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2,156,998

APPARATUS FOR FORMING COMPOSITE METAL ARTICLES

Filed Oct. 18, 1937

2 Sheets-Sheet 1

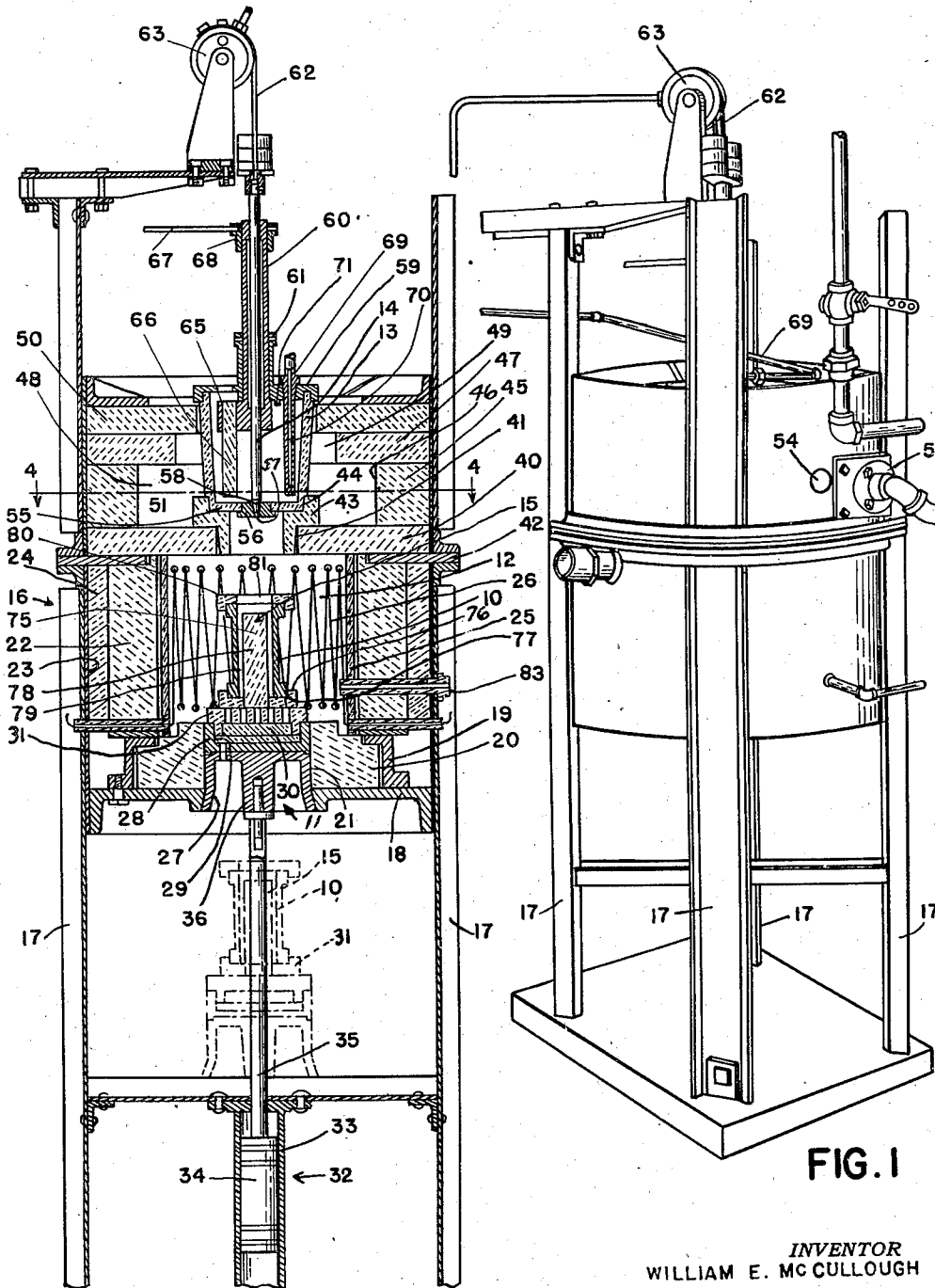


FIG. 1

FIG. 3

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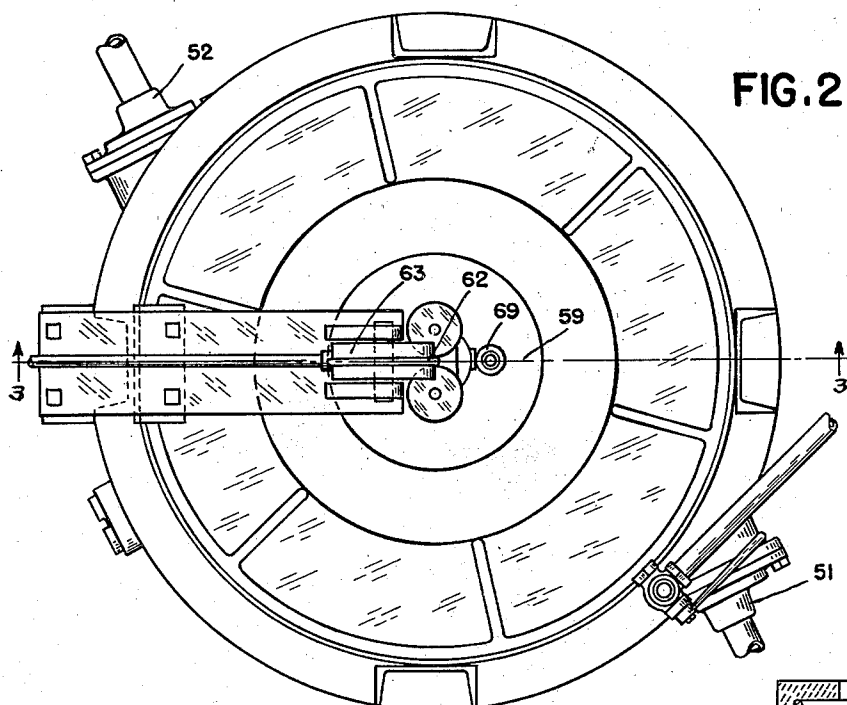


