June 24, 1969 O. J. STENDER 3,451,464

METHOD OF CASTING METALS USING PERMANENT MOLDS

Original Filed April 4, 1966 Sheet 1 of 2

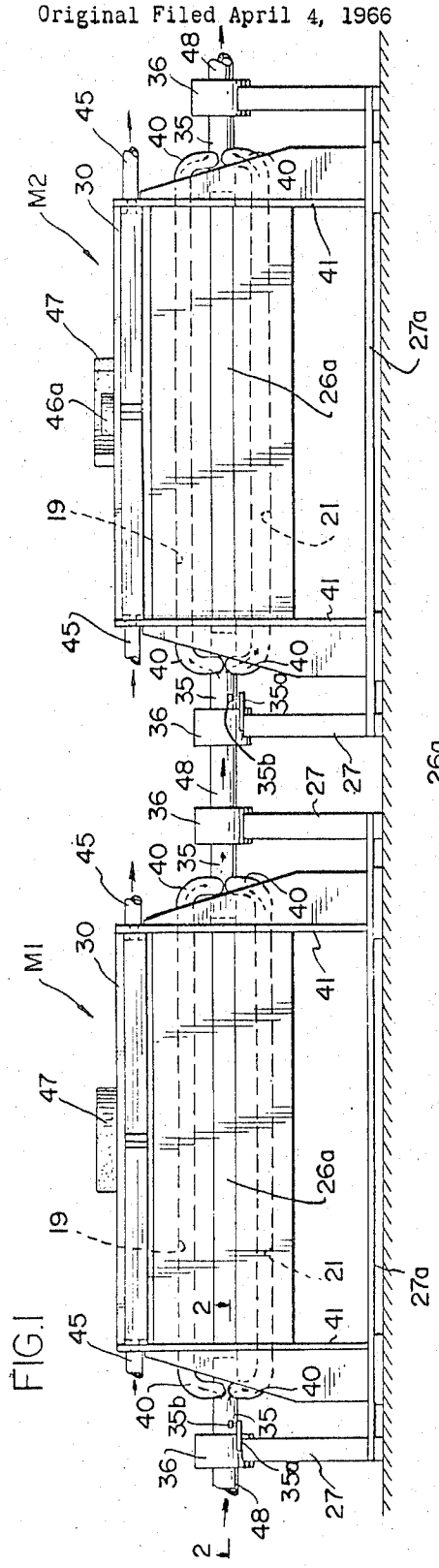


FIG. 1

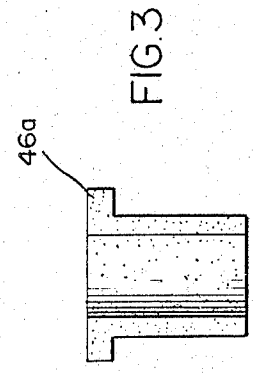


FIG. 3

