May 30, 1950 E. R. CAPITA ET AL 2,509,670

CENTRIFUGAL CASTING MEANS

Filed April 14, 1947 3 Sheets-Sheet 1

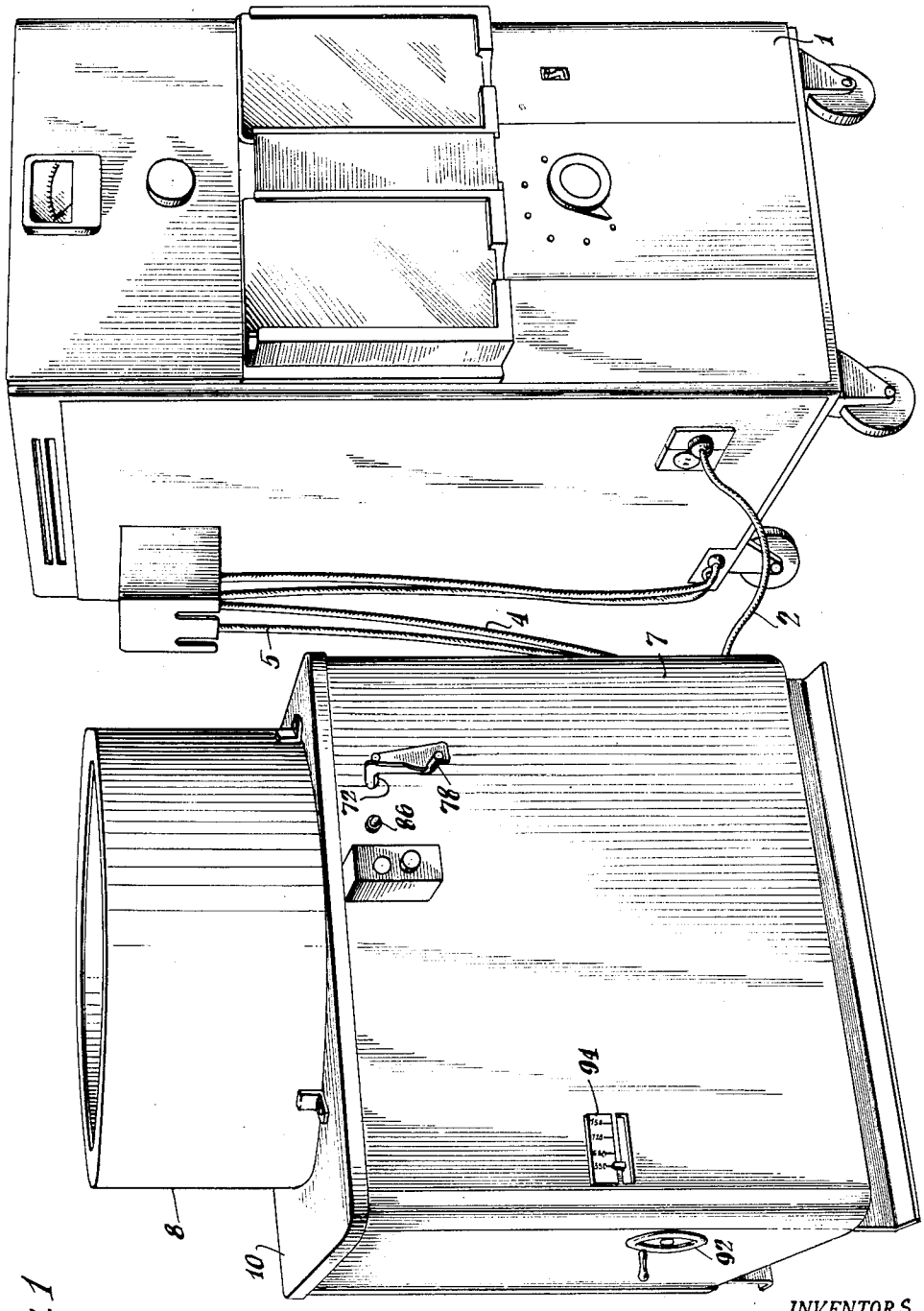


