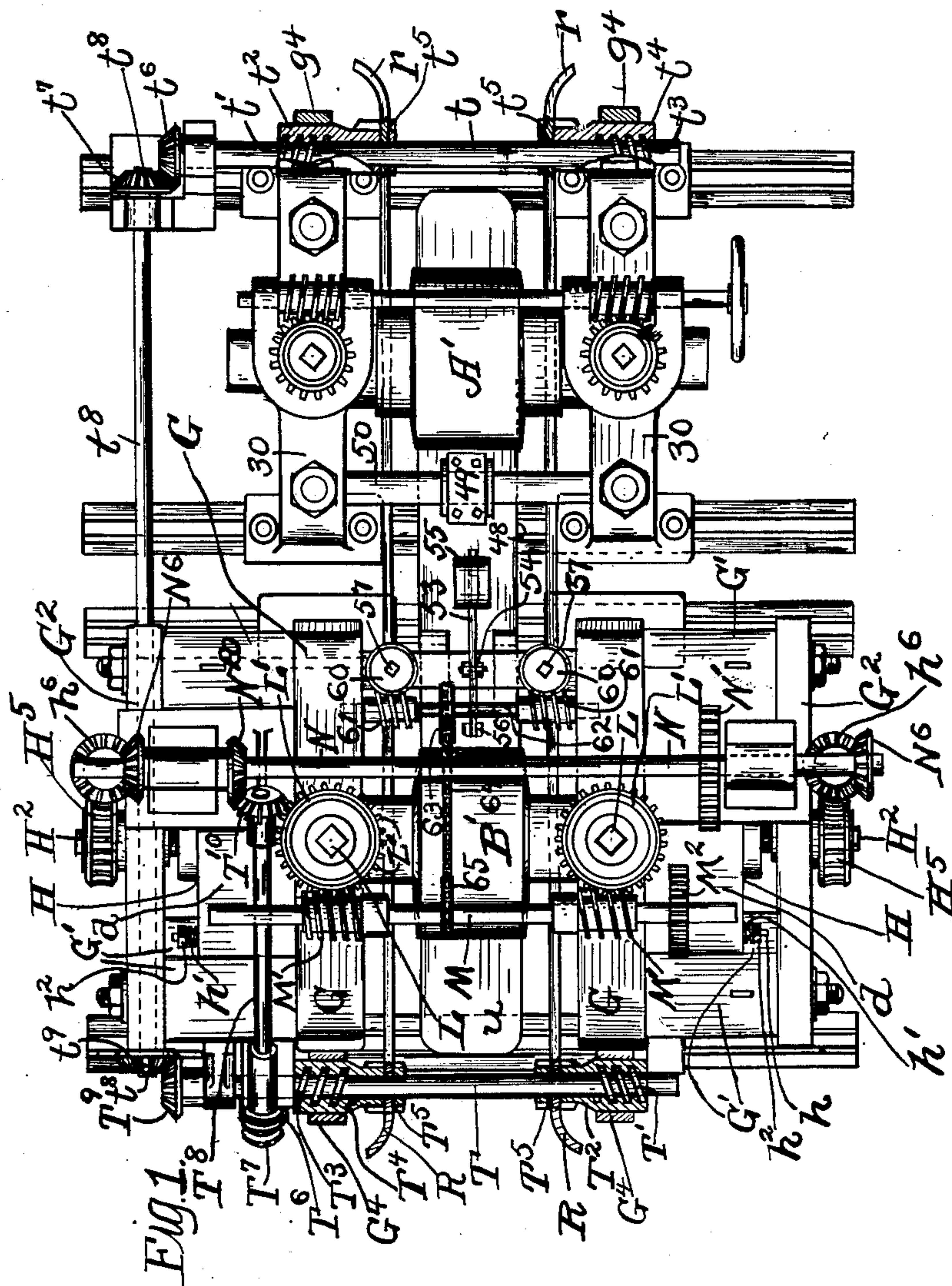


943,633.

H. GREY.
ROLLING MILL.
APPLICATION FILED NOV. 24, 1902.

Patented Dec. 14, 1909.

4 SHEETS—SHEET 1.



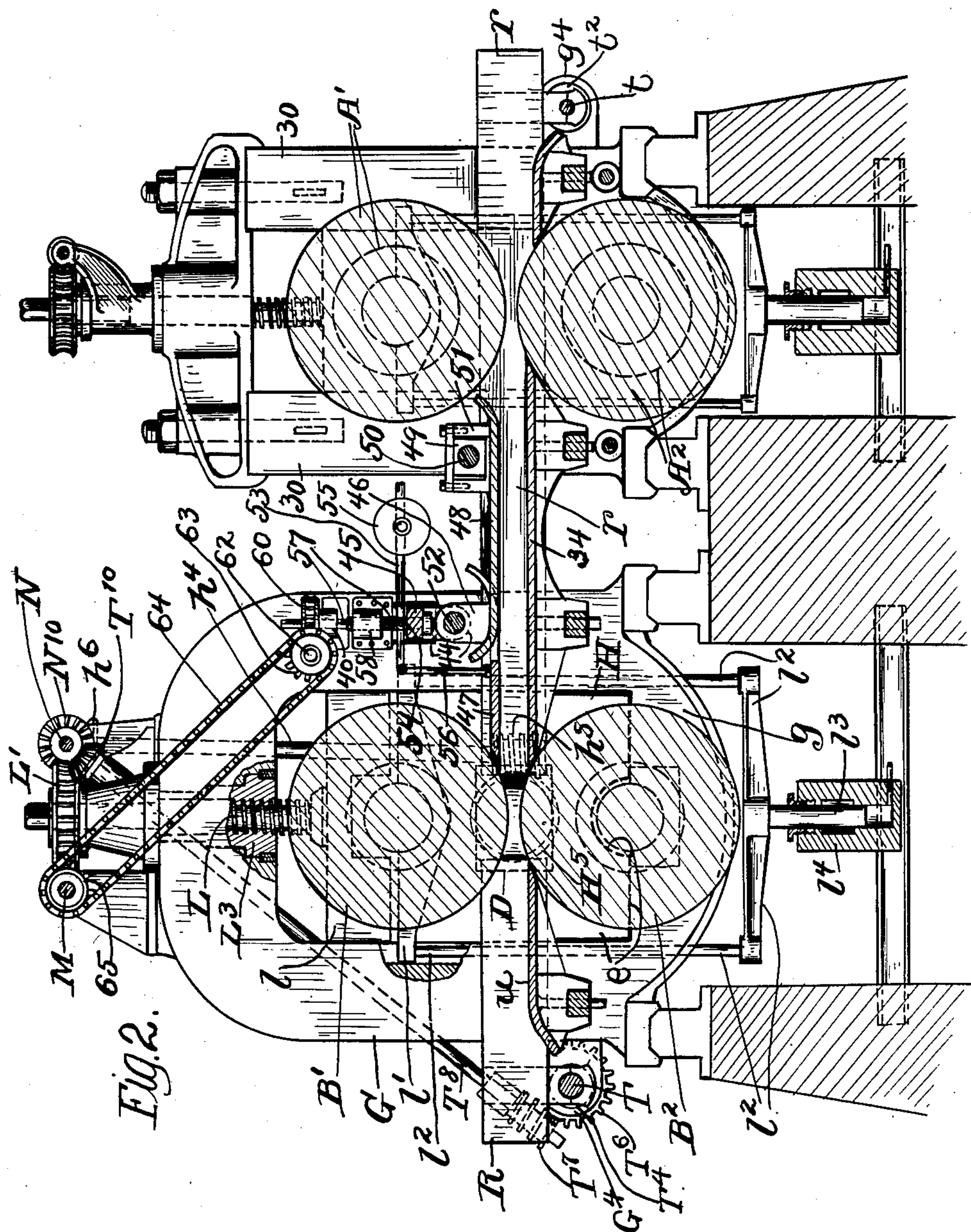
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4 SHEETS—SHEET 2.



