Oct. 7, 1947. G. A. RUBISSOW 2,428,434

CENTRIFUGAL CASTING APPARATUS

Filed Nov. 5, 1943 2 Sheets-Sheet 1

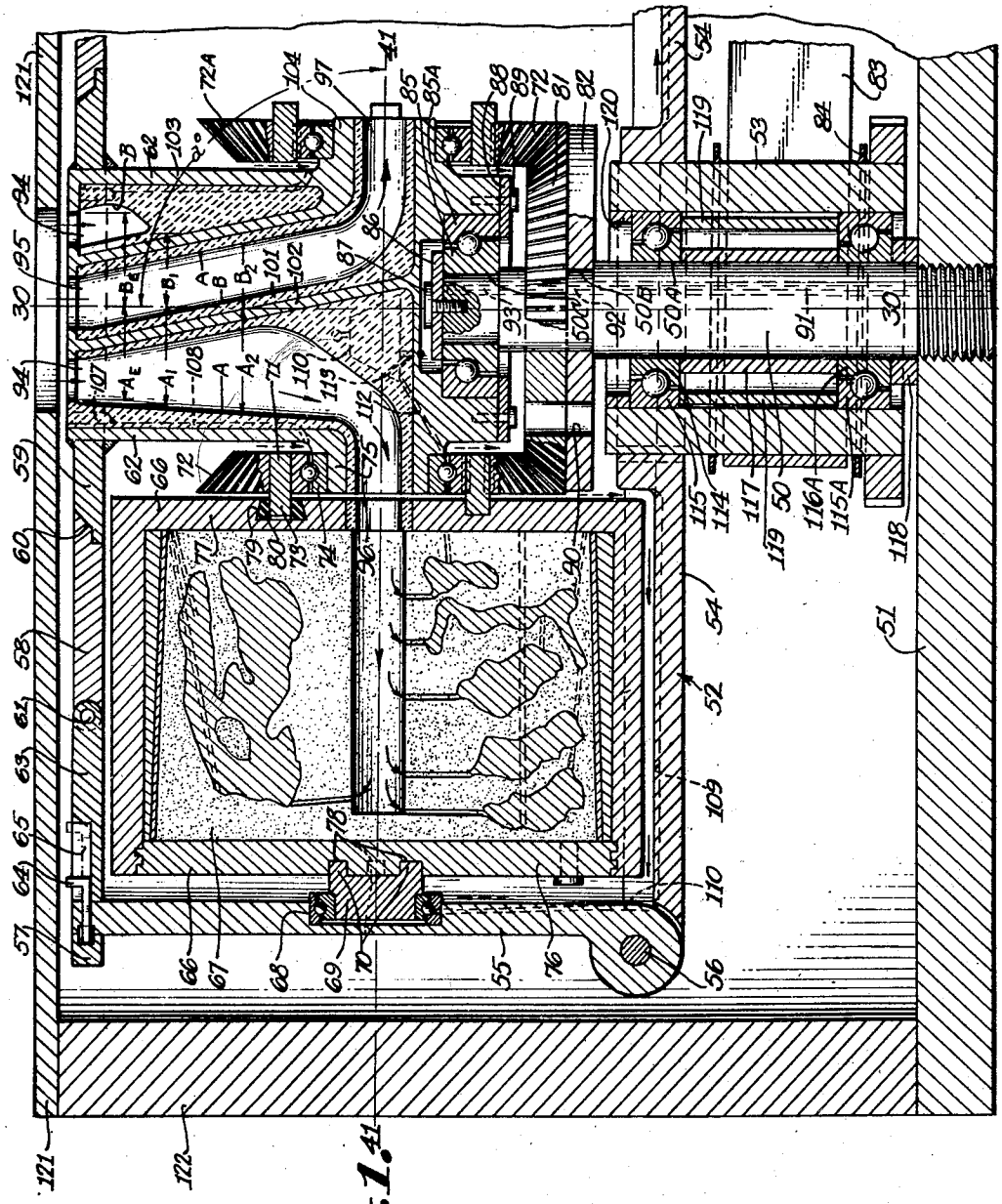


Fig. 1.

