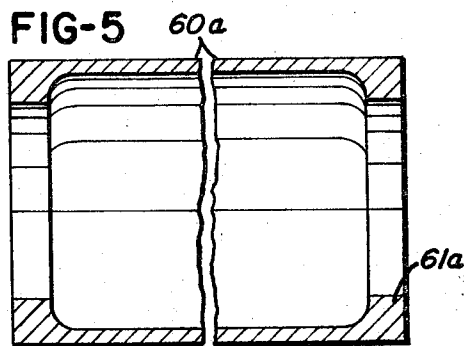
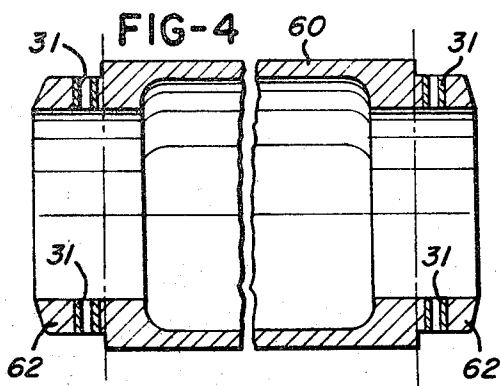
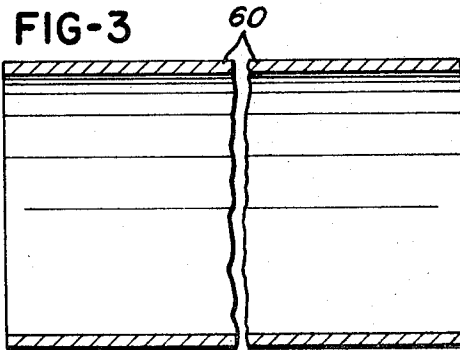
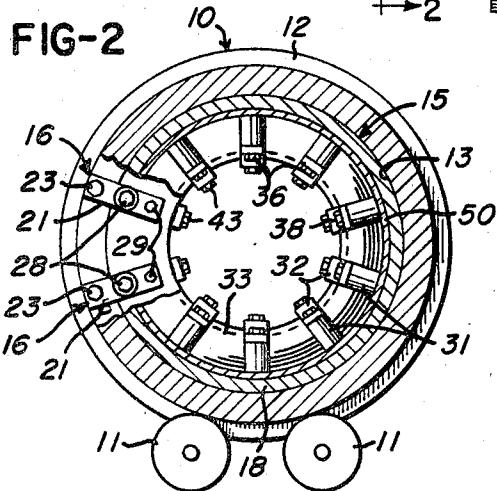
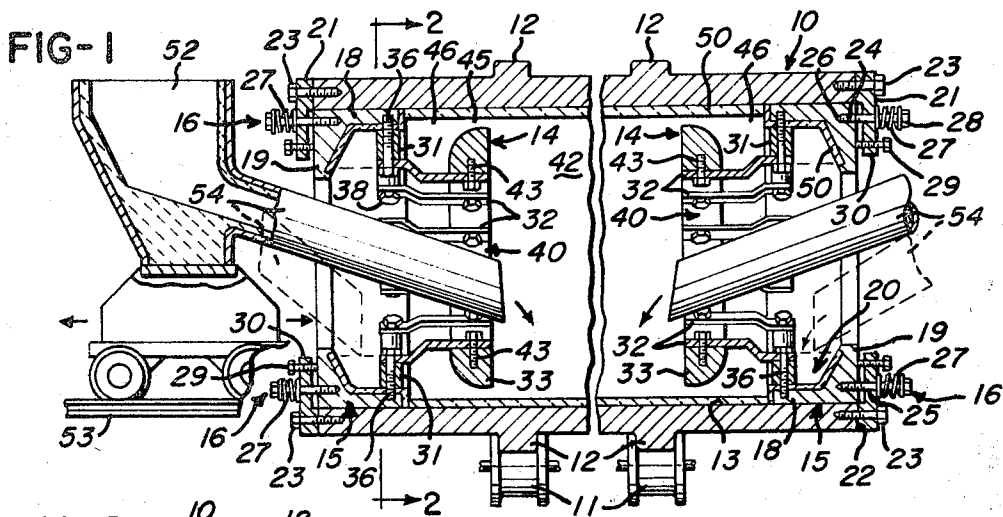


