Feb. 8, 1949. C. H. WELCH 2,461,099

METAL-CASTING MOLD

Filed March 30, 1945

Fig. 1.

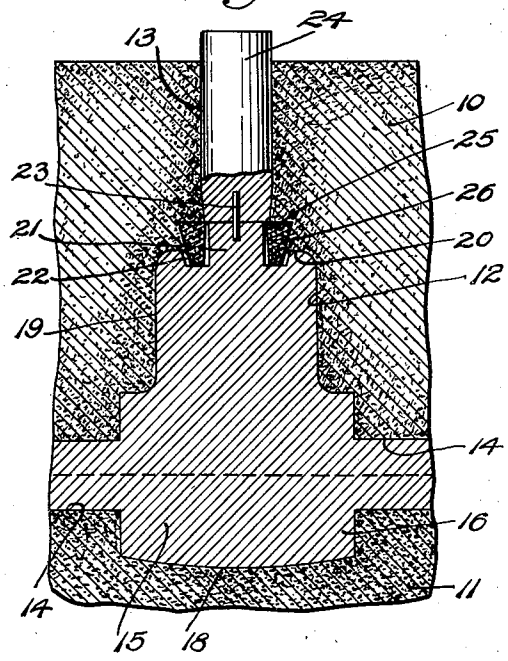


Fig. 2.

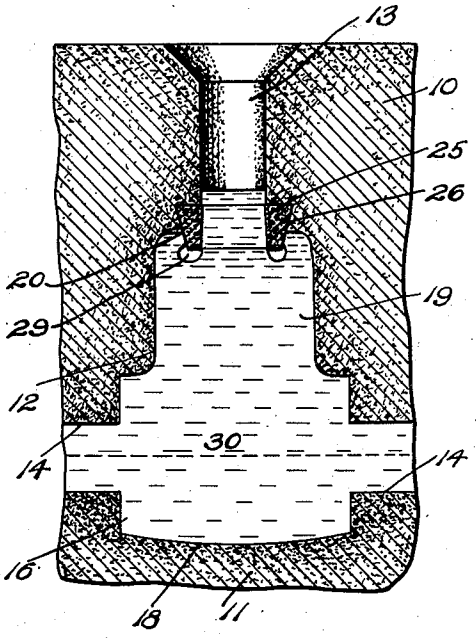


Fig. 3.

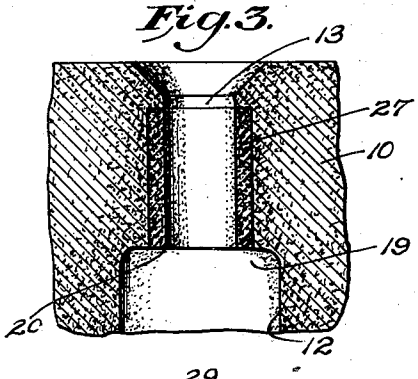
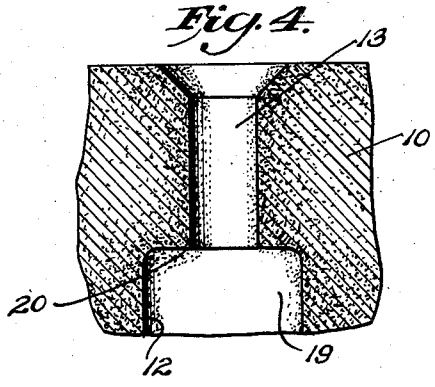


Fig. 4.



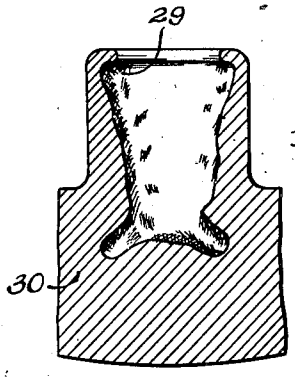


Fig. 5.

Inventor

Cline H. Welch

By W. A. McConnell

Attorney

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METAL-CASTING MOLD

Cline H. Welch, Marion, Ohio, assignor to The Alloy Cast Steel Company, Marion, Ohio, a corporation of Ohio

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2 Claims. (Cl. 22—134)

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This invention relates to an improved mold construction for the casting of heated molten materials, particularly those which are subject to certain shrinkages upon cooling.

In its more specific aspects, my invention is concerned with the casting of metals in molds utilizing one or more head chambers into which the molten metal is poured before entering the casting cavity or cavities of the mold under conditions of gravity flow at atmospheric pressure. Such a system is known in foundry parlance as the "blind" head system.

