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3,144,690
EXOTHERMICALLY REACTING SHAPED PRODUCTS FOR USE IN FOUNDRY PRACTICE
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The present invention relates to exothermically reacting shaped products for use in foundry practice, and more particularly to moldable exothermically reacting compositions finding particular but not necessarily exclusive utility for forming shaped articles having relatively thin walls.

In the production of castings and ingots from molten metal it is common practice to delay solidification of the molten metal in the risers, or the head of the mold or in a head box removably fixed to the head of the mold. As the molten metal cools in the mold it contracts and it is necessary to provide that molten metal should be able to feed from the risers or the like to compensate for such shrinkage. If the metal in the riser, feeding head or head box cools too rapidly so that it solidifies it can no longer provide the necessary reservoir of molten metal and the resulting casting or ingot may show shrinkage cavities, fissures or like defects.

The delay in solidification of the metal in the riser, feeding head or head box may be achieved merely by the provision of a suitable heat-insulating refractory lining, but in many cases this is not sufficient and accordingly the practice is widely used of providing a lining of a composition of which the ingredients react together exothermically when fired by contact with the molten metal. Usually such compositions are aluminothermic, i.e. they contain, essentially, finely divided aluminum and one or more oxidizing agents therefor. Usually they also contain a refractory filler and they may also contain a small proportion of a fluoride. Further, since the compositions have to be shaped, either in situ or by a preforming operation, the compositions usually contain a small amount of a binder substance.

Shaped exothermically reacting heat producing products of the foregoing type are described at length in U.S. Patent No. 2,591,105, British Patent No. 627,678, British Patent No. 774,490, British Patent No. 774,491 and British Patent No. 835,483. These products essentially consist of a mixture of aluminum and an amount of oxidizing agent well below the amount needed to react completely with the aluminum present, to oxidize it completely. To facilitate the burning of the aluminum as well as to lower the temperature at which the reaction starts, a fluoride is added to the compositions usually in amounts of 1 to 5%, although amounts up to about 15% have been added for some purposes. A particular composition range for such a heat producing substance comprises (in parts by weight):

Aluminum, in divided form, such as a mixture of powder and sawings	15-50%.
Sodium nitrate	0-10%.
Manganese dioxide or iron oxides or a mixture of both	5-20%.
Alkali fluoride or alkali aluminum fluoride	1-15%.
Bentonite	0-2%.
Core gum	2-7%.
Refractory filler (e.g. granulated grog or molding sand)	Remainder to make 100%.

More specific compositions are shown in the foregoing patents to which reference should be made for additional details.

It has also been proposed to back or line such exothermically reacting compositions with a layer of heat insulating refractory material, for example grog, sand, or the like. See, for example, British Patents No. 785,984 and No. 826,775.

One object of the present invention is to provide an improved moldable exothermically reacting material capable of being formed into a strong, break resistant, thin walled shaped article, which is sufficiently strong and rigid to retain its form during handling and shipping.

Another object of the invention is to provide an improved moldable composition of exothermically reacting materials of the foregoing character which can be formed into a shaped article such as a slab, sleeve, mold or the like, which article has enhanced strength, impact resistance and abrasion resistance, in addition to desirable exothermic or heat producing characteristics.

A more detailed object of the invention is to provide a moldable exothermically reacting composition of the foregoing character which is capable of being formed into shaped articles having thin walls with a large ratio of wall height to wall thickness.

A further object of the present invention is to provide an exothermically reacting composition of the foregoing type which, when shaped into articles, affords high green strength to prevent the article from collapsing or breaking in the green stage without utilizing excessive amounts of resinous or other binder materials thereby reducing the generation of undesirable gases with the resulted blowing of molten metal when the shaped article is used.

Still a further object of the present invention is to provide a composition of the foregoing type which is economical to produce and is easily worked to afford the desired shaped article without requiring unusual handling, treating or supporting procedures and apparatus.

Other objects and advantages of the present invention will become apparent as the following description proceeds. It should be understood that there is no intention to limit the invention to the specific form disclosed. On the contrary, the intention is to cover all modifications, alternatives, equivalents and uses falling within the spirit and scope of the invention as expressed in the appended claims.

It has been discovered that, when a moldable exothermically reacting composition of the foregoing character is to be employed for forming shaped articles having relatively thin walls compared to the height of the walls, the strength of the article can be substantially increased without affecting the exothermically characteristic or heat producing characteristics by dispersing throughout the composition a small amount of a quantity of metal flock. More particularly, it has been found that if the ratio of the height of the wall to the thickness is large, particularly greater than 9, the addition of a quantity of metal flock or fibres as small as 0.1% by weight of the composition affords a strength which is sufficiently high so that the shaped thin walled articles are self supporting and require no additional supporting bands or the like. The nature of the thin walled shaped articles referred to may most conveniently be defined by the ratio of the wall height (H) to the wall thickness (T) as illustrated in the following table:

	Approximate H/T ratio
Wall thickness less than 1/2" and higher than 6"	12.00
Wall thickness less than 3/4" and higher than 8"	10.66
Wall thickness less than 1" and higher than 10"	10.00
Wall thickness less than 1 1/4" and higher than 12"	9.60
Wall thickness less than 1 1/2" and higher than 14"	9.34
Wall thickness less than 1 3/4" and higher than 16"	9.15
Wall thickness less than 2" and higher than 18"	9.00

It will be observed that in each instance the height to thickness ratio (H/T) is greater than 8 and, more specifically, within the range of 9.0 to 12.0.

