J. E. YORK.

APPARATUS FOR ALTERING ELONGATED STEEL SHAPES.

APPLICATION FILED DEC. 10, 1904.

950,036. **Patented Feb. 22, 1910.**

7 SHEETS—SHEET 1.

FIG. 1.

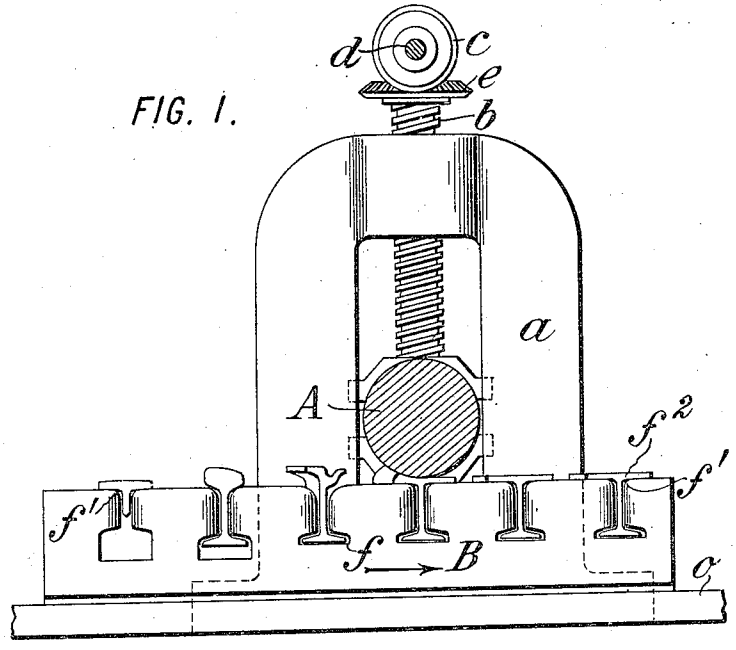


FIG. 2.

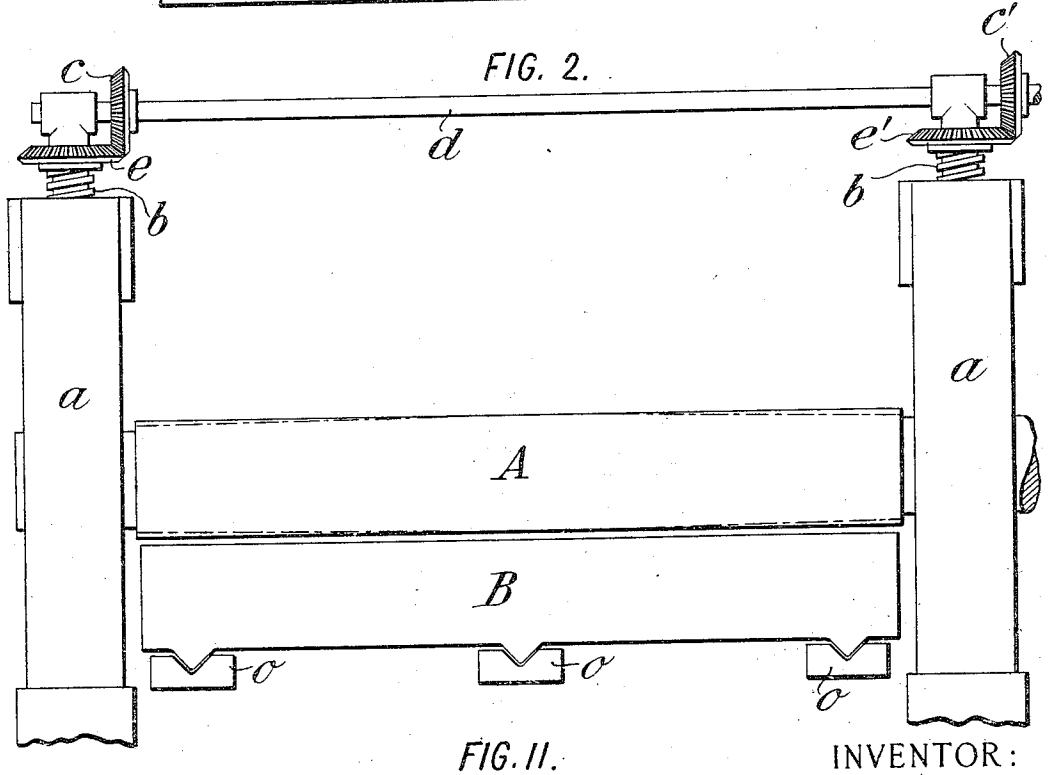
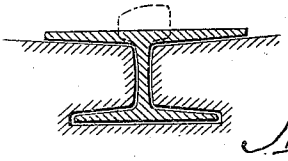


FIG. II.