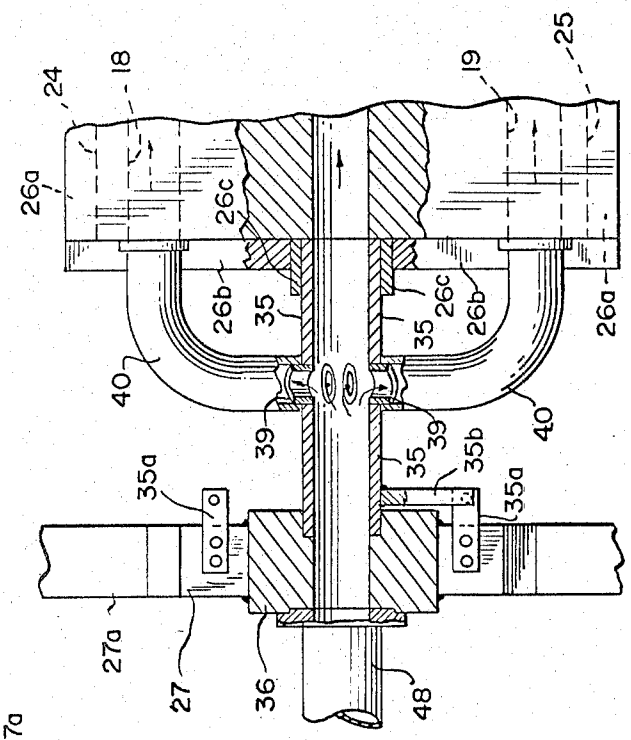


FIG. 2

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FIG. 4

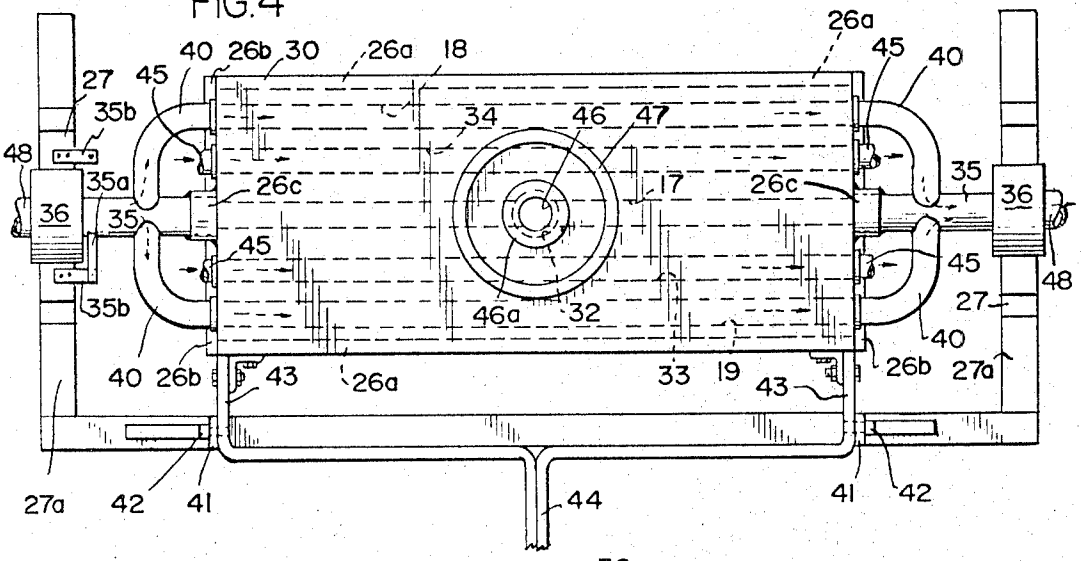


FIG. 5

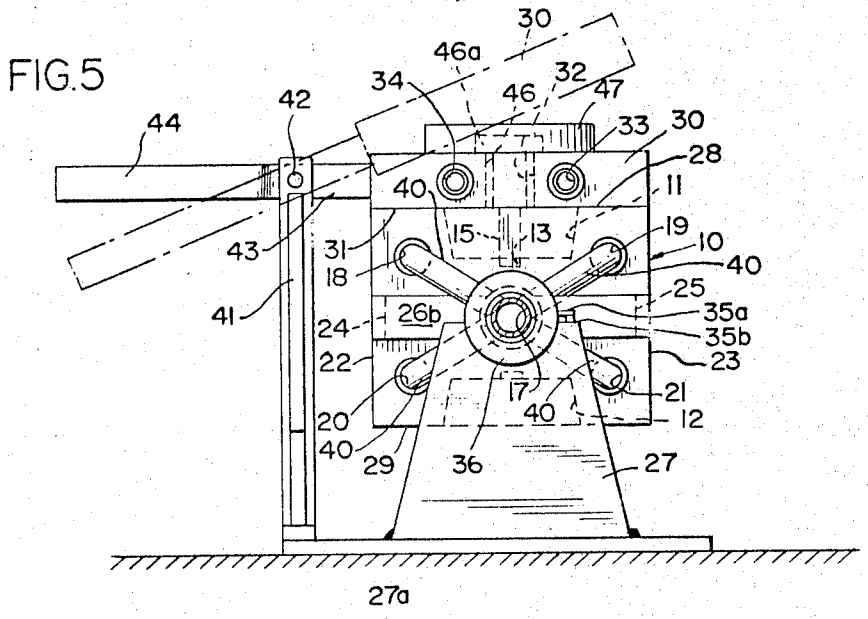
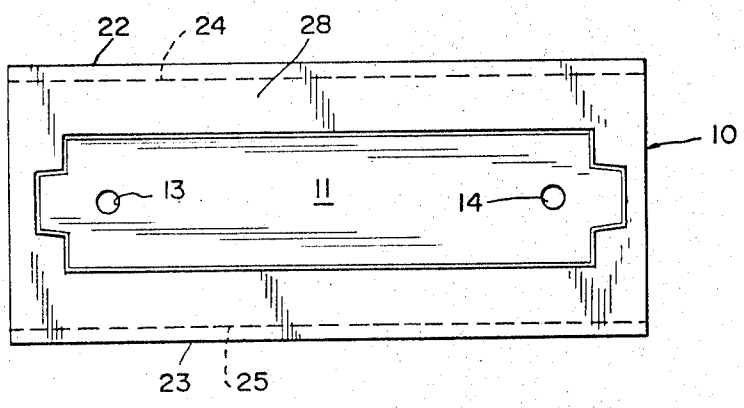


