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PROCESS OF CASTING IRON IN METAL MOLDS.

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To all whom it may concern:

Be it known that I, DANIEL H. MELOCHE, a citizen of the United States, residing at 8450 Fourteenth Street, Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Processes of Casting Iron in Metal Molds, of which the following is a specification.

The object of this invention is to cast gray iron in metal molds and to obtain a casting which will be as machinable as that cast in sand and at the same time have the advantages inherent in the die casting.

Cast iron cast in metal molds has heretofore been less machinable than that cast in sand for this reason, that if the iron is of such composition that the carbon is thrown out of solution by the silicon, that is to say, if the iron contains 2½% to 3½% of silicon then on casting the iron in a metal mold, not only is the carbon not completely precipitated as free carbon, but some of the silicon itself is precipitated unless the molten iron is above 2200° F. The combination of precipitated silicon and dissolved carbon produces a casting less machinable than an ordinary gray iron cast in a sand mold. If the silicon be reduced so as to avoid this difficulty then the percentage of combined carbon correspondingly increases, because, as is well known in the casting art, the less silicon the more combined carbon.

If the cast iron is hotter than 2200° F. the tendency to chill deeper is very pronounced. If this tendency is counteracted, as it may be, by suitable coating and also by highly heating the metal molds, the coatings heretofore in use are unstable, both volatilizing and decomposing so that they fail to protect the surface of the metal mold from the erosive action of the fluid cast iron. In extreme cases the cast iron may even weld to the surface of the mold, but as cast iron is very difficult to weld this is an unusual occurrence.

The formation of hard spots within the casting, when using comparatively cold iron (below 2200° F.), is believed to be due to the well known phenomenon so characteristic of cast iron, namely its expansion on setting, which expansion corresponds somewhat to the recalescence points of steel. Iron is usually poured in a permanent mold at the lowest temperature consistent with fluidity. By so doing the semi-volatile coatings now in use offer sufficient protection so that the molds are permanent. The moment the iron is poured in these molds a skin of iron is formed enclosing within a certain quantity of fluid iron. In an ordinary casting having more or less intricate parts a certain part of the fluid iron is thus trapped in pockets. On removing the casting from the mold, which necessarily happens in quantity production whilst the casting is still red hot (1600° F.), the pressure created by the expansion of these pockets of liquid iron is due entirely to the shell of the iron and not due to the confining influence of the mold. Nevertheless the pressure is sufficient to force the carbon into solution and thereby produce hard spots of white iron which are characteristic of imperfect castings made in permanent metal molds.

To a degree these hard spots may be eliminated by protracted annealing at 1450° F.–1550° F., but the annealing period extends for hours, which increases the cost of the casting.

To overcome these difficulties I have discovered that by using a suitable coating for the mold and maintaining the face of the mold at a temperature corresponding to a dull red heat, namely 1100° F., and pouring iron at a white heat, that is to say above 2200° F., and ejecting the casting from the mold when the outer skin is set I secure castings in which the silicon remains in solution and 90% of the carbon is uniformly distributed at what may best be described as temper carbon, being similar in appearance and properties to the "blackheart" core of malleable castings, the carbon remaining in solution being less than 0.50%.

The exact procedure I practice to get the desired results is as follows: The molds are first protected by a lining of tin oxide applied by means of an oxy-acetylene flame, as set forth in the joint application of Udale and Meloche (the applicant here), Serial Number 559,076, filed May 6, 1922. In order to get the lining of tin oxide to last for two hundred castings, the castings being poured every two minutes or even more frequently, it is necessary I find to apply a coating of lamp black between each casting operation. This coating of lamp black is best applied

by means of a smoky acetylene flame, although I have used other smoky flames for the same purpose. This smoky flame may be applied automatically or by hand as the case may be.

The molds are heated before the iron is cast therein, and as the castings are successively poured in the mold the surface of the mold rapidly increases in temperature, and when the surface of the mold exceeds 1100° F. I admit cooling air within the molds, which are made hollow for this purpose. The surface temperature of the mold desired is between 1000° F. and 1100° F.

The cupola is so operated as to give metal of substantially the following composition:

Total carbon in excess of 3½%

The silicon should be under 3% but over 2¼%

The manganese should be over .5% and under .7%

The sulphur should be less than .07%, although satisfactory castings can be made somewhat in excess of this figure.

