C. M. GREY.

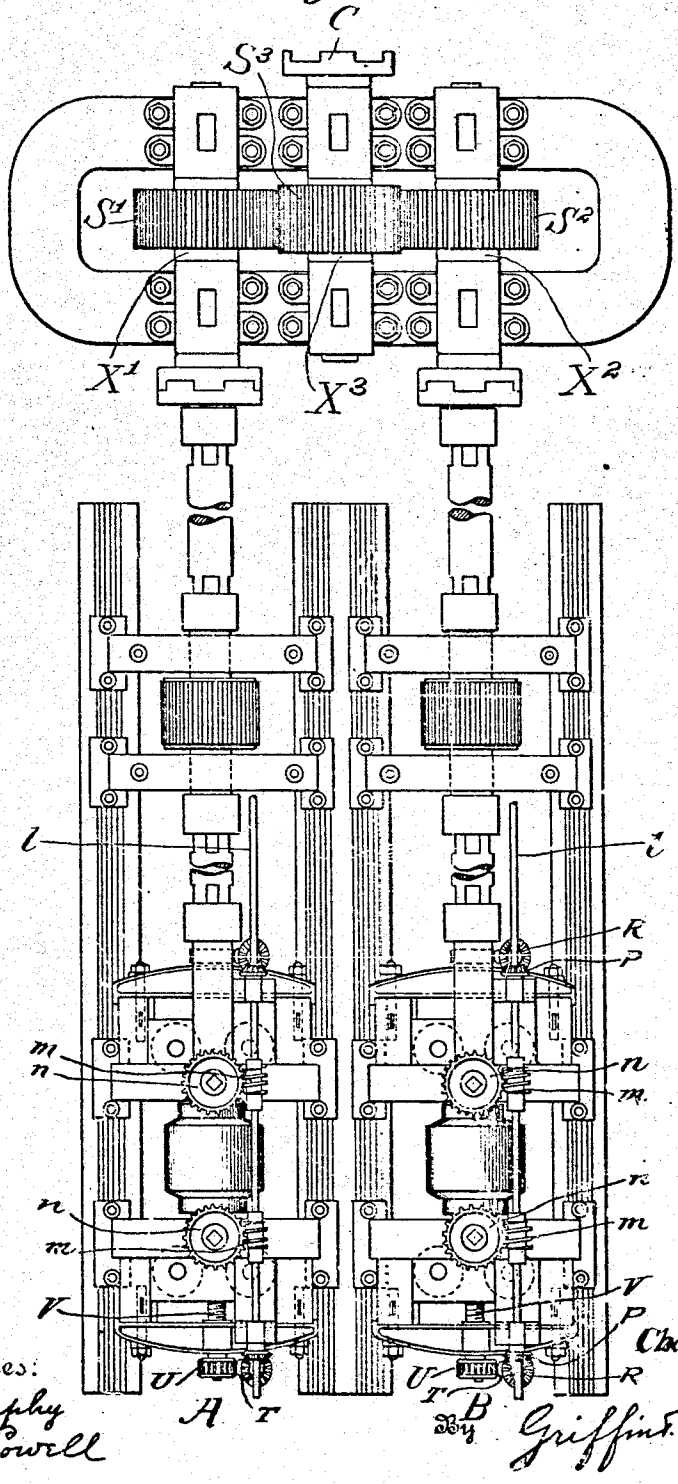
ART OF ROLLING.

APPLICATION FILED JULY 27, 1909.

968,465. Patented Aug. 23, 1910.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
L. L. Murphy
M. C. Powell

Charles M. Grey
Inventor

By Griffin & Bernhard
Attys.

C. M. GREY.

ART OF ROLLING.

APPLICATION FILED JULY 27, 1909.

968,465. Patented Aug. 23, 1910.

2 SHEETS—SHEET 2.

Fig. 2.

