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CASTING READILY OXIDIZABLE METALS

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While the present improvements relate more particularly to casting of magnesium and so-called light metal alloys, in which magnesium is the predominant constituent, it will be understood that the improved method and means involved may also be found adaptable for the casting of other similar readily oxidizable metals. Difficulties encountered in melting and handling, in molten state, magnesium or an alloy largely composed of this metal are well known, and those difficulties are still present when it is attempted to introduce such metal into a mold in any process of casting. For example, when green sand castings are made in the ordinary way by simply pouring the molten magnesium or light metal alloy into an untreated sand mold, not only is there a pronounced tendency for the metal to burn in the sprue, but the surface of the casting formed by contact with the complementary surface of the mold tends to become oxidized, pitted or both, due to the formation of a powder (presumably an oxide or a nitride of the metal). Where the casting poured in this manner is of relatively heavy section, it either completely burns up or is badly damaged, due presumably to the temperature of the metal cast remaining at a relatively high point for a longer period of time than is the case with thin-section castings which chill promptly. Even if the impairment of the surface of such castings as can be made is not serious enough to prevent the cast article from being finished when removed from the mold, the casting has an unsightly appearance and a certain loss of metal is involved. It is to be noted, of course, that the cleaner the casting, the more easily may the subsequent finishing operations be carried out.

It has heretofore been proposed to overcome these difficulties, specifically in casting magnesium and alloys containing the same, by dusting the mold prior to casting the metal with sulphur or equivalent material capable of giving off in contact with the molten metal a vapor which is more easily oxidizable than magnesium. This procedure, however, has the objection that it is obviously difficult to correctly gauge the amount of sulphur or equivalent material thus used and particularly if an excess is applied to the surface, either of the mold proper or the core, so much vapor may be generated that some of it becomes entrapped during the period that the metal is solidifying, the result being blowholes or surface shrinks in the casting.

More recently it has been proposed to avoid the difficulties encountered in casting magnesium and its alloys by using a molding composition containing pulverized carbon, pulverized soapstone, magnesium oxide and a light bodied mineral oil. I have found, however, that the use of magnesium oxide, which is commercially sold as a fine powder, is not only unnecessary but detrimental since it makes the mold less porous and thus tends to prevent the ready escape of gases generated during casting. This in itself is undesirable since it causes pitting, surface shrinks, and general surface injury to the casting. I have further found that the use of magnesium oxide in contact with hot magnesium and its alloys accelerates or promotes the oxidation of the metal.

Accordingly, among the objects of the present invention is the production of an improved molding composition suitable for use in casting readily oxidizable metals such as magnesium and its alloys, the use of such composition further permitting the production of castings having a good surface appearance. Other objects and advantages will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, consists of the method and product hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail means and modes of carrying out the invention, such disclosed means and modes illustrating, however, but several of the various ways in which the principle of the invention may be used.

The mold which is formed to produce a casting of any desired shape or size, e. g. a crankcase for an internal combustion engine or like article, may be made entirely from my improved molding composition consisting of

pulverized carbon, a plasticizing agent and a non-aqueous binder, or may be made from such composition having incorporated therein cores or metal parts as is well known to the art.

I have discovered that where pulverized or finely divided carbon is used instead of sand for forming a mold, that such mold has a much higher heat conductivity than a similar sand mold. This increased heat conductivity causes the hot metal being poured into the mold to chill promptly, which not only decreases the period wherein rapid oxidation can take place but produces a fine grain structure casting having superior properties as compared with a like casting made in sand. In this connection it is to be noted that carbon is chemically and physically not an equivalent to sand since it is not an oxide, it is combustible and has a much higher heat conductivity than sand. I am aware that graphite, powdered coal, and lampblack have been used as facings and washes for molds used in the casting of iron and steel; however, the problem encountered there is in no way comparable with that encountered in the casting of an extremely readily oxidizable metal, such as magnesium and its alloys, which has to be handled and poured at a temperature wherein it readily ignites and burns if exposed to the air.