The quantity of metal flock or fibres necessary to achieve a substantial increase in the mechanical strength of shaped products in height to thickness ratios described above, is as pointed out above, very small and as little as 0.1% by weight of the composition is usually sufficient if the metal flock is of a fine fibrous nature. Larger quantities, for example up to 3% by weight of the composition, may be employed to achieve the desired strength without effecting the heat producing and exothermically reacting characteristics.

The term "metal flock" is used herein to denote metal in the form in which it has one of its dimensions very considerably greater than the other two. The term therefore includes such materials as "wool" and fine turnings of steel or other metals, e.g. aluminum, magnesium, copper, nickel, zinc or ferrous or non-ferrous alloys, and generally any metal in the flock form such as scrap turnings which are obtained by the commonly used machining operations particularly convenient to use. With an aluminothermic composition, it is particularly convenient to use metal flock consisting essentially of aluminum but it must be appreciated that in accordance with this invention such turnings must be of considerable length relative to cross-section and therefore distinguished from the divided aluminum turnings which have been described for use, for example in British Patent No. 627,678. Preferably, the flock is made up of fibres 5 to 20 mm. in length, having a cross-sectional area usually not exceeding 0.5 mm. However, the flock fibres may have greater or smaller length and diameter, for example fibres varying from about 0.01 mm. in diameter and 5 mm. in length to about 1.5 mm. in diameter and 25 mm. in length have been found to be useful, and even lengths of 3 cm. are practicable.

The following example will serve to illustrate the invention.

A moldable exothermically reacting composition was prepared as follows:

Ingredient:	Percent by weight
Aluminum in divided form such as a mixture of powder and sawings-----	24
Nitrates -----	8.5
Manganese dioxide or iron oxide or a mixture of both-----	12
Alkali fluoride or alkali aluminum fluoride-----	3.5
Binders -----	9
Refractory filler (e.g. granulated grog or molding sand)-----	43

Sleeves 20" high and 20" in diameter and weighing approximately 50 lbs. each were prepared from the above composition. These sleeves had a wall thickness of slightly less than 2 1/4" and the height to thickness (H/T) ratio was 9. When 15 such sleeves were subjected to stoving at 200° C. for two hrs., 9 collapsed completely in the stoving oven. The remaining 6 were provided with metal supporting bands so did not wholly collapse although they sagged and cracked badly.

Fifteen similar sleeves also having an H/T ratio of 9 were made from the same composition but 0.25% by

weight of the aluminum flock, average fibres of which were 0.5 mm. in diameter and 20 mm. long, were dispersed throughout the composition by mulling in a horizontal type paddle mixer and passing through a "Royer" aerator to produce a uniform dispersion. The sleeves containing the aluminum flock all retained their shape during stoving, did not sag and were not cracked. They had excellent surface hardness and appearance and, when shipped under normal transit conditions, reached their destination intact.

I claim as my invention:

1. A moldable exothermically reacting composition for use in forming shaped articles having thin walls with a height to thickness ratio greater than about 9, said composition consisting essentially of an aluminothermic composition of 15 to 50% by weight of finely divided aluminum, an oxidizing agent for the aluminum in a quantity stoichiometrically insufficient to combine with all of the aluminum present, 2 to 9% of a binder, 0.1 to 3% by weight of metal flock intimately dispersed therein and the residue being substantially a refractory filler, the said metal flock being formed of metal fibres of diameter at most about 0.5 mm. and length about 5 to about 30 mm.

2. A moldable exothermically reacting composition for use in forming shaped articles having thin walls with a height to thickness ratio greater than about 9, comprising the following ingredients in proportions indicated by weight:

Aluminum in finely divided form-----	15 to 50%.
Sodium nitrate-----	0 to 10%.
Oxidising agent selected from the class consisting of manganese dioxide, iron oxide and mixtures of these-----	5 to 20%.
Fluoride selected from the class consisting of alkali fluoride and alkali aluminum fluoride-----	1 to 15%.
Bentonite -----	0 to 2%.
Core gum-----	2 to 7%.
Metal flock, formed of fibres having a diameter at most about 0.5 mm. and a length between about 5 mm. and 30 mm. -----	0.1 to 3%.
Refractory filler-----	Remainder to make 100%.

3. A molded exothermically reacting shaped article having thin walls with a height to thickness ratio of greater than about 9, comprising an exothermically reacting composition consisting essentially of an aluminothermic composition of 15 to 50% by weight of finely divided aluminum, an oxidizing agent for the aluminum in a quantity stoichiometrically insufficient to combine with all of the aluminum present, 2 to 9% of a binder, 0.1 to 3% by weight of metal flock intimately dispersed therein and the residue being substantially a refractory filler, the said metal flock being formed of metal fibres of diameter at most about 0.5 mm. and length about 5 to about 30 mm.

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