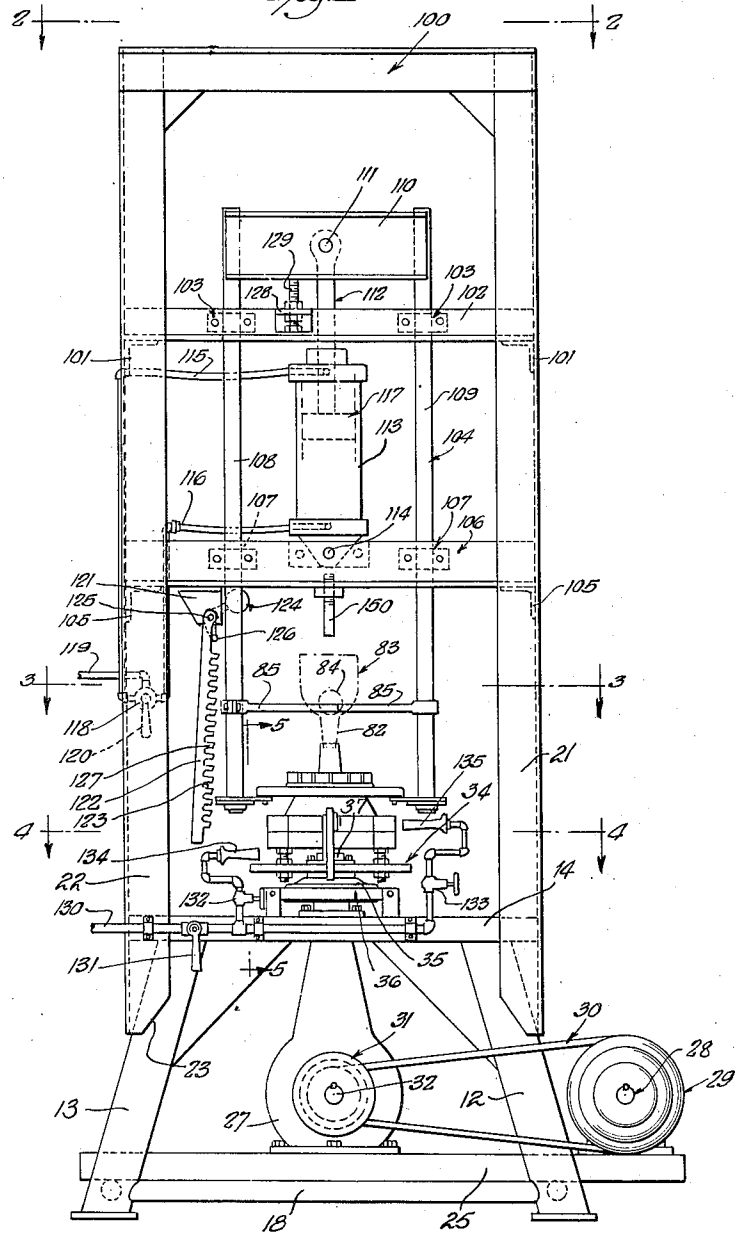
May 9, 1950 J. A. TOLEIK 2,507,388

CENTRIFUGAL CASTING MACHINE

Filed June 1, 1946 4 Sheets-Sheet 1

Fig. 1



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CENTRIFUGAL CASTING MACHINE

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Fig. 2

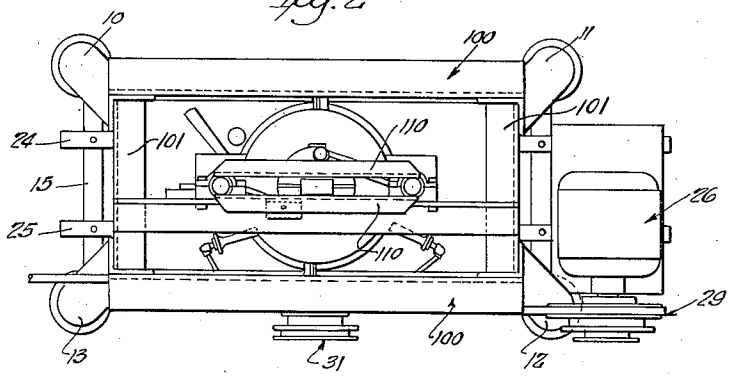


Fig. 3

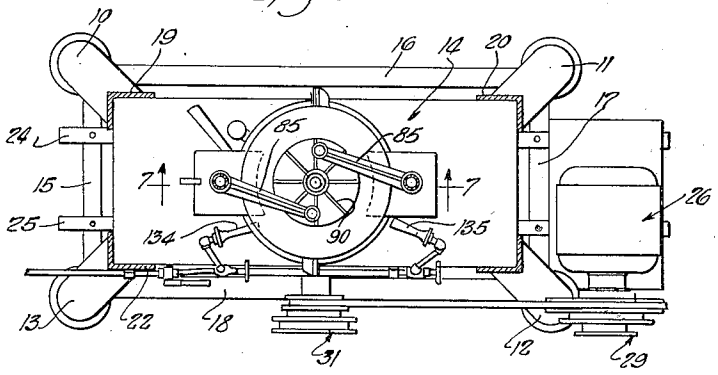
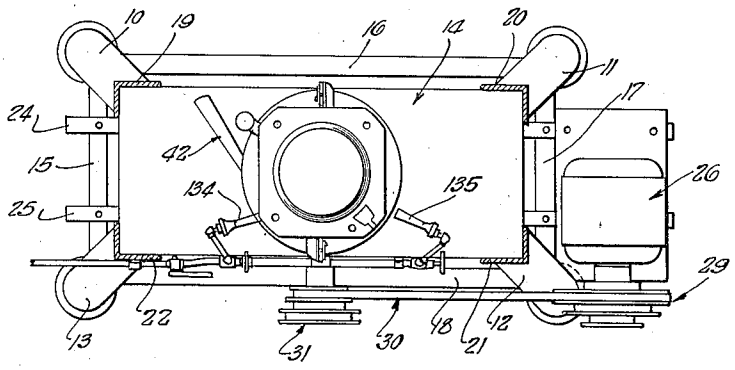