WITNESSES:

Fred Whitz

René Bruine

INVENTOR:

James E. York,

By Attorneys,

Arthur O. Fraser & Co

J. E. YORK.

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7 SHEETS—SHEET 2.

FIG. 3.

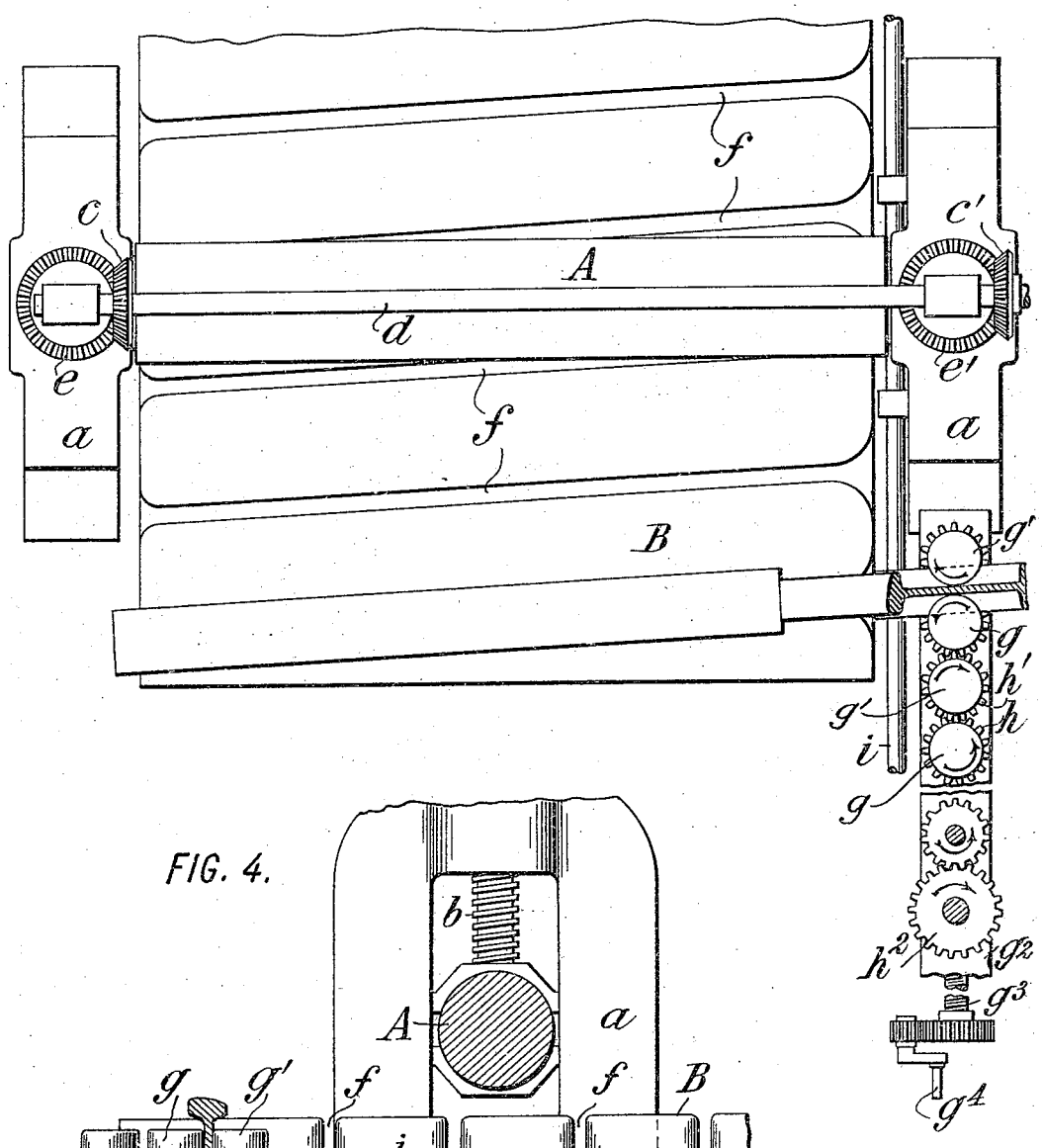

FIG. 4.

