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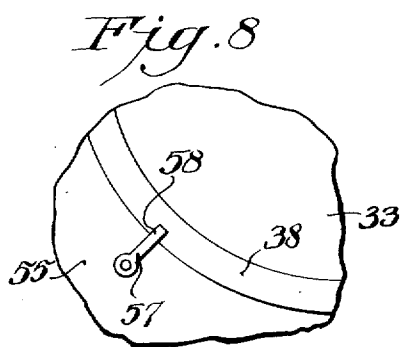
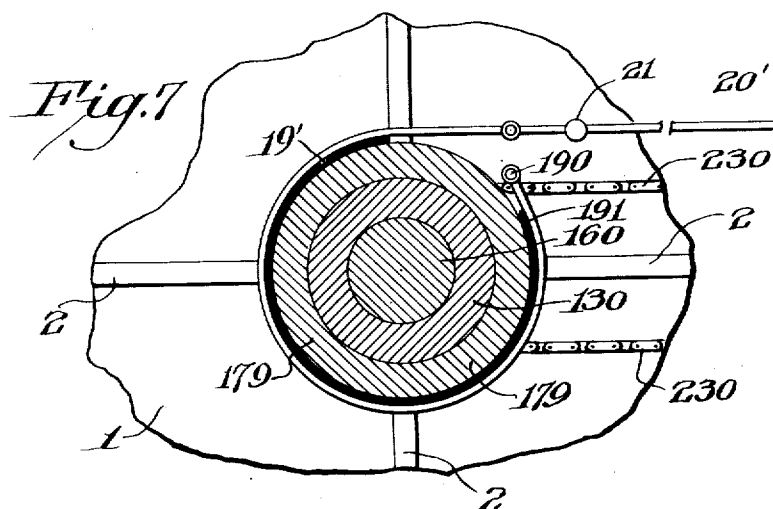
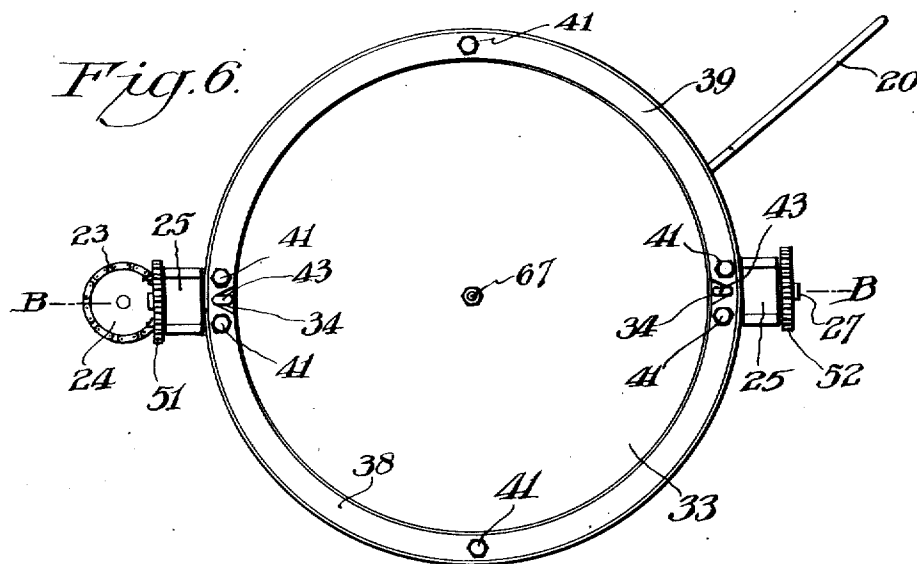
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CENTRIFUGAL CASTING MACHINES

