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EXTINGUISHING FIRES AND EXTINGUISH-
ING COMPOSITIONS THEREFOR

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Metal alloys of high magnesium content, for instance the alloy known under the registered trade-mark "Elektron," are commonly used in the automobile, aircraft and armaments industries, and in machining them, for instance in turning, drilling and grinding them, they are liable to catch fire and burn violently. Hitherto it has been very difficult to extinguish such fires. Fires of burning magnesium or aluminium powder have been even more difficult to extinguish, and in the past if such powders have become ignited the fire has very often meant the complete loss of the mass of powder which has caught fire. Furthermore, incendiary bombs in which metals such as magnesium, aluminium or sodium are ignited are also notoriously difficult to extinguish. The fires cannot be extinguished with common extinguishing means such as water or carbon dioxide, for burning magnesium, for example, will combine with the oxygen in these substances and continue burning. One method of meeting the difficulty is to cover the burning metal with sand, but this is unsatisfactory for the reason that the sand does not really extinguish the fire, and the fire continues to burn underneath the sand (with a resulting loss of the metal) and will flare up again if the covering sand is removed.

We have now made the discovery that fires of burning metals such as magnesium, aluminium, calcium, sodium and potassium and their alloys can readily be smothered and extinguished by means of a mixture of powdered bitumen and a powdered inert substantially non-fusible inorganic substance (or filler). By "substantially non-fusible" it is meant that the inorganic substance is one that does not fuse to any substantial degree when the mixture is applied to the fire. It appears that on contact with the fire the bitumen fuses and forms an oxygen-excluding blanket over the surface of the burning metal, and in point of fact instead of the bitumen there may be employed (mixed with the inorganic substance) other powdered fusible solid organic substances which are capable of forming an oxygen-excluding blanket over the burning metal and which do not react with the burning metal so as to support its combustion. It seems that the substances suitable are in general those having an essentially hydrocarbon structure and containing a relatively large hydrocarbon group, although small proportions of oxygen, sulphur or other elements may be present. Thus higher fatty acids such as stearic acid can be used, and these contain a long hy-

drocarbon chain with only a small proportion of oxygen. Substances such as sugar, which are not essentially hydrocarbon and in fact contain much oxygen, seem to be able to support the combustion of magnesium, presumably being reduced.

Powdered bitumen itself is in point of fact capable of smothering the fire without the inert inorganic substance or filler, but it is actually quite unsatisfactory, partly for the reason that the particles of powdered bitumen tend to coalesce on keeping at ordinary temperatures, and consequently powdered bitumen is not a suitable substance to be kept in readiness as a fire-extinguishing substance. Furthermore, there is a great tendency for pure bitumen, when applied to the fire, to melt and run, so that it is difficult to keep the bitumen at the point where it is applied. If the inert filler is present the mixture will remain for an adequate time at least in powdered form on storage, and in addition the filler has the capacity of holding the bitumen on a burning surface. Furthermore, it appears that the filler acts to some degree as a conductor of heat and thereby assists in extinguishing the fire by removing heat and causing the temperature to fall.

Where bitumen is employed, as is preferable, the bitumen may be natural asphalt or an artificial form such as the asphaltic residue from the distillation of petroleum or the pitch residue from the distillation of such materials as coal tar, shale oil or the like; it is to be understood that the term "bitumen" includes all these substances. It will be appreciated that in practice a bitumen of fairly high softening point (e. g. 120° C.) is preferable, for it can be ground more easily and the powder (even when mixed with a filler) has less tendency to agglomerate on storing.

In place of the bitumen there may for instance be employed another solid hydrocarbon, a mineral, animal, vegetable or synthetic wax (paraffin wax and beeswax are very satisfactory), a higher aliphatic acid such as stearic acid (as indicated above), a higher aliphatic alcohol, an ester of a higher aliphatic acid or alcohol, or a soap. Thus dry sodium stearate (medical soap) and aluminium stearate and resinate are useful. Fusible resins, e. g. resinous acids such as rosin, can be used.