FIG. 2

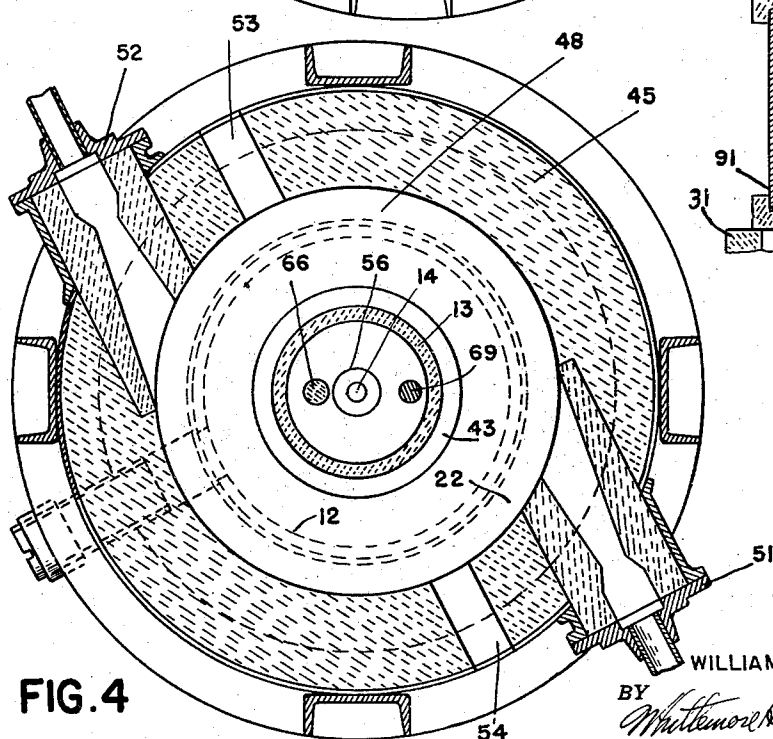


FIG. 4

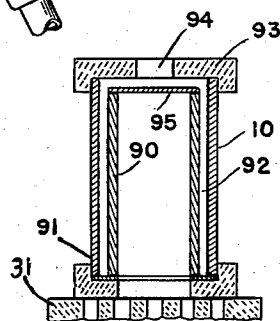


FIG. 5

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APPARATUS FOR FORMING COMPOSITE
METAL ARTICLES

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5 Claims. (Cl. 22—58)

This invention relates generally to an improved method and apparatus for casting composite metal articles and refers more particularly to casting linings in bearings or like members.

It is one of the principal objects of this invention to provide a method and apparatus of the type set forth capable of securing a more uniform product by eliminating, to a large extent, manual control of casting conditions.

Another advantageous feature of the present invention consists in the provision of a method and apparatus for casting linings in articles wherein the steps of melting the metal, heating the articles, casting the lining, and initially cooling the resulting casting, are all carried out under such closely controlled atmospheric conditions as to prevent oxidation of the metal from the time it is converted to its molten state to the time it is initially cooled in the mold.

Another object of this invention is to preheat the article or mold to the casting temperature in a chamber having an atmosphere free from air or oxygen so that there is no danger of the surfaces of the article, or mold, from becoming oxidized and, in turn, effect oxidation of the molten metal subsequently poured into the mold.

Still another object of this invention consists in converting the metal to its molten state in a crucible containing an atmosphere which is also free from air or oxygen so that the oxidation of the metal will not take place during the melting operation.

In addition to the foregoing, the present invention contemplates pouring the molten metal into the mold cavity in an atmosphere which is also characterized in that it will not oxidize the metal during the time it is poured into the cavity.

The foregoing, as well as other objects, will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, wherein:—

Figure 1 is a perspective view of apparatus constructed in accordance with this invention;

Figure 2 is a plan view of the apparatus shown in Figure 1;

Figure 3 is a sectional view taken substantially on the plane indicated by the line 3—3 of Figure 2;

Figure 4 is a cross sectional view taken substantially on the plane indicated by the line 4—4 of Figure 3; and

Figure 5 is a sectional view illustrating a slightly modified form of construction.

In general, a mold containing a bearing shell 10 and a core cooperating with the inner sur-

face of the shell to form a cavity are supported on a platform 11 within a heating chamber 12 and molten metal is permitted to flow by gravity into the cavity from a crucible 13 supported above the heating chamber 12. The heating chamber 12 is sealed and the atmosphere in this chamber, as well as the atmosphere in the crucible 13, is effectively controlled so as to be free from air or oxygen. This is accomplished, in the present instance, by replacing the atmosphere in both the crucible and heating chamber with a gas which will not oxidize the metal at the temperatures used in the pouring operation. As a result of the above, no air or oxygen is permitted to contact with the metal from the time it is converted to its molten state to the time it is poured into the bearing shell and, as a consequence, the metal forming the lining of the shell will afford a highly satisfactory bearing surface.

After the proper amount of molten metal has been poured into the shell 10, the discharge opening in the bottom of the crucible is closed by a valve 14 and the platform 11 is lowered to locate the bearing shell in a position below the heating chamber 12 where it may be conveniently removed from the platform and subjected to a cooling operation (not shown herein). The core 15 is then removed from the bearing and the latter is machined to the proper size.

