May 17, 1932. F. G. CARRINGTON 1,858,478

PROCESS OF CASTING METAL CENTRIFUGALLY

Filed Nov. 7, 1928 2 Sheets-Sheet 1

FIG. 1.

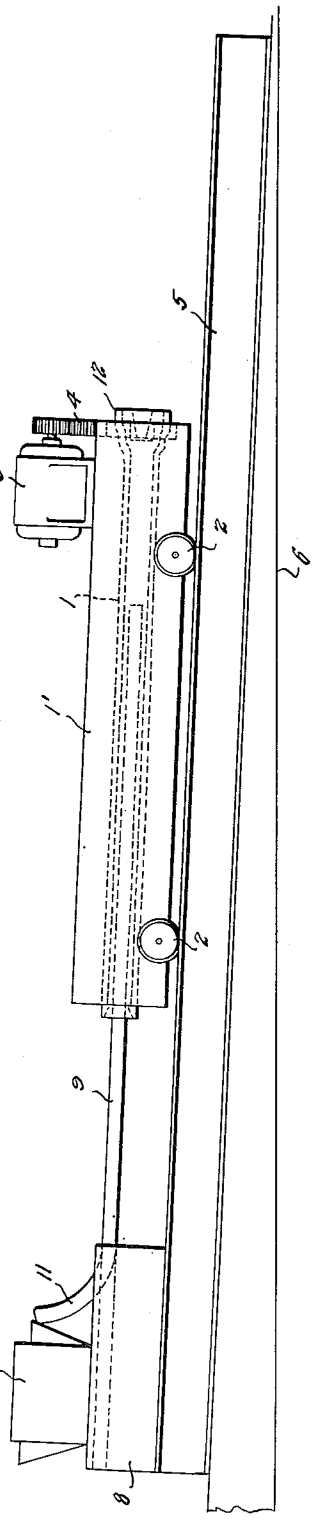


FIG. 7.

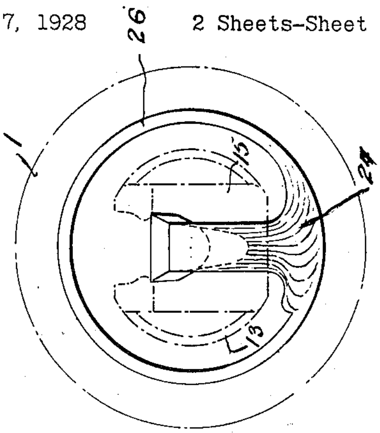
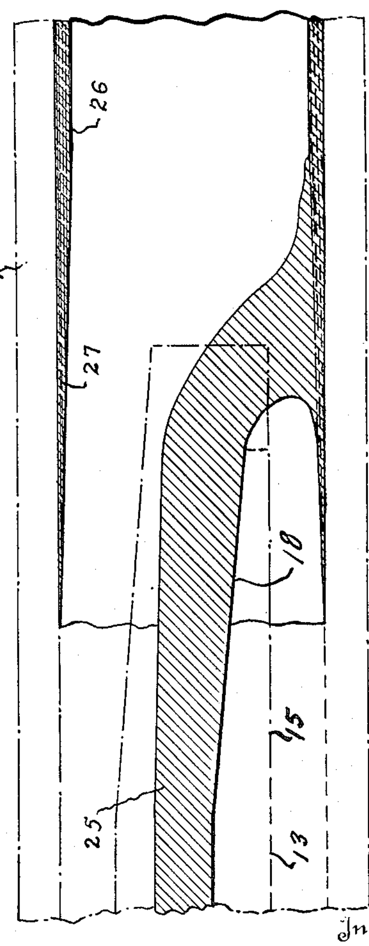


FIG. 6.



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Filed Nov. 7, 1928 2 Sheets-Sheet 2

FIG. 3.

