Nov. 18, 1969 M. LAFFIN 3,478,814

CONTINUOUS POURING OF METALS

Filed June 22, 1967

Fig. 1

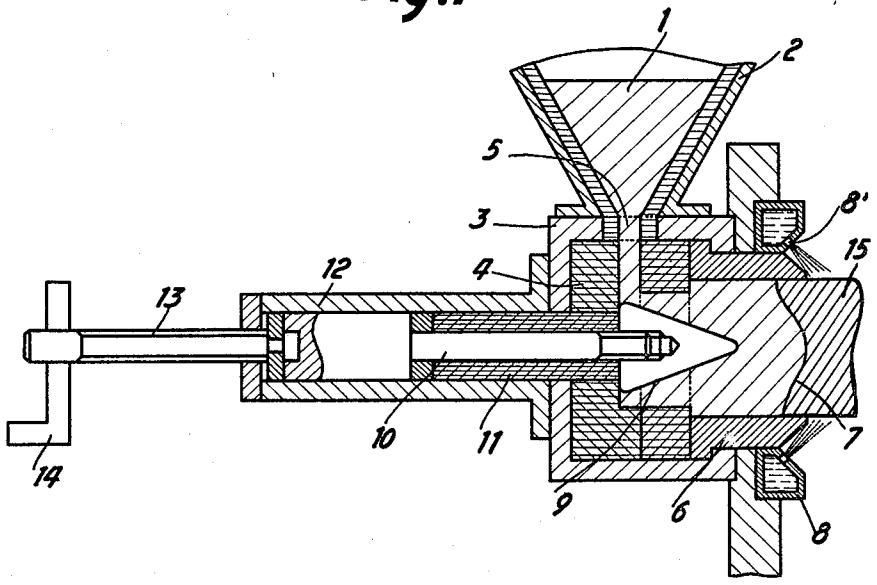
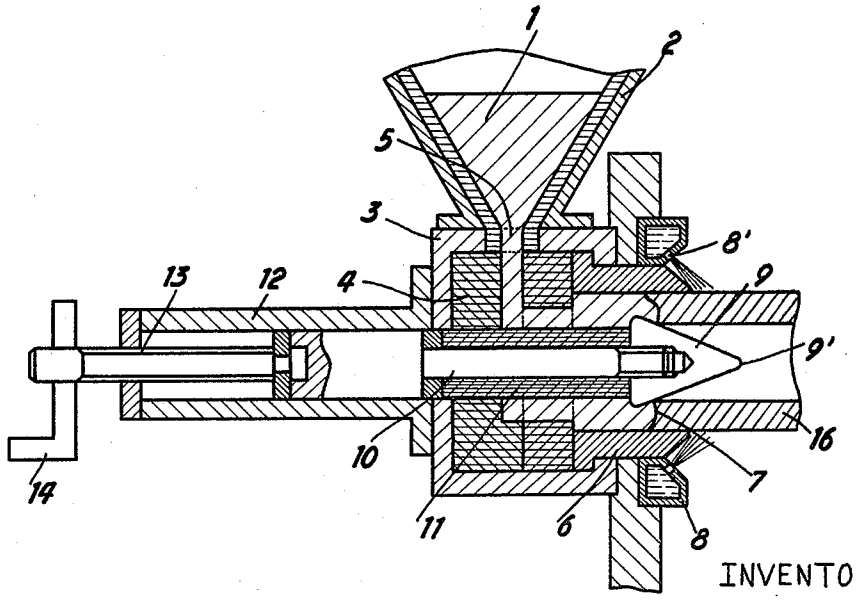


Fig. 2



INVENTOR

MICHEL LAFFIN

by

Webb, Burden, Robinson & Webb

HIS ATTORNEYS

United States Patent Office 3,478,814
Patented Nov. 18, 1969

3,478,814

CONTINUOUS POURING OF METALS

Michel Laffin, Annecy, France, assignor to Societe Anonyme: Ugine Kuhlmann, Paris, France, a corporation of France

Filed June 22, 1967, Ser. No. 648,097
Claims priority, application France, June 24, 1966, 66,750
Int. Cl. B22d 15/02
U.S. Cl. 164—281 2 Claims

ABSTRACT OF THE DISCLOSURE

The method of continuous pouring, particularly horizontal pouring, of metal pipes, especially thin-walled pipes, by means of a chill mold comprising a mandrel at the molten metal inlet, is characterized by the fact that the mandrel is moved along the pouring axis from upstream and within the poured metal so as progressively to attain the desired value of the inner section of the poured article, the intersection of the front surface of solidification and the mandrel surface defining the inner section of the poured tubular article.

