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HEAT-PRODUCING MIXTURES

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This invention relates to heat-producing mixtures and more particularly to such mixtures of value for use in the production of castings and ingots from molten metal.

It is well known in the production of castings or ingots from molten metals, to delay the solidification of the uppermost part of the molten metal, which may be in a hot top or riser of the mould, for the purpose of maintaining a reservoir of molten metal which, by feeding molten metal to the main casting or ingot will compensate for shrinkage of the casting or ingot as it solidifies and thus prevent the formation of cavities or fissures in the cast metal.

It is also well known practice to effect the foregoing result by providing in the riser, hot top or other strategic position in the mould assembly, a body of a composition of which the ingredients will react exothermically at the temperature of the molten metal, generating sufficient heat to delay the solidification for the purpose indicated. Most commonly such compositions are based on a mixture of aluminium and an oxidising agent therefor and control over the speed of reaction of these ingredients may be achieved by using less than the stoichiometric equivalent of oxidising agent and having a proportion of a fluoride present. In this connection reference is made to British Patent No. 627,678 which describes such compositions.

Compositions as aforesaid usually also contain a proportion of an inert filler such as grog or sand. Whilst they are of particular use for the purposes indicated above such exothermic compositions have been described for a wide variety of other uses in the foundry industry.

Unfortunately aluminium remains an expensive metal for the purpose indicated and economic reasons dictate that the aluminium used should be in the form of granulated or powdered scrap aluminium, e.g. turnings or grindings.

It has now been discovered that very good exothermic compositions may be formulated using elemental silicon to replace the fluoride and according to the present invention therefore a heat producing composition comprises aluminium in admixture with oxidising agents, and finely divided elemental silicon. Such mixtures may optionally contain other ingredients as set forth later herein.

According to a preferred form of the present invention the compositions contain both silicon and some iron powder to act as a trigger for the exothermic material. The proportions may vary widely in dependence on the desired proportions of the final composition and the degree of fineness of the materials used. Generally the compositions will contain 2 to 12% of their weight of silicon and preferably also up to 10% of iron powder.

It is important that the silicon employed should be in a fine state of subdivision, and with other variants remaining unchanged, it can generally be said that the finer the degree of subdivision of the silicon the more effective is the degree of sensitivity it imparts to the exothermic reaction. Control over the size of the silicon particles accordingly affords an overall method of controlling the rate of onset of the reaction. Generally it is found preferable that the silicon should be so finely divided

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that at least 50% and preferably 75% of it will pass a 200 mesh.

Elemental silicon is obtainable commercially in very finely divided form as a by-product of the silicone industry, i.e. the industry concerned with the production of polysiloxane fluids, gums and resins. Such material has been found to be of particular value for the purpose of the present invention. In any event the silicon used should preferably be at least of a degree of purity better than 60%.

The aluminium present in the compositions should also for best results be in finely divided form. A suitable grading of aluminium is that in which at least 6% and preferably at least 20% will pass a 200 mesh and at least 40% will pass a 100 mesh.

Suitable oxidising agents are any of those mentioned for use in British Patent No. 627,678, e.g. nitrates, chlorates or manganese or iron oxides. It is usually preferred to employ a mixture of an oxidising agent selected from nitrates or chlorates or mixtures thereof on the one hand and iron oxide and manganese oxide, or mixtures thereof on the other hand.

It has further been discovered that the aforesaid compositions may advantageously contain a small proportion, e.g. up to 10% by weight, of finely divided metallic iron. Compositions containing this ingredient may be formulated so as to be readily controllable as to their sensitivity to temperature, i.e. the point at which the reaction sets in, and as to the rate of the reaction. No explanation for the advantages of having iron present can be offered but the effect is quite pronounced. When iron is used it may be additional to the silicon or may replace part of it so that the total of iron, and silicon will generally not exceed about 25% of the whole composition. The iron should preferably be so finely divided that at least 60% and preferably 80% of it will pass a 200 mesh.

The compositions may further contain a filler such as grog or sand and if they are required to be moulded in situ, or preformed as moulded shapes, the compositions may further contain a binding agent such as a gum, e.g. core gum, bentonite or other binding material.

As just mentioned, the granular or powdered compositions of this invention may be moulded in situ, e.g. in a riser or hot top for a casting or ingot mould, or may be preformed to desired shapes, e.g. sleeves or slabs. The slabs may be of a multi-layer character also including a layer or layers of mildly exothermic compositions and/or heat-insulating or refractory materials, as described for example in British Patents Nos. 785,984 and 805,823.

