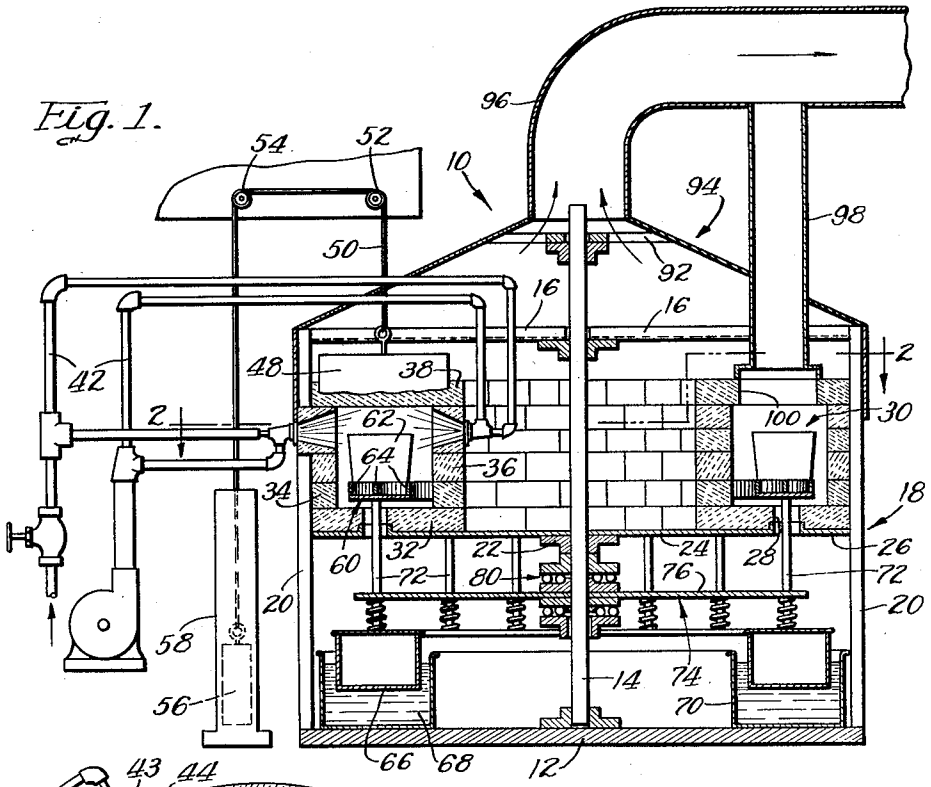
Oct. 10, 1950 J. FREI, JR 2,525,407

FURNACE

Filed April 25, 1947

Fig. 1.



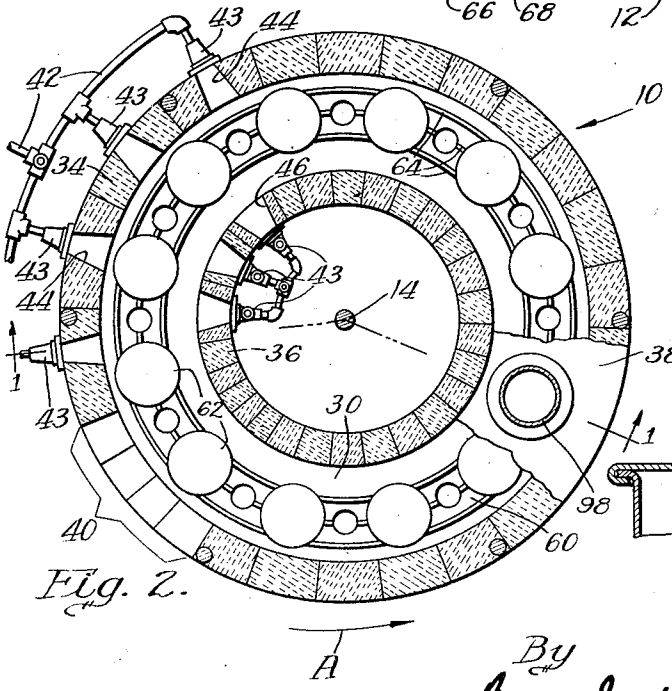
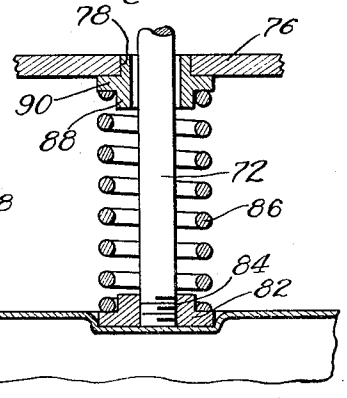


Fig. 2.