Inventor,

George A. Rubissow

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CENTRIFUGAL CASTING APPARATUS

Filed Nov. 5, 1943 2 Sheets-Sheet 2

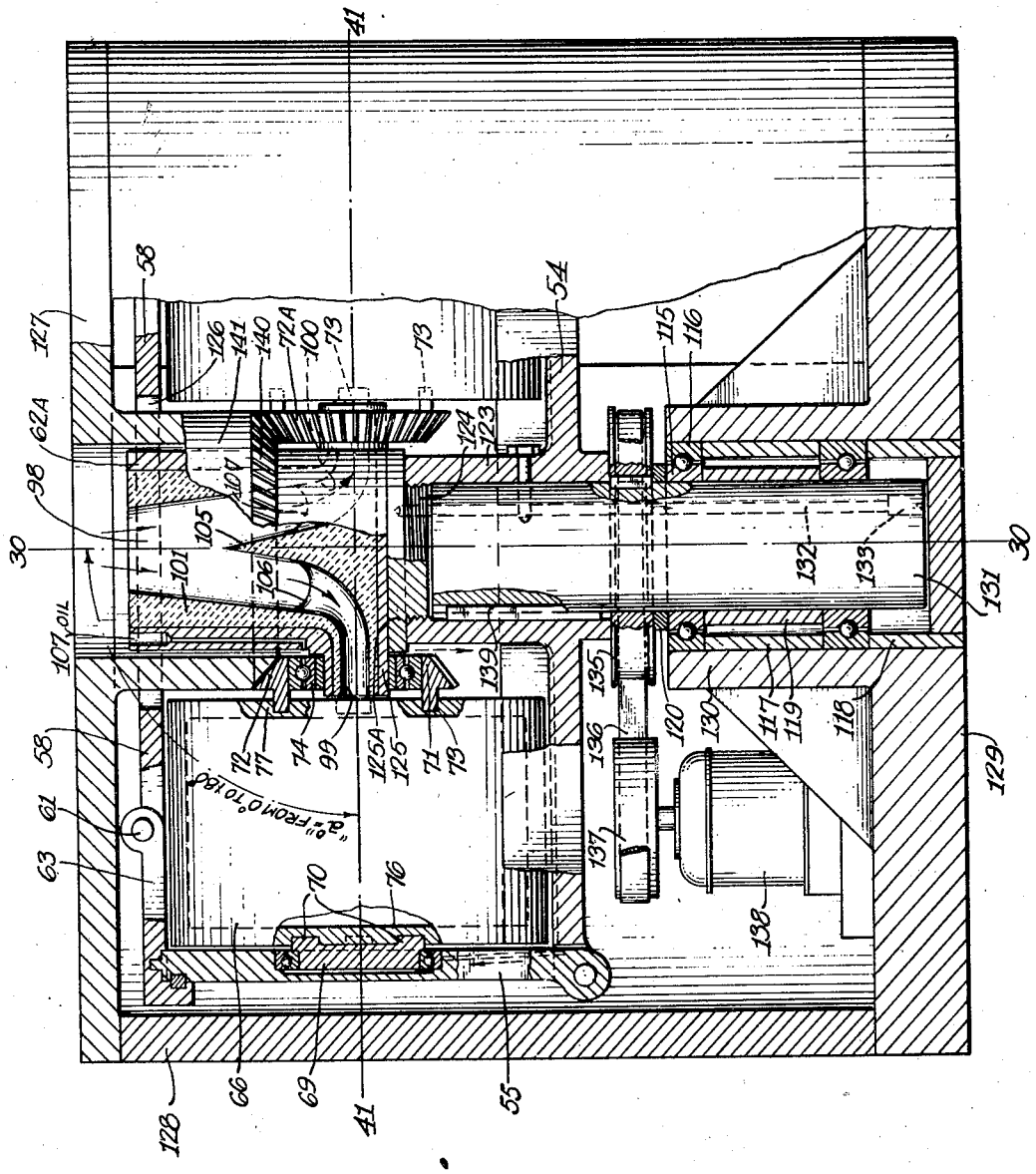


Fig. 2.

Inventor,
George A. Rubissow

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CENTRIFUGAL CASTING APPARATUS

George A. Rubissow, New York, N. Y.

Application November 5, 1943, Serial No. 509,036

3 Claims. (Cl. 22—65)

1

This invention and improvement is a continuation in part of the co-pending applications for Letters Patent registered in the United States Patent Office under the following Serial Numbers, dates and titles: Serial No. 497,658, Centrifugal compation and casting method apparatus therefor and products so obtained, filed Aug. 6, 1943, and Serial No. 502,778, Double vector centrifugal casting method apparatus therefor and products so obtained, filed Sept. 17, 1943.