The powder may be used loose, i.e. without binder, as an antipiping compound which is placed loose, or in packets, on the surface of the metal when pouring is complete.

The following example will serve to illustrate the invention:

Example

A composition containing both silicon and iron powder is formulated as follows:

	Parts by weight
Aluminium	12-40
Oxidising agents (sodium nitrate or chlorate plus iron oxide)	6-15
Magnesium powder	0-2
Iron powder	0-10
Silicon	2-12
Binder	2-10
Sand or grog to make 100 parts by weight.	

A particular composition of value with the foregoing ranges is:

	Parts by weight
Aluminium -----	20
Sodium nitrate -----	13
Iron powder -----	3
Silicon -----	5
Binder -----	3
Sand or grog to make 56 parts by weight.	

In the foregoing example the silicon and the aluminium, and the iron should be of particle sizes within the ranges indicated above.

I claim as my invention:

1. A heat-producing composition consisting essentially of an admixture of silicon, aluminium, oxidising agent and iron, together with an inert filler material, the said admixture consisting essentially of 2 to 12 parts by weight of elemental silicon, 12 to 40 parts by weight of elemental aluminium, 6 to 15 parts by weight of oxidising agent and up to 10 parts by weight of iron, all in finely divided condition and the balance inert filler material.

2. A heat-producing composition consisting essentially of an admixture of elemental silicon, elemental aluminium, oxidising agent selected from the class consisting of alkali metal nitrates and chlorates and manganese and iron oxides, and elemental iron, together with an inert filler material selected from the class consisting of sand and grog, the said admixture consisting essentially of 2 to 12 parts by weight of said elemental silicon, 12 to 40 parts by weight of said elemental aluminium, 6 to 15 parts by weight of said oxidising agent and up to 10 parts by weight of said elemental iron, all in finely divided condition and the balance inert filler material.

3. A heat-producing composition consisting essentially of an admixture of silicon, aluminium, oxidising agent and iron, together with an inert filler material, the said admixture consisting essentially of 2 to 12 parts by weight of finely divided elemental silicon of which at least 50% will pass a 200 mesh, 12 to 40 parts by weight of finely divided aluminium of which at least 6% will pass a 200 mesh and at least 40% will pass a 100 mesh, 6 to 15 parts by weight of said oxidising agent in finely divided condition and up to 10 parts by weight of finely divided elemental iron of which at least 60% will pass a 200 mesh and the balance inert filler material.

4. A heat-producing composition consisting essentially of an admixture of elemental silicon, elemental aluminium, oxidising agent selected from the class consisting of alkali metal nitrates and chlorates and manganese and iron oxides, and elemental iron, together with an inert filler material selected from the class consisting of

sand and grog, the said admixture consisting essentially of 2 to 12 parts by weight of finely divided elemental silicon of which at least 50% will pass a 200 mesh, 12 to 40 parts by weight of finely divided aluminium of which at least 6% will pass a 200 mesh and at least 40% will pass a 100 mesh, 6 to 15 parts by weight of said oxidising agent in finely divided condition and up to 10 parts by weight of finely divided elemental iron of which at least 60% will pass a 200 mesh and the balance inert filler material.

5. A shaped heat-producing composition consisting essentially of an admixture of silicon, aluminium, oxidising agent and iron, together with an inert filler material, the said admixture consisting essentially of 2 to 12 parts by weight of elemental silicon, 12 to 40 parts by weight of elemental aluminium, 6 to 15 parts by weight of oxidising agent and up to 10 parts by weight of iron, all in finely divided condition, the said composition further containing 2 to 10 parts by weight of a binder material and the balance inert filler material.

6. A shaped heat-producing composition consisting essentially of an admixture of elemental silicon, elemental aluminium, oxidising agent selected from the class consisting of alkali metal nitrates and chlorates and manganese and iron oxides, and elemental iron, together with an inert filler material selected from the class consisting of sand and grog, the said admixture consisting essentially of 2 to 12 parts by weight of finely divided elemental silicon of which at least 50% will pass a 200 mesh, 12 to 40 parts by weight of finely divided aluminium of which at least 6% will pass a 200 mesh and at least 40% will pass a 100 mesh, 6 to 15 parts by weight of said oxidising agent in finely divided condition and up to 10 parts by weight of finely divided elemental iron of which at least 60% will pass a 200 mesh, the said composition further containing 2 to 10 parts by weight of a binder material and the balance inert filler material.

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