May 9, 1939. C. W. HAZELETT 2,157,538

DISTRIBUTING DEVICE

Filed April 2, 1937 3 Sheets-Sheet 1

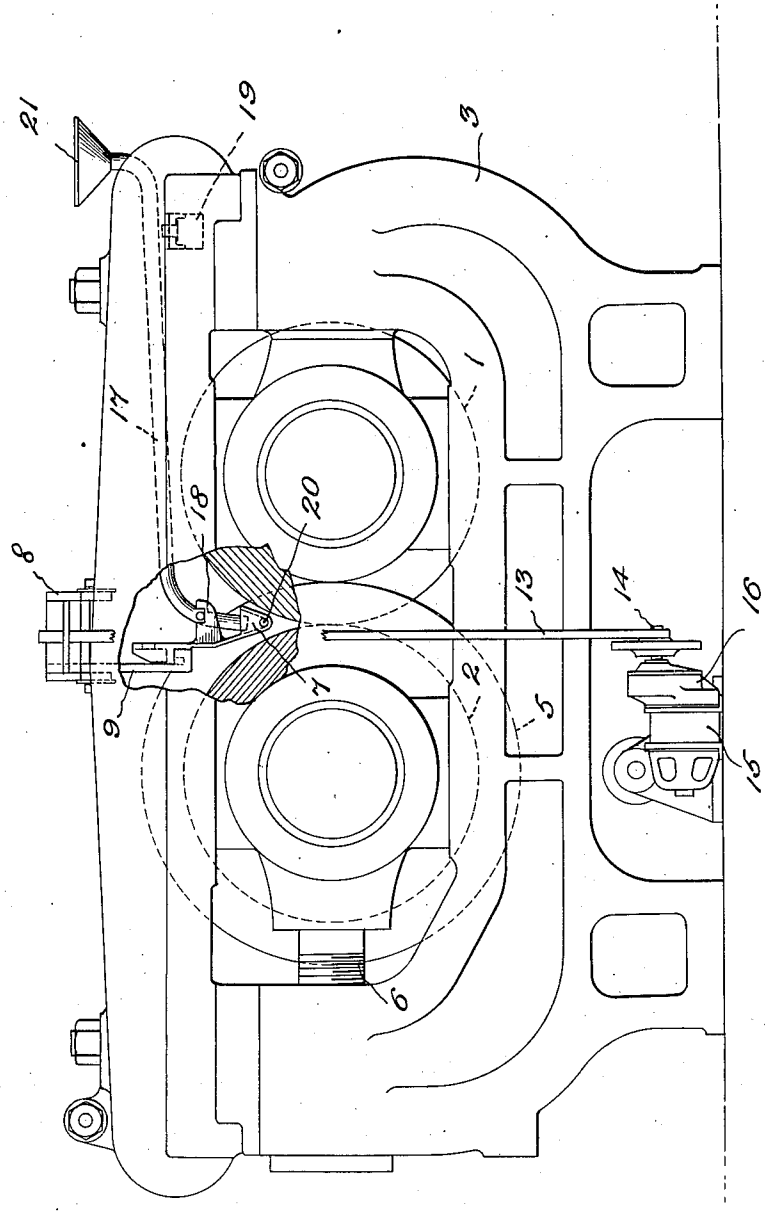


Fig. 1.