Where using pulverized carbon and oil alone for producing my improved molding composition, I have found that the percentage range by weight (of all ingredients) of the carbon lies between 75–90 per cent. while the oil may vary from 25–10 per cent. The factors varying the percentage depend principally upon the sieve analysis of the carbon, the type of oil, and the nature of the casting to be made. While I have found that the molds made from mixtures of pulverized carbon and oil will produce good castings, I normally prefer to add thereto a "plasticizing" agent (1 to 30 per cent) such as soapstone, or some other suitable silicate, such as bentonite.

Example 1

Where using pulverized carbon and oil alone I have found that good castings can be made by using the following composition:—

18% medium body mineral oil mixed with
82% carbon (pulverized coke) having the following sieve analysis—

Percentage	Mesh
33	40–100
47	100–200
20	Through 200

Example 2

Where using a plasticizer such as soapstone in addition to pulverized carbon and oil, I have found that the following composition produces satisfactory castings:—

13% medium body mineral oil
10% finely powdered soapstone
77% carbon (pulverized coke) having the following sieve analysis—

Percentage	Mesh
33	40–100
47	100–200
20	Through 200

In using the above compositions I have found that the castings produced present a good surface that is free from excessive oxidation, pitting and surface shrinks, and further I have found that the tensile properties, Brinell hardness, fatigue endurance and toughness of such castings are above the average of like articles cast in sand according to current practice.

In using my improved molding composition for casting, a small portion of the volatile liquid binder is gasified by the hot metal poured into the mold. After the so poured casting has cooled to a point where it will not ignite when exposed to air, it can then be shaken out and the molding composition reconditioned by adding thereto sufficient of the non-aqueous volatile liquid binder to moisten and place the composition in shape for reuse, it being noted that the other ingredients of the composition will be substantially unaffected by casting conditions. The volatile liquid binder, preferably mineral oil, acts substantially the same in making my improved molding composition "green" and moldable as does water in the conventional water bound green sand molds but without the bad effects encountered due to water or steam giving up oxygen to oxidize the metal. While I have mentioned pulverized coke as the carbon material used in my improved molding composition I do not wish to be limited to that material since I have found that pulverized coal and other similar hard high carbon compounds can be used in like manner. The term "carbon" will accordingly be understood to broadly cover this class of materials unless otherwise specified. Further, I have found that the mesh of the pulverized carbon can vary considerably from that specifically noted in the foregoing examples, the mesh used depending upon the permeability and bond strength desired.

Other modes of applying the principle of my invention may be employed instead of those explained, change being made as regards the method and product herein disclosed provided the method and product stated by any of the following claims or the equivalent thereof be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. The process of casting a readily oxi-

dizable metal, which consists in forming a mold from a mixture of pulverized carbon and a plasticizer rendered moldable by being mixed with a gasifiable non-aqueous liquid, and casting said metal in said mold.

2. The process of casting a readily oxidizable metal, which consists in forming a mold from a mixture of pulverized carbon and a plasticizer rendered moldable by being mixed with a gasifiable mineral oil, and casting said metal in said mold.

3. The process of casting a readily oxidizable metal, which consists in forming a mold from a mixture of pulverized carbon and pulverized soapstone rendered moldable by being mixed with a gasifiable non-aqueous liquid, and casting said metal in said mold.

4. The process of casting magnesium and alloys thereof, which consists in forming a mold from a mixture of pulverized carbon and pulverized soapstone rendered moldable by being mixed with a gasifiable mineral oil, and casting said metal in said mold.

5. A mold for casting a readily oxidizable metal consisting of pulverized carbon, a plasticizer and a gasifiable non-aqueous liquid binder.

6. A mold for casting magnesium and alloys thereof consisting of pulverized carbon, pulverized soapstone and a medium body mineral oil binder.

7. A mold for casting magnesium and alloys thereof consisting of approximately 77 per cent of pulverized carbon, 10 per cent of pulverized soapstone and 13 per cent of a medium body mineral oil.

Signed by me this 28th day of June, 1930.

JOHN A. GANN.