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CENTRIFUGAL PIPE CASTING MACHINE

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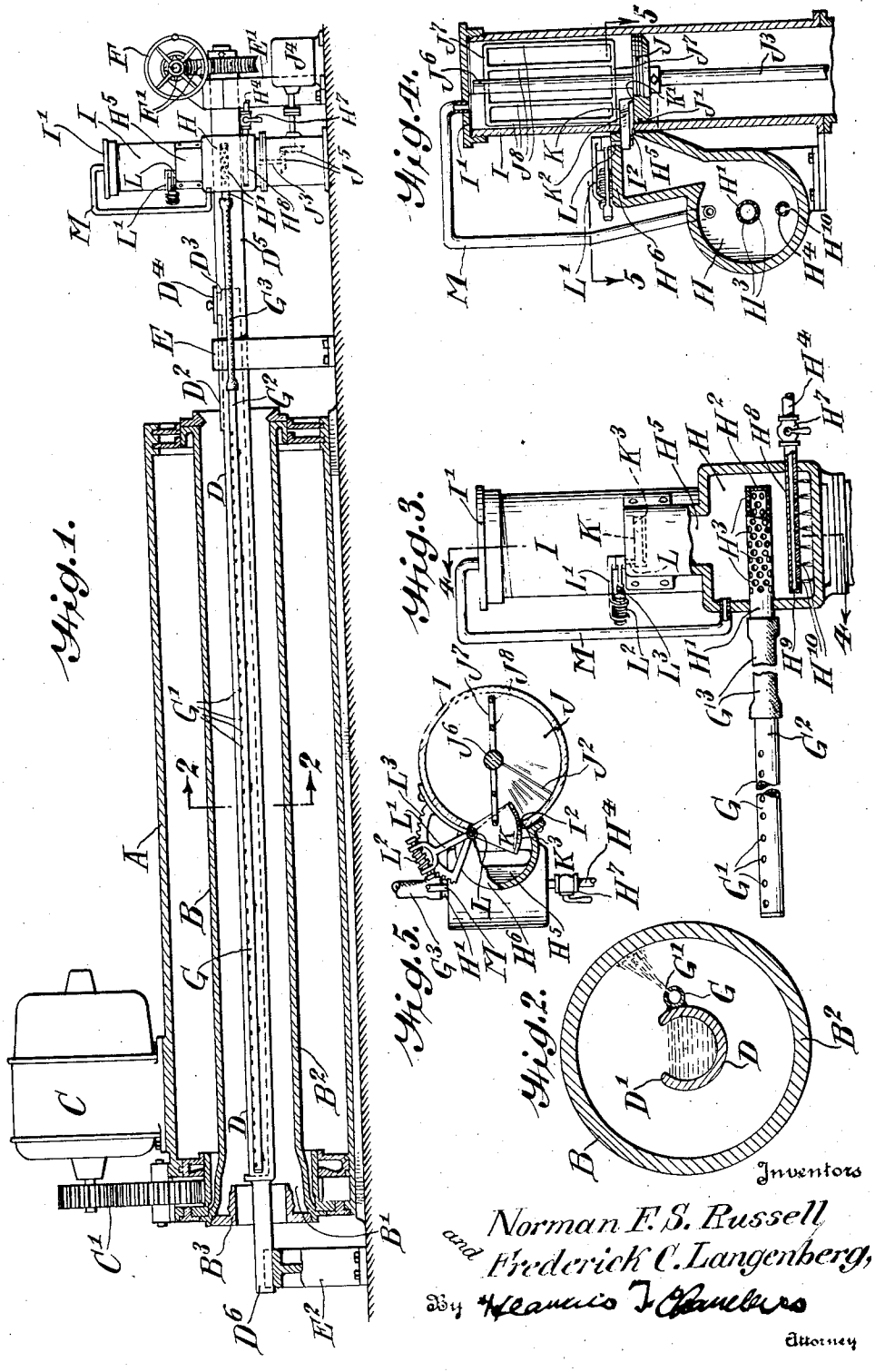


Fig. 1.

Fig. 4.

Fig. 3.

Fig. 5.

Fig. 2.

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CENTRIFUGAL PIPE CASTING MACHINE

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Application June 6, 1933, Serial No. 674,504

4 Claims. (Cl. 22—65)

Our invention relates to pipe casting apparatus and has for its object to provide such apparatus with new and useful improvements whereby a coating of finely divided dry mold coating material can be applied to the cylindrical portion of a centrifugal mold by means of a jet of carrier gas charged with the coating material, said coating being applied in advance of the charging of molten metal into the mold.