WITNESSES:

Fred Whitz

René Bruine

INVENTOR:

James E. York,

By Attorneys,

Arthur C. Fraser & Co

J. E. YORK.

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7 SHEETS—SHEET 3.

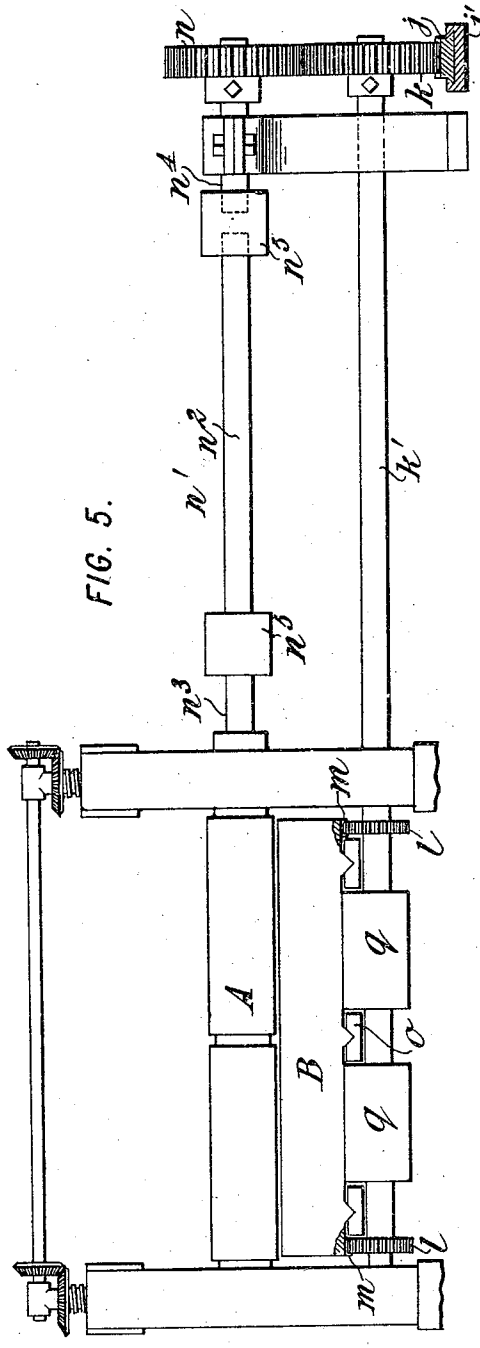

FIG. 5.

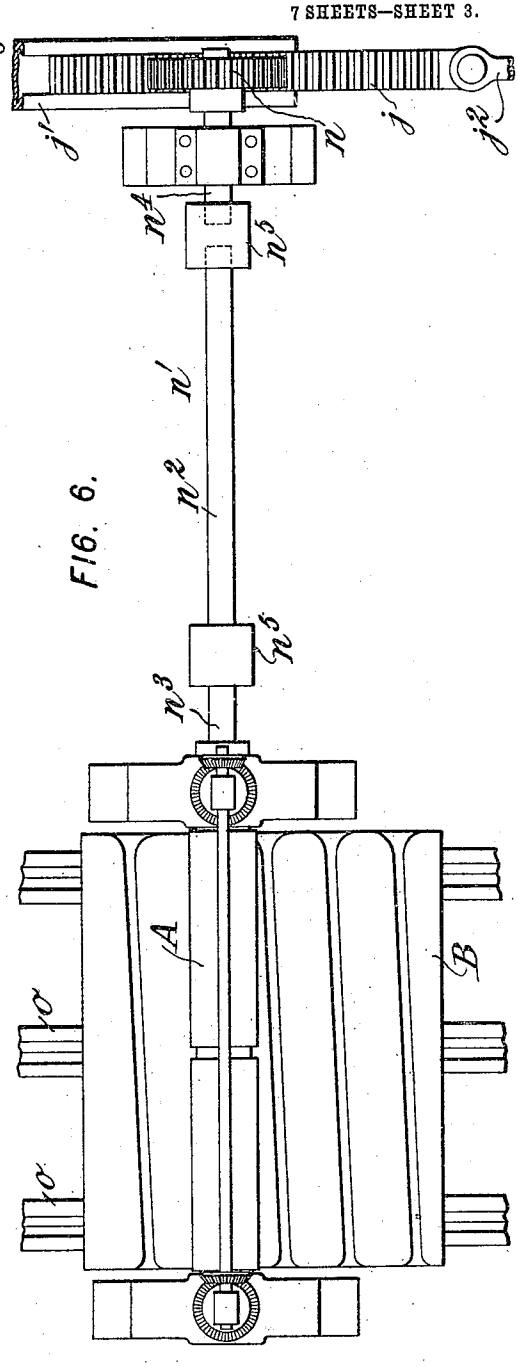

FIG. 6.