Fig. 4



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CENTRIFUGAL CASTING MACHINE

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Fig. 5

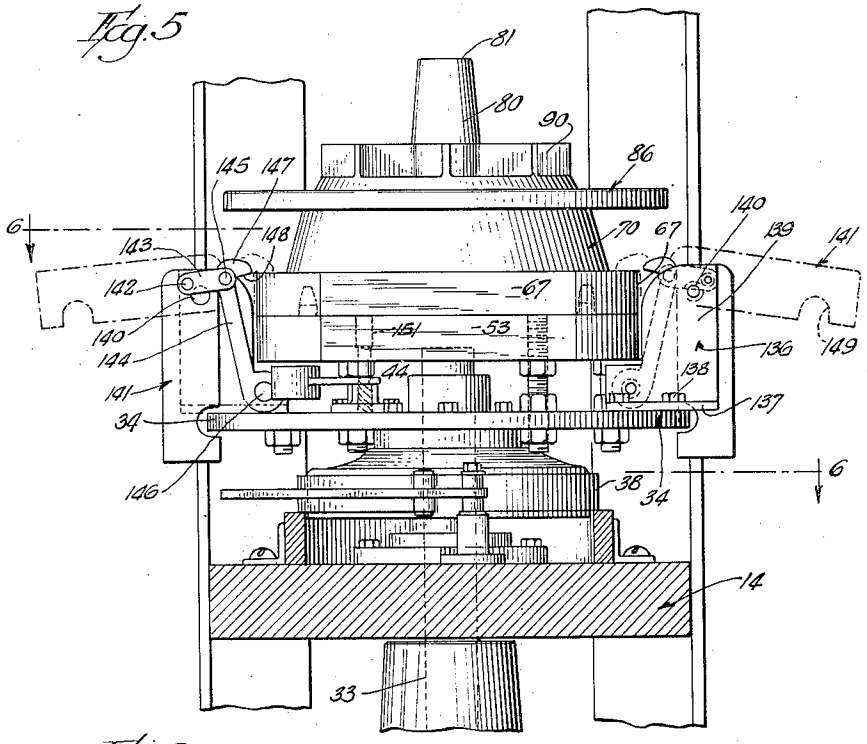
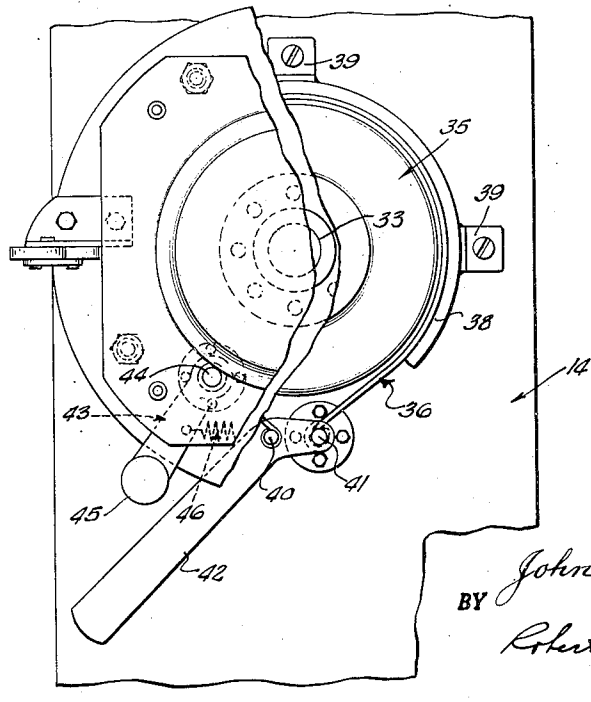