In our application filed October 19, 1932, Serial Number 638,480, we have described the application of finely divided dry coating material to the cylindrical surface of a centrifugal pipe mold in advance of the charging of molten metal upon the coated surface by means of a jet of carrier gas charged with finely divided dry coating material in such manner as to build up upon the mold surface a coating made up of the particles of dry coating material and of adsorbed films of the carrier gas and we have particularly described and claimed in our said prior application the application of the method to pipe casting apparatus in which the molten metal is delivered to the cylindrical portion of the mold through a relatively retractable runner delivering the metal to the mold in the form of a helix and the building up of the coating in advance of the contact of molten metal with the coated surface by a retracting jet of charged carrier gas moving through the mold at substantially the same speed as the retracting runner and delivering the coating progressively to the cylindrical portion of the mold in immediate advance of the contact of the metal therewith and we have pointed out in our said prior application that the best results are obtained where the molten metal is brought in contact with the coated surface as promptly as is practicable for the double reason that the longer the coating remains uncontacted by the molten metal, the more liability there is for fractures to occur in the coating and that the longer the coating remains uncontacted by molten metal the more liability there is for the entrained films of carrier gas forming part of the coating to escape.

We have also in our said prior application pointed out that the best results are obtained where the thickness of the coating deposited upon the mold surface exceeds as little as possible that minimum thickness which will bring about the desired retardation of heat transfer from the molten metal to the mold and we have noted that with the most effective coating materials, of which ferro-silicon is a good example, a coating made up of particles of the finely divided dry coating material delivered by the carrier gas jet in quantity not to exceed that which, if evenly distributed over the mold and compacted thereon, would form a coating of .0003" in thickness, has been found to give excellent results and we have also pointed out that it is not, in ordinary cases, advisable that in coating the mold that the charge delivered by the carrier gas jet should exceed that which, under the same conditions, would form a coating in excess of .001" in thickness for the reason that the thicker the coating the greater is the liability of the occurrence of fractures in the coating by slipping or scaling or by reason of the impact of the molten metal upon the coated surface. It is important that the above facts should be had in mind in using the apparatus which forms the subject matter of our present application and which is designed to effect the coating of the cylindrical portion of a centrifugal pipe mold throughout its entire length prior to the charging of the molten metal into the coated mold, this being necessary where a mold is charged with molten metal by means of a dump trough delivering the metal substantially at the same time over the length of the cylindrical surface of the mold.

While, for reasons that we have stated, it is advisable that the thickness of the coating deposited upon the mold should be kept as thin as will make it effective to prevent the formation of a chill, particularly with regard to the quality of the casting produced and while it is true that thicker coatings are more liable to fracture than thinner coatings, we have found that in using the dump trough method of charging a coated mold with molten metal there is less tendency for the occurrence of fractures and displacement of the coating from the impact of the molten metal than is the case where the molten metal is supplied through a retracting runner and that in such a method of casting it is practical to use a considerably thicker coating than where the metal is supplied through a retracting runner.

In our co-pending method application, filed June 6, 1933, Serial Number 674,502 we have described and claimed the method by which the cylindrical portion of a centrifugal mold is coated throughout its entire length prior to the pouring of metal into the mold and the metal then poured upon the so-coated surface and we have particularly described and claimed the method by which the coating is so applied by means of a charged carrier gas jet of a length equal to that of the cylindrical portion of the mold and

directed simultaneously over the entire length of the mold and in which the application of the coating is preferably immediately followed by the charging of molten metal simultaneously along the length of the coated portion of the mold and in our co-pending application, filed June 6, 1933, Serial Number 674,506 we have described and claimed the combination with a centrifugal pipe mold of a carrier gas jet nozzle extending over the entire cylindrical portion of the mold and delivering a jet of carrier gas over the entire length of said mold portion and preferably the charging of the jet of carrier gas with a finely divided dry coating material after its issue from the nozzle from a receptacle located in the mold adapted to hold a charge of the coating material and extending over the length of the cylindrical portion of the mold and in such relation to the jet nozzle as to feed its contents into the formed jet before its contact with the mold surface.

Our present invention consists, generally speaking, in the combination with a centrifugal pipe mold of a carrier gas jet nozzle extending over the length of the cylindrical portion of the mold and adapted to deliver a jet of carrier gas along the entire length of said cylindrical portion with means for charging the carrier gas, before it is admitted to the jet nozzle, with a charge of finely divided dry coating material, the jet nozzle being preferably used in connection with the dump trough adapted to deliver molten metal simultaneously or substantially so along the entire length of the cylindrical mold section.

