Feb. 19, 1952 C F. GRAY 2,586,027

CASTING APPARATUS

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Fig. 1.

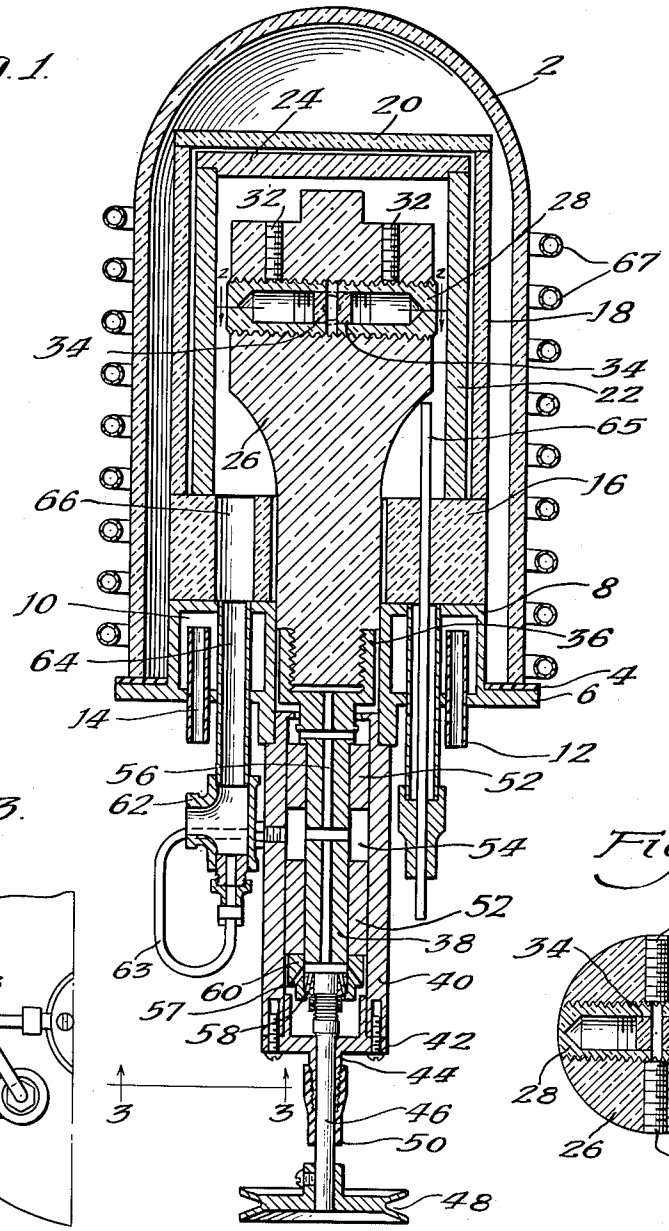


Fig. 3.

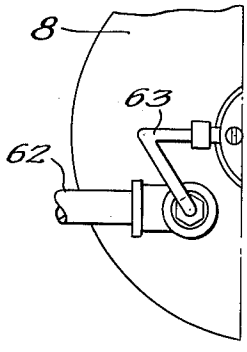


Fig. 2.

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CASTING APPARATUS

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9 Claims. (Cl. 22—65)

1

This invention relates to casting apparatus, and more particularly to a novel centrifugal device for casting metals such as uranium in vacuo.

An object of the invention is to design a centrifugal casting device wherein novel means are provided for balancing the rotor before actuation thereof.

Another object of the invention is to provide a novel adjustable mounting for the crucibles or molds carried by the rotor.

Still another object of the invention is to provide a novel bearing for the rotor shaft, said shaft comprising passage means to accommodate evacuation of the housing around the shaft for the purpose of eliminating atmospheric pressure on the shaft lubricant and decreasing axial thrust on the shaft due to atmospheric pressure against the portion of the shaft extending externally of the vacuum housing for connection to associated rotating means.

The foregoing and other objects of the invention will become apparent from a consideration of the following specification and the accompanying drawings, wherein:

Fig. 1 is a side view principally in vertical section and partly in elevation of a novel casting device embodying the invention;

Fig. 2 is a cross sectional view through the rotor taken on the line 2—2 of Fig. 1; and

Fig. 3 is a fragmentary bottom plan view taken from the point indicated by the line 3—3 of Fig. 1.

Describing the invention in detail, the novel device comprises a vacuum housing generally designated 2 which is preferably in the form of a quartz cylinder mounted on a rubber gasket 4 supported by a flange 6 of an annular water cooled head 8 having an internal annular water chamber 10 connected to inlet and outlet conduits 12 and 14.