In this system, as customarily practiced, the sand mold is formed generally to provide communicating casting and head chambers, the molten metal being introduced into a gate opening of the mold and caused to flow first into the bottom of the head chamber and, thereafter, through one or more communicating passages into the casting chamber or cavity of the mold. In theory, as cooling of the heated metal in the casting cavity takes place, with accompanying volumetric shrinkage, additional metal, obtained from the reservoir present in the head chamber, is fed to the cavity to compensate for such shrinkage, thereby producing sound castings of desired weight, form and dimensions.

In actual practice, however, certain objections or practicable difficulties are present when the "blind" head method of casting is carried out with conventional molds. The principal difficulty is that of maintaining the reservoir of molten metal in the head chamber under such conditions that it will flow or feed freely and without hindrance to the casting cavity or cavities as the demand therefor is created.

To obtain such desirable free and unobstructed flow of the molten metal from the head chamber to the casting cavity, under the action of gravity and atmospheric pressure, it is important that the reservoir of the highly heated metal in the head chamber be protected against heat loss and premature solidification and, further, that the interior of this body of head metal to be properly vented to the atmosphere in a manner precluding the development of flow-restricting sub-atmospheric pressures in the shrinkage cavities or pockets formed therein.

Accordingly, it is an object of the present invention to provide a practical and economical metal-casting mold, utilizing the "blind" head principle of operation, and wherein an improved venting for the molten metal introduced into the head chamber is provided in order to insure proper shrinkage-compensating flow thereof to the casting cavity.

It is another object to provide a mold in which atmospheric pressure is maintained on the feed portion of the molten head metal by forming the top of the head chamber with a gate or metal-

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pouring opening of reduced diameter as compared with that of said chamber, so that the metal introduced into the head chamber enters the latter directly through its top and, in accordance with the gravitational flow characteristics of molten metal, expands against the side walls of the head chamber, leaving in approximately the upper central region of the head metal a pocket or void which is open to the atmosphere through the gate opening.

For a further understanding of the invention, and additional objects and advantages thereof, reference is to be had to the following description and the accompanying drawings, wherein:

Fig. 1 is a vertical sectional view taken through a mold formed in accordance with the present invention. In this figure, there has been shown in vertical section the head chamber-forming pattern, the separable gate-forming pattern and a core at the shouldered juncture of the head chamber with the gate opening.

Fig. 2 is a similar view with the head chamber and gate patterns removed, showing the head chamber filled with molten metal;

Fig. 3 is a fragmentary sectional view, showing the gate opening provided with a modified tubular form of core;

Fig. 4 is a view similar to Fig. 3 and illustrating the appearance of the gate opening when the same is not provided with a core;

Fig. 5 is a vertical sectional view taken through the metal of the head chamber following cooling and solidification thereof and disclosing a representative appearance of the venting pocket or void formed therein.

Referring more particularly to the drawing, and especially to Fig. 1 thereof, the same illustrates a sand mold embodyig a cope 10 and a drag 11 in which is formed a head chamber 12, a gate 13, and one or more passages 14 for conducting metal from the head chamber to the casting-forming cavity or cavities, not shown, of the mold. The head chamber 12 and the passages 14 may be formed in the mold by means of a pattern, shown at 15. This pattern is so shaped that, when removed from the mold, the head chamber formed thereby possesses a lower region 16 of greatest diameter which communicates with one or more of the horizontal passages 14 leading to the casting cavity or cavities.

It will be noted that the passages 14 have their lower walls disposed in a horizontal plane somewhat above the concave bottom wall 18 of the head chamber, for a purpose to be hereinafter explained. Above the enlarged lower region 16, the head chamber is somewhat reduced in diameter to provide an upper region 19 and communicating with the top of the region 19 is the centrally disposed lower end of the gate opening 13, which is substantially smaller in diameter

than the region 19, forming an annular shoulder shown at 20.

In the preferred form of my invention, as illustrated in Figs. 1 and 2, the top of the pattern 15 is formed with a central boss 21 and a surrounding circular groove 22. Extending upwardly from the center of the boss 21 is a pin 23, the latter being received within a socket provided in the lower end of a gate stick or pattern 24, the pin 23 serving to center the gate stick during the formation of the sand body of the mold. The boss or projection 21 of the pattern 15 serves to support the gate stick above a ring-like core 25, so that the latter will not be injured when the gate stick is tapped preparatory to removing the same from the mold. The outer annular surfaces of the core 25 are downwardly tapered, as at 26, in order to hold the core in proper position in the mold after removal of the pattern 15. The bottom of the core is positioned in the groove 22 of the pattern in order to hold and support the same in proper position while the mold is being rammed.

