

June 24, 1941.

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2,246,907

CONTINUOUS MOLDING MACHINE

Filed April 12, 1940

2 Sheets-Sheet 1

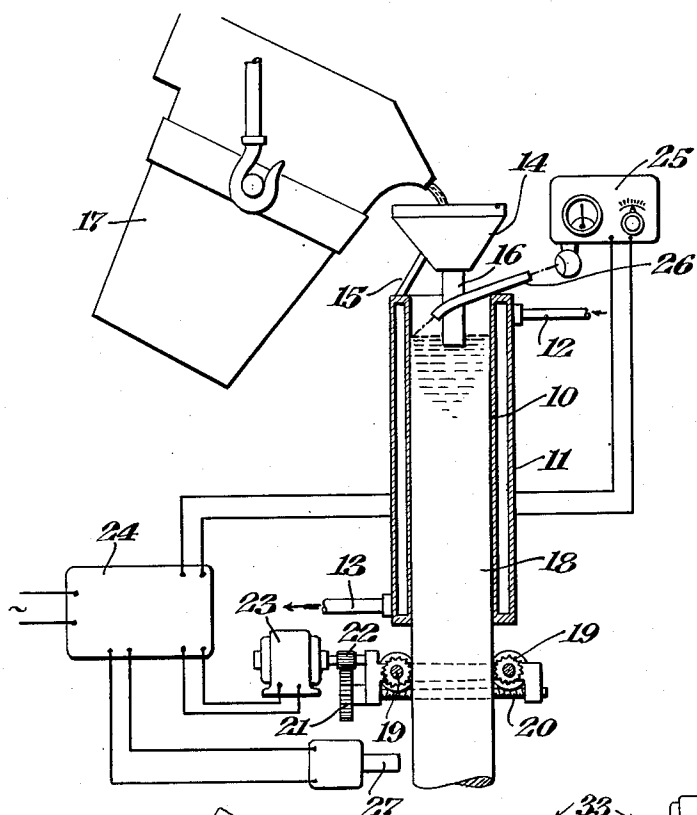


Fig. 1.

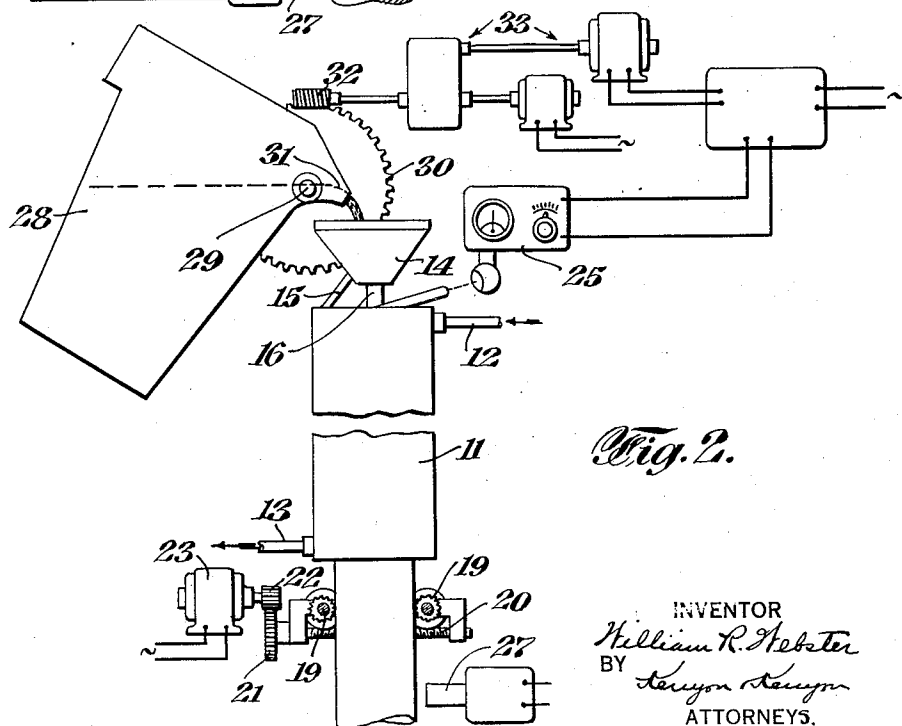


Fig. 2.