WITNESSES:
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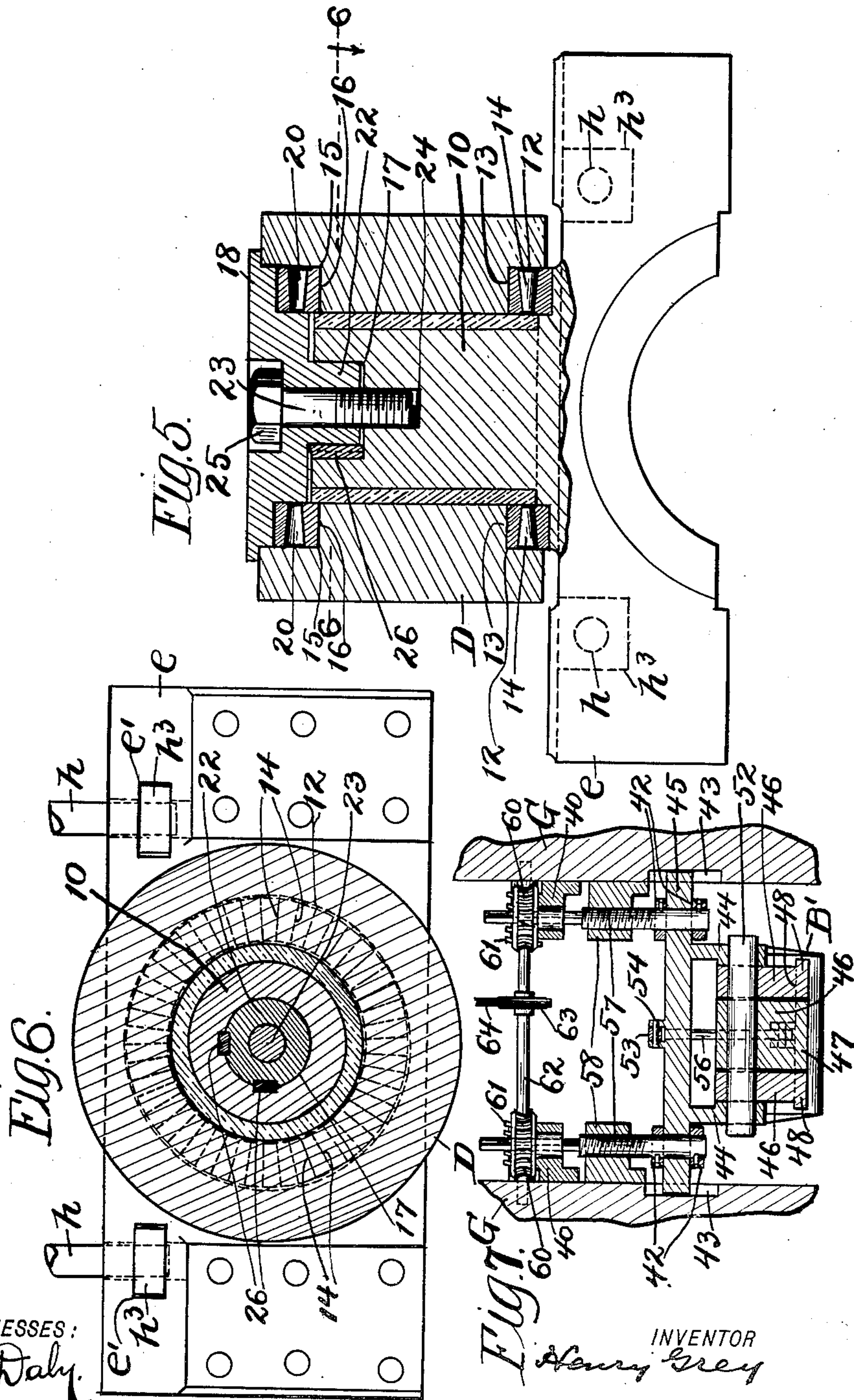
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Patented Dec. 14, 1909.

4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

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ROLLING-MILL.

943,633.

Specification of Letters Patent.

Patented Dec. 14, 1909.

Application filed November 28, 1902. Serial No. 133,098.

To all whom it may concern:

Be it known that I, HENRY GREY, a citizen of the United States of America, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Rolling-Mills; and I hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

This invention relates to improvements in mills or apparatus for rolling metallic beams, girders and structural work generally.

This invention pertains more especially to a mill which is adapted for use in rolling flanged beams or bars and comprises, first, a pair of horizontal web-reducing rolls arranged one above the other and in the same vertical plane and next above and next below the path of the blank to be operated upon, and in position to operate upon the upper side and lower side, respectively, of the web of the blank or work and upon the inner sides of the flanges or heads of the blank or work, with one of the said rolls, and preferably the top roll, adjustable vertically toward and from the other roll; second, two vertical or upright side rolls arranged next to and at opposite sides, respectively, of the path of the blank and in position to operate upon the entire outer sides of the heads or flanges of the blank or work and carried by slides or supports which are adjustable toward or from each other so as to render the said side rolls adjustable apart; third, another pair of supplementary horizontal rolls arranged a suitable distance laterally of and from and parallel with the aforesaid web-reducing rolls and in position to operate upon the edges of the flanges or heads of the blank or work in the passage of the latter to or from the web-reducing rolls and adjacent side rolls; and, fourth, a covered passage-way for conducting and guiding the blank or work in its passage between the web-reducing rolls and the aforesaid supplementary rolls.

One object of the present invention is to provide a desirable top bearing as well as a bottom bearing for each vertical side roll employed to operate upon the outer side of a flange or head of the blank or work, and successfully prevent upward displacement of

the said roll during the reduction of the blank by the roll and to avoid torsional strain upon the screw which is employed in retaining the said top bearing in place and engages a correspondingly screw-threaded hole formed in the axle embraced by the said roll. I would here remark that I am aware that with necks on the ends of the said vertical rolls the frames or supports holding such necks would offer resistance to the rising of the said rolls vertically, but in practice when making wide-flanged bars, beams or sections, the construction of these rolls with necks thereon would have the result of so increasing the diameter of the body of rolls, or decreasing the diameter of the neck of the said rolls, that the mill would be incapable of resisting the forces employed.