Fig. 1

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Fig. 2

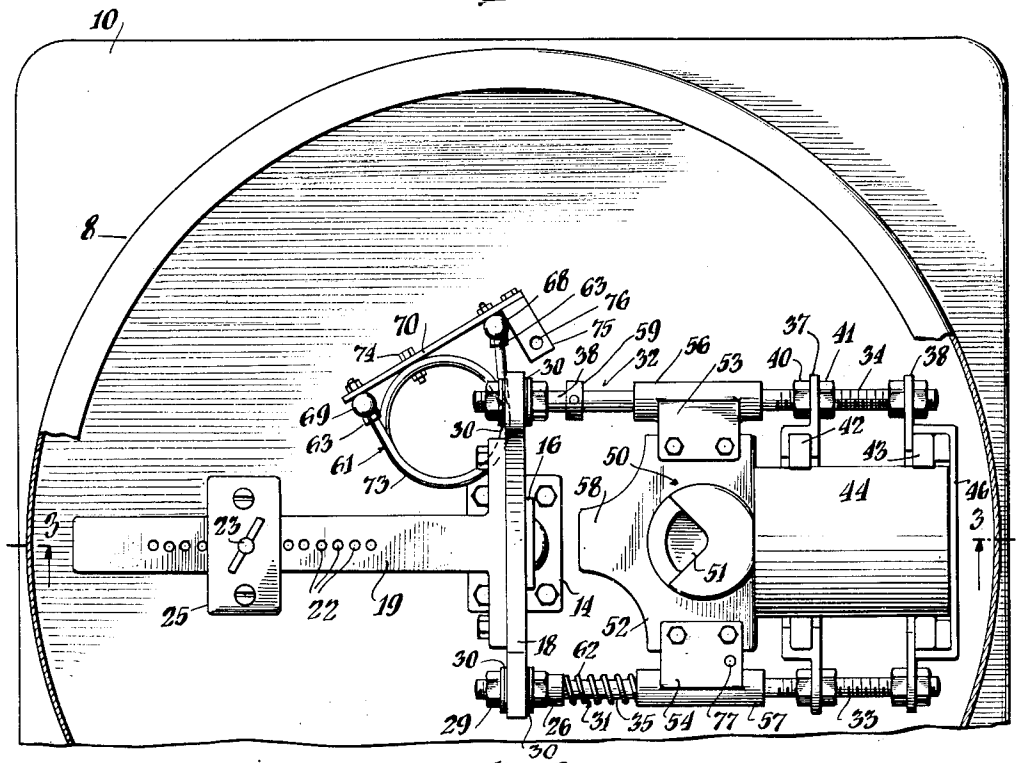
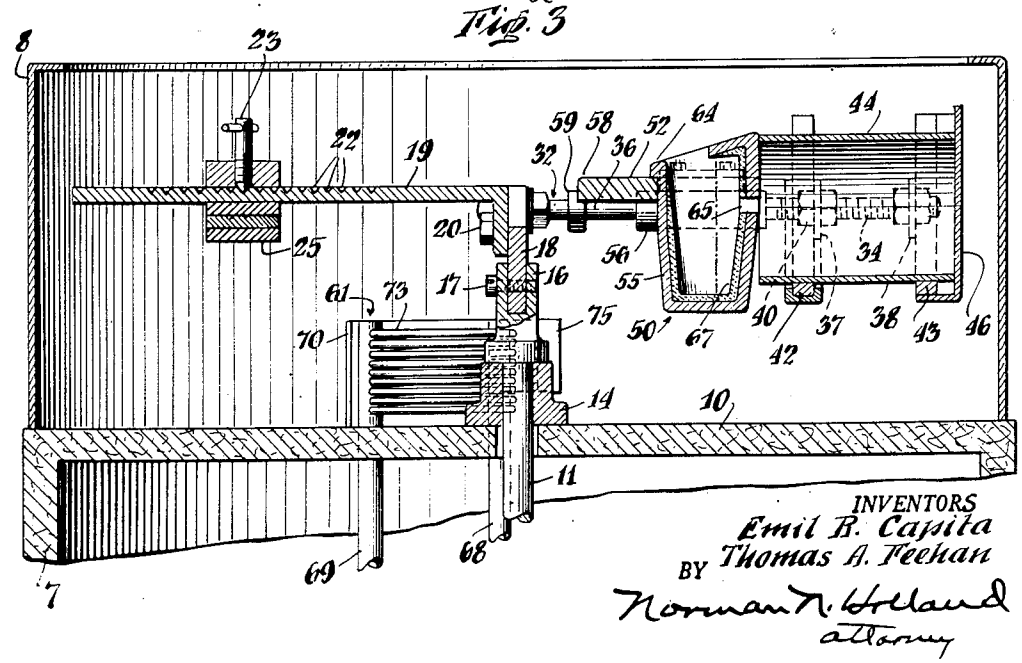