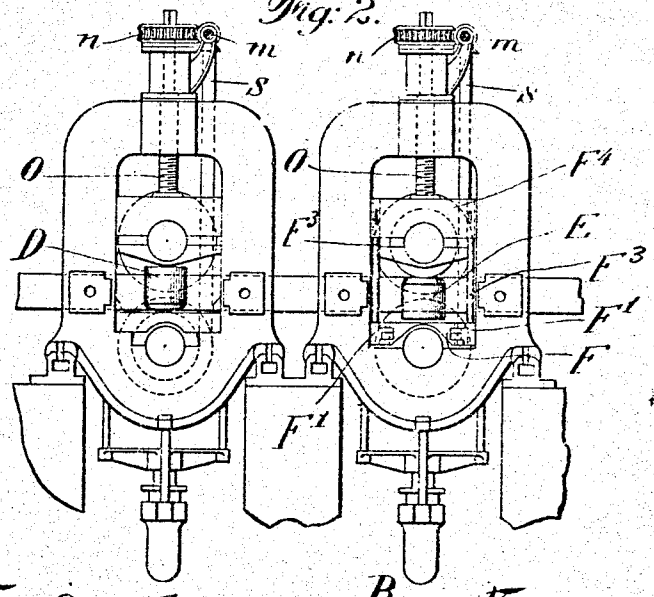


Fig. 3. A

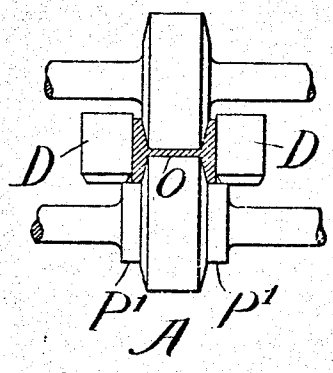


Fig. 4. B

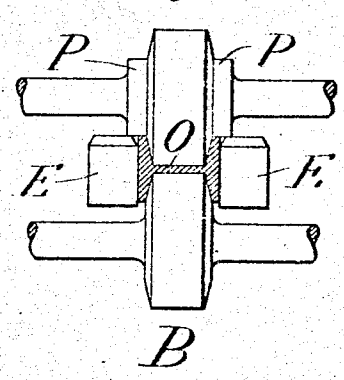


Fig. 5.

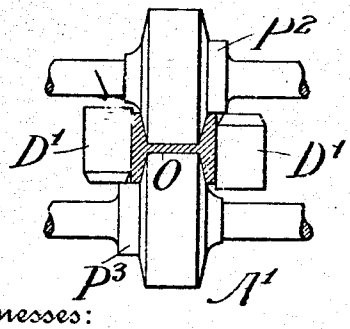
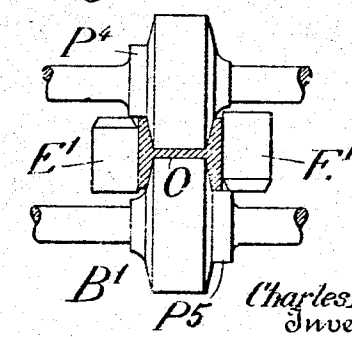


Fig. 6.



Witnesses:
S. J. Murphy
M. C. Powell

Charles M. Grey
Inventor
By Griffin & Bernhard
Attys.

UNITED STATES PATENT OFFICE.

CHARLES M. GREY, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO NEW YORK STEEL BEAM & GIRDER COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

ART OF ROLLING.

968,465. Specification of Letters Patent. Patented Aug. 23, 1910.

Application filed July 27, 1909. Serial No. 509,772.

To all whom it may concern:

Be it known that I, CHARLES M. GREY, a citizen of the United States, residing in East Orange, county of Essex, and State of New Jersey, have invented certain new and useful Improvements in the Art of Rolling, of which the following is a specification.

This invention is a new and useful rolling mill, wherein I employ main trains having rolls of a novel construction, for the rolling of beams, channels and other flanged sections, and the invention embodies, also, a new method of rolling.

In the rolling mill forming the subject matter of this invention I utilize the so called universal trains, or stands of rolls, of that type containing horizontal and vertical rolls wherein the axes of both the horizontal and vertical rolls are in the same plane. It has heretofore been the practice, in operating mills of this type, to use trains other than those constituting the universal train, frequently termed supplemental mills, to operate upon the edge of the flanges so as to regulate the width of the flanges, but the present invention enables said supplementary mill to be dispensed with.