Fig. 6



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Fig. 7

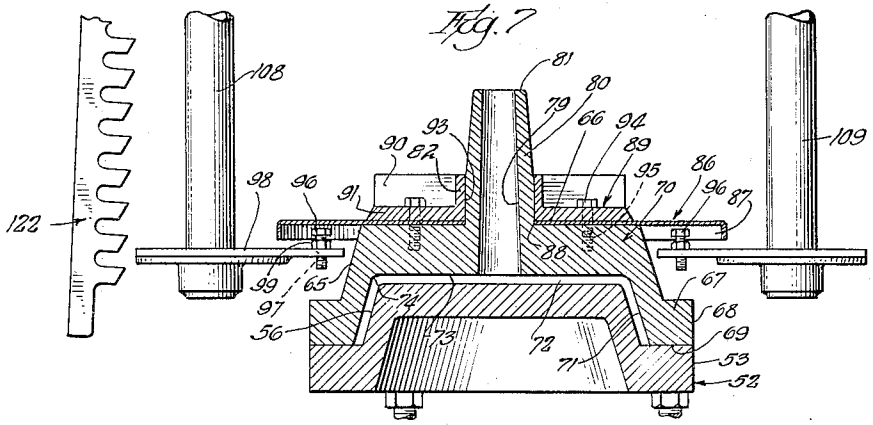
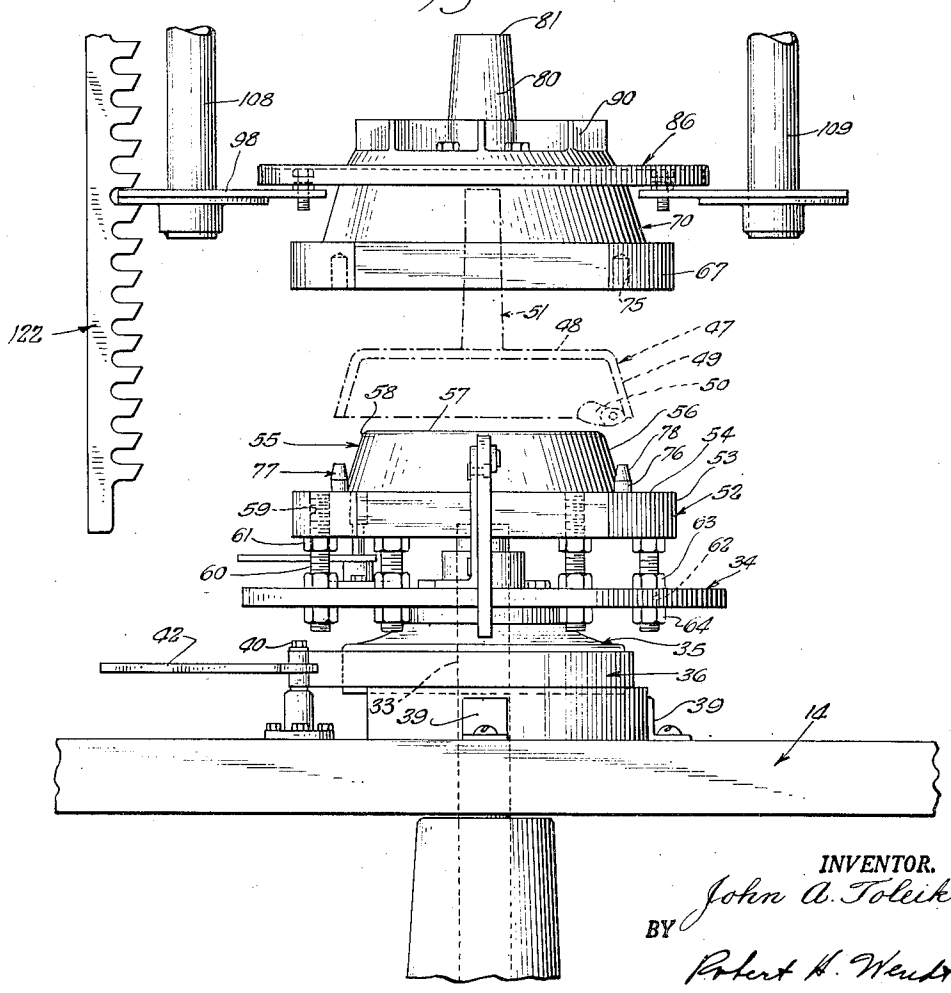


Fig. 8



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UNITED STATES PATENT OFFICE

2,507,388

CENTRIFUGAL CASTING MACHINE

John A. Toleik, Berwyn, Ill.

Application June 1, 1946, Serial No. 673,823

5 Claims. (Cl. 22—65)

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The present invention relates to centrifugal casting machines. So far as I am aware, no one up to the present invention has been able to make satisfactory magnesium castings centrifugally on account of the oxides and other inclusions which have been found present in castings of this metal when they have been made centrifugally according to the methods of the prior art.

The present invention contemplates the use of the ladle for casting metals and the like covered in my prior application filed April 17, 1946, Serial No. 662,733, now matured into Patent No. 2,497,838, by means of which the ladle may be so filled that a neutral atmosphere is maintained above the metal in the ladle, the oxides floating on top of the metal in the furnace are substantially all kept out of the ladle, and such oxides as may be included are discharged into the sprue or kept in the ladle.

One of the objects of the present invention is the provision of an improved centrifugal casting machine by means of which substantially perfect castings may be made, having a fine grained, homogeneous structure substantially free of oxides, other inclusions, or porosity.

Another object of the invention is the provision of an improved centrifugal casting machine by means of which castings may be made more expeditiously, as most of the operations involved in the making of the casting and handling of the molds may be made automatic.

Another object of the invention is the provision of an improved centrifugal casting machine having automatic means for locking the cope and drag, or mold halves, together while the mold is rotating, and for automatically releasing them when the rotation of the mold stops.

Another object is the provision of a relatively quick actuating device for lifting the cope from the drag, and the provision of automatic means for ejecting the casting from the mold.

Another object is the provision of an improved centrifugal casting machine which includes brake means for stopping the rotation of the mold quickly, preheating means for bringing the mold parts up to casting temperature, cooling means for cooling both the cope and drag, and pneumatic means for separating the mold halves.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the drawings, of which there are four sheets:

Fig. 1 is a side elevational view of a centrifugal casting machine embodying the invention.

Fig. 2 is a top plan view taken on the plane of the line 2—2 of Fig. 1, looking in the direction of the arrows.

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Fig. 3 is a horizontal sectional view taken on the plane of the line 3—3 of Fig. 1, looking in the direction of the arrows.

Fig. 4 is a horizontal view taken on the plane of the line 4—4 of Fig. 1, looking in the direction of the arrows.

Fig. 5 is a fragmentary elevational view taken on the plane of the line 5—5 of Fig. 1, looking in the direction of the arrows.

Fig. 6 is a fragmentary sectional view taken on the plane of the line 6—6 of Fig. 5, looking in the direction of the arrows.

Fig. 7 is a fragmentary vertical sectional view taken on the plane of the line 7—7 of Fig. 3, looking in the direction of the arrows.

