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METHOD FOR MAKING SOUND METAL CASTINGS

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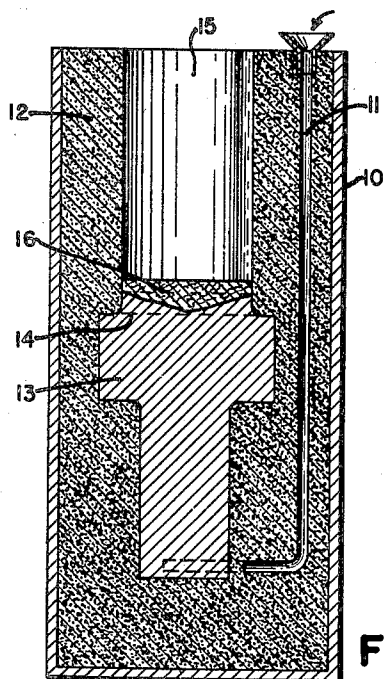


FIG. 1

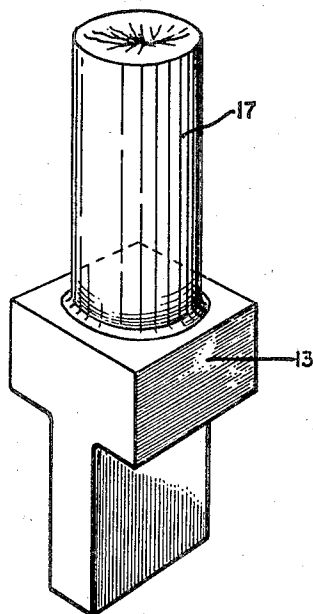


FIG. 2

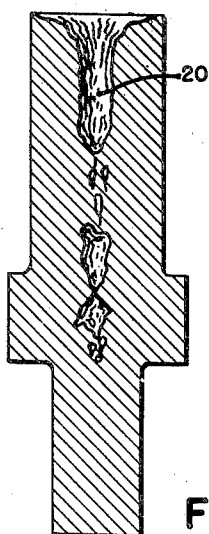


FIG. 3

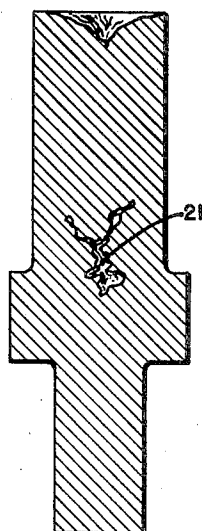


FIG. 4

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METHOD FOR MAKING SOUND
METAL CASTINGS

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1 Claim. (Cl. 22—215)

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This invention relates in general to the casting of metals and more particularly to an improved method of making sound castings by using exothermic powders.

In the production of castings by the pouring of molten metal, the most troublesome defect, regardless of the metal used, is shrinkage. The problem of shrinkage, coupled with the attempt to have a high percentage yield of good casting to metal melted, has resulted in an effort to reduce or eliminate this defect. A general practice in the founding art is to provide a riser for the mold in which the molten metal rises in the mold, the appearance of the metal in the riser indicating that the mold is filled. The fact that the metal ordinarily freezes from the outside surfaces toward the center results in "piping," or the creation of a crater in the center of the riser which may extend into the casting thus causing a defect. The most usually employed remedial measure is to provide a large sink-head to provide sufficient molten metal to properly feed the casting. Another method directed toward eliminating "pipe" has been to provide insulation to prevent too rapid cooling of the metal in the riser. Insulating sleeves and liquefiers have been used with varying degrees of success. In casting steel, insulating fire brick has been used to keep the metal evenly molten, and at times, heat has been produced in the top of ingots by applying an electric arc. The above-mentioned methods are satisfactory to some extent, but there is no assurance that defects due to shrinkage will always be eliminated. Also if the difficulty is ultimately overcome, the cure might be worse than the illness. For example, a sink-head attached to the casting, of sufficient size to properly feed the casting, might easily be larger than the casting itself.

Accordingly, the primary object of this invention is to provide a method to eliminate shrinkage defects which occur during the process of metal founding.

A further object of this invention is to provide a method to eliminate shrinkage defects in metal or metal alloy castings.

A further object of this invention is to increase the yield of sound casting to metal melted.

Another object of the invention is to provide a method of utilizing an exothermic powder for producing a sink-head of highly superheated metal.

A still further object of the present invention is to provide a method of using an exothermic

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powder which provides upon reaction an insulating cap over the metal in the riser.

These and other objects of the invention will be apparent from the detailed description when taken with the accompanying drawings in which:

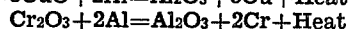
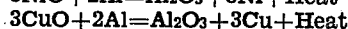
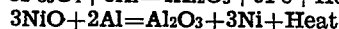
Fig. 1 is a vertical sectional drawing of a casting made in accordance with the method of our invention as it stands in its mold after solidification has become complete;

Fig. 2 is an isometric view of a test casting illustrating the shape of the casting made in the mold of Fig. 1 according to the prior art;

Fig. 3 is a vertical sectional drawing of a casting of the shape shown in Fig. 2 made by one practice of the prior art; and

Fig. 4 is a vertical sectional view of a casting of the shape shown in Fig. 2 made by another practice of the prior art.