Fig. 3.



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FURNACE

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3 Claims. (Cl. 263—7)

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My invention relates to a furnace and to a method of heat treating articles and particularly to a furnace for and method of continuously heat treating molds for casting.

Although my invention may be used advantageously for the heat treatment of many types of articles, it is particularly well adapted for continuous heating of flasks which contain molds, such as are used in centrifugal casting operations, and the invention will therefore be described in that connection. The flasks contain mold forming material of silica in finely divided form which surrounds a wax or plastic pattern corresponding in shape to the object to be cast. When the pattern is removed from the mold by being melted and burned out, the space which it occupied constitutes the mold cavity into which molten metal will be cast.

It is highly important that during the melting and burning out of the wax or plastic patterns that none of the particles of the finely divided mold-forming material detach themselves from the surface of the mold cavity, otherwise the mold cavity would be imperfect in shape and cause an imperfection in the casting. It is an object of my invention to provide adequate heating of a mold while supporting it substantially free of vibrations whereby the pattern may be burned out without causing particles of the mold forming material to become detached from the surface of the mold cavity. In accomplishing this object I provide a platform for the flasks which contain the molds to be heated, which platform is supported by a float which is carried on a body of liquid. In this way vibrations received by the furnace or its supporting structure are not transmitted in any substantial degree to the platform which carries the flasks and their molds.

It is a further object of my invention to produce molds which not only have the pattern of the mold completely burned out without damage to the mold cavity but which also are heated to the temperature desired, in some cases to a temperature approximating that of the molten metal which will be delivered to it in the casting operation.

So that continuous casting may be performed by centrifugal casting machines, it is a further object of my invention to provide a furnace which is adapted to heat a series of flasks in sequence so that a properly heated mold with the pattern burned out will be ready each time the molten metal to be cast is at the proper temperature in the crucible of a centrifugal casting machine such as that illustrated in my copending application, Serial No. 751,655, filed June 2, 1947. In this way a flask containing a properly heated mold may be removed from the furnace and immediately transferred to the casting machine and the molten metal cast with a minimum of delay. There is therefore a minimum loss of heat in the mold and a minimum loss of heat from the crucible containing the metal to be cast. Consequently chilling of the metal in the crucible and also as it is being cast in the mold is eliminated.

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In the accomplishment of the foregoing object I provide an additional advantage in that the furnace of my invention provides a rotatable annular work supporting platform and a single entrance or loading station for the platform such that fresh flasks may be positioned on the platform as heated flasks are removed therefrom to go to the centrifugal casting machine. This arrangement provides convenience and economy in operation since only a single operator is required for loading and unloading the platform. Since the platform is annular, the furnace is compact and does not have to extend longitudinally over a great extent of floor space. Although I refer to the platform as being annular in shape it will be understood that any platform substantially circular in outline may be employed and constitutes an equivalent structure. Even a rectangular platform could be employed, but it would not be practical.

It is a further object of my invention to provide a self-balancing mechanism for the annular float-supported platform of my furnace so that as flasks or other objects are initially placed on the work supporting platform and thereby form an unbalanced load on it, the platform will be maintained substantially horizontal so that the flasks will not tip over or slide from the platform.

It is still another object of my invention to provide in the heating chamber of my furnace means for causing a flow of heat from that zone of the chamber where the heating means is located toward the entrance of the chamber where the objects to be heated are introduced to the chamber. This construction is provided so that as the movable platform carries the objects to be heated toward the zone where the maximum desired temperature is imparted to them, they pass through a zone of increasing temperature and thereby are gradually, not suddenly, subjected to high temperatures.

Other objects, uses and advantages of my invention will become apparent from the following description when taken with the accompanying drawings in which:

Figure 1 is a sectional view taken along the line 1—1 of Figure 2 of the furnace of my invention;

Figure 2 is a sectional view on the line 2—2 of Figure 1; and

Figure 3 is an enlarged view of the details of part of the self-balancing mechanism for the work supporting platform.