FIG. 6



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METHOD OF CASTING METALS USING PERMANENT MOLDS

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Original application Apr. 4, 1966, Ser. No. 539,807, now Patent No. 3,398,783, dated Aug. 27, 1968. Divided and this application June 28, 1968, Ser. No. 740,952

Int. Cl. B22d 33/02

U.S. Cl. 164—137 2 Claims

ABSTRACT OF THE DISCLOSURE

A method of metal casting with permanent molds in which a mold is provided that has first and second cavities in opposite faces, and a permanent cope is provided which may close either of the cavities and has a gating hole; in which the mold is positioned with the first cavity uppermost, said first cavity is closed with the cope, and a charge of molten casting metal is poured into the mold through the gating hole and allowed to cool to a non-plastic state; and in which the mold is then inverted, the second cavity is closed with the cope, molten metal is poured through the gating hole into the second cavity which is retained uppermost until shrinkage of the casting in the first cavity permits said casting to drop out; and in which the mold is then again inverted to place the first cavity uppermost.

This application is a division of my copending application 539,807, filed Apr. 4, 1966, titled, Metal Foundry Layout Using Permanent Molds, and now Patent No. 3,398,783.

The very simple types of castings such as those used for elevator counterweights, which are generally rectangular castings having a couple of bolt holes to receive bolts to fasten them to a frame, and which do not require a finely finished surface, have customarily been molded in sand molds because of the low cost of such molds. Furthermore, there are few suitable mold materials which are capable of absorbing, without damage, the heat from a casting as large as that for an elevator counterweight which is commonly an uninterrupted slug of material approximately 20 inches long, 9 inches wide, and 3 inches thick. The only openings are the bolt holes which may be about an inch and a half in diameter.

Not only are permanent molds relativley expensive but when they are large enough and heavy enough to handle a casting as large as that required for elevator counterweights they must have thick enough walls that there are distinct problems of breakdown of the mold if it is not cooled in some way.

In accordance with the present invention, the mold consists of a one-piece block of high density synthetic graphite that has a mold cavity which has slightly tapered walls and is unobstructedly open at one side of the graphite block. The surface of the graphite block surrounding the open top of the cavity is very smoothly finished, so that when the undersurface of a smoothly finished synthetic graphite cope rests upon the graphite block the surfaces may provide a substantially metal-proof joint which permits very little flash of molten metal from the mold cavity. Both the mold block and the cope are provided with liquid coolant bores which extend continuously from end to end of the block and of the cope, so that cooling water may be circulated both through the mold and the cope continuously during a molding operation.

The cope is provided with a relatively large sized gate hole through which metal is poured into the mold cavity. In order to permit ready removal of the cope from the mold block without any seizing between the sprue and the wall of the gate, a frangible sleeve is placed in the gate hole so that when the cope is to be removed the sleeve can break apart to free the cope from the sprue. Conveniently the sleeve may be a conventional structure of molding sand and binder.

A loose collar is placed on the cope surrounding the sleeve to furnish a metal cup which receives metal that misses the sleeve or splashes out.

Further in accordance with the present invention, the mold block is formed with molding cavities in two opposite faces, and is mounted for rotation on a horizontal axis so that either the first or the second mold cavity may be placed uppermost and used for molding, with the cavity which is toward the bottom retaining the freshly poured and cooling metal casting until the latter has shrunk enough to drop by gravity out of the cavity.

The mold structures of the present invention are particularly adaptable to a very simple foundry layout in which a plurality of the permanent mold structures with the rotatable permanent mold blocks are placed end to end with coolant hoses or pipes connecting the bores of the mold blocks and of the copes together in series with a source of liquid coolant such as water.

In commercial foundry operations, the disclosed structure, with the high density synthetic graphite mold block and cope, has been used for the formation of several hundred castings from an individual mold cavity with no significant changes in the dimensions of the cavity. Mold life is considerably extended by using a metal chill in the bottom of the mold beneath the gate hole to protect the bottom of the cavity from erosion by molten metal.

The invention is illustrated in a preferred embodiment in the accompanying drawings in which:

FIG. 1 is an elevational view of a series of the permanent mold structures arranged end to end in spaced relationship and connected in series with a source of liquid coolant;

FIG. 2 is a fragmentary sectional view taken substantially as indicated along the line 2—2 of FIG. 1;

FIG. 3 is a longitudinal sectional view of one of the frangible gate sleeves;

FIG. 4 is a plan view of a permanent mold structure embodying the invention;

FIG. 5 is an end elevational view of the permanent mold structure; and

FIG. 6 is a plan view of the permanent mold block.