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METHOD AND APPARATUS FOR CASTING AN INTERNALLY
FLANGED TUBULAR MEMBER
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METHOD AND APPARATUS FOR CASTING AN INTERNALLY FLANGED TUBULAR MEMBER

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ABSTRACT OF THE DISCLOSURE

Method and apparatus for centrifugally casting a tubular member having internal flanges by utilizing a core case having baffles which separate the interior into central and flange-forming chambers connected by an annular passage at the periphery of the baffle. A first pour of metal is made into the core case and allowed to solidify at least partially to block the passages, and then a second pour of the molten metal is made into the flange-forming chambers to create integral internal flanges when the metal solidifies.

BACKGROUND OF THE INVENTION

This invention has special relation to the production of large tubular shells for uses such as in dryer drums, suction rolls and other similar tubular members of the type which are widely employed in the manufacture and/or handling of paper and other web materials, and which require the strength characteristics developed by centrifugal casting. Shells of this type commonly require the application of end heads, particularly in cases such as dryer drums and suction rolls, which must be secured to the shells in pressre-tight relation, and a convenient procedure for this purpose is to provide internal flanges within the shells to which the end heads can be bolted or otherwise secured.

It has been a common practice in producing shells of of the general type outlined above to cast the shell centrifugally with essentially the desired uniform final thickness and then to weld separately fabricated flanges to the inner surfaces of the shell. This process involves substantial added expense both in the welding operation and also in the separate production of the individual flange members. In addition, some metals which are commonly used for shells produced by centrifugally casting cannot be welded successfully, such for example as bronze in the case of paper machine suction rolls, and it has been a common practice to cast the shells for such rolls substantially thicker than would otherwise be necessary in order to provide adequate wall thickness to receive the mounting bolts for the associated end heads.

In addition to the present practice as set forth above, pertinent background art includes the methods and apparatus disclosed in the U.S. patents of Rojecki No. 3,263,285, issued Aug. 2, 1966, and Fruitman No. 3,293,708, issued Dec. 27, 1966, both assigned to the assignee of this invention. In Rojecki, a quantity of molten metal is placed into the rotating core case having central and flange-forming chambers connected by annular passages between the baffles and the inner surface of the core case, and then the central chamber is sealed and pressurized to cause a portion of the molten metal to flow into the flange-forming chamber and create the internal flange when the metal solidifies.

The Fruitman patent discloses a core case assembly similar to Rojecki's, but the molten metal is caused to flow through the annular passage into the flange-forming chamber by placing a molten material having a specific gravity less than that of the molten metal in the central

chamber to cause a preset volume of the metal to flow into the flange forming chamber wherein it solidifies. Then the molten material is removed, either before or after solidification, to produce a tubular casting having one or more internal flanges.

It is also prior art to cast centrifugally an elongated composite tube by first centrifugally casting an outer metal tube, and after solidification thereof has occurred and while the mold is still rotating, casting a second dissimilar metal into the interior thereof. A composite tubular casting results since the second volume of molten metal partially melts the first casting and thus fuses the two metals together. A disclosure of this process appears in an article entitled "Composite Tubing" by M. L. Samuels in the June 1962 issue of Materials in Design Engineering.

SUMMARY OF THE INVENTION

A tubular member having at least one internal flange is cast by placing a first preset volume of molten metal into a rotating core case having flange-forming and central chambers therein separated by a baffle. An annular passage formed between the outer periphery of the baffle and the inner surface of the core case interconnects these chambers and provides for the flow of molten metal between the chambers. The volume of molten metal in the first pour is at least sufficient to fill the entire passage, and after the first pour has at least partially solidified to block the passage, a second pour of an additional quantity of molten metal is made into an annular opening to the flange-forming chamber wherein it solidifies and forms as integral internal flange.

