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CENTRIFUGAL CASTING MACHINE

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This invention relates to centrifugal casting machines, and more particularly to apparatus for casting hollow metal bodies, such as iron pipe, in rotary molds. The invention in its preferred form is especially directed to a centrifugal pipe casting machine wherein two or more molds are simultaneously conveyed to operative positions within the machine, are then simultaneously rotated and simultaneously charged with molten metal, and are thereafter simultaneously discharged from the machine.

The principal object of the invention is to provide a more efficient and more economical apparatus for casting pipe or like hollow metal bodies. Herefore for the centrifugal casting of pipe it has been customary to employ a battery or group of centrifugal casting machines, each comprising a motor, driving mechanism associated with the motor and adapted to rotate one mold at a time, and mechanism including a ladle and spout adapted to pour one mold at a time. According to my present invention, the capacity of a centrifugal casting machine is increased without increase in the power or time required for its operation. This end I accomplish by the provision of a driving mechanism adapted to accommodate a plurality of molds and to rotate them together, and by the provision of means for simultaneously pouring such molds while in rotation.

A further object of the invention is to provide in such a centrifugal casting machine means for mechanically conveying a set of molds in spaced parallel relation to operative engagement with the driving mechanism, said means being also preferably adapted to discharge the set of molds from the driving mechanism in a similar manner.

Still another object of the invention is to provide in such a centrifugal casting machine driving mechanism for effecting rotation of the molds, which driving mechanism is capable of ready adjustment so that molds of large or small diameters may be accommodated with equal facility.

Other more specific objects and advantages characterizing my invention will become more fully apparent from the description hereinafter of one embodiment of the invention as applied to a machine for the centrifugal casting of iron pipe. The description which follows has reference to the accompanying drawings, whereof:

Fig. I represents a plan view of a centrifugal casting machine and of the flask runways leading to and from the machine.
the driving rollers 8 and idle rollers 12 are re-
strained against movement in the direction of
their longitudinal axes by a guide roller 13 which
turns loosely on a portion of the shaft 10 and en-
gages guide flanges 14 on the flasks 2.

At the opposite end of the pit 5 from that at
which the motor 1 is located, there is a track 15,
leading to the edge of the pit 5, on which a ladle
car 16 is adapted to run. As clearly shown in Fig.
10, if the ladle car 16 carries thereon pouring spouts
17, and a stand 18 having pivoted thereon a pair of
interconnected ladles 19. The ladles are move-
table together about trunnions 20 to effect dis-
charge of molten metal into the pouring spouts
17. The pouring spouts 17 are so disposed as to
enter the head ends of the flasks 2 when the ladle
car is moved to the limit of its travel toward the
pit 5.

To swing the pair of ladles 19 simultaneously
about the trunnions 20, a cable 21 is employed, the
cable 21 having a hooked end 22 which engages
a connecting bar 23 joining one ladle 19 with the
other. The cable 21 passes upward through a
guide sheave 24 around a movable sheave 25 to
reach point 26 where it is attached to a vertical beam
27. Mounted on a bracket 28 on the vertical beam
27 there is a pressure cylinder 29 having a plunger
30 to which the movable sheave 25 is attached.

In an obvious manner by operation of the cylin-
der 29, the movable sheave 25 is raised or lower-
ed with corresponding elevation or depression of
the connecting bar 23 of the ladles 19: and thus
the ladles 19 are swung about their trunnions
20 to deposit metal into the pouring spouts 17
from which the metal is simultaneously charged
into the ends of the two flasks which are in opera-
tive position on the machine.

On the stationary bed frame 4 there is mounted
a mold carrier comprising generally a vertically
movable roller table 31, and a horizontally mov-
able flat plate 32 on the roller table 31. Vertical
movement is imparted to the roller table 31 by
means of a hydraulic cylinder 33 mounted on the
underside of the bed frame 4. The hydraulic
cylinder has a plunger 34 to the end of which is
attached a cross head 35 operating on guide rods
36. To the cross head 35 are attached links 37
which join the ends of opposite pairs of crank
arms 38. The crank arms 38 are fulcrumed in
swinging movement within depending projections
39 of the bed frame 4. Each crank arm 38 is in
turn pivotally connected to movable links 40, the
ends of which are attached to a bottom frame 41.
The bottom frame 41 is guided for vertical move-
ment within the pit 5 by means of guide columns
42, which are movable within collars 43 on the
bed frame 4. In an obvious manner, the actua-
tion of the hydraulic elevating cylinder 33 causes
the bottom frame 41 to be moved upward or down-
ward through the above described linkage.

