Sept. 13, 1938. M. TAMA 2,130,202

CONTINUOUSLY CASTING PIPES

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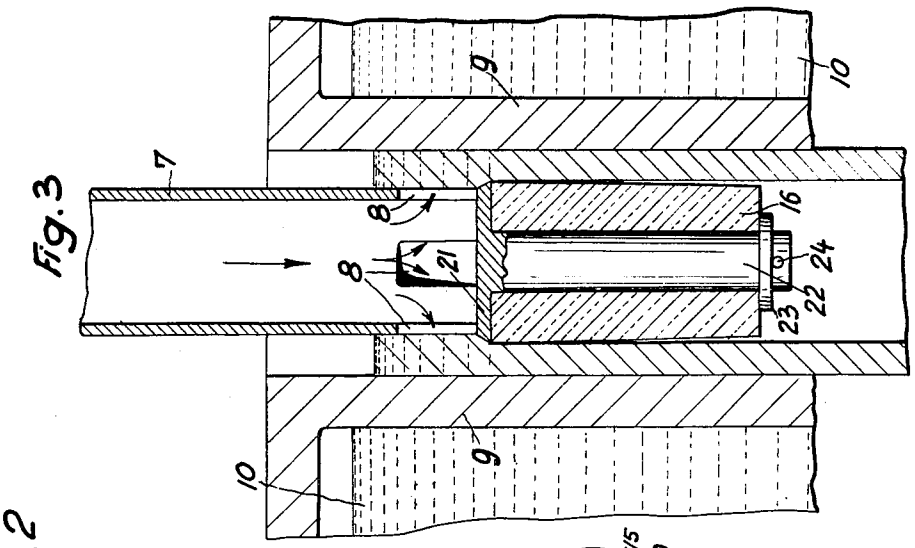

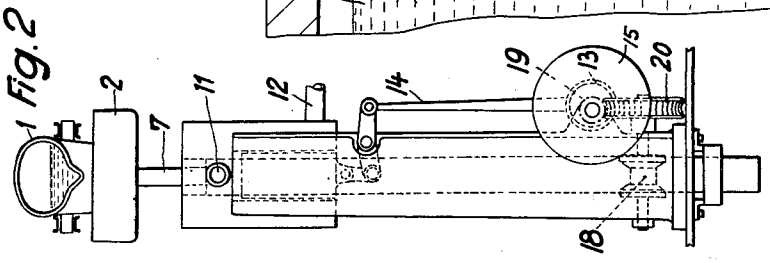

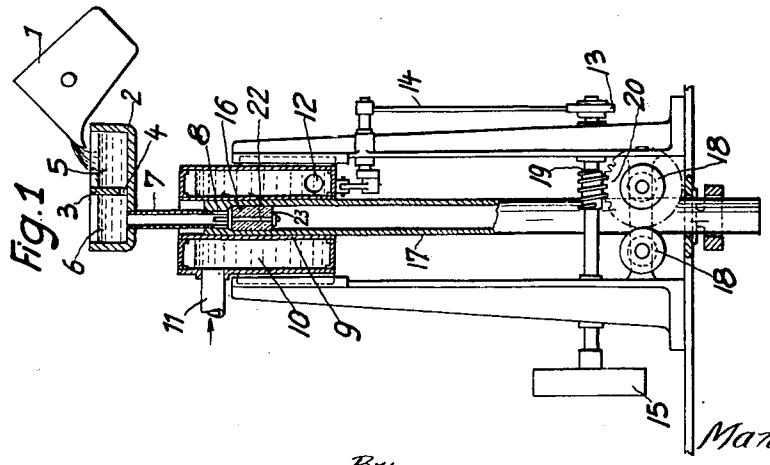

Inventor:

Manuel Tama

By Williams, Bradbury, McCaleb & Hinkle

Attys.

