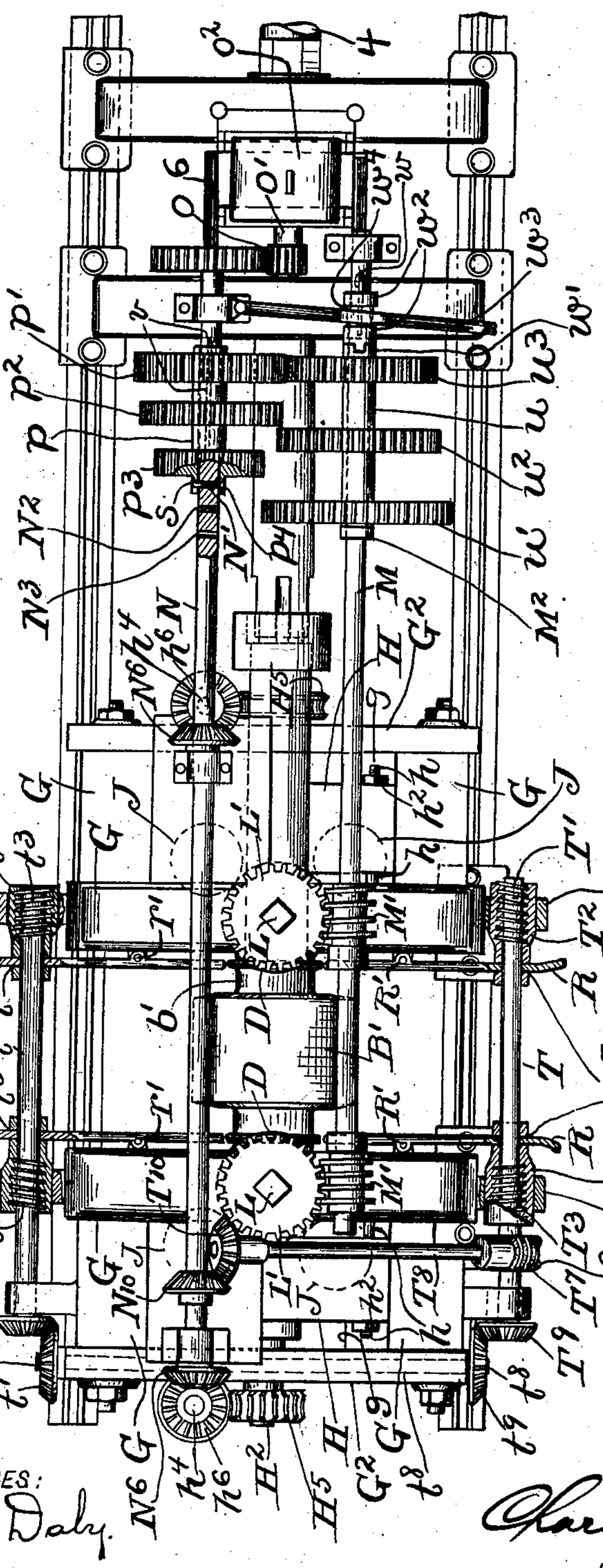
No. 744,535. PATENTED NOV. 17, 1903.

C. M. GREY.

ROLLING MILL.

APPLICATION FILED SEPT. 19, 1902.

NO MODEL. 4 SHEETS—SHEET 1.



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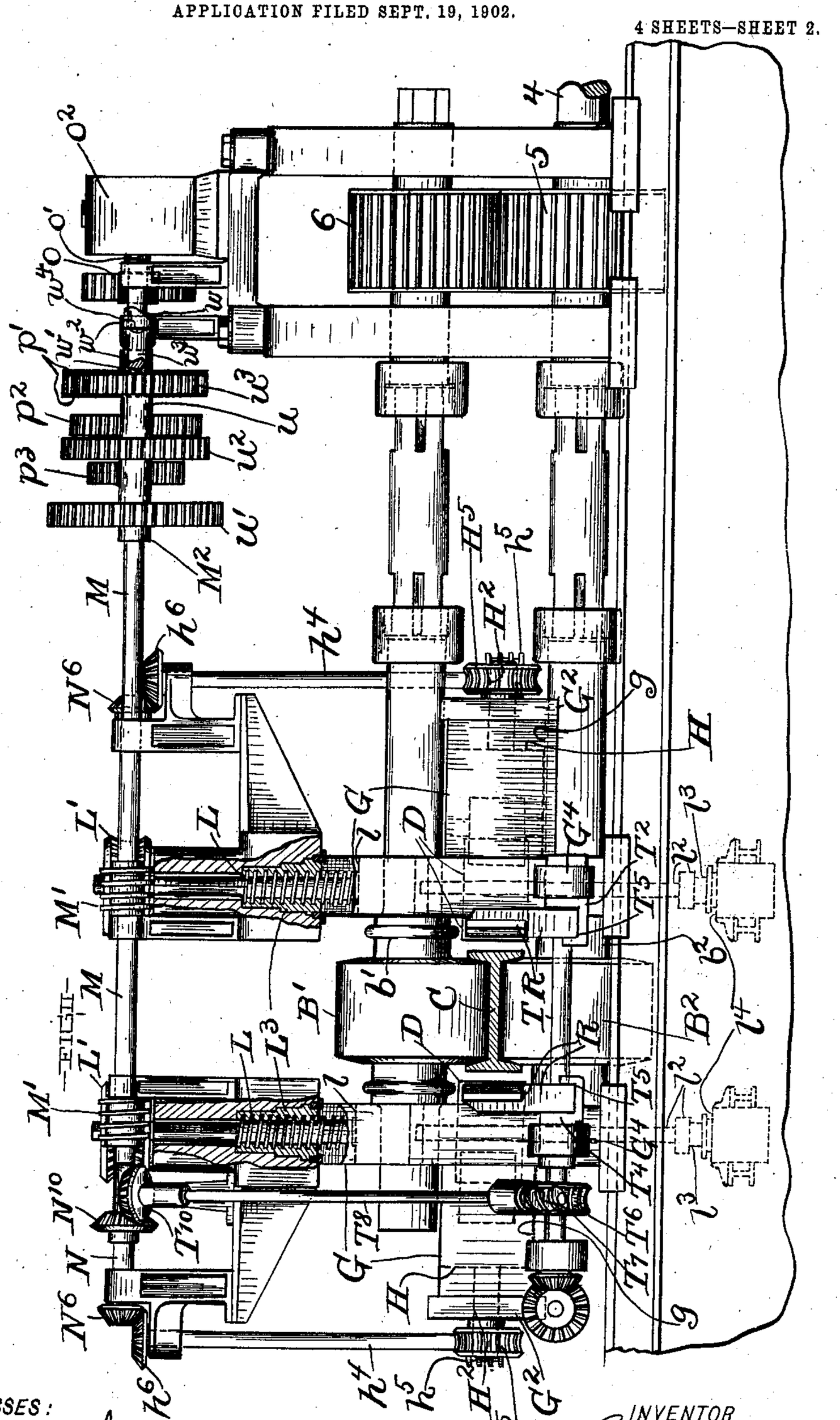

