This invention relates to centrifugal casting devices and, more particularly, to devices of this type suitable for centrifugally casting coverings of different materials on the inside surfaces of tubular metal members to adapt such members to various purposes such as protecting the inner surfaces from corrosion or lining such inner surfaces with bearing material to permit the use of tubular members in producing therefrom tubular bearings, cam shaft bearings, etc.

The primary object of this invention is the provision of a centrifugal casting device in which rotary means at a predetermined speed axially and horizontally rotate a tubular member enclosing predetermined amounts of lining material, in which induction heating means effect heating of the tubular member and the lining material therein to predetermined degrees and in which quenching means effect quenching of the heated rotating tubular member by bringing substantially radially with a single sheet-like water stream extended over the entire length of the tubular member.

Another object of the invention is the provision of a centrifugal casting device in which rotary driving means horizontally and axially support and drive a tubular member by engagement with its opposed open ends, in which heated lining material feeding means feed a predetermined amount of liquidized lining material through the driving means into the supported tubular member, in which high frequency induction heating means effect heating of the tubular member to predetermined degrees by an induction heating coil encircling the tubular member lengthwise thereof, and in which pivotally supported tank quenching means effect by their tilting quenching of the heated rotating tubular member by radially hitting the member with a single sheet-like stream of water extending over the entire length of the tubular member.

Further objects of the invention include the provision of a centrifugal casting device which embodies a lathe-like arrangement for horizontally supporting and driving a tubular member when engaged at its open ends with live and dead centers of such arrangement; which embodies crucible means associated with one of the centers of the lathe arrangement of liquidized lining material through such center into the horizontally supported tubular member; which embodies metering valve means in said crucible means to permit feeding of predetermined amounts of liquidized lining material from the crucible means into the tubular member; which embodies quenching tank means arranged to align the pivot axis of the tank means with the top edge of the quenching tank wall forming in quenching operation the spilling gate for the quenching stream; and which includes in one of the centers of the lathe-like arrangement passage means permitting for casting operations feeding of bond-inducing gases or vapor means into the tubular member.

Additional objects and novel features of construction, combinations and relations of parts by which the objects in view have been attained will appear and are set forth in detail in the course of the following specification.

The drawings accompanying and forming part of the specification illustrate a certain practical embodiment of the invention, but it will be apparent as the specification proceeds that the structure may be modified and changed in various ways without departure from the true spirit and broad scope of the invention.

In the drawings:
Fig. 1 is a side elevation partly in section of a centrifugal casting device constructed in accordance with the invention;
Fig. 2 is a plan elevation partly in section of the centrifugal casting device shown in Fig. 1;
Fig. 3 is a transversal sectional view through the centrifugal casting device, the section being taken on line 3-3 of Fig. 1;
Fig. 4 is another transversal sectional view through the centrifugal casting device, the section being taken on line 4-4 of Fig. 1;
Fig. 5 is a transversal sectional view taken on line 5-5 of Fig. 1; and
Fig. 6 is a transversal sectional view taken on line 6-6 of Fig. 1.

