

March 24, 1942.

M. TAMA

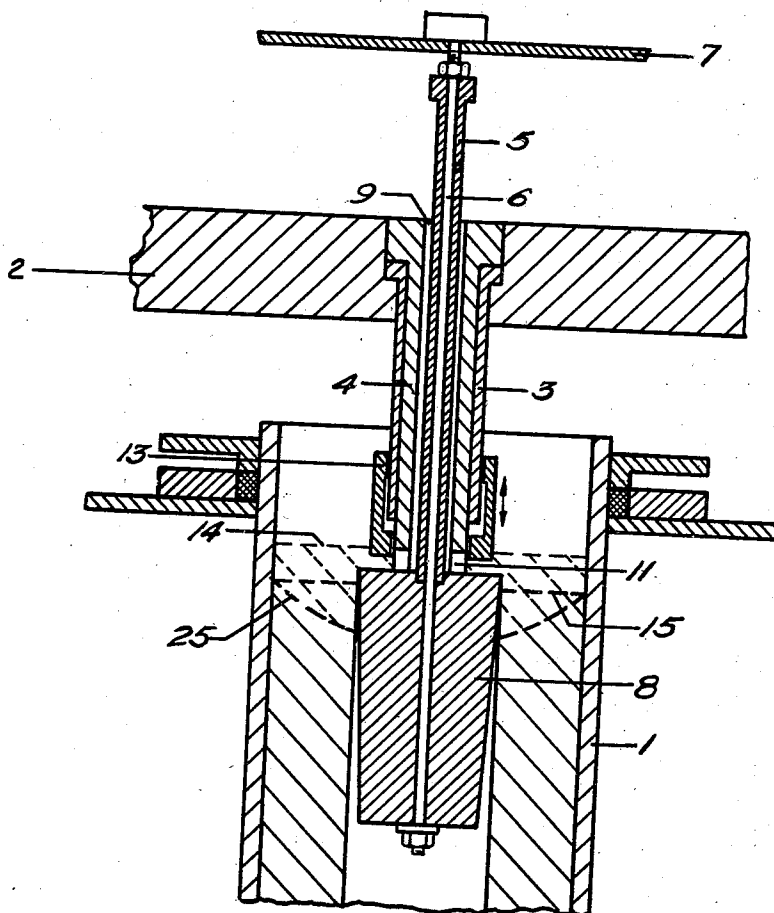
2,277,375

CONTINUOUS CASTING OF METAL TUBES

Filed April 5, 1941

2 Sheets-Sheet 1

FIG. 1



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2 Sheets-Sheet 2

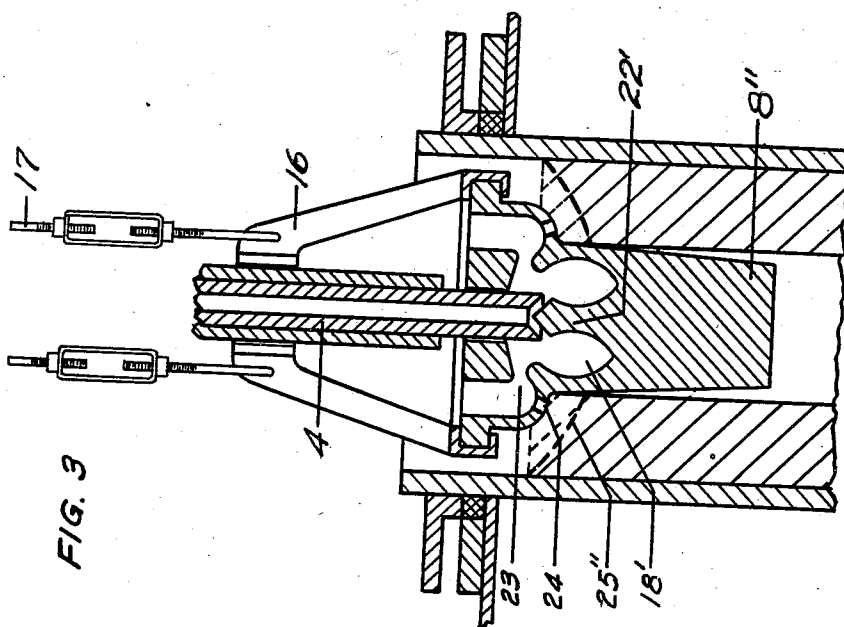


FIG. 3

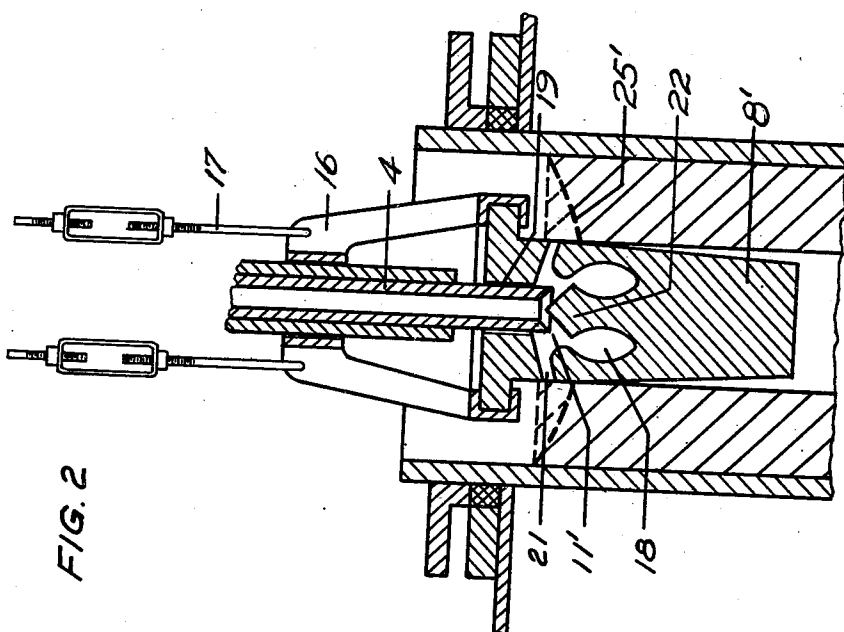


FIG. 2

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CONTINUOUS CASTING OF METAL TUBES

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Application April 5, 1941, Serial No. 387,010
In Germany April 8, 1940

5 Claims. (Cl. 22—57.2)

The present invention relates to devices for continuously casting metal tubes and particularly is concerned with a device in which the liquid metal is admitted by way of a supply pipe.

In a known device of this kind a mandrel is arranged directly adjacent and below a supply pipe for the liquid metal which is provided with lateral openings by way of which the metal may flow into an annular space between the mandrel and a mold. Such a device has been patented by me and is described in U. S. Patent 2,130,202. The operation of devices of this construction is satisfactory for the production of tubes the walls of which are of small thickness. However, if tubes having thicker walls are to be cast, certain difficulties arise due to the disturbance of the cooling conditions effected by the continuously admitted metal. Therefore, care is to be taken, that the cooling and solidification of the freshly admitted metal occurs as rapidly and as uniformly as possible.

According to the invention this object is obtained by so arranging the lateral discharge openings at the supply pipe that the liquid metal, after leaving the supply pipe, is guided for a certain distance and directed toward the cooled mold wall before flowing into the free annular space. This arrangement causes the admitted hot metal to be uniformly distributed and directly supplied to the cooled mold walls, where it may deliver the largest portion of its solidification heat. Whirlings and non-uniform solidification levels due to such whirlings are hereby prevented.