WITNESSES:

Fred Whitz

René Paine

INVENTOR:

James E. York,

By Attorneys,

Arthur O. Fraser & Co

J. E. YORK.

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7 SHEETS—SHEET 4.

FIG. 7.

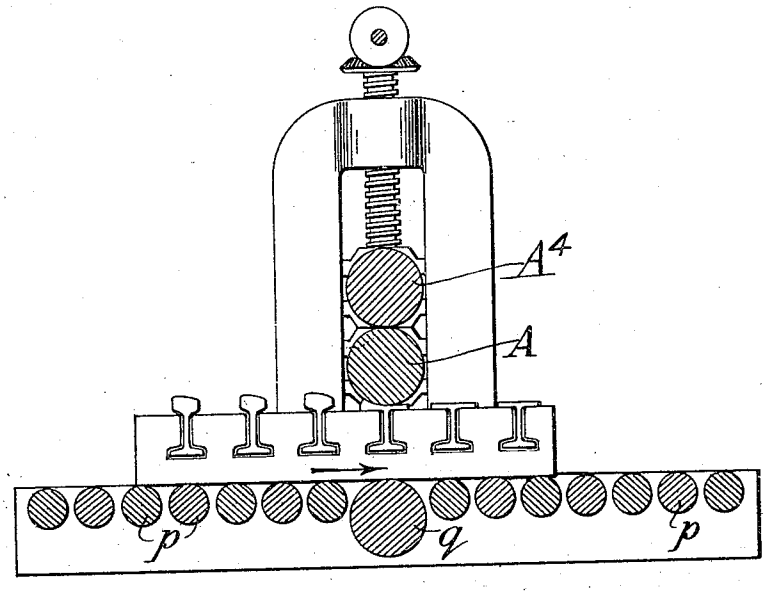
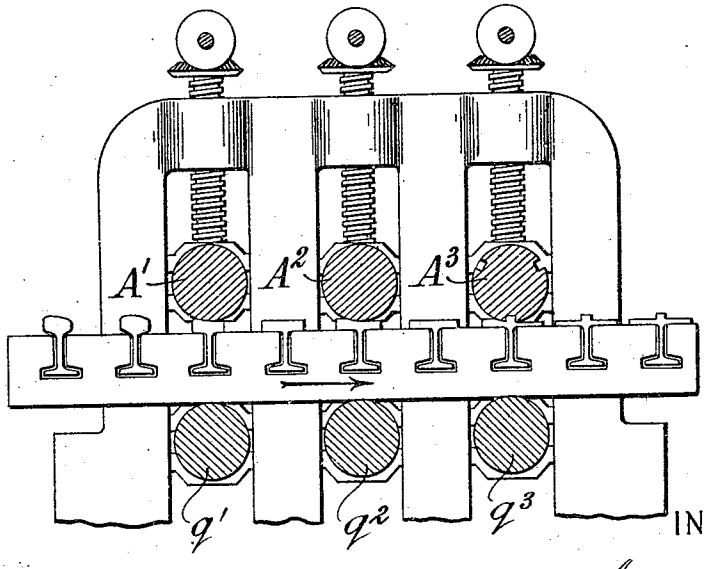


FIG. 8.



WITNESSES:

Fred White

René Bruine

INVENTOR:

James E. York,

By Attorneys,

Arthur O. Fraser & Co.

J. E. YORK.

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7 SHEETS—SHEET 5.

FIG. 9.

