Sept. 20, 1938. R. ARDELT 2,130,726

MOLD FOR CENTRIFUGAL CASTING

Filed Feb. 6, 1936 2 Sheets-Sheet 1

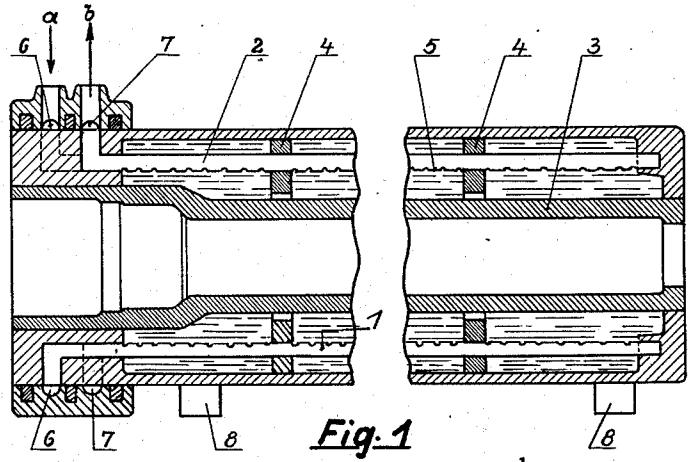


Fig. 1

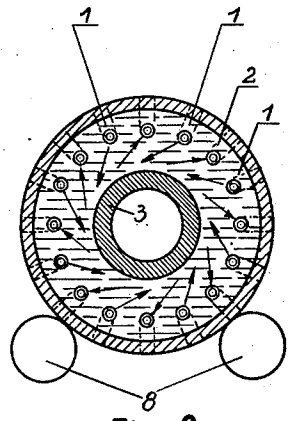


Fig. 2

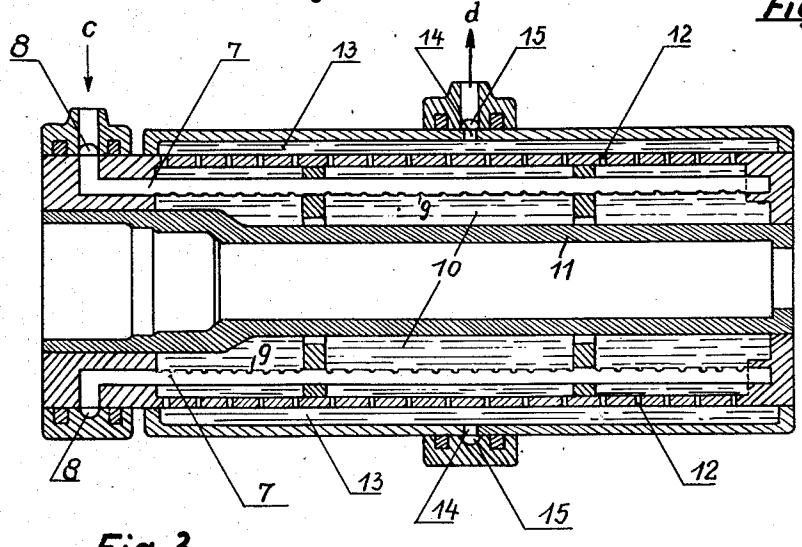


Fig. 3

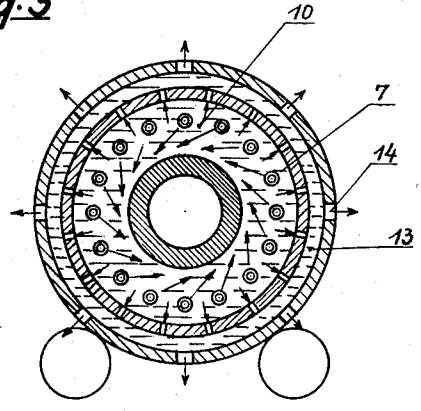


Fig. 4

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MOLD FOR CENTRIFUGAL CASTING