Our invention will be best understood as described in connection with the drawing which illustrates centrifugal pipe casting apparatus provided with our improvements and in which

Figure 1 is an elevation of a centrifugal pipe casting machine embodying our invention with the mold housing shown in section and a portion of one of the dump trough supporting pedestals also shown in section.

Figure 2 is a cross-section on the line 2—2 of Fig. 1.

Figure 3 is an elevation on a larger scale of a portion of the apparatus for feeding the jet nozzle with a carrier gas with finely divided dry coating material, portions of the apparatus being shown in section.

Figure 4 is a sectional view taken as on the line 4—4 of Fig. 3, and

Figure 5 is a cross-section on the line 5—5 of Fig. 4.

A indicates the mold housing, which may serve as a water box or jacket through which extends the mold B, rotatably supported on the walls of the housing and rotated by means of a motor C through the gearing C^1. The mold, as shown, is made up of a bell B^1 and a cylindrical portion B^2. At B^3 we have indicated a core set in the bell mouth of the mold. D indicates a dump trough for molten metal which extends over and slightly beyond the cylindrical portion of the mold and has a pouring lip D^1 over which the molten metal is delivered when the trough is tilted and which extends over and slightly beyond the cylindrical portion of the mold. As shown, the dump trough extends through and beyond the spigot end of the mold. As indicated at D^2, this portion of the trough is cylindrical and is provided at its end with a filling chamber D^3, through which molten metal is introduced into the dump trough and which is shown as provided with a lid D^4. D^5 is a shaft extension from this cylindrical end of the dump trough and D^6 another shaft extension from the delivery end of the dump trough. The cylindrical portion of the dump trough is shown as supported rotatably on a pedestal E and the shaft extension D^5 is rotatably supported on a pedestal E^1 and the dump trough is tilted by means of a hand wheel F connected to the shaft D^5 by means of gearing, indicated at F^1. A support for the other end of the dump trough is not absolutely necessary but, as shown, the shaft D^6 is supported on a pedestal E^2 which, in the construction indicated, must be made removable to permit the withdrawal of the cast pipe from the mold. G is a carrier gas nozzle located in the mold and extending over and, as shown, slightly beyond the cylindrical portion. This nozzle is provided with holes, as indicated at G^1, extending over the cylindrical portion of the mold so as to deliver a jet of carrier gas of a length equal to or slightly greater than the cylindrical portion of the mold. As shown, this nozzle is supported on the side of the dump trough opposite the pouring lip of the trough. An unperforated portion G^2 of the nozzle extends beyond the spigot end of the mold and, as shown, is connected by a flexible hose G^3 to the mechanism for supplying the nozzle with a carrier gas and with finely divided dry coating material. H is a mixing chamber in which the carrier gas supplied to the nozzle G is charged with finely divided dry coating material. This mixing chamber is connected to the hose G^3 through a pipe H^1 which pipe projects through the greater part of the length of the mixing chamber, is closed at its end as indicated at H^2, and provided with a multiple series of perforations, as indicated at H^3. Gas under pressure is delivered to the mixing chamber from a source of supply, not shown, through a pipe H^4 provided with a valve H^7. An extension H^8 to the pipe H^4 extends through the greater part of the length of the mixing chamber H and has a closed end, as indicated at H^9 and opens into the mixing chamber through a multiple series of holes, as indicated at H^{10}. Finely divided dry coating material is delivered to the mixing chamber through a hopper H^5, which is provided with a tight closure as indicated at H^6.

While any effective feeding device for delivering a uniform supply of the coating material to the hopper may be employed, we preferably employ a slight modification of the feeding mechanism forming the subject matter of the application for Letters Patent, filed by Hunt and Arnold, October 29, 1932, Serial Number 640,258, now Patent No. 1,939,703, dated Dec. 19, 1933, this feeding device consisting of an upright cylindrical container I having a tight closure at its top, as indicated at I^1. The bottom of the container is formed by a rotatable disk J, forming a tight joint with the wall of the container, as indicated at J^1, and having radial grooves upon its upper surface, as indicated at J^2. This disk is supported on a shaft J^3 which is rotated by a motor J^4, through gearing, as indicated at J^5. A centrally located spindle J^6 extends from the center of the disk upward into the container and from this spindle extend lateral arms, as indicated at J^7, which, in turn, support connecting bars, indicated at J^8. I^2 indicates an outlet opening formed through the wall of the container and opening into the hopper H^5. In this opening is located the angularly adjustable knife K, sup-

ported on a rotatable shaft L, which is angularly adjustable, the adjustment being effected as illustrated through a forked lever L^1 supporting a worm L^2 engaged in a stationary toothed segment L^3. The knife K is formed with a sharpened edge as indicated at K^1 and with a laterally extending flange K^2 which fits against the top of the opening I^2 and is formed with a sharpened edge, as indicated at K^3.