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CONTINUOUSLY CASTING PIPE

Manuel Tama, Zurich, Switzerland

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5 Claims. (Cl. 22—200.1)

The present invention relates to a method and an apparatus for continuously casting pipes or tubes adapted to be further treated by rolling, drawing and the like. The new method may be utilized for casting tubes or pipes from all suitable metals used in the industry, as steel, copper, brass, aluminium, etc. It is further adapted to produce pipes or tubes having walls of such thicknesses as to be able to be further treated according to usual methods, that is to say, tubes or pipes are intended to be produced having wall thicknesses of about 4–10 mm. and a diameter of about 40–200 mm.

Under the expression "continuously casting" the production of tubes or pipes in infinite length is to be understood. By connecting a cutting device to the casting apparatus it is, however, possible to produce tubes or pipes of suitable length for the further manufacture.

Various methods have already been proposed to produce castings of solid cross section and some of these methods have been successful in practice. For the production of hollow castings, however, no methods are known hitherto which have been successful in practice.

The method according to the present invention consists in this, that the metal is poured from above into a mold which, in a well known manner, may be reciprocated in the direction of its longitudinal axis, and that the solidified tube or pipe is drawn off from the mold by means of a conveying device, the solidification heat being substantially conducted away from the interior to the exterior.

The new method is further characterized by using an artificially cooled mold and a mandrel of ceramic material as exterior and interior mold respectively. The liquid hot metal is preferably supplied in the direction from the axis to the exterior circumference of the tube or pipe to be formed.

The apparatus forming the subject matter of the invention substantially consists of a hollow tube serving to pour in the liquid metal, the lower end of said tube being closed by a bottom and provided with lateral outlet openings. The pouring in tube advantageously simultaneously serves to carry the ceramic mandrel which preferably consists of graphite.

One embodiment of an apparatus for carrying out the method according to the invention is shown by way of example in the accompanying drawing.

In this drawing:

Fig. 1 is an elevation of a casting apparatus partly in section,

Fig. 2 is a side elevation of the apparatus shown in Fig. 1 and

Fig. 3 is a detail sectional view showing on a larger scale the upper end of the mold.

The operation of the method and the apparatus may first of all be explained by the aid of Figures 1 and 2.

The liquid metal contained in a ladle 1 is poured into an intermediate receptacle 2, consisting of refractory material. The intermediate receptacle 2 is provided with a partition wall 3 provided at the lower end with an opening 4, so that the two compartments 5 and 6 of the receptacle 2 communicate with each other. The metal supplied to the compartment 5 directly flows into the compartment 6. As, however, the two compartments 5 and 6 communicate with each other at the bottom only, the slags floating on the upper surface of the metal in the compartment 5 of the receptacle 2 cannot reach the compartment 6. The metal from the compartment 6 flows through a pipe 7 consisting of suitable material and provided at the lower end with outlets 8 opening into the mold 9 which is surrounded by a space 10 cooled by water or another liquid.

The cooling water is supplied through a socket 11 and withdrawn through a pipe 12. The water-cooled mold 9 together with the water space 10, the socket 11 and pipe 12, are, in a well known manner, reciprocated in the longitudinal direction of the pipe to be produced, and this reciprocation may, for instance, be effected by an eccentric means 13, 14 driven by means of a pulley 15.

The metal flowing through the pipe 7 fills the space between the exterior wall of the mold 9 and the interior mandrel 16. In this manner, a tube or pipe 17 is produced which slowly is withdrawn from below by rolls 18.

The rolls 18 are driven by means of a worm 19, fixed upon the shaft of the pulley 15 and engaging a worm wheel 20 connected to one of the rolls 18.

The mandrel 16 consists of ceramic material and is intentionally not made of metal to prevent heat from being conducted away from the interior. An essential point in carrying out the new method is the withdrawal of heat to the exterior by the contact of the liquid metal with the cooled walls of the mold 9. As known from experience, the poured in material very quickly shrinks at the point of contact with the wall of

the mold 9, so that a hollow space is formed between the pipe or tube 17 and the wall of the mold 9 which hollow space is the greater, the more the tube produced progresses downwardly. In spite of the fact, that after shrinkage no contact exists any more with the wall of the mold, heat is disbursed by radiation to the exterior.