Fig. 3



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Fig. 5

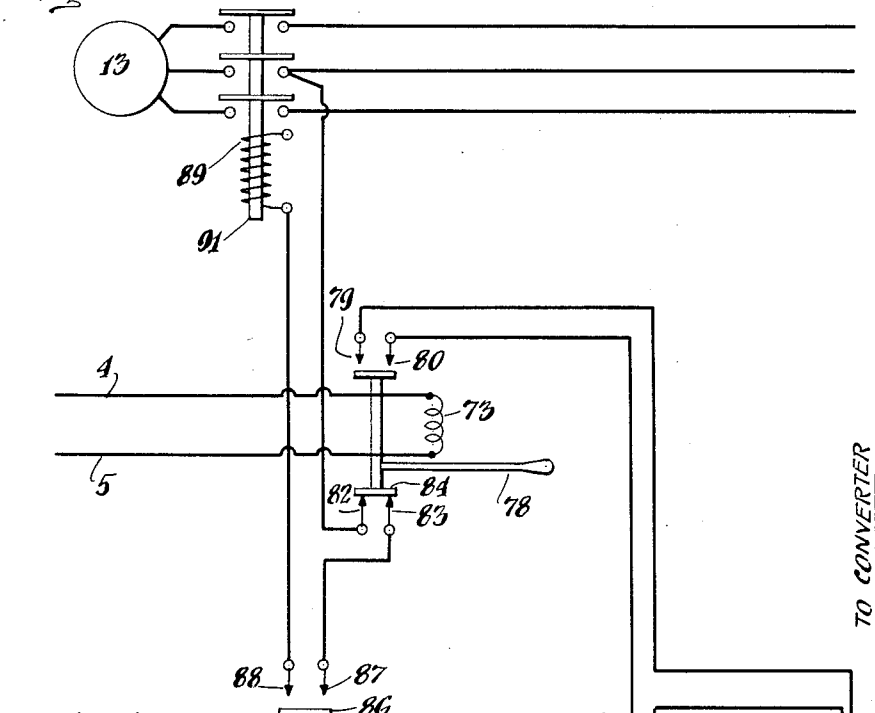
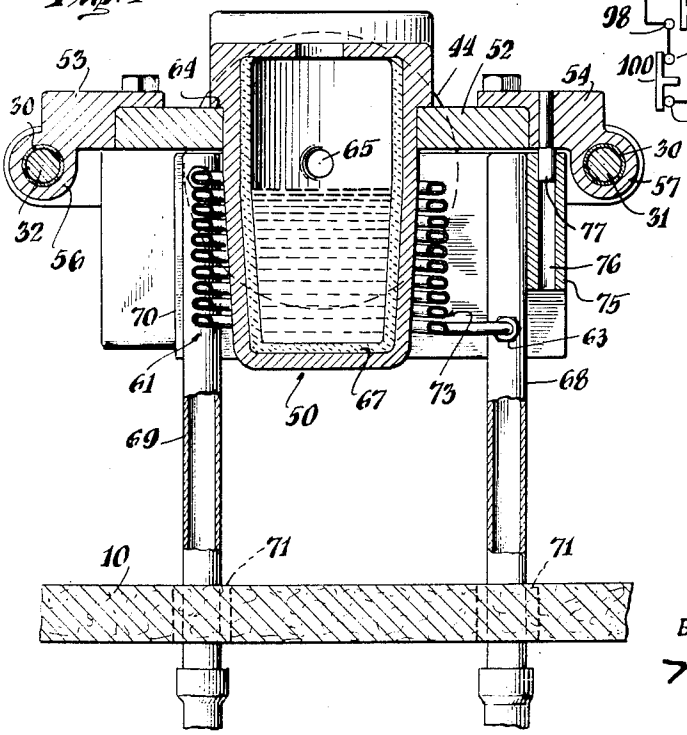


Fig. 4



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CENTRIFUGAL CASTING MEANS

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10 Claims. (Cl. 22—65)

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The present invention relates to means for melting and centrifugally casting metals.

Manufacturers concerned with casting operations are constantly on the alert for better casting mechanism or devices. This is particularly true of those manufacturers who are interested in commercially producing articles by centrifugal casting methods, this method being a special type of casting in which a mold and its flask are whirled or revolved so that metal is thrown outwardly by centrifugal force and shaped in accordance with the form of the particular mold held within the flask. Articles formed by centrifugal casting are desirable as they have a minimum of shrinks or blowholes and the metal has a relatively dense structure.

