Dec. 29, 1942. J. Q. HOLMES 2,306,883

METHOD OF MAKING CORES FOR PERMANENT MOLD

Filed March 21, 1941

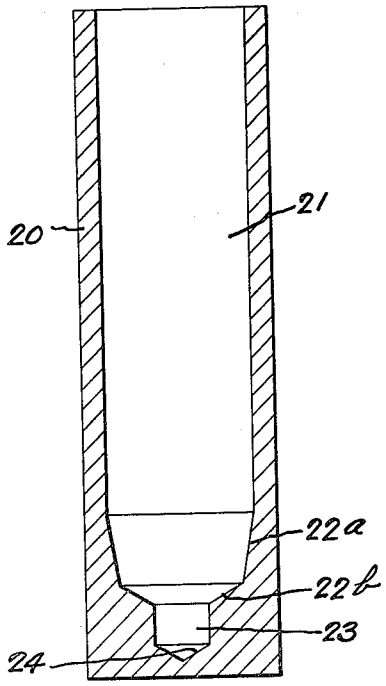


Fig. 1

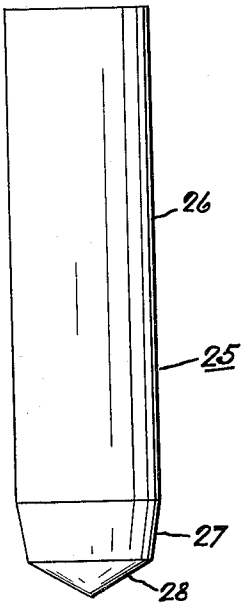


Fig. 2

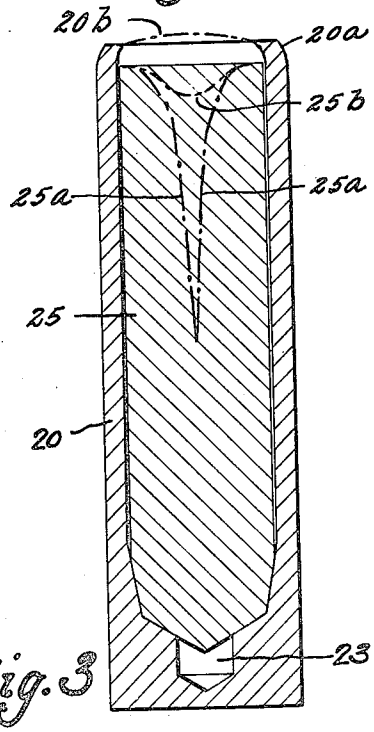


Fig. 3

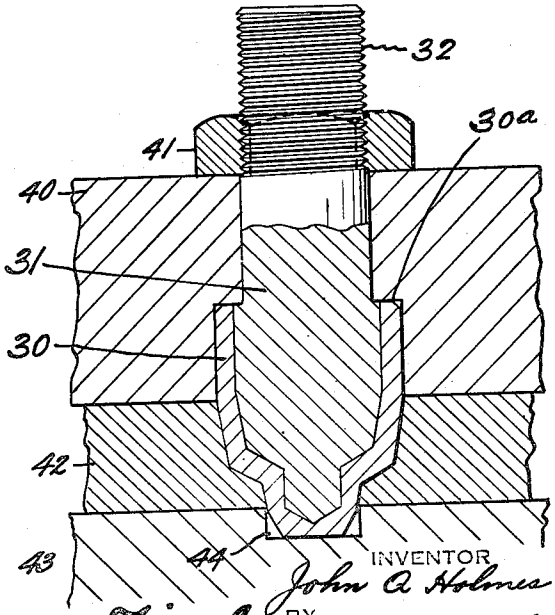


Fig. 4

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METHOD OF MAKING CORES FOR PERMANENT MOLDS

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Application March 21, 1941, Serial No. 384,499

3 Claims. (Cl. 29—148)

This application is a continuation in part of application Serial No. 332,182, filed April 29, 1940.