Referring now more in detail to the apparatus selected herein for the purpose of illustrating the present invention, it will be noted that the same comprises a vertical furnace 16 supported by a plurality of legs 17 and having a bottom wall 18 centrally apertured to provide for extending the platform 11 upwardly therethrough. Supported upon the plate 18 by means of the ring 19 is an element 20 formed of refractory material and having an opening 21 therethrough in registration with the opening through the bottom plate 18 of the furnace. The element 20 forms the bottom wall of the pouring chamber 12 and supports the drum-shaped element 22 which is also composed of refractory material, and forms the vertical side wall of the pouring chamber 12. It will be observed from Figure 3 that the outer surface of the element 22 is spaced inwardly from the annular side wall 23 of the furnace and this space is filled with a suitable insulating material 24. The inner annular surface of the element 22 is lined with a shell 25 having an electrical heating element 26 associated therewith and designed to maintain the temperature in the chamber 12 sufficiently high to prevent solidification of the metal during the pouring operation and to heat

the steel bearing shell to the bonding temperature.

The platform 11 comprises an inverted cup-shaped section 27 extending through the opening in the bottom wall 18 into the opening 21 in the element 20 and having the lower edge portion flared outwardly and adapted to engage the correspondingly tapered wall of the central opening through the bottom wall 18 to provide a seal which prevents the passage of air into the chamber 12 when the platform is in its uppermost position, shown by the full lines in Figure 3. Supported upon the upper end of the section 27 is a top section 28 recessed, as at 29, to receive a refractory material 30 and adapted to support a table 31 which, in turn, forms a support for the bearing shell 10.

The platform 11 is movable between the two positions shown in Figure 3 by means of a fluid pressure actuated device 32 comprising a vertical cylinder 33 and a piston 34 reciprocally mounted in the cylinder. A rod 35 operatively connects the piston 34 in the cylinder 33 to a central hub 36 formed integral with the cup-shaped section 27 of the platform 11. In accordance with conventional practice, fluid pressure is alternately admitted to the cylinder 33 on opposite sides of the piston 34 in a manner (not shown herein) for effecting reciprocation of the piston.

The top end of the annular pouring chamber 12 is closed by means of a plate 40 of refractory material having a central opening 41 therethrough and having the outer edge portion resting upon a ring 42 which, in turn, is secured to the side wall of the furnace. A sleeve 43 of heat resisting material is sleeved in the opening 41 and is provided with an enlargement above the plate 40 for supporting the crucible 13. As shown in Figure 3, the enlargement is recessed, as at 44, to receive the lower end of the crucible 13 and for holding the latter in an upright position in the furnace. Seated upon the plate 40 is a ring 45 of refractory material having the inner annular wall 46 surrounding the lower end portion of the crucible and cooperating with a top plate 47 of refractory material to form a burner chamber 48. The plate 47 is supported upon the top surface of the ring 45 and is formed with an enlarged opening 49 through the center thereof to provide for receiving the crucible 13. A cover 50 of refractory material is seated upon the plate 47 and cooperates with the upper portion of the crucible 13 to close the heating chamber 48.

Upon reference to Figure 4, it will be noted that heat is generated in the chamber 48 by means of two burners 51 and 52. The two burners are predeterminedly arranged with respect to the annular chamber 48 to cause the products of combustion to travel circumferentially of this chamber around the crucible 13. In detail, it will be noted from Figure 2 that the two burners are arranged in opposed relationship at opposite sides of the furnace and extend substantially tangentially to the annular chamber 48. The products of combustion discharged from the burner 51 escape from the heating chamber through a discharge opening 53 located adjacent the burner 52 and the products of combustion of the latter burner are permitted to escape from the furnace through a discharge opening 54 located adjacent the burner 51.

The crucible 13 is formed of a heat resisting material and has a threaded opening through the

center of the bottom wall 55 thereof for detachably receiving a valve or cap member 56. The member 56 is formed with a restricted discharge opening 57 therethrough having an outwardly flared portion at the upper end thereof forming a tapered valve seat 58 for engagement with the correspondingly tapered lower end of the valve plunger 14. The valve plunger 14 extends upwardly through the cover 59 for the crucible and is slidably mounted in a bushing 60 rotatably supported in a hub 61 on the cover 59. The upper end of the valve plunger is operatively connected to a cable 62 which extends over a suitable pulley 63 and terminates in a position where it may be conveniently manipulated by the operator. It will, of course, be understood from the above that the valve plunger is operated by the action of gravity to close the discharge port 57 in the bottom of the crucible and is manually lifted to open this port by the cable 62.