By definition, an exothermic reaction is one that liberates heat during the reaction. The basis of the present invention is to use the heat so liberated to superheat the molten metal in the riser of a mold to insure directional solidification. The chemical formulae for four general reactions, for steel application, for Monel application, and for bronze application involve some or combinations of the following or similar oxides:



A mixture of the above respective oxides or other is usually employed so that the chemical components of the metal resulting from the reaction matches that of the parent casting being treated. The reaction is started by applying exothermic powder on top of the molten metal in the riser, the heat of the metal being sufficient to ignite the mixture. Examination of the formulae shows that the two basic anti-shrinkage aids are provided, namely (1) production of superheated metal in the riser where heat is needed, and (2) production of a hot refractory insulating cap (principally Al_2O_3 slag) in the riser to conserve this heat. It is then possible to stop pouring a mold when the metal just reaches the riser, add the exothermic powder to insure proper solidification, and thereby obtain a very high yield of sound casting to metal melted. This method may be readily understood by reference to Fig. 1 wherein is shown a conventional flask 10, having a gate 11, the mold 12 and the casting 13. the dotted line 14 representing the upper extremity of the finished cast-

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ing. The riser 15 of the mold 12 has been illustrated as being of considerable length whereby it may be used in the making of castings by the prior art methods which will be more fully discussed in connection with Figs. 3 and 4.

The method of our invention does not require the long riser, however, since during the filling of the mold 12 through the gate 11, the pouring is stopped as the molten metal just reaches the riser (approximately in the region of the dotted line 14), and the exothermic powder then added. As outlined above, the exothermic powder produces superheated metal in the riser as well as a refractory cap 16 which covers the metal. In actual tests, using this method, we have obtained castings having only a saucer-like depression appearing at the top of the casting, and no internal shrinkage, substantially as illustrated in Fig. 1. The method has been illustrated as applied to a simple casting, but it is to be understood that it is equally applicable to more complex castings where a plurality of risers are used on a single casting.

In contrast to the castings produced by our method, reference is made to Figs. 3 and 4 which illustrate castings which were made using prior art methods. These castings were made of the same shape and size as the casting of Fig. 2. The lower T-shaped portion 13 is the desired casting, and the cylindrical portion 17 is the solidified metal normally contained in the riser, which must be cut off and remelted. The casting of Fig. 3 was made by pouring the molten metal to completely fill the riser 15 and then adding conventional carbon-free pipe eliminator to the top of the metal. No exothermic powder was used. It will be noted that the usual pipe 20 occurs at the top of the riser, and that shrinkage extends into the casting. The casting of Fig. 4 was made in a similar manner except that instead of adding carbon-free pipe eliminator to the top of the molten metal in the completely filled riser, exothermic powder was applied. It will be noted that the pipe at the top of the casting has been practically eliminated, but that there is some secondary shrinkage 21 at the base of the riser. It is therefore apparent that there is a distinct advantage to stopping the pouring of the metal as it just reaches the riser and then adding exothermic powder, rather than applying the exothermic powder to the top of the filled riser.

In addition to producing sound castings, the prime requisite in foundry practice, it is also apparent from Figs. 1, 3 and 4 that the percentage yield of sound castings produced to metal poured is materially increased by the use of our method.

As previously mentioned, powders of the exothermic type must be compounded chemically to match the metal to which they are added. A mixture of iron oxide with aluminum properly graded as to particle sizes is satisfactory for steel, but would not, of course, be suitable for corrosion resisting steel or non-ferrous metals. For corrosion resisting steel the metal generated from the reaction must usually contain substantial percentages of chromium and nickel. The oxides of chromium and nickel are accordingly incorporated in the original mixture in proper balance with the iron oxide. If economically advantageous, some of the chromium may be added in metallic form. In the case of Monel the mixture is made up of nickel oxide, copper oxide,

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aluminum and other ingredients to control the heat level and viscosity of the slag. It is important to note at this point the explosive character sometimes encountered with copper oxide when unadvisedly used alone or in certain combinations with other oxides with aluminum, particularly when not properly graded. This situation makes the production of exothermic powders for copper alloys more difficult than is the case with steel. However, such mixtures have been made, and can be safely used with due precaution. No particular problem exists with ordinary steel and chromium-nickel mixtures.

In applying exothermic powders, the success of the operation depends on using a sufficient amount. Successful results have been obtained by additions of 5% to 25% by weight of the casting and riser combined, the normal amount being about 15%. It appears that the required amount of exothermic material is about the same for all risers of the same diameter regardless of the casting size.

The foregoing discussion has brought out the fact that the present invention is applicable to practically all metals and alloys. Accordingly, the reactions set forth and the metals mentioned in the foregoing description are not intended to limit the invention, but rather the spirit and scope of the invention is to be defined only by the appended claims. The terms "metal" and "metal alloys" have been used interchangeably throughout the foregoing discussion; therefore it is to be understood that the term "metal" as used in the appended claims shall include alloys as well as pure metals.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

A method of making sound metal castings with a high percentage yield of good casting to metal poured, comprising the steps of pouring molten metal into a mold having a riser cavity, stopping the pouring when the metal reaches the bottom of the riser, and adding to the surface of the molten metal at the bottom of the riser cavity an exothermic powder mixture in the amount of 5% to 25% of the weight of the metal in the mold, said powder mixture including an oxide of the metal used in the casting.

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