The invention embodies mechanism for rolling flanged sections of metal, such as I-beams, H-beams, girder or channel beams, etc., without the necessity of raising or lowering feed tables at each passage of the bar as is the case in three-high mills. This is accomplished, moreover, without the use of the so called "supplementary mills" which operate only on the flange edges of the section being rolled, and require a heavy and costly equipment, which equipment is not utilized, however, to materially reduce the area of the section.

In universal mills supplied with supplementary rolls for working on flange edges only, the main rolls, *i. e.*, those working on both sides of the web and the inner and outer sides of the flanges, are subject to excessive wear, due to the fact that they must stand the abrasion incident to the reduction of area of the bar at each passage through the rolls. In applicant's invention this wear or abrasion, due to the reduction of area of the bar, is very materially overcome, since it is divided up between two sets of rolls, and, accordingly, is only half of what it is on each main set of a mill working in conjunction with supplementary or edge forming rolls. A mill embodying this invention enables two sets of supplementary trains to be dispensed with without loss of function, and, moreover, the new mill occupies only one-half the room and requires only one-half the roll changing that is necessary in order to provide against the wear of rolling a given tonnage on universal mills employing supplementary rolls.

In the accompanying drawings I have illustrated different practical embodiments of the invention, but the constructions shown therein are to be understood as illustrative only, and not as defining the limits of the invention, except as the scope of the claims demands.

Figure 1 is a plan view of my improved mill showing, also, a suitable driving mechanism therefor; Fig. 2 is an end elevation of the trains shown in Fig. 1, but, for clearness, omitting the backing rolls for the vertical rolls of said trains; Figs. 3 and 4 are diagrammatic views of the horizontal and vertical rolls of the trains shown in Figs. 1 and 2, and showing the piece in position to be operated upon; Figs. 5 and 6 are diagrammatic views of the horizontal and vertical rolls of the train shown in Figs. 1 and 2 illustrating a modification of the arrangement of rolls, shown in Figs. 3 and 4, and which might be used in practicing the invention.

Referring particularly to Fig. 1, I have illustrated therein two sets or stands of rolls, A and B, and each stand consists of four working rolls, two horizontal and two vertical, all having their axes in the same plane. The top horizontal roll of one train, say train B, has flange edge rolling collars, P, see Fig. 4, while the horizontal roll cooperating therewith is not provided with such collars. In the other train, however, say train, A, the bottom horizontal roll has flange edge rolling collars, P', see Fig. 3, while its coöperating horizontal roll is not provided with such collars.

The foregoing arrangement of flange edge rolling collars may be varied, as shown in Figs. 5 and 6, wherein the flange edge rolling collars are diagonally opposite one flange edge rolling collar, P^2, being formed on one roll, and another flange edge rolling collar, P^3, being formed at the opposite end of the other roll, see Fig. 5, or in opposing positions, as shown at P^4 and P^5, Fig. 6.

In Fig. 5, the vertical rolls are lettered, D′, and in Fig. 6, E′. I have designated the train shown in Fig. 5 as A′, and that shown in Fig. 6 as B′.

Fig. 2 is an end elevation of trains, A and B, omitting the backing rolls for the vertical rolls, D and E, and it will be observed that one end of each of the vertical rolls, E, is closely adjacent to the flange edge rolling collars, P, on the top roll, while one end of each of vertical rolls, D, are closely adjacent to the flange edge rolling collars, P′, on the bottom roll of train, A. Each vertical roll, E, is supported on a saddle, F, free to slide in blocks, F, which blocks are supported by the rods, F^2, attached to the top chucks, F^1. As a result, the upper edges of the vertical rolls, E, are always closely adjacent to the flange edge rolling collar, P, on the top roll, but, at the same time, are capable of lateral adjustment on account of being slidably mounted in the blocks, F′. The rolls, D, are held closely adjacent to the flange edge rolling collar, P′, on the bottom roll by any suitable means which prevents the saddle on which it is mounted from being displaced vertically.

