W. A. DUNN.

ROLLER MILL.

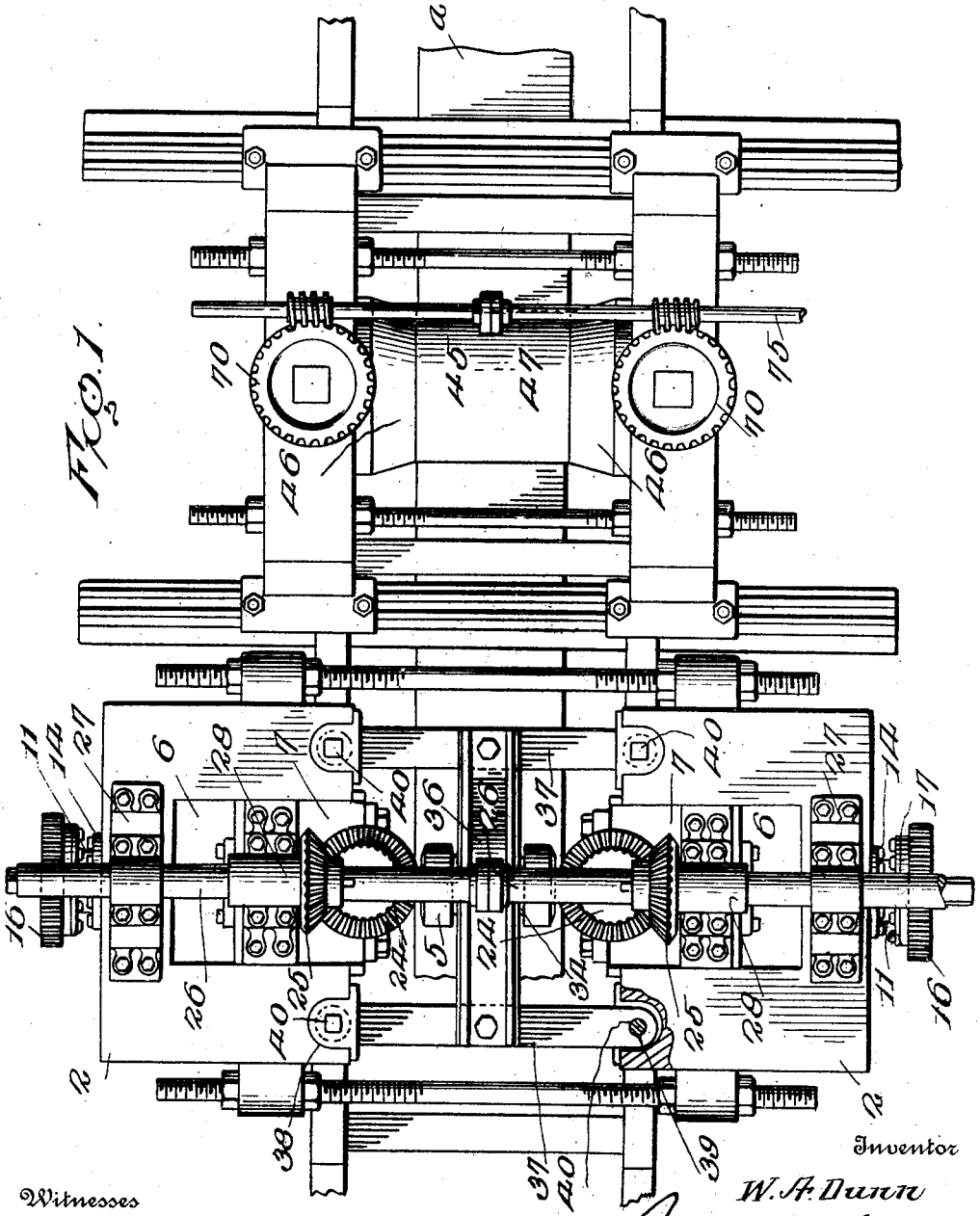
APPLICATION FILED APR. 19, 1910.

1,002,906.

Patented Sept. 12, 1911.

5 SHEETS—SHEET 1.

FIG. 1.