This invention may also be used in combination with the improvements and methods patented in the United States under the numbers: #2,208,230; 2,222,266; and 2,325,019.

This invention relates to a centrifugal casting apparatus for casting various materials or treatment of the same under the influence of two simultaneously-acting centrifugal forces.

This apparatus may be used in combination with molds for casting therein of various machine parts, precision parts, all types of ingots, all types of objects produced by casting of fusible materials.

According to this invention, the molten material is poured from a rotatable pouring gate provided in close vicinity to the mold, into the mold through a pouring distributing gate provided therein. This is done preferably while the apparatus and the rotatable pouring gate and the mold are all in rotation and while the material is still in a molten state. In this way, all the hollows and crevices of the mold will be filled with the molten material, and this simultaneous rotation of the material and the mold around two different axes of rotation thus brings the material under the influence of a double vector centrifugal force until the casting is completed.

The above and further objects and novel features of this invention will more fully appear from the following description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for purposes of illustration only and are not intended as a definition of the limits of this invention.

In the drawings, wherein like reference characters are used, they refer to like parts throughout the several views and their descriptions:

Figure 1 is a schematical side view partly in cross section with parts broken out of one aspect of an apparatus according to this invention.

Figure 2 is a schematical simplified side view, in cross-section with parts broken out of another

2

embodiment of an apparatus according to this invention.

Figure 1 shows one aspect of the apparatus comprising a non-rotatable shaft **50** rigidly mounted on a support or base **51**. The shaft serves as a supporting shaft for that part of the apparatus which is rotated around it. This rotating part of the apparatus comprises a rotatable frame **52** which may itself be either a rigid frame, or a frame having parts such as compose the frame **52**, consisting, among others, of a collar member **53** to which is rigidly mounted a supporting member or lever **54—54** on the end of which is mounted a pivotal arm **55** through the intermediary of a pivot **56** for instance, or through another suitable interconnection known to those skilled in the art; an upper supporting plate or member or arm **57—58—59** which may compose one solid body or consist of detachable parts (such as for instance, part **57** detachable from part **58** and from part **59**) which are mounted rigidly on the casing of the rotating pouring gate **62**. This supporting plate **57—58—59** may have an articulated or limitedly pivotal end **63** which may pivot on a pivot or axle **61**, for example. If desired, it may be provided on its outer end with a slot **65** in which a key **64** of any design may be mounted to interlock the pivotal arm **55** with the supporting plate **57—58—59**. The plate **57—58—59** may be rigidly affixed to the rotatable pouring gate **62**, in which case the arm **55** may be made so that it will easily interlock on its free end with the supporting upper plate **57—58—59** by an arresting bar, sliding locking member, or any other suitable means.

The structure shown on the drawing is presented only as one of the possible embodiments and this invention is not limited thereto.

The operation of the rotatable frame is simple: The limitedly pivotable end **63** may be lifted after the key is unlocked and the arm **55** is then pivoted downwards. This enables the casing **66** in which the mold **67** is placed to become easily freed. It is preferable that arm **55** be provided with a bearing **68** one part of which is rigid with arm **55** (or if it is itself a bearing, be a part thereof) and the other part rigid with the member **69**. Member **69** will be designated herein as a casing supporting rotatable locking member because it supports the pressure to the casing caused by the centrifugal force in the radial direction around the axis of secondary rotation **30—30** and because it is, itself, rotatable around the first axis of rotation **41—41**; also because it is pro-

vided with interlocking teeth 70 or the like which enables it to operatively engage or connect with (interlock) the casing 66. This arrangement establishes a shaft of rotation around the first axis of rotation 41—41, assuming that the other end of this imaginary shaft is supported by the similar member 71—73—74 mounted on a suitable part of the rotatable pouring gate 62.

Member 69 may have any suitable shape or form and may have any number of teeth 70 deemed expedient. The bottom 76 of the casing should have openings or grooves 78 provided therein so that when the teeth 70 register therein the casing becomes operatively interconnected with the member 69 and is able to freely rotate, provided that the upper part of the casing 77 is also at the same time operatively interconnected with the member 71—73—74. The teeth 70 and the openings 78 may have sufficient clearance if it is desired to provide a more easy unlocking.

Instead of teeth, another locking system may be used—for example, the member 69 may simply be a cylinder-like member and the bottom of the casing may have a cylindrical groove to receive the same.