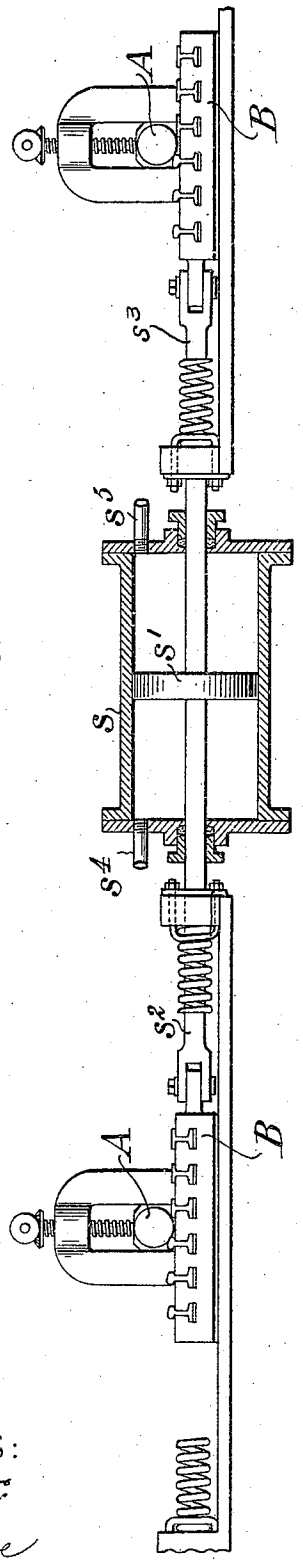
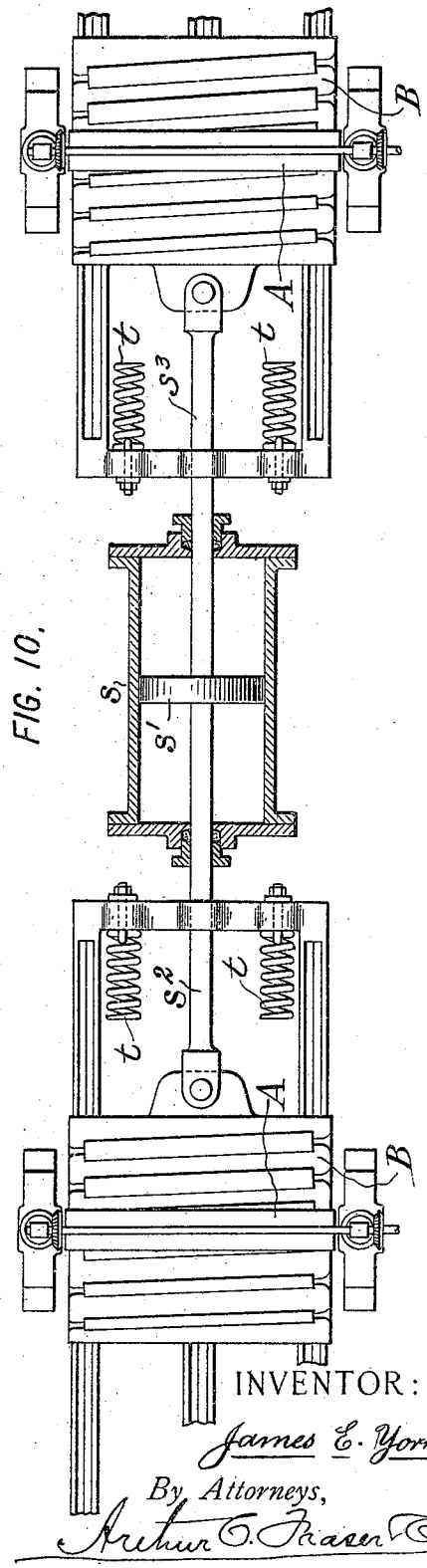


FIG. 10.



WITNESSES:

Fred Whitty

Rene' Bruine

INVENTOR:

James E. York,

By Attorneys,

Arthur O. Fraser & Co

J. E. YORK.

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7 SHEETS—SHEET 6.