In the modification shown in Figure 3, the ring-like core of Fig. 1 has been shown as replaced by a tubular or sleeve-type core 27, which is of a height to extend throughout the major portion of the total length of the gate. Both cores, however, serve to maintain the shoulder 20 at the juncture of the gate opening with the head chamber. However, as in Fig. 4, the use of the core may be omitted when the sand body of the mold possesses a composition admitting of the absence of a core.

Following the removal of the pattern 15 and the gate stick 24, the mold is poured by introducing the molten metal directly into the head chamber through the gate passage in its top. The metal so introduced first fills the sump or basin formed in the bottom of the chamber 12, thereafter overflowing its upper edges and traveling through the passage or passages 14 leading to the casting cavities of the mold. The provision of this sump or basin provides for a smooth uniform travel of the molten metal into the casting cavities by minimizing flow turbulence and thereby also reducing the washing of sand by the action of the flowing metal from the walls of the metal passages of the mold. As the molten metal enters and fills the head chamber, the same expands into engagement with the side surfaces of the upper region 19, leaving, as shown in Fig. 5, a pocket or void 29 in the upper region of the "blind" head 30, which is in communication with the atmosphere through the gas permeable core and sand structure of the mold and, also, the gate 13.

As explained above, the fault of the ordinary "blind" head arises primarily from the early solidification of the molten metal in the areas immediately adjoining the wall surfaces of the head chamber, with resultant exclusion of atmospheric pressure from the still molten metal in the interior of the head. By pouring the molten metal directly into the top of a head chamber possessing a greater diameter than the pouring gate, the vent pocket or void 29 is created so that atmospheric pressure continues to be applied to the molten interior of the "blind" head for a sufficient period of time to effect the required feeding of the molten metal to the casting cavities to compensate for cooling shrinkages. Fig. 5 discloses representatively the appearance of the pocket or void following solidification of the head metal. It will be observed that this pocket

or void extends well down into the body of the metal, indicating the withdrawal or atmospheric displacement of the molten metal within the interior of the head following initial solidification of the head metal on the surfaces of the head chamber of the mold.

By introducing the molten metal directly into the top of the head chamber, the metal remains in a flowable liquid state for a longer period of time than can be obtained with prior molds, since heat losses are minimized through less exposure of the metal to the atmosphere. Again, due to the gate entering the top of the head chamber, smaller volumes of metal are required for a given operation, since the long gates of the prior art are omitted. Further, the highly heated metal at its maximum temperature enters the head chamber directly, increasing the temperature of that region so that proper feeding thereof to the casting cavity is insured, since the metal remains in its highly fluid state for a longer period of time than other molds of which I am aware. In castings employing multiple "blind" heads, it will be understood that metals are introduced directly into one of the chambers for such heads and in the other chamber or chambers, the openings in the top thereof may serve as vents, rather than as gates.

In practicing my invention, it is important to form the mold so as to maintain the corner or shoulder, indicated at 20 and formed at the junction of the gate 13 and the bed chamber 19. This is done preferably through the use of the core 25, although other arrangements, as shown in the drawing, are possible. By maintaining this corner or shoulder, I take advantage of the natural pouring characteristics of molten metal which, through expansion into contact with the side walls of the chamber 19, causes such delayed cooling and shrinkage of the hot metal that atmospheric pressures are maintained on its molten interior or free-flowing constituents to assure the complete filling of the mold cavities and the production of sound castings.

I claim:

1. A metal casting mold of cope and drag sections having a sand body including a blind head cavity with passage means to communicate with a casting cavity, a pouring gate, said blind head cavity having said pouring gate disposed at the top thereof and in direct communication therewith and forming with said blind head cavity an upward extension of smaller volume than said blind head cavity, said blind head cavity having an upper region and a lower region, said upper region providing substantially perpendicular surfaces forming an expansion zone for metal introduced into the blind head cavity, the lower region having a greater diameter than the upper region, and the upper region having a greater diameter than the passage of the pouring gate, a core located at the juncture of the pouring gate passage and the blind head cavity and defining an annular shoulder, the lower region of the blind head cavity having a bottom defining a sump.

2. A metal casting mold of cope and drag sections having a sand body including a blind head cavity with passage means to communicate with a casting cavity, a pouring gate, said blind head cavity having said pouring gate disposed at the top thereof and in direct communication therewith and forming with said blind head cavity an upward extension of smaller volume than said blind head cavity, said blind head cavity having an upper region and a lower region, said upper

region forming an expansion zone for metal introduced into the blind head cavity, the lower region having a greater diameter than the upper region and the upper region having a greater diameter than the passage of the pouring gate, and a core located at the juncture of the pouring gate passage and the blind head cavity and depending downwardly into said cavity and defining an annular shoulder.

CLINE H. WELCH.

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