Heating of tubular member 21 while supported by spindles 10 and 16 is effected by high frequency induction heating means 22 which embodies an open-ended water-cooled induction heating coil 23 arranged in axial alignment with spindles 10 and 16 and sized to freely encircle tubular member 21 over its entire length. The thus constructed drive support and heating arrangement has opposing end portions of spindles 10 and 16 and induction heating coil 23 enclosed in a housing 24 by extending said spindles through the side walls 25 of such housing. Centrifugal casting device 22 additionally embodies a quenching device 26 which is arranged in housing 24 and embodies a longitudinally non-shiftable supported elongated quenching tank 27 arranged pivotally in housing 24 above induction heating coil 23. For such purpose tank 27 is secured to its side walls 28, 29 pivot brackets 30, 31 which mount stud shafts 32, 33 pivotally mounted in bearings 34 in side walls 25 of housing 24. These stud shafts are axially aligned with the horizontally extended upper inner horizontal edge 34 of rear
wall 35 of tank 27 to effect in quenching operations discharge of quenching water from tank 27 over a stationary water spill way formed by upper horizontal edge 34' of rear wall 35 of said tank in a sheet-like quenching stream extending over the entire length of tank 27 to be quenched. Quenching operations of quenching device 26 take place when stud shaft 32 on bracket 30 is rotated in the direction of arrow 36 (see Fig. 5) to discharge the quenching water from tank 27 over horizontal upper edge 34' of rear wall 35 of such tank. This rotation of stud shaft 32 is effected by an air cylinder 37 coupled by rack bar 38 with a gear 39 on extension 40 of stud shaft 32. A hydraulic cylinder 42 which has the opposite ends of its working chamber coupled with each other by a valve-controlled pipe connection 43 controlled by an adjustable valve member 44 permits full control of the rotary speed of stud shaft 32 and therewith full control of the volume of quenching water spilled per time-interval on the tubular member to be quenched. Quenching tank 27 is filled with water from a source of supply (not shown) which feeds water into hollow stud shaft 33 and hence through a pipe 45 into tank 27. A series of overflow openings on said wall 35 of tank 27 insure filling of said tank to the desired level by overflowing all excess water which together with the quenching water is discharged from housing 24 through a discharge wasteline 48 at the bottom of said housing.

The centrifugal casting device thus described permits centrifugal casting operations in which a solid or liquid lining material for the tubular member is placed into such body prior to its axial support on spindles 10 and 16 and such casting device can readily be adapted to permit feeding of properly metered amounts of liquefied lining material into a tubular body 21 when supported on spindles 10 and 16 and at a standstill or rotated by drive spindle 10 as previously described. In the latter case liquefied lining material is fed into the tubular body through one of the spindles 10 or 16 and, as shown in the example disclosed in the drawings, spindle 16 is used for such purpose. This latter spindle includes an angular passage 49 for feeding liquefied lining material into the tubular member, which passage communicates through pipeline 50 with bottom end 51 of a valve-controlled crucible 52 containing the lining material and mounted on wheeled base 15 of said tank. Crucible 52 is heated by a resistence coil 53 connected to a source of electric energy (not shown) and embodies a conical melting chamber 54 having in its bottom wall 55 a central outlet passage 56 and a breather passage 57 which mounts a breather pipe 58 extended upwardly into chamber 54 close to the top thereof. The passages 56 and 57 extend into a cross bore 59 in the bottom end 51 of the crucible, which cross bore rotatory supports a metering valve member 60 and has extended therefrom an outlet passage 61 arranged opposite to central outlet passage 56 in axial alignment therewith.

Metering valve member 60 meters the amount of liquefied lining material to be fed into tubular member 21 when supported in horizontal position by spindles 10 and 16 of lathe-like structure 7. This valve member consists of a headed hollow valve cock 62 which is axially non-rotatably extended through cross bore 59 and projecting from a central chamber 63 adjustable in size, as the wall of said chamber is formed by a shiftable plug 64 threadedly engaged with the internally threaded wall 65 of such chamber. The thus constructed valve cock 62 includes a radial bore 68 which extends into chamber 63 and by rotation of the valve cock may be selectively aligned with either the central outlet passage 56 of melting chamber 54 or outlet passage 61 of cross bore 59. In addition valve cock 62 includes two oppositely arranged radial bores 66 and 67 arranged to be aligned by rotation of valve cock 62 with breather passage 57 to permit proper feeding of liquefied lining material from melting chamber 54 into liquid chamber 63 and discharge of such material from liquid chamber 63 through pipeline 50 and angular passage 49 into the tubular member 21.

In the operation of the device, which as customary may be effected by electrically controlled timing mechanism, a tubular member 21, preferably with inwardly curved end portions 69 (see Fig. 9), is placed between the spindles 10 and 16 of head stock 8 and tail stock 9 and the latter rigidly clamped to frame 3 by means of setscrew member 28. Then a metered amount of liquefied lining material such as Babbit-metal is fed into member 21 by operation of handle 70 on valve cock 62 and rotation of tubular member 21 is started by actuation of motor 12 to rotate such member at a predetermined speed. At the same time, or shortly thereafter, high frequency induction heating arrangement 22 is actuated for a time-interval to effect induction heating of member 21 by induction heating coil 23 so as to hold the lining material in liquid state and then, after spinning tubular member 21 for a short time-interval, such member is quenched by quenching device 26 hitting such member over its entire length with a sheet-like quenching stream of water travelling in a direction opposite to the direction of in-fitting water as with tubular member 21. After quenching operations tubular member 21 continues its rotation for another short time-interval until sufficiently cooled to permit its removal and resetting of the centrifugal casting device for another heat. It is obvious that feeding of Babbit-metal into member 21 may be controlled when such member is rotating and that other steps incidental to the above referred to operation of the device may be added without departing from the broad scope of the invention.