Filed June 15, 1953

2 Sheets-Sheet 1



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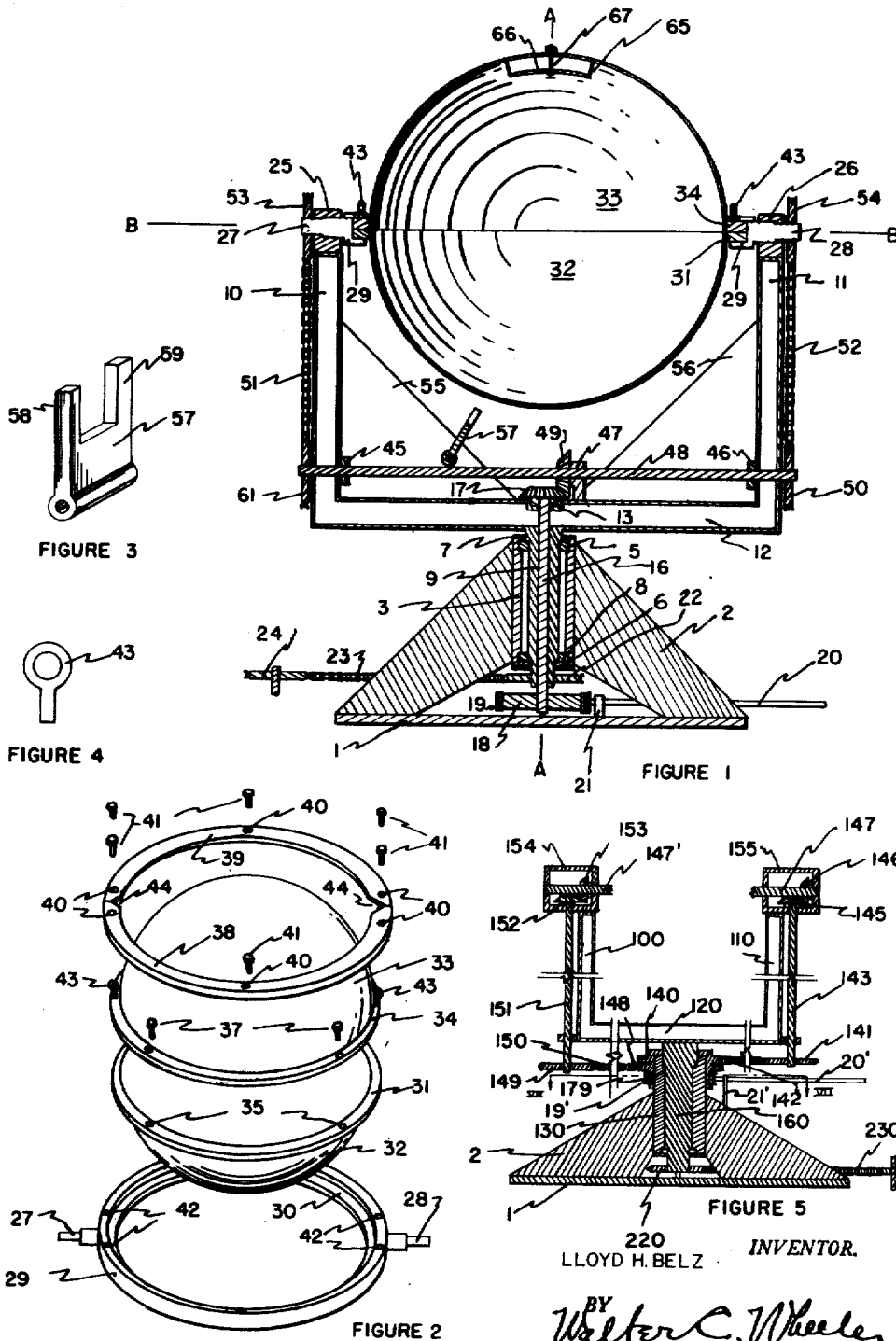
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CENTRIFUGAL CASTING MACHINES

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6 Claims. (Cl. 18—26)

This invention relates to centrifugal casting machines, and especially to machines that are suitable for casting hollow shells, the outer contours of which are surfaces of revolution and to processes of casting such shells.

Centrifugal casting machines having a rotatable mold carried by a frame which is adapted for rotation in a plane transverse to the frame have long been known but the arrangement in such machines for supplying power to the mold, for controlling the rotation of the mold and the means for loading and unloading the mold have left much to be desired.