One of the difficulties with available centrifugal casting mechanisms is their extremely limited field of use; most of them are designed and built to perform some particular casting task and are restricted almost solely to repeated performance of only that task. Existing means for heating and melting a metal charge are limited generally to use with a particular crucible or furnace. With other mechanisms there is lacking a most desirable or optimum passage of molten metal from a crucible into a flask mold.

The present invention aims to overcome or minimize the above and other disadvantages or objections by providing a new and improved centrifugal casting device which is adapted to be utilized with various flasks and crucibles and which embodies new and improved means for heating and melting metals. The invention further contemplates the provision of means adapted to facilitate foolproof operation of the present new and improved centrifugal casting mechanism and to facilitate passage of molten metal from a crucible into the mold of a flask.

An object of the present invention is to provide a new and improved centrifugal casting mechanism.

Another object of the invention is to provide a new and improved centrifugal casting mechanism adapted to be used with various sizes of molding flasks.

Another object of the invention is to provide a new and improved centrifugal casting mechanism which is foolproof in operation.

Still another object of the invention is to provide for improved passage of molten metal into a mold.

A still further object of the invention is to provide a new and improved heating means for use with a centrifugal casting mechanism.

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Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein:

Fig. 1 is a perspective view illustrating a preferred embodiment of the invention;

Fig. 2 is a top plan view illustrating a preferred embodiment of the present invention;

Fig. 3 is a fragmentary sectional view taken along the line 3—3 of Fig. 2;

Fig. 4 is a sectional view showing certain of the parts in heating relationship; and

Fig. 5 is a view of a wiring diagram showing a preferred form of electrical hook-up.

Referring again to the drawings and more particularly to Fig. 1 thereof, there is shown a cabinet 1 adapted to contain any suitable mechanism for creating a high frequency current for use with the centrifugal casting mechanism to be hereinafter described.

The high frequency current creating means is shown connected by suitable cables 2, 4, and 5 with the cabinet 7 at the left side of Fig. 1. These various connections will be hereinafter described in greater detail. The centrifugal casting mechanism itself is contained within an outer casing 8 at the upper part of the cabinet 7 and is shown more particularly in Figs. 2, 3 and 4 of the drawings.

The mechanism shown in detail in Figs. 2 and 3 comprises a platform or base 10 of asbestos through which extends a rotatable shaft 11 that connects beneath the platform 10 with a motor 13 (Fig. 4). The shaft 11 is shown extending through a suitable bearing 14 secured by bolts to the base 10 and it may be provided adjacent the upper part thereof with a flanged plate 16 to which is secured, by bolts 17, a bracketlike member 18. An arm 19, secured by bolts 20 to one side of the bracketlike member 18, is shown provided with a plurality of notches or apertures 22 for receiving the end of a threaded key 23 to lock or maintain in desired position an adjustable counterweight 25. The counterweight 25 has an aperture therein for receiving the counterweight arm 19 and may be moved to a suitable position along the arm, the particular position in which it is locked or secured depending upon the weight

of objects located at the opposite side of the bracketlike member 18.

Connected with opposite ends of the bracketlike member 18 by nuts 26 and 29 are spaced arms or shafts 31 and 32, each of which is provided with threaded end portions 33 and 34 and relatively smooth guide surfaces 35 and 36. The shafts or arms 31 and 32 are preferably electrically insulated by any suitable means, such as insulating members 30; this avoids induced electrical circuit through arms 31 and 32, counterweight arm 19, and mold holding means 42 and 43.

A pair of channel-like structures 37 and 38 are shown carried in spaced relationship on the threaded portions 33 and 34 of the spaced shafts 31 and 32, each of the channel-like structures having apertures at opposite sides thereof through which extend the spaced shafts 31 and 32. The channel-like structures may be retained in desired position by nuts 40 and 41 located at opposite sides of the flanges through which extend the spaced shafts 31 and 32. Positioned within the grooves or channels of the channel-like structures 37 and 38 are substantially U-shaped flask receiving members 42 and 43. A mold flask 44 may be lowered into the opening of the upwardly disposed U-shaped portions of the flask receiving members 42 and 43 with one end of the flask in abutting relationship with a plate member 46 carried at the outer side of the channel-like structure 38; the opposite end of a mold in the flask is open so that metal from a crucible 50 may be transferred into the mold when the device is in operation.