M is a pipe connecting the mixing chamber H with the top of the container I. The provision of this pipe and the use of a tight closure I^1 for the container and a tight closure H^6 for the hopper, constitute the modifications which we have made in the structure of the feeding mechanism of the Hunt and Arnold application, Serial No. 640,258, apart from the novel construction of the mixing chamber.

In operation, the dump trough D is charged with molten metal through its filling extension D^3. The container I is charged with finely divided dry mold coating material and its closure I^1 secured in place. The disk J is set in rotation which involves the rotation of the cylindrical and vertical bars J^7 and J^8, secured to the spindle J^6, by means of which and the grooves J^2 of the disk J, the charge of finely divided coating material in the container is set in rotation and the knife K pares off from the rotating cylinder made up of the charge, a very accurately determinable feed of the pulverized material which passes into the hopper H^5 and through it into the mixing chamber H. The carrier gas under pressure is turned on by opening the valve H^7 and, passing into the mixing chamber H, is delivered along the length thereof through the openings H^3 in the pipe extension H^1. The gas thus directed, keeps the finely divided dry mold coating material from the feeding apparatus in agitation in the mixing chamber H and the mixture of gas and finely divided material passes into the perforated pipe H^1 and, by this pipe, through the connection shown to the nozzle G, from which the carrier gas charged with the finely divided coating material, issues through the openings G^1, forming a jet G^4, which is delivered along the entire length of the cylindrical portion of the mold. The mold, it will be understood, is, during the delivery of the charged jet of carrier gas, set in rotation so that the finely divided coating material is delivered progressively to successive longitudinal areas of the cylindrical portion of the mold, building up thereon a symmetrical coating of the finely divided coating material. When a coating of the desired thickness has been built up upon the mold, gas under pressure is cut off as by closing the valve H^7 and the dump trough D is then tilted as by means of the hand wheel F, to feed its contents into the rotating coated mold; then, when the cast pipe is set, the pedestal E^2, if used, is removed, the core B^3 also removed and the cast pipe withdrawn from the mold in any convenient way.

In using an elongated carrier gas nozzle, such as G, it is desirable, in order to maintain an approximately even feed of the charged carrier gas from the entire effective length of the nozzle, that the gas should remain under pressure in the nozzle and we have found it advisable to form the openings G^1 in the nozzle of such size that their aggregate area will be about one-half the cross-sectional area of the nozzle. But this relation between the aggregate outlet areas and the cross-sectional area of the nozzle may be considerably modified in relation to each other so long as the cross-sectional area materially exceeds the outlet areas. So long as the area of the outlet openings from the nozzle is considerably less than the cross-sectional area of the nozzle, it is practicable to effect a very even distribution of outflow along the effective length of the nozzle by regulating, as by means of the valve H^7, the pressure of gas in the mixing chamber and it should be had in mind, in regulating the pressure, that the jet of carrier gas should be so regulated in amount and velocity as not to impact against the mold surface with sufficient energy to carry away to any considerable extent the particles of coating material impacted against the mold by the carrier jet.

Having now described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. Apparatus for coating centrifugal pipe molds with finely divided dry coating material comprising in combination with a centrifugal pipe mold having a cylindrical section, a jet nozzle for carrier gas extending within the mold along substantially the entire cylindrical portion of the mold and adapted to deliver a jet of carrier gas along the entire length of said cylindrical portion, means for supplying gas under pressure to said nozzle and means for charging said gas, prior to its entry into the nozzle, with finely divided dry mold coating material.

2. In a centrifugal pipe casting apparatus comprising a rotatable mold having a cylindrical section and a dump trough for molten metal adapted to extend over the cylindrical portion of the mold and to deliver its charge of molten metal along the entire cylindrical surface, the combination therewith of a carrier gas nozzle extending along the cylindrical surface of the mold and adapted to deliver a jet of carrier gas along the entire length of said cylindrical surface, means for supplying gas under pressure to said nozzle and means for charging said gas, prior to its entry into the nozzle, with finely divided dry mold coating material.

3. Apparatus as called for in claim 2, in which the carrier gas nozzle is secured to and supported by the dump trough.

4. Apparatus as called for in claim 1, in which the jet nozzle is provided with a series of outlet holes for the delivery of the carrier gas having an aggregate area materially less than that of the cross-sectional area of the nozzle.

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