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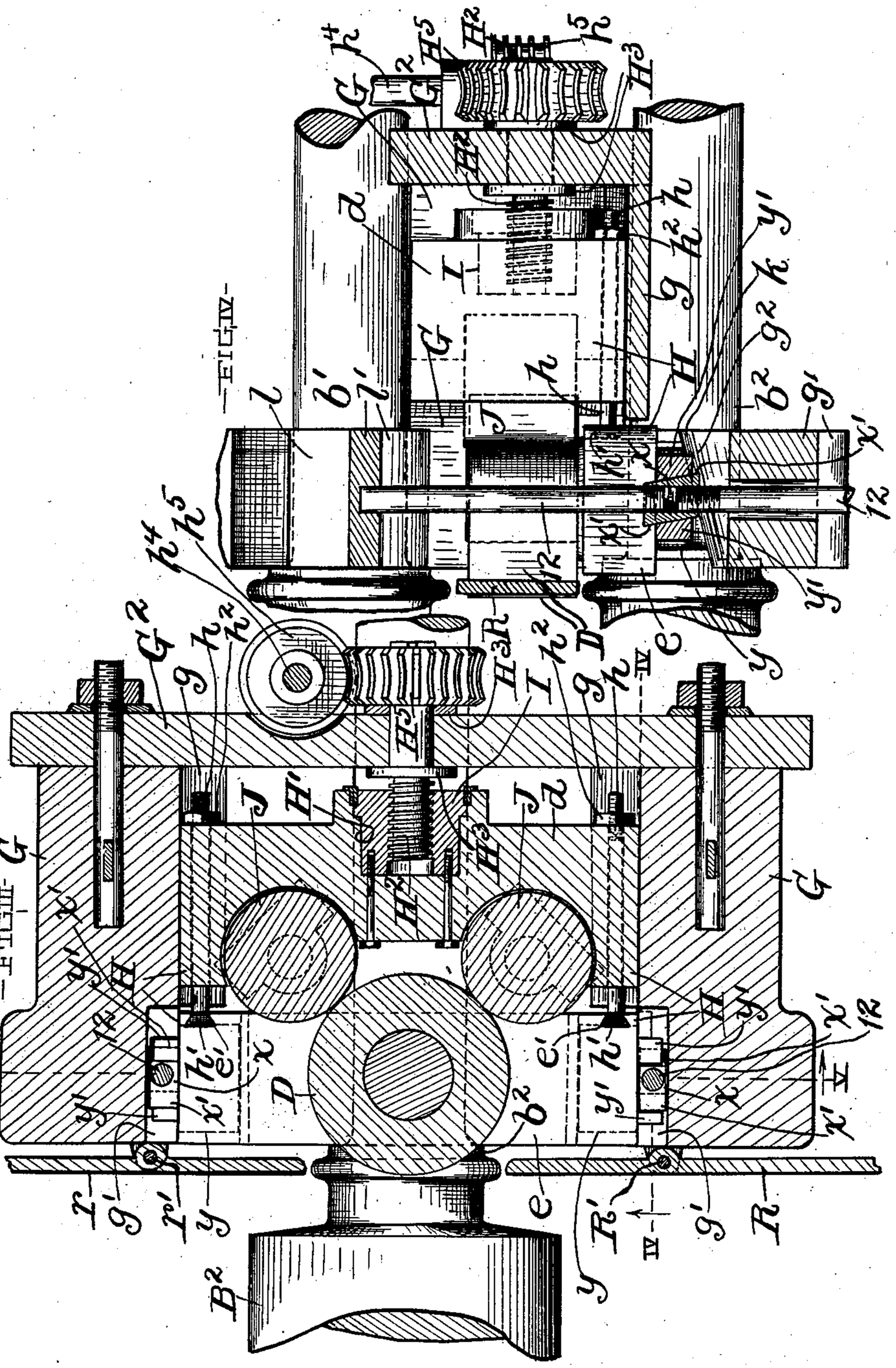

