Mar. 3, 1925. 1,528,303

A. F. ROCKWELL

MEANS AND METHOD FOR CENTRIFUGAL CASTING

Original Filed April 8, 1920 2 Sheets-Sheet 1

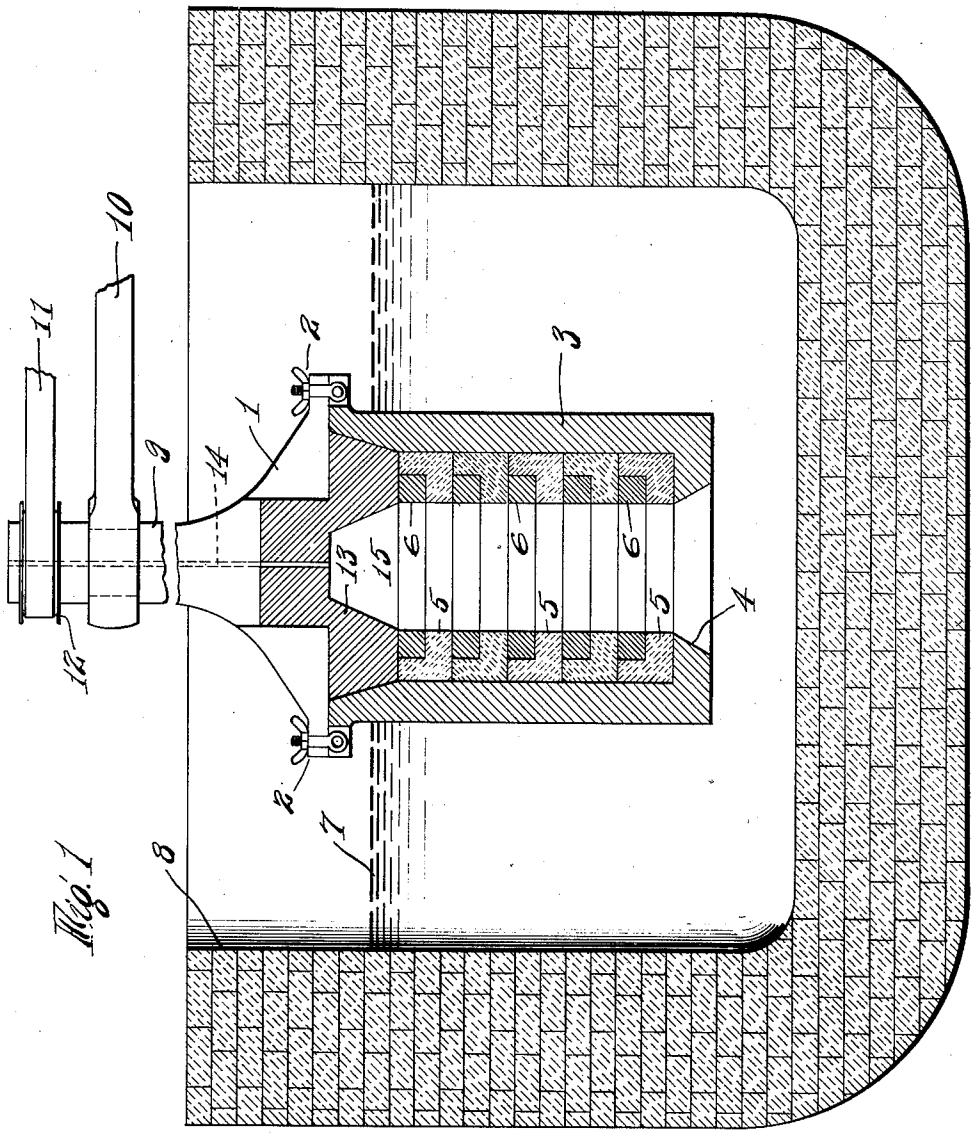

Fig. 1

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Fig. 2

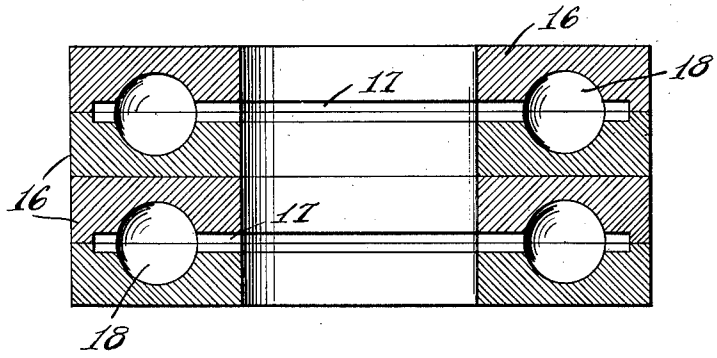
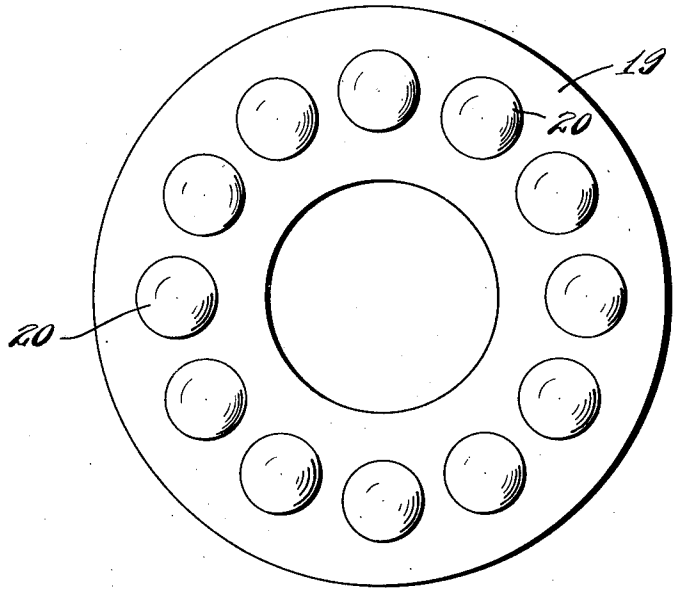


Fig. 3



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UNITED STATES PATENT OFFICE.

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MEANS AND METHOD FOR CENTRIFUGAL CASTING.

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To all whom it may concern:

Be it known that I, ALBERT F. ROCKWELL, a citizen of the United States, and a resident of Bristol, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Means and Methods for Centrifugal Casting, of which the following is a specification.

This invention relates to the art of metal casting and particularly to means and the method for producing relatively small castings of steel or other refractory metal by a centrifugal process.

Comparatively large castings have heretofore been successfully made by the use of a centrifugal process, but because of a premature chilling and solidifying of smaller masses of metal when subject to the cooling influence exerted by the larger masses comprising the casting apparatus, the successful production by centrifugal process of small castings of refractory metals such as steel has not, so far as I am aware, been heretofore achieved.

I have discovered that this premature chilling and solidifying of molten metal in forming small castings by a centrifugal process can be prevented by using a mold support capable of being rapidly rotated at will, and also being lowered into and withdrawn from a considerable mass of molten metal contained preferably in the pot or crucible of a furnace. When this mechanism is lowered into the pot or crucible the molds are at once filled with molten metal, and as a result of the centrifugal force created by the rapid rotation of the mechanism, the molds are held full after the mechanism is withdrawn and is cooled in the air.