On the guide rods 36, lock nuts 44 are em-
ployed to limit the extent of the vertical move-
ment of the roller table 31. Rigidly attached to
the bottom frame 41, there are a series of vertical
rods 45 which lead upward through sleeves 46 at
the sides of the bed frame 4 and through openings
47 centrally of the bed frame 4. At their upper
ends, the vertical rods 45 are secured to outstand-
ing flanges 48 of the roller table 31, as shown in
Figs. V, VI and VII.

The roller table 31 has thereon a series of rollers
49 disposed in double rows in a horizontal plane.
Horizontal movement of the carrier plate 32 on
the rollers 49 of the roller table 31 is effected by
means of an additional hydraulic cylinder 50 lo-
eated at one side of the bed frame 4. A plunger
51 of the hydraulic cylinder 50 terminates in a
cross head 52 which is guided in its horizontal
movement by rods 54. Connecting rods 55 are
pivotally joined to the cross head 52 and at their
other ends to depending brackets 50 on the flask
carrier plate 32, on which a ladle car is adapted to
run. Operation of the hydraulic cylinder 50 effects horizontal move-
ment of the carrier plate 32 on the roller table 31.

At the right hand side of the flask carrier, as
shown in Figs. V, VI and VII, there is a runway
comprehensively designated at 57. The runway
comprises a pair of parallel skids 58 which leads
to a position adjacent to the idle roller 12 at that
side of the machine. Flasks 2 are rolled by hand
along the runway 57 to positions immediately
above the corresponding end of the flask carrier
plate 32. On each rail or skid near its end, there
is an automatic flask stop 59. The flask
stops 59, as shown in detail in Figs. III and IV, are
pivoted on shafts 60 and spaced at the inside of
the rails 58 by spacers 61. Each flask stop 59 is
adapted to be swung about its shaft 60. Each flask
stop 59 is pivoted on a pin 62 which is engaged
within each slot 63 there is a pin 63 which is fixed to a projection 64 at the end of the
roller table 31. Accordingly, with upward move-
ment of the roller table 31, the flask stops 59 are
swung downward to positions beneath the top sur-
faces of the rails 58, whereas with downward
movement of the roller table 31, the flask stops
59 are swung upward to positions above the top
surfaces of the rails 58. Thus in an obvious man-
ner, flasks are prevented from being moved onto
the rollers 8, 12 except when the roller table 31 is in the downward position.

At the opposite side of the machine, there is a
discharge runway comprehensively designated at
65, comprising a pair of rails or skids 66. The
rails 66 terminate at points adjacent to the idle
rollers 8 at that side of the machine. As shown
in Figs. V, VI and VII, and in more detail in Figs.
X and XI, each discharge skid 66 is provided with
a swinging check device 67. The swinging checks
67 are pivoted on shafts 68 and are spaced at the
inside of the skids by spacing blocks 69. Each
check device 67 is provided with a projecting
portion 70 having bottom surfaces 71 and
72 which alternatively engage the top of the spac-
blocg 69 as flasks are moved along the rails 66
in the direction of the arrow. It will be readily
apparent that the check device 67, as shown in
elevated position in Fig. X, can be swung downward in a counter-clockwise direction below the top sur-
face of the rail 66 to the position shown in dot-
and-dash lines by movement of a flask in the di-
rection of the arrow, but cannot be swung in the
reverse or clockwise direction, and hence prevents
a flask from rolling backward onto the rollers 8, 12
of the machine.

The skids 58 and 66 of the supply and discharge
runways 57 and 65 are shown in the form of ordi-
nary rails and may be supported by pedestals or
the like on the floor of the foundry. As shown in
Fig. I, two such skids 58 of the supply runway
are arranged in parallel relation close together at
that side of the runway which is near the ladle
actuating mechanism. In like manner, two skids
66 of the discharge runway 65 are arranged in par
allel relation close together at the correspond-
ing side of that runway. Accordingly, the flanges
14 of the flasks 2 are engaged within the tracks
formed by the paired skids 58 and 66, and thus
the flasks 2 are guided in their movement with
prevention of shifting in the direction of their length.

As shown in Figs. VIII and IX, the centrifugal casting machine herein illustrated is capable of accommodating flasks of different diameters. The driving shaft 10 of the driving rollers 8 is mounted in bearings 73 which are eccentrically fitted into correspondingly shaped recesses 74 in the bearing stands 75 attached by brackets 76 to the top of the bed frame 4. The shafts 77 of the idle rollers 12 are eccentrically mounted between the ends of the bearings 78 which are detachably fitted into additional recesses 79 in the top of the bearing stands 75. When the bearings 78 of the idle rollers 12 are mounted in the positions shown in Fig. VIII, the distance between the longitudinal axes of the driving roller 11 and the longitudinal axis of the driving roller becomes as indicated at the dimension line \( \alpha \) in Fig. VIII.