The head 8 supports an annular heat insulator 16 composed of any suitable material such as firebrick, said insulator supporting a cylinder 18 and a cap 20 of any desired heat insulating material such as sillimanite.

Within the cylinder 18 is a graphite inductor cylinder 22 and cap 24 containing a rotor 26. The rotor is preferably formed of graphite and contains a plurality of graphite crucibles 28 threaded into the rotor. A pair of graphite adjusting members 30 (Fig. 2) are threaded into the rotor and are disposed approximately perpendicular to the crucible members 28. A set screw 32 is threaded vertically into the rotor to maintain each member 28 and 30 in a predetermined position at which the rotor is balanced as hereinafter discussed. Each crucible is provided with a graphite cap 34 threaded into the crucible to retain a charge of uranium therein.

2

The rotor extends through the annular insulator 16 and through the annular head 8 for threaded connection as at 36 to a rotor shaft 38 which extends through a vacuum tube 40 afforded a vacuum tight connection to the head 8 in any convenient manner as by welding.

The end of the tube 40 remote from the head 8 is closed by a cover plate or wall 42 comprising a central flanged opening 44 receiving a reduced portion 46 of the rotor shaft 38 which extends externally of the vacuum tube 40 for connection to any desired rotating means such as a pulley wheel 48. A rubber tube 50 is sleeved over the reduced portion 46 of the rotor shaft and the flange around the opening 44 to afford a vacuum tight seal for the shaft.

The shaft 38 is sleeved within spaced collar bearings 52 fitted within the tube 40 and defining a space 54 connected to a fluid passage 56 extending through the shaft 38 and connected to the rotor tube above the top bearing 52 and below the bottom bearing 52 for the purposes hereinafter described. The reduced portion 46 of the rotor shaft is connected to the bottom bearing 52 by a conventional thrust bearing 58 of the roller type adapted to take the thrust of the atmospheric pressure against the portion 46 of the rotor shaft which extends externally of the vacuum tube 40. As will be clearly seen in Fig. 1, the passage 56 through the rotor shaft communicates with ports 57 through the collar 60 carrying the outer race of the thrust bearing 58 to afford communication with the bottom of the tube 40 around the reduced portion 46 of the shaft 38.

A vacuum line 62 is connected to a tube 64 extending through the head 8 and communicating with a passage 66 through the insulator 16. The line 62 is also connected by a pipe 63 to the space 54 between the bearings 52. Thus as the portion of the housing containing the rotor 26 is evacuated, the tube 40 is evacuated above the top bearing 52 and below the thrust bearing 58 to prevent forcing of the shaft lubricant into cylinder 22 and to minimize axial upward thrust on the rotor 26 due to atmospheric pressure on the portion 46 of the rotor shaft. Thus it will be understood that the atmospheric pressure can only act on the diameter of the portion 46 to exert upward thrust against the shaft, said thrust being taken by the above-mentioned bearing 58.

A thermocouple 65 extends through the head 8 and a complementary opening in the insulator 16

into the inductor cylinder 22 for the purpose of indicating the temperature therewithin. An induction coil 67 is provided for heating the rotor and the contents of the crucible members 28 to the desired temperature.

In operation of the device, small blocks of uranium varying in size from 0.5 to 20 grams are inserted into the crucibles 28 which are charged with equal weights of uranium. The crucibles are then threaded into the rotor which is balanced by screwing the crucibles in and out and by the similar manipulation of the adjusting members 30. After the rotor has been balanced, the members 28 and 30 are locked by the set screws 32, and the rotor is attached to the threaded drive shaft 36.

It will be noted at this point that the above-mentioned passage 56 through the shaft 38 is effective to equalize the pressure within the cylinder 22 and within the portion of the tube 40 above and below bearings 52, thus preventing atmospheric pressure within the tube from forcing the lubricant for the shaft 38 upwardly within the tube. The tube 40 and shaft 38 are preferably provided with vertically overlapping flanges defining a labyrinthian passage to prevent the lubricant from working upwardly around the shaft 38.

After the device has been assembled, as above described, the crucibles are heated by means of the coil 67 to a value of about 1600° C. while the rotor is being rotated at any desired rate to urge the uranium or other metal radially outwardly to conform to the shape of the mold space within the crucibles 28. Thereafter the coil 67 is deenergized and the crucibles are permitted to cool until the molten metal therein has solidified, whereupon the rotor is stopped and the device is disassembled to accommodate removal of the uranium ingots or castings.