Phosphorus should be less than .7%

The coke used in the cupola should be comparatively free from sulphur, preferably under 1%. Very little soft steel scrap is added, 5% being the usual figure in order to maintain the high percentage of carbon which I have found desirable, and the scrap iron is held down to 10%, but the real secret of successful die casting iron is the control of the temperature by means of the blast so that the iron is discharged at above 2500° F., for the reasons set forth above. The molds in which the iron is cast are made of somewhat harder iron than the iron cast therein.

The reasons for the successful results obtained by using iron white hot (over 2200° F.) are, I believe, as follows:—Ordinarily gray cast iron expands when it sets, but if the cast iron be poured into the molds at a temperature greatly in excess of the setting temperature, the molten iron contained within the skin of iron formed on the surface of the casting when ejected from the permanent mold is hot iron, that is to say it is iron at a temperature above that of the temperature at which iron sets and as it cools to the temperature of freezing it contracts and thereby counteracts the compression stresses set up during the subsequent expansions of the iron.

The resulting castings, therefore, have substantially the same specific gravity as the castings made in sand molds. Whilst specific gravity in itself is of no importance it indicates whether the carbon in the iron is in the free or the combined state and therefore is a guide to the quality of the casting produced. Of course, where there are blow holes within the casting then this casting is apparently less dense, but of course it is otherwise defective and therefore the density is of value as a criterion only to castings free from blow holes.

The added advantage of pouring extremely hot iron in heated molds is that the iron being more fluid forms a better surface free from pin holes and those other surface imperfections known as cold shots, which latter are characteristic of castings produced with comparatively cold iron. By cold iron, of course, is meant iron which is slightly above its setting point of approximately 2000° F.

What I claim is:

1. The process of casting gray iron in permanent molds, consisting of pouring the metal while above 2200 deg. F. into a permanent mold having a semi-permanent lining of a metallic oxide which is of low thermal conductivity and which vaporizes at a temperature greater than the white heat of the iron cast therein.

2. The process of casting gray iron in permanent molds, consisting of pouring the metal while above 2200 deg. F. into a permanent mold having a semi-permanent lining of a metallic oxide which is of low thermal conductivity and which vaporizes at a temperature greater than the temperature of the metal cast therein, such lining having a coating of carbon in addition to the metallic oxide, said carbon being liberated from the coating when the molten metal enters the mold.

3. The process of casting gray iron in permanent molds, consisting of pouring the metal at a temperature greater than 2200° F. into a permanent metal mold having a semi-permanent lining of metallic oxide which is of low thermal conductivity and which does not materially vaporize at the temperature, 2200° F., of the molten iron cast therein.

4. The process of casting gray iron in permanent molds, consisting of pouring the metal above 2200° F. into a permanent mold having a semi-permanent lining of a metallic oxide which is of low thermal conductivity and which does not materially vaporize at the temperature of the molten iron cast therein, said lining having a coating of carbon in addition to the said metallic oxide lining, a portion of said carbon being removed from the coating by each casting operation.

5. The process of casting gray iron in permanent molds, consisting of pouring the metal while above 2200 deg. F. into highly heated metal molds having a semi-permanent lining of a metallic oxide which is of low thermal conductivity and which vaporizes at a temperature greater than the white heat of the iron cast therein.

6. The process of casting gray iron in permanent molds, consisting of pouring the

metal while above 2200 deg. F. into highly heated metal molds having a semi-permanent lining of a metallic oxide which is of low thermal conductivity and which vaporizes at a temperature greater than the temperature of the metal cast therein, such lining having a coating of carbon in addition to the metallic oxide, said carbon being liberated from the coating when the molten metal enters the mold.

7. The process of casting gray iron in permanent molds, consisting of pouring the metal while above 2200 deg. F. into highly heated metal molds having a semi-permanent lining of stannic oxide, applying a coating of carbon super-imposed on the lining of stannic oxide, renewing the coating of carbon between each casting operation.

8. The process of continuously casting gray iron at a temperature above 2200° F. into a series of permanent metal molds, maintaining the temperature of the surface of the metal molds between 900° F. and 1200° F., semi-permanently lining the surface of the metal molds with stannic oxide and applying a coating of lamp black between each casting operation.

In testimony whereof I affix my signature.

DANIEL H. MELOCHE.