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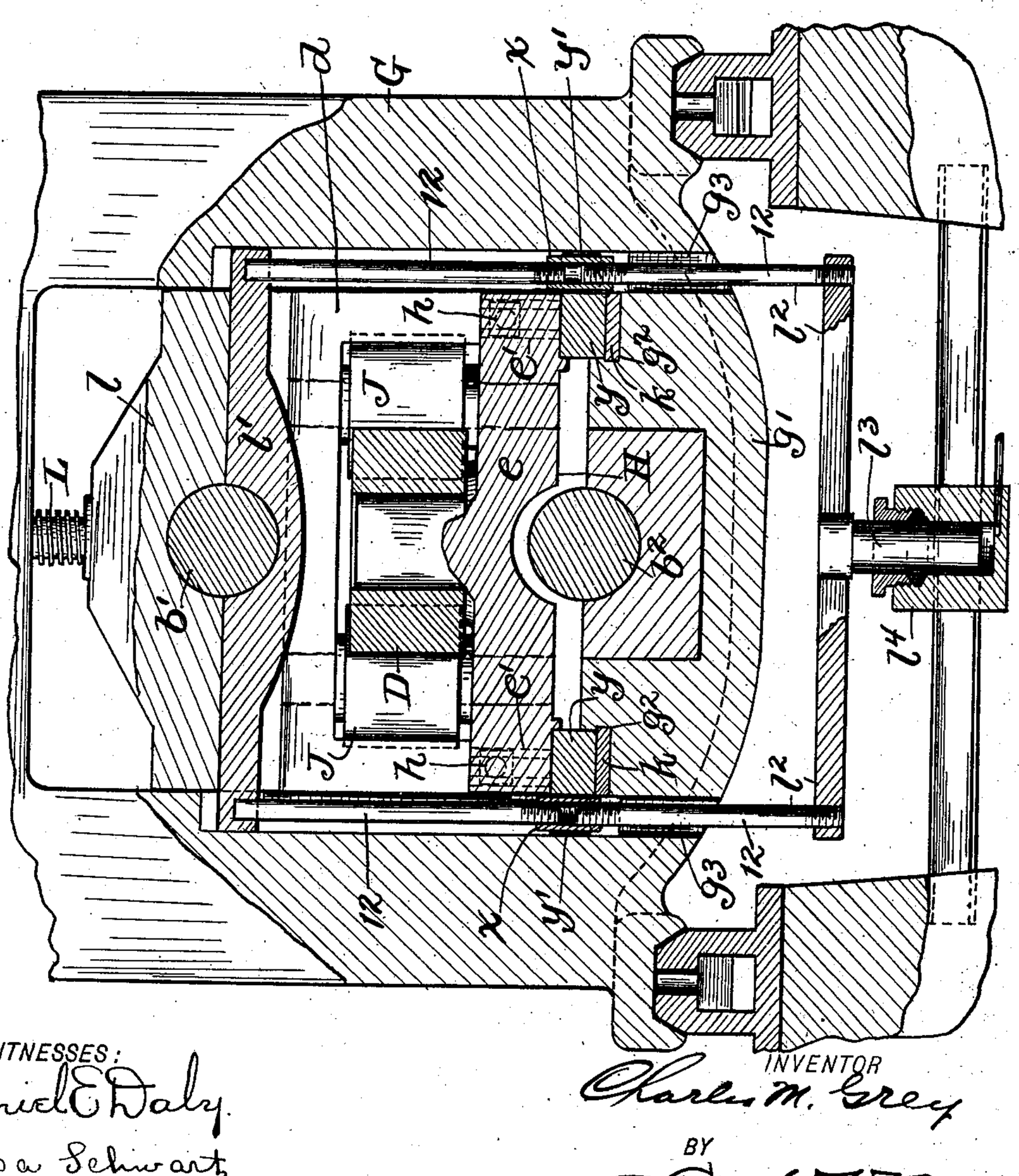

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No. 744,535. Patented November 17, 1903.

UNITED STATES PATENT OFFICE.

CHARLES M. GREY, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN UNIVERSAL MILL COMPANY, OF NEW YORK, N. Y., A CORPORATION OF WEST VIRGINIA.

ROLLING-MILL.

SPECIFICATION forming part of Letters Patent No. 744,535, dated November 17, 1903.

Application filed September 19, 1902. Serial No. 124,086. (No model.)

To all whom it may concern:

Be it known that I, CHARLES M. 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 a flanged beam or bar fed through the mill, with its web or body portion arranged horizontally, and comprises, first, two horizontal rolls arranged one above the other and in the same vertical plane and in position to operate upon the upper side and lower side, respectively, of the web of the blank or work, with one of the said rolls laterally adjustable vertically toward or from the other web-reducing roll; second, two vertical or upright endwise vertically-shiftable side rolls arranged at opposite ends, respectively, of the horizontal rolls and in position to operate upon and cover the outer sides of the heads or flanges of the blank or work and carried by slides which are adjustable toward or from each other, so as to render the said side rolls adjustable apart; third, two straightening-bars arranged at opposite sides, respectively, of the path of the blank or work at one side of the horizontal rolls and operated as required to gradually and intermittently effect a straightening of the blank or product; fourth, two side guides arranged at opposite sides, respectively, of the path of the blank or work at the opposite side of the horizontal rolls; fifth, a shaft operatively connected with screws instrumental in effecting the adjustment of the upper horizontal roll; sixth, another shaft arranged parallel with the said screw-operating shaft and operatively connected with the aforesaid side-roll-carrying slides; seventh, power-transmitting means whereby variable motion is transmissible from one to the other of the said shafts, so that the adjustable horizontal web-reducing roll and the upright flange-reducing side rolls are simultaneously shifted inwardly during a readjustment of the said rolls to reduce the passage formed between the rolls between successive passes of the blank or work through the mill; eighth, means whereby the upright side rolls are shiftable vertically or endwise, and, ninth, means whereby the shifting of the said side rolls vertically or endwise is simultaneous with and in the same direction as and entirely dependent upon the vertical shifting of the adjustable horizontal roll.