In Figure 3 of the drawings, the lower end of the bushing 60 is shown as extending into the crucible and as having an eccentric portion 65 into which a stirring bar 66 is secured. The stirring bar is formed of a heat resisting material and extends to a position adjacent the bottom of the crucible. The bar is oscillated to agitate the molten metal in the crucible by means of a spider 67 having a hub 68 secured to the upper end of the bushing 60.

It has previously been stated that the atmosphere in the crucible is controlled to such an extent that the latter is free from air or oxygen and this is accomplished herein by replacing the atmosphere in the crucible with a gas of the type which will not oxidize the metal at the temperatures employed. In the present instance, the gas is admitted through a fitting 69 in the cover 59 of the crucible and is conducted to a point immediately adjacent the bottom of the crucible through a tube 70 of a heat resisting material, such as graphite. It may be pointed out at this time that in cases where the tube assumes a position in the path of travel of the stirring bar 66, a suitable stop 71 is formed on the inner surface of the cover 59 adjacent the tube for engaging the eccentric 65 to prevent either the latter or stirring bar from contacting with the tube 70. The provision of the stop 71 is of particular importance in cases where the tube 70 is formed of graphite, or some other fragile material, since it prevents breakage of the tube by the stirring bar.

The bearing shell 10 is supported on the platform 11 and is positioned by a core 75 so that the shell is located directly below the discharge passage 57 through the bottom wall of the crucible. One type of core that may be used is shown in Figure 3 as having a base 76 recessed, as at 77, to receive the lower end of the bearing shell and having a vertical portion 78 extending axially through the bearing shell 10. The diameter of the vertical portion 78 is such as to provide an annular space 79 at the inner side of the bearing shell slightly greater than the thickness of the lining desired, and it is within this space that the molten metal from the crucible is discharged. The upper end of the bearing shell is protected by a cap 80 preferably of the same material as the core, and the latter is formed with an opening 81 therethrough communicating with the annular space 79 to permit the molten metal to flow by gravity from the discharge port 57 into the space 79.

In order to form a highly satisfactory bearing

surface, it is important to guard against oxidation of the metal as it flows from the valve port 57 into the space 79, and this is accomplished in the present instance by replacing the atmosphere in the chamber 12 with a gas characterized in that it will not oxidize the metal at the prevailing temperatures. This gas is introduced into the chamber 12 through the medium of a conduit 83 extending through the side wall of the chamber 12. As a matter of fact, with the present invention, the lining cast on the inner surface of the bearing shell is not submitted to the air until the platform 11 is lowered to the dotted line position shown in Figure 3 and, at this time, the metal is sufficiently set that exposing the same to the air does not affect the quality of the casting.

Operation

Assuming that the parts are in the position thereof shown in Figure 3, a metal of the type required to form the desired lining in the bearing shell is placed in the crucible 13. The atmosphere or air within the crucible is replaced by a gas which is introduced into the crucible through the tube 70 and which will not oxidize the metal at the prevailing melting temperatures. At the same time, this gas is introduced into the pouring chamber 12 and replaces the atmosphere in this chamber so that there will be no danger of oxidizing the metal during its passage from the crucible to the space 79 in the bearing shell 10, nor of oxidizing the steel shell during heating to the casting temperature. After the metal in the crucible has been converted to its molten state by the heat generated in the chamber 43, the valve rod 14 is lifted by the operator and sufficient molten metal is permitted to flow by gravity through the port 57 into the space 79 to fill the latter. A suitable glass covered sight opening is provided in the side of the pouring chamber 12 so that the operator may determine when sufficient metal has been poured to completely fill the bearing shell and to take care of the shrinkage that exists when the metal solidifies. When the required amount of metal has been poured, the cable 62 is released and the valve plunger returns to its closed position under the action of gravity. The platform 11 is lowered to the dotted line position thereof shown in Figure 3 and the bearing shell, with its lining and core, is introduced to a cooling operation (not shown herein). The core is then removed from the bearing and the lining is machined to the proper dimension.