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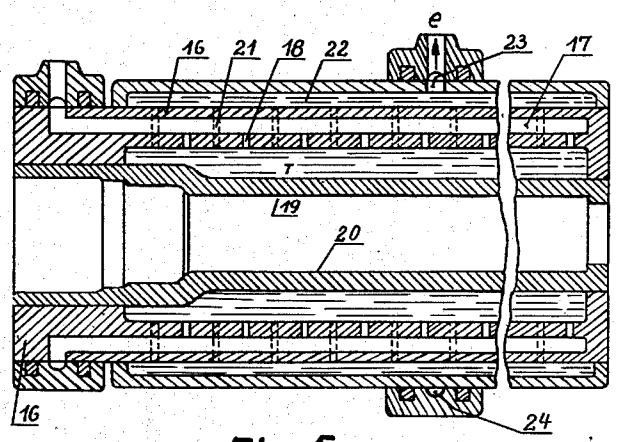


Fig. 5

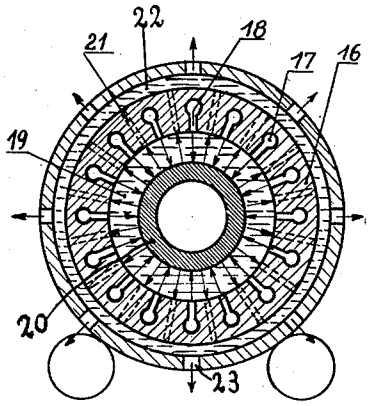


Fig. 6

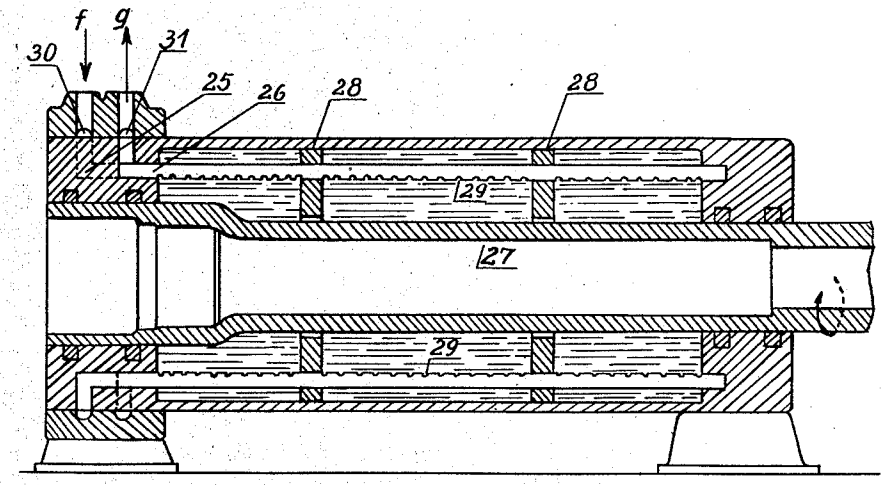


Fig. 7

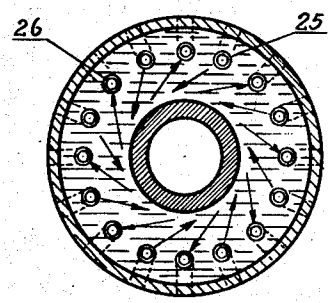


Fig. 8

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2,130,726

MOLD FOR CENTRIFUGAL CASTING

Robert Ardelt, Eberswalde, near Berlin, Germany

Application February 6, 1936, Serial No. 62,659
In Germany February 6, 1935

10 Claims. (Cl. 22—65)

My invention relates to molds for centrifugal casting and more particularly to molds for casting tubes of iron and other metallic materials.

It is an object of my invention to provide a cooling device, which avoids the drawbacks of the devices known heretofore.

Another object of my invention is to obtain a uniform cooling effect over the whole surface of the mold for example by preventing the formation of steam cushions on the outer surface of the mold and other objections to a uniform cooling.

Another object is to obtain a device, which is cheap in manufacture and safe and efficient in operation.

Another object is to prevent an early destruction of the mold by cracks and deformations and the like and to obtain castings of high and uniform quality.

Other objects of my invention will result from the description of the invention which follows.

