry in an airtight container. However, by use of non-hydroscopic filler materials, no such precaution has to be taken and the fire extinguishing composition can be stored even in damp places without danger of absorbing an excessive amount of moisture. A fire extinguishing composition which comprises a substance such as Chrysotile asbestos fiber, hydrated Portland cement, or the like, containing water of constitution, is, however, to be regarded as a dry granular composition, if the composition does not contain any substantial amount of free or hygroscopic water.

In usual practice, the finely-divided solid material is mixed with the bitumen while the bitumen is in a heated liquefied condition. The bitumen is usually heated about 100° to 250° F. above its softening point. Ordinarily, the mixing temperature is around 350° to 450° F. There are some finely-divided solid materials which are decomposed at such temperatures, and for this reason it is desirable to use finely-divided solid materials that are heat resistant at 450° F., namely, that maintain their structural integrity, except for possible loss of water of constitution, or the like,

at such temperatures during a mixing operation. The use of high temperatures during the preparation of the fire extinguishing composition can be avoided, however, by mixing the filler material with powdered high-softening-point bitumen, mixing the materials with a fluxing material that is adapted to combine with the powdered bitumen at relatively low temperatures, e. g., at temperatures not above about 200° F., to produce asphaltic material having a softening point within the range above-mentioned and then causing the bitumen components to occur, e. g., by application of pressure, in an amalgamated condition. The resulting material, solid at ordinary temperatures, can then be crushed or ground to a granular condition. In such case, it is not essential to use a finely-divided solid material that is heat resistant at 450° F.

With regard to the amount of finely-divided solid material that is employed, even small amounts such as ten per cent. of the bituminous granules, has some effectiveness. However, it is ordinarily desirable that the bituminous granules contain at least about twenty-five per cent. by weight of the finely-divided solid material, and it is preferable to use fifty per cent. or more of the finely-divided solid material. At the other extreme, it is preferable not to use more than about seventy per cent. by weight of the finely-divided solid material, in order that the bituminous granules may be tough and coherent and in order that there may be sufficient bituminous material present to seal the granules together when the granules are distributed over a fire. However, even greater amounts of finely-divided solid material may be used, even up to eighty per cent. by weight of the bituminous granules, with some degree of effectiveness.

When the proportion of finely-divided solid material is relatively low; that is, under about fifty per cent. by weight of the bituminous granules, the bituminous granules may be somewhat adhesive and may tend to stick together, particularly if the softening point of the bitumen is below about 200° F. Ordinarily, it is desirable to make the fire extinguishing composition so that the bituminous granules will not tend to stick together in storage, but will remain in a granular condition for long periods of storing by utilizing a sufficient amount of finely-divided solid material to counteract any natural adhesiveness of the bitumen per se. If, however, the granules have a tendency to stick together, this may be counteracted by including with the bituminous granules a dustlike separating material such as powdered talc, slate dust, ground slag, brick dust, etc. The use of such materials should be kept relatively low, however, and should merely occur as a superficial dust on the bituminous granules. For example, about two per cent. of the fire extinguishing composition may be in the form of the separating dust adherent to the bituminous granules. It is preferable that the amount of such dust occurring on the outside of the bituminous granules constitute less than about ten per cent. of the fire extinguishing composition.

It is important that the fire extinguishing composition of the present invention be in granular form. It is preferable that the composition be such that it will pass an 8-mesh screen and will be retained on a 65-mesh screen. It is also preferable that the granules be graded in size. Thus, it is desirable to have in the composition some granules which are retained on the 14-mesh screen, some which are retained on a 28-mesh screen, and, in addition, some granules which pass a 48-mesh screen. Preferably, at least about thirty per cent. by weight of the composition is retained on a 14-mesh testing screen and at least about sixty-five per cent. by weight is retained on a 28-mesh testing sieve, while at least about two per cent. by weight passes a 48-mesh testing sieve and is retained on a 65-mesh testing sieve. When the particles are graded in this manner, they tend to form an impervious blanket with greater rapidity upon being placed on a mass of burning material than if the granules all are of substantially the same size. The particular sizes above-mentioned, while preferred, are not essential, inasmuch as coarser granules, namely, around 4-mesh granules, may be used and some amounts of finer granules, such as those just retained on a 100-mesh sieve, may be included. It is ordinarily desirable that the granules be of irregular shape, inasmuch as granules of irregular shape tend to stay in place, when deposited as a covering layer on a burning mass, better than granules which are more or less spheroidal in form.