As the mandrel 16 consists of a ceramic material and is not cooled, but on the contrary is continuously maintained upon higher temperatures by the flowing in metal, practically no heat is conducted away from the interior of the pipe or tube 17. Moreover, in this manner the portions of the tube 17 facing the centre slower solidify than the exterior portions. The metal, therefore, more slowly shrinks at the interior portions than at the exterior portions and sticking of the tube or pipe 17 to the mandrel 16 is already prevented by this essential measure, i. e. by conducting away heat to the exterior only.

A further measure for preventing sticking of the tube or pipe 17 to the mandrel 16 is the manufacture of the mandrel of graphite, a material upon which, as is well known, most metals have no moistening effect.

Finally it is of great importance to use a mandrel 16 which is tapered in such a manner, that its diameter decreases towards the lower end.

Fig. 3 shows on a larger scale further details of the most important portions of the casting mold and the mandrel, i. e. the part of the apparatus, at which the tube or pipe is formed.

Here again the molten metal is introduced into the casting mold by means of the tube 7 consisting of a material resisting the attack of the metal poured into it. Such materials are known either as ceramic or as metallic materials. The heating of the tube 7 to the temperature of the metal flowing through may, in a well known manner be effected, for instance by means of electric resistances so as to prevent solidification of the metal between the walls. The lower end of the pipe 7 is provided with a bottom 21 and with a plurality of openings 8, through which the metal may flow out. These outlets preferably extend to the bottom 21, so that no bags whatever are formed, which would prevent the free flow of the metal. Welded to the bottom 21 is a bolt 22 serving to connect the mandrel 16 consisting of a ceramic material. The mandrel 16 is held by means of a washer 23 and a pin 24. In this figure, 9 is the wall of the casting mold which, in a well known manner, is made of copper and surrounded by a water space 10 to obtain a violent cooling effect.

The movement of the casting mold 9 in the direction of the longitudinal axis of the tube 7 may be chosen as desired provided this movement allows the formation of the tube or pipe 17.

Preferably, this movement is so chosen that the downward movement of the casting mold 9 corresponds to the feed of the tube or pipe 17, whereas the upward movement is relatively fast, as is well known per se.

What I claim is:

1. In a device for continuously casting metal tubes, the combination comprising, a water cooled mold, a mandrel arranged in said mold in spaced relation to the inner periphery thereof, a tube to support said mandrel and to supply melted metal to be cast, said tube being spaced from the inner periphery of said mold a distance greater than said mandrel to provide an annular space above said mandrel of greater cross section than that of the tube to be cast.

2. In a device for continuously casting metal tubes, the combination comprising, a water cooled mold, a mandrel arranged in said mold in spaced relation to the inner periphery thereof, said mandrel being composed of a refractory substance and having its greatest diameter at the top thereof, a tube of less diameter than the mandrel to support said mandrel and to supply metal to be cast, and said tube being closed at its lower end and having openings directly above the closure.

3. In a device for continuously casting metal tubes, the combination comprising, a water cooled mold, a mandrel arranged in said mold in spaced relation to the inner periphery thereof, a tube of smaller diameter than said mandrel arranged coaxially of said mold, a plate closing the lower end of said tube, a bolt depending from said plate to support said mandrel, and openings in said tube above said plate.

4. In a device for continuously casting metal tubes, the combination comprising, a mold, means rapidly to conduct heat away from said mold, a mandrel supported in said mold in spaced relation to the inner periphery thereof, said mandrel being of a substance of low heat conductivity so that the exterior surface of a cast tube will cool faster than the interior surface thereof, said mandrel having its greatest diameter at the top, means to introduce melted metal to be cast into said mold above said mandrel, and means to remove a cast tube from said mold below said mandrel.

5. The method of casting continuous lengths of seamless metal tubes which comprises, continuously feeding molten metal into an annular mold between a sleeve and a mandrel, causing said cast tube to cool on its exterior surface and shrink away from said sleeve, later causing said cast tube to cool on its interior surface and shrink away from said mandrel, and finally withdrawing the solidified tube from beneath said mold.

MANUEL TAMA.