The primary object of my present invention is to provide a construction whereby not only a change in the extent of the travel of the upper horizontal roll toward the lower horizontal roll relative to the extent of travel of the side roll, straightening-bar, and side guide at one side of the horizontal rolls toward the side roll, straightening-bar, and side guide at the opposite side of the horizontal rolls can be conveniently and speedily effected practically without incurring any interruption in the operation of the mill, but the upright side rolls are shiftable vertically simultaneously with the adjustment of the adjustable horizontal roll and the vertical shiftability or adjustment of the said side rolls is wholly dependent upon the adjustment of the adjustable horizontal roll, so that an accurate maintenance of the said side rolls vertically central relative to the blank or work to be operated upon by the said side rolls is insured and an adjustable horizontal roll having the diametrically largest necks or trunnions practicable without interference between the said necks or trunnions and the side rolls is accommodated.

Another object of this invention is to provide such improved arrangement and combinations of parts that the means employed in effecting the lateral adjustment of the upright side rolls and the means instrumental in vertically or endwise shifting the said side rolls can be operated independently of each other.

With these objects in view and to the end of realizing other advantages hereinafter appearing this invention consists in certain fea-

tures of construction and combinations of parts hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure I is a top plan of a mill embodying my invention and portions are broken away and in section in this figure to more clearly show the construction. Fig. II is a side elevation of the mill, partly in section. Fig. III is a top plan of a portion of the mill, largely in section, taken centrally between the upper and lower ends of one of the side rolls D. Fig. IV is a side elevation of a portion of the mill, largely in section, on line IV IV, Fig. III, looking in the direction indicated by the arrow. Fig. V is an elevation, largely in section, on line V V, Fig. III, looking in the direction indicated by the arrow.

My improved rolling-mill 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 and at a right angle to the said horizontal rolls. The roll B′ is arranged above and transversely of the upper side of the path of the blank or work in position to operate upon the upper side of the web of the blank and upon the inner sides of the flanges or heads of the blank above the web.

The roll B^2 is arranged below and transversely of the path of the blank in position to operate upon the lower side of the web and upon the inner sides of the heads or flanges below the web.

The two side rolls D and D are arranged at opposite sides, respectively, of the path of the blank in position to operate upon the outer side of the adjacent flange or head of the blank.

The blank or work C is shown in position in Fig. II.

The rolls B′ and B^2 are practically of the same diameter and rotated in opposite directions, respectively, and 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 is of course suitably heated preparatory to its introduction into the mill and fed through the mill with its web arranged horizontally.

An engine-shaft 4 (see Fig. II) is operatively provided with a gear 5, which is operatively connected in any suitable manner with a neck or trunnion b^2 of the bottom web-reducing roll B^2. The gear 5 meshes with a diametrically corresponding gear 6, which is operatively connected in any approved manner with the adjacent trunnion b' of the top web-reducing roll B′.

The bottom roll B^2 is suitably supported from two housings G and G, which are arranged a suitable distance apart at opposite sides, respectively, of the path of the blank.

It is obvious that for work of the character indicated one of the web-reducing rolls must be adjustable vertically and the side rolls D and D must be adjustable apart. In the mill illustrated the top roll B′ is adjustable toward and from the bottom roll B^2. It is obvious also that the adjustable rolls B′ and D and D are at the commencement of the operation of the mill set as required for the first pass of the heated blank.

The adjustment of the rolls B′ and D D relative to the path of the blank or work is effected simultaneously, and the side rolls D D in adjusting them apart simultaneously with the adjustment of the top roll 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. Both slides H and H are adjustable toward or from each other, and the two rolls D and D are therefore adjustable apart.

Each slide H is operatively connected at its central portion with a screw H^2, arranged parallel with the travel of the said slide. The said screw H^2 engages a correspondingly-threaded nut I, (see Fig. III,) rigidly secured within a recess H′, formed in the central portion of 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 supported as will hereinafter appear. The said outer slide member d carries the thrust-bearing for the side roll D, carried by the said slide, and the said thrust-bearing 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 bolts or rods h are attached to the inner or roll-bearing slide member e. 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 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 rollers in contact with the roll, and the slide member d is retained in the adjustment required to hold its rollers in contact with the roll by nuts h^2, which engage threads formed upon the said rods h at the outer end of the said slide member. Each rod h extends into a recess e', formed in the inner or roll-bearing slide member e, and the said rod is provided within the said recess with a head h', and the said recess is correspondingly shaped to receive the said head with sufficient closeness to prevent detachment of the rod from the said slide member by pulling endwise upon the said rod.

The recesses e' of a slide member e extend vertically of the said slide member and are open at their upper ends to accommodate the introduction of the engaging rods h into the said slide member e during the assemblage of the parts. 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, when the two slides H and H are adjusted apart without interfering with the vertical shiftability of the said inner slide member independently of the said outer slide member and without detaching the said inner slide member from the said outer slide member during the vertical shifting of the said inner slide member.

Each slide-operating screw H^2 extends from the connected slide H outwardly through a yoke-forming beam or piece 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 screw at opposite sides, respectively, of the said piece G^2, prevent endwise movement of the screw during the rotation of the screw.

It is obvious that each slide H and the roll supported thereby are adjusted toward or from the pair of horizontal rolls B' B^2, according as the connected screw H^2 is turned in the one direction or the other.

Two upright screws L L (see Figs. I and II) engage correspondingly-threaded nuts L^3, fixed or formed in the tops of housings G G. Saddles l (see also Fig. V) are interposed between the lower ends of said screws and the trunnions of the top roll B', which trunnions have bearing in boxes l', which rest upon vertically-movable frames or structures l^2, engaged and held in the desired adjustment by the pistons l^3 of hydraulic cylinders l^4, and thereby supporting the roll at the desired elevation controlled by the screws L.