The baffle is supported by a baffle assembly which can be removed and partially reused, and which facilitates pouring of molten metal into the flange-forming chambers. Thus each baffle assembly includes an end dam resiliently supported in the core case to support removably a plurality of radial plugs which in turn support the baffles. These plgs and the end dams define an annular pouring opening to the flange forming chamber which allows the second pour of molten metal to be made directly into the flange-forming chamber. The metal surrounds the plugs, which become embedded in the metal when it solidifies and are removed by trimming the finished casting.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view through the casting apparatus in accordance with the invention for performing the method of the invention;

FIG. 2 is a sectional view taken along the line 2—2 of FIG. 1; and

FIG. 3—5 illustrate schematically the successive steps and the method of the invention in conjunction with the apparatus shown in FIG. 1, and with the core case omitted.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates casting apparatus including a tubular core case 10 supported on and rotated by drive rollers 11 which engage drive bands 12 extending circumferentially around the outer surface of the case 10. The core case 10 is generally tubular in configuration and has a cylindrical inner surface 13 with removable baffle assemblies 14 in each end thereof including annular end dams 15 secured in place by the contraction compensating assemblies 16 which compensate for thermal contraction during solidification and cooling of the metal. Each of these dams includes a short tubular portion 18 which engages the inner surface 13 of the core case 10, and a radially inwardly extending flange portion 19 which tapers toward the center of the core case 10 and partially defines the annular grooves 20

for receiving molten metal, as will be described. The end dams are constructed of a heat resistant material.

The compensating assemblies 16 are spaced angularly around the core case 10 (FIG. 2) and include the inwardly extending brackets 21 which are rigidly secured to the end surfaces 22 of the core case 10 by the mounting screws 23. The screws 24 extend through openings 25 in the respective brackets 21 into threaded engagement with the bores 26 in the end dam 15 to permit axial movement of the end dams. The springs 27 are interposed between the brackets 21 and the heads 28 of the screws 24 and thus urge the end dams toward the brackets 21 and into engagement with the adjustable stop screws 29 which are threadably secured on the innermost ends 30 of the brackets 21. While the brackets 21 are shown as being mounted on the end surface 22, it is within the scope of the invention to modify these brackets for mounting on the inside surface 13 of an elongated core case.

The baffle assemblies 14 also include a plurality of equally spaced plugs 31 having the axially extending arms 32 thereon which support the annular baffle 33 on each of the end dams 14. Specifically, each of the small cylindrical plugs 31 is secured in place on the tubular portion 18 of the end dam 15 by a screw 36 which extends centrally through the plug and into an internally threaded bore in the tubular portion 18. The screw 36 also secures the axially extending parallel arms 32 in place by clamping one end thereof between the head 38 of the screw and the top surface of the plug 31 (FIG. 1).

The axially extending arms 32 are disposed parallel to each other and circumferentially of the core case 10 to define the large openings 46 to the central chamber 42. The baffles 33 have inner diameters which correspond to the outer diameter defined by the innermost ends of the arms 32 so that the baffles 33 can be easily placed on the arms 32 and secured in place by screws 43 which extend through the ends of the arms and into the baffles.

Each baffle 33 has an outer diameter which is a predetermined amount smaller than the inner diameter of the core case 10 to provide annular passages 45 of uniform predetermined width between the central chamber 42 of the core case 10 and the flange-forming chambers 46 on the other sides of the baffles 33. These baffles are preferably constructed of a ceramic or other material capable of withstanding substantial forces and high temperatures without being damaged during the casting operation. They may be constructed in one piece, or they may have several segments which can be assembled and disassembled.