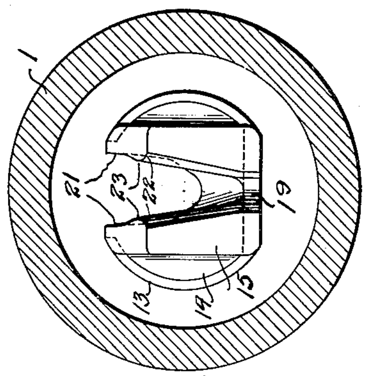


FIG. 5.

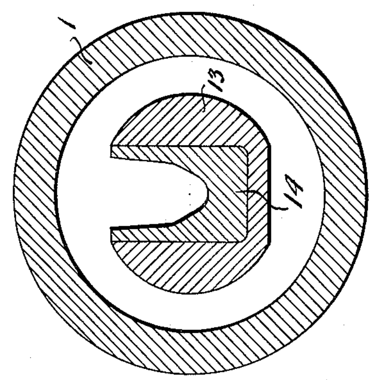


FIG. 2.

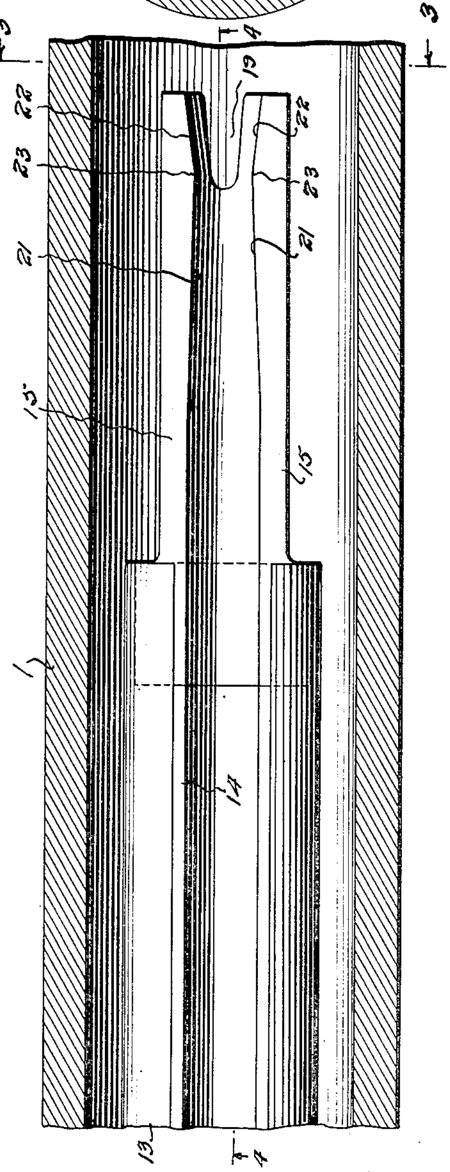
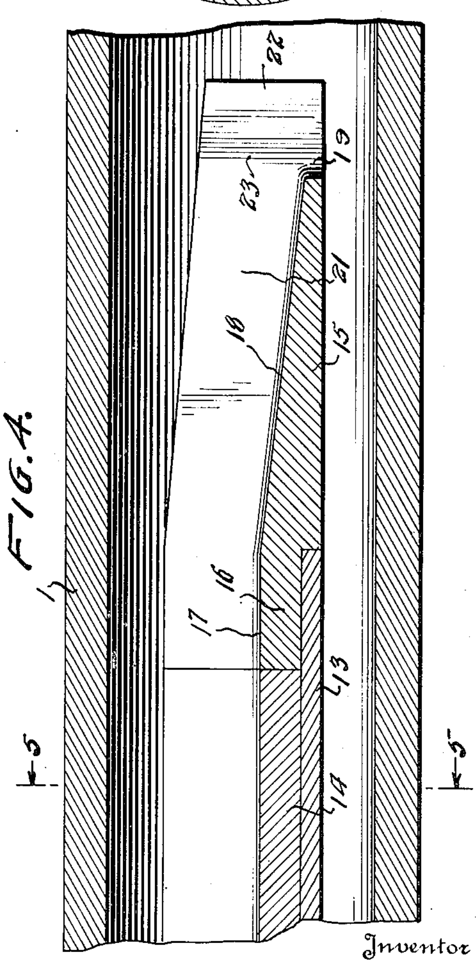


FIG. 4.