The mechanism employed for rotating the screws L and H^2 is shown to be as follows: Upon the upper end or portion of each screw L 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 and are shiftable endwise of 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. Upon the outer end of each screw H^2 is operatively mounted a worm-wheel H^5, 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 with a bevel-gear h^6, which meshes with a bevel-gear N^6, operatively mounted upon a shaft N, which is suitably driven in the one or the other direction, according as the slides H H, and consequently the side rolls D D, are shifted toward or from each other.

Bottom and top guides (not shown) for preventing vertical displacement of the work during the operation of the mill should be provided; but such guides form no part of the present invention and are therefore not illustrated in this application.

It is obvious that, as already indicated, the top web-reducing roll B', and with it the flange-reducing side rolls D 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 again adjusted to enlarge the work-receiving passage between them, as required for another blank.

Two side guide-forming bars r r for the work (see Figs. I and III) are arranged at one side of the rolls B' and B^2 at opposite sides, respectively, of the path of the blank or work, and two side guide-forming and work-straightening bars R R are arranged at the other side of the said rolls at opposite sides, respectively, of the path of the blank.

The bars R R extend longitudinally of the said path and are pivoted vertically near their inner ends, as at R', to the different housings G G, respectively, so that the said bars R are capable of being swung horizontally on their pivotal bearings toward or from each other. Bars R R near their outer or free ends are operatively connected with each other (see Figs. I and II) by a horizontally-arranged shaft T, which extends transversely of and below the path of the blank through the lower portions of the bars R 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 said nuts, and in the mill illustrated the lower portion of each bar R loosely embraces the shaft and engages a recess T^5, formed in 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 shaft T^8, which extends into close proximity to the shaft N (see Figs. I and II) 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.

Guides r r extend longitudinally of the path of the blank or work and are pivoted vertically at or near their inner ends, as at r', to the different housings G and G, respectively, so that the said guides are capable of being swung horizontally on their pivotal bearings toward or from each other upon the operation of a horizontally-arranged shaft t, which extends transversely of and below the path of the blank through the lower portions of the guides r 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 loosely embraces the shaft t and engages a recess t^5, formed in 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 the shaft T and 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.

By the construction hereinbefore described it will be observed that the side guides r, the work-straightening bars R, and the side-roll-carrying slides H are all operatively connected with one and the same shaft N, and consequently both guides r, both bars R, and both side rolls D are simultaneously adjusted apart during the operation of the said shaft.

The shaft N is intergeared at one end, as at o, with the shaft o' of an engine or motor o^2, only diagrammatically shown. (See Figs. I and II.) A sleeve p is slidably and operatively mounted upon and adjustable endwise of the shaft N. Three spur-gears p', p^2, and p^3 are formed upon the sleeve p at suitable intervals longitudinally of the sleeve and differ in diameter or number of teeth. The relative arrangement of the said gears is such that the middle-sized gear p^2 is arranged centrally between the largest p' and the smallest p^3 of the said gears.

A sleeve u is loosely mounted upon the shaft M adjacent to the sleeve p on the shaft N. The sleeve u has as many gears formed thereon as there are gears on the sleeve p. Hence the sleeve u has three gears u', u^2, and u^3, which are arranged at suitable intervals longitudinally of the said sleeve and differ in diameter or number of teeth. The relative arrangement of the gears u', u^2, and u^3 is such that the middle-sized gear u^2 is arranged centrally between the largest u' and the smallest u^3 of the said gears.

The arrangement of the gears of the sleeve u relative to the arrangement of the gears of the sleeve p is such that the largest, middle-sized, or smallest of the gears of the sleeve p shall be rendered operative and brought into mesh with the smallest, middle-sized, or largest, respectively, of the gears of the sleeve u, according as the sleeve p is in its extreme position in the one direction, in its intermediate position, or in its extreme position in the opposite direction endwise of the shaft N, and when any gear of the sleeve p is in mesh with a gear of the sleeve u the remaining gears of the sleeve u are out of mesh with their companion gears on the sleeve p.

Means for securing the gear-bearing sleeve p in the desired adjustment comprises a pin s, which extends through a hole p^4 in the said sleeve into engagement with any one of three holes N', N^2, and N^3, formed in the shaft N at suitable intervals longitudinally of the said shaft. The arrangement of the said holes relative to the different positions of the sleeve p is such that the hole p^4 in the sleeve shall be in registry with the hole N' or with hole N^2 or with hole N^3, according as the said sleeve is adjusted with its largest gear p' or with its middle-sized gear p^2 or with its smallest gear p^3 in an operative position. Obviously only the pin s has to be withdrawn from the engaging hole in the shaft N preparatory to a readjustment of the sleeve p, and the said sleeve is then secured in its readjustment by sliding the pin into the shaft's hole which is then opposite the said pin.

The operative connection between the sleeve p and the shaft N is formed, preferably, by the well-known means of groove and feather, as at v, which feather extends far enough longitudinally of the range of adjustment of the said sleeve to maintain operative connection between the said sleeve and the said shaft in any adjustment of the said sleeve.