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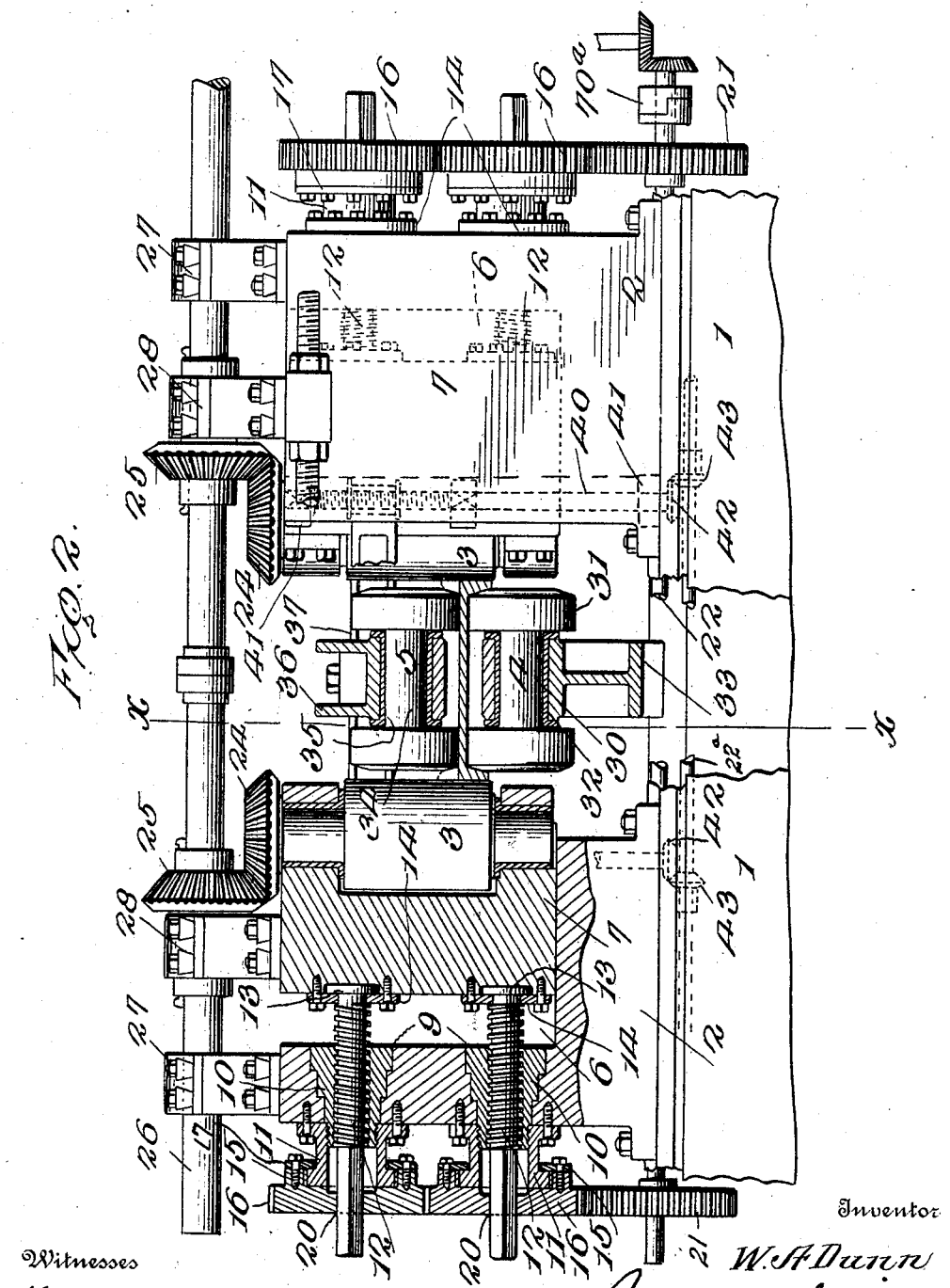
6 SHEETS—SHEET 2.

FIG. 2.



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5 SHEETS—SHEET 3.

FIG. 4.