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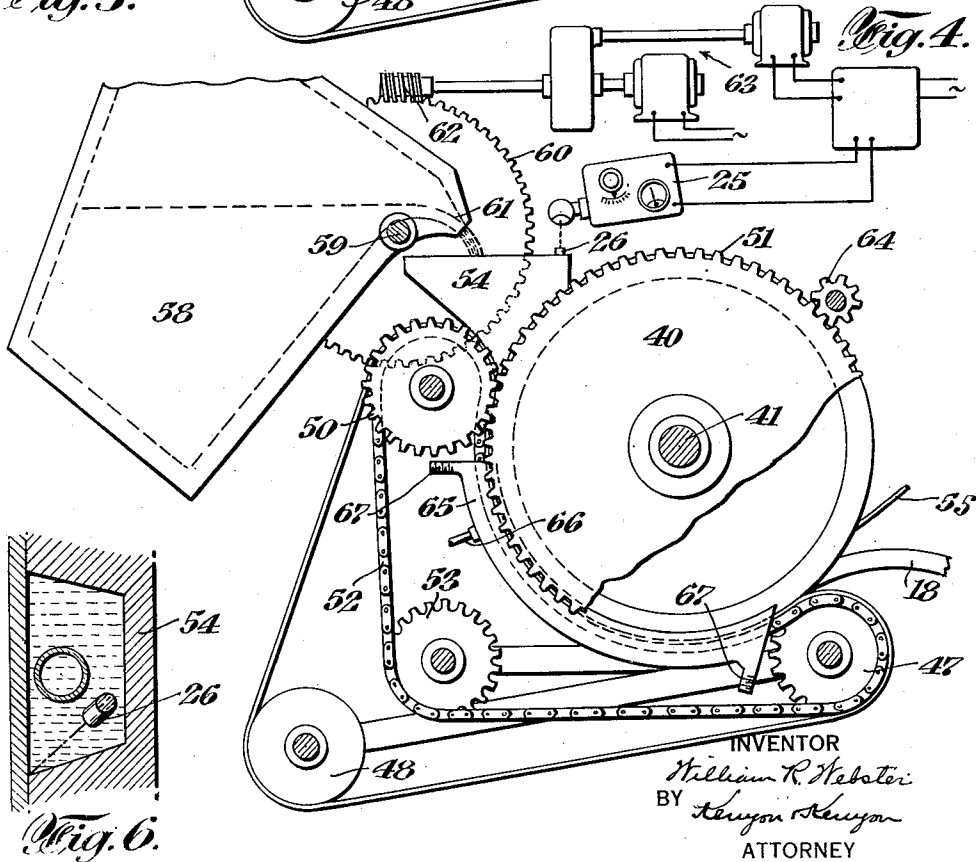
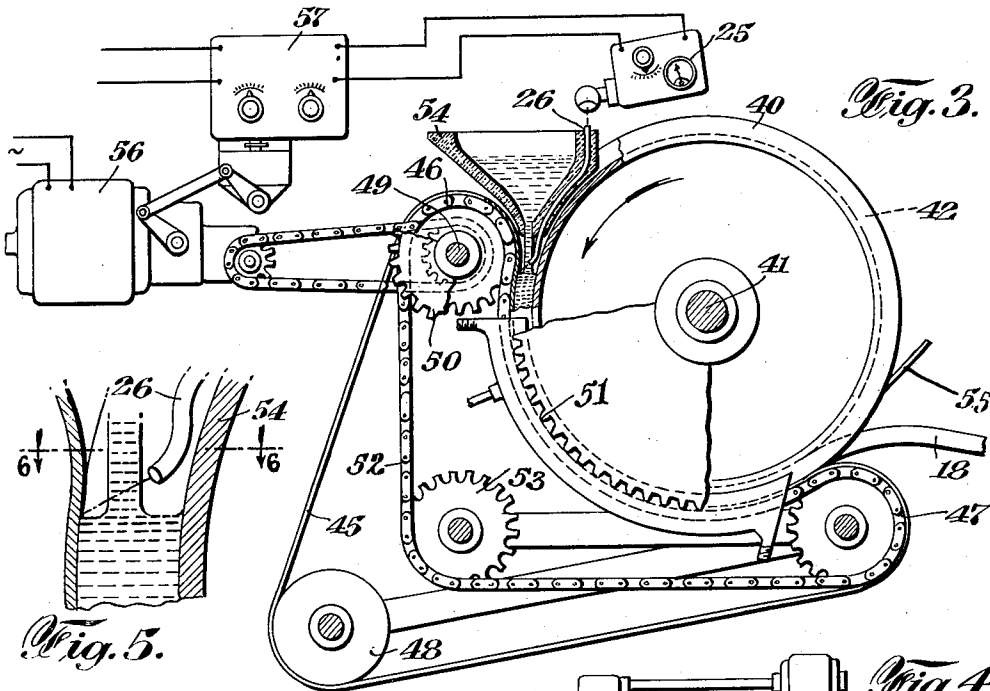
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CONTINUOUS MOLDING MACHINE

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2 Sheets-Sheet 2



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2,246,907

CONTINUOUS MOLDING MACHINE

William R. Webster, Bridgeport, Conn.

