Aug. 17, 1937. H. C. FRETZ 2,090,289

CENTRIFUGAL CASTING MOLD

Filed June 12, 1934

Fig 1

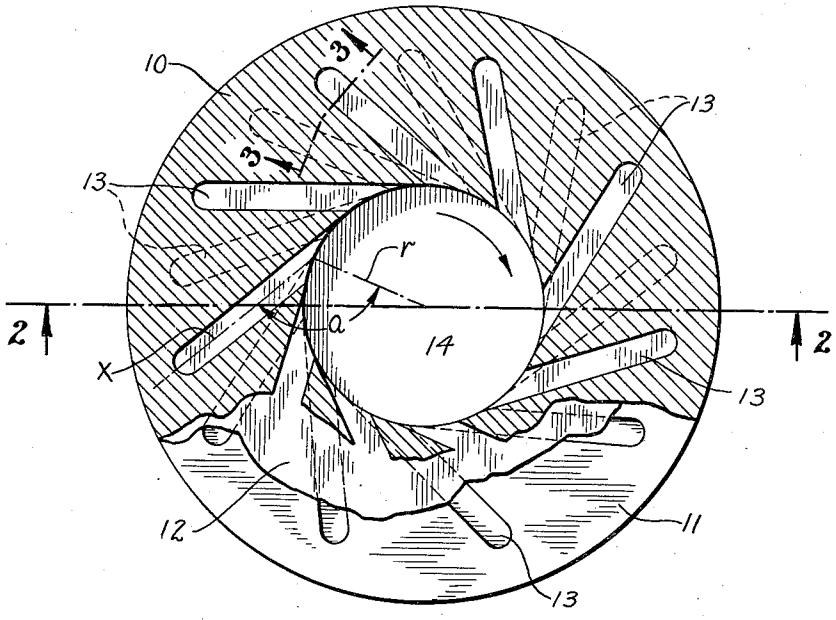
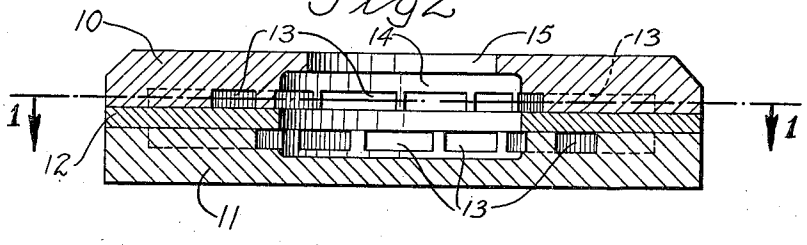


Fig 2



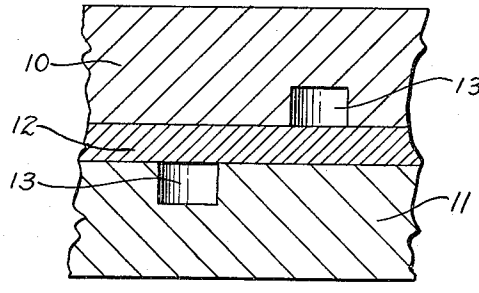


Fig 3

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CENTRIFUGAL CASTING MOLD

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7 Claims. (Cl. 22—65)

This invention relates to centrifugal casting molds, having for its object the provision of a novel improved mold adapted especially for casting materials having a high temperature melting point, for example, upwards of about 1700° C. The new mold is suitable for use, for instance, in the centrifugal casting machine disclosed in United States Patent No. 1,924,976, issued August 29, 1933, to L. H. Brown.

Materials, such as certain alloys containing tungsten, that melt at extremely high temperatures tend to freeze so quickly when the source of heat is removed that the time required for transferring the molten material from the crucible into the casting cavities of the mold is an element of primary importance. To assist in minimizing this time, use is made of centrifugal force to create a pressure on the molten material and force it into the casting cavity.