Preferably, as shown in the drawings, spring-pressed dead center 14 and spinele 16 is axially perforated as indicated at 71 and in communication with a pipe nipple 72 to permit, if necessary for proper bonding of lining 73 to inner wall 74 of tubular member 21, feeding of inert or bond-effecting gas into the tubular member.

Having thus described my invention:

I claim:

1. In a lathe-like centrifugal casting device with horizontally arranged axially rotatable spaced supporting and driving centers, a fixedly supported freely exposed open-wound elongated high-frequency induction heating coil extended between the centers of the device and with dimensions to freely encircle tubular members supported by such centers, a fixed quenching arrangement supported above said heating coil and including an elongated open-top quenching tank pivotally mounted to be tilted on an axis parallel to the axis of the induction heating coil, and controlled operating means adapted to tilt the open-top quenching tank to effect controlled gravity actuated discharge of liquid from said open-top quenching tank on said induction heating coil and tubular members supported by said centers.

2. A lathe-like centrifugal casting device as described in claim 1, including a stationary housing encircling and fixedly supporting said induction heating coil and said quenching arrangement, said housing having opposed parallel walls transversely arranged with respect to the axis of the heating coil, and bearings in said walls pivotally mounting the elongated open-top quenching tank above said induction heating coil in axial parallel relation with respect thereto.

3. A lathe-like centrifugal casting device as described in claim 1, wherein the induction heating coil and the quenching arrangement are enclosed in a housing, wherein the quenching tank has extended from opposite sides of a pair of shaft portions pivotally supporting the tank in opposed walls of the housing, and wherein one of the shaft portions includes axially thereof passage means effecting communication of the tank with a source of liquid outside of the housing to permit in any position of said tank feeding of liquid from the source of liquid into the tank.

4. A lathe-like centrifugal casting device as described
in claim 1, wherein the elongated open-top quenching tank embodies a side-wall portion arranged in a plane parallel to the axis of the induction heating coil, wherein this side-wall portion is formed with a straight top edge extended parallel to the axis of the induction heating coil to permit the discharge of a sheet-like liquid stream in spill-way fashion from the open-top tank on the induction heating coil and a tubular member supported by said centers.

5. A lathe-like centrifugal casting device as described in claim 4, wherein the elongated open-top quenching tank is mounted to pivot about an axis aligned with the top edge of the said side-wall portion of the quenching tank.

6. In a lathe-like centrifugal casting device with horizontally arranged axially rotatable spaced supporting and driving centers, a fixedly supported freely exposed open-wound elongated high-frequency induction heating coil extended between the centers of the device coaxial therewith and dimensioned to freely encircle tubular members supported by such centers, a fixed quenching arrangement supported above said heating coil and including an elongated open-top quenching tank pivotally mounted to be tilted on an axis arranged parallel above the axis of the induction heating coil in laterally offset relation with respect thereto, and controlled operating means adapted to tilt said open-top quenching tank to effect controlled gravity actuated discharge of liquid from said open-top quenching tank on said heating coil and through said coil on tubular members supported by said centers.

7. In a lathe-like centrifugal casting device for lining tubular members, horizontally arranged axially rotatable cone-shaped centers adapted to extend into said tubular members for centering and sealing same, a fixedly supported freely exposed open-wound elongated high-frequency induction heating coil extended between said centers coaxial therewith, a tiltably supported elongated open-top quenching tank above said induction heating coil, and speed-controlled tilting means adapted to effect controlled tilting of said open-top quenching tank and discharge therefrom by gravity a liquid stream on the induction heating coil and tubular members supported by said centers.

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