Nov. 26, 1957 J. H. BEYER 2,814,083

MOLD COATING APPARATUS

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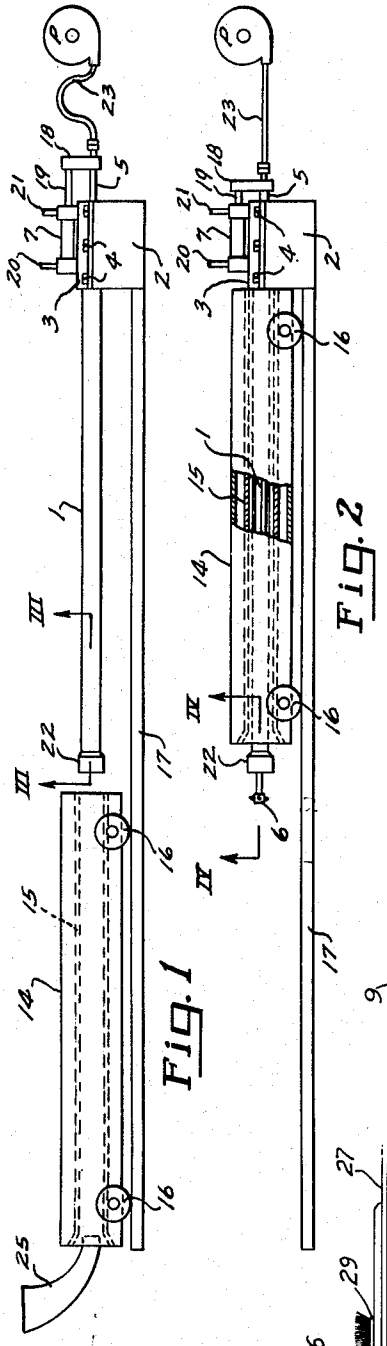


Fig. 1

Fig. 2

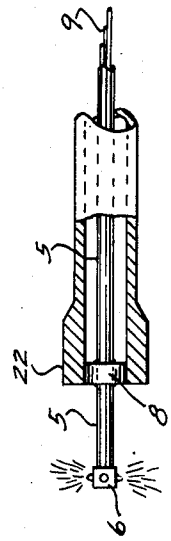


Fig. 4

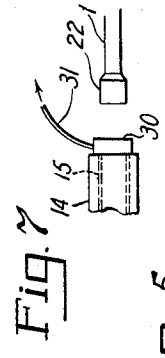


Fig. 7

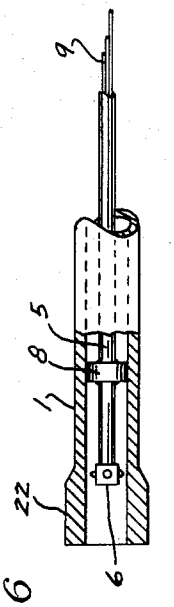


Fig. 3

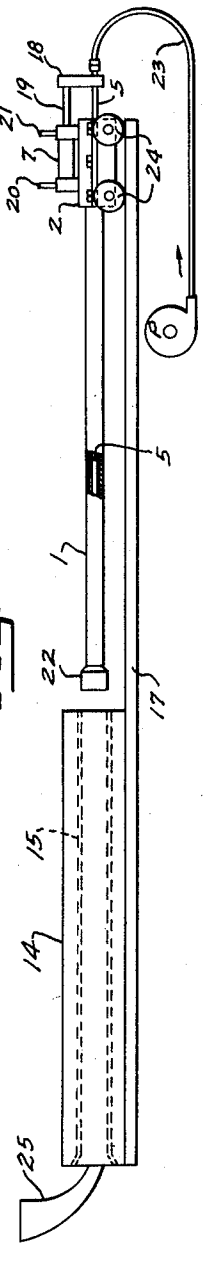


Fig. 5

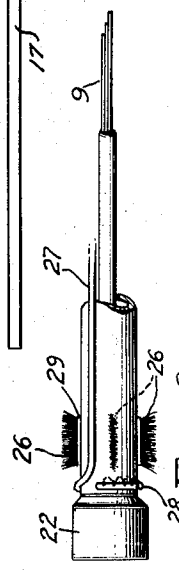


Fig. 6

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MOLD COATING APPARATUS

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10 Claims. (Cl. 22—94)

The present invention relates to an apparatus for use in the manufacture of tubular metal bodies by centrifugal casting, and more particularly it relates to an apparatus for applying a coating material uniformly to the inner surface of molds used in the centrifugal casting of pipe and other tubular products, for removing the casting from the mold after solidification, and for removing residual mold coating material from the interior mold surface.