Further features and advantages of the invention may be gathered from the following description relating to the drawings which by way of example show some devices according to the invention.

In these drawings:

Fig. 1 is a diagrammatic longitudinal section through one device according to the invention.

Fig. 2 shows a longitudinal section through a second construction according to the invention, and

Fig. 3 is a longitudinal section through a construction according to the invention, similar to that of Fig. 2.

In the construction shown in Fig. 1 the mold 1 is adapted to be sprayed from the outside with a cooling medium, for instance water, in a manner similar to that known in connection with extrusion presses. Above the mold, a tank or the melting furnace for the liquid metal itself is arranged. In Fig. 1 only the bottom 2 of this tank furnace is shown and into this bottom a tube

4 surrounded by an insulating sleeve 3 is inserted. Within the tube 4 a rod 6 surrounded by an insulating coating 5 is provided the upper end of which is suspended from a support 7. The lower end of the rod 6 carries the mandrel 8 consisting of refractory material. Between the tube 4 and the coating 5 of the rod 6 an annular space 9 is formed which serves as supply pipe for the liquid metal which at the end of the tube 4 may flow, by way of the lateral opening 11, into the mold. The head of the mandrel 8 is of such width that its plate-like or plain upper surface 12 serves as distributor for the liquid metal. The metal, therefore, is deflected from its initial vertical direction of flow into the horizontal direction and as a result flows directly toward the wall of the mold 1.

To control the velocity of flow, a socket-like slide 13 is slidably arranged upon the end of the tube 4. By lifting or lowering this slide the velocity of flow may be controlled or the admission of metal may be interrupted.