The means for mounting and adjusting the vertical rolls is substantially the same as the means employed in universal mills, one example of which is disclosed in Grey's Patent, No. 943,635, granted Dec. 14, 1909, but such means may be described, generally, as follows.

By reference to Fig. 1 it will be observed that each stand of rolls is provided with a shaft, *l*, extending across the top of both housings and showing an end broken off adjacent to the pinion housing. Said shaft, in practice, is operated, *i. e.*, rotated, by any suitable motor, such as an electric motor. The shaft is provided with worms, *m*, which mesh with worm wheels, *n*, which wheels are so mounted on top of screws, O (Figs. 1 and 2) as to rotate said screws, while at the same time permitting them to move vertically (key or feather). Said screws effect the vertical adjustment of the horizontal rolls. The shaft, *l*, is also provided with bevel gears, P, meshing with gears, R, which latter are mounted upon a shaft (S) extending downward to a worm, T, which in turn mesh with a worm gear, U. Worm gear, U, is mounted upon the end of a screw, V, this latter screw effecting the in and out adjustment of the vertical rolls. It will thus be seen that with each adjustment of the horizontal rolls, which takes place before each succeeding reduction of the bar in cross sectional area, as it passes through said horizontal rolls, that the vertical rolls are, also, adjusted inward, through the mechanism described, thereby resulting in a proportional reduction of the cross sectional area of the flanges of the bar operated upon.

It will be observed that the vertical rolls are beveled at the ends that are adjacent to the flange edge rolling collars. This bevel is an important feature of my invention, for the reasons, mainly, that when the bar is being reduced in cross sectional area between the horizontal and vertical rolls no reduction in thickness of the flanges is made at the extreme end of the bevel, the latter being made sufficiently small in diameter to escape all pressure coming from any reasonable reduction in thickness of the flanges at one passage of the bar, and it provides a space for any metal that may be displaced or spread by the rolling action of the flange edge rolling collars. This space is of such form as to allow such displaced metal to assume a triangular shape, which shape facilitates the rolling or working of it into the body of the flange upon the next passage of the bar through the rolls. For instance, referring to Figs. 3 and 4, supposing we are working through mill, A, in one direction, and passing through mill, B, without any reduction; then working through B and passing through A without any reduction in cross section, but with the rolls of A placed in exactly the same position relatively as they are in B while rolling; it follows that even if there was a tendency to spread the metal at the edges of the flanges in B, it would be all straightened out in passing through A although A would otherwise be idle. If the vertical rolls were not beveled the displaced metal would spread out between the flange edge rolling collar and the end of the vertical roll adjacent thereto, forming a thin and proportionately wide fin which would be cold lapped into the flanges on the next passage of the bar. This cold lapping is fatal to the production of merchantable bars, hence the great importance of providing for the proper shaping of such fin as may occur.

Fig. 1 illustrates, also, the pinions or gears for operating the mill, and they are connected to a suitable drive, which, as shown, comprises three gear wheels, S′, S^2, S^3, mounted on shafts, X′, X^2, X^3, respectively. The middle shaft, X^3, is connected to a suitable motor through the medium of clutch, C. The two outside shafts are in turn connected to the pinions operating trains, A and B, in such a manner as to revolve the trains in the same direction.

In operating the mill as shown, one stand of rolls operates on the bar at each passage of the bar through the mill, while the rolls of the other stand are spaced sufficiently apart to render them inoperative as regards reduction in area of the bar. It is to be understood, of course, that the applicant does not limit himself to the particular type of drive illustrated, as any suitable device might be used for this purpose.

The drawings forming part of this specification contain many features, old in the art and the operation of which are well known, so I have not deemed it necessary to describe them in detail.