This invention pertains to the manufacture of castings and more particularly to making iron castings in a permanent molding machine having molds of heat resisting metal. As these molds are relatively large, they can be provided with adequate heat radiating surfaces so that the heat from the molten metal enclosed between them can be readily dissipated to the air which circulates in contact with these radiating surfaces. Where the casting requires a hole or recess of considerable depth or length as compared with its cross-sectional dimensions, it is necessary to use a core of material offering even greater resistance to the disintegrating effects of molten iron due to the fact that the transfer of heat away from the core is much slower than from the mold bodies. Sand cores have been used in connection with permanent mold foundry, but a sand core is destroyed during a single use. Various attempts have been made to use permanent cores of special alloys, but even these disintegrate relatively rapidly and must frequently be replaced. The difficulty with special alloy cores is that their ability to transfer heat is relatively low, although their ability to resist disintegration would be relatively high if some means were provided to take away the heat rapidly.

The present invention aims to provide a core which has both high resistivity to disintegration from molten iron and high ability to transfer heat away from the core surface to a heat dissipating medium such as circulating air. In the disclosed embodiment thereof, the aim of the invention is accomplished by a composite metallic structure comprising a core shell of stainless steel united by a good thermal bond with a rod of metal having great heat conductivity such as copper. The bond between the steel shell and the copper rod must be so thermally perfect as it is possible to obtain. Therefore, the present invention aims to provide a method of obtaining this thermal bond or union. This method consists in providing a shell of stainless steel in the form of a tube closed at one end and a rod of copper shaped to fit within the cavity of the steel shell. After the rod and shell are assembled and placed in a vertical position with the closed end of the steel shell down, they are heated above the melting point of copper for a time sufficient to cause the copper to penetrate into the steel to provide such a union or bond that heat will thereafter readily pass from the steel to the copper.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred embodiment of the present invention is clearly shown.

In the drawing:

Fig. 1, is a longitudinal sectional view of the stainless steel shell.

Fig. 2 is a side view of the copper rod.

Fig. 3 is a longitudinal sectional view of the assembly of the steel shell and copper rod.

Fig. 4 is a side view, partly in longitudinal section of the completed composite structures which forms a permanent core for a mold.

Referring to Fig. 1, a shell **20** of stainless steel or other alloy or metal offering high resistance to disintegration is provided with a bore **21** of larger diameter tapering at **22***a* and **22***b* into a bore **23** of smaller diameter ending in a conical surface **24**.

Referring to Fig. 2, a rod **25** of copper or other metal or alloy having good heat conductivity is shaped to provide a shank **26** adapted to fit loosely within the bore **21** of blank **20**, a tapering surface **27** adapted to fit against tapering surface **22***a* of shell **20**, and a conical end **28** adapted to fit surface **22***b* of the shell **20**. The clearance between shank **26** and bore **21** is about 1/64 inch as shown in Fig. 3.

While the assembly is vertical, it is preheated for about 40 minutes in a furnace having a temperature of about 1350° F.; and then the assembly is heated to 2100° F. in a high temperature furnace, which is above the melting point of copper. This temperature is maintained for about one hour which is sufficient to cause the molten copper to penetrate into the steel shell. The assembly is cooled in the furnace as the furnace temperature drops to about 1000° F. or below red heat.

The reason for preheating at the lower temperature is (1) to relieve the high heat furnace, (2) to secure more uniform heating and (3) to prevent weakening the structure of the stainless steel shell by reducing the time during which it is in the high heat furnace. Then the assembly is removed and is cooled in surrounding air.

Before the rod **25** is placed within the shell **20** the cavity of the shell is filled with borax flux. After assembling the upper end of the shell **20** is peened over (as indicated at **20***a* in Fig. 3) and a quantity of borax and ground glass is placed within the shell and upon the upper end of the rod **25**. The function of the borax is to prevent

oxidation of the copper rod and steel shell. The function of the ground glass is to combine with the borax upon the top of the rod to form a crust indicated by dot-dash line 20*b* in Fig. 3.