Another object of this invention is the provision, between the web-reducing rolls and the rolls employed to operate on the edges of the flanges or heads of the blank or work, of a work-conducting passage-way which has side walls, top and bottom walls, all extending approximately from a point in close proximity to the last-mentioned rolls to a point in close proximity to the web-reducing rolls, so that the blank or work, in its passage between the pair of web-reducing rolls and the pair of rolls arranged to operate on the edges of the heads or flanges of the blank or work, shall be continuously guided not only in a lateral but also a vertical direction. I would remark, first, that the bottom wall or bottom of the said passage-way prevents downward displacement of the blank or work and is enough narrower than the space between the side walls of the said passage-way to afford a bottom-bearing only for the web of the blank or work; second, that the top or cover-forming wall of the said passage-way is preferably made in vertically adjustable sections which form guides arranged to prevent upward displacement of the blank or work and immovable except during a readjustment of the same, and means whereby the said sections are simultaneously raised or lowered simultaneously with the elevation or lowering of the top web-reducing roll is provided, and third, the opposite side walls of the said passage-way are arranged at opposite sides, respectively, of the path of the blank or work and form guides arranged to prevent displacement of the

work laterally in opposite directions respectively and instrumental in straightening the work, and are pivoted vertically near the vertical side rolls to the different slides respectively which carry the said side rolls, and move toward or from each other simultaneously and equally with the adjustment apart of the said side rolls according as the aforesaid slides are actuated toward or from each other.

Another object of this invention consists in connection with the pivoting of the said side guides near the vertical side rolls to the slides which carry the said rolls, in extending the said guides between and beyond the outer side of the rolls employed to operate upon the edges of the heads or flanges of the blank or work, and providing means, preferably at the outer side of the said last-mentioned rolls, whereby is facilitated the swinging of the said guides toward or from each other simultaneously with but a greater distance than the movement of the vertical side rolls toward or from each other so as to enable blooms or blanks, which are not straight, to readily pass between and be caught by the rolls employed to operate on the edges of the flanges or heads of the blank and to participate in effecting a gradual straightening of the blank during the reduction of the blank.

Another object of this invention is to so connect the inner end-portion or member of each slide which carries a side roll with the outer end-portion or member of the said slide, which outer slide-member is provided with thrust-bearing-forming rollers against which the said side roll bears laterally and outwardly in rolling, that the said side roll is yieldingly maintained, by an elastic pressure, against the said rollers and does not spring from the said rollers when the blank or work passes from between the two side rolls and consequently is not thrown violently against the said rollers when the said rolls engage the work.

With these objects in view, and to the end of realizing other advantages hereinafter appearing, my invention consists in certain features of construction, and combinations of parts, hereinafter described and pointed out in the claims.

In the accompanying drawings, Figure 1 is a top plan of a rolling mill embodying my invention, and portions are broken away and in section in this figure to more clearly show the construction. Fig. 2 is a side elevation of the mill, largely in central section, and portions are broken away and in section in this figure to more clearly show the construction. Fig. 3 is a top plan of the mill, largely in section taken between the rolls of the pair of web-reducing rolls B' and B^2 and between the pairs of flange-edge-rolling rolls A' and A^2 . Fig. 4 is a side elevation in section and

in detail, illustrative of the connection between the members d and e of a slide H. Fig. 5 is an elevation in detail, largely in central section taken through one of the vertical upright flange-reducing side-rolls D. Fig. 6 is a top plan in horizontal section on line 6—6, Fig. 5. Fig. 7 is an elevation in detail, largely in section, of the greater portion of the operative connection between the shaft M and the top guides 47 and 48. Figs. 2 and 3 are drawn on the same scale and on a somewhat larger scale than Fig. 1. Figs. 4 and 7 are drawn on the same scale and on a scale larger than Figs. 2 and 3. Figs. 5 and 6 are drawn on the same scale and on a scale larger than Figs. 4 and 7.

The mill illustrated in the said drawings comprises an upper horizontal roll B' , a lower horizontal roll B^2 and two vertical side rolls D and D arranged at opposite ends, respectively, of the said horizontal rolls, and centrally between the axes of the said horizontal rolls. The top and bottom rolls B' and B^2 form a pair of web-reducing rolls arranged one above the other and in the same vertical plane and next above and next below the path of the blank to be operated upon and in position to operate upon the upper side and lower side respectively of the web of the blank or work and upon the inner sides of the flanges or heads of the blank or work. The two vertical or upright side rolls D are arranged next to and at opposite sides, respectively of the path of the work and in position to operate upon the entire outer sides of the heads or flanges of the blank or work, and carried by slides which are adjustable toward or from each other, as will hereinafter appear, so as to render the said side rolls adjustable apart. The blank or work C is shown in position in Fig. 4. The top roll B' is adjustable vertically relative to the bottom roll B^2 which is supported in any approved manner from two housings G and G which are arranged at opposite sides, respectively, of and a suitable distance from the path of the blank or work. The rolls B' and B^2 are practically of the same diameter and rotated in opposite directions respectively, but means for rotating the said rolls are too well known to require description or illustration in this application. The side rolls D may be driven by the contact of the blank or work therewith or in any other approved manner.

The blank or work is given as many passes through the mill as are required to complete the rolling or shaping of the work, and the blank or work is of course suitably heated preparatory to its introduction into the mill, and the work is fed with its web arranged horizontally.

It is obvious, that for work of the character indicated the adjustable top roll B' and the adjustable side rolls D are, at the

commencement of the operation of the mill, set as required for the first pass of the bloom or heated blank. The adjustment of the rolls B' and D , relative to the path of the blank or work, is effected simultaneously, and the side rolls D , in adjusting them apart simultaneously with the adjustment of the top roll B' , are moved more rapidly than the top roll in order to avoid long crop ends and torn or cracked flange-edges on the finished product.

Each housing G , near its lower end adjacent to the adjacent trunnion of the bottom web-reducing roll B^2 , is provided with brackets G' which form a slideway for and support the outer end-portion or member d of a slide H whose inner end-portion or member e carries one of the side rolls D . The two slides H are movable with and in the direction in which the side-rolls D are adjustable. Both slides H are movable, therefore, toward or from each other. Each slide H is operatively connected, at its central portion, with a screw H^2 arranged parallel with the travel of the slide, which screw engages a correspondingly threaded nut I (see Fig. 3) rigidly secured within and to the outer end-portion or member d of the slide. The said member d is connected with but has an adjustment toward and from and independently of the roll-bearing inner end-portion or member e of the said slide, which member e is suitably supported from the housing which supports the aforesaid slide-member d . Preferably the legs of each housing G are connected together at the bottom by a web g as shown in Figs. 2 and 4. The webs g support the bottom-web-reducing roll B^2 and the inner end-portions or roll-bearing members e of the slides H .

The outer member d of each slide H carries the thrust-bearing for the side roll D carried by the inner member e of the said slide, and the said thrust-bearing (see Fig. 3) comprises two large vertical rollers J and J arranged a suitable distance apart at the outer side of and engaging the said side roll. Two rods h are attached to the said inner or roll-bearing slide-member e and extend, parallel with the travel of the slide, freely through the outer or roller-bearing slide-member d , as shown more clearly in Fig. 4. The space had between the two slide-members d and e accommodates the adjustment of the outer slide-member d upon the said rods h toward the inner slide-member e . The adjustability of the outer slide-member d accommodates the taking up of any wear between the said side-roll D and the engaging rollers J and the maintenance of the said rollers in contact with the said roll, and the said slide-member d is yieldingly retained in the adjustment required to hold its rollers J in contact with the said roll D by springs h' which are mounted and

confined upon the rods h between the outer end of the said slide-member d and nuts h^2 which engage threads formed upon the said rods h at the said outer end of the said slide-member. Each rod h extends into and is screw-threaded within the inner or roll-bearing slide-member e which, as shown in Fig. 4, contains a nut h^3 engaging with threads upon and embracing the said inner end-portion of the said rod, and the slide-member e is recessed, as at e' , to receive the said nut h^3 with sufficient closeness to prevent detachment of the said rod from the said slide-member during an endwise and outward pull upon the said rod. It will be observed therefore, that the inner and roll-bearing slide-member e of each slide is hitched to or connected with the outer and roller-bearing slide-member d of the said slide in such a manner that the said inner slide-member is shifted simultaneously with the said outer slide-member during a readjustment apart of the two slides H .