The bearings 73 and 78 are secured to the bearing stands 75 by bolts 80. By reversal of the idle roller bearings 78 within their recesses 79, the distance between the axes of the idle rollers and the center of the driving roller becomes as indicated at the dimension line \( \gamma \) in Fig. IX. Accordingly, when the bearings 78 of the idle rollers are set in predetermined positions, such as shown in Fig. VIII, on the bearing stands 75, flasks of relatively small diameters, varying within certain limits, can be accommodated for rotation; whereas, when the bearings 78 are set in the same position within the recesses 79 but are reversed as to their ends, they are adapted to accommodate flasks of relatively large diameters.

The flask carrier plate 32 is shown in the present example of the invention provided with six flask receiving pockets \( a, b, c, d, e, f \), consisting of paired lugs 81 having oppositely directed inclined surfaces 82. Other formations may obviously be employed on the flask carrier for the same purpose, it being understood that the series of pockets serves to carry the flasks 2 in predetermined spaced parallel relation from positions on the supply runway 57 to the rollers 8, 12 and 13 and from positions on the rollers 8, 12 to positions on the discharge runway 65.

The operation of the centrifugal casting machine is as follows. Assuming that a pair of flasks are disposed on the rollers 8, 12 and that other flasks are lined upon the supply runway 57, at the admission side of the machine, as shown in Fig. V, the machine is ready for operation.

The pair of flasks on the rollers 8, 12 are caused to rotate at a high speed by operation of the motor 1. When rotating at the desired speed, the ladle car 16 is brought to a position at the edge of the pit 5 and the interconnected ladles 19 are tilted about their trunnions 20 to pour molten metal into the pouring spouts 17 from whence it flows simultaneously into the two molds, the flasks of which are mounted on the rollers 8, 12. After the pair of flasks have been rotated for the desired length of time, the mold carrying the slab is stopped and the flask carrier plate 32 with the flasks attached is raised out of the way, to be returned to the manner of its former position and to be lifted off the supply rails 58.

Upon actuation of the hydraulic cylinder 50, the flask carrier plate 32 is moved along the roller table until the flasks occupy the positions shown in Fig. VI. Thereafter the roller table 31 is depressed by actuation of the cylinder 33. Downward movement of the flask carrier causes the two flasks A and B in which the casting operation has taken place to be deposited on the discharge rails 66, causes two empty flasks C and D to be deposited on the rollers 8, 12, and causes two other flasks E and F to be advanced in position on the supply rails 58, the parts assuming the positions shown in Fig. VII. Two new flasks being in operative engagement with the driving mechanism, the machine is then ready for another casting operation, and the process may be continued in like manner without interruption.

Obviously a fresh supply of flasks may be brought to the supply runway 58 in any desired manner and charged flasks may be removed from the discharge runway 65 in any desired manner. It will be observed that incident to the upward movement of the roller table 31, the automatic flask stop 59 is moved out of the way so as not to interfere with the progression of the flasks onto the rollers 8, 12. Moreover, incidental to the horizontal movement of the flask carrier plate 32, the flasks are caused to pass over the check device 67, causing it to swing back and forth from its normal position, the check device preventing accidental reverse movement of a flask, see Fig. X.

While I have described in some detail a particular mechanism by which the roller table is elevated and depressed, and a particular mechanism for effecting horizontal movement of the flask carrier plate, it will be readily apparent that various other instrumentalities may be used to effect the desired result, and it is to be understood that the specific mechanism here illustrated and described is but one example of the practice of the invention. Furthermore, the nature of the runways which lead to and from the driving mechanism of the machine is such that many other forms of skids, conveyors or the like may be substituted therefor. In fact, my invention contemplates a variety of different types of mechanism to accomplish the various functions of the casting machine, all of which are considered to be within the scope of the annexed claims.

Having thus described my invention, I claim:

1. Apparatus for centrifugally casting hollow metal bodies comprising a frame, bearings thereon for supporting a plurality of molds with their axes in substantially horizontal and parallel relation, means for simultaneously rotating said molds, and a mold carrier adapted to support a plurality of molds in spaced parallel relation to each other, said mold carrier being movable transversely from one side of the frame to the other and operable to deposit simultaneously on said bearings a set of molds to be charged, and there-
after to discharge simultaneously from said bearings a set of charged molds.

3. Apparatus for centrifugally casting hollow metal bodies comprising a frame, bearings thereon for supporting a plurality of molds with their axes in substantially horizontal and parallel relation, means for simultaneously rotating said molds, a mold supply runway leading to one side of the apparatus, and a mold carrier adapted to support a plurality of molds in spaced parallel relation to each other, said carrier being movable from the supply runway across said frame to said bearings, and means for raising and lowering said mold carrier whereby molds may be lifted from the supply runway and deposited on said bearings.

