

Nov. 23, 1943.

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2,334,701

MEANS FOR CASTING METALS

Filed Dec. 21, 1942

2 Sheets-Sheet 1

FIG - 1 -

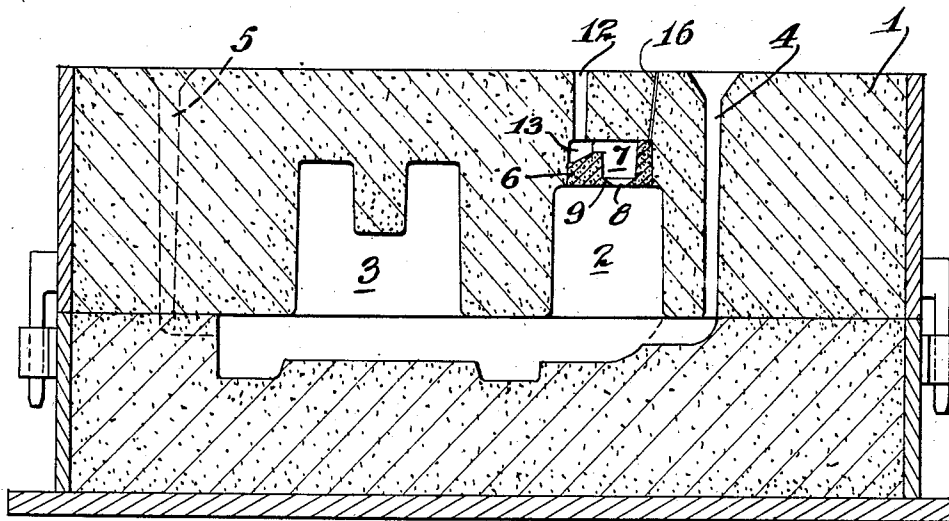
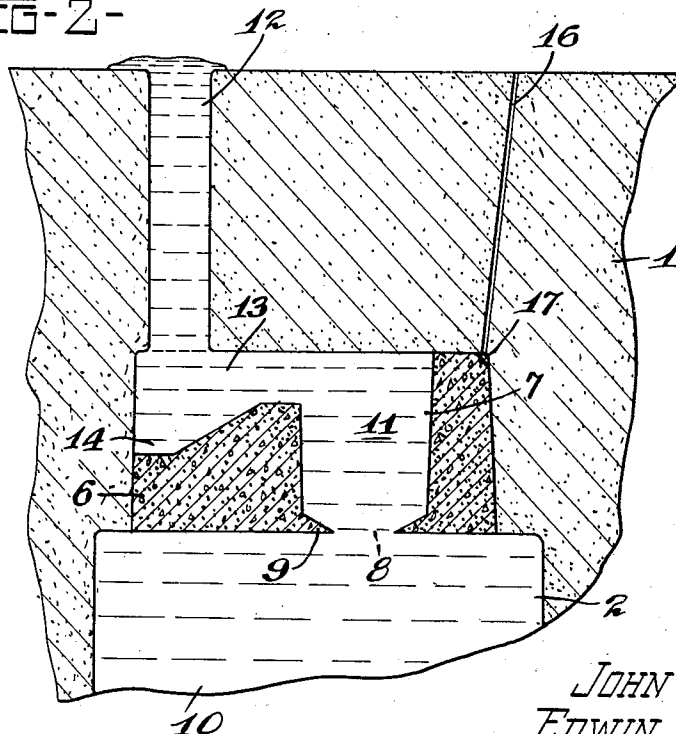