Referring to the drawings in greater detail, and referring first to FIGS. 5 and 6, a permanent mold block **10** of refractory material has a first mold cavity **11**, and a second identical mold cavity **12**, which are formed in opposite faces of the block. Each cavity is slightly tapered, is free of undercuts, and is provided on its longitudinal center line with shallow round recesses such as the recesses **13** and **14** in the cavity **11**, to receive cores, such as **15** for recess **13** (FIG. 5).

The particular mold cavities **11** and **12** are to produce elevator counterweights, and are approximately 20 inches long, 9 inches wide, and 3⅛ inches deep. The core positioning holes **13** and **14** are approximately 1⅜ inches in diameter and ½ inch deep, and the cores (**15** in FIG. 5) are to leave holes in the cast part to receive fastening bolts by means of which the counterweights are secured to a frame.

The mold block **10** is preferably made of a high density synthetic graphite. The block **10** is originally molded as a solid rectangular piece, and the cavities are thereafter machined into it.

In addition to the cavities **11** and **12**, the block **10** is provided with water coolant bores, **17**, **18**, **19**, **20** and

21 which extend entirely through it from end to end in spaced relationship to the cavities 11 and 12. The bores are also formed in the carbon block by machining. Extending from end to end of the longitudinal sides 22 and 23 of the block are milled grooves 24 and 25 which receive a mounting frame 26 (FIG. 4) by means of which the mold block is supported in a base 27.

A first surface 28 of the block and a second surface 29 in which the respective cavities 11 and 12 are formed surround said cavities and are very smoothly finished by machining so as to provide a very close fit with a cope 30 (see FIG. 5) which has a smoothly finished bottom surface 31 that makes a close fit with either of the surfaces 28 or 29 of the mold block. The cope has a relatively large diameter gate hole 32 which extends through it from top to bottom, and a pair of liquid coolant bores 33 and 34 extend from end to end of the cope.

Referring now to FIG. 4, the mounting frame 26 for the mold block 10 is made in two identical halves, each of which includes a longitudinal portion 26*a* which is seated in one of the grooves 24 or 25, transverse portions 26*b* that extend across both ends of the block, and collar portions 26*c* which are firmly clamped to a coolant pipe 35, the outer end of which is journaled in a hollow trunnion 36 which is connected with a liquid coolant source such as a waterline having a shut-off valve (not illustrated in the drawings). The pipe 35 and trunnion 36 are provided with a conventional water-seal (not shown). The coolant pipe 35 is provided with four nipples 39 (FIG. 2) to receive hoses or pipes 40 which are connected to the coolant bores 18 to 21 of the mold block 10.

As best seen in FIG. 5, supporting posts 41 extend transversely from base plate 27*a* and are provided with pivots 42 to receive hinge arms 43 which support the cope 30 and provide means for moving the cope upwardly away from the facing surface of the mold block 10 so as to expose the cavity 11 or the cavity 12, as the case may be. The hinge arm 43 is provided with a handle 44, and if desired a foot treadle (not shown) of conventional type may be provided for moving the cope, and a conventional locking linkage may be used to latch the cope in open position.

Connected with the coolant bores 33 and 34 of the cope are sections of hose 45 (FIG. 1) which are also connected to the source of water, and which are long enough that they do not interfere with raising and lowering of the cope about the pivots 42.

It is apparent from the description of the hollow trunnions 36 and the rotatable pipes 35 that the mold block 10 may be rotated to position either the mold cavity 11 or the mold cavity 12 uppermost, so that one cavity may be filled with molten metal while a casting in the other mold cavity is cooling.

The rotatable pipe 35 at each end of the mold block is provided with a radially extending stop 35*a*, and the supporting base 17 is provided with a pair of adjustable stops 35*b* with which the radial stop 35*a* may abut to assure that the mold block is precisely horizontal regardless of whether the mold cavity 11 or the mold cavity 12 is uppermost. Assuming that the mold cavity 11 is uppermost, and the mold cavity 12 is at the bottom, a casting in the cavity 12 eventually shrinks enough to drop out of the cavity by gravity.

Before molten metal is poured into either mold cavity, the cope 30 is lowered to close the open top of the cavity, and a frangible sleeve 46 (see FIG. 3) is set in the gate hole 32 of the cope, and a loose frangible collar 47 is set on the cope surrounding the sleeve to form a cup which confines any molten metal that may drop outside the sleeve during the filling of the mold. The frangible sleeve 46 is used in the gate hole 32 so that when the cope is pivoted to open position the frangible sleeve may be crushed and destroyed and thus permit the cope to be freed from the sprue.