Application April 12, 1940, Serial No. 329,247

7 Claims. (Cl. 22—57.2)

This invention relates to continuous molding machines and more especially to machines for molding bars or rods of non-ferrous metal.

Heretofore, continuous molding machines have not been satisfactory due to the lack of uniformity in the molded rods or bars. The lack of uniformity has been due to the absence of means for controlling the relation of the feed rate of the molten metal to the discharge rate of the molded bar or rod. If the molded rod or bar is discharged at too low a rate, the molten metal overflows the mold and if the discharge rate is too great, then liquid metal is discharged instead of solidified metal.

An object of this invention is to provide a continuous molding machine in which the relation between the feed rate of molten metal and the discharge rate of the molded bar or rod is so controlled that uniformity is obtained.

A machine embodying this invention preferably comprises a molding chamber having an inlet and an outlet with the outlet desirably at a lower elevation than the inlet. The chamber may be a stationary continuous cylinder or may be composed of a movable endless member having a peripheral channel in combination with a cover for the channel over a portion of its length, and the cover may be an endless band or the like movable in synchronism with said member. Means are provided to introduce molten metal into the chamber inlet and means are provided to promote solidification of the metal in its passage through the molding chamber. Automatic means are provided for regulating the ratio of molten metal inflow to the linear emergent speed of the solidified metal and such means preferably is of a nature to be responsive to the level of molten metal in the chamber, although such means alternatively may be responsive to the temperature of the emerging solidified metal. The regulation of the ratio of molten metal inflow to solidified metal output is so controlled that back-up of the metal in the channel with consequent overflow is prevented as well as the possibility of metal emerging from the molding channel in fluid form.

Other objects, novel features and advantages of this invention will become apparent from the following specification and accompanying drawings, wherein:

Fig. 1 is a sectional view partially in elevation of an apparatus embodying the invention, certain of the parts being shown schematically;

Fig. 2 is an elevation of a modification of the embodiment illustrated in Fig. 1;

Fig. 3 is an elevation partly in section of a different embodiment of the invention;

Fig. 4 is a sectional view of a modification of the embodiment shown in Fig. 3;

Fig. 5 is an enlarged fragmentary view of the modification illustrated in Fig. 3, and

Fig. 6 is a section on the line 6—6 of Fig. 5.

In Figs. 1 and 2, 10 is a molding tube or chamber of tubular form open at both ends and housed within a casing 11 to provide a jacket for circulating cooling liquid around the molding tube. Pipes 12 and 13 are provided for supplying and withdrawing the cooling liquid. A pouring box 14 is supported above the molding tube 11 by struts 15 and a pipe 16 extends from the bottom of the pouring box 14 into the mold tube 10 a predetermined distance below the top of the molding tube. Molten metal to be cast is delivered from the furnace to suitable means, such as a tiltable ladle 17 from which the molten metal is discharged into the pouring box 14, the rate of flow from the pouring box through the pipe 16 into the molding chamber being constant.

Means well known in the art, but not disclosed herein are provided for initiating the forming of the ingot blank or stool 18 in the mold, an example of such means being illustrated in the patent to Williams, No. 2,079,644. The ingot 18 is withdrawn from the mold tube by any suitable extracting or withdrawing mechanism, such for example, as toothed rollers 19 which engage the surface of the ingot. These rollers are operated in synchronism by a driving screw 20 provided at one end with a gear 21 which meshes with a pinion 22 mounted on the armature shaft of a motor 23. The motor 23 is connected in circuit with a variable current supply 24, the operation of which is controlled by a photo-electric cell 25. A quartz rod 26 or the like is arranged with one end properly positioned to deliver light to the photo-electric cell 25 and extends into the molding tube 10, the arrangement being such that the axis line of the rod is angularly related to the surface of the molten metal in the molding tube. With this arrangement, light is transmitted from the molten metal through the rod 26 to the photo-electric cell when the height of molten metal in the tube lies above the point at which the axis line intersects the tube wall, but is transmitted only slightly or not at all when the molten metal level is below such point.

The inter-connection between the photo-electric cell 25 and the variable current supply 24 is such that a decrease in the light transmitted to

the photo-electric cell results in a decrease in the current supplied to the motor 23 with consequent decrease in the speed of rotation of the toothed wheels 19 and retardation of the emergent speed of the ingot 18 and that an increase in the light transmitted to the photo-electric cell results in an increase in the current supplied to the motor 23 with consequent faster rotation of the toothed wheels 19 and acceleration of the emergent speed of the ingot. The emergent speed of the ingot is thus varied in response to the height of the molten metal in the tube 10 and since the supply of molten metal to the tube is at a constant rate, uniformity is maintained in the condition of the bar emerging from the molding chamber.