The crucible 50 is shown retained within an opening of a transverse member 52 carried at opposite sides thereof by inwardly extending portions 53 and 54 of tubular support members 56 and 57. The hollow portions of the tubular members 56 and 57 are shown extending about the spaced arms 31 and 32 and they may move along these arm members in connection with the operation of the mechanism, as will be later described.

The transverse member 52 is shown provided with an extension 58 adapted to be received by a cut-out portion of the bracketlike member 18 to assist in limiting movement of the transverse member in the direction of the vertical shaft 11. In some instances it may also be desirable to provide a collar member 59 on one of the shafts 31 or 32 for limting the extent of movement of the transverse member 52 along the supporting shafts. The purpose of the collar 59 or outwardly extending portion 58 is to facilitate alignment of the lower part 55 of the crucible 50 with a heating device 61. When the transverse member 52 and crucible 50 are moved to position adjacent the upright shaft 11 these stops tend to correctly position the lower part 55 of the crucible 50 accurately with respect to the heating means 61 so that danger of damaging any of the operating parts in connection with the operation of the mechanism is minimized.

A light spring or other resilient means 62 is shown extending about one of the shafts 31 and is adapted to normally urge the transverse member 52 and crucible 50 outwardly toward the open end of a flask 44 carried by the supporting brackets 42 and 43 so that a discharge opening at the side of the crucible will move into contiguous relationship with an entrance opening to a mold carried within the flask 44. The reason for this spring 62 and its outward urging effect will be hereinafter explained in greater detail.

The crucible 50 is preferably provided with an outwardly extending flange 64 adapted to rest against adjacent edges of the aperture in the transverse member 52 and the crucible extends downwardly through the opening 51 so that the major portion 55 thereof is positioned beneath the transverse portion 52. The upper part of the crucible 50 is shown provided with a charging opening 51 for facilitating insertion of material and with an exit or discharge opening 65 at a side wall thereof facing toward the flask 44. Preferably the side walls of the refractory material 67 with which the crucible 50 is lined are inclined at the discharge side of the crucible toward the exit opening 65 to provide an improved flow of molten metal to and through the discharge opening upon operation of the mechanism.

The means for heating the crucible and melting metal in it is shown more particularly in Fig. 4. The heating means is shown in Fig. 4 in elevated heating position surrounding the downwardly extending portion of the crucible, and in Figs. 2 and 3 in a lower non-heating position. As shown the heating means 61 comprises an induction coil 73 mounted on a plate member 70 carried by a pair of spaced, vertically disposed hollow shafts 68 and 69. Shafts 68 and 69 extend through an electrically insulating bushing 71 fitted into the asbestos base 10; a commercially available material known by the trade name "Mycalex" has proven satisfactory for the bushing 71 but any suitable material may be used. The induction heating coil 73 may be carried on the bracket or plate 70 by a clamp and bolt arrangement 74, the coil itself preferably comprising a length of substantially helically arranged copper tubing formed to a sufficient diameter to receive with the center portion or opening thereof the depending portion 55 of the crucible 50. Up and down movement of the hollow shafts 68 and 69 elevates and lowers the heating coil 73.

The hollow copper tubing comprising the coil 73 may be connected at the ends thereof by couplings 63 with the hollow shafts 68 and 69 and the lower ends of the shafts may be connected by rubber or other flexible connections with a supply of cooling water so that heating effects generated in the coil by eddy currents or the like may be removed.

The shafts 68 and 69 may be connected in any suitable manner with the cables 4 and 5 referred to in connection with Fig. 1 of the drawings, the latter cables extending into the cabinet 1 and being connected with a suitable high frequency current generating means therein.

Adjacent one end of the plate 70 is shown a hollow block member 75, preferably of asbestos or the like having an aperture 76 at its upper part. The aperture 76 is adapted to receive a pin 77 carried by and extending downwardly from one of the arms 54 of a tubular member 57 movably mounted on a shaft 31. The spaced shafts 68 and 69 are adapted to move vertically so that the coil 73 may be moved upwardly to a position surrounding or extending about the downwardly extending part 55 of the crucible 50. As the coil 73, plate 70 and block 75 move upwardly, the downwardly extending pin 77 may be guided into the aperture 76, to thus facilitate correct alignment of the parts and positioning of the heating coil about the lower part of the crucible. When the coil is elevated surrounding the crucible, as shown in Fig. 4, high frequency current may be supplied to the coil to heat by induction and melt a charge of material carried in the cru-

cible; such heating is rapid and efficient and favorably increases the rate of production over ordinary resistance elements of the type used in irons or toasters.