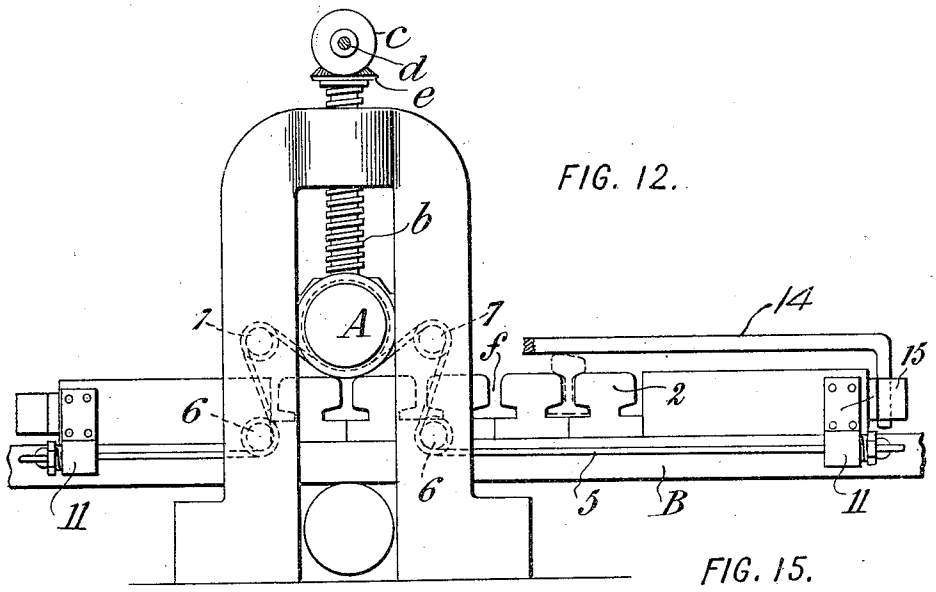


FIG. 12.

FIG. 15.

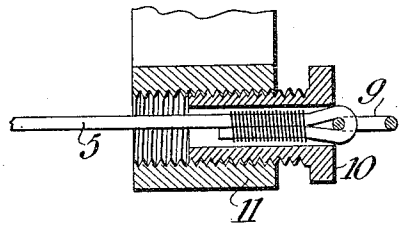


FIG. 14.

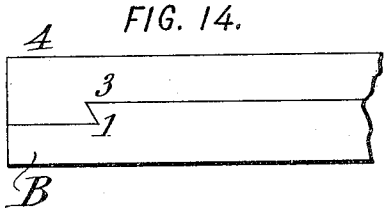
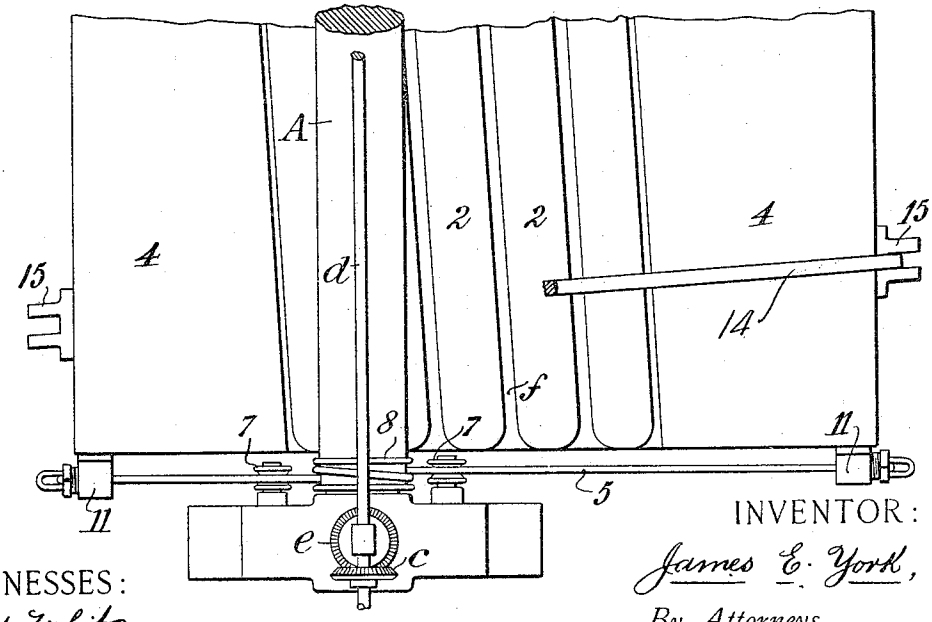


FIG. 13.



WITNESSES:

Fred White

René Bruine

INVENTOR:

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By Attorneys,

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J. E. YORK.

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950,036. Patented Feb. 22, 1910.

7 SHEETS—SHEET 7.

FIG. 16.