The apparatus may also be provided with alternate control apparatus comprising a radiation pyrometer 27 or other suitable heat sensitive device arranged to be influenced by the temperature of the ingot as it leaves the molding tube. Such pyrometer is electrically connected to the variable current supply 24 in such manner that an increase of temperature in the emergent ingot results in a decrease in the current supplied to the motor 23 with consequent decrease in the emergent speed of the ingot while a decrease in the temperature of the emerging bar results in an increase in the current supplied to the motor 23 with consequent increase in emergent speed of the ingot. The pyrometer 27 may be used as a substitute for or in addition to the photo-electric cell 25 and may not enter into the control of the motor 23 under normal operating conditions.

In the modification illustrated in Fig. 2, an adjustable furnace 28 of the standard induction type is supported by the shaft 29 which carries the worm wheel 30. The nozzle 31 of the furnace is arranged to discharge into the pouring box 14. A worm wheel 32 meshes with the gear 30 and is driven by variable speed means indicated generally at 33 and regulated by the photo-electric cell 25. The variable speed means 33 is designed to cause rotation of the worm wheel 32 at a faster or slower speed, depending upon the height of the molten metal in the molding tube 10. As the height of the molten metal in the tube decreases, the rotational speed of the worm 32 is increased to tilt the furnace 28 to increase the rate of flow of the molten metal into the tube and this causes a rise in the level of the molten metal in the tube. In the event of an increase in the height of molten metal in the tube 10, the speed rate of the worm 32 is decreased with a consequent reduction in the rate of flow of molten metal into the tube. Also, in this embodiment, a radiation pyrometer 27 may also be used to regulate tilting of the furnace 28. Constant current is supplied to the motor 23 with resulting constant rotational speed of the toothed wheels 19.

In the embodiment illustrated in Figs. 3 and 4, a molding wheel 40 is carried by the shaft 41 and is provided with a peripheral channel 42. Over a portion of its length, the channel 42 is closed by an endless band 45 which passes around guide rollers 46 and 47 and a tensioning idler 48. The roller 46 is fixed to a shaft 49 and on the shafts 41 and 49 are provided gears 50 and 51 for effecting synchronism of the wheel 40 and the band 45. The band 45 preferably is reinforced by a link chain 52 of the Morse silent type, the chain being interposed between the band and each of the rollers 46 and 47 and provided with suitable teeth to co-operate with the chain links, the

chain also passing around a tensioning roller 53. A pouring box 54 is supported adjacent the upper point of contact of the band with the wheel and has a nozzle portion extending into the covered portion of the channel. A stripper 55 is provided for stripping the finished bar from the wheel. In Fig. 3, the shaft 49 is connected through suitable driving mechanism with a variable speed power transmitter 56, which is controlled by a suitable balancing device 57 such, for example, as one commonly known in the industry as a "Micromax electric control" which is a sensitive balance for regulating the output in proportion to demand and usually comprises an electrical controller unit and a relay detector unit, which in the drawings are illustrated diagrammatically.

In the wall of the pouring box 54 is provided a quartz rod 26 with its lower end having the same arrangement as described in connection with the preceding modifications (see Figs. 5 and 6). A photo-electric cell 25 is arranged to receive light from the end of the quartz rod 26 and is suitably connected to the transmitter 57. The inter-connection between the photo-electric cell and the transmitter is such that an increase of height of the molten metal in the molding chamber results in an increase of the rotational speed of the wheel 40 and a decrease in the height of molten metal in the molding chamber results in a decrease in the speed of the wheel.

In the modification of Fig. 4, an adjustable furnace 58 of the standard induction type is supported by the shaft 59 which carries the worm wheel 60. The nozzle 61 of the furnace is arranged to discharge into the pouring box 54. A worm wheel 62 meshes with the gear 60 and is driven by variable speed means indicated generally at 63 and regulated by the photo-electric cell 25. The variable speed means 63 is designed to cause rotation of the worm wheel 62 at a faster or slower speed, depending upon the temperature of the ingot 18 emerging from the channel in the molding wheel. As the height of the molten metal in the molding channel decreases, the rotational speed of the worm 62 is increased to tilt the furnace 58 to increase the rate of flow of the molten metal into the covered portion of the wheel and in the event of an increase in the height of the molten metal, the speed rate of the worm 62 is decreased with consequent reduction in the rate of flow of molten metal into the molding chamber. The wheel 40 is rotated at constant speed through the medium of a pinion 64 in mesh with the gear 51.