By the construction hereinbefore described it will be observed that motion is transmitted from the shaft N to the shaft M through the medium of the gear-bearing sleeves p and u; but the sleeve u, as already indicated, is loosely mounted upon the shaft M, and in order to transmit power to the shaft M through the medium of the sleeves p and u operative connection must be established between the sleeve u and the said shaft M, and the means employed for thus establishing operative connection between the shaft M and the sleeve u comprises a clutch which has one of its members w' formed upon the said sleeve and has its other member w^2 slidably and operatively mounted upon the shaft M by the well-known means of groove and feather w. A suitably-applied lever w^3 engages an annular groove w^4, formed in the clutch member w^2, and obviously operative connection between the shaft M and the sleeve u is estab-

lished or interrupted, according as the slidable clutch member w^2 is actuated into or out of operative engagement with the companion and relatively stationary clutch member w'. The clutch member w' is formed, preferably, upon one end of the sleeve u, and the shaft M is provided next adjacent to the opposite end of the sleeve with a collar M^7, which prevents endwise displacement of the said sleeve during the actuation of the slidable clutch member w^2 into engagement with the relatively stationary clutch member w'. It will be observed, therefore, that by the provision of the two parallel shafts M and N and the mechanism hereinbefore described for transmitting power from the primarily-driven shaft N to the secondarily-driven shaft and for changing the speed of the latter relative to the speed of the primarily-driven shaft the travel of the pair of side rolls D, pair of side guides r, and pair of work-straightening bars R during the adjustment apart of the members of the said pairs relative to the travel of the top web-reducing roll during the adjustment of the said top roll relative to the bottom web-reducing roll can be readily changed without necessitating the removal of any gearing or otherwise incurring material interruption in the operation of the mill.

Of course the travel of the side rolls D during their adjustment apart is preferably more rapid than the travel of the top web-reducing roll during the adjustment of the said top roll relative to the bottom web-reducing roll. The travel of the side guides r during the adjustment apart of the said guides is preferably about the same as the travel of the side-roll-carrying slides H during the adjustment apart of the side rolls. The travel of the work-straightening bars R during the adjustment apart of the said bars is preferably more rapid than the travel of the side guides; but the desired travel of the side-roll-carrying slides H, work-straightening bars R, and side guides r can be readily attained by properly relatively proportioning the gearing instrumental in transmitting power from the shaft N to the said side guides r, work-straightening bars R, and side-roll-carrying slides H; but the travel of the said side-roll-carrying slides H, work-straightening bars R, and side guides r during their adjustment will be changed simultaneously and correspondingly relative to the travel of the top web-reducing roll upon changing the relative speeds of the shafts N and M. For instance, as illustrated, the smallest gear u^3 of the sleeve u is in mesh with the largest gear p' of the shaft p, so that a readjustment of the sleeve p to bring its intermediate gear p^2 into mesh with the intermediate gear u^2 of the sleeve u, which gear u^2 is larger diametrically than the gear p^2, will result in a difference between the speeds of the shafts N and M, and the speed of the shaft N will then be greater relative to the speed of the shaft M, and consequently the travel of the side-roll-carrying slides H, the side guide r, and the work-straightening bars R during a readjustment of the said work-straightening bars R, side guides r, and side-roll-carrying slides H will then be correspondingly greater than the travel of the top web-reducing roll during a readjustment of the said top roll. Obviously upon a readjustment of the sleeve p to bring the smallest gear p^3 of the said sleeve into mesh with the largest gear u' of the sleeve u the difference between the speeds of the shafts N and M in favor of the shaft N will be still greater, and the travel of the side-roll-carrying slides H, work-straightening bars R, and side guides r during a readjustment of the said parts is increased correspondingly relative to the travel of the top web-reducing roll during a readjustment of the said top roll. It will be observed also that upon a disengagement of the slidable clutch member w^2 from the relatively stationary clutch member w' the sleeve u will be left to run idly upon the shaft M, and the shaft N can be rotated independently of the shaft M. A simultaneous adjustment of the side rolls, side guides, and work-straightening bars can then be effected independently of the adjustment of the adjustable web-reducing roll as may be required in setting or relatively adjusting the adjustable work-engageable parts of the mill preparatory to the commencement of the operation of the mill.

The legs of each housing G are connected at the bottom of the said housing by a web g', which extends in under and supports the adjacent neck or trunnion of the bottom web-reducing roll, as shown very clearly in Fig. V, and extends, of course, in under the inner end portion or member e of the slide H, which supports or carries the side roll D, which is arranged above the said neck or trunnion, as shown also in Figs. III and IV, and two blocks y are interposed between the said slide member e and the aforesaid web at opposite sides, respectively, of the said neck or trunnion, and the said blocks form slideways for the said slide member. The lower surface of each block y slopes upwardly and outwardly toward the outer end of the slide member e, which rests upon the said block and engages a correspondingly-sloping seat formed upon the web g'. The said seat is formed, preferably, by a plate k, which rests upon the correspondingly-sloping bottom of a recess g^2, formed in the web g' of the housing which supports the said slide. The said blocks y form, therefore, wedges, interposed between the lower surface of the inner end portion or member e of the said slide H and the web g' of the housing which supports the said slide, and the said member of the said slide and consequently the roll borne by the said slide member are elevated or lowered, according as the said wedges y are actuated endwise in the one direction or the other, and the importance of the vertical shiftability of the said slide member independently of the outer slide member of the said slide is therefore obvious. The

side rolls D should be kept central vertically relative to the blank or work being operated upon, so as to always wholly cover the outer sides of the heads or flanges of the said blank, and the said rolls are adjusted vertically preparatory to the commencement of the operation of the mill to bring them central vertically relative to the path of the said blank. The operation of the wedges y is effected by an operative connection between the said wedges and the top web-reducing roll, so that the inner slide members e, and consequently the side rolls, are during each readjustment of the said top roll shifted vertically as required to maintain the said rolls central with the path of the blank and to accommodate the employment of a top roll having the diametrically largest necks or trunnions practicable.