It is among the objects of the present invention to provide a centrifugal casting machine having two axes of rotation in which both axes of rotation intersect within the surface of rotation of the object to be cast.

Another object of the invention is to provide a device of this general class in which the mounting for the mold provides for replacing a mold containing a hollow casting with an empty mold.

A further object of the invention is to provide means for controlling or stopping the rotation on one axis whilst rotating the mold on another axis.

Still further objects of the invention will become apparent from the following description which is made with reference to the drawing which is illustrative of specific embodiments of the invention in which

Figure 1 is a side elevational view partially in cross section, said section being in a plane passing through the upright axis of rotation and through the rotatable frame and mold,

Figure 2 is a perspective exploded view of the parts of a cylindrical rotatable mold together with certain of the mountings therefor,

Figure 3 is a perspective view of a holding device for temporarily preventing rotation of the mold on one of its axes,

Figure 4 is a side elevational view of an eye member mounted on the mold for attaching means for removing and replacing molds or parts thereof in the frame,

Figure 5 is a cross sectional view similar to Figure 1 of a modified driving means,

Figure 6 is a top plan view of the device shown in Figure 1,

Figure 7 is a cross sectional view taken along the line VII—VII of Figure 5 showing a top plan view of various details of the brake mechanism, and

Figure 8 is a fragmentary elevational view illustrating the relationship of the mold flange and the latching device when the mold is in a position ninety degrees from that shown in Figure 1, and the latch is in engagement with the mold ring.

In general, the device comprises a base 1 having secured thereto at least three upright supports 2 upon which the device is supported. The uprights supports are disposed obliquely and are fastened at their bottom ends to the base member 1. At their converging upper ends they are fastened to an elongated cylindrical hollow

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member 3 within which the upper and lower thrust bearings 5 and 6 and the annular bearings 7 and 8 for the tubular frame supporting drive shaft 9 are mounted. The frame comprises a tubular structural member of rectangular cross section having two upright legs 10 and 11 welded at their lower ends to the horizontal member 12 thereof. The horizontal member 12 is suitably secured to the upper end of shaft 9 and centrally on the top of the member 12 is mounted the main spindle bearing 13.

The main spindle 16 is mounted in an upright position within the hollow shaft 9 through which it projects at the upper end for mounting the bevel gear 17 and at the lower end for mounting the brake drum 18. Cooperating with the brake drum 18 in known manner is the brake band 19 which may desirably be manually operated by the brake rod 20 which is supported by and in sliding engagement with the support 21. The bevel gear 17 and brake drum 18 may desirably be keyed to the drive shaft 16. Keyed at the lower projecting end of the hollow shaft 16 is the main drive sprocket wheel 22 which may be a pulley, pinion or other rotatable member. The sprocket wheel 22 is driven from any suitable source of power through the chain 23 and pinion 24.

At the upper ends of the branches 10 and 11 of the frame are mounted bearings 25 and 26 in which the stub shafts 27 and 28 are rotatably mounted. The stub shafts 27 and 28 are mounted diametrically on the outside of the mold supporting ring 29 with their axes in the same diameter of the circular ring 29. The circular ring 29 is counter sunk to provide a recess and seat 30 within and upon which the out-turned rim 31 of the lower part of the mold 32 is seated. In the modification shown in Figure 2 the mold is a spherical shell comprising the hemispherical lower portions 32 and the hemispherical upper part 33. The upper part of the mold has an out-turned edge 34 corresponding to the edge or lip 31. The upper and lower parts of the mold are preferably clamped together independently of their mounting in the rotating ring 29 and for this purpose the lower ring 32 may be provided with threaded bolt holes 35 conveniently spaced around the lip 31 to provide a tightly closed joint when the set screws 36 are passed through the bolt holes 37 in the margin 34 of the upper part of the mold and screwed down snugly. If desired a gasket seat may be provided in the facing surfaces of the lips 31 and 34 for mounting a gasket to assure freedom from leakage. The assembled mold is seated on the facing 30 of the rotatable ring 29 and the mold is securely held in place in the ring 29 by the semi-circular parts 38 and 39 of the clamping ring. The clamping ring is provided with bolt holes 40 suitably spaced to receive the set screws 41 which are screwed down on the ring 40 into the threaded holes 42 in the rotatable ring 29. The bolts 37 may be counter sunk in the rim 34 so that the clamping ring 39 will contact the rim 34 or the clamping ring may bear on the heads of the bolts 37 to hold the mold securely in the counter sunk portion of the rotating ring. Notches 44 are cut in the split clamping ring to avoid interference thereof with the eye bolts 43 which are secured at diametrically opposite points of the rim of the upper part of the mold for lifting the mold into and removing the assembled mold from its mounting in the rotatable ring 29.