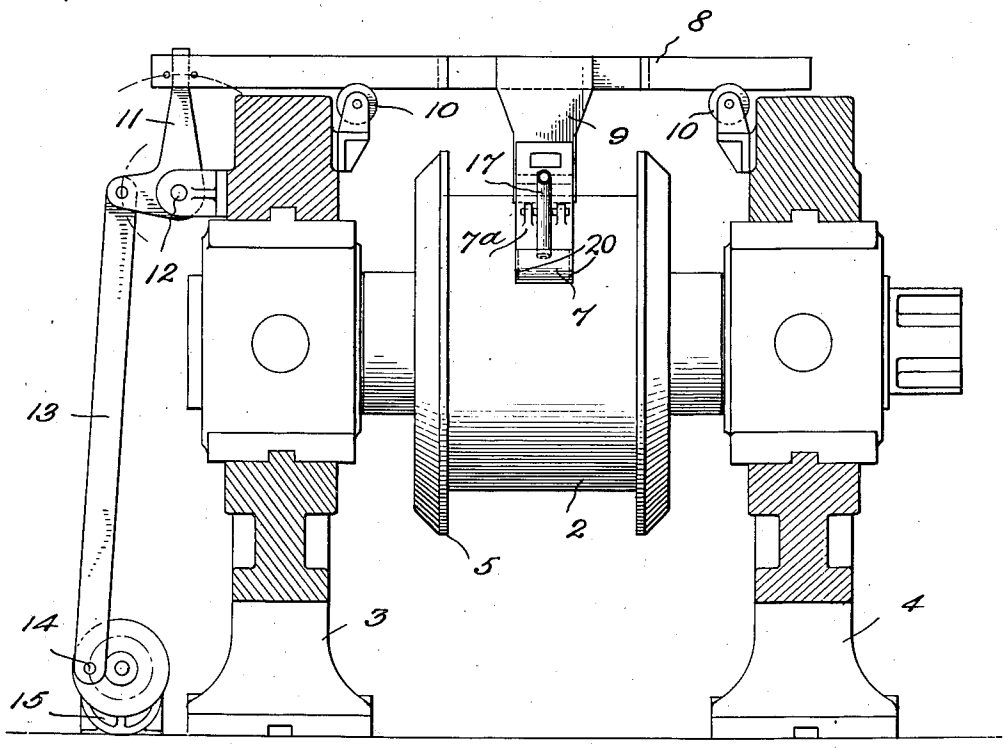
INVENTOR.
CLARENCE W. HAZELETT
BY
a. W. Weller
ATTORNEY.

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Filed April 2, 1937 3 Sheets-Sheet 2

Fig. 2.



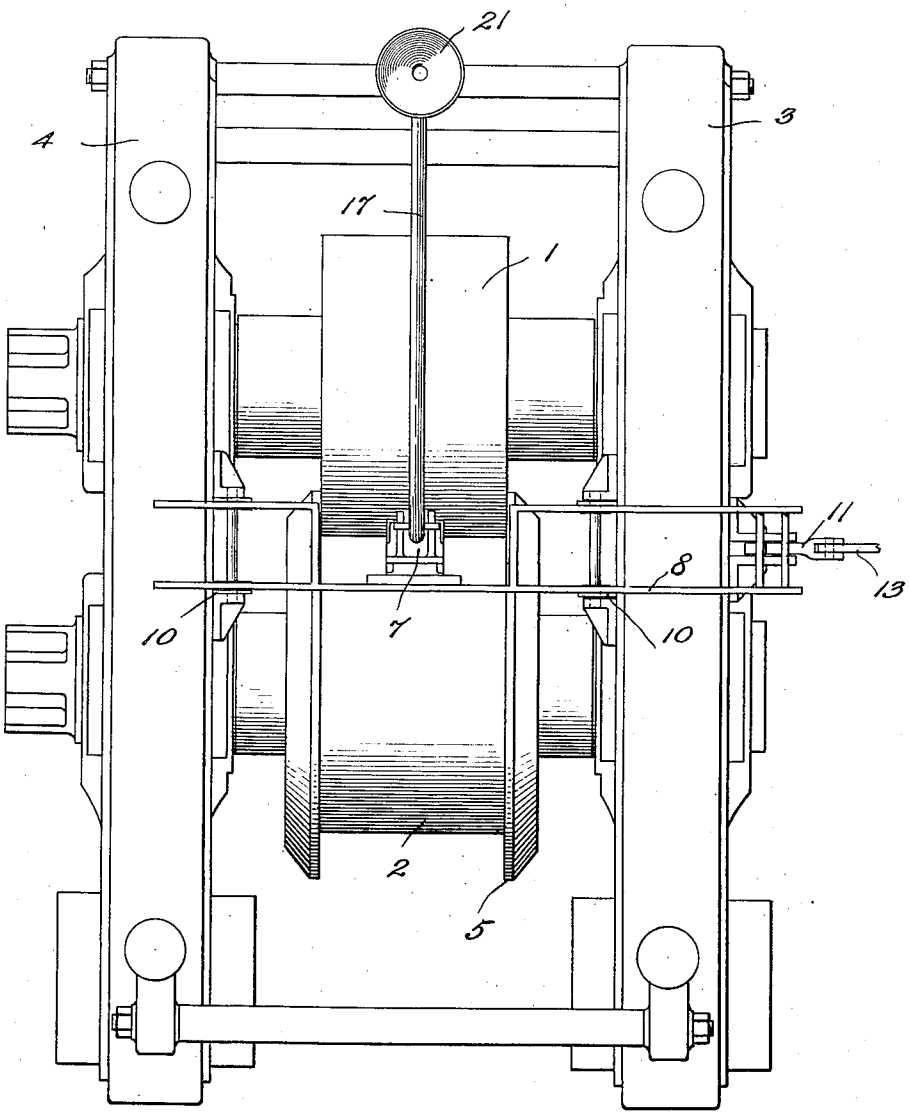
INVENTOR.
CLARENCE W. HAZELETT
BY
ATTORNEY.