The member 69 may also have a thread, instead of teeth, and the bottom of the casing 76 may be provided with a female thread, both screwed together in the direction opposite to the direction in which the casing rotates around its own axis of rotation.

The member 71 is both in operation and design substantially the same as member 69, with the exception that it is mounted on an exit-orifice-part of the rotating pouring gate and has additionally a gear 72 mounted on the outer part thereof.

The two members 69 and 71 should be coaxial with the axis 41—41, and should be rotatable about the axis 41—41, as shown on Figure 1.

The teeth 73 transmit the rotation to the casing 66 through the upper part 77 thereof. The openings or grooves which these teeth have to engage must also be precisely made.

It is preferable that a strictly controllable clearance should be provided in the radial direction of said rotation.

If it is found desirable to provide a smoother action during the casting process, grooves 79 may be provided with rubber cushions placed so that when the teeth engage the groove, they will contact the rubber in the plane perpendicular to the radius of rotation around the first axis of rotation 41—41 and thus absorb the shock from the torque while transmitting the rotation from gear 72 to casing 66.

The rubber cushion should preferably be placed as shown by 80 on Figure 1.

Ball bearings are shown throughout the figures of this specification, but any other suitable bearing means may be used.

The rotation of the casing 66 around axis 41—41 is caused by the operative engagement of the gear 72 with the fixed gear 81, keyed or otherwise rigidly affixed on the fixed shaft 50.

When the rotatable frame 54 is rotated by suitable driving means such as a driving gear of a motor (not shown on Figure 1) or by a belt 83 through a pulley 84 or by other means, then gear 72 is forced to roll in engagement with fixed gear 81, thus rotating the casing 66 with which it is operatively interconnected by the teeth 73 and grooves 79 (or the like). As a result, the casing with the mold therein will rotate

simultaneously around axis 30—30 and axis 41—41. The two axes are shown on Figures 1 and 2, as intersecting one another, but this invention is not limited thereto, and the two axes of independent rotation may have any desirable position in the same plane, or in two planes, one relative to the other.

The axes 30—30 and 41—41 may lie at any suitable angle to each other and the 90° angle shown on Figures 1 and 2 is not definitive, as it may be anything from 0 to 180°.

In the case that the angle is 0° and 180°, the first rotation around the first axis 30—30 may coincide with the rotation around the second axis 41—41 or be parallel thereto but at a distance therefrom.

The rotatable pouring gate is one of the very important features of this invention, enabling the transmission of the molten material during rotation from the outside to the mold rotating simultaneously around two different axes of rotation.

One of the important aspects in connection with this rotatable pouring gate is that it may itself be a carrier of the casing-supporting-rotatable-locking-member such as 71—72—73—74 mounted on its walls. This aspect is one of the most useful for providing an economical construction of the apparatus, and is therefore of high industrial importance.

Furthermore, the herein described embodiments of the main aspect permit easy functioning of the apparatus and easy replacement of the casing and the mold by another, the design of the casing being simple and inexpensive. An apparatus such as described herein may handle hundreds of casting operations in a few hours, and each of these casting operations may comprise at least two casings, each having at least one mold of the same or different shapes and sizes.

The rotatable pouring gate 62 may be mounted on the fixed shaft 50 through bearing means 85, or it may be free from any interconnection with the fixed shaft 50. This is not shown on the drawing, being self-evident.

When bearing 85—85A or any other suitable type is used, its inner part 85 may be affixed firmly by a screw, key or locking plate 87, to the part 86 of the fixed shaft 50. The outer part 85—A of the bearing should be firmly affixed to the frame or housing of the rotatable pouring gate 62 by means of a key, or a plate 88 and a plurality of screws 89, or by any other suitable locking means. To permit the apparatus to be easily dismounted, passages (one or more) 90 may be provided in the gear 81 and its supporting plate 82 (if any). To facilitate the dismounting of the apparatus, an ordinary long key 91—92—93 may be used, having three or more step-like sections to register the different diameters 50—A, 50—B, 50—C, of the fixed shaft 50. By a single removal of the key, all the members and parts it locks will be dismantled.

The apparatuses shown on Figures 1 and 2, have only two casings (such as casing 66 for example) per each apparatus. This has been done for simplification of the design, but is not definitive and does not limit any of the apparatuses or any of the claims to the use of two casings per apparatus, and one single casing per apparatus may be used, in which case a counterweight should be provided for balancing the rotating members, or any number of casings found suitable. Particularly good results will be obtained with an apparatus having 2, 3, 4, 5 or 6 casings in the same plane, or in double or triple rows.