From the foregoing description of the mill, it is believed its operation will be readily understood by those skilled in the art, but it may be described, briefly, as follows: The driving crab or clutch, C, Fig. 1, is driven by any suitable motor or engine which is to be reversible at will, so that when the engine is driven in one direction, say in the line from A to B, only one stand of rolls either A or B will be used to reduce the cross section of the bar being operated upon; but when this bar, while traveling in the direction indicated, shall have passed through both the stands of rolls, in one of which the cross sectional area is reduced, and on the other of which no work is done at all, the mechanism is reversed, whereupon the bar travels in the opposite direction and is reduced in cross sectional area in that stand of rolls through which it previously passed without being so reduced. Thus the bar is caused to travel alternately in one direction or the other and when traveling in one direction is reduced in cross sectional area in one stand of rolls and when traveling in the other direction is reduced in area in the other set. For example, as the piece operated upon, *o*, passes through train, A, both sides of the web, the inner and outer sides of the flanges, and the edges of the bottom flanges will be rolled or elongated, while the top edges of the flanges will be free to spread in a vertical direction; now as the piece, being reversed in direction passes through mill, B, both sides of the web and the inner and outer sides of flanges and the top edge of flanges will be rolled while the bottom edge will be free to spread as before described.

As the rolling action on half the flange edges is designed to take place on alternate passages in accordance with the direction in which the bar is being delivered, and the action on the other half of the flange edges is made when the piece is being delivered in the opposite direction, it is evident that the operation of this mill is not dependent upon vertically opposite edges being operated on at alternate passes, but may be accomplished by working on diagonally opposite flanges at each alternate pass, as illustrated in Figs. 5 and 6.

One embodiment of the invention is illustrated in Figs. 2, 3, and 4 of the drawings, but an obvious modification consists in providing two stands of rolls, of the type described, one horizontal roll of each stand being fitted with flange edge rolling collars having one end of each of the vertical rolls closely adjacent thereto. Furthermore, this horizontal roll, thus fitted with flange edge rolling collars, would be relatively fixed, *i. e.*, would not have to be adjusted during the process of rolling, and the space between the two horizontal rolls of each train would be decreased for each successive pass by the vertical adjustment of the horizontal roll not provided with flange edge rolling collars. Means would be provided, of course, for the adjustment of the end of the vertical roll toward or away from the axis of the roll fitted with flange edge rolling collars and the vertical rolls in all cases would be so mounted as to be capable of lateral adjustment for each successive pass. The arrangement of the rolls previously described would, naturally, be the preferred form, since considerably fewer adjustments of the rolls are required therein.

The method disclosed in the foregoing description forms a valuable feature of the invention, and claims covering the same are appended hereto.

Having thus fully described the invention, what I claim as new, and desire to secure by Letters Patent is:

1. In a rolling mill for rolling sections having a web and four flanges, two stands of rolls each of which contains vertical and horizontal rolls the axes of all of which rolls are in the same plane, the rolls of one set being provided with working surfaces adapted to operate on the web and on the faces of the flanges and on the edges of two of the flanges only, and the rolls of the other set being provided with working surfaces adapted to operate on the web and on the faces of the flanges and on the edges of the two other flanges not operated upon by the first set of rolls, the said stands being so positioned relative to each other that both deliver the bar in the same direction at each rolling operation, and the reduction in cross section will be effected alternately on one stand and then on the other.

2. In a rolling mill for rolling sections having a web and four flanges, two stands of rolls each of which contains vertical and horizontal rolls the axes of all of which rolls are in the same plane, the rolls of one set being provided with working surfaces adapted to operate on the web and on the faces of the flanges and on the edges of the two flanges on one side of the web only, and the rolls of the other set being provided with working surfaces adapted to also operate on the web and on the faces of the flanges and on the edges only of the two flanges on the opposite side of the web from those operated upon by the first set of rolls.

3. In a rolling mill of the character indicated, the combination of vertical and horizontal rolls having their axes in the same plane, one of the said horizontal rolls being fitted with flange edge rolling collars,

the said vertical rolls having one end closely adjacent to the surface of said flange edge rolling collars, means whereby the vertical rolls may be moved up and down with the flange reducing collars, and to substantially the same extent, means for adjusting the vertical rolls laterally at each passage of the bar, and a single operating mechanism by which the adjustments of the vertical and horizontal rolls are effected simultaneously.