By the construction hereinbefore described it is obvious that the rollers J of the slide-member d of each slide H are yieldingly and constantly held against the roll D of the inner member e of the said slide so that the said roll does not spring from the said rollers when the blank or work passes from between the two rolls D and consequently is not thrown violently against the said rollers when the said rolls again engage the work.

Each slide-operating screw H^2 extends from the connected slide H outwardly through a yoke-forming bar G^2 which connects together and is secured to the two legs of the housing which supports the said slide. Two collars H^3 and H^3 , which are fixed or formed upon the said screw at opposite sides respectively of the said yoke, prevent endwise movement of the screw during the rotation of the screw. It is obvious that each slide H , and the side roll D supported thereby, are adjusted toward or from the pair of horizontal rolls B' and B^2 according as the connected screw H^2 is turned in the one direction or the other.

The means employed for holding each side-roll D down upon its support which, as already indicated, is formed by the inner end-portion or member e of the slide H which carries the said roll, is shown very clearly in Figs. 5 and 6. The said slide-member e is provided, centrally of the said roll D , with an upwardly projecting and vertically arranged axle 10, and the said roll is bored vertically and centrally to accommodate the location of the said axle and the means employed in forming a top bearing for the roll. The said roll D is provided, in its lower end, with an annular recess 12 which extends around the lower end of the axle 10 so as to form, within the lower por-

tion of the roll, a downwardly facing annular shoulder 13, and anti-friction devices in the form of conical rollers 14 are arranged between the said shoulder and the aforesaid slide-member *e* which forms the bottom-bearing or main support for the roll. The rollers 14 are arranged radially of the roll and taper inwardly. The said roll D is provided, in its upper end, with an annular recess 15 which is arranged in the main above and extends around the upper end of the axle 10 so as to form, within the upper portion of the roll, a downwardly facing annular shoulder 16. The said axle 10 is provided, in its upper end and centrally, with a circular recess 17. A disk or cap 18, which forms the top-bearing of the said roll D, is arranged within the upper recess 15 and overlaps anti-friction devices which are in the form of conical rollers 20 interposed between the shoulder 16 and the said cap. The rollers 20 are arranged radially and taper inwardly. The cap 18 is provided centrally with a depending boss 22 which extends into and snugly fits the recess 17, and a screw 23 extends centrally and vertically through the said boss into engagement with a correspondingly screw-threaded hole 24 formed in the axle, which screw is provided, at its upper end, with a head or member 25 arranged to hold the said cap downwardly. Means which prevents circumferential displacement of the cap 18 is provided and comprises, preferably, any suitable number of keys 26 which extend from within the boss 22 to within the boss-surrounding wall of the recess 17.

By the construction hereinbefore described it will be observed that the provision of necks on the side-rolls D is avoided; that a rising of the side-rolls D upon the axles 10 toward the necks of the top horizontal roll B' is prevented, and consequently a top roll B' having diametrically large necks or trunnions is accommodated; that the said side rolls are adequately supported at the bottom; that vertical displacement of the said side-rolls is effectually prevented and consequently the said side rolls will at all times be in position to completely cover the flanges or heads of the blank or work upon which the said side rolls operate during the operation of the mill. Also, by the construction hereinbefore described the friction between the caps or top-bearings for the side rolls D is reduced to a minimum and circumferential displacement of the said top bearings is effectually prevented, and torsional action upon the screws 23 is avoided.

Two vertical screws L (see Fig. 1) are arranged above the different necks or trunnions respectively of the top horizontal roll B'. Each screw L, as shown in Fig. 2, engages a correspondingly screw-threaded nut L³ fixed or formed in the top of the adjacent

housing G. Between the lower end of each screw L and the adjacent trunnion or neck of the top roll B' is interposed a saddle *l* (see Fig. 2), and the said neck or trunnion has bearing in a half-box *l'* which rests upon a vertically movable frame or structure *l*² engaged and held in the desired adjustment by the piston *l*³ of a hydraulic cylinder *l*⁴ and obviously instrumental in supporting the said roll at the desired elevation controlled by the screws L.

The mechanism employed for rotating the screws L and H² is shown to be as follows:— Upon the upper end or portion of each screw L (see Fig. 1) is operatively mounted a worm-wheel L' which meshes with a worm M' formed upon a suitably supported horizontally-arranged shaft M which is arranged at the top of and above the housings G. The upper ends of screws L are angular in cross-section and extend through corresponding holes in the central portions of the engaging wheels L' without interrupting operative connection between the said wheels and screws. The shaft M is suitably driven in the one direction or the other according as the screws L, and consequently the top roll B', are to be elevated or lowered. The shaft M is operatively provided, at one end, with a driving-wheel M² to which power is applied in any approved manner. Upon the outer end of each screw H² (see Fig. 3) is operatively mounted a worm-wheel H⁵ which meshes with a worm *h*⁵ formed upon a suitably supported upright shaft *h*⁴. Each shaft *h*⁴ is operatively provided, at its upper end, (see Figs. 1 and 2) with a bevel-gear *h*⁶ which meshes with a bevel-gear N⁶ operatively mounted upon a shaft N which is suitably driven in the one or the other direction according as the slides H, and consequently the side rolls D, are to be shifted toward or from each other. The shaft N is operatively provided, at one end, with a driving-wheel N' to which power is applied in any approved manner.

It is obvious that, as already indicated, the top web-reducing roll B' and with it the flange-reducing side rolls D are set, preparatory to the first pass of a heated blank that requires reducing, the distance apart required for the first pass, which distance forms the largest work-receiving passage between the said rolls during the reducing operation upon the blank, and said passage is rendered smaller preparatory to each successive pass of the work, and the rolls after the work has had its finishing pass are re-adjusted to enlarge the work-receiving passage between them as required for another blank.

At one side and a suitable distance laterally of the horizontal web-reducing rolls B' and B² (see Figs. 1, 2 and 3) are arranged two horizontal rolls A' and A² which are

parallel with the rolls B' and B^2 and arranged one above the other and respectively next above and next below the path of the blank or work to be operated upon and shaped and placed to operate upon the edges of the heads or flanges of the blank or work. The rolls A' and A^2 are supported in a manner substantially the same as the manner of supporting the rolls B' and B^2 . The upper roll A' is adjustable vertically toward and from the lower roll A^2 , and the means for adjusting the top roll A' is substantially the same as the means for adjusting the web-reducing roll B' and does not constitute any portion of the claimed subject-matter of this application. The rolls A' and A^2 are operated in any approved manner.