Fig. 8 is a view similar to Fig. 5, showing the mold parts in the position with the casting in the act of being ejected from the cope by means of an automatic ejector.

Referring to Figs. 1 to 4, the casting machine preferably comprises a lower frame structure such as the four tubular legs 10–13 located at the four corners of a metal table top 14 to the under side of which the legs may be welded, the legs being joined by tubular braces 15–18, each of which has its end welded to a leg to form a lower bracing frame of substantially rectangular shape.

The table top 14 may project beyond the upper ends of the legs at each corner, and may have secured to it the four upwardly extending frame members 19–22 of angular shape, each one of which may have its flanges welded to the two edges of the table at each corner, and may have its flanges beveled at 23, at the lower end, for engagement with the legs 10–13 to which they may be welded.

A pair of transverse frame members 24, 25 may extend the longest dimension of the table beneath the top 14, and may be secured to the braces 15 and 17 by welding or by suitable bolts or rivets, to provide a support for the driving motor 26 and for the gear housing 27, the motor being preferably located outside of the frame, and the gear housing 27 being centrally located below the table top 14.

Drive shaft 28 of motor 26 may be provided with a multiple-grooved V-pulley 29 for engagement with the V-belt 30, which also engages in the grooves of a second multiple-groove V-pulley 31 carried by the driven shaft 32, rotatably mounted in bearings in the housing 27.

Any suitable form of gear reduction may be employed, the one illustrated being similar to that utilized in the rear axle housing of an automobile, except that a direct gear drive is employed between the driven shaft 32 and the vertical shaft 33 (Fig. 1) which passes through a suitable aperture in the table top 14.

The vertical shaft 33 is keyed or otherwise secured to a rotating turntable plate 34, the shaft

being provided with a brake drum 35 engaged by a brake band 36. A suitable anti-friction bearing 37 rotatably supports the upper end of vertical shaft 33.

Referring to Fig. 6, the structure is broken away in this fragmentary plan view to show the brake drum 35 and the brake band 36. The brake band may be supported by a cylindrical housing 38 which is secured to the table top by means of a plurality of angle brackets 39, and the band may have its ends secured to the pins 40 and 41 on a brake lever 42 which itself is pivotally mounted on the pin 41.

The ends of brake band 36 are formed with cylindrical formations which act as bearings about the pins 40 and 41, and the tendency of the brake band 36 is to expand, sliding outward on the cylindrical support 38 out of contact with the drum 35. When the lever 42 is moved in a counter-clockwise direction in Fig. 6, the band 36 is tightened on the drum 35, but when it is released, the brake releases the drum 35.

43 indicates a lever carried by the rotating turntable plate 34 and threaded upon a stud 44. This lever may carry a weight 45 at its outer end, and may be urged by means of a spring 46 in a counterclockwise direction.

The stud 44 carries a coarse thread extending in a clockwise direction looking from the top (Fig. 5), and the hub of the lever 43 surrounding stud 44 is internally threaded so that when the lever 43 is turned in a clockwise direction, looking from the top, that is, the direction of the arrow in Fig. 6, it tends to rise upon the stud 44 to engage an ejector pin 151, Fig. 5. The ejector pin 151 is located with its upper plane end flush with the bottom of the cavity 72 or casting 47 at one of its edges, and the ejector pin 151 also engages the lower plane surface 69 of the cope 70 so that the ejector pin 151 must be withdrawn into the flush position before the two mold halves can be placed together.

A spring 46 urges the lever 43 into the position in which the ejector pin 151 is retracted, the spring being hooked in the lever 43 and having its other end secured to the turntable 34.

Referring to Fig. 7, the two mold halves are there shown in section, and this is a mold which is adapted to be used for forming a frying pan 47 (Fig. 8) of the type having a flat bottom 48, frusto-conical sides 49, and a radially extending handle tang 50 which is to be engaged by an insulating handle. The sprue 51 is, of course, cut off along the plane of the outside of the bottom 48.

The drag or lower mold member 52 (Fig. 8) comprises a metal member formed with a round base 53 which has a plane upper surface 54 and supports an upwardly projecting mold formation 55 with frusto-conical sides 56 and a flat top 57. The corner between sides 56 and top 57 is rounded at 58 to provide a pan 47 which is more easily cleaned.

The present molds are preferably molds which may be made of an alloy sold under the name of "Meehanite," a calcium silicide cast iron which has a fine grain structure which provides a smooth surface, and which can be tempered to withstand the temperatures to which it is subjected in casting aluminum and magnesium. The mold may thus be made by casting the mold in a plaster pattern of suitable characteristics, thus saving machining operations, which would otherwise be required to make the permanent mold.

The lower mold member or drag is provided with a plurality of threaded bores 59 for receiving the threaded stud bolts 60, preferably equally spaced, and four in number, by means of which the lower mold member 52 is fixedly mounted on the turntable 34. After being threaded into bores 59, bolts 60 are secured by lock nuts 61, and the bolts pass through unthreaded bores 62 in turntable 34, where they are secured by nuts 63 above and nuts 64 below the turntable.

The upper mold half 70 comprises a substantially conical body 65 having a plane upper surface 66 and a radially projecting annular flange 67 terminating at an edge 68 which may be flush with the edge 53 of the drag 52. The flange 67 has a lower plane surface 69 which fits against the plane surface 54 on the drag 52.

Cope 70 has a frusto-conical cavity 71 which is concentric with the frusto-conical outer surface 56 on the drag 52, but spaced therefrom sufficiently to provide the mold cavity 72 of the same thickness as exemplified in the casting 47. The cavity of the cope 70 has a plane upper surface 73 which joins to the side wall 71 with the rounded corner at 74 to form the outside of the pan 47 with rounded corners.