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Patented May 17, 1932 1,858,478

UNITED STATES PATENT OFFICE

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PROCESS OF CASTING METAL CENTRIFUGALLY

Application filed November 7, 1928. Serial No. 317,817.

This invention relates to centrifugal casting, and more particularly has reference to the deposition of molten metal in a rotating mold.

The method of centrifugal casting in most common use comprises pouring molten metal into a rotating horizontal cylindrical mold from an "end-pouring" trough and building up the casting helically by longitudinally moving the mold and trough relative to each other. During this operation the metal is subjected to various forces. The first is the force impelling it along the trough. This, however, is partially compensated for by the relative movement of the mold and trough. Usually, though not always, the trough remains stationary while the mold traverses it, but even if the trough moves while the mold remains axially stationary, this relative movement takes up a large part of the velocity of the stream. A second force to which the metal is subjected results from the rotation of the metal when it is caught up by the spinning mold. A third force is the centrifugal force set up in the metal by the rotation of the mold and its contents.

For castings with uniform walls, it is particularly essential that the longitudinal flow of the metal be neutralized as quickly as possible to prevent a continued flow down the mold. This neutralization is effected not only by the relative longitudinal movement of the mold and trough but by the centrifugal force which causes the metal to spread out and partially reverse its direction of flow. The speed at which the mold is required to revolve in order to spread the metal is so great, however, that there is a strong tendency toward surging and splashing. This tendency is aggravated by the fact that the metal is usually poured from the discharge end of the trough in a ribbon whose longer dimension is transverse to the axis of the mold. As a consequence this ribbon on striking the mold is whipped by the rotation into a tubular formation parallel to the mold's axis. This whipping and change of direction creates surges and splashes which have a deleterious effect upon the cast product.

The surges make for a pipe of non-uniform thickness, as there is apt to be a solidification of the cast metal before it has been distributed uniformly about the mold.

The telescopic movement of the trough and mold establishes a time gradient for the deposition of metal at different points along the length of the mold. In view of this time element, any splashing means that the metal within a given area is not contemporaneously cooled. For instance, those drops that splash upon a section which has not yet received the metal solidify prior to solidification of the stream which is subsequently poured upon that section. Consequently these drops do not fuse into the body of the pipe when it is cast over them, and produce defects in the finished article, commonly called "splashes."

It is the object of the present invention to reduce the surging and splashing of metal which occurs when using the present types of "end-pouring" troughs and to deposit the molten metal within the mold in such a manner as to produce a better and more homogeneous casting.

I have attained this object by shaping the pouring spout of an end pouring trough so that the stream of metal is narrowed and deepened, emerging from the spout in the form of a flat ribbon flowing on edge. Thus the metal strikes the mold edgewise with its dimension longitudinally of the mold greater than its transverse dimension, quite the reverse of the situation resulting from the use of the ordinary end-pouring trough. In this way the rotating mold readily picks up and distributes the metal with little splashing or surging. While the present application is directed to the process of depositing the metal within the mold, the pouring trough herein described is being separately claimed in a copending divisional application Serial No. 552,898 filed July 24, 1931.

Figure 1 is a diagrammatic showing of a pipe mold, trough and associated mechanism.

Figure 2 is a longitudinal sectional view of a mold and a top plan view of the discharge end of a trough and spout mounted therein.

Figure 3 is a view along the line 3—3 of

Figure 2, looking in the direction of the arrows.

Figure 4 is a sectional view along the line 4—4 of Figure 2 looking in the direction of the arrows.

Figure 5 is a sectional view along the line 5—5 of Figure 4 looking in the direction of the arrows.

Figure 6 is a view similar to Figure 4, with the exception of showing metal in the process of pouring and the formation of a casting within the mold.