I find that with this arrangement there is no premature solidifying or freezing of the metal in the molds such as has been unavoidable with any attempted use of former constructions. So long as the mechanism is rotating in the pot or furnace, and if the pot is sufficiently large with relation to the mold mechanism, the metal in contact with and filling the molds continues liquid since it is in effect a part of the larger body of molten metal filling the pot and subject to the heat of the furnace. It is only after the mold-carrying mechanism is lifted out of the crucible and when the only molten metal remaining in the mold-carrying mechanism is held in the mold by the centrifugal force created by the rapid rotation of the mechanism, that the metal in the molds solidifies in the shape desired.

I find that castings produced by this process are not only cheaply produced but have qualities which give them great superiority for some important purposes. They are, for example, particularly adapted to be converted into members of antifriction bearings which have to meet onerous requirements. These valuable qualities are the result of the operation of centrifugal force on the body of molten metal within the mold mechanism, great pressure being exerted by this force upon the molten metal and the denser particles being thrown outwardly from the axis of rotation. If the pot or crucible contains gas bubbles or inert impurities not chemically combined with the metals, these tend to be supplanted in the molds by denser purer metal through the action of centrifugal force. The pressure of centrifugal force tends, moreover, to produce in the metal as it cools a homogeneous mass of desirable molecular structure.

In the drawing,

Figure 1 is a view, partly in side elevation and partly in vertical section of a centrifugal casting device embodying the invention.

Figure 2 is a sectional view of a modified form of mold adapted to be used in the device shown in Figure 1.

Figure 3 is a plan view of a casting obtained by the use of the mold shown in Figure 2.

Referring to the drawing, in Figure 1 there is shown a casting apparatus embodying the invention in which a base member 1 is provided with lugs 2, to which corresponding lugs on an annular mold-supporting device 3 can be attached. The annular or cylindrical member 3 is open at its lower end and provided with an inwardly-extending shoulder or shelf member 4 which is arranged to provide immediate supporting engagement with the lowermost of a plurality of tiers of annular mold members 5 formed

of steel or any other suitable material and in any desired conformation, the mold members being shown as L-shaped in section in Figure 1 to thereby provide annular recesses for the production of bearing race rings 6.