Where it is stated above that the inorganic substance used in the mixture is inert and substantially non-fusible when applied to the fire, it is meant that for practical purposes the sub-

stance does not appear to melt or change when the mixture comes into contact with the fire, although as stated above it has a pronounced action in assisting the fusible substance to extinguish the fire. A very good example of a suitable inorganic substance is powdered slate; other examples are sand, aluminium oxide, magnesium oxide, graphite (which for the purposes of this specification is regarded as inorganic), and china clay. It will readily be appreciated, however, that owing to the extremely high temperature of burning magnesium for instance (and still more aluminium), there may conceivably be some slight or incipient fusion or change of the inorganic substance in the layer of the mixture which comes into immediate contact with the burning metal (in the case of graphite, for instance, there is possibly some slight chemical reaction), but in practice the temperature of the burning material is rapidly reduced by the extinguishing powder and the inorganic substance remains practically unchanged, at least through the bulk of the extinguishing composition. Inorganic compounds which are reduced by burning magnesium to such an extent that they are capable of supporting a magnesium fire even if the free access of air is prevented (as in general are easily fusible oxygen-containing salts such as sulphates, phosphates and carbonates) are clearly unsuitable, and are of course not included among the inert substances which may be used according to the invention.

An inorganic substance having a relatively high heat-conductivity, as for instance powdered slate seems to have, is preferably used, in order to reduce the temperature of the fire as quickly as possible.

Although excessively dry materials are not necessary, the materials used according to the invention should be practically water-free, as otherwise the water present is liable to support combustion of the burning material.

The proportion of bitumen or other organic substance present in the mixture can vary between wide limits, but must of course be sufficiently high to have the desired extinguishing effect on the fire. Mixtures of about equal parts by weight of powdered bitumen and powdered slate have been found very satisfactory. Furthermore, mixtures containing more than one of the organic extinguishing substances or more than one inorganic filler, or both, can be used. Thus a mixture of approximately equal parts of bitumen and slate powder containing a small proportion of a soap such as aluminium stearate (e. g. containing 45% of bitumen, 45% of slate powder and 10% of aluminium stearate) is perhaps more efficient than a similar mixture without the soap.

In practice it is usually convenient simply to spread or shovel the extinguishing mixture over the burning material. However, it is to be noted that although the action of the mixture is apparently largely to cover the burning surface and exclude air, this does not mean that the mixture is necessarily merely heaped over the burning mass in the same way as sand is heaped over burning magnesium to confine the fire to within the mass of the metal. On the contrary, where the burning mass consists of discrete particles, as for instance when magnesium turnings are burning, the extinguishing mixture may be mixed with the burning mass by shovelling, for instance, and may thus be distributed throughout the

mass, and will still extinguish the fire. This is of evident advantage in rapidly extinguishing the fire. In point of fact, one of the important functions of the extinguishing mixture is apparently to withdraw heat from the burning metal, and this may possibly be assisted by mixing the former with the burning mass.

The bitumen or other powdered fusible solid organic substances in the above compositions can also be replaced by semi-solid substances such as dry greases or fats. In this case the semi-solid substance cannot reasonably be powdered, but is mixed with the powdered inorganic filler to form a kind of paste.

If the mixtures of the invention are to be used for extinguishing incendiary bombs, the hardness of the inorganic filler is relatively unimportant. If, however, it is to be used for extinguishing magnesium, magnesium alloy, aluminium or other metal which has become ignited while being machined, in a lathe for instance, a hard abrasive filler such as sand is not very suitable, for it would be liable to damage the machinery. In such a case a smooth non-abrasive filler such as slate powder, china clay or graphite is to be preferred. Hence an important group of the mixtures referred to above are those containing bitumen or other organic substance, as defined above, and a substantially non-abrasive filler. Such substances as bitumens, waxes and the like form on heating sticky masses and will adhere to a surface to which they are applied. This is very valuable where the metal burning is in a machine in which it is being worked, for the extinguishing mixture tends to remain on the surface of the metal where it is burning and also on adjacent areas. The fire can then be extinguished without damage to the machinery, and the extinguishing mixture afterwards removed from the parts of the machinery to which it has been applied. The unburnt metal is of course recovered.