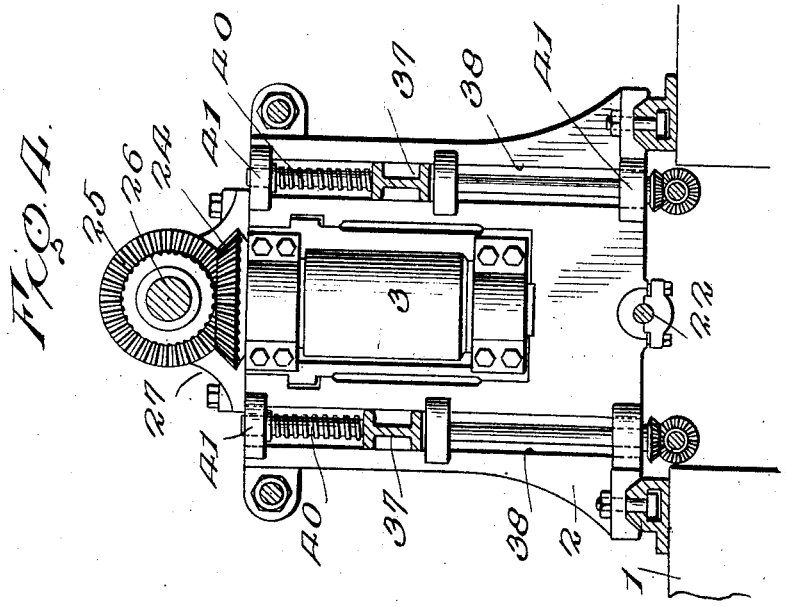
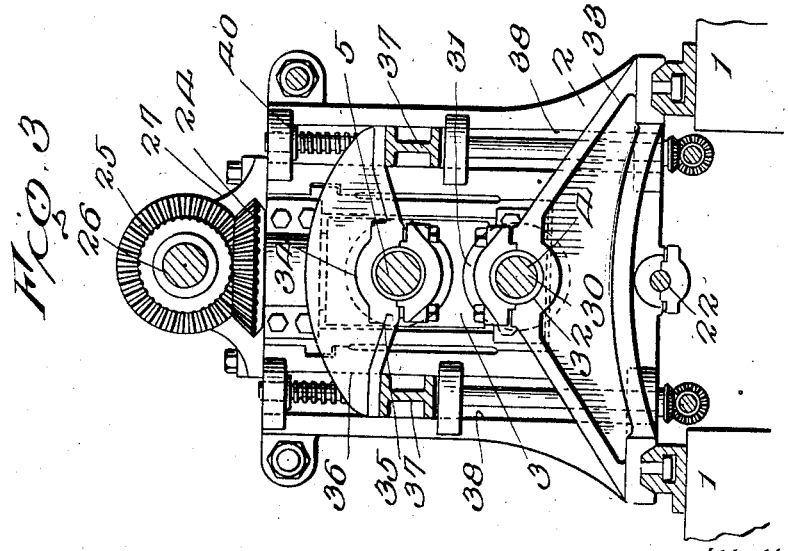


FIG. 3.



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5 SHEETS—SHEET 4.