The passage-way for the blank or work between the web-reducing rolls B' and B^2 and the flange-edge-rolling rolls A' and A^2 is practically closed at the top as well as at the sides and bottom from end to end of the said passage-way. The bottom wall or bottom of the said passage-way is preferably a bar or plate 34 which is supported in any approved manner and extends from a point in close proximity to the bottom web-reducing roll B^2 to a point in close proximity to the bottom roll A^2 as shown in Fig. 2. The top wall or cover of the said passage-way is formed by two plates 47 and 48 arranged next adjacent to the top roll A' and top roll B' respectively. The plates 47 and 48 form top guides which prevent upward displacement of the blank or work. The guide 48 extends from a point in close proximity to the roll B' a suitable distance toward the roll A' . The guide 47 extends from a point in close proximity to the roll A' a suitable distance toward the roll B' . The guides 47 and 48 extend into close proximity to each other at their adjacent ends. The guides 47 and 48 are simultaneously raised or lowered according as the top web-reducing roll B' is elevated or lowered during a readjustment of the said roll, as will hereinafter more clearly appear. As shown in Figs. 1 and 2, the guide 47 is carried, at its end which is adjacent to the roll A' , by a slide 51 mounted on a box 49 which is pivoted horizontally and transversely of the path of the blank or work by rotatably mounting it upon a shaft or rod 50 which is correspondingly arranged transversely of the said path and at the top of the said guide and supported in any approved manner, as, for instance, by the housings 30 in which the rolls A' and A^2 are mounted. The slide 51 extends longitudinally of the guide 48 a suitable distance beyond opposite sides of the box 49 so that the guide 48 is capable of sliding longitudinally. Adjacent ends of the guides 47 and 48 (see Figs. 2 and 7) have interlocking ears 46 easily embracing a shaft or pin 52 which is arranged horizontally and transversely of

the path of the blank or work. A vertically shiftable slide-forming bar 45 is arranged parallel with and longitudinally of the pin 52 above the ears 46 and is provided, at its under side, with depending boxes 44 which afford bearing to the said pin. The bar or slide 45 engages correspondingly vertically arranged slideways 43 formed in the housings G. Two vertically arranged screw-threaded spindles 57 are arranged a suitable distance apart between the housings G and engage with correspondingly vertically arranged and correspondingly threaded nuts 58 which are secured to the said housings. The screws 57 extend loosely through the slide 45 and have collars 42 at the top and bottom of the said slide so that the screws are turnably attached to the said slide. Each spindle 57 extends upwardly through and a suitable distance above the engaging nut 58, and on each spindle, above the engaging nut, is operatively mounted a worm-wheel 60 which rests upon a bracket 40 secured to the adjacent housing G. The worm-wheels 60 mesh with worms 61 which are formed upon a shaft 62 arranged horizontally and extending between and supported from the housings G. The operative connection between each spindle 57 and the engaging worm-wheel 60 is such that the spindle can move endwise independently of the worm-wheel, and in the mill illustrated the upper portions of the said spindles are angular and extend easily through correspondingly angular axial bores in the said wheels. A sprocket-wheel 63 is operatively mounted upon the shaft 62 between the two worms 61 and is operatively connected by a chain 64 with a sprocket-wheel 65 which is operatively mounted upon the worm-shaft M. The arrangement of the parts is such that both guides 47 and 48, by the operative connection between them and the worm-shaft M, are simultaneously lowered or elevated according as the top web-reducing roll B' is lowered or elevated by power transmitted to the said roll from the shaft M. A counterbalance for the guide 48 is provided and consists of a weight or poise 55 arranged above the central portion of the guide 47 and mounted on a lever 53 which is fulcrumed, as at 54, to the slide 45 and, between the said slide and the top roll B' , is operatively connected, by a link 56, to the guide 48. The under sides of adjacent ends of the guides 47 and 48, below their interlocking ears 46, preferably slope or curve upwardly toward the extremities of the said ends, and the guide 47 turns or curves upwardly toward the roll A' between the said roll and the pivot 50.

The side walls r of the passage-way extending between the two pairs of rolls B' B^2 and A' A^2 form guides which are instrumental in preventing displacement of the

blank or work laterally of the said passage-way in opposite directions respectively when the blank or work is being passed from one to the other of the said pairs of rolls. The guides r are pivoted vertically, as at r' , (see Fig. 3) to the roll-bearing member c of the different slides II respectively so that the said guides are adjusted apart simultaneously with the adjustment apart of the side-rolls D and while they are adjusted apart are capable of being swung horizontally on their pivotal bearings toward or from each other for the purpose more especially of enabling the said guides to recede from or approach each other more rapidly than the said rolls D recede from or approach each other during a readjustment of the slides H. The guides r extend from their pivotal bearings r' (see Figs. 2 and 3) to and between the flange-edge-rolling rolls A' and A^2 and beyond the outer sides of the said rolls where the said guides are operatively connected with the mechanism employed to actuate the said guides toward or from each other simultaneously with and in addition to the actuation of the said guides toward or from each other by the operation of the slides H, which mechanism (see Figs. 1 and 2) comprises preferably a horizontally arranged shaft t which extends transversely of and below the work's path through the lower portions of the guides r . A right-handed screw t' is formed upon the shaft t at the outer side of one of the said guides r , and a left-handed screw t^3 is formed upon the shaft at the outer side of the other guide r . Screws t and t^3 are operatively engaged by two nuts t^2 and t^4 , respectively. Said nuts t^2 and t^4 have bearing in and are arranged to slide endwise of lugs g^4 formed upon the housings G, and each guide r is operatively connected with one of the said nuts, and in the mill illustrated the lower portion of each guide r slidably embraces the shaft t and engages a recess t^5 formed in the inner end of the connected nut. Shaft t is operatively provided, at one end, with a bevel gear t^6 which meshes with a bevel-gear t^7 operatively mounted upon a suitably supported shaft t^8 which is arranged horizontally and at right angles to the shaft t . Shaft t^8 extends from adjacent the shaft t toward and into suitable proximity to a shaft T which is arranged parallel with the shaft t . The shaft t adjacent the shaft T is operatively provided with a bevel-gear t^9 which meshes with a bevel-gear T^9 fixed to the shaft T.

As already indicated, the side-guides r are arranged at that side of the pairs of rolls B' and B^2 which faces the web-reducing rolls A' and A^2 , but at the opposite side of the said pairs of rolls B' and B^2 are arranged two side guides and work-straightening bars R which are arranged at opposite sides re-

spectively of the path of the blank or work. The bars R are pivoted vertically, as at R' , to the roll-bearing member c of the different slides II respectively so that the said bars are adjusted apart simultaneously with the adjustment apart of the side-rolls D and while they are adjusted apart are capable of being swung horizontally on their pivotal bearings toward or from each other for the purpose more especially of enabling the said bars to recede from or approach each other more rapidly than the said rolls D recede from or approach each other during a readjustment of the slides H. The bars R extend from their pivotal bearings r' (see Figs. 1, 2 and 3) a suitable distance longitudinally of the path of the blank or work and are operatively connected, near their outer or free ends, with the mechanism employed to actuate the said bars toward or from each other simultaneously with and in addition to the actuation of the said bars toward or from each other by the operation of the slides H, which mechanism comprises preferably the shaft T which, as already indicated, is arranged horizontally and extends transversely of and below the path of the blank or work through the lower portions of the bars R. A right-handed screw T' is formed upon the shaft T at the outer side of one of the bars R, and a left-handed screw T^3 is formed upon the said shaft at the outer side of the other bar R. Screws T' and T^3 are operatively engaged by two nuts T^2 and T^4 , respectively. The said nuts have bearing in and are arranged to slide endwise of lugs G^4 formed upon the housings G, and each bar R is operatively connected, with one of the aforesaid nuts, and in the mill illustrated the lower portion of each bar R slidably embraces the shaft and engages a recess T^5 formed in the inner end of the connected nut. The shaft T is operatively provided with a worm-wheel T^6 which meshes with a worm T^7 formed upon a diagonally-arranged shaft T^8 which extends into close proximity to the shaft N (see Figs. 1 and 2) and is operatively provided with a bevel-gear T^{10} which meshes with a bevel-gear N^{10} operatively mounted upon the said shaft N.