It will be understood that the above-described embodiment of the invention is merely by way of illustration and not limitation inasmuch as various modifications will be readily apparent to those skilled in the art without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. Vacuum casting apparatus comprising a vacuum housing, a rotor in said housing, said rotor being adapted to receive mold crucibles radially of the rotor axis in adjustable and balanced relationship, a tube connected at one end thereof to said housing, a wall closing the opposite end of said tube, spaced bearing collars fitted in said tube, a shaft connected to said rotor and sleeved within said bearings, said shaft having a reduced portion extending through a complementary opening in said wall, means affording a vacuum tight seal around said portion and said opening, fluid passage means extending through said shaft from said space to the opposite ends of said tube, means for exhausting said housing and said space, and means connected to said portion for rotation of said shaft.

2. Vacuum casting apparatus comprising a vacuum housing, a rotor in said housing, said rotor having mold spaces disposed radially of the rotor axis and adapted to maintain said rotor in balance, means externally of said housing for heating said mold, a tube connected at its upper end to said housing, a wall closing the lower end of said tube, spaced top and bottom collar bearings fitted in said tube, a shaft connected to said rotor and sleeved within said bearings, said shaft having a portion extending through a complementary opening in said wall, means affording a vacuum-tight seal around said portion and said opening, means for evacuating said housing, and means for preventing lubricant for said shaft from being urged into said housing comprising fluid passage means extending through said shaft from the space between said bearings to the opposite end of said tube above and below said bearings respectively, and means for exhausting said space to approximately the same value as that within said housing.

3. Vacuum casting apparatus comprising a vacuum housing, a rotor in said housing, at least two opposed crucible members in said rotor adapted to maintain the rotor in balance, means externally of said housing for heating said mold, a tube connected at its upper end to said housing, a wall closing the lower end of said tube, spaced top and bottom bearings fitted in said tube, a shaft connected to said rotor and sleeved within said bearings, said shaft having a portion extending through a complementary opening in said wall, means affording a vacuum-tight seal around said portion and said opening, means for evacuating said housing, means for preventing lubricant for said shaft from being urged into said housing comprising fluid passage means extending through said shaft from the space between said bearings to the opposite ends of said tube above and below said bearings respectively, and overlapping flanges on said shaft and tube respectively above the top bearing defining a labyrinthian passage to restrict flow of fluid upwardly in said tube.

4. Vacuum casting apparatus comprising a vacuum housing, a rotor therein having at least two opposed crucible members and adjusting members adapted to maintain said rotor in balance, a shaft connected to said rotor and having a reduced portion extending through an opening in a wall of said housing, fluid-tight means for sealing said opening, spaced collar bearings fitted in said housing and sleeved around said shaft, fluid passage means connecting the space between said bearings to the portions of said housing at the remote sides of said bearings, means for exhausting said space and the portion of said housing containing said rotor, and means for heating said rotor.

5. Vacuum casting apparatus comprising a vacuum housing, a rotor therein having at least two opposed molds adapted to be adjusted to maintain said rotor in balance, a shaft connected to said rotor and having a reduced portion extending through an opening in a wall of said housing, fluid-tight means for sealing said opening, spaced collar bearings fitted in said housing and sleeved around said shaft, fluid passage means connecting the space between said bearings to the portions of said housing at the remote sides of said bearings, means for exhausting said space and the portion of said housing containing said rotor, means for heating said rotor, and a thrust bearing connecting said portion to one of said spaced bearings.

6. Vacuum casting apparatus comprising a vacuum housing, a rotor therein having at least two opposed mold spaces adapted to receive crucible members to maintain said rotor in balance, a shaft connected to said rotor and having a portion extending through an opening in a wall of said housing, spaced collar bearings fitted in said housing and sleeved around said shaft, fluid passage means connecting the space between said bearings to the portions of said housing at the remote sides of said bearings, a vacuum line con-

nected to said space and independently connected to the portion of said housing containing said rotor, and means for heating said rotor.

7. Vacuum casting apparatus comprising a housing, a rotor therein, a plurality of crucible members threaded radially into said rotor for adjustment to balance the same, and a plurality of adjusting members threaded radially into said rotor for balancing the same, all of said members being equidistantly spaced about the axis of said rotor.

8. Vacuum casting apparatus comprising a housing, a rotor therein, a plurality of adjusting members threaded radially into said rotor for adjustment to balance the same, at least two opposed members comprising mold spaces therein and removable cap means for sealing said spaces, and means for heating said rotor.

9. Apparatus for melting metal that comprises a chamber, a rotatable shaft positioned in the chamber, a rotor fixed to said shaft and positioned in the chamber, said rotor being adapted to receive and retain metal to be melted in at least two opposed molds to maintain the rotor in balance, induction heating means surrounding the chamber and the rotor therein, and means for evacuating said chamber.

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