It is known that molds for centrifugal casting and more particularly metallic molds, such as iron molds, in which tubes and similar castings are cast directly (i. e. without sand lining) must be provided with cooling means in order to maintain a predetermined temperature within the mold. As is further known the quality of the castings and the life of the mold depend very much upon a uniform temperature in all parts of the cooling wall of the mold. The cooling means known heretofore do not comply with these requirements at all and especially they show two faults. Firstly differences in temperature occur in the cooling liquid itself as, after entering the cooling space, the cooling liquid is heated at first at one point of the cooling wall and is then transmitted in a heated state to other points in order to have a cooling effect there. A still greater drawback originates from the fact that the centrifugal force, which builds-up when the mold is rotating, tends to move the cooling liquid away from the cooling wall thus giving rise to the formation of steam cushions which prevent an efficient heat transmission. If however the cooling of the mold is not uniform, strains will result within the mold which very often effect the formation of cracks that soon destroy the mold. But already a deformation of the mold, caused by differences in the temperature within the mold, may render this mold unfit for use. A cooling, which is not uniform, does not only affect the mold itself but also the castings which, on account of the irregular cooling, show stresses and different hardness.

My invention avoids these drawbacks by distributing the cooling liquid uniformly over the whole circumference and the whole length of the mold by way of a distributing system which introduces a cooling liquid into a cooling space situated between the metallic mold proper and a shell surrounding this mold. This distributing system is provided with inlet ports which are situated opposite the cooling wall of the mold at such places that the cooling liquid is thrown on the cooling wall in the form of jets. By this arrangement it is very easy to raise the kinetic energy of the jets (which can be obtained by changing the pressure or by giving the inlet ports a certain size or form or by varying the distance of the inlet ports from the cooling wall) to such a point that the force of the jets, being directed towards the interior of the mold, is as much greater than the centrifugal force as is wanted, thus making sure of a good cooling effect and preventing the forming of steam cushions. The cooling liquid is carried away from the cooling space near the hitting points of the jets by a plurality of outlet ports which also extend over the whole circumference and the whole length of the mold, thus assuring the same temperature at all points of the cooling face, as the cooling liquid reaches all points of the cooling surface with the same temperature and is led off from this surface with a temperature raised for the same amount.

My invention further consists in using for the device mentioned above a cooling liquid, which has a high boiling point of at least 200° C., the cooling liquid being introduced into the cooling space with a temperature of about 150° C. A cooling liquid which is specially adapted for this purpose is glycerine. The cooling liquid of the kind referred to may be discharged from the cooling space with a temperature which lies below the boiling point of this liquid under normal pressure. The advantages of using a relatively hot cooling liquid are firstly that the difference in the temperatures of the mold are reduced to a small amount, thus increasing the life of the mold very much. A further advantage lies in the fact that the quality of the tubes thus produced is improved. When casting long tubes the mold will be cooled sufficiently by the hot cooling liquid at that end of the mold where the casting process is started, while at the other end, at which the casting has not yet been started, a preheating of the mold by the cooling liquid is obtained. It was found out that a preheating to 150° C. of the cooling liquid is quite sufficient for preventing a substantial hardening of the surface

of cast iron tubes, as the mold, at the place where the liquid iron impinges on it, is further preheated by heat conducted through the mold from the finished part of the tube to this place.

In this way it is possible to avoid the expensive annealing of the casting necessary until now or to replace the intensive annealing by a very short and therefore cheap annealing process. Besides this advantage the waste is decreased as the annealing process never can close cracks which have been formed already. It was found that when using glycerine introduced at a temperature of about 180° C. and discharged with a temperature of about 230° C. castings will be obtained, the quality of which is equal to the ordinary castings obtained from sandspun molds, except the utmost outer surface which is only slightly hardened.

The accompanying drawings show several embodiments of the invention.

Figs. 1, 3, 5 and 7 show a longitudinal section and Figs. 2, 4, 6 and 8 a corresponding transversal section through three different molds according to the invention.

The cooling liquid in the cooling space, which lies between the walls of the outer shell and the mold proper, is led to the mold by way of a distributing system in such a way that it reaches the outside surface of the mold well distributed and uniformly, the distributing system being provided with a plurality of small inlet ports being arranged within the cooling space over the whole length and the whole circumference of the mold proper. The cooling liquid may be introduced radially to the mold or, in order to get a better efficiency and uniformity, inclined to the radial direction. By introducing the cooling liquid inclined to the radial direction a good circulation of fresh cooling liquid around the mold is obtained even if the mold is not rotating. The uninterrupted circulation of fresh cooling liquid around the mold is of greatest importance when the mold is not moving, as in this way the vapours forming at the circumference of the mold are continuously washed away and strains within the material are avoided which otherwise might cause deformations of the mold. The proposed cooling of the molds may be obtained in several different ways according to the different embodiments of the invention shown in the drawings.