Under usual operating conditions the liquid metal forms a level in the mold about in the height indicated at 14. It has been found, however, that the condition of the outer surface of the tube produced depends substantially on the velocity of flow of the metal. The latter again depends on the diameter of the mold and the velocity with which the solidified tube portion is removed. At a high rate of casting the liquid metal may impinge upon the walls of the mold in such a manner, that breaker waves are formed which may cause overlappings and similar surface defects. These serious drawbacks may be removed by the very simple method of lowering the level of the metal in the mold to the position shown at 15 in Fig. 1. Practically, when flowing over the edge of the head of the mandrel 8, the height of fall of the metal amounts to about 10 mm. which reduces its velocity of flow towards the walls of the mold so that no breaker waves may be formed.

According to the construction shown in Fig. 2 the mandrel 8' is suspended from a rod system 16, 17 which allows lifting and lowering of the mandrel relative to the supply pipe 4. Moreover, the mandrel 8' is provided, directly behind the discharge opening 11', with an annular trough-like recess 18 which is filled with metal flowing through the opening 11'. This recess serves the purpose of quieting the metal current and eventually of degasification. Gases eventually formed may escape by way of the annular slot 19. The overflow and distribution of the quiet metal from

the recess 18 is effected by openings 21 which are radically directed toward the wall of the mold and may lead somewhat obliquely downward to prevent the formation of the above mentioned breaker waves. Within the annular recess 18 a cone 22 is provided which cooperates with the opening 11' of the tube 4. By lifting and lowering the mandrel 8' the rate of casting may easily be controlled or the opening of the tube 4 may be closed completely.

In the construction shown in Fig. 3 openings 23 are connected to the trough-like recess 18' provided in the mandrel 8''. These openings 23 facilitate the degasification of the metal leaving the recess 18'. In this construction which is designed to obtain special large rates of casting the discharge openings 24 are rather strongly inclined downwardly so that breaker waves mentioned in the construction according to Fig. 1 cannot be formed at the wall of the mold.

It has been found most desirable to have the baffles so placed that the hot liquid metal will be directed in a smooth continuous stream from the supply pipe to the outer mold wall so that its heat may be withdrawn quickly, and so that the metal reaching the inner mandrel surface will be somewhat cooler.

As disclosed in my earlier patent, heretofore mentioned, it is desirable that all the heat of the molten metal forming the tube be withdrawn from the outer mold wall to prevent a binding between the inner tube surface and mandrel which must result if the mandrel is cooled as for instance in the disclosure of the British Patent 492,216, Figs. 3 and 4.

In my present invention the metal forming the tube solidifies along a line somewhat as shown by the dotted line 25 in Fig. 1. I have found that this is a very important consideration in the continuous casting of tubes.

Having thus described my invention what I claim as new and desire to protect by United States Letters Patent is as follows:

I claim:

1. A device for continuously casting metal tubes comprising a mold, a mandrel within said mold forming an annular space between the two, a centrally located supply pipe for conducting

molten metal to said annular space and means for regulating the flow and for uniformly distributing molten metal from said supply pipe substantially only against the wall of said mold.

2. A device for continuously casting metal tubes comprising a mold, a mandrel within said mold made of refractory material and, with the mold wall, forming an annular space for receiving molten metal, a centrally located supply pipe for conducting molten metal to said annular space said supply pipe being adapted with lateral openings cooperating with the top of said mandrel to deflect molten metal away from the sides of said mandrel and against the wall of said mold and means for regulating the size of the lateral openings for controlling the flow of molten metal into the annular channel.

3. A device for continuously casting metal tubes comprising a mold, a mandrel in spaced relation to the walls of the mold forming an annular space, a centrally located supply pipe positioned to feed molten metal onto and across the top of said mandrel and substantially only against the mold wall said pipe and mandrel being movable relative to each other whereby an opening between the two may be regulated to control the flow of molten metal into the annular space.

4. A device for continuously casting metal tubes comprising a mold, a mandrel in spaced relation to the walls of the mold forming an annular space, a centrally located supply pipe positioned to feed molten metal into trough-like recesses in the top of said mandrel and thence outwardly substantially only against the mold wall, said pipe and mandrel being movable relative to each other whereby an opening between the two may be regulated to control the flow of molten metal in the annular space.

5. In the method of continuously casting tubes by use of the apparatus set out in claim 4, the step of regulating the flow of metal from the supply pipe and the speed of withdrawal of the tube so that the level of the liquid metal in the annular space is always below the lowest level of the molten metal outlet in the supply pipe.

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