It is well known to cast tubular metal bodies in permanent metal molds and to apply a coating material to the inner surface of the mold prior to casting. In the methods currently employed, the coating material is applied by reciprocating a spray or other discharge device axially within the mold while the latter is rotating. In order to accomplish this result, it has been the practice to carry the discharge device at the free end of a lance structure so arranged with respect to the mold that it may enter the latter axially during relative longitudinal movement therebetween, as taught, for example, in U. S. Patent No. 2,399,606.

Ejection of castings made by such methods can be accomplished in a number of ways, the most convenient being by means of a push-out bar which also enters the mold axially during relative longitudinal movement of the mold and bar, the free end of the bar engaging one end of the tubular casting and causing its ejection from the opposite end of the mold.

The disadvantage inherent in such casting methods as heretofore practiced is that the potential speed of casting has not been accomplished due to the necessity of traversing the mold through two two-way strokes per cast. Thus, when casting through a pouring spout, with the mold and spout maintained longitudinally stationary, a two-way stroke of the mold, or of the coating lance, is required for applying the mold coating, and a second two-way stroke of the mold, or of the ejecting device, is required for ejection of the casting.

One of the reasons an extra two-way stroke is required is that after ejection of a casting the mold must be retracted relative to the ejector in order to remove the ejector to permit entry of the coating lance. This difficulty can only be eliminated by utilizing a common lance for ejecting and for coating.

The present invention makes it possible to employ a common lance for ejecting a casting and for applying mold coating material to the inner surface of the mold. By the use of the apparatus of this invention the lance may be caused to enter the mold axially by relative movement of the mold and lance, and a casting ejected thereby. After ejection of the casting, the same lance may be activated to apply a coating to the inner surface of the mold during relative movement in the opposite direction.

Removal of residual mold coating material from the interior mold surface after removal of the casting and before the application of new coating material for a succeeding casting is desirable to prevent the uneven build-

up of coating within the mold, which results in unequal heat extraction from the mold during casting and may lead to casting difficulties and possible defective castings. Normally in repetitive casting operations the mold is not brushed out between casts, one reason being that additional time would be required for this separate operation, entailing reciprocating the mold over a brush or reciprocating a brush through the mold bore. It is only by combining the brush-out operation with some step already required that it becomes feasible. In accordance with this invention, apparatus is provided which makes it possible for the first time to brush out the mold after each casting without the usual loss of time required for this operation.

The principal object of this invention is accordingly to provide an apparatus which can be used as both a casting ejector and a mold coating lance.

An additional object is to provide an apparatus which can be used as a casting ejector, a mold coating lance, and means for removal of residual coating after casting.

Another object of the invention is the provision of an apparatus which in one position acts as a casting ejector, and in another position serves as a means for coating the inner surface of a mold.

Still an additional object is to provide a tubular lance, the free end of which is adapted to enter a mold axially, and which contains mold coating means within its bore, said mold coating means being adapted to protrude past the free end of the lance and to return to a position in the bore.

Other objects, features and advantages of the invention will become apparent from the following description of the invention taken in connection with the accompanying drawings wherein there is shown, for the purpose of illustration, a preferred embodiment of the invention, and wherein:

Figure 1 is a somewhat diagrammatic side elevation showing a centrifugal casting apparatus utilizing the lance structure of this invention, and wherein the coating means is retracted as when the lance is to eject a casting;

Figure 2 is a diagrammatic side elevation of the casting apparatus of Figure 1, but with the lance protruding throughout the length of the mold following ejection of a casting, and with the coating applicator extended to position to apply a coating to the mold during retraction of the mold.

Figure 3 is an enlarged partly sectional view taken along line III—III of Figure 1, showing in greater detail the lance structure and with the coating applicator in retracted position within the bore of the outer tube.

Figure 4 is an enlarged partly sectional view taken along line IV—IV of Figure 2, showing in greater detail the lance structure and with the casting applicator in extended position past the end of the outer tube.

Figure 5 is a somewhat diagrammatic side elevation of a modification of the invention, wherein the mold carriage remains stationary while the lance structure is reciprocated.

Figure 6 is an enlarged side elevation of the free end of the lance structure, including brushout means and air delivery supply means.

Figure 7 is a diagrammatic side elevation of the spigot end of a casting apparatus with means attached for applying partial vacuum to the mold.

Referring now to the drawings, there is shown a casting machine of conventional design, provided with a pair of horizontal parallel rails **17**. Mold carriage **14** is adapted for reciprocal movement over rails **17** by means of wheels **16** attached to the carriage. The carriage carries cylindrical metal mold **15** which is adapted to rotate about its horizontal axis. The mold is cooled according to suitable means well known to the art.

Molten metal is directed into the bore of the mold through pouring spout 25.