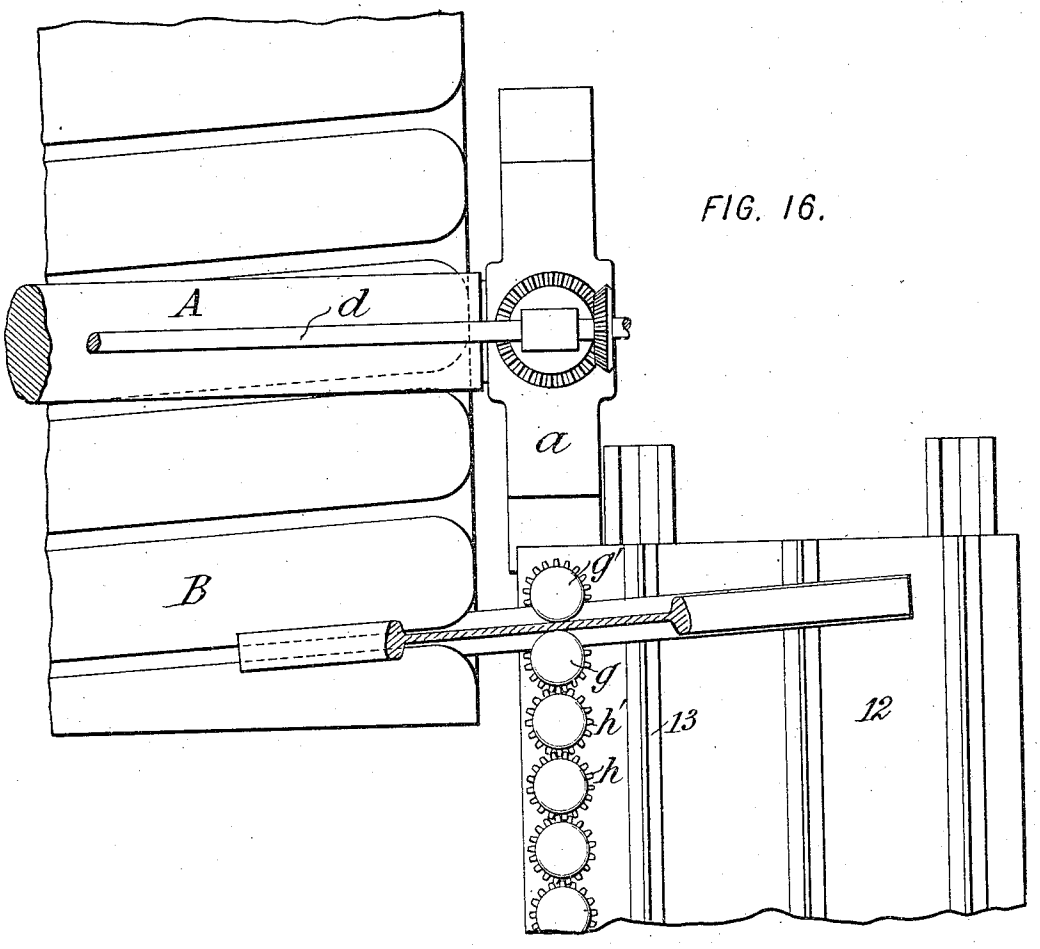
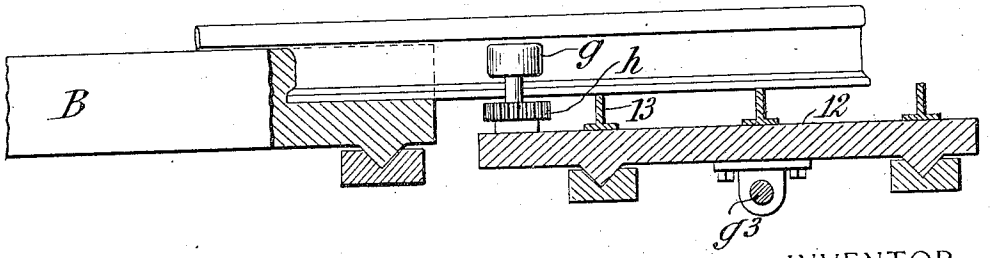


FIG. 17.



INVENTOR:

James E. York,

By Attorneys,

Arthur C. Fraser & Co

WITNESSES:

Fred Whitty

René Bruine

UNITED STATES PATENT OFFICE.

JAMES E. YORK, OF NEW YORK, N. Y., ASSIGNOR TO YORK ROLLING PROCESS COMPANY, A CORPORATION OF NEW YORK.

APPARATUS FOR ALTERING ELONGATED STEEL SHAPES.

950,036. Specification of Letters Patent. Patented Feb. 22, 1910.

Application filed December 10, 1904. Serial No. 236,354.

To all whom it may concern:

Be it known that I, JAMES E. YORK, a citizen of the United States, residing in the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Apparatus for Altering Elongated Steel Shapes, of which the following is a specification.