Referring now more particularly to Figs. 1 and 2, these figures show the feed pipes 1 and 2 for the cooling liquid, these pipes being arranged uniformly around the mold 3. The feed pipes are held in position by several rings 4, which hold them against the action of the centrifugal force. A feed pipe and a discharge pipe are always arranged one aside of the other, these pipes containing small holes 5 over their whole length which lie close to each other. The cooling liquid is led to the mold in the direction of the arrow *a* by way of the non-rotating annular channel 6 and the feed pipes 1 opening into this channel, while the liquid is returned by way of the discharge pipes 2 and the non-rotating annular channel 7 in the direction of the arrow *b*. With 8 rolls are designated on which the mold 3 is rotating together with the cooling means, but with exception of the device containing the channels 6 and 7.

Figs. 3 and 4 show feed pipes 7, which are also uniformly distributed around the mold and are held by rings, in this case all pipes serving as feed pipes. The cooling liquid is introduced in the direction of the arrow *c* by way of the non-rotating body containing the channel 8, the feed pipes 7 and the plurality of small holes 9 within these pipes and acts upon the mold 11 within the annular cooling space 10. From this space the cooling liquid passes through many small holes 12 into the annular space 13 and from there through the holes 14 into the annular channel 15, from which it is discharged in the direction of the arrow *d*.

As shown in Figs. 5 and 6 the cooling liquid reaches the cooling space 19 by way of the channels 17 and the small holes 18 provided within the cylindrical body 16. From the cooling space 19 the cooling liquid passes through a plurality of small radial channels 21, which are uniformly distributed over the whole length and the whole circumference of the mold, into the space 22 and from there through openings 23 into the annular channel 24, from where the liquid is discharged in the direction of the arrow *e*.

Figs. 7 and 8 show that the invention also may be embodied by devices in which the outer shell is not rotating while the mold proper rotates. In Figs. 7 and 8 the same example is employed as already shown in Figs. 1 and 2. It goes without saying that the same arrangement may be used for the other examples described before.

In the embodiment of the invention shown in the Figs. 7 and 8 only the mold proper 27 is rotating. The cooling liquid is distributed by way of the pipes 25 and is discharged by the pipes 26. The different pipes are held by rings 28 and are provided with openings 29 for the passage of the cooling liquid. The pipes 25 and 26 are connected to a common feed pipe 36 and to a common discharge pipe 31.

What I claim is:

1. An apparatus for centrifugal casting comprising a metallic mold, an outer shell, said mold and said shell forming a cooling space, feeding means and discharge means for carrying a cooling liquid to and from said cooling space respectively, said feeding means having inlet ports communicating with said cooling space, and being directed onto the outer surface of said metallic mold, said discharge means having outlet ports communicating with said cooling space, said inlet and outlet ports being distributed over the whole circumference and over the whole length of said metallic mold, and two means separate from each other for connecting said feeding means to an external source of cooling liquid supply, and said discharge means to the outside on a level above said shell respectively.

2. An apparatus for centrifugal casting comprising a metallic mold, an outer shell, said mold and said shell forming a cooling space, a system of pipes fixed within said cooling space, said pipes serving for introducing and discharging a cooling liquid to and from the cooling space, said pipes being provided with a plurality of small ports distributed over the whole circumference and over the whole length of said metallic mold, means for feeding the cooling liquid to every second pipe, and means for discharging the cooling liquid from the rest of the pipes on a level above said shell.

3. An apparatus for centrifugal casting comprising a metallic mold, an outer shell, said mold and said shell forming a cooling space, a system of pipes fixed within said cooling space, said pipes being provided with a plurality of small ports over the whole length and the whole circumference of said metallic mold, a tube between said system of pipes and said outer shell, said tube being also provided with a plurality of small ports

over the whole length and the whole circumference of said metallic mold, said system of pipes and said tube serving for introducing and discharging a cooling liquid to and from said cooling space respectively, means for feeding cooling liquid to said pipes, and means for discharging the cooling liquid from the space between the outer shell and the tube on a level above said shell.