End journals 45 and 46 are mounted on the lower parts of the upright arms 10 and 11 of the rotatable frame and a central bearing 47 is provided near the center of the horizontal part 12 of the frame in which the horizontal shaft 48 is mounted to rotate. Keyed onto the central portion of the shaft 48 is a bevel gear

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49 which is mounted to mesh with the power transmitting bevel gear 17. The shaft extends beyond the bearings 45 and 46 to accommodate the sprocket wheels 61 and 50 which are keyed to the ends of the shaft outside of the upright arms 10 and 11 of the frame. Drive chains 51 and 52 pass over sprocket wheels 49 to sprocket wheels 53 and 59 to sprocket wheel 54 which are keyed to the ends of stub shafts 27 and 28 which project beyond the journals 25 and 26 respectively.

The upright arms 10 and 11 are reinforced by triangular members 55 and 56 which are welded along their perpendicular edges to the inside of the upright and horizontal frame members. A forked latching member 57 is pivotally mounted on the reinforcing member 55 so that the outer forked portions 58 and 59 will engage the mounting ring 39 and rotatable frame 29 respectively when the mold is secured in place and the mold is turned through an angle of 90° from that shown in Figure 1. The latching member is freely and pivotally mounted on a bolt which is suitably secured to the member 55 so that when the latch is in latched position in engagement with the mounting ring 38 or 39 and mold supporting ring 29, and the power is applied to shafts 27 and 28 tending to turn the mold on their axes, the latch will be held obliquely and in engagement with the mold frame for a period while the mold is turned solely on the vertical axis of the mold frame. Then by decreasing the power applied to hold the mounting ring and mold supporting ring against the latch, the resulting release of pressure on one fork of the latch will enable the forked portion of the latch to fall out of contact with the rotating frame and permit the mold to freely rotate on the axes of shafts 27 and 28.

Referring again to Figure 1, for casting a sphere the lower hemispherical mold 33 is mounted in the mold supporting ring 29 and an amount of self hardenable material sufficient to form the walls of the hollow object to be cast, such as wet Portland cement and sand mortar, or a charge of liquid plastic material is poured thereinto. The upper hemispherical part of the mold 33 is superimposed on the lower part 32 with the bolt holes registering. Then the mold is tightly closed by screwing down the cap screws 37 which are suitably distributed around the periphery of the rim 34 to provide a seal. A gasket (not shown) may be used on the facing of rim 31 between the hemispheres, if desired. After the hemispheres are sealed the spherical mold thus formed is securely clamped into the counter sunk mold supporting ring 29 by clamping the ring members 39 securely on the heads of the cap screws 37 by screwing the four cap screws 41 into the threaded holes 42 in the ring 29. The charged mold thus being mounted in place in the machine, it is rotated through an angle of 90° to bring the ring in position for latching and the latch 57 is raised into an oblique position as shown in Figure 1 so that the prongs 58 and 59 engage opposite sides of the rim and prevent the mold from rotating on the horizontal diametrical axis which lies in the plane of the drawing but does not prevent the frame from rotating about the vertical intersecting diametrical axis of the sphere which lies in the plane of the drawing.