FIG-2-



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2 Sheets-Sheet 2

FIG-3-

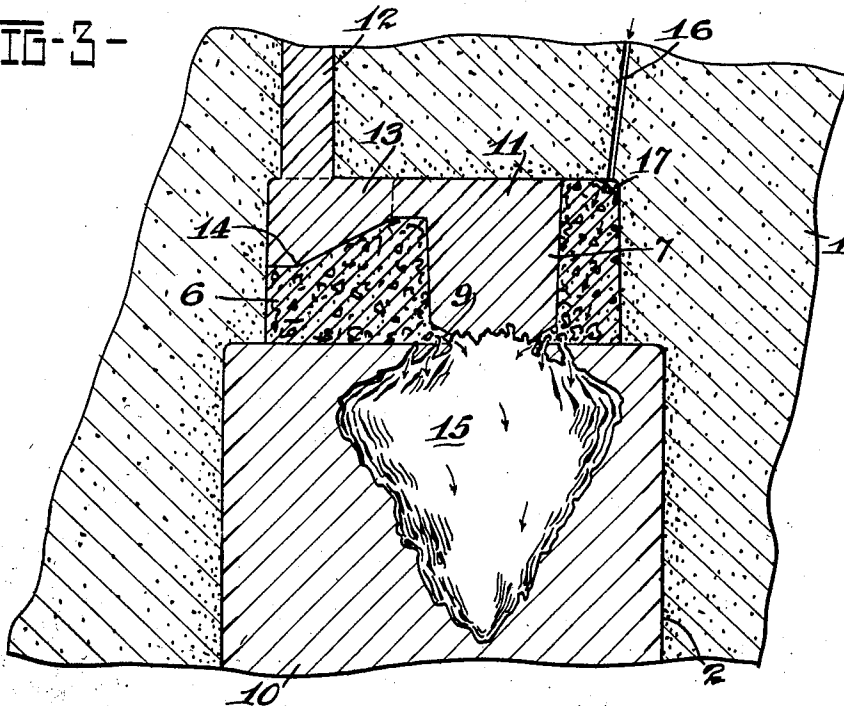


FIG-5-

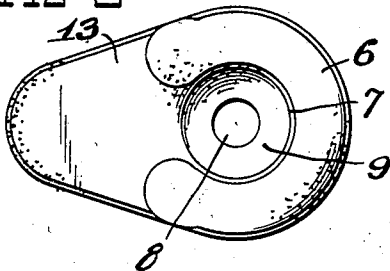


FIG-4-

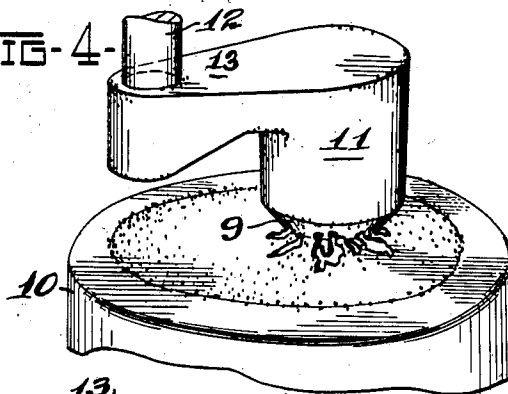


FIG-6-

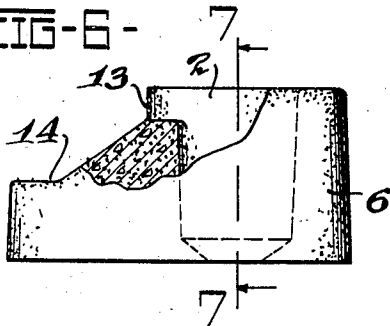
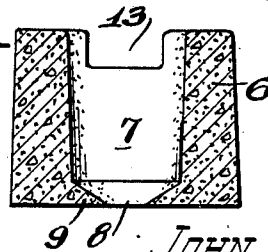


FIG-7-



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MEANS FOR CASTING METALS

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9 Claims. (Cl. 22—134)

This invention relates to the casting of metals, and particularly steel, by the blind head method, wherein the feed metal for shrinkage in the casting is contained in a so-called "blind head" or riser and is forced into the mold by atmospheric pressure on the head metal.

It is known in foundry practice that it is necessary to keep the feed portion of the molten metal in the head open to atmospheric pressure to eliminate creating a vacuum and to help insure the proper shrinkage feed of metal to the casting. Attempts have been made to accomplish this, but these, so far as we are aware, have not been entirely satisfactory for the reason that failure in the necessary shrinkage feed sometimes takes place, particularly with large castings, due to the lack of air pressure supply to the blind head cavity and the consequent creation of a vacuum therein, and also that inspection of such castings to determine shrinkage feed conditions is difficult or impossible upon shaking out the mold and without sawing into the head metal or otherwise acting on it to expose its interior condition.

An object of the invention is the provision, in connection with a blind head type of casting mold, of novel and efficient means, of a gas permeable nature, for retarding solidification of the head metal at a predetermined point on its surface and thereby insuring the admission of air under atmospheric pressure to the shrinkage cavity of the blind head at such point to relieve any vacuum therein occasioned by shrinkage feed of metal to the casting.

Another object of the invention is the provision, in connection with a blind head type of casting mold, of novel and efficient means which will not only act to retard cooling and setting of the head metal at a desired point of admission of air under atmospheric pressure thereto to relieve a shrinkage feed vacuum therein, but will also leave the blind head in a condition, when the mold has been shaken out, to enable an immediate external inspection thereof to determine if proper shrinkage feed for the casting has taken place.