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Fig. 3.



INVENTOR.
CLARENCE W. HAZELETT
BY
ATTORNEY.

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UNITED STATES PATENT OFFICE

2,157,538

DISTRIBUTING DEVICE

Clarence W. Hazelett, Greenwich, Conn.

Application April 2, 1937, Serial No. 134,487

6 Claims. (Cl. 22—57.5)

The present invention relates to the production of solid metal strip directly from molten metal, and, more particularly, to an improved means for distributing molten metal over a casting area to produce metal products of uniform cross section and of uniform structure.

It is an object of the present invention to provide an improved casting mill for continuously producing metal products of uniform cross section and of uniform structure directly from molten metal maintained in the form of a molten bath in between the bight of a pair of rolls.

It is another object of the present invention to provide a novel and improved mill for producing solid metal strip of accentuated width directly from a bath of molten metal in between the bight of a pair of rolls and maintained at a substantially uniform temperature throughout the width of said rolls.

It is a further object of the invention to provide a novel and improved distributing device for mills of the described character for pouring molten metal in controlled and preferred quantities in between the bight of a pair of co-operating rolls in a direction substantially parallel to the roll axes, and in such distribution as to maintain preferred temperature conditions of the molten bath along the width of the rolls.

The invention also contemplates an oscillatable distributing device for mills of the character described adapted to introduce a stream of molten metal into a bath maintained in between the bight of a pair of rolls in a direction substantially horizontal and parallel to the axes of the rolls and in such distribution along the rolls that substantially the same temperatures of the bath are maintained in the terminal regions of the rolls and in the intermediate regions thereof.

Other and further objects and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings, in which

Fig. 1 illustrates a side elevational view, having parts broken away for purposes of clarity, of a casting mill embodying the principles of the present invention;

Fig. 2 depicts a vertical sectional view, having parts in elevation, of a casting mill embodying the invention; and

Fig. 3 is a top elevational view of the casting mill shown in Figs. 1 and 2.

Broadly stated, according to the principles of my invention, I provide a pair of rolls rotatably mounted in a frame and provide driving means for rotating said rolls at a predetermined and preferred rate. One of the rolls may be provided with a flange or other suitable means at the ends thereof which form end dams and define a casting space within the bight of the rolls. Of course, any other type of end dam may be employed with equal or similar results. Above the bight of the rolls I provide an oscillatably mounted distributor member for the purpose of feeding molten metal into a bath of molten metal maintained in the casting space. The distributor member is provided with suitable actuating means adapted to oscillate or reciprocate the distributor in a direction parallel to the axes of the rolls. This oscillatory or reciprocating motion of the distributor will have the effect of distributing the stream of fresh molten metal along the full length of the rolls. I have discovered that novel and unexpected results can be obtained by imparting a linear velocity to the distributor which is different in different regions of its path. Assuming that the molten metal is fed at a uniform rate to the distributing member from an electric furnace, or the like, the quantity of metal discharged from the distributor in the unit of time will be constant. However, if the distributor is oscillated, the amount of metal discharged in a certain region of the bath will be in inverse ratio to the linear speed of the distributor in such region. In other words, the greater the linear speed of the distributor in the region contemplated, the smaller is the amount of molten metal discharged in said region. Thus, by imparting a predetermined linear velocity to the distributor, any desired distribution of the molten metal along the width of the rolls or of the bath may be readily and positively obtained. I have found that generally speaking it is of advantage to discharge accentuated amounts of molten metal at the ends of the rolls where due to the presence of the dams the cooling is relatively great and to discharge relatively small amounts in the intermediate regions of the bath. By discharging larger quantities of molten metal in the regions where the cooling is greater and smaller quantities of metal in the regions where the cooling is lower, it is possible to maintain substantially uniform temperature throughout the length of the rolls which is a preferred condition of operation in casting mills of the described type.