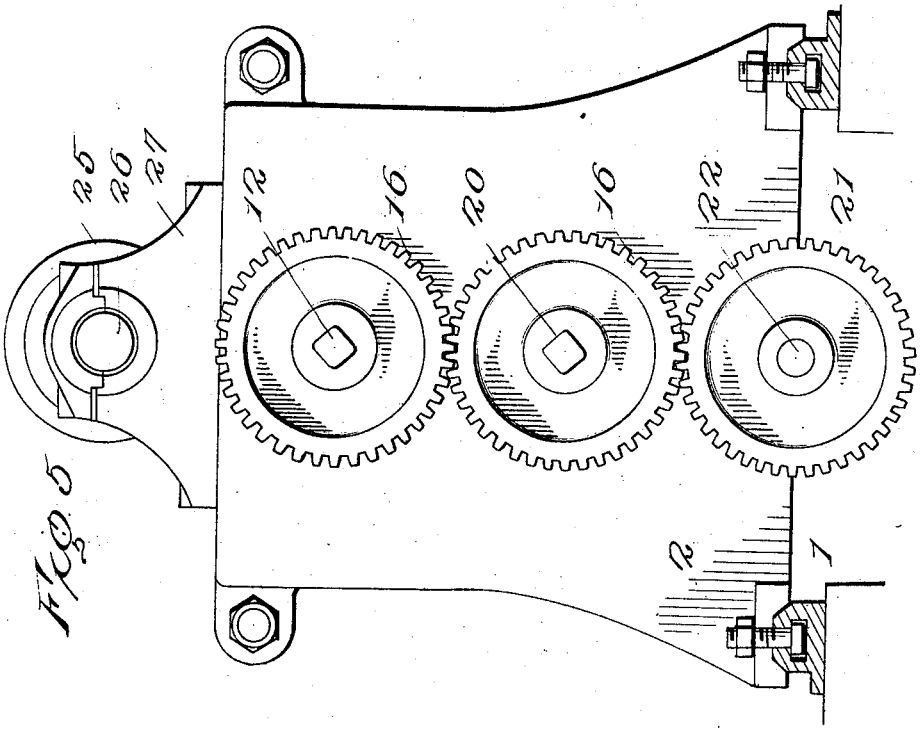

Fig. 5.

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5 SHEETS—SHEET 5.

Fig. 6.

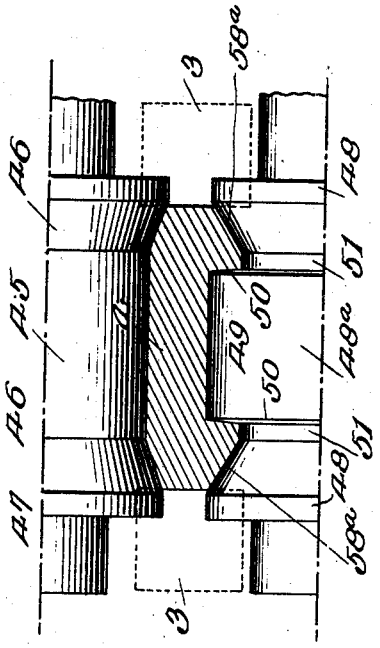
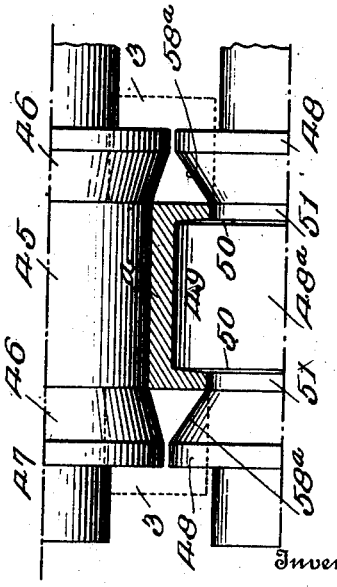


Fig. 7.



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UNITED STATES PATENT OFFICE.

WILLIAM A. DUNN, OF SMITHVILLE, MINNESOTA, ASSIGNOR OF ONE-HALF TO ATHOL MORTON MILLER, OF DULUTH, MINNESOTA.

ROLLER-MILL.

1,002,906. Specification of Letters Patent. **Patented Sept. 12, 1911.**

Application filed April 19, 1910. Serial No. 556,379.

To all whom it may concern:

Be it known that I, WILLIAM A. DUNN, a citizen of the United States, residing at Smithville, in the county of St. Louis and State of Minnesota, have invented certain new and useful Improvements in Roller-Mills, of which the following is a specification.

This invention relates to improvements in mills, designed primarily for shaping structural beam blanks of various types.

The invention relates to improvements in the structure disclosed in a patent granted to me Sept. 16, 1902, No. 709081.

According to my present invention, I provide specially designed rolls to engage the upper and lower surfaces of the ingots to effectively resist the tendency of the metal to buckle at the time side pressure of two vertical rolls is exerted, on each edge of the blank.

A further object of the present invention is to provide means for raising and lowering the upper pressure roll adjacent the vertical rolls, as the metal is reduced in thickness by the several passes made through the mill. As the upper pressure roll is subjected to great upward strain when the metal passes under it, it becomes vitally important to provide a substantial means to resist this strain, and yet be able to effect the raising and lowering with as little friction as possible. I have therefore provided a carriage of improved construction to accommodate the pressure roll, and also improved mechanism for raising and lowering the same.