4. An apparatus for centrifugal casting comprising a metallic mold, an outer shell, said mold and said shell forming a cooling space therebetween, a cylindrical body arranged between said metallic mold and said outer shell and being concentric therewith, said cylindrical body being provided on its inner surface only with a plurality of inlet ports and being also provided with a plurality of outlet ports alternatively arranged with respect to the inlet port over substantially the whole length and the whole circumference of said metallic mold, means for feeding a cooling liquid to said inlet ports and means separate from said feeding means for carrying away the cooling liquid from said outlet ports on a level above said shell.

5. An apparatus for centrifugal casting comprising a metallic mold, an outer shell, said mold and said shell forming a cooling space, a cylindrical body between said metallic mold and said outer shell, said cylindrical body being provided on its inner surface with a plurality of inlet ports and outlet ports alternately arranged to each other over the whole length and the whole circumference of said metallic mold, first means for feeding a cooling liquid to said inlet ports, and second means for carrying away the cooling liquid from said outlet ports, said first means comprising axial channels connecting the inlet ports of the same row with each other and means for feeding the cooling liquid to said axial channels, said second means comprising radial channels connecting said outlet ports with the annular space between said cylindrical body and said outer shell, and means for carrying away the cooling liquid from said annular space between said cylindrical body and said outer shell on a level above said shell.

6. An apparatus for centrifugal casting comprising a metallic mold, an outer shell, said mold and said shell forming a cooling space and being rigidly connected with each other so as to rotate together, feeding means and discharge means for carrying a cooling liquid to and from said cooling space respectively, said feeding means having inlet ports communicating with said cooling space and being directed onto the outer surface of said metallic mold, said discharge means having outlet ports communicating with said cooling space, said inlet and outlet ports being distributed over the whole circumference and over the whole length of said metallic mold, and two means separate from each other for connecting said feeding means to an external source of cooling liquid supply, and said discharge means to the outside above the level of the shell respectively.

7. An apparatus for centrifugal casting comprising a metallic mold, a supported outer shell, said mold and said shell forming a cooling space and being so arranged and constructed, as to permit the metallic mold to rotate while the outer shell stays fixed on its supports, feeding means and discharge means for carrying a cooling liquid to and away from said cooling space respectively, said feeding means having inlet ports communicating with said cooling space and being directed onto the outer surface of said metallic mold, said discharge means having outlet ports communicating with said cooling space, said inlet and outlet ports being distributed over the whole circumference and over the whole length of said metallic mold, and two means separate from each other for connecting said feeding means to an external source of cooling liquid supply, and said discharge means to the outside on a level above said shell respectively.

8. An apparatus for centrifugal casting comprising a metallic mold, an outer shell, said mold and said shell forming a cooling space, a cylindrical body between said mold and said shell, said cylindrical body having a plurality of axial channels, each with a plurality of inlet ports directed towards said mold, said cylindrical body having also a plurality of radial channels connecting the spaces at the inside and at the outside of the cylindrical body with each other, means for feeding a cooling liquid to said axial channels, and means for carrying off cooling liquid from the space between said cylindrical body and said shell on a level above said shell.

9. An apparatus for centrifugal casting comprising a metallic mold, an outer shell, said mold and said shell forming a cooling space adapted to be completely filled with a cooling liquid, means for admitting cooling liquid to said cooling space, and means for carrying cooling liquid away from said cooling space, said means including a plurality of inlet and outlet ports respectively, said ports being distributed over the entire circumference and length of the mold and being so arranged as to create, within the cooling space, a plurality of inlet currents directed radially towards the outer surface of said mold, and of outlet currents directed radially towards said shell, means for feeding liquid to said admitting means, and means for collectively discharging the liquid having passed said outlet ports, said discharging means comprising a ring channel surrounding said shell and communicating with the inside thereof, and having an outlet above said shell so as to safeguard complete filling of said cooling space with liquid.

10. An apparatus for centrifugal casting comprising an elongated metallic mold, an outer shell, said mold and said shell forming a space so enclosed as to be completely filled with a cooling liquid, a pipe-like system within said cooling space, said pipe-like system comprising feeding channels and discharge channels, and two means separate from each other for connecting said feeding channels to an external source of cooling liquid supply, and said discharge channels to the outside above the level of said shell respectively, said feeding channels having inlet ports and said discharge channels having outlet ports, said inlet and outlet ports being distributed over the whole length and circumference of said mold, and being so directed as to create a plurality of individual currents within said cooling space towards and away from the outer surface of said mold.

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