Preferably each wedge y, as shown in Figs. III, IV, and V, is provided upon its outer side with two lugs y', which engage opposite sides, respectively, of a vertically-arranged internally-screw-threaded union x, which embraces and couples together the adjacent correspondingly externally-threaded ends of the two sections 12 of an upright of a frame l^2, which is instrumental, as already indicated, in supporting the top web-reducing roll B', and the said union has the external contour required to form two vertically and reversely arranged wedges x', arranged between the aforesaid lugs—that is, each upright of each frame l^2 is provided centrally between its ends with two upright wedges x', which are reversely arranged snugly between the lugs y', formed upon and projecting from a wedge y. One of the said wedges x', as shown very clearly in Fig. IV, tapers downwardly, therefore, and engages the inner of the said lugs y', whereas the other of the said wedges x' tapers upwardly and engages the outer of the said lugs. Hence during the descent of the uprights 12 of the frame l^2 during the lowering of the top roll B' the downwardly-tapering wedges x' will operate to actuate the wedges y endwise toward the lower ends of or adown the sloping seats k, and thereby permit the inner end portions or members e of the slides H, and consequently the side rolls D, to lower by gravity without, however, otherwise shifting the said slide members e and rolls D and without interfering with the capability of the said rolls to be adjusted laterally independently of the operation of the said wedges, and the upwardly-tapering wedges x' move idly during and thereby accommodate the operation of the downwardly-tapering wedges x'. During the ascent of the frames l^2 to elevate the top roll B' the upwardly-tapering wedges x' of the said uprights will operate to actuate the wedges y endwise toward the upper ends of or up the sloping seats k, and thereby result in an elevation of the inner end portions or members e of the slides H, and consequently the side rolls D, without, however, otherwise shifting the said slide members e and rolls D and without interfering with the capability of the said rolls to be adjusted laterally independently of the operation of the wedges, and the downwardly-tapering wedges x' move idly during and thereby accommodate the operation of the upwardly-tapering wedges x'.

The web g' of each housing G is of course suitably slotted, as at g^3, to accommodate the location of the frame l^2, whose uprights extend through the said web.

It will be observed that by the construction hereinbefore described the wedges x operate as required to shift the engaging wedges y in the direction required to lower or elevate the slide members e, and consequently side rolls D, according as the top web-reducing roll B' is lowered or elevated and that therefore the endwise or longitudinal shiftability of the side rolls is dependent entirely on the adjustment of the top roll laterally toward and from the path of the blank or work and that the side rolls D are shifted endwise simultaneously with and in the same direction as the top roll B' during each readjustment of the said top roll and that the means employed in shifting the said side rolls D vertically or endwise and the means instrumental in adjusting the said side rolls laterally are capable of being operated independently of each other.

What I claim is—

1. In a rolling-mill, a longitudinally or endwise shiftable upright reducing-roll adjusting laterally toward and from the path of the blank or work and arranged to operate upon one portion of the blank or work; another reducing-roll arranged in a horizontal plane and in position to operate upon another portion of the blank or work and adjustable toward and from the aforesaid path; a vertically-adjustable support for the upright roll; means instrumental in laterally adjusting the upright roll toward and from the path of the blank or work; means instrumental in shifting the aforesaid roll-support vertically, and means whereby the said roll-support-shifting means is operated to shift the said roll-support when and in the same direction in which the horizontally-arranged roll is shifted during a readjustment of the horizontally-arranged roll, and the aforesaid roll-support-shifting means and the means instrumental in laterally adjusting the upright roll relative to the path of the blank or work being capable of being operated independently of each other.

2. In a rolling-mill, a longitudinally or endwise shiftable upright reducing-roll arranged to operate upon one portion of the blank or work; a vertically-shiftable support for the said roll, which support is arranged below the roll; means instrumental in shifting the roll-support vertically; means for adjusting the said roll-support toward and from the path of the blank or work; another reducing-roll arranged in a horizontal plane and in position to operate upon another portion of the blank or work and adjustable toward and

from the aforesaid path, and means whereby the aforesaid roll-support-shifting means is operated to shift the aforesaid roll-support when and in the same direction in which the horizontally-arranged roll is shifted during a readjustment of the horizontally-arranged roll, and the said roll-support-shifting means and the means instrumental in adjusting the said roll-support laterally relative to the path of the blank or work being capable of being operated independently of each other.

3. The combination, with a longitudinally or endwise shiftable upright reducing-roll arranged to operate upon a portion of the blank or work; a lateral thrust-bearing for the said roll, and a suitably-supported slide adjustable toward and from the path of the blank or work and comprising an outer end portion or member bearing the aforesaid thrust-bearing, an inner end portion or member which bears the upright roll, and such an operative connection between the said portions or members of the slide as will render the inner slide member capable of being shifted independently of and without becoming disconnected from the outer slide member, of means for vertically shifting the inner and roll-bearing slide member independently of the outer slide member.

4. The combination, with a longitudinally or endwise shiftable upright reducing-roll arranged to operate upon a portion of the blank or work; a lateral thrust-bearing for the said roll, and a slide adjustable toward and from the path of the blank or work and comprising a suitably-supported outer end portion or member bearing the said thrust-bearing, an inner end portion or member which bears the roll, and such an operative connection between the said portions or members of the slide as will accommodate a vertical shifting of the inner slide member independently of and without disconnecting it from the outer slide member, of wedges bearing the inner and roll-bearing slide member, bottom bearings for the wedges, and means for operating the said wedges, and the arrangement of parts being such that the inner and roll-bearing slide member is elevated independently of the outer slide member according as the wedges are actuated in the one direction or the other.

5. The combination, with a roll arranged in a horizontal plane and in position to operate on one portion of the blank or work; a longitudinally or endwise shiftable upright reducing-roll arranged to operate upon another portion of the blank or work; a thrust-bearing for the upright roll, and a slide adjustable toward and from the path of the blank or work and comprising a suitably-supported outer end portion or member which bears the upright roll, and such an operative connection between the said portions or members of the slide as will accommodate a vertical shifting of the inner and roll-bearing slide member independently of and without disconnecting it from the outer slide member, of means bearing the inner roll-bearing slide member and instrumental in shifting the said slide member vertically and means whereby the operation of the means instrumental in supporting and vertically shifting the inner and roll-bearing slide member is dependent on the adjustment of the first-mentioned roll.