A further object of the invention is to provide specially constructed mechanism for operating the vertical rolls which determine the width of a blank. According to my present improvements in this particular, I arrange the adjusting screws, one above the other, and in direct alinement with the center of the axis of the vertical rolls, thereby making it possible for the screws to receive the outward thrust exerted by the passing ingot directly in line with the center of the vertical rolls and making possible the use of ingots of greater depth than in mills now in use.

My invention also relates to improvements in the formation of the shaping rolls, whereby the mill may be adapted, by the substitution of various combination of rolls, to make beam blanks of various shapes, without in anywise altering the operating mechanism.

My present invention also comprises a structure wherein a pressure roll engages the inside of the flange of the ingot on which the vertical side rolls are working and which thereby prevents any displacement of the metal as the same is forced inwardly by the said rolls. A further advantage of the roll engaging the inner side of the flange is the resulting effect of reducing the thickness of such flange to a degree not possible where such roll is not employed.

The invention also comprehends improvements in the specific details of construction and arrangement of parts to be hereinafter described, and particularly pointed out in the claims.

In the drawings:—Figure 1 is a plan view of my improved mill. Fig. 2 is a view of the vertical rolls and their mountings, one of the latter shown in section to better illustrate the details of construction. Fig. 3 is a longitudinal sectional view on the line *x*—*x* Fig. 2. Fig. 4 is an inside view of one of the vertical rolls and its mounting. Fig. 5 is a side elevation of the frame in which the vertical rolls are mounted and the gears by means of which the said rolls are adjusted. Fig. 6 is a view of a pair of horizontal shaping rolls, with an ingot making its first pass therebetween preparatory to forming a channel beam blank. Fig. 7 is a view similar to Fig. 6, but illustrating the last pass of the ingot, the latter having been shaped to form a channel beam blank.

The same numerals refer to like parts in all the figures.

1 indicates supports for the frames 2—2, which carry the vertical rolls 3—3, and the horizontal supporting and pressure rolls 4 and 5. Each frame 2, is provided with a cut away portion 6 to form a guide way for a sliding bearing block 7, having ribs to engage corresponding grooves in the walls of the guide way. The inner face of each of the sliding bearing blocks is formed with a recess, and the upper and lower walls of the recess are formed with openings to receive the journals of one of the vertical rolls 3. The periphery of each roll 3 is smooth throughout its length, as clearly shown in Fig. 2. In the outer vertical wall of each frame 2, are two horizontal openings 9—9, one located above and in

alinement with the other, and both being axially in the plane of the axis of the vertical rolls. In each of said openings is inserted an interiorly threaded bushing 10, of suitable metal. The bushing is also threaded on its outer end and receives a collar 11.

Extending from each sliding bearing block are two screws 12, one having a right hand thread and the other a left hand thread and which engage the correspondingly threaded bushings, and each has square extension protruding through the collar 11. The inner end of each screw is formed with a flange 13 which fits in a recess in the sliding bearing block, and is adapted to turn freely in the latter. A retaining plate 14, fits over each screw, and against the flange 13 thereof, and is bolted to the face of the sliding block to retain the flange in its recess. This construction is designed to form a substantial swivel connection between the screws and the sliding blocks. The retaining plates 14, while serving to form a part of the swivel connection, also form bearing surfaces against which the flanged ends of the screw bear when the sliding blocks are drawn out.

The hubs 15, of gears 16, fit over the outer flanged end of each collar 11, and to the inner face of each hub is bolted an annular flange 17, which engage behind the flange on the end of the said collar, thereby holding the gear in position, for it to freely revolve. Each gear 16, is formed with a square opening 20, through which passes the square extension of one of the screws 12. The gears 16—16 on each side the frames mesh with each other, and they are revolved by a gear 21, mounted on a line shaft 22, extending under the frames 2—2.

Of course it will be understood that the construction just described, is the same on both sides of the mill, and by reason of the train of gears being connected, both sliding bearing blocks will be simultaneously moved.