In this connection it has been found that magnesium, magnesium alloy, aluminium or other metal which has become ignited when being machined can also be readily extinguished by mixtures of a mineral oil or similar liquid and a substantially non-abrasive filler of the type referred to above, and in this case the oil appears to act in much the same manner as does bitumen. By the term "similar liquid" is meant a liquid which has an essentially hydrocarbon structure (although it may contain small proportions of oxygen, for instance) and contains a relatively large hydrocarbon group and which does not react with the burning metal so as to support its combustion. Examples of such liquids are oleic and naphthenic acids and oils other than mineral oils. The oil may be natural or synthetic, and may be an animal or vegetable oil, for instance cotton seed oil. However, mineral oils and similar liquid hydrocarbons of relatively high flash point seem to be preferable, and lubricating oils and heavy motor oils are particularly useful. As in the case of bitumen, oils and similar liquids are capable of smothering magnesium fires without the fillers, but they are not satisfactory on account of the difficulty of maintaining a layer of the liquid in contact with the burning metal. Nevertheless, pastes formed from the liquids and the non-abrasive fillers referred to above have been found very satisfactory for extinguishing magnesium or other metal which is burning in machinery, and can be pumped on to the fire.

It should be added, however (and this applies to bitumen and analogous compositions, whether applied to incendiary bombs or other fires, as well as to pastes), that the extinguishing compositions of the invention should not be applied to the fire with such force that the fire is scattered, but should be applied comparatively gently. Thus pastes can be applied over the fire (from an ejecting apparatus) in the form of a broad and thick ribbon, and will in this event be of such a viscosity that a broad and thick ribbon can be formed. One advantage of applying a ribbon of the paste is that the burning metal can then readily be covered. Pastes formed by adding china clay to lubricating oil or heavy motor oil until the product has a suitable viscosity are very satisfactory, and in practice mixtures of roughly equal parts by weight of the oil and china clay are suitable, although the precise proportions will depend upon the viscosity of the oil and of the mixture.

It should be added that a mixture of mineral oil, for instance, and an abrasive filling material such as sand is capable of extinguishing the fire, but such mixtures are of little value for extinguishing metal burning in machinery, for they would damage the machinery. Nor are they of any real value in extinguishing incendiary bombs, for the oil might permeate the surroundings and render them too inflammable and dangerous owing to the volatility of the oil. In a factory where magnesium or other metal is being machined the dangers arising from the use of the oil are negligible, but this would not be the case in buildings generally which have to be protected against incendiary bombs.

It will be appreciated that many of the substances referred to above will burn when applied to the burning bomb or other material. This is the case with bitumen and mineral oils, for instance. However, if the extinguishing substance itself catches fire, it can in practice be extinguished by the continued application of the extinguishing mixture. Thus on applying a bitumen mixture to burning magnesium the first effect is that the magnesium is extinguished and of course the local intensity of the heat and light is reduced, but the bitumen burns. The second effect is that the further application of bitumen extinguishes any bitumen which has caught fire, so that the apparent effect of the addition of the bitumen mixture to the metal is that the fire is caused to subside and is finally extinguished altogether. In practice the bitumen mixture is applied over the surface of the burning metal until it is completely covered and further of the mixture is then applied wherever flames persist.

Of course, if the amount of the bitumen or other extinguishing substance employed is sufficient to extinguish the burning metal but insufficient to extinguish the flames of the extinguishing substance itself, the fire of burning metal is in effect replaced by a fire of burning bitumen or other substance. When metal which has become ignited in machinery is being extinguished the resulting bitumen fire will soon subside, and in any case the bitumen fire is much less dangerous than the burning metal. The important fact is that the metal, which burns at a very high temperature, is extinguished, and if any fire remains it is relatively innocuous.

It will be appreciated that notwithstanding these remarks, if insufficient of the extinguishing composition is used or if it is inefficiently applied the metal may actually burn out before

it is extinguished. Even then the extinguishing compositions of the invention effectively limit the scope of the fire and greatly reduce the danger. Usually, however, the burning metal is actually extinguished before it is completely burnt.

It is pertinent to add here that when incendiary bombs become ignited the intense heat developed invariably starts a fire in the immediate surroundings, and there are accordingly two different types of fire to be dealt with, firstly the ignited bomb and secondly the conflagration in the surroundings, of burning wood for example. The incendiary bomb itself can be smothered by means of the compositions described above. It is highly advantageous if the organic extinguishing substance in the composition is resistant to ordinary fire-extinguishing agents such as water, carbon dioxide or mechanical or chemical foam, for in this case the surrounding fire can then be extinguished by the ordinary extinguishing agent without any great danger of this agent penetrating to the bomb and causing it to flare up if it has not yet been quite extinguished or to be reignited. In fact if the resistant extinguishing substance applied to the bomb catches fire itself this fire can be extinguished by means of the ordinary fire extinguishing agent applied to the surrounding fire without causing the bomb to flare up. The bomb need not be removed before the ordinary extinguishing agent is used. It is naturally not necessary for the extinguishing substance to be absolutely resistant to the ordinary extinguishing agent subsequently applied, provided that it is sufficiently resistant to prevent the ordinary extinguishing agent from causing the bomb to flare up. Bitumen is an excellent example of a substance which is sufficiently resistant to ordinary extinguishing agents to enable these to be used, and easily-fusible water-insoluble soaps such as magnesium oleate are other examples, these being easily-fusible solids which give water-insoluble layers not easily washed away.