By the construction hereinbefore described it will be observed that if the screws H^2 , and the shafts t and T are rotated at the same speed, a pitch of the threads of the shaft t greater than the pitch of the threads of the screws H^2 will result in the adjustment apart of the guides r by the operation of the shaft t more rapidly than the adjustment apart of the said guides by the adjustment apart of the slides H, and that a pitch of the threads of the shaft T greater than the pitch of the threads of the shaft t will result in the adjustment apart of the work-straightening bars R by the operation of the

shaft T not only more rapidly than the adjustment apart of the said bars by the adjustment apart of the slides H but more rapidly than the adjustment apart of the said guides r by the operation of the shaft t.

A bottom-guide or support u arranged next below the path of the blank or work between the work-straightening bars R is of course provided.

I would here remark that the pivotal connection of the side guides directly with the slides in suitable proximity to the vertical side rolls whereby the said guides are adjusted simultaneously with the adjustment of the said slides, and the means for swinging the said guides toward or from each other during their adjustment by the shifting of the slides, constitutes a meritorious and not unimportant combination when the necessity of having the mill readily capable of receiving and operating upon crooked blanks is considered. A variety of curves are found in blanks brought to the mill, and when the front end of a blank,—that is, the end of the blank which first enters the mill,—is crooked the side guides must be far enough apart at their outer ends to enable the blank to reach the rolls. The pivoting of the side guides to the slides which carry the vertical side rolls accommodates the maintenance of the required close relationship between the inner ends of the said guides and the said rolls and at the same time accommodates the swinging of the said guides far enough apart at their outer ends to permit a curved or crooked blank to readily pass between them to the rolls.

The bottom wall or bottom of the passage-way for the blank or work between the web-reducing rolls B', B² and the flange-edge-rolling rolls A', A², and the top wall or cover over the said passage-way and formed by the bars or plates 47 and 48, are, as shown in Figs. 2 and 3, arranged respectively next above and next below the path of the web of the blank and between the side guides r. The said bottom and the said cover are a little less in width than the web-reducing surfaces of the web-reducing rolls B', B² and perform the functions of lateral or side guides between the paths of the heads or flanges of the blank as well as bottom and top guides for the web. Hence the top wall or cover and bottom wall of the said passage-way prevent displacement of the blank laterally of the path of the blank as well as vertically, and the said passage-way is practically closed at the top, bottom and sides from a point in close proximity to the flange-edge-rolling rolls to a point in close proximity to the web-reducing rolls.

Referring again to the application and operation of the guides r I would remark that my invention embraces broadly the provision, in connection with the horizontal rolls

and vertical rolls and the slides carrying the different vertical rolls respectively and adjustable toward and from each other, of two guides arranged at one side of the horizontal rolls but at opposite sides respectively of the path of the blank, which guides are pivoted or fulcrumed vertically at one end to the different slides respectively and independently adjustable at the other end so that the said guides are capable of being swung toward or from each other while they are adjusted by the shifting of the slides, and means for swinging the said guides toward or from each other at a greater speed than the mechanism which adjusts the aforesaid slides so that the space between the outer ends of the guides is enlarged or decreased during the adjustment of the guides by the shifting of the slides and so that, as already hereinbefore indicated, the maintenance of the required close relationship between the inner ends of the said guides and the vertical rolls is accommodated as well as the swinging of the said guides far enough apart at their outer ends to permit a crooked or curved blank to readily pass between the guides. In other words, by the construction and arrangement of parts described and shown the inner ends of the guides r are kept in approximately the same position relative to the vertical rolls which move inwardly at every adjustment, and the ends of the guides which protrude beyond the flange-edge-rolling rolls are moved faster than the ends carried by the slides. A close relationship is kept between the inner ends of the said guides and the vertical rolls, and at the same time the guides can be swung, at their outer ends where they first receive the blank, far enough apart to permit the various and indefinite variety of crooked shaped bars or blanks coming to the mill.

What I claim is:—

1. In a rolling mill, the combination, with a slideway; a slide engaging the said slideway and consisting of two parts or members; a reducing-roll carried by one of the said slide-members; a lateral bearing for the roll and carried by the other slide-member, and the last-mentioned slide-member being attached to but adjustable independently of and toward or from the roll-bearing slide-member and operatively engaged by means for shifting the slide, and suitably applied means acting to yieldingly retain the independently adjustable slide-member in its inner position so as to maintain the aforesaid lateral bearing constantly in contact with the roll.

2. The combination, with a slideway; a slide engaging the said slideway and consisting of two parts or members; a reducing-roll carried by one of the said slide-members; a lateral bearing for the roll and carried by

the other slide-member and the last-mentioned slide-member being attached to but adjustable independently of and toward or from the roll-bearing slide-member, and suitably applied springs acting to retain the independently adjustable slide-member in its inner position so as to maintain the aforesaid lateral bearing in contact with the roll.

3. The combination, with a slideway; a slide engaging the said slideway and consisting of two parts or members; a reducing-roll supported from one of the said slide-members; rollers sustaining the roll and carried by the other slide-member, and the roller-bearing slide-member being adjustable independently of and toward or from the roll-bearing slide-member; screw-threaded rods extending easily through the independently adjustable part and attached to the roll-bearing part; nuts upon the said rods at the outer end of the said adjustable part, and elastic means on the said rods between the said nuts and the said outer end of the said adjustable part, substantially as shown, for the purpose specified.

4. The combination, with a slideway; a slide engaging the said slideway and consisting of two parts or members; a reducing-roll supported from one of the said slide-members; rollers sustaining the roll and carried by the other slide-member, and the roller-bearing slide-member being adjustable independently of and toward or from the roll-bearing slide-member; screw-threaded rods extending easily through the independently adjustable part and attached to the roll-bearing part; nuts upon the said rods at the outer end of the said adjustable part, and spiral springs mounted and confined upon the said rods between the said nuts and the said outer end of the said adjustable part, substantially as shown, for the purpose specified.

5. The combination, with a pair of horizontal web-reducing rolls arranged one above the other and in position to operate upon opposite sides respectively of the web of a blank having a web between two flanges and upon the inner sides of the said flanges, vertical rolls arranged to operate upon the outer sides of the flanges, and horizontal rolls arranged a suitable distance from and parallel with the aforesaid web-reducing rolls in position to operate upon the edges of the flanges, of a passage-way for the work between the pair of web-reducing rolls and the rolls arranged to operate upon the edges of the flanges, which passage-way has a vertically adjustable cover which is a little less in width than the web of the blank and practically extends from a point in close proximity to the web-reducing rolls to a point in close proximity to the flange-reducing rolls, and mechanism for shifting the said cover vertically, and the said cover be-

ing immovable except by the operation of the said mechanism.