In Figure 5, I have shown a slightly modified form of core construction. In this figure, a metal tube 90 is concentrically located within the bearing shell 10 and is welded to the latter at the lower end thereof in the manner designated by the reference character 91. The external diameter of the tube 90 is sufficiently less than the internal diameter of the bearing shell to provide a space 92 slightly greater than the thickness of the lining desired. The top of the shell is closed by means of a cover 93 having a centrally arranged opening 94 therethrough providing for the passage of molten metal into the space 92. Also, the upper end of the tube 90 is closed by means of a disc 95 welded in place. With this construction, it is necessary to remove the metal tube 91 by a boring operation, but the metal core contributes materially in securing a highly effective lining structure.

What I claim as my invention is:

1. In apparatus for casting metals, the combination with a mold having a cavity, of a crucible

containing the metal adapted to be poured and having a valve controlled discharge port in the bottom wall thereof, a chamber positioned below the crucible and having an opening through the top wall closed by the bottom wall of the crucible, said chamber also having an opening in the bottom wall thereof, and a platform for supporting the mold movable from a position beneath the chamber to a position within said opening.

2. In apparatus for casting metals, a crucible adapted to contain the molten metal and having a discharge port in the bottom wall thereof, a removable cover for the upper end of the crucible and having a hub portion, a sleeve rotatably mounted in the hub portion and having the lower end extending into the crucible, a stirring bar secured to the lower end of the sleeve at a point offset from the axis of rocking movement of the sleeve, and a rod slidably mounted in the sleeve having a portion at the lower end controlling the discharge port in the bottom wall of the crucible.

3. In apparatus for casting a lining in bearing shells or the like, a chamber having openings in the top and bottom walls thereof, a platform movable from a position below the chamber into the opening of the bottom wall of the chamber to close said opening, means for positioning the bearing shell on the platform with its axis extending vertically of the chamber, means closing the lower end of the bearing shell and cooperating with the inner annular surface of the shell to form a space having a width approximating the thickness of the lining desired, means for introducing a gas into the chamber to provide an atmosphere which is substantially free from air, and means located above the chamber for melting metal in the presence of an atmosphere similar to the one existing in the chamber and for discharging the molten metal through the opening in the top wall of the chamber into the annular space in the bearing shell.

4. In apparatus for casting a lining in a bearing shell or the like, a heating chamber containing a non-oxidizing gas and having an opening through the top wall thereof, means for supporting a bearing shell in said chamber with the axis of the shell extending vertically and substantially in alignment with said opening, means extending into said bearing shell and cooperating with the inner annular surface of the shell to form a space having a width approximating the thickness of the lining desired, and a crucible also containing a non-oxidizing gas and supported above the chamber with the bottom wall forming a closure for the opening in the top wall of the chamber, said crucible adapted to contain a molten metal and having an opening in the bottom wall in registration with the opening through the top wall of the chamber whereby the molten metal flows by gravity in the presence of a non-oxidizing atmosphere to the space within said bearing shell.

5. In apparatus for casting a lining in a bearing shell or the like, a heating chamber containing a non-oxidizing gas and having an opening through the top wall, means for supporting said bearing shell in said chamber with the axis of the shell extending vertically and substantially in alignment with said opening, means extending into said bearing shell and cooperating with the inner annular surface of said shell to form a space having a width approximating the thickness of the lining desired, a crucible also containing a non-oxidizing gas and supported above the chamber with the bottom wall forming a closure for the opening in the top wall of the cham-

ber, said crucible adapted to contain molten metal and having a valve controlled opening in the bottom wall registering with the opening in the top wall of the chamber for discharging molten metal into the space in said bearing shell, a heating chamber surrounding the lower portion of the

crucible, and a plurality of heating units arranged to discharge heating medium into the chamber surrounding the crucible substantially tangentially to the inner side wall of the latter chamber.

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