The casting device thus constituted is so supported that it can, while rotating, be lowered in a mass of molten metal 7 contained in the crucible 8 of a suitable furnace, and, for this purpose, is shown with the stem or shaft 9 journaled in the end of an arm 10 by means of which the casting device can be raised or lowered or swung laterally at the convenience of the operator. The particular means illustrated for this purpose is not of itself an essential part of the invention and may be displaced by any other suitable means by which the manipulation of the casting device may be achieved. The casting device may be rotatably driven in any suitable manner, such as through a belt connection 11 with a pulley 12 fixed to the shaft 9.

In order to operate the device the mold-supporting member 3, which is detached from the conical seat 13 for the purpose, is filled with a supply of the mold rings 5 which are preferably formed of steel with their masses so proportioned to the masses of metal adapted to be contained in the mold chambers or cavities that the exchange of heat units between the mold rings and the casting metal is not sufficient to raise the temperature of the mold rings to the point of melting, or to an otherwise injurious degree. I find that the use of mold members of steel or other metal results in the production of castings having very smooth surfaces so as to dispense with a number of subsequent working operations hitherto necessary before the final grinding and thus add in a substantial degree to the efficiency of the process as a whole.

The cylindrical mold-supporting member 3 is then clamped into position on the seat 13, the conical formation of which serves to center the member 3 with relation to the shaft 9 to obviate an unbalanced condition in operation. The assembled casting device is then set into rotation and lowered into the molten steel or other metal 7, the vent passage 14 providing for the emission of air from the chamber 15 and the rise of a column of molten metal therein.

Meanwhile at least that part of the column of liquid metal within the chamber 15 and in contact with the molds of the casting device has been set into rotation with the molds so that the action of centrifugal force subjects the hot metal within the mold chambers to pressure, and under the continuing action displaces from these chambers gas bubbles and lighter particles of foreign material which may be present in the metal, and at the same time compresses and condenses the metal itself. The metal retained in the mold cavities will thus tend to be of a purer quality and denser character and will be retained in place in the grooves by the rotating action of the casting device, which will be continued after it is lifted out of the crucible until the ring members 6 have become sufficiently hard to permit of their removal.

In addition to forming the ball raceway rings, it is possible also to form or partially form the ball members by the described process and thus to obtain a bearing structure in which all the parts subject to wear are formed of the dense, wear-resisting castings produced in the manner described. In order to produce ball members, molds 16, preferably of the general formation shown in Figure 2 are made use of, in which the molds cooperate with each other to form annular channels 17 opening inwardly, the channels being enlarged at intervals to form spherical cavities 18.

It will be seen that a casting 19 of the form shown in Figure 3 will be produced in each mold chamber formed by the mold members 16 of Figure 2. The spherical enlargements 20 in the casting 19, when the surplus connecting metal has been trimmed from them in a punching or other suitable process in either a hot or cold condition, form the desired ball members, and when these members, as well as the race rings produced by the apparatus shown in Figure 1, are ground to their final precise dimensions, they are ready to be assembled to produce a complete bearing structure.

With the construction described, not only is it possible to produce relatively small castings without premature solidifying of the casting metal, but also the casting operation is conducted in a simple and cleanly manner and without wastage of metal.

What I claim is:

1. A centrifugal casting device comprising a rotatable mold member constructed and arranged to be at will bodily immersed in and withdrawn from a mass of molten metal.

2. A centrifugal casting device comprising a rotatable mold member and means for immersing the mold member in a mass of the molten material from which the castings are to be formed, so as to fill the molds, and said means being operable to withdraw the mold member from the vessel containing the mass of material in which it is immersed while it is rotating.

3. A centrifugal casting device comprising a rotatable mold member, means for immersing the mold member in a mass of molten metal so as to fill the molds therewith, means for rotating the mold member while so immersed, and said means being operable to withdrawn the mold member

from the vessel containing the mass of metal in which the mold member is immersed while continuing its rotation.

4. A centrifugal casting device comprising a rotatable member carrying molds which are arranged around an interior space so as to open directly into this space toward an axis of rotation extending vertically through this open interior space, the whole arranged so that it may be immersed in a mass of molten metal with the said interior space open toward the bottom of said mass of molten metal so as to cause the molten metal to flow up freely in said interior space and fill said molds as such immersion takes place.

5. That method of centrifugal casting which consists in immersing a rotatable annular mold member having a mold cavity opening radially inward in a mass of molten metal, and withdrawing it while rotating and continuing a rotation of the member until the metal cools.

6. The methods of centrifugal casting which consists in rotating an annular mold member having a mold cavity opening radially inwardly in a mass of molten metal, and separating the mass of metal from the metal in said mold cavity while rotating the mold and continuing the rotation of the mold until the metal cools.

7. A centrifugal casting device comprising a rotatable mold member constructed and arranged to be immersed in or withdrawn from a mass of molten metal while the member is rotating.

ALBERT F. ROCKWELL.