6. The combination, with a pair of horizontal web-reducing rolls arranged to operate upon opposite sides respectively of the web of a blank having a web between flanges and upon the inner sides of the flanges, vertical rolls arranged to operate upon the outer sides of the flanges, and horizontal rolls parallel with and arranged a suitable distance from the aforesaid web-reducing rolls in position to operate upon the edges of the flanges, of a passage-way for the blank between the pair of web-reducing rolls and the rolls arranged to operate upon the edges of the flanges, which passage-way has a top wall or cover practically extending from a point in close proximity to the last-mentioned rolls to a point in close proximity to the web-reducing rolls and comprising two normally immovable but vertically adjustable sections forming opposite end-portions respectively of the said cover, and mechanism for shifting the said sections toward or from the bottom of the said passage-way.

7. The combination, with a pair of web-reducing rolls arranged to operate upon opposite sides respectively of the web of a blank or work and upon the inner sides of the heads or flanges of the work, rolls arranged to operate upon the outer sides of the said flanges or heads, and rolls arranged a suitable distance from and laterally of the aforesaid web-reducing rolls in position to operate upon the edges of the heads or flanges, of a passage-way for the work between the pair of web-reducing rolls and the rolls arranged to operate upon the edges of the heads or flanges, which passage-way has the top-wall or cover thereof composed of sections which are adjustable vertically and mechanism whereby the said sections are simultaneously actuated toward or from the bottom of the said passage-way.

8. The combination, with a pair of web-reducing rolls arranged in a horizontal plane and in position to operate upon opposite sides respectively of the web of a blank or work and upon the inner sides of the heads or flanges of the work, upright side-rolls arranged to operate upon the outer sides of the said flanges or heads and rolls arranged a suitable distance from and laterally of the aforesaid web-reducing rolls in position to operate upon the edges of the heads or flanges, of a vertically adjustable guide-forming plate or section adjacent and extending into close proximity to the top web-reducing roll and arranged to form a portion of the top wall or cover of the passage-way which extends toward the web-reducing roll from a point in close proximity to the rolls arranged to operate upon the edges of the heads or flanges, and another

vertically adjustable guide-forming plate or section extending between the first-mentioned guide-forming section and the upper of the last-mentioned rolls, and means for simultaneously adjusting both of the said guide-forming plates or sections relative to the bottom of the aforesaid passage-way.

9. The combination, with a pair of web-reducing rolls arranged in a horizontal plane and in position to operate upon opposite sides respectively of the web of a blank or work and upon the inner sides of the heads or flanges of the work, upright side rolls arranged to operate upon the outer side of the said flanges or heads, and rolls arranged a suitable distance from and laterally of the aforesaid web-reducing rolls in position to operate upon the edges of the heads or flanges, of a vertically adjustable guide adjacent and extending into close proximity to the top web-reducing roll and arranged to form a portion of the top wall or cover of the passage-way which extends from a point in close proximity to the web-reducing rolls to a point in close proximity to the rolls arranged to operate upon the edges of the heads or flanges, and a vertically tiltable guide-forming section arranged to form a portion of the aforesaid top wall or cover and extending between the first-mentioned guide and the last-mentioned rolls and pivotally supported adjacent to and near the last-mentioned rolls, and means for adjusting both of the said guides simultaneously relative to the bottom of the aforesaid passage-way.

10. In a rolling mill of the character indicated wherein the blank or work is fed with its web arranged horizontally, the combination, with a roll arranged in a horizontal plane below and transversely of the path of the blank or work in position to operate upon the lower side of the web and upon the inner sides of the heads or flanges of the blank or work, another and vertically adjustable roll arranged in a horizontal plane directly over the first-mentioned roll and extending transversely of the upper side of the aforesaid path in position to operate upon the upper side of the web and upon the inner sides of the heads or flanges, upright side rolls arranged to operate upon the outer sides of the said flanges or heads, means for shifting the top web-reducing roll vertically toward or from the lower web-reducing roll, and a pair of rolls arranged a suitable distance from and laterally of the web-reducing rolls in position to operate upon the edges of the heads or flanges, of a passage-way for the blank or work between the last-mentioned pair of rolls and the pair of web-reducing rolls which passage-way has its top wall or cover comprising two vertically adjustable sec-

tions which extend into close proximity to the edge-rolling rolls and web-reducing rolls respectively, and means whereby both of the said sections of the said top wall or cover are equally or approximately equally adjusted simultaneously with and in the same direction as the top web-reducing roll is shifted during a readjustment of the said top web-reducing roll relative to the bottom web-reducing roll.

11. The combination, with two horizontal rolls arranged one above the other and in position to operate upon opposite sides respectively of the web and upon the inner sides of the flanges of the blank, vertical rolls arranged to operate upon the outer sides of the flanges, and two slides carrying the different vertical rolls respectively and adjustable toward and from each other, of two guides arranged at one side of the web-reducing rolls but at opposite sides respectively of the path of the blank, which guides are pivoted or fulcrumed vertically, at one end, to the different slides respectively and independently adjustable at the other end so that the said guides are capable of being swung toward or from each other while they are adjusted by the shifting of the slides, and means for swinging the said guides toward and from each other at a greater speed than the mechanism which adjusts the aforesaid slides so that the space between the outer ends of the guides is enlarged or decreased during the adjustment of the guides by the shifting of the slides.

12. The combination, with a pair of horizontal rolls arranged one above the other and in position to operate upon opposite sides respectively of the web and upon the inner sides of the flanges of the blank; vertical side rolls arranged to operate upon the outer sides of the flanges; two slides carrying the different vertical rolls respectively and adjustable toward and from each other, and a pair of rolls arranged at one side of and parallel with and a suitable distance from the web-reducing rolls in position to operate upon the edges of the flanges, of two guides pivoted or fulcrumed vertically, at one end, to the different aforesaid slides respectively and independently adjustable at the other end, which guides have the arrangement and length required to form the side walls of the passage-way for the blank between the last-mentioned pair of rolls and the pair of web-reducing rolls, and mechanism for swinging the said guides toward and from each other at a greater speed than the mechanism which adjusts the aforesaid slides so that the space between the outer ends of the guides can be enlarged or decreased during the adjustment of the guides by the shifting of the slides.

13. In a rolling mill of the character in-

5 dicated, a pair of horizontal rolls arranged
 one above the other and in position to op-
 erate upon opposite sides respectively of the
 web and upon the inner sides of the flanges
 10 of the blank and adjustable to decrease or
 increase the space between them; mechan-
 ism instrumental in relatively readjusting
 the web-reducing rolls; a suitably driven
 shaft operatively connected with the said
 15 mechanism; vertical rolls arranged to op-
 erate upon the outer sides of the flanges;
 two slides carrying the different vertical
 rolls respectively and adjustable toward and
 from each other; mechanism for simulta-
 20 neously shifting or adjusting the said slides
 toward or from each other; another suitably
 driven shaft parallel with the first-men-
 tioned shaft and operatively connected with
 the slide-adjusting mechanism; two guides
 25 pivoted or fulcrumed, at one end, to differ-
 ent slides respectively and arranged to form
 opposite side walls respectively of the pas-
 sage-way for the blank, and mechanism op-
 eratively connecting the said guides with
 one of the aforesaid shafts and, during the
 adjustment of the guides by the shifting of
 the slides, operating at a greater speed than
 the slide-adjusting mechanism.