As indicated above, one advantage of the extinguishing mixtures of the invention is that the fire can actually be extinguished; even in the case of fires of such easily-burning materials as metallic paint powders, magnesium powders (e. g. flashlight powders), aluminium powders and magnesium swarfs, i. e. turnings, drilling chips and the like, the unburnt metal is protected by the extinguishing mixture, and on removal of the extinguishing layer the unburnt metal, be it powder or other material, is recovered. This means a saving of material, which is vastly better than allowing the fire to burn itself out with the loss of all the metal. In the case of metal powders, it is preferable not to mix the extinguishing composition with the powder but simply to cover the burning mass, for otherwise difficulty may be experienced in separating out the metal powder afterwards.

In conclusion, it is of course to be understood that where in the following claims a reference is made to mixtures of organic substances and inert inorganic substances, this is intended to include mixtures containing more than one of the organic substances or more than one of the inorganic substances, or more than one of each of these.

We claim:

1. A mixture, suitable for use in extinguishing magnesium or similar fires, of a powdered fusible solid organic substance which is capable of forming an at least semi-liquid oxygen-excluding

blanket over the burning material and which does not react with the burning material so as to support its combustion and a powdered inert substantially non-fusible inorganic substance.

- 5 2. A mixture, suitable for use in extinguishing magnesium or similar fires, of a powdered fusible solid organic substance selected from the group consisting of hydrocarbons, waxes, higher aliphatic acids and esters thereof, higher aliphatic
- 10 alcohols and esters thereof, soaps and resins, which is capable of forming an oxygen-excluding blanket over the burning material and which does not react with the burning material so as to support its combustion and a powdered inert substantially non-fusible inorganic substance.
- 15 3. A mixture, suitable for use in extinguishing magnesium or similar fires, of powdered bitumen and a powdered inert substantially non-fusible inorganic substance.
- 20 4. A mixture, suitable for use in extinguishing magnesium or similar fires, of a semi-solid organic substance which is capable of forming an at least semi-liquid oxygen-excluding blanket over the burning material and which does not react
- 25 with the burning material so as to support its combustion and a powdered inert substantially non-fusible inorganic substance.
5. A mixture, suitable for use in extinguishing magnesium or similar fires, of a powdered fusible
- 30 solid organic substance which is capable of forming an at least semi-liquid oxygen-excluding blanket over the burning material and which does not react with the burning material so as to support its combustion and a powdered inert substantially non-fusible inorganic substance, the said inorganic substance being substantially non-abrasive.
- 35 6. A mixture, suitable for use in extinguishing magnesium or similar fires, of powdered bitumen and a powdered inert substantially non-fusible inorganic substance, the said inorganic substance being substantially non-abrasive.
- 40 7. A mixture, suitable for use in extinguishing magnesium or similar fires, which is a paste formed from a mineral oil and a powdered inert substantially non-fusible inorganic substance, the said inorganic substance being substantially non-abrasive.
- 45 8. A mixture, suitable for use in extinguishing magnesium or similar fires, of powdered bitumen and slate powder.
- 50 9. A mixture, suitable for use in extinguishing magnesium or similar fires, consisting essentially of approximately equal parts by weight of powdered bitumen and slate powder together with a small proportion of aluminium stearate or other water-insoluble soap.
- 55 10. A method of extinguishing the fire of burning magnesium, aluminium, calcium, sodium, potassium and other metals and their alloys, comprising smothering the fire by a mixture of a powdered fusible solid organic substance which is capable of forming an at least semi-liquid oxygen-excluding blanket over the burning material and
- 60 which does not react with the burning material so as to support its combustion and a powdered inert substantially non-fusible inorganic substance.
- 65 11. A method of extinguishing the fire of burning magnesium, aluminium, calcium, sodium, potassium and other metals and their alloys, comprising smothering the fire by a mixture of powdered bitumen and a powdered inert substantially non-fusible inorganic substance.
- 70 12. A method of extinguishing the fire of burn-

ing magnesium, aluminium, calcium, sodium, potassium and other metals and their alloys, comprising smothering the fire by a mixture of powdered bitumen and slate powder.