6. The combination, with an endwise-shiftable reducing-roll arranged to operate upon a portion of the blank or work, of a suitably-applied wedge instrumental in shifting the roll endwise, a pair of reversely-arranged wedges applied to actuate the first-mentioned wedge in opposite directions, respectively, and means for actuating the said reversely-arranged wedges simultaneously in the same direction.

7. The combination, with a vertical or upright reducing-roll arranged to operate upon one portion of the blank or work; a vertically-shiftable member arranged below and bearing the said roll, and another reducing-roll arranged in a horizontal plane and in position to operate upon another portion of the blank or work and adjustable vertically, of wedges supporting and arranged below the aforesaid shiftable roll-bearing member, bottom bearings for the wedges, and means for shifting the said wedges endwise, and means whereby the operation of the said wedge-shifting means is caused to be simultaneous with and dependent on the adjustment of the horizontal roll, and the arrangement of the parts being such that during a readjustment of the said horizontal roll the upright roll moves down or up according as the horizontal roll is lowered or elevated.

8. The combination, with a vertical or upright reducing-roll arranged to operate upon one portion of the blank or work; another reducing-roll arranged in a horizontal plane in position to operate upon another portion of the blank or work and adjustable vertically; a vertically-shiftable member arranged below and bearing the upright roll; and a bottom bearing below the said vertically-shiftable roll-bearing member, of means instrumental in shifting the said roll-bearing member vertically and interposed between the said roll-bearing member and the aforesaid bottom bearing, and means whereby the operation of the said shifting means is caused to be simultaneous with and dependent on the adjustment of the horizontal roll, and the arrangement of the parts being such that during a readjustment of the said horizontal roll the upright roll moves down or up according as the horizontal roll is lowered or elevated.

9. In a rolling-mill of the character indicated, an endwise-shiftable laterally-adjustable upright reducing-roll arranged to operate upon one portion of the blank or work, means instrumental in effecting the lateral adjustment of the said roll, a shaft operatively connected with the said roll-adjusting

means, another roll arranged at angle to the endwise-shiftable roll in position to operate upon another portion of the blank or work and laterally adjustable toward and from the path of the blank or work, mechanism instrumental in effecting the adjustment of the second-mentioned roll, another shaft parallel with the first-mentioned shaft and operatively connected with the last-mentioned roll-shifting mechanism, means whereby power is transmitted from one to the other of the said shafts and whereby the relative speeds of the said shafts can be changed so as to render changeable the ratio of the distance which one of the said rolls is laterally adjusted to the distance which the other roll is laterally adjusted during a readjustment of the said rolls, and means whereby the endwise-shiftable roll is shifted endwise simultaneously with and in the same direction as the other roll is adjusted.

10. The combination of a roll arranged transversely of the path of the blank or work in position to operate upon one side of the web and upon the inner sides of the heads or flanges of the blank or work, another roll arranged transversely of the aforesaid path in position to operate upon the opposite side of the web and upon the inner sides of the heads or flanges and adjustable toward or from the first-mentioned web-reducing roll, mechanism instrumental in effecting the adjustment of the adjustable web-reducing roll, a shaft operatively connected with the said mechanism, endwise-shiftable rolls arranged to operate upon the outer sides of the flanges or heads of the blank or work and adjustable apart, means for adjusting the last-mentioned rolls toward or from each other, another shaft parallel with the first-mentioned shaft and operatively connected with the last-mentioned roll-shifting means, means whereby the relative speeds of the said shafts can be changed so as to render changeable the ratio of the distance which the adjustable web-reducing roll is shifted to the distance which the exclusively flange-reducing rolls are adjusted apart, and means whereby the endwise-shiftable rolls are shifted endwise simultaneously with and in the same direction as the adjustable web-reducing roll is adjusted.

11. The combination of a horizontal roll arranged transversely of the path of the blank or work fed with its web arranged horizontally, 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 horizontal roll arranged transversely 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 and adjustable toward and from the bottom web-reducing roll, mechanism instrumental in effecting the adjustment of the adjustable web-reducing roll, a shaft operatively connected with the said mechanism, endwise-shiftable vertical or upright side rolls arranged to operate upon the outer sides of the flanges or heads, two slides carrying the different side rolls respectively, means for adjusting the said slides toward or from each other, another shaft parallel with the first-mentioned shaft and operatively connected with the said slide-shifting means, means whereby power is transmitted from the one to the other of the said shafts and whereby the relative speeds of the said shafts can be changed so as to render changeable the ratio of the distance which the adjustable web-reducing roll is shifted to the distance which the side rolls are laterally shifted, means instrumental in shifting the side rolls endwise, and means whereby the operation of the last-mentioned roll-shifting means is simultaneous with and dependent on the adjustment of the adjustable web-reducing roll, and the arrangement of the parts being such that the side rolls are shifted endwise and in the same direction in which the adjustable web-reducing roll is adjusted.

12. In a rolling-mill, a pair of horizontal rolls, means for adjusting them toward and from each other, a side roll, means whereby the adjustment apart of the horizontal rolls imparts a proportionate vertical adjustment to the side roll, and means whereby a lateral adjustment of the side roll may be effected independent of the said other adjustments.

In testimony whereof I sign the foregoing specification, in the presence of two witnesses, this 5th day of September, 1902, at Cleveland, Ohio.

CHARLES M. GREY.

Witnesses:
C. H. DORER,
TELSA SCHWARTZ.