30 14. In a rolling mill of the character indi-
 cated, a pair of horizontal rolls arranged one
 above the other and in position to operate
 upon opposite sides respectively of the web
 and upon the inner sides of the flanges of
 35 the blank and relatively adjustable to in-
 crease or decrease the space between them,
 mechanism instrumental in relatively read-
 justing the said rolls, a shaft operatively
 connected with the said mechanism, vertical
 40 rolls arranged to operate upon the outer
 sides of the flanges, two slides carrying the
 different vertical rolls respectively and ad-
 justable toward or from each other, another
 shaft operatively connected with the last-
 mentioned roll-shifting means, a pair of
 45 rolls arranged a suitable distance from and
 laterally of the web-reducing rolls in posi-
 tion to operate upon the edges of the flanges,
 two guides pivoted vertically to the different
 aforesaid slides respectively and arranged
 50 to form opposite side walls respectively of
 the passage-way for the blank between the
 last-mentioned pair of rolls and the pair
 of web-reducing rolls, and mechanism op-
 eratively connecting the said guides with
 55 the last-mentioned shaft a suitable distance
 from their pivotal bearings.

60 15. In a rolling mill of the character indi-
 cated, a pair of horizontal rolls arranged
 one above the other and in position to op-
 erate upon opposite sides respectively of the
 web and upon the inner sides of the flanges
 of the blank and relatively adjustable to
 increase or decrease the space between them,
 mechanism instrumental in relatively read-
 65 justing said rolls, a shaft operatively con-

nected with the said mechanism, vertical
 rolls arranged to operate upon the outer
 sides of the flanges, two slides carrying the
 different vertical rolls respectively and ad-
 justable toward or from each other, another
 70 shaft parallel with the first-mentioned shaft
 and operatively connected with the last-
 mentioned roll-shifting means, a pair of
 rolls arranged parallel with and a suitable
 distance from and at one side of the web-
 75 reducing rolls in position to operate upon
 the edges of the flanges, two guides pivoted
 vertically to the different aforesaid slides
 respectively and arranged to form opposite
 side-walls respectively of the passage-way
 80 for the blank or work between the last-men-
 tioned pair of rolls and the pair of web-reduc-
 ing rolls, mechanism operatively connecting
 the said guides with the shaft instrumental
 in adjusting the aforesaid slides, and two
 85 vertically adjustable sections arranged to
 form opposite end-portions respectively of a
 top wall or cover for the aforesaid passage-
 way and operatively connected with the
 first-mentioned shaft.

90 16. The combination, with a pair of hori-
 zontal rolls arranged one above the other
 and in position to operate upon opposite
 sides respectively of the web and upon the
 inner sides of the flanges of the blank, up-
 95 right side rolls arranged to operate upon the
 outer sides of the flanges, two slides carry-
 ing the different side rolls respectively and
 adjustable toward or from each other, a pair
 of work-straightening bars arranged at one
 100 side of the pair of horizontal rolls but at
 opposite sides respectively of the path of
 the blank and pivoted vertically to the dif-
 ferent aforesaid slides respectively, a pair
 of guides arranged at opposite sides respec-
 105 tively of the aforesaid path at the opposite
 side of the pair of horizontal rolls and piv-
 oted vertically to the different aforesaid
 slides respectively, mechanism for shifting
 the said slides toward or from each other,
 110 mechanism for swinging the aforesaid
 guides toward or from each other at a
 greater speed than the mechanism which ad-
 justs the aforesaid slides during the adjust-
 ment of the guides by the shifting of the
 115 slides, and mechanism for swinging the
 aforesaid bars toward or from each other at
 a greater speed than the mechanism which
 adjusts the said slides during the adjustment
 of the bars by the shifting of the said slides.

120 17. In a rolling mill of the character indi-
 cated, a pair of horizontal rolls arranged to
 operate upon opposite sides respectively of
 the web and upon the inner sides of the
 flanges of the blank, and the said rolls being
 125 relatively adjustable to increase or decrease
 the space between them, mechanism instru-
 mental in relatively readjusting said rolls,
 a shaft operatively connected with the said
 mechanism, upright side rolls arranged to
 130

operate upon the outer sides of the flanges, two slides carrying the different side rolls respectively and adjustable toward or from each other, a pair of work-straightening bars arranged at opposite sides respectively of the path of the blank at one side of the pair of horizontal rolls and pivoted vertically to the different aforesaid slides respectively, a pair of guides arranged at opposite sides respectively of the aforesaid path at the opposite side of the pair of horizontal rolls and pivoted vertically to the different aforesaid slides respectively, mechanism for adjusting the said slides, a shaft parallel with the first-mentioned shaft and operatively connected with the said slide-adjusting mechanism, mechanism instrumental in swinging the aforesaid guides toward or from each other at a greater speed than the mechanism which adjusts the slides during the adjustment of the guides by the operation of the slides, and mechanism for swinging the aforesaid bars from or toward each other at a greater speed than the mechanism which adjusts the slides during the adjustment of the bars by the operation of the said slides.

18. The combination, with a pair of web-reducing rolls arranged to operate upon opposite sides respectively of the web of the blank and upon the inner sides of the heads or flanges of the blank; rolls arranged to operate upon the outer sides of the flanges or heads, and rolls arranged a suitable distance from and parallel with the aforesaid web-reducing rolls in position to operate upon the edges of the heads or flanges, of a passage-way for the work between the web-reducing rolls and the rolls arranged to operate upon the edges of the heads or flanges, which passage-way has a bottom-wall or bottom, a top or cover, and side walls, all practically extending from a point in close proximity to the flange-edge-rolling rolls to a point in close proximity to the web-reducing rolls and being practically immovable during

ing the passage of the blank through the said passage-way, and the aforesaid top or cover and bottom wall of the said passage-way being both somewhat less in width than the web-reducing surfaces of the web-reducing rolls and arranged to form lateral guides as well as top and bottom guides respectively for the blank.

19. The combination, with a pair of web-reducing rolls arranged to operate upon opposite sides respectively of the web of the blank and upon the inner sides of the heads or flanges of the blank; rolls arranged to operate upon the outer sides of the flanges or heads, and rolls arranged a suitable distance from and parallel with the aforesaid web-reducing rolls in position to operate upon the edges of the heads or flanges, of a passage-way for the work between the web-reducing rolls and the rolls arranged to operate upon the edges of the heads or flanges, which passage-way has a bottom-wall and a top or cover practically extending from a point in close proximity to the flange-edge-rolling rolls to a point in close proximity to the web-reducing rolls and being practically immovable during the passage of the blank through the said passage-way, and the aforesaid top or cover and bottom wall of the said passage-way being both somewhat less in width than the web-reducing surfaces of the web-reducing rolls and arranged between the paths of the heads or flanges of the blank so as to form lateral guides as well as top and bottom guides for the blank during the passage of the blank through the aforesaid passage-way.

In testimony whereof, I sign the foregoing specification, in the presence of two witnesses, this 6th day of September 1902, at Cleveland, Ohio.

HENRY GREY.

Witnesses:

C. H. DORER,
TELSA SCHWARTZ.