Adjacent the end of rails 17, opposite the pouring end, there is provided a support 2 for one end of the combination ejector and coating applicator of this invention. This apapratus comprises essentially an outer tube portion 1, the axis of which is in alignment with the axis of the mold 15 and which has a length equal to or greater than the mold. One end of tube 1 is affixed to support 2 by means of bracket 3 secured by bolts 4. The opposite or free end of tube 1 is provided with an annular pushout ring 22 which has an outside diameter slightly smaller than the inside diameter of the mold, but at least slightly larger than the inside diameter of the casting to be pushed out when ring 22 transpierces the mold during relative longitudinal movement therebetween. The same tube 1 can be utilized with molds of different inside diameters by providing annular rings 22 of corresponding sizes to be secured to the end of tube 1.

Coating material is applied to the inner surface of mold 15 by means of a smaller tube 5 mounted within the bore of tube 1. The smaller tube 5 is maintained substantially coaxially with tube 1 by means of guide cylinders 8 which can be rigidly attached to tube 5 and slidably mounted in tube 1, as shown, or conversely rigidly attached to tube 1 with tube 5 slidably mounted in the cylinder 8.

An arm 18 is attached adjacent to one end of smaller tube 5, which arm is also connected to extension 19 of a piston operating in cylinder 7 mounted on support 2 parallel to tube 5. The piston and extension are operated reciprocally within cylinder 7 by fluid pressure introduced through fittings 20 or 21.

At the opposite end of tube 5, or adjacent to that end, there is provided spray head 6 or other suitable means for directing the coating material against the inner surface of the mold. In operation, spray head 6 is retracted, by applying fluid pressure to cylinder 7 through fitting 20, into the bore of tube 1 as shown in Figure 3 while the apparatus is being used to push a casting from the mold. When the end of tube 1 is protruding past the end of the mold, after having ejected the casting, fluid pressure is applied through fitting 21 to force the piston in cylinder 7 toward that end, thus causing tube 5 to move in that direction until spray head 6 is extended to an exposed position past the end of tube 1 and pushout ring 22, as shown in Figure 4. The mold coating material is then applied to the inner mold surface by spray head 6 during relative retraction of the mold. The coating material is conveyed to spray head 6 through tube 5 by compressed air, pump, or other suitable means. There is shown a pump to supply coating material to tube 5 through flexible conduit 23. For certain types of mold coating material, individual small tubes 9 inside tube 5 may be used to supply the coating material and air to the spray nozzles.

While the retractable spray head constitutes the preferred means for applying the coating material, it will be obvious that the invention also contemplates alternative means. For example, the tube 5 can be adapted to spray the coating material to the mold from a position back of the pushout ring 22 by the provision of an opening in outer tube 1 at such position. Other means will occur to those skilled in the art and are also contemplated by this invention.

If it is desired to utilize the apparatus of this invention for the additional function of removing residual mold coating material after each casting is removed, it is only necessary to secure a brush or brushes 26 to the peripheral surface of tube 1 adjacent pushout ring 22. The individual bristles of the brush must be long enough to contact the inner surface of the mold during relative movement of tube 1 through the mold bore. In operation, the brushes 26 will remove residual coating material adhering to the inner mold surface during relative retraction of the lance, during which time the mold is rotating. Complete removal of residual coating from the mold interior, after brushing from the inner surface, can effectively be accomplished by application of a partial vacuum to the spigot end of the mold. Sufficient partial vacuum can be applied to the mold by attaching a hood 30, connected with a vacuum source by means of conduit 31, to the spigot end of the mold. To prevent the vacuum from drawing outside air from the bell end throughout the length of the mold, it may be desirable to supply air by a small tube 27 extending along tube 1 to a position between pushout ring 22 and the brush or brushes where the tube can encircle the outer tube 1. The smaller tube can deliver the air from such position toward the brush, through openings 28, thus effecting efficient removal of loose residual coating material toward the vacuum source.

In Figure 5 there is shown an alternative arrangement, wherein support 2 is adapted to reciprocate on rails 17 by means of wheels 24. In this embodiment the carriage 14 and mold 15 are maintained longitudinally stationary while the support moves toward the mold to eject the casting and coats the mold during retraction substantially as previously described.

I claim:

1. A device for use in combination with a centrifugal casting apparatus, wherein a metal mold is adapted to rotate about its horizontal axis and to reciprocate longitudinally comprising an outer tube, a mounting at one end of the outer tube for supporting the same horizontally in alignment with the bore of said mold, the free end of the outer tube having an outside diameter slightly smaller than the inside diameter of the mold, whereby said free end can pass through the bore of said mold during relative horizontal movement therebetween to eject a casting from said mold, an inner tube supported coaxially within the outer tube, a spray head carried by said inner tube adjacent the end thereof remote from said mounting, means for moving said inner tube axially until said spray head extends beyond the free end of the outer tube and for retracting said inner tube until said spray head is within the bore of the outer tube, and means for supplying coating material to said spray head.