On the upper journals of the two vertical rolls 3—3 are bevel gears 24—24 which mesh with beveled gears 25—25, on a transversely arranged line shaft 26, mounted in bearings 27, on the frames 2—2. The gears 25, are splined to the line shaft, and are adapted to have a sliding movement thereon, a bearing 28 being provided for so mounting each gear, the said bearings being secured to the sliding bearing blocks.

The supporting roll 4, is formed at its center with a reduced portion to provide a journal 30, and its flanged edges 31 are beveled to fit snugly the tape 79 of the walls of the flanges of the beam blanks being supported. The journal 30 is supported in a bearing 32, formed in a base 33, secured to the supports 1—1. The pressure roll 5, is constructed exactly the same as the supporting roll 4 and it is adjustable toward and from the metal being operated upon. The central journal 34 of the pressure roll 5, is mounted in a bearing 35, formed in a yoke 36, secured to end cross bars 37. The ends of the latter fit in vertically disposed slots 38, in the frames 2—2. The ends of the bars 37, projecting in the slots and are formed with threaded openings 39, through which pass vertical screws 40, mounted to turn in suitable bearings 41. On the lower ends of the screws 40, are beveled gears 42, which mesh with beveled gears 43, on shafts 22^a. The gearing is so timed that as the ingots are reduced in thickness by being shaped by the horizontal shaping rolls, to be described the pressure roll will be lowered to contact with the top of the web of the beam blank as it passes over the supporting roll 4. By this construction of rolls, I am enabled to operate successfully on much wider ingots, hence produce larger beam blanks, than heretofore. This is due to the fact that the ends of the rolls form substantially bearing surfaces on the inner surfaces of the flanges of the beam blanks, when the metal is forced inwardly by the action of the vertical rolls. Furthermore the metal is for all practical purposes clamped between the rolls at the time the vertical rolls are acting on it, which effectually prevents the metal buckling.

The horizontal shaping rolls differ in configuration, according to the beam blank desired to be made. For shaping ordinary channel beam blanks the upper horizontal roll 47 will have a central cylindrical portion 45 (see Figs. 6 and 7) there being an inclined annular surface 46, from each end of the said central cylindrical portion. The lower horizontal roll 48^a is formed with flanged ends 48, and a central cylindrical portion 49 over which the ingot *a* fits. The edges 50, of the cylindrical portion 49, are beveled to reduced necks 51. The ends of the roll from the necks incline up at 58^a, to, and merge into the end flanges 48.

In the operation of the mill, the ingot is passed back and forth between the vertical and horizontal rolls until it has been reduced in thickness and shape to the desired outline, this depending altogether upon the character of beam blanks being rolled and the shape of the rolls placed in the mill to obtain the result.

Referring particularly to the illustrations disclosed in Figs. 6 and 7 where rolls are arranged for the formation of a channel beam blank, it will be seen that when the ingot makes the first pass between the horizontal rolls 47 and 48^a the metal is crowded down in the cavities formed by the necks 51, and by the downward pressure of the upper roll operated through the instrumentality of the gearing 70, which is substantially the same as that disclosed in the pat-