In the embodiment illustrated in Figs. 3 and 4, means are provided to promote solidification of the metal in the covered portion of the channel. Such means are indicated generally by the reference character 65 and preferably are of the same construction as illustrated in applicant's co-pending application, Serial No. 221,925. The unit 65 is provided with a water supply pipe 66 and two outlets 67, all as fully shown and described in said co-pending application.

In the embodiment illustrated in Figs. 1 and 2, the molding tube 10 may be of any desired cross-section, although in the drawings, it is shown as cylindrical. The cross section of the tube 10 alone would depend entirely upon the shape of the ingot which it is desired to produce. Likewise, in the embodiment illustrated in Figs. 3 and 4, the channel 42 may be of any desired cross section. Furthermore, it is to be understood that various modifications may be made in the

structure above described, without in any way departing from the spirit of the invention as defined in the appended claims.

This application is a continuation in part of William R. Webster application, Serial No. 221,925, filed July 29, 1938.

I claim:

1. A continuous molding apparatus comprising a molding chamber having an inlet and an outlet, means for continuously introducing molten metal through said inlet into said chamber, means to promote solidification of the molten metal in said chamber, means for withdrawing solidified metal from said chamber through said outlet, and means responsive to height increase of molten metal in said chamber to decrease the ratio of the molten metal flow rate to the linear emergent speed of the solidified metal discharged from said chamber and responsive to height decrease of molten metal in said chamber to increase the ratio of the molten metal flow rate to the linear emergent speed of the solidified metal, said last-named means consisting of a light transmitting member extending into the upper end of said chamber in position to transmit light from said molten metal only when the level thereof exceeds a predetermined height and light sensitive means to which light is transmitted through said member.

2. A continuous molding apparatus comprising a molding chamber having an inlet and an outlet, means for continuously introducing molten metal through said inlet into said chamber, means to promote solidification of the molten metal in said chamber, means for withdrawing solidified metal from said chamber through said outlet, and means responsive to height increase of molten metal in said chamber to increase the linear emergent speed of solidified metal from said chamber and responsive to height decrease of the molten metal in said chamber to decrease the linear emergent speed of the solidified metal.

3. A continuous molding apparatus comprising a molding chamber having an inlet and an outlet, means for continuously introducing molten metal through said inlet into said chamber, means to promote solidification of the molten metal in said chamber, means for withdrawing solidified metal from said chamber through said outlet, and means responsive to height increase of the molten metal in said chamber to decrease the flow rate of molten metal into said chamber and responsive to height decrease of molten metal in said chamber to increase the flow rate of molten metal into said chamber, said last-named means consisting of a light transmitting member extending into the upper end of said chamber in position to transmit light from said

molten metal only when the level thereof exceeds a predetermined height and light sensitive means to which light is transmitted through said member.

4. A continuous molding apparatus according to claim 2 in which the height responsive means comprises a light transmitting member extending into the upper end of said chamber in position to transmit light from said molten metal only when the level thereof exceeds a predetermined height, and light responsive means to which light is transmitted through said member.

5. A continuous molding apparatus comprising a molding chamber having an inlet and an outlet, means for continuously introducing molten metal through said inlet into said chamber, means to promote solidification of the molten metal in said chamber, means for withdrawing solidified metal from said chamber through said outlet, and temperature sensitive means responsive to temperature increase of the solidified metal emerging from said chamber to increase the ratio of the molten metal flow rate to the linear emergent speed of solidified metal from said chamber and responsive to temperature decrease of said solidified metal to decrease the ratio of the molten metal flow rate to the linear emergent speed of said solidified metal.

6. A continuous molding apparatus comprising a molding chamber having an inlet and an outlet, means for continuously introducing molten metal through said inlet into said chamber, means to promote solidification of the molten metal in said chamber, means for withdrawing solidified metal from said chamber through said outlet, and temperature sensitive means responsive to temperature increase of the solidified metal emerging from said chamber to decrease the linear emergent speed of the solidified metal and responsive to temperature decrease of said solidified metal to increase the linear emergent speed of solidified metal.

7. A continuous molding apparatus comprising a molding chamber having an inlet and an outlet, means for continuously introducing molten metal through said inlet into said chamber, means to promote solidification of the molten metal in said chamber, means for withdrawing solidified metal from said chamber through said outlet, and temperature sensitive means responsive to temperature increase of the solidified metal emerging from said chamber to increase the molten metal flow rate and responsive to temperature decrease of said solidified metal to decrease the molten metal flow rate.

WILLIAM R. WEBSTER.