When the bituminous granules contain a considerable amount of finely-divided solid material, especially fibrous material, they can be prepared so as to be tough and so as not to crumble in handling and shipment, although, as aforesaid, if the amount of bitumen is reduced excessively the granules become excessively brittle and tend to crumble. On the other hand, if only a small amount of finely-divided solid material is used in conjunction with a material such as coal tar pitch having a softening point about 300° F., the material is quite brittle and tends to form dust during handling and shipment. The toughness of the granules can be conveniently tested by placing 100 grams of the granular material in a cylindrical metal container two inches in internal diameter and four feet in length that contains nine smooth round stones about one inch in diameter of the type used in ball mills. The granular material before being placed in the container is screened so as to eliminate substantially all material passing a 100-mesh screen. The container is then inverted a given number of times, which, for the purpose of test, is one hundred times. If, after the material has been treated in this manner, less than five per cent. of the granular material can be screened through a 100-mesh testing screen, the material is registered as "tough," as this term is used herein. It is preferable, but not essential, that the bituminous granules be tough so that they will not crumble and disintegrate into dust during handling and shipment.

The stability of the bituminous material, namely, its resistance to displacement or flow at elevated temperature, may be ascertained by determining its viscosity index at 1200° F. While we do not know of any standard method of determining viscosity index at this temperature, such value can conveniently be determined in the following way. A metal plate is heated to, and maintained at, substantially 1200° F. Seven grams of the fire extinguishing composition in granular form are placed on the plate in the form of a cone. The time required for the bituminous granules to melt and form a liquid mass on the plate is taken as the viscosity index of the material. Preferred bituminous granular fire extinguishing composition, according to this invention, does not appear to melt at all, but retains its granular form on the plate with only slight

fluxing of the granules together to form a cake-like mass. Other fire extinguishing compositions soften somewhat, but tend to carbonize gradually without melting and substantial lateral flowing to form a liquid mass on the plate. Such materials are also suitable for use according to this invention. It is desirable that the viscosity index be greater than about fifteen minutes. If the bituminous composition contains more than about fifty per cent. of finely-divided heat resistant solid material, the viscosity index at 1200° F. is normally so high that the fire extinguishing composition does not melt at all. Certain filler materials, such as mineral fiber, are especially effective in increasing the viscosity index at 1200° F. of the bituminous material, and if such materials are present, bituminous fire extinguishing compositions having a viscosity index in excess of fifteen minutes, may be made even when considerably less than fifty per cent. of finely-divided solid material is present. The use of fire extinguishing composition having a viscosity index above about fifteen minutes is especially desirable when the composition is used in extinguishing burning magnesium or magnesium alloys, inasmuch as the fire extinguishing composition does not tend to flow off of the burning metal. Moreover, when the composition has a high viscosity index, the burning metal can be transferred to a layer of the fire extinguishing composition spread on a support and, notwithstanding the intense heat of the burning metal, the fire extinguishing composition does not melt so as to permit the metal to settle to the support as would be the case if granular bitumen by itself were used. This is advantageous not only when the fire is on a support such as a wood floor, but it is also advantageous when the fire is on a concrete floor. Concrete floors contain water of constitution in the hydrated Portland cement, which water of constitution is liberated by the intense heat of burning magnesium metal. The sudden liberation of this water caused by the heat of the burning metal tends to forcefully disrupt the concrete, thereby scattering the burning metal, thus spreading the fire, increasing the hazard to persons attempting to extinguish the fire, and, of course, injuring the concrete floor.