4. In a mill of the character indicated, a stand of rolls having vertical and horizontal rolls, said horizontal rolls being adjustable vertically relatively to each other, flange edge rolling collars on said horizontal rolls, each of said flange edge rolling collars having closely adjacent thereto the end of one of the vertical rolls, said vertical rolls being adjustable vertically, and to substantially the same extent at each adjustment as is the flange edge rolling collar against which one of its ends is adjacent, means for adjusting the vertical rolls laterally for each passage of the bar, and a single operating mechanism by which the adjustments of the vertical and horizontal rolls are effected simultaneously.

5. In a mill of the character described, a stand of vertical and horizontal rolls having their axes in the same plane, one of said horizontal rolls having flange edge rolling collars, one end of said vertical rolls being provided with a beveled portion of less diameter than said vertical roll for the purpose of facilitating the formation of a fin, if any is made, with a wide base, the beveled ends of the vertical rolls being positioned closely adjacent to said flange edge rolling collars.

6. In a rolling mill for rolling channeled sections, etc., the combination of two vertical rolls, and two horizontal rolls coöperating therewith, flange edge rolling collars on said horizontal rolls, said vertical rolls being cut away at their ends adjacent to said collars, thereby producing a free space into which metal may flow.

7. In a mill of the character indicated, two horizontal rolls, and two vertical rolls coöperating therewith, one end of each of said vertical rolls being of less diameter than the body thereof.

8. In a mill of the character described, two stands of vertical and horizontal rolls each stand having the axes of its four rolls in the same plane, the top horizontal roll in one stand having flange edge rolling collars, and the bottom horizontal roll in the other stand having flange edge rolling collars, all the said flange edge rolling collars of both stands having closely adjacent thereto the beveled end of a vertical roll said beveled end being of less diameter than the body thereof for the purpose of gradually freeing said end from the maximum compressive force resisted by the main body of said vertical roll when operating upon the piece being rolled.

9. The method of rolling flanged shapes, such as I-beams, girders or H-bars on universal mills having horizontal and vertical rolls with their axes in the same plane, which consists in rolling the piece, at every passage of the bar, on both sides of the web and flanges thereof, but operating at one pass upon only the upwardly projecting flange edges and simultaneously allowing the downwardly projecting flange edges unrestricted spread, and then reversing the said operations on the respective flange edges of the bar at the next passage of the piece through the mill.

10. The method of rolling flanged shapes, such as I-beams, girders or H-bars, which consists in rolling the piece, at every passage of the bar, on both sides of the web and flanges but operating at one pass on a part only of the flange edges of the piece being rolled and simultaneously allowing the other flange edges unrestricted spread and then reversing this operation on the next passage of the bar so as to operate on the edges not operated upon during the previous passage.

11. The method of rolling flanged shapes, such as I-beams, girders or H-bars, on universal rolling mills of that type wherein the axes of all the rolls are in the same plane, which consists in rolling the piece, at every passage of the bar, on both sides of the web and flanges but operating at one pass on a part only of the flange edges of the piece being rolled and simultaneously allowing the other flange edges unrestricted spread and then reversing this operation on the next passage of the bar so as to operate on the edges not operated upon during the previous passage.

12. The method of rolling flanged shapes such as I-beams, girders or H-bars, on universal mills having two stands of rolls each stand having horizontal and vertical rolls with their axes in the same plane, which consists in rolling the piece at every working passage of the bar on both sides of the web and flanges thereof but operating on first stand in one direction upon two flange edges only and simultaneously allowing the other two flange edges unrestricted spread, then reversing the said operations of rolling by passing the piece through the second stand of rolls in the opposite direction, thereby operating upon the two edges of those flanges that were in the former case allowed unrestricted spread and simultaneously allowing the other flange edges unrestricted spread.

13. In a rolling mill, a stand of rolls having vertical and horizontal rolls which have their axes in the same plane, means for changing the vertical distance between the horizontal rolls after each passage of the

bar, one of said horizontal rolls being provided with two flange edge rolling collars, closely adjacent to the rolling surface of each of which is the end of one vertical roll, the said vertical rolls being so mounted as to be held in such position during the operation of rolling and being capable of adjustment horizontally after each passage of the bar, and a single operating mechanism by which the adjustments of the vertical and horizontal rolls are effected simultaneously.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES M. GREY.

Witnesses:
JAS. H. GRIFFIN,
H. T. BERNHARD.