Referring now to the drawings, the reference numeral 10 indicates the furnace generally. To the center of the base 12 of furnace 10 there is secured a vertically extending post or pillar 14 which supports cross bars, such as the bars 16, at its upper end. The outer framework, indicated generally by the reference numeral 18, comprises a series of vertically extending posts or angle irons, such as the posts which interconnect the base 12 with the cross bars 16. At an intermediate point on the center post 14 there is positioned a fixed bracket 22 which carries a supporting platform 24. At a corresponding height on the posts 20 of the outer framework 18 there is supported an annular platform 26 which is spaced from the platform 24 in such fashion as to provide an annular slot 28 for a purpose to be described hereinafter.

A heating chamber or oven, indicated generally by the reference numeral 30 is annular in form and is constructed of fire brick or other heat resistant material. The base 32 of the heating chamber 30 is supported on the platforms 24 and 26, and side walls 34 and 36 in turn are supported on the base 32. A top wall 38 bridges the side walls 34 and 36 to complete the chamber. An entrance 40 (see Figure 2) to the chamber 30 is provided by an opening in the outer side wall 34.

The heating chamber 30 may be heated by any one of a number of well known heat supplying means. The furnace illustrated is gas fired, but it will be appreciated that it may be oil fired or electrically heated if desired. Gas supply pipes 42 from a gas source (not shown) have their burners or jets 43 located adjacent apertures 44 and 46 in the side walls 34 and 36, respectively, of the oven 30. As may be seen in Figures 1 and 2 the apertures flare inwardly to accommodate the flame which issues from the burners 43 when they are lit. The gas burners 43, generally referred to as the heat supplying means, extend only part way about the annular heating chamber and, as will be noted from Figure 2, extend inwardly of the chamber 30 from one side of the entrance 40.

A door 48 of fire resistant material is adapted to close off the entrance 40 from that zone of the heating chamber 30 which contains the heat supplying means. The door 48 has secured to it a wire cable which passes over a pair of pulley wheels 52 and 54 and has secured at its other end a counterweight 56 which is guided in a vertically extending tube 58. By means of the counterweight 56 and cable 50, the door 48 may be easily raised or lowered with little effort by the operator who is standing adjacent the entrance 40.

Within the heating chamber 30 of furnace 10, there is an annular movable platform indicated generally by the reference numeral 60. The articles to be heated, such as flasks 62, are placed on the platform 60 for movement through the heating chamber 30. Vertically extending flanges or ridges 64 may be formed on the top surface of platform 60 for supporting the flasks 62 and for permitting an open space beneath the flasks so that the pattern, when melted, may run out or readily vaporize. It will be understood that the flasks are placed in inverted position upon the platform 60, that is, with the pouring sprue of the mold pointed downwardly so that the pattern, when melted, may flow downwardly on to the platform 60 between the ridges 64. Instead of flanges or ridges 64, temporary, removable supports, such as a pair of fire bricks, providing an opening beneath the mold cavity of the flasks may be employed. Platform 60 is supported by means of a hollow float 66 formed of sheet metal. The float may, of course, be formed of wood or other material which will float in the liquid 68 which supports it. The liquid is carried in an annular sheet metal tank 70. Tank 70 is positioned on the base 12 of furnace 10 and is axially aligned with the annular heating chamber 30. Float 66 is interconnected with the supporting platform 60 by means of a plurality of vertically extending rods 72. The float is movable within the annular tank 70 and in order to guide it so that the vertically extending rods 72 connected to it do not touch either of the side walls of the heating chamber 30 which define the annular slot 28 through the rods 72 extend, guide means, indicated generally by the reference numeral 74, is provided.