The invention is fully described in the following specification, and a preferred embodiment thereof illustrated in the accompanying drawings, in which—

Figure 1 is a central vertical section of a mold embodying the invention before the pouring of metal therein; Fig. 2 is an enlargement of the portion of Fig. 1 which includes the inventive feature and as it appears immediately after the pouring of the metal has been completed and before ignition of the core material, if of a combustible

nature, has taken place; Fig. 3 is an enlarged fragmentary view similar to Fig. 2, illustrating the condition of the poured metal in the blind head after the shrinkage feeding action and showing the combustible core member embodying the invention as partially consumed; Fig. 4 is a perspective view of the upper portion of the blind head metal of a casting after it has been shaken out from the mold and with the pop metal partially attached thereto; Fig. 5 is a top plan view of the core member embodying the invention; Fig. 6 is a side elevation thereof with a part broken away, and Fig. 7 is a section on the line 7—7 in Fig. 6.

Referring to the drawings, 1 is a conventional showing of a blind head type of sand mold commonly used in the casting of metals and which has the customary blind head cavity 2 and the communicating casting cavity 3. Pouring of molten metal into the mold may be effected either through a gate 4 opening into the blind head cavity 2 or through a gate 5, shown in dotted lines in Fig. 1, opening directly into the casting cavity 3.

In carrying out the feature of the present invention, a core member 6 is mounted in a wall of the blind head 2, preferably its top wall. This core is a unit in itself separate from the mold body, is freely gas permeable in its nature, and preferably has a green core permeability of from 40 up as measured by what is known as "Dieter's" machine commonly used in foundries for measuring the permeability of sand. This permeability characteristic is important to insure free passage of air through the core member, and for satisfactory results should not be less than 40. While this core may be composed entirely of sand bound together by a suitable binder, such for instance as oil, a cereal binder and water, and good results be obtained, it is preferable to include a material in the composition which will give off heat by reason of its combustion when in contact with or in close relation to the molten metal in the blind head and which rises in the core, as hereinafter described.

Any suitable material which will ignite below the temperature of molten metal, may be used, and both coke powder and coal powder of a fairly coarse ground nature have been found to be very satisfactory for this purpose. The quantity of such material used for best results depends to some extent on the size of the casting and that of the blind head in connection with which used and also on the acceleration it is desired to give to the feeding action of the blind head metal to

take care of metal shrinkage in the casting. In practice, very good results have been obtained with various size castings and heads by a mixture of approximately 30% coal powder or other suitable combustible material, together with binder, and the remainder of sand. In many cases where more rapid chilling takes place, such, for instance, as small castings, or where other more drastic chilling conditions, due to pouring time or metal travel, are present, it is found desirable to increase the percentage of combustible material up to 100% so that it will more quickly ignite and thus more quickly act to slow up solidification of the contacting metal in the head.

The core 6 forms what may be termed a "pop chamber" 7 which is open at its bottom or inner end, relative to the head cavity 2, through a restricted opening 8 of sufficient size to permit molten metal from the blind head to flow freely therethrough, such opening being formed by an internal flange or wall part 9 at the inner edge of the core and which completely surrounds the opening. This flange 9 tapers to a thin edge from the body portion of the core, so that the contact of the molten metal therewith at top and bottom will cause a rapid progressive heating of the flange outwardly from the opening. In other words, the hottest portion of the flange will first be at its sharp edge and will thence progress inwardly to the body end of the flange. The chamber 7 is considerably larger in diameter than an ordinary blind head vent passage, so as to form the head metal 10 with a "pop" portion 11 of considerable body to prevent a too rapid solidification thereof and at the same time to cause it to have a greater heating action on the body material of the core than possible with metal in a vent passage of ordinary size. Vents of ordinary size vary from one-eighth of an inch to one inch, depending on size of casting. This heating action of the core body is particularly important when such body includes material which is intended to ignite and burn under the action of the metal heat.

The "pop" chamber 7 is open at its top to the outside air through a vent passage 12 in the mold sand, such passage being of less diameter than the "pop" chamber 7 but of suitable size to void air and gas from the head cavity as the metal rises therein, thus preventing the formation of back pressure, and also to permit molten metal to rise freely in the vent to its top when the mold cavity 3, the blind head 2 and the chamber 7 have become filled, thereby indicating a full condition of such parts. It is preferable, but not necessary, to have the vent passage 12 extend from the core 2 in offset relation to the chamber 7, so that any sand or foreign matter falling therethrough will not be deposited in the chamber and pass therethrough into the blind head cavity. For this purpose, the core has a passage or channel 13 opening laterally from the top portion of its chamber 7 and deepening and broadening therefrom to form a pocket 14 below the offset riser passage 12, so as to catch any matter falling therethrough. In reality, the chamber 7 and passage 12 combine to form a vent passage from the blind head cavity with the chamber portion thereof, which is immediately adjacent to the head cavity, of greater cross-sectional capacity than the passage 12, and with the enlarged inner end portion 7 of the vent passage partially separated from the head cavity by a thin wall 9 which tapers and gradually broadens from

a thin edge outwardly from the opening 8 which it forms.