Upon applying power to turn the sprocket wheel 22 from the source of power through sprocket wheel 24 and chain belt 23, the hollow shaft 9 and frame are turned on a vertical axis A—A which lies in the plane of the drawing of Figure 1. The band 19 on the brake drum 18 is released rendering vertical shaft 16 and bevel gear 17 free to rotate. The bevel gear 49, which is mounted on the frame and meshes with bevel gear 17, may travel around or turn bevel gear 17 more or less depending upon the relative drag on the several gears 17 and 49, but by reason of the locking of mold against rotation on the second axis B—B by the latching member 57 the rotation solely on the vertical axis A—A is assured, and latch 57 will be normally retained in its oblique latching position by the urge of the sphere to turn on the axis B—B and the bearing of the ring 29 on one leg of the latch 57. This

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rotation solely on the axis A—A causes the fluid charge within the spherical mold to distribute itself in a ring shaped body by reason of its tendency to flow and the centrifugal force tending to cause segregation in a plane perpendicular to the axis A—A. Upon the formation of this horizontal ring of molding material the urge to turn on the axis B—B will decrease to the extent that the latch 57 will be allowed to unlatch and drop into a horizontal position so that the sphere will be released to turn freely on the axis B—B.

Then the brake band 19 is gradually tightened on the brake drum 18 by suitably manipulating the brake rod 20, thereby positively locking shaft 16 and bevel gear 17 against turning and requiring bevel gear 49 to be rotated by reason of its travel around its meshing gear 17. This travel of the gear 49 around gear 17 causes shaft 48 to rotate and drive sprocket wheel 50, chain belt 52 and sprocket 54 to rotate shaft 28 and the spherical mold on the horizontal axis B—B, whilst the frame and sphere are also being rotated simultaneously on the vertical intersecting axis A—A. Rotation on this axis causes the ring shaped form material within the sphere to be distributed in a layer over the entire inside surface of the sphere where it is retained by continued rotation until it is set sufficiently to retain its spherical shape. The application of power is discontinued, the half rings 38 and 39 are removed and the mold is lifted out of the ring 29 by lifting on the eye bolts 43. The sphere thus molded is set aside in the mold and allowed to cure until it is sufficiently hardened to remove the molds. It is convenient to employ a plurality of molds when using a slow setting molding material, the number of molds depending upon the speed of setting. In this way the molds can be successively mounted in the ring 29 as fast as the mold spheres receive a set and the molds are removed from the ring.

For providing openings, special shapes or the mounting of insets in the molded wall are desired, they may be attached to the wall of the sphere by suitable releasable means. For example, a manhole or handhole in a molded sphere may be provided by securing a closed wall or ring 65 to the shell of the mold. The ring 65 is desirably given clearance so that it may be disengaged from the molded wall when the hemispherical mold is removed. For this purpose a dish-shaped member having a bottom 66 and outwardly flaring side walls 65 deep enough to extend through the molded wall of the sphere may be provided. The rim of the dish member is fitted to the inner contour of the mold so as to prevent leakage of molding material within the dish and a threaded bolt 67 is passed outwardly through the bottom of the dish and wall of the mold. A nut 68 is screwed down on the bolt to hold the form in place. The dish form may be given any desired cross section to provide the desired shaped opening.

In molding different kinds of material, different relative speeds of rotation will be required for rotation on the different axes, depending upon whether a molded wall of substantially uniform thickness is desired, or whether greater thickness of wall is desired in one peripheral band. Means are conveniently provided in the present device by varying the gear ratio of bevel gear 17 to bevel gear 49, or by varying the ratio of sprocket 50 to sprocket 54 so that the relative speed of rotation of the frame on one axis to the speed of rotation of the spherical mold on a perpendicular intersecting axis will be increased or decreased as the case may be. This adjustment accommodates itself to the use of a large variety of molding materials having different molding and flow properties. Another adjustment enabling the use of the present device for molding materials having different molding properties is the convenient means for varying the speed of the primary drive shaft, such as shaft 9 of Figure 1, or 160 of Fig. 5, when power is provided at a given speed, such as that provided by an electric motor of constant speed. For this purpose the ratio of the primary drive sprocket 22 or 220, as the case may be, can be easily changed to

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larger or smaller ratios, or alternatively a variable speed power transmitting device of well known design can be used instead of the main sprocket wheels.