Flange 67 of the upper mold half 70 is provided with a plurality, preferably three or four, of equally spaced axial sockets 75 of cylindrical shape, adapted to receive the cylindrical part 76 of a plurality of alignment pins 77, each of which has a tapered upper end 78. The alignment pins 77 are so fixedly located in the drag 52 that when they are in the sockets 75, and the cylindrical surfaces 76 are engaging the outer cylindrical walls of sockets 75, the cope and drag are aligned, as shown in Fig. 7, with a uniform spacing on all sides of the cavity 72. The two mold parts also have the laterally projecting cavity formation adapted to form the shank 50 for supporting a handle.

The cope 70 is also provided with the centrally located and upwardly extending filling opening and sprue conduit 79 which comprises an upwardly tapering bore defined by a tubular member 80. The filling opening 79 may terminate in a plane upper edge 81, and the bore 79 is of sufficient size to receive the discharge conduit 82 of a ladle 83, having a ball valve 84 for controlling the discharge of molten metal shown and described in my prior application on the ladle.

Discharge conduit 82 of the ladle has such a loose fit in the filling opening 79 and it is supported by means of one or the other of the supporting arms 85 so that the ladle 83 may stand still while the mold rotates during the filling operation. The upper mold half is preferably provided with a supporting plate or shield 86 comprising a sheet metal plate having a depending cylindrical flange 87 and a centrally located aperture 88 for passing the sprue conduit 80.

Shield 86 may be secured to upper mold half 70 by a fin casting 89 comprising a cast metal member of circular shape provided with a plurality of radially extending fins 90. Fin casting 89 has a lower circular body 91 and a tubular member 92 which surrounds the conduit 80, the latter being received in a bore 93. A plurality of screw-bolts 94 pass through the fin plate 89 and through the shield 86, and are threaded into threaded bores 95 in the upper mold half 70.

The shield 86 is preferably circular and of such diameter that it extends well over the supporting screw-bolts 96 which are intended to support the cope when it is to be lifted from the drag, as shown in Fig. 8. Screw-bolts 96 are

threaded into threaded bores 97 in the supporting plates 98 where they are secured by lock nuts 99. The two screw-bolts 96 are diametrically opposite each other, and they are at such an elevation that they hold the cope parallel to the drag by engaging the shield 86 at the same time, and lifting the cope axially from the drag by a mechanism further to be described.

The vertically extending angle irons 19—22 are joined at the top by a pair of transversely extending frame members 100, one of which joins the frame members 19, 20, and another the frame members 21, 22. Additional shorter frame members 101 (Fig. 1) extend between angle irons 19 and 22 and angle irons 20 and 21 at a somewhat lower elevation for supporting the transverse frame member 102 which is adapted to carry the upper guides 103 for a cope lifting mechanism, indicated in its entirety by the numeral 104.

At a lower elevation there are two more frame members 105 extending horizontally and joining the angle irons 19—22 and 20—21 for supporting another transverse frame member 106 which carries guides 107 for the lifting mechanism 104. The lifting mechanism 104 for the cope may comprise a pair of cylindrical rods or shafts 108, 109, and the guides 103, 107 may be in the nature of pillow block bearings having cylindrical bores for receiving the rods 108, 109. Thus the rods 108, 109 are mounted for up and down motion.

Rods 108, 109 are joined at the upper end by a pair of transverse frame members 110 (Fig. 1, Fig. 2), these frame members being welded to the opposite faces of the rods to hold rods 108, 109 in parallel relation. Frame members 110 form a cross-head which has a transverse pin 111 mounted on it for pivotal securement to the upper end of a piston rod 112.

The piston rod 112 extends into a cylinder 113 in which it is provided with a two-way piston, and the cylinder 113 is pivotally mounted on a pin 114 which is pivotally mounted on the transverse frame member 106. Suitable flexible conduits 115, 116 communicate with the cylinder 113 at its upper end above the piston 117, and at its lower end below the piston 117. These conduits lead to a two-way valve 118 which also communicates with a source of air under pressure through conduit 119.

Valve 118 has a handle 120 which, when located in middle position, shuts off communication to both cylinder conduits 115, 116, thus holding the sliding mechanism 104 in the position in which it happens to be. When handle 120 is moved in one direction, air can be admitted into the conduit 116 which leads to cylinder 113, lifting piston 117. When handle 120 is moved in the opposite direction, air is admitted to the cylinder 113 above the piston 117, thereby moving the sliding mechanism 104 downward. By means of valve 118 the air may be suitably throttled so that its movement is without shock.

The rods 108, 109 extend downwardly on both sides of the shield 86 which is secured to the cope, and these rods support the plates 98 which carry the screw-bolts 96 which are located under the shield 86 in position to lift the shield. Rods 108, 109 also support the arms 85 which they carry by means of adjustable clamps so that these arms may be adjusted as desired, to provide a rest for the handle or bottom of the ladle 83 of my prior application, while the mold is being filled.

In order to prevent accidental dropping of the cope while the mold cavity is being inspected or

cleaned, the transverse frame member 106 may have a bracket 121 pivotally supporting a multiple-toothed latch 122, any of the grooves 123 of which is adapted to receive one of the plates 98 carried by one of the rods 108. Thus the mechanism may be latched in the upper position also, or it may be latched with the molds only slightly separated for the preheating operation.

A ball-weighted lever 124 is pivoted on the same pin 125 as the latch 122, and has a bell crank arm with a lug 126 engaging the inner side of the latch lever 122. When the ball 124 is in the position shown in Fig. 1 its weight is sufficient to hold the lever 122 out of latching position, but when the ball 124 is swung over in a counter-clockwise direction, and the lug 126 no longer engages lever 122, gravity swings the lever 122 into latching position at all times.