The number of revolutions per minute of the casing around the first axis 30—30 (R. P. M.—1), and around the second axis 41—41 (R. P. M.—2) may be as deemed expedient. The ratio of

$$\frac{\text{R. P. M.-1}}{\text{R. P. M.-2}}$$

may be anything desired; for example, it may be equal to "1" as shown on Figure 1, or greater than "1," and may also be smaller than "1." However, the choice of the ratio is an important factor and should be thoroughly considered for the purpose in question.

The gate 62 may be provided with two entrance openings 94 and 95 as shown on Figure 1 and have two exit-openings 96—97 provided in the bottom part (substantially concentric with the first axis of rotation). The gate 62 may also be provided with one entrance opening 98 as shown on Figure 2, and still have one or two or more distributing exit-openings 99 and 100 on its bottom to correspond to the amount of casings to be filled from the same rotatable pouring gate.

The distances between the inner walls of the gate 62 may, for instance, follow the design given on Figures 1 and 2—namely have the wall A farther away from the axis 30—30 than the wall B, the distances or radii A_E be bigger than B_E, A_1 bigger than B_1, A_2 bigger than B_2, etc.

Still another aspect of this invention comprises means for the lubrication of the apparatus during the rotation. The lubricating oil may be poured into a storage space 107 on the top of the gate 62, Figure 1, and will thereafter obligatorily follow the channel 108 and emerge close to the bearing 74 which will thus be lubricated. Thereafter the oil will follow substantially the direction of centrifugal force and gravity of the oil—i. e. it will follow the dotted arrows and thereby lubricate the teeth of the gears 72 and 81, whereat it will automatically be projected towards the supporting frame 54.

If desired, an oil-storage space may also be provided in the inner part of the gate 62—for instance 110, and through the channel 112 and 113 be fed into bearings 74 and 85. If desired, ordinary oil or grease packings may be provided instead of the herein described centrifugally acting self-lubrication means and method.

The supporting collar 52 provided with ball bearings such as 114—115 and 115A and 116A may be additionally provided with the supports 117 and 118 in order to facilitate the trust action from the weight of the rotating parts of the apparatus. The supports 119 and 120 for similar reasons may be provided respectively to support the parts 115 and 115A of the bearings.

The apparatus should also be preferably provided with a top safety-plate 121 mounted on a side-protective plate 122 which may be affixed and/or mounted on the base 51. This top safety-plate should preferably be equal to about ¾ of the circle, or about ½ to ¾ of a circle, (i. e. embrace about 180°–270°), so that the operator of the apparatus will not only be protected against accidents when pouring the material into the gate or gates, but also may easily dismount the casing 66 by placing the casing with the mold opposite the protective plate 122—i. e. in the position in which there will be no obstacle to the removal of the casing from the bearings, holding and engaging means in which it is mounted. For these reasons, the protective plate 122 should be at least ⅓ of a circle (at least embrace 120°), and larger, preferably. The total apparatus may also be surrounded with a protective plate such as 122, encircling the entire apparatus (360°). In such a structure, one part thereof should be mounted on pivots to permit easy access to the casings 66. This is not shown, being self-explanatory.

Figure 2 shows still another aspect of this apparatus which is substantially identical with the apparatus described above and depicted on Figure 1, but is more economical to use and build.

This apparatus (Figure 2) has the rotatable gate 62A rigidly mounted on the supporting frame member (or lever) 54 on a collar 123 rigid therewith. The collar 123 may be keyed or mounted by means of threads 124 on the body (or frame) of the rotating pouring gate 62A. In the case that the bottom of the gate 125 will not be sufficiently strong, a reinforcement member 125A may be soldered or otherwise affixed to this bottom and the collar 123 may be rigidly mounted thereon by any suitable means.

Instead of mounting the gate 62A on the plate collar 123, it may be mounted directly on the shaft 131, which shaft, contrary to the shaft 50 of Figure 1, is a rotatable shaft and is rotated by suitable means, such as for instance, by the pulley 135 and the belt 136 driven by a motor 138 through pulley 137 or by a gear directly interconnected with a gear mounted on the shaft 131 (not shown on Figure 2), in which case the shaft 131 will then be driven by a motor attached to the first named gear.