ent previously mentioned. The ingot passing from between the two horizontally disposed rolls 47 and 48ª is fed between the vertically disposed rolls 3, which at the first pass of the ingot, are so spaced that they will engage the sides of the ingot, and tend to further crowd in the metal. The ingot is supported on the roll 4 and is pressed down in contact therewith, by the upper roll 5. Were it not for the upper pressure roll 5, the inward pressure caused by the two vertical rolls 3—3 would tend to buckle the metal, and thereby destroy the proportions, as well as the outline of the proposed beam blank. The next pass of the metal between the horizontal rolls, reduces the thickness of the ingot, due to the beveled surfaces 46, and 58ª. The metal is crowded inwardly toward the center of the ingot, and against the ends of the center portion 48ª, of the lower roll, as described in the previously mentioned patent. The upper horizontal roll 47, is lowered by any suitable power being applied to the line shaft, the same power also setting into motion the line shaft 22ª, which, through the medium of the gears 42, and 43, simultaneously lowers the horizontal pressure roll 5, a distance proportionate with the distance traveled by the roll 47, and at the same time through the instrumentality of the gears 16, and screws 12, the two vertically disposed rolls 3, are advanced toward each other a distance commensurate with the size of the ingot after the latter has been subjected to a pass between the two horizontal shaping rolls. This operation is continued until the ingot has been reduced to the desired thickness for the proposed beam blank and the side ribs or flanges of said beam blank have been reduced to the desired thickness. It is when the ingot has been so reduced in thickness as to be more susceptible to a buckling action, due to the side pressure of the vertically disposed rolls 3 that the pressure roll 5, and the supporting roll 4, come mostly into play. This is due to the fact the web or body of the beam blank is so reduced in thickness it is more liable to buckle by the edge pressure exerted in opposite directions by the oppositely disposed rolls, particularly is this true with beams of unusual width. Inasmuch as the roll 4 receives the edge thrust of the side flange of the channel beam blank when the latter is acted on by the rolls 3 it is not necessary to have the pressure roll to engage the entire upper surface of the web, as the flange of the supporting roll prevents the inward pressure of said vertical rolls reaching the center of the web, hence I have devised the pressure roll so as to bear directly on the web of the beam blank at the points, where the buckling action usually takes place, as clearly shown in Fig. 2. The metal is passed back and forth through the mill as many times as may be found necessary to reduce the ingot to the desired shape as has been previously stated. The outward pressure exerted on the sliding blocks, by the ingot when passing between the vertical rolls, distributes the strain throughout the entire length of the said rolls, and thence to the screws, thereby materially preventing breaking of the elements.

By constructing a mill such as described I am enabled to handle ingots of unusual size for the production of beam blanks or plates of unusual width, and length, as the parts are so constructed and arranged as to effectively prevent the metal from buckling and the pressure is so distributed as to enable me to produce with accuracy a beam blank of determined width and thickness.

The action and movement of the vertical and horizontal rolls are controlled by the clutch 70ª, in precisely the same manner, and for the same purpose described in the patent therein mentioned.

What I claim is:

1. In a mill of the class described, the combination of two horizontal shaping rolls, operating means for decreasing the distance between the said rolls, two vertical side gaging rolls, operating means for moving the two vertical side gaging rolls toward each other, a horizontal supporting roll adjacent the vertical side gaging rolls, a horizontal guide roll located over the horizontal supporting roll, and adapted to be moved toward the latter and coöperating therewith to prevent buckling of the metal being operated upon by the vertical side gaging rolls, bearings intermediate the ends of said horizontal supporting and guide rolls in which the latter are mounted, and a train of gearing for operating the several operating means for decreasing the distance between the shaping rolls, decreasing the distance between the vertical side gaging rolls, and moving the pressure roll toward the supporting roll.

2. In a mill of the class described, the combination of two horizontal shaping rolls, operating means for decreasing the distance between said rolls, two vertical side gaging rolls, operating means for moving the two vertical side gaging rolls toward each other, a supporting roll adjacent the vertical side gaging rolls, a pressure roll located over the supporting roll, a yoke having a bearing for the center of the pressure roll, end bars supporting the yoke, screws engaging the bars to move the pressure roll toward the supporting roll, and a train of gears for operating the screws, adjusting the vertical side gaging rolls, and adjusting the upper horizontal roll.

3. In a mill of the class described, the combination with a pair of horizontal shap-

ing rolls, of means for operating the same, two vertical side gaging rolls, two sliding bearings for said vertical side gaging rolls, screws arranged one above the other and each being in alinement with the axis of the vertical roll and swiveled to the blocks, frames in which the bearing blocks slide and having threaded openings for the screws, flanged collars extending from the frames and through which the screws pass, a gear wheel mounted on the flange of each collar and formed with an opening through which the end of a screw passes, a flange on each gear which fits behind the flanges of its respective collar to hold the gear in place, intermediate gearing meshing with the gears on the screws, means for revolving the gearing, a supporting roll for supporting the ingot while being operated upon by the vertical side gaging rolls, a pressure roll having a reduced central portion, said pressure roll being located above the supporting roll, a yoke for supporting the pressure roll, means for operating the yoke, and means for adjusting the vertical side gaging rolls, the pressure roll, and the upper one of the horizontal rolls.