The guide means 74 comprises a plate 76 having a plurality of apertures 78 (see Figure 3) spaced about its margin so that the vertical rods 72 may pass therethrough without ever touching the plate. Plate 76 is carried for rotation about the central post 14 by a roller bearing assembly, indicated generally by the reference numeral 80, which is carried by the central post 14. Plate 76 is not movable axially. A flange 82 secured to the lower end of each rod 72 is adapted to seat upon and connect with the top of the float 66 in a recess. By reason of the collar 84 on the flange 82 a spring 86 is adapted to seat on the flange but be maintained out of contact with the rod 72. The upper end of spring 86 engages about a collar 88 of a flange 90 which is secured to the plate 76 about the aperture 78. In this way the platform 60 is supported upon a float 66, which float has connection with the plate 76 through the medium of a plurality of springs 86. Consequently the vibrations from the ground or base of the furnace will be substantially eliminated by the liquid 68 in the tank 70 and will not be transmitted to the platform 60. Also, vibrations transmitted to the plate 76 will be substantially eliminated by reason of the resilient connection between plate 76 and the float 66 by reason of the springs 86. Consequently plate 76 may guide the supporting platform 60 in its rotation within the chamber 30 without transmitting vibrations thereto and may thereby prevent the float 66 and platform 60 from floating laterally into contact with the side walls of the tank 70 or of the annular slot 28, respectively.

The guiding mechanism 74 serves an additional purpose in that it serves to maintain the movable platform 60 in substantially horizontal position even when an unbalanced load is placed thereon. During the initial loading of platform 60 with the flasks 62, one side of the platform becomes heavier than the other and the float 66 therefore has a tendency to sink downwardly into the liquid 68 of the tank 70 on the loaded side. However, as that side of the float tends to sink, the opposite side tends to rise against the force of the springs 86. Since the upper ends of each of the springs seat against the plate 76,

which is held against axial movement on central post 14, the springs 86 resist upward movement of the float and therefore serve to maintain the float's balance with the result that the platform 60 continues to remain in a substantially horizontal plane. This balancing mechanism, however, transmits substantially no vibration to the platform 60 as was explained above.

Horizontal frame members 16 and 92, which are carried at the upper end of central post 14, serve to brace and support a hood, indicated generally by the reference numeral 94, for the furnace 10. A flue 96 for the hood 94 carries off heat which is escaping from the surface of the heating chamber 30. The hood and flue may be formed of sheet metal or other suitable material and the hood may extend downwardly along the side of the furnace 10, as shown.

Since the wax or plastic patterns are melted or burned out of the molds, various gases and solids will be produced which need to be carried off from the heating chamber or oven 30. For this purpose a flue 98, connecting at its upper end to the flue 96 of hood 94, is provided over the opening 100 in the upper wall 38 of the heating chamber 30. In addition to carrying off waste gases, the flue 98 serves another valuable purpose in that it draws heated air and gases from that zone of the heating chamber where the gas burners are situated around toward the entrance 40 of the chamber 30, so that the flasks which are moving from the entrance in the direction of the arrow A of Figure 2 toward the burners, will be passing through a zone which is increasing in temperature. Consequently, the temperature of the molds is increased gradually and not suddenly. In the preferred form of my invention the flue is located as shown in the drawings, which position corresponds to that at which the patterns in the mold begin to burn. The temperature at this location is approximately 400° F. It will be understood, however, that the flue may be positioned closer to the entrance 40 so that the hot gases and air from the zone which is being heated directly by the gas burners will be drawn around even farther in the chamber 30 to spread out the zone of gradually increasing temperatures through which the flasks travel.

In the operation of my furnace, the gas burners 43 are lit and the operator then begins to load the platform 60 through the entrance 40. The flasks 62 are spaced from each other and as the available portion of platform 60 is covered, it is rotated in the direction of the arrow A of Figure 2 to provide supporting surface on the platform 60 which is yet unfilled. When the molds are being prepared for the casting of non-ferrous metals, the door 48 may be left open, that is, in its raised position while the gas burners are operating. However, if ferrous metals will ultimately be poured into the molds in the flasks 62, the door is lowered so that it is in closed position. Although the platform 60 is generally rotated by hand, it is contemplated that it may be motor driven through the plate 76 and springs 86 or by other means. Any unbalanced load which is placed on platform 60 during the initial loading thereof is counteracted by the springs 86 and plate 76 which operate to maintain the float 66 in substantially the same horizontal plane. As each of the flasks on the platform approaches a position beneath the flue 98, the wax or plastic pattern within the mold has reached a temperature at which it begins to melt, and then burn. The waste gases or combustion are drawn up the flue 98. Simultaneously, heated air and other gases from the zone of the heating chamber 30 which has the gas burners 43 is drawn in a direction opposite to that indicated by the arrow A in Figure 2, toward the flue and toward the flasks which are approaching the zone which is heated directly by the gas burners. This causes the flasks, molds and patterns within the molds to be heated gradually while the patterns are being burned out. When the flasks ultimately reach the zone of the heating chamber 30 which has the gas burners 43, where the temperature may be 1800° F. or higher, the flasks are heated to their desired maximum temperature. Such temperature may approximate that of the metal which will be cast into the molds so that the metal will not be too quickly chilled during the casting operation.