Figure 7 is an end view of the spout during a casting operation, showing the metal being poured therefrom.

Referring more particularly to Figure 1, there is set forth a conventional type of mold 1, rotatably mounted in a mold carriage 1′, which latter is supported by suitable rollers 2. The mold is rotated by a motor 3 or other driving means actuating the mold through a train of gears 4. The rollers 2 run upon a track 5, mounted at an angle to the horizontal as indicated by the line 6. Appropriate means (not shown) are provided for moving the mold on the track 5.

There is also shown in Figure 1, a ladle 7, which may be of any type, mounted upon a support 8. Cantilevered upon the support 8 is an end pouring trough 9. A chute 11 fits within the trough 9 adapted to receive the metal from the ladle 7 and convey it to the channel of the trough 9.

At the beginning of a casting operation the mold carriage 1′ is advanced up the inclined track 5 until the end of the trough 9 is adjacent the bell end 12 of the mold. It is, of course, obvious that my invention is equally well adapted for use in the casting of plain-end pipe, in which case the operation is commenced by pouring metal in the far end of the mold, corresponding to the bell end 12. Metal is discharged from the ladle 7 into the chute 11 and conveyed through the trough 9 to the bell 12, or far end, of the mold. After the bell, or far end, of the mold has been sufficiently filled with metal, the carriage 1′ begins to move down the inclined track 5. During this movement of the carriage, the metal builds up on the interior of the mold in helical laminations, the adjacent laminations coalescing as the casting proceeds.

The foregoing is a general description of the structure and operation of centrifugal casting machines of the end-pouring type. I shall now describe the changes which I have made in this structure in accordance with the present invention.

Referring more particularly to Figures 2 and 5, the trough 9 is composed of a casing 13 composed of one of the steels having a high melting point, preferably annealed, or other suitable refractory material, in the channel of which there is inserted a lining 14. This lining is preferably cast iron, but it may be made up of one of the steels just mentioned, fire clay, or some other appropriate refractory. The channel of the lining 14 is fairly wide, which facilitates the cleaning and removal of any metal that may remain after a casting operation. The shape of the channel of the lining 14 also reduces the surface in contact with the stream of metal as compared to a narrower channel, which, together with the rate of flow of the stream induced by the inclined position of the trough, prevents any considerable escape of heat from the metal. It will be noted that the channel of the lining 14 of the trough is uniform along its length.

Joined to the discharge end of the trough by any suitable means to provide a liquid-tight connection, is a spout 15. The composition of this spout may be cast iron, a high melting point steel, or a refractory such as fire clay. Referring to Figure 4, it will be observed that the bottom of the spout is flush with the bottom of the casing 13, (although this may be inclined), and that a portion 16 of the spout extends within the casing 13 and forms in effect a lining for that portion of the casing so occupied, and affords additional support. The channel of the section 16 is the same as the channel of the lining 14 as indicated at 17. But from the end of the casing 13 the base of the channel falls away as at 18, ending in a slot 19. As shown in Figure 2, the slot 19 flares towards its open end, but, under suitable conditions, its sides may be parallel. The sides of the channel converge as at 21 for a distance, and then, (and substantially at the beginning of the slot 19) flare out as at 22. This forms a throat the function of which is to confine the metal and so prevent an excessive lateral spread as the ribbon falls into the mold.

The effect of this configuration of the spout upon the stream of metal 25 is to constrict its width and increase its depth, thus forming a ribbon of metal flowing edgewise with its larger dimension vertical, as shown in Figure 6. It will be observed that the level of the stream remains substantially that of the stream within the trough 9, but that the depth increases along the sloping portion 18. This shape of the stream is effected by the sloping base and converging side walls, these two factors more or less compensating each other to maintain the same level of the stream as obtains in the trough 9.