Heretofore, the casting cavities in centrifugal casting molds have extended substantially radially outward from the central opening or sprue. In such molds the centrifugal force is not fully developed until the molten material in the sprue is rotating at the same speed as the mold, so that there is an appreciable interval of time before the casting cavities are entirely filled. Furthermore, the inertia of the molten material before it is rotating at the same speed as the mold causes the casting cavities to fill along their back edges first. Consequently, the castings produced often have defective surfaces containing ridges and pits formed by uneven flow of material and step-wise solidification. This is especially true when casting certain alloys high in tungsten, such as those having a composition of:

Tungsten	70 to 95%
Carbon	0.5 to 6%
Other metals	up to 25%

Accordingly, to mitigate the above-discussed disadvantages of known centrifugal casting molds, the present invention comprises a novel centrifugal casting mold in which the casting cavities are so arranged that both centrifugal force and the inertia of the molten material to the angular accelerating force are effectively utilized to exert a pressure on this material and to force it into the casting cavities during rotation of the mold. The exact manner in which this is accomplished will be evident from the following description taken in conjunction with the accompanying drawing, in which:

Figure 1 is a plan view of one section of a preferred form of mold in accordance with this invention;

Figure 2 is a cross-sectional view of the assembled mold on the line 2—2 of Fig. 1; and

Figure 3 is a broken cross-sectional view on the line 3—3 of Figure 1.

Referring to the drawing, the mold may comprise two annular members 10 and 11 separated by a spacer plate 12. The material of which the mold is made may be any suitable material resistant to high temperature heat, for example, a graphite composition. The parts of the mold are held together by any suitable means, such as a clamp or mold holder, which may also conveniently serve as a means of attachment to a power shaft for rotating the mold. Each of the annular members or sections is provided with a plurality of recesses 13 spaced about and communicating with a central opening or sprue 14. The recesses of each member may be vertically staggered with respect to the recesses of the adjoining member, so that a recess in the upper member 10 occupies a position intermediate two recesses of the lower member 11, as indicated by the dotted lines in Figure 1. There is then produced a staggered flow of molten material from the sprue 14 into the recesses 13. The open sides of the recesses 13 are closed in the assembled mold by the spacer plate 12 so as to form a plurality of outwardly extending pockets or casting cavities. These cavities extend rearwardly with respect to the direction of rotation of the mold as indicated by the curved arrow in Figure 1, so that the lagging angle between the longitudinal axis of each recess and the radius of the sprue to the mouth of the recess is between 90 and 170 degrees. This lagging angle is indicated by the angle a between the axis x and the radius r in Figure 1. In a preferred embodiment, the outer edge of each of the recesses 13 is substantially tangential to the periphery of the central sprue 14. The entrance 15 to the central sprue 14 is preferably constricted or necked as indicated in Figure 2 to avoid spattering of the molten material and to facilitate access of the molten material to the casting cavities.

In operation, the mold is rotated at any desired speed in the direction indicated by the curved arrow in Figure 1, the rotating speed varying with the type of material to be cast, the size and shape of the castings, the diameter of the mold, and the viscosity of the molten material. For alloys high in tungsten of the type previously indicated, a speed of 1725 revolutions per minute and a mold six inches in diameter

have been found to be satisfactory. The molten material is then poured into the sprue. Until this material begins to rotate with the mold, no centrifugal force is exerted thereon; the force is entirely an angular accelerating force which acts on the material in a direction tangential to the direction of rotation. As the material increases its rotational speed, the centrifugal force increases and the angular accelerating force decreases until, when the molten material is rotating at the same constant speed as the mold, the force is entirely centrifugal. It will thus be readily appreciated that use is made of both of these forces to press the molten material into the casting cavities of a mold constructed in accordance with the present invention.

A further advantage of the form of mold shown in Figure 1 is that, for a given width of the casting cavity, the mouth of the cavity exposed to the sprue is wider, which further facilitates the entrance of the molten material into the cavity. These features considerably shorten the time required for filling the casting cavities. Furthermore, the material enters the cavity in a straight line approximately parallel to the axis of the cavity, so that the cavity is filled rapidly from the bottom up. The result is to produce an improved casting which is substantially free from flow lines, ridges, pits, and other defects.