In practice, the molten metal, when poured into the mold through the usual pouring gate, fills the casting cavity 3 and blind head cavity 2, and when the latter is full flows up through the opening 8 into the chamber 7 and thence up through the vent or riser passage 12 and from its top to indicate to the pourer the full condition of the mold. It is well known that as the metal in the casting cavity cools, which is inwardly from the mold wall, shrinkage occurs in the casting metal, and metal is supplied to the casting cavity from the blind head to compensate for the shrinkage. It is also known that the vacuum resulting in the blind head metal by such shrinkage feed must be relieved in order to make this feeding action effective and to produce satisfactory castings, and that such relief is obtained by admitting atmospheric pressure to the interior of the molten metal in the head. Attempt has been made by others to accomplish this by projecting a gas permeable refractory member from the sand wall of the blind head into the central portion of the molten metal therein, so that atmospheric pressure may be introduced therethrough to the central portion of the metal in the head which is the last to solidify in cooling. Attempt has also been made by others to accomplish this by providing a member in the wall of the blind head which will burn, fuse or disintegrate under the action of the metal heat and produce gases which tend to relieve the feed vacuum in the head metal. With the use of the gas permeable refractory member, one objection is that the metal has a tendency to solidify and form a skin around the member, thereby preventing the supplying of air pressure therethrough to the head metal and causing failure in the purpose of the member; while with the other means reliance is had particularly on the gas giving-off characteristic of the insert for relieving the vacuum in the head without making any special provision for the admission of atmospheric pressure to the interior of the head metal.

With the present invention ample heat is assured to prevent a freezing of the metal at the intended air admission point or area by passing sufficient molten metal through the opening 8 in the thin flange 9 to not only heat but to maintain such flange at a temperature to prevent solidification of the contacting head metal until the necessary shrinkage feed has taken place. The thinness of the flange 9 defining the opening 8 accelerates this action so that the hottest portion of the core is in this flange and decreases away from the opening in proportion to the increase in thickness of the flange. This so retards the solidifying of the head metal immediately adjacent to the opening that the flange 9, at least at its thin edge portion, remains exposed to the shrinkage cavity 15 (Fig. 3) in the head metal until the casting has fully set, thus permitting constant feed of air under atmospheric pressure to such cavity through the permeable core and its flange 9. The presence of combustible material in the core 6 and its flange 9 also accelerates this action, makes it more efficient and provides a means of securing control of the degree to which air pressure acts on the head metal by the addition of combustible material in suitable percentages. It is found in practice that while a skin may form on the head metal under the outer thick portion

of the flange 9 and progressively thicken outwardly therefrom, the thinner portion of such skin will be more or less honeycombed, having numerous small holes therein, and will permit atmospheric pressure to pass therethrough from within the highly gas permeable core body to tend to relieve any vacuum in the head. This is particularly true if the core contains combustible material such for instance as coke or coal dust, which burns and gives off heat when heated to a predetermined extent by the molten metal in contact with the core.

The venting of the head through the chamber 7 insures that sufficient metal will pass through the opening 8 to properly heat the wall 9. This thin edge wall, in addition to forming a "hot spot" in the head, serves to direct the flow of air under atmospheric pressure into the void or shrinkage cavity in the head metal at the hottest point. To facilitate the supplying of air pressure to the head at such point, and also to some extent through the bottom of the core, the core has a greater permeability than the body sand of the mold and direct communication is also provided between the outside air and the core through a small passage 16 in the mold wall. This passage is shown as communicating with an air pocket 17 at the upper outer edge of the core but which does not communicate with the metal receiving cavity of the core except through the core wall. Due to the gas permeable nature of the core, the air under atmospheric pressure readily passes through the core to the desired hot control point of the metal determined by the thin reentrant flange or wall 9.

In practice, it is found that the best and most dependable results are obtained if a combustible material which will burn under the action of the molten metal is included in the core compound, as this insures the maintenance of a "hot spot" in the head metal at the top of the shrinkage cavity and also materially retards the chilling of the metal in the core.