After a charge of metal in the crucible 50 has been melted, the coil 73 may be quickly lowered to the position indicated in Figs. 3 and 4 of the drawings. As pin 77 moves out of aperture 76 in block member 75, the spring 62 urges the transverse arm 52 and crucible 50 outwardly toward a mold carried within flask 44. The spring 62 urges the crucible outwardly immediately upon freeing of the crucible but not so as to objectionably slam the crucible against flask 44 or its mold. The spring is preferably of such length as to become extended to full length when the crucible discharge opening is in proximity to the mold inlet opening, but it may be such as to become fully extended when the crucible exit opening is spaced about one inch from the mold inlet opening. With the latter spring the action is as follows: since the shaft 11 normally commences to rotate when coil 73 reaches its lower position, centrifugal force moves the crucible the remaining one inch and when the crucible is stopped by the flask, molten metal is thrown outwardly through the crucible discharge opening 65 into a mold cavity within the flask. Thus, with the shorter spring, the crucible moves outwardly quickly and centrifugal force is utilized to move the crucible only a short distance; this feature means that metal may pass from the crucible to a mold within a short period of time after the shaft 11 commences to rotate. Where the spring is of a length to move the mold into contact with the flask, centrifugal force promptly effects movement of the metal into the mold. Any suitable number of springs may be utilized and they may be used on the shaft 32 as well as on the shaft 31.

It is desirable to minimize the possibility of damage to the present mechanism by inadvertent rotation of the shaft 11 during intervals when the heating mechanism 61 is in elevated position with the coil 73 extending about the crucible 50. In the preferred embodiment of the present invention, such accidental damaging is prevented by interlocking connections between the heating mechanism 61 and the motor 13 which is connected with and effective to rotate the shaft 11. When the heater coil is raised to elevated position about the crucible 50 by the lever or arm 78 (Figs. 1 and 4), the contacts 79 and 80 are closed by the bar 81 so that the coil 73 may be energized by high frequency current supplied through the leads 4 and 5. It will be noted that when the contacts 79 and 80 are in closed relationship the contacts 82 and 83 are open by reason of the fact that the bar 84 is out of contact therewith and hence closing the motor switch 86 against the contacts 87 and 88 is ineffective to admit current to the solenoid 89 for moving the motor contactor 91 to close the contacts from a power line to the motor 13.

When the arm or lever 78 is moved so as to lower the coil 73, the bar 84 closes the contacts 82 and 83 and hence current may flow to energize the solenoid 89 and move the motor contactor 91 into position to admit current from a power line to the motor 13.

When the motor push-button 86 is pressed, the motor contactor circuit is partially closed, depending upon whether or not the bar 84 is in position to connect the contacts 82 and 83. If the coil 73 is in elevated position and the bar 84 away from the contacts 82 and 83, the motor 13 will not operate. Conversely when the coil 73 is in lowered position the contacts 82 and 83 will be closed and the motor may start. This interlocking arrangement normally prevents operation of the motor unless the coil assembly is clear of the rotating parts.

Any suitable speed regulator may be connected, in known manner, into the motor circuit so that actuation of the controlling handle or wheel 92 is effective to vary the speed of the motor and hence the revolutions per minute of the shaft 11 and mechanism carried thereby. A suitable speed indicating pointer and plate 94 may be provided to facilitate adjustment of the speed to that required.

When the switch 95 is closed across the contacts 97 and 98, the high frequency current generating means within the cabinet 1 is so connected with the heating coil 73 by the cables 4 and 5 that when the heating coil 73 is in elevated position, with the bar 81 connected across the contacts 79 and 80, the current may operate the heating coil 73; thus the switch 95 and bar 81 are "interlocked" with each other and high frequency current flows through the coil 73 when it is in elevated position around a crucible. Pressing the switch 100 is effective to operate the relay and switch construction shown at 103 and to cease supplying high frequency current to the heating coil 73 even though it is in the elevated position.

In connection with the operation of the above described mechanism, a charged crucible may first be placed into the holder or aperture of the transverse member 52, the supporting shafts 31 and 32 rotated over the heating means 61, and then the downwardly extending part 55 of the crucible placed into alignment with the coil 73 by pressing it inwardly toward the shaft 11. As the coil 73 is elevated by raising the lever or arm 78, the guide pin 77 moves into the aperture 76 in the block member 75 and insures correct alignment of the parts. When the heating mechanism 61 is thus raised to elevated position the lever or arm 78 may be rotated slightly to one side so that it may rest upon a ledge 72 (Fig. 1) to hold the heating mechanism 61 in elevated position.