It is contemplated that variations and modifications of the particular mold shown and described herein may be made without departing from the scope of this invention. The mold may have only a single set of casting cavities, in which case the spacer plate is eliminated and the upper element contains no recesses but serves to close the open side of the recesses in the lower element. Also, it is possible to have more than two sets of casting cavities, in which case one or more of the elements may be provided with recesses on both sides thereof. The length, width, depth, shape, and cross-section of the casting cavities may vary in accordance with the type and shape of the castings desired, the cavities being in all cases so disposed that both the centrifugal force and the angular accelerating force are effectively utilized to force the molten material into the casting cavities during rotation of the mold. It is possible to increase the number of cavities in a mold of any given size by decreasing the size of the mouth of each cavity. These and other variations and modifications are clearly within the scope of the present invention, and I do not wish to be limited to or by the specific embodiments shown herein by way of example.

I claim:

1. A centrifugal casting mold of the type wherein molten material is introduced while the mold has a high angular velocity, which mold is particularly adapted for the production from material having a melting point above 1700° C. of fine grained chill castings substantially free from flow lines, said mold comprising an annular body having an axially disposed circular sprue and a plurality of outwardly and rearwardly extending nonradial mold cavities opening directly into said sprue and having their outer ends closed, said annular body being of material resistant to high temperature heat, the longitudinal axis of each of said cavities being a substantially straight line forming with the radius of said body to the mouth of the cavity a lagging angle between 90 and 170 degrees, whereby the angular accelerating force and the centrifugal force are both effectively utilized to force the molten material into said cavities before said material has attained the angular velocity of the mold, so that the mold cavities are filled completely prior to the solidification of said material.

2. A centrifugal casting mold for high temperature melting materials comprising an annular body of material resistant to high temperature heat, said body having a concentric axially disposed circular sprue and a plurality of outwardly extending molding cavities spaced about and opening directly into said sprue, the outer edges of said cavities being substantially tangential to the periphery of said sprue.

3. A centrifugal casting mold for high temperature melting materials comprising a plurality of cooperating annular members having annular spacer plates therebetween, said annular members and spacer plates being of material resistant to high temperature heat, each of said annular members having a central sprue opening cooperating with a similar opening in said spacer plates and a plurality of recesses spaced about and communicating with said sprue so as to form by cooperation with said spacer plates a plurality of outwardly extending cavities, the angle at which said cavities extend outwardly from said sprue being such that the angular accelerating force as well as the centrifugal force is effectively utilized during rotation of said mold to force the molten material into said cavities and to maintain said material therein.

4. A centrifugal casting mold for high temperature melting point materials containing tungsten, comprising a plurality of cooperating refractory annular members having annular refractory spacer plates therebetween, each of said members having a concentric axially disposed circular sprue opening cooperating with a similar opening in said spacer plates and a plurality of recesses spaced about and communicating with said sprue so as to form by cooperation with said spacer plates a plurality of outwardly extending cavities, the outer edges of said cavities being substantially tangential to the periphery of said opening.

5. A centrifugal casting mold for high temperature melting materials containing tungsten carbide, comprising a plurality of cooperating annular members having annular spacer plates therebetween, said annular members and spacer plates being of material resistant to high temperature heat, each of said annular members having a central sprue opening cooperating with a similar opening in said spacer plates and a plurality of recesses spaced about and communicating with said sprue opening so as to form by cooperation with said spacer plates a plurality of outwardly extending cavities, the recesses of each of said annular members being vertically staggered with respect to the recesses of an adjacent annular member, and the angle at which said cavities extend outwardly from said sprue being such that the angular accelerating force as well as the centrifugal force is effectively utilized during rotation of said mold to force the molten material into said cavities and to maintain said material therein.

6. A centrifugal casting mold for high temperature melting materials comprising a plurality of cooperating annular members having one or more annular spacer plates therebetween, said annular members and spacer plates being of material resistant to high temperature heat, each of said annular members having a central sprue

opening cooperating with a similar opening in said spacer plate or plates and a plurality of separate non-radial recesses spaced about and communicating with said sprue so as to form by cooperation with said spacer plate or plates a plurality of outwardly extending non-radial cavities.

7. A centrifugal casting mold comprising an annular body of material resistant to high temperature heat, said body having an axially disposed circular sprue and a plurality of outwardly extending non-radial cavities having their inner ends opening directly into said sprue and their outer ends closed, the longitudinal axis of each cavity being substantially parallel to a tangent to the periphery of said sprue adjacent the inlet of such cavity.

HILLARD C. FRETZ.