The baffle assemblies 33 are preferably assembled prior to insertion of the end dams 15 into the core case 10. Once the baffles are secured in the core case, the inner surfaces of the core case and end dams 15 are covered with a suitable liner 50 of refractory material so that these parts can withstand and dissipate the heat from the molten metal which is to be poured into the core case.

Molten metal is supplied to the core case 10 through pouring basins 52 which are movable on the tracks 53 and have elongated discharge spouts 54 which can discharge from the metal into the central chamber 42. In addition, the annular grooves 20 between the plugs 31 and the inwardly extending portion 19 of the end dams 15 permit the metal to be poured into the flange-forming chambers 46 without splashing or damage to the baffle assemblies 14.

In accordance with the method of the invention, the assembled core case 10 is first rotated at a predetermined speed which will cause molten metal to assume a uniform thickness on the inside surface of the core case. The speed is determined in conventional manner depending on the metal being used and the diameter of the core case. The pouring basins 52 are then moved to their advanced position so that the spouts 54 project through the openings 40 into the central chamber 42. A predetermined volume of molten metal is then poured through the basins 52 and into the central chamber 42 wherein it forms a tubular

molten mass 60, as shown in FIG. 3, on the inside surface of the core case 10.

The volume of metal which is poured is sufficient to create a molten mass having a thickness equal to the width of the annular passages 45. This tubular mass is allowed to solidify at least partially so that the passages 45 are blocked to further flow of metal therethrough. An exothermic fluxing metal may be poured into the flange-forming chambers 46 through the groove 20 to protect the inside surface of the metal at the ends of the molten mass 60 against oxidation and scuff accumulation.

As soon as the metal in the flange-forming chambers 46 has solidified sufficient to block the passages, a second pour of additional metal is made into the annular grooves 20 from the pouring basins 52, which have been retracted so that the discharge spouts 54 are properly aligned with the grooves 20. This metal then flows around the plugs 31 and into the flange-forming chambers 46 wherein it builds up to form internal flanges 61 on the ends of the tubular mass 60, as shown in FIG. 4. The amount of metal which is poured into the flange-forming chambers 46 is dependent upon the desired inner dimension of the flange 61, which can be varied without departing from the scope of the invention. In some cases it might be necessary to enlarge the length of the plugs 31 so that the support arms 32 are spaced radially inwardly of the molten metal when the flange-forming metal is filled to the desired level.

The metals utilized in the making of the tubular member can be substantially any metals capable of being centrifugally cast. In addition, the metals utilized to create the internal flanges 61 may differ from those utilized to create the tubular portion 60. For example, a metal which becomes very hard on solidification may be used to form the tubular section, whereas a softer metal which is capable of being welded or heat treated can be utilized to form the internal flanges.

Once the pouring operations are completed, the metal is allowed to cool and solidify. As the metal solidifies, it contracts in the usual manner thus applying an axial force which urges the baffles 33 toward each other. Since the baffle assemblies 14 are held in position by the compensating assemblies 16, the dams 15 are allowed to slide inwardly and thus accommodate the thermal contraction without damage to the baffles 33. Specifically, the forces of contraction cause the baffles 33 acting through the arms 32 to slide the dams 15 on the inner surface 13 of the core case. The springs 27 are thus compressed when the screw 24 moves relative to the mounting bracket 21. When the solidification is complete, the rotation of the core case 10 is terminated and the finished casting removed therefrom. This is accomplished by unscrewing the bolts 23 which secure the end dams 15 in place and the bolts 38 which secure the arms 32 to the plugs 31. The end dams 15 are then withdrawn from the core case, and usually this requires one or more sharp heavy blows to the dams 15. Once they are removed, the arms 32 can be disconnected from the baffle 33 by unscrewing the bolts 43. The baffles 33 are removed by breaking them into sections or by disassembly in the case of a segmented baffle. This leaves the plugs 31 embedded in the axial extension 62 of the metal flange which is cut therefrom, and thus the plugs 31 are separated from the finished casting 60a having the internal flanges 61a at each end thereof, as seen in FIG. 5.