The flask 44, which usually consists of a metal tube in which is placed a prepared refractory mold, may next be placed into the openings of the flask holders 42 and 43, with the outwardly disposed end of the flask 44 resting against a plate member 46. The high frequency current to the coil 73 may next be turned on by pressing the push-button 95 to close the contacts 96 and 98.

When a metal charge in the crucible has been brought to a molten condition and is ready for casting, the motor push-button 86 may be closed to connect the contacts 87 and 88. This partially closes the motor contactor circuit; however, since this circuit is also controlled by a limit switch used in connection with the coil raising mechanism, the motor 13 will not commence to rotate the shaft 11 until the arm 78 is moved to its lower position with the bar 84 connecting the contacts 82 and 83. This interlocking arrangement minimizes the possibility of accidental rotation of the shaft 11 until such time as the coil assembly has moved to its downward position, as shown in Figs. 2 and 3.

When the heating mechanism 61 is moved to

its lower position, the relatively light spring 62 may urge the crucible 50 and its carrying mechanism outwardly toward the open end of a mold carried within the flask 44. This quickly places the crucible discharge opening 65 adjacent or in proximity to the entrance opening of a mold and as the shaft 11 commences to rotate, centrifugal force causes the molten metal to flow outwardly and upwardly along the inclined side walls of the crucible 50 adjacent the discharge opening 65 in the side of the crucible. The molten metal will tend to acquire some such position as is indicated in the dotted lines in Fig. 3. Since the molten metal thus leaves the crucible through the discharge aperture 65 in the side of the crucible, a "bottom pour" effect is obtained so that clean metal tends to first enter the mold cavity and the lighter residue oxides or impurities to enter the mold lastly and to form in and upon the sprue, which is generally removed from the article subsequent to the casting operation.

The revolutions of the motor 13 and shaft 11 per unit of time may be selectively determined by means of the wheel 92 and indicating means 94.

It will be seen that the present invention provides a new and improved mechanism for centrifugally casting metals. The induction heating means, which is readily movable into and out of operative position about a crucible, provides a very rapid and efficient heating means. The mechanism or device embodies great flexibility of use in that the flask holding means may be selectively positioned to hold flasks of various sizes and lengths. The crucible and its carrying member may be readily positioned at appropriate locations along the supporting arms to permit rapid insertion and removal of flasks of the same or different sizes. The crucible moves into operative relationship with a flask mold regardless of whether the mold is of relatively short or long dimensions. A new and improved interlocking feature minimizes the possibility of accidentally damaging the machine and injuring an operator by reason of the fact that the heating means is so connected as to require movement of the heating means out of heating position prior to actuation of the rotating parts of the mechanism; the present centrifugal casting mechanism is thus rendered substantially foolproof in operation.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim:

1. In a device of the class described, the combination of a member rotatable about a central axis, crucible supporting means slidably fitted on and freely reciprocable along said rotatable member between an inward heating position adjacent said central axis to an outward position on the member, an open-ended heating coil located adjacent said central axis and out of heating relationship with respect to a crucible supported by said supporting means during rotation of said rotatable member, and means for encircling said crucible with the heating coil, whereby material within the crucible may be melted.

2. In a device of the class described, the combination of a member rotatable about a central axis, crucible supporting means slidably fitted on and freely reciprocable along said rotatable member between an inward heating position adjacent said central axis to an outward position on the member, an open-ended heating coil located adjacent said central axis out of heating relationship with respect to a crucible supported by said supporting means and with its axis out of alignment with that of the crucible during rotation of said rotatable member, complementary pin and recess means carried by said crucible supporting means and heating coil for aligning the open end of the coil with the crucible during movement of one toward the other, and means for encircling said crucible with the heating coil, whereby material within the crucible may be melted.

3. In a device of the class described, the combination of a rotatable member, a crucible bracket slidably mounted on and freely movable along said rotatable member from a heating location adjacent its center of rotation to an outward location thereon, a crucible carried by and movable with said bracket having a portion depending below said bracket, an open ended heating coil adjacent said center of rotation located out of proximity to the depending portion of said crucible during non-heating periods and movable to encircling position around the depending portion of the crucible for heating material within the crucible, and means for elevating said heating coil around the depending portion of the crucible.