Hereinabove fire extinguishing compositions of this invention have been described as consisting of bituminous granules, or such granules carrying a light coating of dusting material to prevent them sticking together at ordinary temperatures. This is of great importance in the practice of the present invention, for in such a composition the bituminous particles are in essentially contiguous relation, so that, as soon as the bitumen in the granules is softened by exposure to fire, the granules tend to adhere together and form a seal which excludes air from the fire. If an excessive amount of non-thermoplastic granular or powdered dusting material were distributed about among the bituminous granules, the bituminous granules would not, when softened, produce an effective seal to prevent the air from coming in contact with the burning material.

While this invention has been described in connection with various examples of the practice thereof, it is to be understood that this has been done for illustrative purposes only, and that the composition and preparation of fire-extinguishing compositions may be varied within quite wide limits according to our invention. Thus, while this invention has been described in connection with the use of bitumens, other thermoplastic materials, solid at ordinary temperatures but meltable at flame temperature, may be employed in compositions of the character aforesaid, especially those having characteristics similar to the bitumens hereinabove described. Such materials should, however, be similar to normally hard bitumens in that, when subjected to a temperature of about 1200° F., they should not give off a substantial amount of oxygen-containing volatile matter that promotes the combustion of burning metallic magnesium. Examples of such thermoplastic materials are coumarone-indene resins, resins produced from petroleum, hard paraffinaceous thermoplastic waxes, and chlorinated diphenyls. Moreover, mixtures of different bitumens or of different thermoplastic materials generally may be employed, as well as mixtures of different finely-divided solid materials. The scope of this invention is to be governed by the language of the following claims.

We claim:

1. A fire extinguishing composition in the form of a granular product, said product comprising a multiplicity of essentially contiguous bituminous granules containing bitumen solid at ordinary atmospheric temperatures and containing finely-divided solid material that is unmeltable when subjected for 5 minutes to a temperature of about 1200° F. and that is uniformly incorporated and intimately commingled with the bitumen in said granules as an integral part of said individual bituminous granules.

2. A fire extinguishing composition in the form of a granular product, said product comprising a multiplicity of essentially contiguous bituminous granules containing at least about thirty per cent. by weight of bitumen having a softening point above about 125° F. and containing at least about twenty-five per cent. by weight of finely divided solid material that is unmeltable when subjected to a temperature of about 1200° F. and that is uniformly incorporated and intimately commingled with the bitumen in said granules as an integral part of the individual bituminous granules, said composition not containing more than forty per cent. by weight of matter volatilizable in 5 minutes exposure at 1200° F., and said composition having a viscosity index at 1200° F. of at least 15 minutes.

3. A fire extinguishing composition according to claim 2, wherein a major proportion of said unmeltable finely-divided solid material is inorganic material that is heat resistant when subjected for 5 minutes to a temperature of 1200° F., and wherein said granules are of the order of size passing an 8 mesh testing sieve with at least about 65% by weight retained on a 28 mesh testing sieve.

4. A fire extinguishing composition in the form of a granular product, said product comprising a multiplicity of essentially contiguous tough bituminous granules containing at least about thirty per cent. by weight of bitumen having a softening point above about 125° F. and not above about 325° F., and containing finely-divided solid material uniformly incorporated and intimately commingled with the bitumen in said granules as an integral part of the individual bituminous granules, said finely-divided solid material comprising particles that are unmeltable and heat resistant when subjected for 5 minutes to a temperature of about 1200° F. and that constitute at least about twenty-five per cent. by weight of said bituminous granules, and said finely-divided solid material not containing an amount of matter volatilizable

in 5 minutes exposure at 1200° F. that is greater than thirty per cent. by weight of said bituminous granules.

5. A fire extinguishing composition in the form of a granular product, according to claim 4, wherein said finely-divided solid material contains an amount of matter volatilizable in 5 minutes' exposure at 1200° F. that constitutes at least about two per cent. by weight of said bituminous granules.

6. A fire extinguishing composition in the form of a granular product, said product comprising a multiplicity of essentially contiguous granules containing a thermoplastic material that is meltable at 1200° F., that does not produce when subjected to such temperature substantial quantities of oxygen-containing volatile matter that promotes the combustion of burning metallic magnesium and that is solid at ordinary atmospheric temperatures, and containing finely-divided solid material that is unmeltable when subjected for 5 minutes to a temperature of about 1200° F. and that is uniformly incorporated and intimately commingled with said thermoplastic material as an integral part of the individual granules.