The permanent mold structure of the present invention lends itself to a very simple foundry layout which is illustrated in FIG. 1, wherein two complete mold assemblies are designated as M1 and M2. It is seen in FIG. 1 that the mold assemblies are disposed end-to-end in spaced relationship, and that the hollow trunnions 36 of the two mold assemblies are connected by a pipe 48 so that the two mold assemblies are connected in series with the source of coolant water. Likewise, coolant hoses 45 connect the coolant bores 33 and 34 of the cope on the assembly M1 with the coolant bores of the cope on the assembly M2, so that the copes are likewise connected in series with the coolant source.

It is apparent from the foregoing description of the foundry layout that additional mold assemblies may be added to the line and the coolant bores of those assemblies may be connected in series with the coolant bores of the mold assemblies M1 and M2.

In operation, assuming that the mold assembly M1 has the cavity 11 uppermost, the bolt hole cores 15 are first placed in the core recesses 13 and 14, the cope 30 is then lowered to bring its finished surface 31 into contact with the finished surface 28 of the mold block 10 and the tops of the cores 15 and 16. A frangible sleeve 46 is placed in the gate hole 32, and a collar 47 is placed on top of the cope surrounding the sleeve. The mold is then ready to receive a charge of molten casting metal which is poured into the cavity through the sleeve, and any molten metal which fails to enter the sleeve or splashes out is confined by the collar 47.

As soon as the sprue and any loose metal in the cup formed by the collar 47 have passed from a molten state into a plastic state, the mold operator uses any suitable implement, preferably a long-handled, wide-bladed scraper, to knock the collar, the excess metal, the top collar flange 46*a* (FIG. 3) and the upper end of the sprue free of the cope. The cope may then be swung about the pivots 42 to open the mold cavity, and in this operation the sprue breaks up the frangible sleeve 46. Thus, the frangible sleeve prevents the sprue from interfering with the opening of the mold.

The mold block is then rotated on the trunnions 36 to position the mold cavity 11 at the bottom and the mold cavity 12 at the top. At this point the casing in he cavity 11 is still at a medium red heat, and has not yet shrunk sufficiently to drop out of the mold cavity. As the casting cools it eventually shrinks enough to drop by gravity from the mold cavity 11. In the meantime, bolt cores 15 and 16 have been positioned in the cavity 12, the cope has been lowered to close the cavity, the frangible sleeve 46 has again been placed in the gate hole 32 and a new frangible collar 47 has been placed on the cope. A charge of molten casting metal is then poured into the cavity 12, and the process is repeated.

Preferably a sufficient number of complete mold assemblies are provided in a foundry layout to permit the molding crew to move the ladle of molten metal along the line of molds so that, for example, all the cavities 11 may first be filled sequentially, the several molds may be inverted sequentially at the proper times, and by the time the ladle has returned to the first mold in the line to fill the first of the cavities 12, the casting in the cavity 11 of the first mold assembly has dropped out of the cavity so that the mold block 10 has more chance to cool than it would if the mold cavity 12 were filled while the casting in the cavity 11 was still at a medium red heat.

The foregoing detailed description is given for clearness of understanding only, and no unnecessary limitations are to be understood therefrom as modifications will be obvious to those skilled in the art.

I claim:

1. A method of metal casting which comprises the successive steps of: providing a permanent mold which has first and second cavities in opposite faces; providing a permanent cope which may close either of said cavities

and has a gating hole; positioning the mold with the first cavity uppermost; closing said first cavity with the cope; mounting a frangible sleeve in the gating hole; pouring a charge of molten casting metal through the sleeve into the mold; lifting said cope from the mold while destroying said frangible sleeve; permitting the charge of metal in the first cavity to cool to a non-plastic state; inverting the mold to position the second cavity uppermost; closing said second cavity with the cope; mounting a frangible sleeve in the gating hole; pouring a charge of molten metal through the sleeve into the second cavity; lifting the cope from the mold while destroying the frangible sleeve; retaining the mold with the second cavity uppermost until the casting metal in the first cavity shrinks sufficiently to drop out of said first cavity; and then inverting the mold to again position the first cavity uppermost.

2. The method of claim 1 which includes the step of continuously circulating a liquid coolant through the mold and the cope throughout the casting process.

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U.S. Cl. X.R.

164—130, 339, 344, 409; 249—137