The shaft 131 may itself, if desired, become a driving shaft. Locking means 139 and/or 132—133 may be provided. This system is thus different from the system shown on Figure 1, insofar that the shaft 131 is rotated, the gate 62A is rigid with the shaft and the upper supporting plate 63—58 does not contact the body of the gate 62A and is provided with an annular opening 126 through which the fixed gear 140 is mounted. The gears 72 and 72A (one or more of them) operatively engage the fixed gear 140 which is equal in function to the fixed gear 81 of Figure 1, forcing the casings 66 to rotate simultaneously around the axes 30—30 and 41—41. The fixed gear 140 may be mounted on a suitable support or on a collar member 141 rigid with the top safety-plate 127, which latter is rigid with the protective plate 128 mounted on the base 129. A collar 130 may be provided on the base 129 to receive bearings 115 and 116 preferably provided respectively with supporting collars 117, 118, 119 and 120.

Having now ascertained and particularly described the nature of the said invention and the manner in which it is to be performed, what I claim is:

1. In a casting apparatus for subjecting the material cast to two simultaneous rotations, a base, a vertical shaft on said base, a mold-carrying frame on said shaft, and rotatable about the axis of said shaft, a rotatable pouring gate casing rigid with said frame and rotatable about the axis of said shaft, a stationary bevel gear fixed to the base, a rotating bevel gear rotatably mounted on said gate casing and meshing with said stationary bevel gear, projections on the side of said rotating bevel gear away from said gate casing, an arm pivoted to said frame at a point opposite said rotating bevel gear and remote from said shaft, a thrust bearing rotatably mounted on said arm in such position that when the arm is perpendicular to axis of rotation of said rotating bevel gear, the axes of rotation of the thrust bearing and the rotating bevel gear

coincide, projections on said thrust bearing, a mold casing having on its molten material receiving side depressions to receive the projections on the rotating bevel gear, said mold casing having depressions on its opposite end to receive the projections on said thrust bearing, and fastening means on said frame engaging the free end of said arm to hold said arm perpendicular to the axis of rotation of said rotating bevel gear after a mold casing has been inserted between said rotating bevel gear and said arm.

2. In a casting apparatus for subjecting the material cast to two simultaneous rotations, a base, a vertical shaft rigid with said base, a mold carrying frame rotatably mounted on said shaft, a rotatable pouring gate casing rigid with said frame and rotatable about the axis of said shaft, a stationary bevel gear fixed to said shaft, a rotating bevel gear rotatably mounted on said gate casing and meshing with said stationary bevel gear, projections on the side of said rotating bevel gear away from said gate casing, an arm pivoted to said frame at a point opposite said rotating bevel gear and remote from said shaft, a thrust bearing rotatably mounted on said arm in such position that when the arm is perpendicular to axis of rotation of said rotating bevel gear, the axes of rotation of the thrust bearing and the rotating bevel gear coincide, projections on said thrust bearing, a mold casing having on its molten material receiving side depressions to receive the projections on the rotating bevel gear, said mold casing having depressions on its opposite end to receive the projections on said thrust bearing, and fastening means on said frame engaging the free end of said arm to hold said arm perpendicular to the axis of rotation of said rotating bevel gear after a mold casing has been inserted between said rotating bevel gear and said arm.

3. In a casting apparatus for subjecting the material cast to two simultaneous rotations, a base, a vertical shaft rotatably mounted on said

base, a mold carrying frame, fixed to said shaft, a rotatable pouring gate casing rigid with said frame, and rotatable about the axis of said shaft, a stationary bevel gear fixed to the base, a rotating bevel gear rotatably mounted on said gate casing and meshing with said stationary bevel gear, projections on the side of said rotating bevel gear away from said gate casing, an arm pivoted to said frame at a point opposite said rotating bevel gear and remote from said shaft, a thrust bearing rotatably mounted on said arm in such position that when the arm is perpendicular to axis of rotation of said rotating bevel gear, the axes of rotation of the thrust bearing and the rotating bevel gear coincide, projections on said thrust bearing, a mold casing having on its molten material receiving side depressions to receive the projections on the rotating bevel gear, said mold casing having depressions on its opposite end to receive the projections on said thrust bearing, and fastening means on said frame engaging the free end of said arm to hold said arm perpendicular to the axis of rotation of said rotating bevel gear after a mold casing has been inserted between said rotating bevel gear and said arm.

GEORGE A. RUBISSOW.

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