

UNITED STATES PATENT OFFICE.

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PROCESS OF MAKING CASTINGS.

1,347,481.

Specification of Letters Patent.

Patented July 20, 1920.

No Drawing.

Application filed September 24, 1917. Serial No. 192,931.

To all whom it may concern:

Be it known that I, ZAY JEFFRIES, a citizen of the United States, residing at East Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Processes of Making Castings, of which the following is a specification.

This invention relates to a process of making castings in permanent molds, the process being particularly adapted for making castings of complex or intricate shapes.

The prime object of the invention is to provide an improved process of making permanent mold castings adapted to eliminate the wastage due to strains and cracks formed in the casting during setting thereof and before its removal from the mold.

A further object is the provision of a process by which the tensile strength of permanent mold castings can be increased.

Another object is the provision of an improved process adapted to increase the hardness of permanent mold castings.

Another object of the invention is the provision of a process by means of which the time required for making permanent mold castings is reduced to a minimum.

The permanent mold method of making castings has been employed, in commercial practice, entirely for the production of castings of non-ferrous metals or alloys having relatively low melting points, *i. e.*, substantially lower than the melting point of iron, the material of which the molds have been made. In the production of permanent mold castings of intricate shapes, it has been found that there is a marked tendency of strains and cracks occurring in the casting before its removal from the mold, such, for example, as internally ribbed pistons and other internal combustion engine parts. This is especially true of castings having shapes in which there are sudden changes in the cross sectional dimensions of the casting, as where a relatively thin section or web merges abruptly with a relatively heavy section, resulting in the formation of sharp angles in the surface of the casting; and it is adjacent these sharp angles that the cracking mentioned tends to occur.

I have heretofore succeeded, to some extent, in overcoming difficulties such as those referred to by means of the invention described in my pending application Serial

No. 126,358, filed October 18, 1916, in which the walls of a permanent iron mold are provided with inserts of metal having a high co-efficient of heat conductivity, the inserts being arranged to engage the metal of the casting at certain points to hasten its cooling at such points and thereby secure a uniform contraction of the casting so as to lessen the danger of strains and cracks. This expedient, however, has structural limitations of a practical sort.

My later studies and experience, especially in the production of aluminum alloy castings in permanent molds, have led to the discovery that the above mentioned difficulties in securing sound castings of intricate forms are due for the most part to the fact that the metal of the castings has a substantially different co-efficient of thermal expansion than the metal of the molds, so that the metal of the casting is subjected to severe stresses and resulting strains because the metal of the casting and that of the mold do not contract together after the casting has set.

I have, therefore, sought to produce permanent molds of metal having substantially the same co-efficient of thermal expansion as the metal of the castings to be produced. The most obvious way of accomplishing this is to form molds of metal having a composition similar to the metal of the castings. This, however, presents the difficulty that the mold material has also substantially the same melting point as the metal of the casting and the danger that the inner walls of the mold would soften and fail to produce clean castings and would rapidly deteriorate. And even if a mold metal having the same co-efficient of thermal expansion as the casting metal, but a different composition, is attainable, as it often is, it usually is found that such mold metal has a relatively low melting point. However, following my experience with iron molds having inserts of lower melting point metal, I have discovered that when the mold metal employed has a relatively high co-efficient of thermal conductivity, as compared with that of iron, it is possible to dissipate the heat absorbed by the mold so rapidly that there is no undue softening of the mold metal and no tendency for the mold to rapidly deteriorate. On the contrary, I have found that by the use of such permanent

molds for intricate castings not only the proportion of castings defective on account of strains and cracks can be immensely reduced but, at the same time, because of the extremely rapid cooling of the molten metal, it is possible to produce castings having a degree of hardness and a tensile strength which were quite impossible of attainment with prior methods. And as a further result of the rapid cooling, the time required for the production of castings is substantially reduced.

For the purpose of more fully characterizing my invention, I will refer in further detail to its application to the production of light weight aluminum alloy castings of intricate forms. The metal to be poured can be prepared in any known or suitable way, depending upon the composition which is desired. The mold is formed in substantially the same way as an iron permanent mold but is made of an alloy having the same composition as the metal to be poured, or of other composition having a similar co-efficient of thermal expansion and preferably a high co-efficient of thermal conductivity. The inner walls of the mold are coated in the usual manner familiar to those skilled in the production of permanent mold castings. The metal is poured at substantially the same temperature as would be employed in casting in permanent iron molds but, whereas a very substantial interval must be allowed for the setting of the casting in the case of an iron mold before the casting can be removed therefrom, a very brief interval only is required in the case of the aluminum alloy mold because of its high thermal conductivity. And when the casting is removed it is found to be free of cracks because of the uniform contraction of casting and mold, and to possess a high degree of hardness and a remarkably high tensile strength, because of the very rapid cooling. And for this same latter reason the rate at which the casting can be produced is substantially increased in comparison with iron mold practice.

Thus in the production of aluminum alloy

castings by this process I attain: (1) elimination of losses due to cracking, (2) a very high degree of hardness, (3) a largely increased tensile strength, the increase being as high as 25 per cent. in comparison with iron mold practice, and (4), a more rapid production. In other words, the new process gives castings having physical characteristics heretofore impossible of attainment and at the same time makes possible a lower cost of production.

I have also successfully applied the new process to the production of aluminum bronze castings, and various other applications can be made, as will be obvious to those skilled in the art. While the advantages of my process are especially notable in the case of metals having high thermal conductivities I do not intend to be understood as limiting my invention to such cases as it may be, and doubtless will be, possible, in the case of metals having lower co-efficients of heat conductivity, to provide permanent molds having the same co-efficients of thermal expansion as the said metals. In fact to those skilled in the art, many widely differing embodiments of my invention will suggest themselves, without departing from the spirit and scope thereof. My disclosures herein are purely illustrative and are not intended to be in any sense limiting.

What I claim is:

The process of making intricate castings, having shapes with abrupt changes in their cross sectional dimensions, from aluminum alloys or other metals having high coefficients of thermal expansion in comparison with iron, said process being characterized by the introduction of the molten metal of the character specified into a permanent mold which is formed of metal having substantially the same coefficient of thermal expansion as the metal of the casting and a high coefficient of thermal conductivity in comparison with iron.

In testimony whereof I hereunto affix my signature.

ZAY JEFFRIES.