4. Apparatus for centrifugally casting hollow metal bodies comprising a frame, bearings thereon for supporting a plurality of molds with their axes in substantially horizontal and parallel relation, means for simultaneously rotating said molds, a mold supply runway at one side of said bearings, a mold discharge runway at the other side of said bearings, and a mold carrier adapted to support a plurality of molds in spaced parallel relation to each other, said carrier being movable across said frame from the supply runway to the discharge runway and operable to deposit simultaneously a set of molds to be charged on said bearings and to discharge simultaneously a set of charged molds from said bearings.

5. Apparatus for centrifugally casting hollow metal bodies comprising a frame, bearings thereon for supporting a plurality of molds with their axes in substantially horizontal and parallel relation, means for simultaneously rotating said molds, a mold supply runway at one side of said frame, a mold discharge runway at the other side of said frame, a carrier movable across the frame between the supply runway and discharge runway, said carrier being adapted to support a plurality of molds in spaced parallel relation to each other, and means for actuating the carrier to advance a set of molds from the supply runway to said bearings and concurrently to advance another set of molds from said bearings to the discharge runway.

6. Apparatus for centrifugally casting hollow metal bodies comprising a frame, bearings thereon for supporting a plurality of molds with their axes in substantially horizontal and parallel relation, means for simultaneously rotating said molds, a mold supply runway at one side of said frame, a mold discharge runway at the other side of said frame, said runways being disposed at substantially the level of said bearings, a carrier movable horizontally between the supply runway and said frame, said carrier being adapted to support a plurality of molds in spaced parallel relation to each other, means for moving the carrier horizontally to advance a set of molds from the supply runway to a position above said bearings and concurrently to advance another set of molds from said bearings to the discharge runway, and means for moving the carrier vertically to lift the molds clear of said runways and bearings incident to said horizontal movement of the carrier.

7. Apparatus for centrifugally casting hollow metal bodies comprising a frame, bearings thereon for supporting a plurality of molds with their axes in substantially horizontal and parallel relation, means for simultaneously rotating said molds, a mold carrier including a table movable vertically on said frame and said bearings, and a conveyor movable horizontally on said table from one side of the frame to the other, said conveyor having spaced pockets for the reception of a plurality of molds, and means for lowering and raising said table thereby to deposit said molds on said runways and to discharge molds therefrom.

8. Apparatus for centrifugally casting cylindrical metal bodies comprising a frame, bearings thereon for supporting a mold in substantially horizontal position, means for rotating said mold, a mold supply runway leading to one side of said frame and the level of said bearings, a mold carrier movable from the supply runway to said bearings, means for raising and lowering said mold carrier, whereby molds may be lifted from the supply runway, transferred to and deposited on said bearings, and a stop being actuated by the movement of said carrier and being effective to prevent progression of molds along said runway except during the transfer operation of said carrier.

9. Apparatus for centrifugally casting cylindrical metal bodies comprising a frame, bearings thereon for supporting a mold in substantially horizontal position, means for rotating said mold, a mold supply runway leading to one side of said frame and the level of said bearings, a mold carrier movable from the supply runway to said bearings, means for raising and lowering said mold carrier, whereby molds may be lifted from the supply runway, transferred to and deposited on said bearings, and a stop normally projecting above said runways and automatically receding to a position below said runway incident to the raising of said mold carrier.

10. Apparatus for centrifugally casting hollow cylindrical bodies comprising a frame, a series of rollers thereon for supporting a plurality of molds with their axes in substantially horizontal and parallel relation, including a driving roller in frictional engagement with two adjacent flasks, and means for rotating said driving roller.

11. Apparatus for centrifugally casting hollow cylindrical bodies comprising a frame, a series of rollers thereon for supporting a plurality of molds with their axes in substantially horizontal and parallel relation, including a central driving roller in frictional engagement with two adjacent flasks, and idle rollers at each side of said driving roller, and means for rotating said driving roller.

12. Apparatus for centrifugally casting hollow metal bodies comprising a frame, sets of rollers disposed transversely thereon and adapted to support a cylindrical mold for revolution about its longitudinal axis, one set of rollers comprising driving rollers, and another comprising idle rollers, and bearings in the form of blocks detachably fitted to said frame transversely thereof for supporting the idle rollers, each said idle roller being eccentrically mounted between the ends of its bearing, and said bearings being re-
versible as to their ends, whereby molds of different diameters may be accommodated on said rollers.

14. Apparatus for centrifugally casting hollow metal bodies comprising a frame, sets of rollers disposed transversely thereon and adapted to support spaced parallel cylindrical molds for revolution about their longitudinal axes, including a set of driving rollers and a set of idle rollers at each side thereof, and bearings in the form of blocks detachably fitted to said frame transversely thereof for supporting the idle rollers, each said idle roller being eccentrically mounted between the ends of its bearing, and said bearings being reversible as to their ends, whereby molds of different diameters may be accommodated on said rollers.

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