The teeth 127 of the latching lever 122 are preferably beveled upwardly so that the sliding mechanism 104 may cam the latch backward as it passes upwardly, but it is caught as it passes downwardly again if the latch 122 is in latching position. The transverse frame member 102 (Fig. 1) near the top, below the cross-head 110, preferably has a threaded bracket 128 provided with an upwardly extending screw-bolt 129 which engages the lower side of cross-head 110 and is secured by suitable lock nuts.

Bolt 129 constitutes an adjustable stop for limiting the downward movement of the sliding mechanism 104. The upward movement may be limited by the piston in the cylinder.

In order to preheat the mold, the frame member preferably carries suitable conduits 130 with a main valve 131, and auxiliary shut-off valve 132, 133 for the two burners 134, 135, which may be located at diametrically opposite sides of the mold. One of the burners 134 may be located to project its flame beneath the drag or between the drag 52 and turntable plate 34. The other burner 135 may be located to play on the upper mold half 70, but is preferably located so that it will project its flame between the two mold halves when they are slightly separated.

As there is a tendency for the heat to rise with the products of combustion, this heats the upper parts of the mold also very effectively, and by means of these burners the mold may be preheated to the proper casting temperature.

The conduit 130 is supplied with a suitable liquid or gaseous fuel suitably mixed with air or oxygen in the proper proportions. If a liquid fuel is used, the burners must, of course, include an atomizing nozzle.

The two mold halves are preferably provided with means for clamping them together, and these means are preferably actuated by centrifugal force. Such a mechanism is shown in Fig. 5, in which the turntable plate 34 supports a pair of upstanding brackets 136 which are similar in shape and oppositely located. Each bracket has an attaching portion 137 secured to the turntable by screw-bolts 138.

The upstanding portion of each bracket is indicated at 139, and it extends to the upper level of the mold flange 67, and is provided with a transverse pin 140 for pivotally mounting a weight lever 141. This weight lever is pivotally connected at 142, by means of a rivet, to a link 143, the other end of which is pivotally connected to a latching member 144 by means of a rivet 145.

The latching lever 144 may be pivotally supported upon flange 136 by a rivet 146, and it extends upwardly and is provided with a hook or

retaining member 147 at its upper end, the lower shoulder 148 of which fits over the top of flange 67 of the cope 70.

The point of pivotal connection of the connecting link 143 to weight lever 141, in Fig. 5, is at 142, outside of the pin 140, so that as the two weight levers 141 rise to the dotted line positions, the link 143 is moved inwardly in each case in a radial direction, causing the latches 144 to move their shoulders 148 over the top of the upper mold half at the flange 67.

Each of the weght levers 141 happens to have a groove 149, which was necessitated by the fact that these levers were made out of bars, and the groove was provided so that they could be pivoted down far enough to free the cope without the lever 141 engaging the turntable plate 34.

The operation of this part of the mechanism is as follows: When the mold is rotated, centrifugal force causes the levers 141 to swing outward to the dotted line positions, automatically causing the latches 144 to clamp the mold halves together as long as the rotation continues. The levers move down to the full-line position when the rotation stops and the centrifugal force decreases.

The threaded rod 150 is an ejector, which is threaded into a bore in the frame member 106 and is secured by a lock nut in such position as to project into the sprue bore 79 when the cope is sufficiently lifted. This ejector 150 engages the sprue when the cope is sufficiently lifted, and causes the casting to be ejected from the cope.

The operation of the mechanism of the casting machine is as follows: When castings are to be made, the mold halves are first spaced slightly and preheated as described. Then the mold is placed in a state of rotation by energizing the motor 26, and the speed of rotation will depend upon the type of metal being cast, the size of the mold, the temperatures employed, etc.

For example, a rotation of 500 to 600 R. P. M. is sufficient for casting aluminum frying pans. If a motor having a speed of 1800 R. P. M. is employed, by means of the stepped pulleys, the belt may be so adjusted as to vary the speed between a wide range of speed limits.

As soon as the mold begins to rotate and reaches a predetermined speed, the centrifugally actuated levers 141 move outward by centrifugal force, and urge the latches 144 into latching position to hold the two halves of the mold together.

The ladle of my prior application may then be filled by depressing its lower filling conduit 82 into the free surface of molten metal in the furnace and opening the ball valve 84 by means of the actuating member provided, so that metal wells up into the ladle 83 from the bottom, and the oxides which are floating on top of the molten metal are pushed to one side and kept from entering the ladle 83.

Should, perchance, a small amount enter the lower filling opening 82 of the ladle 83, these oxides will pass to the top of the molten metal in the ladle 83. If desired, the molten metal may have a neutral atmosphere above it in the ladle to prevent further oxidation, and by means of a suitable conduit extending through the ball valve of my ladle, the mold may be gases or filled with a suitable gas adapted to prevent oxidation in the mold.

The ladle may then be brought to the rotating mold and rested upon one of the arms 85 in such position that its discharge spout 82 is immediately above the sprue conduit 80, and then the ball valve may be opened so that the metal passes downward out of the ladle into the cavity of the rotating mold. There the centrifugal force causes the molten metal to move outward in all directions to fill the mold, and the size of the ladle is so proportioned to the size of the mold that the ladle contains sufficient metal to form one or more castings.

When sufficient metal has been poured into the mold to effect a filling, the ball valve is closed and the ladle is removed, the motor is de-energized, and the mold is stopped rotating as quickly as possible by means of the brake 35, 36.