13. A method of extinguishing the fire of burning magnesium, aluminium, calcium, sodium, potassium and other metals and their alloys, comprising smothering the fire by a mixture of a semi-solid organic substance which is capable of forming an at least semi-liquid oxygen-excluding
- 10 blanket over the burning material and which does not react with the burning material so as to support its combustion and a powdered inert substantially non-fusible inorganic substance.

14. A method of extinguishing the fire of burning magnesium, aluminium, calcium, sodium, potassium and other metals and their alloys, comprising smothering the fire by a mixture which is a paste formed from a mineral oil, and a powdered inert substantially non-fusible inorganic
- 20 substance, the said inorganic substance being substantially non-abrasive.

- 15 15. A method of preventing the total destruction of magnesium, magnesium alloy, aluminium and similar metal which has become ignited in the course of machining it, comprising extinguishing the fire by means of a mixture of a powdered fusible solid organic substance which is capable of forming an at least semi-liquid oxygen-excluding blanket over the burning material and which does not react with the burning material so as to support its combustion and a powdered inert substantially non-fusible inorganic substance, the said inorganic substance being substantially non-abrasive.
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16. A method of preventing the total destruction of magnesium, magnesium alloy, aluminium and similar metal which has become ignited in the course of machining it, comprising extinguishing the fire by means of a mixture of powdered bitumen and slate powder.
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17. A method of preventing the total destruction of magnesium, magnesium alloy, aluminium and similar metal which has become ignited in the course of machining it, comprising extinguishing the fire by means of a mixture which is a paste formed from a mineral oil, and a powdered inert substantially non-fusible inorganic substance, the said inorganic substance being substantially non-abrasive.
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18. A method of dealing with ignited incendiary bombs in which magnesium, aluminium, calcium, sodium, potassium or other metal or an alloy is burning, comprising smothering the fire by means of a mixture of a powdered fusible solid organic substance, relatively resistant to ordinary fire-extinguishing agents, which is capable of forming an at least semi-liquid oxygen-excluding blanket over the burning material and which does not react with the burning material so as to support its combustion and a powdered inert substantially non-fusible inorganic substance, and then, without removing the smothered bomb, extinguishing the subsidiary fire caused by the bomb with an ordinary fire-extinguishing agent.
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19. A mixture suitable for use in extinguishing magnesium or similar fires which comprises a paste formed from a liquid having an essentially hydrocarbon structure and containing a relatively large hydrocarbon group, said liquid being one which does not react with the burning material so as to support its combustion, and a powdered inert substantially non-fusible inorganic
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substance, said inorganic substance being substantially non-abrasive.

20. A method of extinguishing the fire of burning magnesium, aluminium, calcium, sodium, potassium and other metals and their alloys, comprising smothering the fire by a mixture which is a paste formed from a liquid having an essentially hydrocarbon structure and containing a relatively large hydrocarbon group, said liquid being one which does not react with the burning material so as to support its combustion, and a powdered inert, substantially non-fusible inorganic substance, said inorganic substance being substantially non-abrasive.

21. A method of preventing the total destruction of magnesium, magnesium alloy and similar metal which has become ignited in the course of machining it comprising extinguishing the fire by means of a mixture which is a paste formed from a liquid having an essentially hydrocarbon structure and containing a relatively large hydrocarbon group, said liquid being one which does not react with the burning material so as to support its combustion, and a powdered inert, substantially non-fusible inorganic substance, said inorganic substance being substantially non-abrasive.

drocarbon structure and containing a relatively large hydrocarbon group, said liquid being one which does not react with the burning material so as to support its combustion, and a powdered inert substantially non-fusible inorganic substance, said inorganic substance being substantially non-abrasive.

22. A mixture, suitable for use in extinguishing magnesium or similar fires, of an organic substance which is capable of forming an at least semi-liquid oxygen-excluding blanket over the burning material which does not react with the burning material so as to support its combustion and a powdered inert substantially non-fusible inorganic substance.

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