When a casting has been made and the mold shaken out, it is important to be able to readily inspect the heads without first sawing or mutilating them to determine if the proper amount of feed for casting shrinkage has occurred. Upon a shaking out of a mold equipped with the present invention, the core more or less disintegrates and shakes out with the mold sand, and the "pop" either falls off or can be easily knocked off due to the porous nature of the thin skin of metal which may connect the "pop" to the head metal, as indicated in Fig. 4. It is thus possible for the foundryman to readily determine, by external inspection, if the proper air feed to the head has taken place to permit the necessary shrinkage feed, instead of requiring sawing or other mutilation of the head metal for such purpose.

We wish it understood that our invention is not limited to any specific construction, arrangement or form of the parts, as it is capable of numerous modifications and changes without departing from the spirit of the claims.

Having thus described our invention, what we claim as new, and desire to secure by United States Letters Patent, is:

1. A metal casting mold having a casting cavity, a communicating blind head cavity and a vent passage from said last cavity for receiving pop metal from the cavity, with said passage enlarged at its head end and partially sep-

arated from the head cavity by a gas permeable thin edged reentrant wall portion which rapidly heats by contact of molten metal therewith, said wall having communication with the atmosphere and acting to retard the solidification of metal in the head cavity contacting therewith and to admit air under atmospheric pressure to the interior of the head cavity at such point.

2. An arrangement as called for in claim 1 wherein the said wall portion contains a combustible ingredient which will ignite at a temperature lower than that of the molten metal.

3. A metal casting mold having a casting cavity, a communicating blind head cavity and a vent passage through which latter molten metal may rise from the blind head cavity, said passage having its head end enlarged to a greater cross-sectional size than the remaining portion of the passage and the wall of said enlargement having a thin integral reentrant flange part at its inner end with which molten metal must contact in its passage from the head into the enlargement whereby the flange is quickly heated by the metal, said flange being gas permeable and in communication with the atmosphere through the mold wall to permit air under atmospheric pressure to enter the head cavity through the flange to relieve any shrinkage feed vacuum in the head.

4. In a metal casting mold having a casting cavity and a communicating blind head cavity, means forming a pop chamber in the head cavity wall with a restricted opening into the head cavity through which molten metal may flow from the head cavity to fill the chamber and with the wall of said opening forming a portion of the head cavity wall and increasing in thickness outward from a thin edge at the opening, whereby the wall divides molten metal in the chamber and head and is quickly heated by contact therewith and retards solidification of the head metal adjacent to the opening, said wall being freely gas permeable and in communication with the outside air through the mold wall to direct admission of atmospheric pressure to the head cavity through the wall, said chamber having a vent passage leading therefrom.

5. In a sand mold for casting metal, which mold has a casting cavity and a communicating blind head cavity, a core member set into the wall of the head cavity with an end exposed to the interior of the head cavity and forming a pop chamber of greater cross-sectional body than an ordinary vent or riser passage from a blind head cavity, and having a thin reentrant wall at its head end forming a restricted opening between the head cavity and chamber whereby the wall is quickly heated by molten metal flowing from one to the other and the solidification of the metal at the head side thereof is retarded, said core member and its said wall being gas permeable and in communication with the atmosphere through the mold wall, and said chamber having at its top portion a vent passage to the atmosphere.

6. A combination as called for in claim 5 wherein the core material when green has a gas permeability of from approximately 40 up as measured by "Dieter's" machine for measuring the permeability of sand.

7. A combination as called for in claim 5 wherein the material, or at least the reentrant wall part of the core member, is partially of a nature to burn by the communicated heat from molten metal in contact therewith, whereby to accelerate

and prolong the action of said wall in preventing solidification of molten metal in the head cavity adjacent to said opening.

8. In a metal casting mold having a casting cavity and a communicating blind head cavity, a core member having a gas permeable characteristic greater than that of ordinary molding sand and including a combustible ingredient in its mixture which burns at a temperature less than that of molten metal, said core member being set into the top portion of the head cavity wall and forming a part of the inner surface wall of said cavity and also forming a pop chamber of greater cross-sectional size than an ordinary vent passage from a blind head cavity, said core member at the head end of said

chamber having a reentrant wall forming an opening for admitting molten metal from the head to the chamber, said wall gradually thickening from a thin edge outward from the opening to facilitate heating by contact of molten metal therewith, said head wall having provision for admitting air under atmospheric pressure to said core member and also having provision for venting said chamber.

9. A combination as called for in claim 8 wherein the core member has a pocket at a side of the pop chamber and in communication therewith, with a vent passage therefrom in offset relation to said chamber.

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