4. In a device of the class described, the combination of a revolvable arm, crucible supporting means slidably mounted on and freely movable along said revolvable arm, an open ended heating coil adjacent an inner end of said revolvable arm and movable into position around a crucible during periods when the revolvable arm is at rest and said crucible is adjacent said inner end of the revolvable arm, said coil being movable away from said position around said crucible prior to revolution of said arm, means for moving the heating coil into position around the crucible and for moving it away therefrom, and interlocking means preventing initiating revolution of said arm while the crucible is encircled by said heating coil.

5. In a device of the class described, the combination of a revolvable arm, crucible supporting means slidably fitted on said arm and normally freely reciprocable therealong between a crucible-heating position and material-transferring position, a crucible carried by and movable with said supporting means, an open-ended heating coil below said revolvable arm and vertically movable between a heating position around said crucible and a position clear of said crucible, a cooperating guide pin and recess for aligning the crucible with the open end of the coil during movement of the coil toward the crucible, means for elevating the heating coil to said position around a portion of said crucible, and interlocking means adapted to prevent initiating revolution of said arm while the heating coil is elevated and around the crucible.

6. In a device of the class described, the combination of a base, a rotatable shaft extending upwardly from said base, an arm carried by and rotatable with said shaft, a substantially radially movable crucible support slidably fitted on and freely movable along said arm between an inward heating location and an outward discharging lo-

cation, resilient means pressing against said crucible support and urging it outwardly along said arm at all times from said inward heating location toward said outward discharging location, a heating coil positioned between the base and the arm adjacent said rotatable shaft and during non-heating periods spaced from a crucible carried by said support, and means for elevating said coil when the crucible support is at said inward heating location to a position surrounding part of a crucible carried by the support whereby material therein may be melted.

7. In a device of the class described, the combination of a base, a rotatable shaft extending upwardly from said base, an arm carried by and rotatable with said shaft, mold carrying means adjustably positioned on said arm adjacent an outer end thereof, an open ended heating coil adjacent said rotatable shaft, a substantially radially movable crucible support slidably fitted on and freely movable along said arm between a crucible heating position and said mold carrying means at all times other than when surrounded by a heating coil, and means for elevating said open ended coil to a position surrounding part of a crucible carried by said support when the support and crucible are positioned adjacent the rotatable shaft and the crucible is in alignment with said coil, whereby material in the crucible may be melted.

8. In a device of the class described, the combination of a base, a rotatable shaft extending upwardly from said base, an arm carried by and rotatable with said shaft, mold carrying means adjustably positioned on said arm at a location spaced from said shaft, an open ended heating coil adjacent said rotatable shaft and movable between a low position adjacent said base and an elevated position adjacent said arm, a substantially radially movable crucible support slidably fitted on and freely movable along said arm between a crucible heating location adjacent said rotatable shaft and said mold carrying means, means for elevating said open ended coil to a position surrounding part of a crucible carried by said support when the support and crucible are positioned adjacent the rotatable shaft and the crucible is in alignment with said coil, and means operatively interconnecting said coil and said rotatable shaft and preventing rotation of the shaft while the coil is elevated and surrounding any part of the crucible.

9. In a device of the class described, the combination of a rotatable member, means adjacent the outer end of said member for holding a mold, a crucible supporting member slidably mounted on said member and freely movable substantially lengthwise along said member between an inward crucible heating position and said mold holding means, means spaced below said crucible supporting member and located adjacent the axis of rotation of said arm and elevatable to a position surrounding the lower part of a crucible carried by said support for heating and melting a material in the crucible, and resilient means for urging said crucible support along said rotatable member away from said crucible heating position toward said mold holding means and effective upon lowering of said heating means from said position surrounding the lower part of said crucible.

10. In a centrifugal casting mechanism, the combination of a pair of spaced rotatable supporting members, a pair of sleeve-like members slidably fitted on and freely movable along said spaced supporting members between an inward crucible heating position and outwardly disposed mold carrying means, a crucible supporting member extending between and carried by said pair of freely slidable sleeve-like members, a crucible carried by said supporting member having an opening at an outer side wall thereof and mold carrying means disposed adjacent the outer ends of and intermediate said pair of spaced supporting members, a heating coil positioned below said supporting members adjacent their inner ends, a portion of said mold carrying means abruptly limiting outward movement of said crucible with its supporting member and pair of freely slidable sleeve-like members, discharge of metal through the crucible opening into a mold of said mold carrying means being initiated upon striking of the crucible against the mold carrying means.

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