The invention has thus provided apparatus and a method for forming a tubular casting having integral internal flanges by utilizing a rotating core case having the interior divided into central and flange-forming chambers separated by a baffle and interconnected by a passage between the periphery of the baffle and the inside surface of the core case. A first pour is made into the central chamber and allowed to solidify at least partially to block the passage, and then a second pour is made into the flange-forming chamber to form the internal flange. The second pour fuses with the first pour

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to provide an integral connection therebetween. The baffle assembly can be assembled prior to insertion into the core case, and it may be easily disassembled for removal of the finished casting.

While the method herein described, and the form of apparatus for carrying this method into effect, constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and form of apparatus, and that changes may be made in either without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A method of casting a tubular member having at least one internal flange, comprising the steps of rotating a tubular mold about its axis at a speed sufficient to cause molten metal to assume a uniform thickness over the inner surface of said mold, said mold having the interior thereof separated by a baffle into central and flange-forming chambers interconnected by an annular passage of a preset radial width between the outer periphery of the baffle and the inner surface of said mold, making a first pour of a predetermined quantity of molten metal into said mold, said predetermined quantity of molten metal being sufficient to provide a uniform thickness at least equal to said preset width, causing said metal to solidify sufficiently to seal said passage and substantially to prevent flow of metal between said flange-forming and main chambers, making a second pour of an additional quantity of molten metal into said flange-forming chamber, and maintaining said rotation until said molten metals have completely solidified to create a tubular member having an integral internal flange with a preset inner diameter less than the inner diameter of the metal in said main chamber.

2. A method of casting a tubular member having an internal flange as claimed in claim 1, comprising the step of adding an exothermic metal flux to at least said flange-forming chambers after said first pour of molten metal into the tubular mold to minimize oxidation and scuff accumulation therein.

3. A method of casting a tubular member having an internal flange as claimed in claim 1 wherein said second pour occurs after the metal of said first pour is substantially completely solidified.

4. A method of casting a tubular member having an internal flange as claimed in claim 1 wherein said first pour is made into said central chamber and said second pour into said flange-forming chamber.

5. A method of casting a tubular member having an internal flange as claimed in claim 1 wherein both of said pours are made into said flange-forming chamber.

6. A method of casting a tubular member having a plurality of internal flanges substantially as defined in claim 1 wherein said second pour is made into a plurality of said flange-forming chambers.

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7. A method of casting a tubular member having an internal flange as defined in claim 1, comprising the additional steps of removing the baffles from said core case and trimming the outer edges of the casting after said casting has solidified.

8. Apparatus for centrifugally casting a tubular member having an internal flange therein, comprising a tubular mold mounted for rotation about the axis thereof, drive means for rotating said mold at a speed causing molten metal to be distributed evenly over the inner surface thereof, partition means separating the interior of said mold into a main chamber and a flange-forming chamber, said partition means including an annular end dam proportioned for removably mounting in one end of said mold and including a tubular portion extending along the adjacent inner surface of said mold, a baffle adapted for mounting on the inner end of said end dam and having an outer diameter less than the inner diameter of said mold by a predetermined amount to define with said mold an annular passage of predetermined radial width interconnecting said chambers, a plurality of plugs releasably secured to said end dam and extending radially inwardly of said tubular portion thereof, an arm secured to the inner end of each said plug and extending therefrom axially inwardly of said mold, means releasably securing the axially inner end of each said arm to each said baffle to support said baffle in spaced relation with said dam, said plug and said arms being spaced angularly about the interior of said mold to provide spaces therebetween for admitting a second quantity of molten metal to said flange-forming chamber after a first pour of molten metal has been supplied to the interior of said mold in an amount sufficient to fill said annular passage and has solidified sufficiently to block said passage, and means removably securing said end dam to said mold for removal after all molten metal in said mold has solidified.

9. Apparatus as defined in claim 1 comprising means resiliently connecting said end dams to said mold for effecting compensation for thermal contraction of the metal supplied to said mold.

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