A modified drive is illustrated in the partial cross sectional view of Figure 5 and in Fig. 7. In this modification the horizontal frame member 120, which corresponds to the horizontal frame member 12 of Figure 1, is integrally secured to the main upright central drive shaft 160 and the upright drive shaft is keyed to the main drive sprocket 220 over which the main drive chain 230 is passed. Below the horizontal frame member 120 is a somewhat cylindrical downwardly projecting member or housing which surrounds and is journaled on the upright stationary journal 130. The journal 130 constitutes a part of the base member within which the upright main power shaft 160 is journaled to rotate. Integral with the downwardly projecting cylindrical member or keyed thereto is an upper sprocket wheel 140 which drives the sprocket wheel 141 through the chain drive 142. The sprocket 141 is keyed to upright shaft 143 which is journaled in suitable bearings integral with the upright arm 110 of the frame, and at the opposite end of the shaft 143 is keyed the bevel gear 145 which meshes with bevel gear 146 is keyed to horizontal stub shaft 147 which is suitably journaled at the upper end of the right upright arm 110 of the frame. The downwardly extending cylindrical member also is integral with a lower sprocket wheel 148 which drives sprocket 149 at the left through chain 150. The sprocket 149 is keyed to upright shaft 151 which is suitably journaled in the upright left arm 100 of the rotatable frame, and on the upper end of the shaft 151 is keyed the bevel gear 152. The bevel gear 152 meshes with bevel gear 153 which is keyed to the horizontal stub shaft 147'. Horizontal stub shaft 147' is suitably journaled to rotate in the upper end of the left upright arm 100 of the frame on the same axis as the stub shaft 147 and the mold mount 30 is integral with the stub shafts 147 and 147' as shown in Figure 2. In the modification shown in Figure 5, the upright frame members are preferably arranged to constitute housing members for the shafts 143 and 151, and housing members 154 and 155 are provided at the upper ends of the upright arms of the frame to house the bevel gears 145, 146, 152 and 153. The housing of these parts is a desirable safety feature in the present arrangement and it provides excellent means for lubrication and for excluding foreign abrasive material from these vital working parts. The modification shown in Figure 5 is also provided with a locking or latching member (not shown) such as the latch 57 of Figure 1 which is suitably mounted on the frame member to engage the frame member 29 and stop its rotation on the axis of stub shafts 147 and 147' at the beginning of an operation.

The downwardly projecting cylindrical member below the frame also carries a brake drum 179 which is integral with the cylindrical member. A brake band 19' is arranged to be tightened on the brake drum by the operating brake rod 20' which is supported on the base by the bracket 21. A mold supporting ring (not shown) such as ring 29 of Figure 2 carries the stub shafts 147 and 147' at diametrically opposite points. The brake band 19' is fixedly mounted at one end by attaching it to the post 190 which is fixed to the base 1, and a lining 191 is provided for the brake band.

In operation the mold parts charged with the material to be molded are mounted in the mold ring, and the mold is locked with the latch 57 to prevent rotation on the axis of shafts 147 and 147' as described in connection with the modification of Figure 1. Then power is applied to rotate the upright shaft 160 and the frame at a suitable speed. At the start of the operation the mold is locked against rotation on the horizontal axis of shafts 147 and 147' so that the frame carrying the mold rotated freely on the vertical axis of shaft 160 and the brake drum 179 is permitted to turn freely by releasing the brake band 19'. When the material in the mold is sufficiently evenly dis-

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tributed in a horizontal band within the mold, the tension is relieved on the latch 57 tending to permit it to disengage from the mold ring 29 and to release the mold for turning on the other axis 147 and 147'. When the latch or locking member 57 is disengaged, the brake rod 20' is manipulated to tighten the brake band 19', thereby causing the shafts 147 and 147' on the upright frame members and the shafts 143 and 151 housed within the upright arms of the frame to be driven by the sprockets 140 and 148 respectively. Thus as the frame is rotated by driven shaft 160 on its vertical axis and the sprocket wheel 141 on shaft 143 is carried around the sprocket wheel 140, the chain 142, which passes over sprockets 140 and 141, drives sprocket wheel 141, shaft 143, bevel gear 145, bevel gear 146, and shaft 147, and rotates the mold on its horizontal axis, thereby to distribute the ring-formed material gathered within the mold evenly within the mold. Simultaneously the mold is driven by the shaft 147' through ring gear 148, chain 150, sprocket wheel 149, upright shaft 151, bevel gear 152, and bevel gear 153, all of which are proportioned to drive stub shaft 147' at the same speed as stub shaft 147.