This preferred and desirable condition of operation may be readily obtained according to the principles of my invention by maintaining the distributor in a harmonic motion. As those

skilled in the art know, a harmonic motion is produced, for example, by the vertical projection of a point moving on a circular path at a uniform velocity, and is characterized by a relatively high speed at the intermediate part of its travel and by relatively low speeds at the ends of the displacement where the velocity is passing through zero and its direction is reversed. Such harmonic motion of the distributor is obtainable with great facility by means of suitable actuating means such as cranks, eccentrics or suitable cam discs or cam surfaces. The harmonic motion of the distributor will cause the discharge of relatively large amounts of molten metal into the terminal portions of the bath and relatively small amounts of metal in the intermediate regions of the bath whereby the desired temperature control of the bath is readily obtained and is positively maintained. Although in general a pure harmonic motion of the distributor is preferred, in some cases superior results are obtained by imparting such velocities to the distributor, for example by means of a cam, which is some other periodic function of time and which permits to adjust the periodical or reciprocating displacement of the distributor to the various metals or alloys and to the individual characteristic or cooling properties of the particular casting mill contemplated. Of course, in view of the foregoing principles, those skilled in the art will have no difficulty in determining the particular periodic function which is preferred for the particular case. The distributor is preferably so mounted that it discharges the molten metal into the bath underneath the surface of the bath and in a substantially horizontal direction in order to prevent the setting up of currents in a vertical direction which would disturb and remelt the metal already frozen in the bight of the rolls and would detrimentally influence the formation of a sound and perfect strip of uniform cross section and structure. The distributor is in turn supplied with molten metal from an electric furnace or the like, by means of a suitable conduit at least portion of which is adapted to follow the oscillatory displacement of the distributor. As an alternative, it is also possible to provide a stationary distributing box extending along the full length of the rolls and having an inlet or feed pipe constructed and arranged to oscillate along the full length of the distributing box and thus distributing the molten metal therein at a predetermined and preferred rate.

For the purpose of giving those skilled in the art a better understanding of the invention, the following description is given of a preferred embodiment.

Referring now more particularly to the drawings, a pair of rolls 1 and 2 are rotatably mounted in frames 3 and 4 and are adapted to be rotated at a controlled speed by means of suitable driving means (not shown). Roll 2 is provided with a flange 5 which cooperates with roll 1 to define a casting space between the bight of the rolls. The distance between the rolls may be adjusted by means of member 6 whereby the gauge of the product may be accurately controlled. Above the bight of the rolls is provided a distributing device 7*a* in the form of a bucket or box 7 which is suspended from a substantially horizontal beam 8 by means of a connecting member 9. Beam 8 is slideably mounted on rolls 10 provided in a suitable portion of frames 3 and 4 and is capable of being displaced in a direction parallel to the axes of rolls 1 and 2 of the mill. The actuating means for the horizontal beam comprises a bell crank lever 11, pivotally mounted in a pin 12, a connecting rod 13, and a crank 14. The crank is rotated by means of a small electromotor 15 through a reducing gear 16. Of course, similar oscillatory displacements of the beam and of the distributor box thereon may be obtained by means of cams, chains, and the like. The molten metal is brought to the distributing device by means of a conduit 17 supported at one end by a notched arm 18 rigidly connected to a projection of suspension member 9 of the distributing device 7, and pivoted at 19. Apertures 20 are provided in the ends of box or bucket 7 so that the molten metal discharging into the box 7 of the distributing device has the direction of its flow reversed and changed into a substantially horizontal flow which is discharged into the bath formed between the rolls. The far end of conduit 17 is provided with a funnel 21 for receiving the molten metal from a suitable source of supply, such as, for example, an electric furnace.