As the temperature of the assembly is raised, the borax flux in cavity 23 vaporizes and lifts the rod 25 from its seat upon the surfaces 22*a* and 22*b* of the shell. The rod 25 cannot be lifted by the pressure of borax vapor above the upper end of the shell 20 because the rod 25 is confined below the peened over flange 20*a*. The borax vapors ascend through the annular space between the rod 25 and shell 20 and cleanse the surfaces defining this space, thus preparing them for the union which takes place when the melted copper contacts the heated surface of the stainless steel shell.

As the copper rod melts, the shell cavity 23 is filled with molten copper which displaces any flux left in the cavity. The flux collects in a puddle upon the top of the copper mass and combines with the ground glass to form a crust or seal 20*b* which prevents too rapid cooling of the upper end of rod 25 and provides for more uniform shrinkage of the copper rod. When the crust is not present, the crater left in the cooled rod 25 will be as deep as indicated by dot-dash lines 25*a*. The crust or seal 20*b* provides for more uniform shrinkage of rod 25 so that the crater will be only as deep as indicated at 25*b*.

The structure is then rough machined to provide approximately the shape shown in Fig. 4, and it is subjected to a heat treatment for the purpose of tempering the steel core to reduce its brittleness. This treatment is preferably the treatment recommended for Firth Sterling Type T stainless steel.

After the heat treatment, the assembly is machined to a final finish as shown in Fig. 4, which discloses a steel core 30 in the form of a shell or thimble thermally bonded to a copper rod having a smooth shank 31 adapted to fit within a counterbored hole provided in a mold 40 and having a threaded portion 32 adapted, when the core is mounted upon the mold 40, to project beyond the outside of the mold body and there to receive a copper nut 41 by which the core is fastened to the mold 40. When the nut is tightened on the threads 32, a shoulder 30*a* of the core 30 is drawn tight against an inner surface of the counterbored hold in the mold. The threaded portion 32 together with the clamping nut 41 which secures it are located in a heat dissipating medium such as circulating air which carries away the heat conducted by the shank 31 from the hot molten metal 42 confined between the mold 40 and a mold 43 having a recess 44 which serves as a pilot for receiving the tip end of the core.

While the embodiments of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. The method of making a core for a permanent mold which includes the steps of making a closed-end tubular shell of metal having high heat resistivity, making a rod of metal having high heat conductivity so shaped as to fit within the shell, assembling the shell and rod, placing in a vertical position with the closed end of the shell down, heating the assembly, while being fluxed, above the melting point of the rod for a time sufficient to effect penetration of the former metal by the latter metal, cooling the assembly, machining the shell to form the closed end portion thereof into the core, and cutting away the open end portion of the shell so as to expose the rod.

2. The method of making a core for a permanent mold which includes the steps of making a closed-end tubular shell of metal having high heat resistivity and provided with a cavity at the closed end, making a rod of metal having high heat conductivity so shaped as to fit within the shell and to cover the cavity at the closed end of the shell, placing flux within said cavity, placing the rod within the shell, placing the assembly in a vertical position with the closed end of the shell down, peening the upper end of the shell against the upper end of the rod, placing upon the rod flux mixed with crust forming material, heating the assembly above the melting point of the rod for a time sufficient to effect penetration of the shell by the metal of the rod, cooling the assembly, machining the shell to form the closed end portion thereof into the core, and cutting away the open end portion of the shell so as to expose the rod.

3. The method of making a core for a permanent mold which includes the steps of making a closed-end tubular shell of metal having high heat resistivity and provided with a cavity at the closed end, making a rod of metal having high heat conductivity so shaped as to fit within the shell and to cover the cavity at the closed end of the shell, placing flux within said cavity, placing the rod within the shell, placing the assembly in a vertical position with the closed end of the shell down, peening the upper end of the shell toward the upper end of the rod, placing upon the rod flux mixed with crust forming material, heating the assembly above the melting point of the rod for a time sufficient to effect penetration of the shell by the metal of the rod, and removing a portion of the shell at the open end thereof to expose the rod.

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