The present apparatus is especially suitable for casting hollow bodies of revolution and for producing therein walls of substantially uniform thickness and structure. Particularly suitable for liquid storage are spherical hollow bodies cast in the apparatus of the present invention in that when the casting is composed of a moldable hardenable composition, such as a sand and Portland cement mixture, the larger and dense particles of sand tend to segregate uniformly toward the outer surface, thereby tending to produce a more dense and uniform inner layer of smaller particles which is the most suitable wall structure for containers for such purposes.

I claim:

1. A centrifugal casting machine comprising a support, an upright journaled rotatable drive shaft mounted on said support, means driven by an external power source for rotating said upright shaft, a symmetrical closed mold mounted to rotate on two of its axes which pass through a center of rotation within the mold, a frame integral with said journaled drive shaft upon which said mold is mounted, said mold being mounted in turn on said frame with the axis of said upright journaled rotatable drive shaft passing through said center of rotation, a driven rotatable member mounted in said frame, said rotatable member being mounted to connect directly with said mold and having its axis of rotation disposed at an angle to the axis of rotation of said drive shaft and intersecting the same at said central point of said mold, an upright rotatable differential shaft having a bevel gear mounted integrally on one end thereof, means for driving said upright rotatable shaft including a differential having two meshing bevel gears, the first of which is mounted on said upright shaft journaled in the frame, and having its axis parallel to the axis of said rotatable drive shaft, and the other gear of said differential being in driving connection with said first bevel gear and said driven rotatable member, a releasable stop member on said frame mounted to engage said mold and prevent temporarily the rotation of the same on the axis of said driven rotatable member whilst permitting rotation on the axis of the drive shaft, and a brake operable to retard and prevent at will the rotation of said upright shaft whilst permitting continuous rotation of said drive shaft.

2. The device of claim 1 in which the upright drive shaft is disposed vertically.

3. The device of claim 1 in which the differential shaft is mounted horizontally in the frame, the upright rotatable drive shaft is mounted vertically, and one beveled gear of the differential is integral with the driven rotatable member.

4. The device of claim 1 in which the axis of the differential shaft journaled in the frame is also journaled within the upright drive shaft, and one of the beveled gears

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of the differential is integrally mounted at the upper end of said differential shaft, and the other beveled gear is mounted on a horizontally disposed shaft which is rotatably mounted in the frame.

5 A centrifugal casting machine comprising a support; an upright journaled drive shaft mounted on said support; a frame integral with said upright drive shaft; a symmetrical closed mold rotatably supported on said frame and disposed thereon with the axis of said journaled drive shaft passing within the mold and through the center of rotation thereof; means driven by an external power source for rotating the drive shaft, frame and mold continuously on the upright axis of the drive shaft and frame; a differential shaft journaled within said drive shaft and frame, said differential shaft being disposed with its axis coextensive with the axis of said drive shaft; a differential comprising two bevel gears, one of the gears of which is integrally mounted upon said differential shaft; a driven differential shaft journaled to rotate in the frame, said driven differential shaft having integrally mounted thereon the other beveled gear of said differential in continually meshing engagement with said first named bevel gear; stub shafts journaled in said frame; means for mounting

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said mold on said stub shafts with the axes of the stub shafts intersecting the axis of the upright drive shaft at the center of rotation and within the mold; a brake mounted on said upright differential shaft for regulating at will the speed of rotation of said shaft; means operatively connecting said differential shaft with said stub shafts for controlling the rotation of the stub shafts; and a releasable stop member on said frame mounted to engage said mold and prevent temporarily the rotation of the mold on the axis of said stub shafts, whilst permitting rotation on the axis of said drive shaft.

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