4. In a mill of the class described, the combination of a frame, a pair of vertically disposed side gaging rolls, sliding bearing blocks in which the vertical side gaging rolls are mounted, means for adjusting the vertical side gaging rolls, a supporting roll over which an ingot passes, the end faces of the supporting roll being spaced from the operative faces of the vertical side gaging rolls at all times, whereby to form spaces which confine the flanges formed on an ingot, a pressure roll above the supporting roll, a yoke for carrying the pressure roll, means for adjusting the pressure roll, and a pair of horizontal shaping rolls which coöperate with the vertical side gaging rolls to shape the ingot.

5. In a mill of the class described, the combination of a pair of horizontally disposed shaping rolls, a pair of vertically disposed side gaging rolls, means for adjusting the vertical side gaging rolls, a supporting roll adjacent the vertical rolls, a pressure roll above the supporting roll, said pressure roll being reduced at its center, a yoke in which the reduced portion of the pressure roll is mounted, two supporting bars on which the yoke is carried, means for raising and lowering the supporting bars to adjust the pressure roll, and a train of gearing for adjusting the vertical side gaging rolls, the pressure roll and one of the horizontal rolls.

6. In a mill of the class described, the combination of two horizontal rolls, one of said rolls having a reduced neck and a beveled annular surface extending from the neck to form a flange on an ingot, the other said roll bearing on the opposite surface of the ingot, two vertical side gaging rolls cooperating with the horizontal rolls, an upper pressure roll adjacent the vertical side gaging rolls, a lower supporting roll below and in the plane of the pressure roll, and means intermediate the ends of the pressure and supporting rolls for mounting the latter.

7. In a mill of the class described, the combination of two horizontal shaping rolls, one of said rolls having a continuous cylindrical portion, and a reduced neck at each end thereof, the said cylindrical portion forming a support for the entire surface of a beam between the flanges thereof, and an outwardly beveled annular surface extending from each neck to form flanges on an ingot, the other horizontal shaping roll having a central cylindrical portion slightly wider than the cylindrical portion of the first mentioned horizontal shaping roll, and formed at opposite ends with outwardly beveled portions, the said beveled portions being of greater diameter than the cylindrical portion, the cylindrical portion of said second roll extending the entire distance between the outwardly beveled portions of said roll to engage one entire surface of the beam, an upper pressure roll, a lower supporting roll below and in the plane of the pressure roll, a vertical roll at each end of the pressure and supporting rolls, and means for adjusting said vertical rolls toward and from the pressure and supporting rolls.

8. In a mill of the class described, the combination of a pair of horizontally disposed rolls, one of said rolls having a central cylindrical portion and reduced necks adjacent said cylindrical portions and outwardly beveled flanges extending from said necks, the other said roll having a central cylindrical portion of greater length than the central cylindrical portion of the companion roll and having outwardly beveled flanges extending from the cylindrical portion, a supporting roll, a pressure roll, a vertical roll adjacent to and spaced from the ends of the supporting and pressure rolls, and screws located in alinement with the axis and above and below the center of the vertical rolls for adjusting the latter rolls.

9. In a mill of the class described, the combination of a pair of horizontally disposed rolls provided with means for forming and gaging flanges, a horizontal supporting roll, a horizontal pressure roll, means for supporting said pressure and supporting rolls between the ends thereof, a vertical gaging roll spaced from the opposite ends of the pressure and supporting rolls, a carriage for supporting each of said vertical gaging rolls, a pair of screws lo-

cated one above the other and extending from each carriage in line with the axis of the roll, gears for simultaneously turning the screws of both carriages to adjust the gaging rolls and gears for operating the vertical gaging rolls.

10. In a mill of the class described, the combination of a pair of shaping rolls, a horizontal supporting roll and a horizontal pressure roll in alinement with the shaping rolls, each of said pressure and supporting rolls having a central reduced portion, bearings in which the central reduced portions of the said rolls are mounted, means for adjusting one of said bearings, vertically disposed side gaging rolls adjacent to and spaced from the ends of the supporting and pressure rolls, and means for adjusting said vertical gaging rolls.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM A. DUNN.

Witnesses:
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