The rotation should be stopped while the metal is still plastic in the sprue bore 79 so that it will run down to close the centrifugally formed bore which would otherwise be present while the mold and molten metal are rotated.

As the mold stops, due to the immediate use of the brake after the metal has been discharged from the ladle into the mold, centrifugal force acting on the latching mechanism ceases, and the latching mechanism which secures the mold halves together is automatically released. The lever 43, which has been rotating in radial position with the turntable 34, and which has a weight 45 at its outer end, tends to continue in its direction of rotation, tensioning the spring 46 and rising on the threads of stud 44 to lift ejector pin 151 automatically due to the inertia of lever 43. Thus not only are the mold halves released from being clamped together, but the ejector automatically lifts the cope from the drag and lifts the casting with it, the casting being carried by the cope.

Thereupon, the cope is lifted by means of the lifting mechanism by turning the compressed air valve to the lifting position. The casting lifts with the cope from the drag, and as the mold rises the ejector 150, carried by a fixed frame member 106, passes into the sprue bore 79, and acting on the sprue, drives the casting downward out of the cope. The casting is then removed, and the mold inspected to be sure that it is clean, and, thereafter, the valve handle 129 may be moved in the opposite direction to lower the lifting mechanism 104.

The cope having been lifted while the mold was not rotating, the two halves of the mold will still be in the same rotative position, and as the cope is lowered upon the drag, the alignment pins 77, with their tapered ends 78, will go into the socket 75 and bring the mold halves into proper registry.

The castings made by the foregoing mechanism are found to be sound, of a fine-grain structure, and without porosity, and substantially without any included oxides or other inclusions. My method of casting may be briefly summarized as follows:

A rotating mold is provided with a centrally located sprue conduit located on the axis of rotation and extending upwardly. Metal is melted in a furnace and maintained in a clean condition at a suitable casting temperature, and is taken from the furnace by a ladle having a downwardly extending filling and discharge opening. This discharge opening is valved on the inside, and the ladle is filled by depressing the filling opening below the free surface of the molten metal in the furnace so as to fill the ladle by welling up the metal from below, this avoiding the oxides on the surface of the molten metal.

When the ladle is properly filled, the valve is closed to prevent the molten metal from running out, and the ladle is then placed axially of the

rotating mold, with its discharge opening in substantial registry with the axially located filling opening of the mold, and the valve of the ladle is opened.

The metal then runs downward out of the ladle, into the mold, with a minimum shock and a minimum exposure of metal to the atmosphere, and a minimum oxidation, and the pouring is continued until the mold is filled, any oxides which are present going to the top of the metal in the ladle and appearing in the sprue of the mold.

The mold having been filled, the ladle is removed, the rotation stopped, and the cope and drag separated. The rotation must be stopped quickly enough so that the metal in the sprue is still in plastic condition, so that it will run down in the sprue conduit to close the bore, which is otherwise brought about by the action of centrifugal force on the metal in the mold, even down to the bottom of the pan being cast. The plastic metal running down in the sprue will close the bottom of the pan and provide a sound, perfectly shaped casting.

The casting should be removed promptly to prevent restraint by the mold, and, thereafter, the sprue may be cut off from the bottom of the casting.

It will thus be observed that I have invented an improved casting machine by means of which inclusions of oxides or other inclusions are substantially eliminated.

By means of the supply of suitable gas to the top of the metal in the ladle, and suitable gas through the ball valve into the discharge conduit of the ladle, the metal in the ladle may be kept free of oxidation, and the mold itself may be filled with suitable gas to prevent oxidation, this gas escaping through the cracks between the mold halves as the mold is being filled. Gas also may escape up the center of the sprue conduit, since the metal tends to be thrown to the outer wall of the sprue conduit in the same manner as it is moved outwardly in the mold by centrifugal force.

By means of my casting machine and by utilizing my improved ladle, castings may be made of many different metals, including magnesium, which, so far as I am aware, has never been cast successfully in a centrifugal casting machine. The making of castings is accomplished very expeditiously, and the casting illustrated may be made at the rate of about four castings per minute with my casting machine.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a centrifugal casting machine, the combination of a supporting frame comprising a plurality of legs, a table for supporting a mold, a base carried by the legs, a driving motor and driven vertical shaft extending through said table, an upwardly extending frame comprising a plurality of vertical frame members joined by transverse horizontal frame members, said horizontal frame members extending at right angles to each other to each of the corners of the frame, and supporting a plurality of intermediate horizontal frame members, a turn table carried by said shaft, a brake drum carried by the shaft below the turn table, said turn table having a plurality of axially extending, regularly spaced, threaded bolts secured thereto by nuts and arranged in a circle, and a drag having threaded apertures for receiving said bolts which are threaded into said drag to secure the drag to the turn table in centered position at right angles to the axis of the shaft, and a cope fitting over said drag and forming with the drag a mold cavity, said cope having a centrally located, vertically extending filling opening, a circular metal plate carried by the top of the cope and projecting radially from the cope, a pair of rods slidably mounted upon said intermediate frame members, said rods being joined by a cross head and intermediate frame members, a hydraulic cylinder and piston connected to the cross head to lift the sliding rods, and a pair of arms carried by the lower ends of the sliding rods and extending under said circular, steel plate for lifting the cope hydraulically from the drag.