Various methods and devices are known and generally used for the continuous pouring of hollow metal bodies. Amongst other devices one has been described for the continuous horizontal pouring of metal pipes, such as aluminum-tin pipes, in which a stationary mandrel with a slightly tapered head is positioned at the entrance of the chill mold. Now, it has been established that by operating in accordance with these methods, or with these known devices, continuous pouring of a thick walled pipe or solid rod is relatively easy, but for pouring thin-walled pipes difficulties arise which render the method useless in practice.

Study of the phenomena has shown that these last difficulties arise essentially at the beginning of the pouring operation; in continuous pouring of a thin-walled tubular product, blocking of the apparatus by solidification of the metal before continuous pouring conditions are established is often seen at the beginning of the operation owing to the small cross-section of the product. Such incidents by reason of the cost of repairs and immobilization of material, as well as the loss of metal and production they entail, are all the more irksome as their occurrence is as frequent as they are irregular.

The manufacture of thin-walled metal pipes is sufficiently important for it to have been the subject of efforts, which have been unsuccessful up to now, to overcome the serious drawbacks inherent in the known methods. As it is essential that the manufacture should not be burdened with additional expense, efforts were deliberately directed to providing as simple a means as possible and preferably adaptable to known apparatus to permit thin-walled pipes to be manufactured by continuous, and more especially horizontal pouring. Having posed the primary problem of simplicity and efficiency, the applicant was surprised to ascertain that all the aforesaid drawbacks could be eliminated and that the advantages of continuous, and more particularly horizontal, pouring of solid rods and thick-walled pipes were retained for thin-walled pipes when, in order to pour thin-walled pipes, the poured metal was forced to take progressively the desired final internal section of the product. This result can generally be obtained with a mandrel having a generally tapered shape and which is moved in the inlet of the chill mold according to the axis of pouring from an initial rearward position.

According to the invention, the method of continuous pouring, particularly horizontal pouring, of metal pipes, especially thin-walled pipes, by means of a chill mold comprising a mandrel at the molten metal inlet, is characterized by the fact that the mandrel is moved along the pouring axis from upstream and within the poured metal so as progressively to attain the desired value of the inner section of the poured article, the intersection of the front surface of solidification and the mandrel surface defining the inner section of the poured tubular article. This intersection is referred to as the active section of the mandrel. Pouring can be started in solid cross section and pass progressively to the tubular article, pouring can also be started with a small diameter hollow inner section.

It is possible, for instance, to pour first a solid member, then from a predetermined rear position and up to a front position also predetermined as a function of the nature of the metal and the characteristics of the size of the pipe to be obtained, to advance the mandrel progressively and without stopping until the desired inner section and wall thickness is obtained. At the start of the operation the mandrel is maintained in a position on the pouring axis such that at first, and until stable operation is established, a thicker wall than desired is obtained and the mandrel is then moved forward until the final thin wall is obtained. At least the extreme rearward position of the front point or apex of the mandrel is upstream of the extreme rearward position of the solidification face of the metal; this corresponding to solid section pouring. In the forward position of the mandrel the largest cross-section of the mandrel, which is at its rear portion, is upstream of the extreme forward solidification face position.

The method according to the invention can be used at the start of continuous pouring of hollow products, especially those with thin walls, it can also be used to pass without interrupting pouring from one type of product to another; for instance, from a pipe of given wall thickness to a pipe of another wall thickness. The new method therefore eliminates the drawbacks of anterior methods, especially all risk of untimely solidification during the first moments of the operation; owing to this fact it provided important industrial advantages in the manufacture and quality of products. One of these advantages lies in the possibility of substantially reducing the production tolerances of the tubular articles produced, as the method permits the inner section of the poured product to be adjusted or controlled without stopping the continuous pouring operation, by very slight movements of the mandrel for instance.

Another object of the invention is an apparatus for putting the invention into effect. Such an apparatus comprising molten metal feed means; a coolable chill mold; means for extracting the poured article and a mandrel having a tapering head penetrating the chill mold, is characterized by the fact that it is provided with means permitting the said mandrel and the solidification face of the poured metal to be displaced longitudinally with respect to each other. For example, the installation can be characterized by the fact that it is provided with means for moving the mandrel along the axis of the chill mold within the poured metal and that the head of the mandrel has a section increasing continuously from the downstream to the upstream end. The head of the mandrel can be conical with a rounded head situated downstream; the mandrel head can also have a curvilinear surface whose tangents are all inclined in the same direction with respect to the axis of the chill mold.

In the case of an aluminum-tin alloy, or alloys having similar mechanical properties, it is advantageous that the generatrices of the conical mandrel should have a slope

of about 7° in the solidification face zone. For other metals or alloys it is easy in each case to determine the value to give the said slope after a few trials. The rate of development of the section of the mandrel should correspond to a slope of the generatrix of the cone which does not depart from that providing an inner "skin" of the poured product which is acceptable to the extent of leading to the rupture of this "skin," and therefore to the failure of the pouring operation. In the aforesaid case of aluminum-tin alloys and the like it is advantageous to use cones whose half angle at the summit is between about 15 and 20°.