From the foregoing description, the operation of my improved casting mill and distributor will be readily understood by those skilled in the art. A continuous stream of molten metal is fed into the distributing box 7 through casting funnel 21 and conduit 17. At the same time rolls 1 and 2 are rotated at a speed in conformity with the rate of solidification of the molten metal in the bath provided above the bight of the rolls, whereby a solidified strip of substantially constant cross section is discharged from the bight of the rolls. To assure uniform cross section and uniform structure of the strip, the distributor box is oscillated by means of motor 15 which through reducing gear 16 crank 14 and connecting rod 13 will cause reciprocating displacement of bell crank lever 11 and horizontal reciprocating displacement of horizontal beam 8. The reciprocating or oscillatory displacement of beam 8 will, of course, cause similar displacement of distributor box 7 whereby molten metal fed to the box through conduit 17 will be discharged into the molten bath through the apertures 20 provided on the sides of the box. It will be readily observed from the drawings that the motion of the distributing box will be a harmonic motion and thus a much larger amount of molten metal will be discharged into the bath in the proximity of the end dams where the speed of the distributor box is passing through zero and is reversed than in the intermediate regions of the bath where the velocity of the distributor box is the highest. Thus, the desired temperature conditions can be maintained in a simple, positive and efficient manner. Of course, crank 14 may be replaced by means of suitable cam discs, cam grooves, actuating chains and the like, whereby any desired periodical control of the velocity of the distributing box may be obtained. In some cases I found it very advantageous to provide exchangeable cam discs to adjust the operation of the distributing box to the various operating conditions encountered when different metals or alloys are used or when other factors in the operation of the mill are varied.

It will be noted that the mill embodying the principles of the present invention provides numerous important advantages. First of all, the mill and the distributor device of the invention provides reciprocating or oscillatory displacement of the distributor box along the width of the rolls the molten metal being distributed along the

bath in a preferred and predetermined manner. Thus, in the illustrated preferred embodiment of the invention in which a crank is employed to provide the reciprocating motion of the distributor box, the molten metal is distributed in such a manner that more metal is deposited at the ends or terminal portions of the rolls in proximity of the flanges, than at the intermediate or center region. This result is obtained by the oscillating motion imparted to the distributing device which involves slow motion and stopping of the box at the ends of the stroke and compensates for the increased cooling due to the flanges or dams.

It is also to be observed that the oscillatory displacement and its advantages are not limited to a harmonic motion but the linear velocity of the distributing device or box may be controlled in accordance with any other periodic function of time as this has been explained more fully hereinabove. This can be readily accomplished by means of various mechanical elements such as, for example, cams whereby any desired amount of metal may be delivered at any particular region of the bath parallel to the roll axes.

A further advantage derived from the construction embodying the principles of the invention is the possibility of pouring a relatively large quantity of metal through a single conduit, such as 17. In this manner it is possible to dispense with auxiliary heating of the distributing device which heretofore was indispensable in order to prevent freezing or skulling. It has been found that the relatively large amounts of molten metal passed through casting funnel 21 and conduit 17 are sufficient to maintain these elements at the desired temperatures at which the cooling effect on the incoming metal is negligible.

Furthermore, in the distributing device of the invention the molten metal is introduced and flows quietly into the distributor box below the level of the molten metal therein thereby obtaining the advantages of underpouring. Likewise, the stream of molten metal flows uniformly through both apertures in the distributor box due to the hydraulic head therein and in consequence of the horizontal apertures is discharged into the bath without producing any vertical velocity. Thus, the incoming stream cannot penetrate the part of the metal already frozen or solidified on the roll surface, and any interference with the correct and uniform course of the solidification is substantially eliminated.

Although the present invention has been described in connection with a preferred embodiment thereof, variations and modifications may be resorted to by those skilled in the art without departing from the principles of the present invention. I consider all of these variations and modifications as within the true spirit and scope of the present invention as disclosed in the present description and defined by the appended claims.

I claim:

1. In a casting mill for producing solid metal of substantially constant cross-section throughout its length directly from a mass of molten metal having a pair of adjacent and operatively associated rolls, end dams at the ends of the rolls and defining a casting space therewith adapted to hold a bath of molten metal, and means for rotating said rolls to cause the ejection of solidified metal from the bight of the rolls; the improvement which comprises a horizontal beam mounted above the bight of said rolls, a plurality of rollers for displaceably supporting said beam, a distributing box depending from said beam, pivotally mounted conduit means protruding into said box for feeding molten metal thereinto, substantially horizontal apertures in said box to discharge molten metal into said bath underneath the surface thereof and without imparting a vertical velocity thereto, a power-driven crank for converting continuous rotation into a reciprocating motion, and means including a connecting rod and a bell-crank lever for transferring said reciprocating motion to said beam whereby said distributing box will be reciprocated in a direction parallel to the roll axes and will pour larger quantities of molten metal at the ends of the rolls than at the central portions thereof.