The metal begins to fall perceptibly toward the mold the moment that it reaches the discharge end of the sloping portion 18, which is the slot 19, but by reason of its depth the upper strata of the stream are delayed in their drop toward the mold, the walls 22 forming in effect a wing for the slot 19 and preventing too great a spread of the stream. In the absence of these wings and the slot 19, the metal would have a tendency to fall from the end of the spout in substantially a sheet that would be perpendicular to the longitudinal axis of the mold. By my invention, however, the metal is poured in the form of a ribbon that is parallel with the longitudinal axis, and consequently prevents the surge which would naturally result from the rotation of the metal when it strikes the mold.

Figures 6 and 7 show the form assumed by the metal as it leaves the spout. It will be observed that the stream is constricted in width at the moment it falls through the slot 19 of the spout, and may be considered as formed of laminations 24. These laminations 24 readily assume the altered shape produced by rotation of the metal, and easily take the form of the tubular mass of metal 26. Consequently any tendency of the metal to surge or splash is reduced to a minimum. In Figure 6 it will be seen that the mass 26 tapers as at 27 toward a point on the mold in the rear of the slot 19. This tapering portion is gradually built up as the mold moves along the track 5 until it is uniform with the rest of the casting. The result is that the cast pipe is free from splashes or solidified surges.

It is believed that the operation of my invention may be readily comprehended from the foregoing description. Metal is deposited in the liner 14 and flows through it to the spout 15. In the spout the stream is converged by the walls 21, and increased in depth by virtue of the decline in the base of the channel 18 and the restriction in width. The throat 23 narrows the stream to the desired maximum. The velocity is reduced to approach the rate of speed at which the carriage 1⁷ travels. This tends to neutralize the force set up by the longitudinal movement of the carriage. Furthermore, as above pointed out, the metal falls upon the mold in rather a ribbon formation, which readily adjusts itself to the rotation with the mold after its longitudinal flow in the trough. The result is that the stream of metal impinges upon the mold in a form that is best adapted to assume its new shape. This reduces surging and splashing of the metal to a minimum, and obviates the deleterious effects that have attended the prior processes and apparatus.

It will be readily seen that my invention constitutes a real advance over the prior art in that the product resulting therefrom is free from the disadvantages that are now prevalent, these being principally a non-uniformity in thickness of the pipe and the formation of splashes.

While I have set forth and described in some detail one method of effecting my invention, it is obvious that various modifications may be made in the means herein set forth without altering the underlying principles, and without departing from the true scope of my invention as defined in the appended claims, by which alone I wish my invention to be limited.

I claim:

1. The process of casting metal centrifugally within a rotating mold which comprises pouring a stream of molten metal into the mold from a stream flowing longitudinally of the mold, constricting the flowing stream just before it falls into the mold so that its depth is greater than its width, and moving the mold relative to the stream to build up the casting helically.

2. The process of casting metal centrifugally within a rotating mold which comprises pouring a stream of molten metal into the mold from a stream flowing longitudinally of the mold, constricting the flowing stream just before it falls into the mold so that its depth is greater than its width, confining the stream as it falls to prevent lateral spread of the metal before it strikes the mold, and moving the mold relative to the stream to build up the casting helically.

3. The process of casting metal centrifugally within a rotating mold which consists in discharging a stream of molten metal longitudinally of the mold in the form of a relatively thin sheet and moving the mold relative to the sheet to build up the casting helically.

4. The process of casting metal centrifugally within a rotating mold which consists in discharging a stream of molten metal under substantially constant pressure longitudinally of the mold in the form of a relatively thin sheet and moving the mold relative to the sheet to build up the casting helically.

5. The process of casting metal centrifugally within a rotating mold which consists in projecting a stream of molten metal longitudinally of the mold in the form of a relatively thin sheet, confining the stream as it falls against lateral spread before it strikes the mold, and moving the mold relative to the sheet to build up the casting helically.

6. The process of casting metal centrifugally within a rotating mold which consists in discharging longitudinally into the mold a stream of metal having a cross-section of appreciably greater vertical dimension than horizontal dimension, and moving the mold relative to the stream to build up the casting helically.

In testimony whereof I affix my signature.

FRANK G. CARRINGTON.