In the appended drawing an example of embodiment of an installation is shown for carrying the method according to the invention into effect. In the drawing:

FIG. 1 is a diagrammatical longitudinal cross-sectional view of a horizontal continuous pouring apparatus according to the invention;

FIG. 2 is a similar view to FIGURE 1 but for another position of the mandrel.

In the drawing there is seen the container **2** which receives the molten metal **1** from a pouring ladle or similar one (not shown). The container **2**, lagged with a suitable insulating material **4**, is sealingly mounted on the pouring head **3**, also thermo-lagged, with which it communicates by an orifice **5**. In the pouring head **3** is secured, by any known sealing means, the horizontal chill mold **6** provided with a cooling jacket **8** pierced by holes **8'** through which jets of cooling water can spout. On the other side of head **3** is sealingly mounted a sleeve **12** within which is slidingly mounted in a sealed manner the stem **10** surrounded with a thermoinsulating material **11** along a length substantially equal to that of its possible movement; the downstream or front end of the stem **10** is secured in any known way to conical head **9** of the mandrel. The longitudinal displacement of stem **10** is controlled by a screw **13** driven in rotation by crank **14**.

The operation of this installation is as follows: initially the head of mandrel **9** is in the extreme rear position shown in FIGURE 1; as the molten metal **1** passes from the container **2** into chill mold **6** through orifice **5** of the pouring head **3** it surrounds the rear end of the conical head **9**. In response to the effect of the jets of water issuing through orifices **8'** of the jacket **8**, the metal **1** cools and a solid bar **15** is obtained from the solidification face **7** of the metal.

As soon as the metal is flowing evenly the crank **14** is activated to displace the stem **10** and head **9** of the mandrel progressively downstream the end **9'** of the head has just passed beyond the solidification face **7** and a pipe **16** is then obtained whose wall-thickness is determined by the position of the intersection between the solidification face **7** and the "active" surface of the head, i.e. the portion of the surface of the head upstream of which the metal is still molten. As the molten metal **1** continues to arrive the article formed is a tube with a wall of the desired thickness, without it having been necessary in practice to move the head **9** to any extent.

The movement of the mandrel by the control screw is adjusted as a function of requirements and according to the measurements carried out on the poured product, to keep the solidification face preferably in a substantially fixed position in the chill mold. This adjustment can, of course, be carried out automatically by suitable measuring and control devices. Finally, it should be noted that, if necessary, modification of the cooling operation permits the position of this solidification face to be modified.

What we claim is:

1. A device for the continuous pouring of metal shapes, from bars to tubes having thin walls, comprising a container for liquid metal, on the inner wall of the container a layer of thermoinsulating material, a latreally thermoinsulated opening in the container for discharge of the liquid metal, a pouring head sealing surrounding said opening and having a rear wall and a front wall, each wall with an opening therethrough both openings having a common axis, the inside of said head being provided with thermoinsulating material traversed by channels coaxial and respectively communicating with the opening in the rear and front walls of the pouring head, a horizontal chill mold having a cross section approximately that of the metal shape, said chill mold having an outlet for the metal shape and a rear part tightly surrounding the said front opening of the pouring head, an annular jacket for cooling water surrounding the peripheral outlet zone of the chill mold, holes in said jacket which are directed to project water on the outer face of the outlet of the chill mold and of the metal shapes, a sleeve tightly fitted at one end around the rear opening of the pouring head, a detachable rear end at the other end of the sleeve the rear and front openings of the pouring head and the chill mold having said common axis, in the sleeve an axially movable unit consisting of a metal stem and of a thermoinsulating material surrounding the stem and having an outer diameter equal to the common inner diameters of the sleeve and of the opening in the rear wall of the pouring head, means to displace axially said unit between a rear and a front position, a mandrel fitted on the inner end of the stem, said mandrel in the rear position of said unit having at least a part of its apex portion in the chill mold and its rear end applied both to the radial end surface of the insulating material of the unit and to an annular portion of the inner surface of the insulating material in the pouring head around its rear opening, and said mandrel in the front position of said unit having its apex portion in about the vicinity of the outlet section of the chill mold.

2. A device according to claim **1**, for the pouring of aluminum tin alloys, in which the mandrel surface is generally conical and the generators of the mandrel surface are inclined at about 7° to the axis of the chill mold, in the zone corresponding to the solidified metal limit in said mold.

References Cited

UNITED STATES PATENTS

2,996,771	8/1961	Armand et al.	164—283
3,228,075	1/1966	Lindemann	164—85
3,398,780	8/1968	Yearley	164—83 X

FOREIGN PATENTS

580,845	8/1959	Canada.
869,104	5/1961	Great Britain.

J. SPENCER OVERHOLSTER, Primary Examiner

R. S. ANNEAR, Assistant Examiner

U.S. Cl. X.R.

164—85