2. In a casting mill for producing solid metal of substantially constant cross-section throughout its length directly from a mass of molten metal having a pair of adjacent and operatively associated rolls, end dams at the ends of said rolls and defining a casting space therewith adapted to hold a bath of molten metal, and means for rotating said rolls to cause the ejection of solidified metal from the bight of the rolls, the improvement which comprises a displaceable horizontal beam located above the bight of said rolls, a distributing box secured to said beam and extending into said bath, pivotally mounted conduit means protruding into said box for feeding molten metal thereinto, substantially horizontal apertures in said box to discharge molten metal into said bath underneath the surface thereof, a bell crank lever and a connecting rod for reciprocating said beam and said distributing box, and a power-driven crank for actuating said reciprocating means whereby said distributing box will be reciprocated at a periodically varying linear velocity.

3. In a casting mill for producing solid metal of substantially constant cross-section throughout its length directly from a mass of molten metal having a pair of adjacent and operatively associated rolls, end dams at the ends of said rolls and defining a casting space therewith adapted to hold a bath of molten metal, and means for rotating said rolls to cause the ejection of solidified metal from the bight of the rolls; the improvement which comprises a displaceable horizontal beam above the bight of said rolls, a distributing box secured to said beam and extending into said bath, conduit means for feeding molten metal to said box, substantially horizontal apertures in said box to discharge molten metal into said bath underneath the surface thereof, and actuating means including a crank and a motor for reciprocating said beam and said distributing box in a direction parallel to the roll axes to impart to said box low velocities at the ends and high velocities in the middle of said rolls.

4. In a casting mill for producing solid metal of substantially constant cross-section throughout its length directly from a mass of molten metal having a pair of adjacent and operatively associated rolls, end dams at the ends of said rolls and defining a casting space therewith adapted to hold a bath of molten metal, and means for rotating said rolls to cause the ejection of solidified metal from the bight of the rolls; the improvement which comprises a displaceable horizontal beam above the bight of said rolls, a distributing box secured to said beam and having substantially horizontal delivery ap-

ertures, means for feeding molten metal to said box, and means for reciprocating said beam and said box in a direction parallel to the roll axes and imparting to said box low velocities at the ends and high velocities in the middle of said rolls whereby more metal is poured at the ends of said rolls than at the central portion thereof.

5. In a casting mill for producing solid metal of substantially constant cross-section throughout its length directly from a mass of molten metal including a pair of adjacent and operatively associated rolls, end dams at the ends of said rolls and defining a casting space therewith adapted to hold a bath of molten metal, and means for rotating said rolls to cause the ejection of solidified metal from the bight of the rolls; the improvement which comprises feeding means including a distributing box for feeding molten metal to said bath, substantially horizontal delivery apertures in said box for changing the direction of the incoming stream at a point closer to the bath surface than the depth of the bath, a displaceable supporting member for said box, and means for reciprocating said member and said box in a direction parallel to the roll axes and imparting to said box low velocities at the ends and high velocities in the middle of said rolls whereby more metal is poured at the end of said rolls than at the central portion thereof.

6. In a casting mill for producing solid metal of substantially constant cross-section throughout its length directly from a mass of molten metal having a pair of adjacent and operatively associated rolls, end dams at the ends of said rolls and defining a casting space therewith adapted to hold a bath of molten metal, and means for rotating said rolls to cause the ejection of solidified metal from the bight of the rolls; the improvement which comprises feeding means including a displaceable apertured member for feeding molten metal to said bath in a substantially horizontal direction and underneath the surface of said bath, and means for reciprocating said member in a direction parallel to the roll axes and imparting to said member low velocities at the ends and high velocities in the middle of said rolls whereby more metal is poured at the ends of said rolls than at the central portions thereof.

CLARENCE W. HAZELETT.