7. A fire extinguishing composition in the form of a dry granular product, said product comprising a multiplicity of essentially contiguous tough granules containing a thermoplastic material that has a softening point between about 125° F. and about 325° F. and that does not produce, when brought into contact with burning magnesium, substantial quantities of oxygen-containing volatile matter that promotes the combustion of burning magnesium, and containing at least twenty-five per cent by weight of finely-divided solid material that is unmeltable and heat resistant when subjected for 5 minutes to a temperature of 1200° F. and that is uniformly incorporated and intimately commingled with said thermoplastic material as an integral part of the individual granules, the viscosity index of said composition being greater than about 15 minutes, and said finely-divided solid material containing not more than about thirty per cent. by weight of matter volatilizable in 5 minutes exposure at 1200° F.

8. A fire extinguishing composition in the form of a granular product, said product comprising a multiplicity of essentially contiguous granules containing about thirty per cent. to about seventy-five per cent. by weight of bitumen having a softening point between about 125° F. and about 325° F. and containing about twenty-five per cent. to about seventy per cent. by weight of finely-divided solid material uniformly incorporated and intimately commingled with the bitumen in said granules as an integral part of the individual bituminous granules, said finely-divided solid material comprising mineral fiber constituting at least about ten per cent. of said bituminous granules, and said finely-divided solid material not containing an amount of matter volatilizable in 5 minutes exposure at 1200° F. that is greater than about thirty per cent. by weight of said bituminous granules.

9. A method of extinguishing burning material, which comprises applying to the burning material a granular material containing a multiplicity of essentially contiguous granules containing at least about thirty per cent. by weight of bituminous material that is solid at ordinary atmospheric temperature and containing at least about twenty-five per cent. by weight of finely-divided solid material that is unmeltable and heat resistant when subjected for 5 minutes to a temperature of about 1200° F. and that is uniformly incorporated and intimately commingled with the bitumen in said granules as an integral part of said bituminous granules, thereby softening the bitumen in said contiguous granules adjacent the burning material and causing said granules to adhere together to form an air-excluding protective blanket which excludes air from said burning material, a bitumen in said granules adjacent said burning material carbonizing and forming with the skeletal body of finely-divided unmeltable and heat resistant material in said granules a coherent granular heat insulating mass.

10. A method of extinguishing burning material, which comprises applying to the burning material a granular material containing a multiplicity of essentially contiguous granules containing at least about thirty per cent. by weight of bituminous material having a softening point of about 125° F. to about 325° F. and containing at least about twenty-five per cent. by weight of finely-divided solid material that is unmeltable and heat resistant when subjected for 5 minutes to a temperature of about 1200° F. and that is uniformly incorporated and intimately commingled with the bitumen in said granules as an integral part of said bituminous granules, the said finely-divided solid material containing about two per cent. to about thirty per cent. by weight of the bituminous granules of matter volatilizable upon 5 minutes exposure at 1200° F. and the said composition having a viscosity index of at least about 15 minutes, thereby softening the bitumen in said contiguous granules adjacent the burning material and liberating volatilizable matter within said granules which expands said granules and develops pores therein, and thereby causing said granules to adhere together to form an air-excluding protective blanket which excludes air from said burning material, the bitumen in said granules adjacent the burning material carbonizing and forming with the skeletal body of finely-divided unmeltable and heat resistant material in said granules a heat insulating mass of coherent porous granules.

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HAROLD W. GREIDER.

CERTIFICATE OF CORRECTION.

Patent No. 2,385,500. September 25, 1945.

GEORGE ARTHUR FASOLD, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 11, for "of air" insert --of the air--; page 5, second column, line 52, strike out "registered" and insert instead --regarded--; page 7, second column, line 23, claim 9, for "a bitumen" read --the bitumen--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of December, A. D. 1945.

Leslie Frazer

(Seal) First Assistant Commissioner of Patents.