As the platform becomes fully loaded and the initial flasks placed thereon approach the entrance 40 after passing through the zone of maximum temperature, the operator will raise the door 48, rotate the platform, lower the door 48 and remove a flask 62. A fresh flask 62 is then placed upon the platform where the heated one was removed and the door 48 is again raised and the platform rotated in the direction of the arrow A to thereby deliver to the entrance 40 another heated flask 62. It will be appreciated that by a suitable camming arrangement or other means, the rotation of the platform 60 could automatically cause a raising and lowering of the door 48 to permit the passage of heated flasks beneath the door to the entrance 40. It will be seen that I provide continuous heat treatment of flasks, which continuous treatment is very advantageous when casting operations are carried out by centrifugal casting machines at a rapid rate. My furnace provides heated flasks at the proper temperature and proper time for positioning in a centrifugal casting machine with a minimum loss of heat from the flasks and a minimum loss of heat from metal in the crucible of the casting machine. Coordination of the timing of operations between the casting machine and the furnace may be provided so that the rate of delivery of the furnace corresponds to the rate of casting in a centrifugal casting machine.

Any vibrations which, during the burning out of the patterns, would tend to dislodge particles of the mold forming material from the sides of the casting cavity are eliminated by supporting the platform 60 by means of the float 66 in a body of liquid 68. Furthermore the mechanism for maintaining the platform balanced is so constructed as to eliminate substantially all vibrations from being transmitted through it to the platform 60. Said balancing mechanism also serves to guide the platform 60 and float 66 in their associated movements to prevent their contact with the walls of the heating chamber 30 and the walls of the tank 70, respectively. Since my furnace may be operated continuously and since the temperature therein may be maintained at the desired degree at all times, it will be seen that great savings in time are provided as contrasted with operations in the standard furnace wherein flasks are positioned, heated and withdrawn and the furnace then permitted to cool down before being loaded again with another batch of flasks.

Although I have described and illustrated a preferred embodiment of my invention, I do not intend to be limited thereto except in so far as the appended claims are so limited, since my dis-

closure will suggest to those skilled in the art certain modifications and changes.

I claim:

1. In a furnace having walls defining a chamber, an entrance to said chamber, an opening in a wall of said chamber and means for supplying heat to the chamber, the combination of a rotatable work supporting platform; means for supporting the platform including a movable float, liquid for carrying the float, and supporting elements interposed between the platform and the float and adapted to extend through said opening in a wall of the chamber; a fixed support, a resistor member rotatably carried by said fixed support and resiliently engaging the float for the platform and acting to maintain the float balanced when unbalanced loads are applied to the platform.

2. A furnace comprising, in combination, wall means defining a heating chamber, means for supplying heat to said chamber, an entrance to said chamber, a movable work supporting platform within said chamber, floating means for buoyantly supporting the platform, means acting to maintain the floating means balanced when unbalanced loads are applied to the platform, said balancing means comprising a resistor member and resilient means interposed between the resistor member and the floating means.

3. A furnace comprising, in combination, wall means defining a heating chamber, means for supplying heat to said chamber, an entrance to said chamber, a work supporting platform movable within said chamber, floating means for buoyantly supporting the platform, said floating means including a liquid-containing-tank and a float disposed therein beneath said platform and

supporting elements interposed between the platform and float, and means for guiding the platform for movement and for acting to maintain the floating means balanced when unbalanced loads are applied to the platform, said guiding and balancing means comprising an apertured rotatable plate fixed against axial movement and a plurality of resilient elements interconnecting the rotatable plate and the float, each of said supporting elements extending through, and being out of contact with, an aperture in said plate and a resilient member.

JOHN FREI, JR.

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