2. Apparatus according to claim 1 having brushing means mounted on the said outer tube adjacent the free end thereof and adapted to remove residual coating adhering to the inner surface of said mold.

3. Apparatus according to claim 2 having means for supplying air from a position adjacent the free end of said outer tube toward said brushing means, and means for applying a partial vacuum to the end of the mold through which said outer tube enters.

4. In combination, a cylindrical metal mold adapted to rotate about its horizontal axis, an outer tube supported horizontally in alignment with the axis of said mold by a mounting adjacent to one end thereof, said tube having a free end portion with an outside diameter slightly smaller than the inside diameter of said mold, said mold and said outer tube being adapted for relative longitudinal reciprocating movement therebetween whereby said free end portion passes through the bore of said mold, an inner tube supported coaxially within the outer tube for reciprocating movement along its axis from a position whereby the end thereof remote from said mounting protrudes past said end portion of said outer tube to a position whereby the end is within the bore of said outer tube, a spray head mounted on said inner tube adjacent the end thereof remote from said mounting, and means for supplying coating material to said spray head.

5. In combination with a centrifugal casting apparatus wherein a metal mold is adapted to rotate about its horizontal axis and to reciprocate longitudinally, a device comprising an outer tube, a mounting at one end of the outer tube for supporting the same horizontally in alignment

with the bore of said mold, the free end of the outer tube having an outside diameter slightly smaller than the inside diameter of the mold, whereby said free end can pass through the bore of said mold during relative horizontal movement therebetween to eject a casting from said mold, an inner tube supported coaxially within the outer tube, a spray head carried by said inner tube adjacent the end thereof remote from said mounting, and means for supplying coating material to said spray head.

6. Apparatus according to claim 5 with brushing means mounted on the said outer tube adjacent the end thereof remote from said mounting and adapted to remove residual coating from the inner surface of said mold.

7. In combination, a cylindrical metal mold adapted to rotate about its horizontal axis, an outer tube supported horizontally in alignment with the axis of said mold, said tube having a free end portion with an outside diameter slightly smaller than the inside diameter of said mold and adapted to eject a casting from said mold, said mold and said outer tube being adapted for relative longitudinal reciprocating movement therebetween whereby the free end of said outer tube passes through the bore of said mold to eject a casting therefrom during such movement in one direction, an inner tube supported coaxially within the outer tube for reciprocating movement along its axis relative to the outer tube, a spray head mounted on said inner tube adjacent the end thereof which passes through said mold, and means for supplying coating material to said spray head.

8. In combination, a cylindrical metal mold adapted to rotate about its horizontal axis and to reciprocate longitudinally, an outer tube supported horizontally in alignment with the axis of said mold, said tube having a free end portion with an outside diameter slightly smaller than the inside diameter of said mold and adapted to eject a casting from said mold, said free end of said outer tube being adapted to pass through the bore of said mold during longitudinal reciprocating movement of the mold to eject a casting therefrom during such movement in one direction, an inner tube supported coaxially within the outer tube for reciprocating movement along its axis relative to the outer tube, a spray head mounted on said inner tube adjacent the end thereof passing through said mold, and means for supplying coating material to said spray head.

9. In combination, a cylindrical metal mold adapted to rotate about its horizontal axis, an outer tube supported horizontally in alignment with the axis of said mold and mounted to reciprocate longitudinally, said tube having a free end portion with an outside diameter slightly smaller than the inside diameter of said mold and adapted to eject a casting from said mold, said free end of said outer tube being adapted to pass through the bore of said mold during longitudinal reciprocating movement of the tube to eject a casting therefrom during such movement in one direction, an inner tube supported coaxially within the outer tube for reciprocating movement along its axis relative to the outer tube, a spray head mounted on said inner tube adjacent the end thereof passing through said mold, and means for supplying coating material to said spray head.

10. In combination with a cylindrical metal mold adapted to rotate about its horizontal axis, a lance for applying coating material to the inner surface of said mold and to eject castings from said mold comprising an outer tube having a free end portion with an outside diameter slightly smaller than the inside diameter of said mold and adapted to eject a casting therefrom, and an inner tube supported coaxially within the outer tube, a mounting at one end of the outer tube for supporting the same horizontally in alignment with said mold, means for effecting relative reciprocating movement between said mold and said lance to eject a casting from said mold during such movement in one direction, a spray head carried by said inner tube adjacent the end thereof remote from said mounting, means for supplying coating material to said spray head, and means for cleaning said mold in advance of application of said coating.

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