2. In a centrifugal casting machine, the combination of a supporting frame comprising a plurality of legs, a table for supporting a mold, a base carried by the legs, a driving motor and driven vertical shaft extending through said table, an upwardly extending frame comprising a plurality of vertical frame members joined by transverse horizontal frame members, said horizontal frame members extending at right angles to each other to each of the corners of the frame, and supporting a plurality of intermediate horizontal frame members, a turn table carried by said shaft, a brake drum carried by the shaft below the turn table, said turn table having a plurality of axially extending, regularly spaced, threaded bolts secured thereto by nuts and arranged in a circle, and a drag having threaded apertures for receiving said bolts which are threaded into said drag to secure the drag to the turn table in centered position at right angles to the axis of the shaft, and a cope fitting over said drag and forming with the drag a mold cavity, said cope having a centrally located, vertically extending filling opening, a circular metal plate carried by the top of the cope and projecting radially from the cope, a pair of rods slidably mounted upon said intermediate frame members, said rods being joined by a cross head and intermediate frame members, a hydraulic cylinder and piston connected to the cross head to lift the sliding rods, and a pair of arms carried by the lower ends of the sliding rods and extending under said circular, steel plate for lifting the cope hydraulically from the drag, said table also supporting a brake-band extending about said brake-drum and having one end secured to a pin and the other end pivotally mounted on a lever which is pivoted on said pin.

3. In a centrifugal casting machine, the combination of a supporting frame comprising a plurality of legs, a table for supporting a mold, a base carried by the legs, a driving motor and driven vertical shaft extending through said table, an upwardly extending frame comprising a plurality of vertical frame members joined by transverse horizontal frame members, said horizontal frame members extending at right angles to each other to each of the corners of the frame, and supporting a plurality of intermediate horizontal frame members, a turn table carried by said shaft, a brake-drum carried by the shaft below the turn table, said turn table having a

plurality of axially extending, regularly spaced, threaded bolts secured thereto by nuts and arranged in a circle, and a drag having threaded apertures for receiving said bolts which are threaded into said drag to secure the drag to the turn table in centered position at right angles to the axis of the shaft, and a cope fitting over said drag and forming with the drag a mold cavity, said cope having a centrally located, vertically extending filling opening, a circular metal plate carried by the top of the cope and projecting radially from the cope, a pair of rods slidably mounted upon said intermediate frame members, said rods being joined by a cross head and intermediate frame members, a hydraulic cylinder and piston connected to the cross head to lift the sliding rods, and a pair of arms carried by the lower ends of the sliding rods and extending under said circular, steel plate for lifting the cope hydraulically from the drag, and a pivoted latching member having a multiplicity of supporting shoulders separated by grooves movable by gravity into engagement with one of the arms on said sliding rods for holding the sliding rods and cope in elevated position.

4. In a centrifugal casting machine, the combination of a supporting frame comprising a plurality of legs, a table for supporting a mold, a base carried by the legs, a driving motor and driven vertical shaft extending through said table, an upwardly extending frame comprising a plurality of vertical frame members joined by transverse horizontal frame members, said horizontal frame members extending at right angles to each other to each of the corners of the frame, and supporting a plurality of intermediate horizontal frame members, a turn table carried by said shaft, a brake-drum carried by the shaft below the turn table, said turn table having a plurality of axially extending, regularly spaced, threaded bolts secured thereto by nuts and arranged in a circle, and a drag having threaded apertures for receiving said bolts which are threaded into said drag to secure the drag to the turn table in centered position at right angles to the axis of the shaft, and a cope fitting over said drag and forming with the drag a mold cavity, said cope having a centrally located, vertically extending filling opening, a circular metal plate carried by the top of the cope and projecting radially from the cope, a pair of rods slidably mounted upon said intermediate frame members, said rods being joined by a cross head and intermediate frame members, a hydraulic cylinder and piston connected to the cross head to lift the sliding rods, and a pair of arms carried by the lower ends of the sliding rods and extending under said circular, steel plate for lifting the cope hydraulically from the drag, said turn table supporting, at diametrically opposite points, a pair of pivotally mounted locking levers, the pivots of said levers being offset and located under the drag, and each lever having a locking shoulder at its free end for engaging over the top edge of said cope, said levers each being mounted upon a bracket carried by the turn table and said bracket supporting a depending pivoted weight connected by a link to said lever in each case, the weight swinging outward due to centrifugal force and locking the cope to the drag while they are rotating.

5. In a centrifugal casting machine, the combination of a supporting frame comprising a plurality of legs, a table for supporting a mold, a base carried by the legs, a driving motor and driven vertical shaft extending through said table, an upwardly extending frame comprising a plurality of vertical frame members joined by transverse horizontal frame members, said horizontal frame members extending at right angles to each other to each of the corners of the frame, and supporting a plurality of intermediate horizontal frame members, a turn table carried by said shaft, a brake-drum carried by the shaft below the turn table, said turn table having a plurality of axially extending, regularly spaced, threaded bolts secured thereto by nuts and arranged in a circle, and a drag having threaded apertures for receiving said bolts which are threaded into said drag to secure the drag to the turn table in centered position at right angles to the axis of the shaft, and a cope fitting over said drag and forming with the drag a mold cavity, said cope having a centrally located, vertically extending filling opening, a circular metal plate carried by the top of the cope and projecting radially from the cope, a pair of rods slidably mounted upon said intermediate frame members, said rods being joined by a cross head and intermediate frame members, a hydraulic cylinder and piston connected to the cross head to lift the sliding rods, and a pair of arms carried by the lower ends of the sliding rods and extending under said circular, steel plate for lifting the cope hydraulically from the drag, an ejector pin extending through an aperture in said drag in position to engage a casting in said cavity, said pin being mounted upon a threaded stud and said stud carrying a weighted lever, and a spring for urging said weighted lever into a position where the ejector pin is retracted, the weighted lever tending to move onward in the direction of rotation against its spring when the brake is applied to the rotating drag, the threaded member lifting the ejector pin to eject the casting from the drag as the brake is applied, the casting and cope being lifted together.

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