In rolling elongated steel shapes such as rails of all types, channels, I-beams, tees, angles or rods, it is customary to run them lengthwise through passes between pairs of rolls, the successive passes being of such shape as to gradually bring the metal to the desired shape in cross-section. Experience shows that in such processes the flow of metal is practically all in the direction of the length of the bar, or the direction of rotation of the rolls at the points where they engage the bar. No material amount of lateral spreading can be obtained. Therefore the original bar from which the final shape is to be obtained must be of such cross-section as to inclose the cross-section of the final shape. It is apparent therefore that in order to make deep flanges there is a great quantity of metal which must be rolled down from the original bar and the process becomes very expensive. Furthermore as the depth of the flanges to be rolled increases it becomes more difficult to secure a good grip of the rolls on the bar without an excessive taper of the flanges. These processes are therefore of comparatively limited usefulness.

According to this invention it is proposed to roll such elongated bars (in which generic term I include the various shapes mentioned and all others of a similar character) transversely of their length. This improvement at once opens up a wide field of usefulness for rolling processes. When combined with the old longitudinal rolling process the flow of metal is under almost unlimited control. A most important field is in the rerolling of old or worn rails, beams, rods or the like which at present are useful only as scrap. This old material may be reshaped by the present process and brought to symmetrical cross-section, and may be utilized regardless of any holes or rivets therein, without even removing such rivets. The process may be carried out upon only a part of the section if desired, as for example upon only the head of an old rail, the original symmetrical shape of the web and the base being unchanged. Preferably the metal or at least the part of it which is to be reshaped is reheated to a moderate temperature, and this moderate reheating improves greatly the quality of the steel if injured by the high heat of the original rolling.

Another feature of improvement consists in rolling the bars or shapes on a flat bed, and this feature applies either to longitudinal or transverse rolling, though it is of particular value in the latter case. The ordinary system of passing the bars between two revolving rolls in which generally one part of the bar is elongated more than another part, produces a curving of the finished shape which necessitates an additional operation for straightening it. In rolling on a flat bed, and preferably holding the bar flat on such bed, there can not be any lateral bending.

Another feature of improvement is in the rolling of the bars obliquely. The word "transversely" is used here to include all directions crossing the lengthwise direction of the bar, thus including the oblique rolling referred to. This oblique rolling has the advantage as compared with a rolling directly at right angles to the length, that the bar is brought under the operation of the roll gradually and not at the same instant throughout its entire length.

A further feature of improvement is in the transverse rolling of the bar at separated portions of its length so as to make a finished shape of differing cross-section at different points.

The improved machine which I have designed for carrying out the described process comprises a roll and a bed, with means for providing a relative movement thereof. Preferably the roll is mounted to rotate in stationary bearings, and the bed is provided with means for supporting the bar or other shape to be operated upon, and is moved past the roll. The bed in its preferred form is substantially flat, is reciprocated in a direction approximately at right angles to the roll, and is provided with means for holding the bars in a position oblique to the roll. This preferred form is susceptible of various modifications however, some of which are illustrated in the accompanying drawings.

Figure 1 of the drawings is a longitudinal section illustrating one embodiment of

my invention. Fig. 2 is an end elevation thereof. Fig. 3 is a plan. Fig. 4 is a side elevation of part of Fig. 3. Fig. 5 is an end elevation illustrating means for reciprocating the bed. Fig. 6 is a plan of Fig. 5. Figs. 7 and 8 are views illustrating different forms of the apparatus. Fig. 9 is a side elevation illustrating more or less diagrammatically a method of connecting a pair of mills to a single motor. Fig. 10 is a plan of Fig. 9. Fig. 11 is a sectional view of a detail. Figs. 12, 13, 14 and 15 are respectively a side elevation and plan end view and detail of another form of apparatus. Fig. 16 is a plan of another apparatus. Fig. 17 is a cross-section of the same.

Referring first to Figs. 1 to 4, which illustrate the preferred construction of my improved apparatus in its simplest form, let A indicate a suitable roll, and B a reciprocating bed. The roller A is mounted in bearings *a* at each side of the mill, and is adjustably held therein by screws *b* which are rotated by bevel gears *c c'* mounted on a common shaft *d* which mesh with similar gears *e e'* carried by the screws *b*. The bed B is adapted to be reciprocated by any suitable driving mechanism, and the roll A is preferably positively rotated in the same direction as the bed.

The machine shown is especially adapted for the rerolling of old rails into cross-ties or other shapes, and for this purpose the bed is provided with grooves *f* of a shape to receive the bases and webs of the rails. Any suitable supporting or holding means for the bars to be rolled may be substituted however for the grooves *f*. An important feature of construction of the grooves *f*, when designed for the specific purpose just stated, is the provision of curved faces *f'*, as best shown in Fig. 1. Such faces permit the flowing of the metal in such manner during the rolling operation that fillets f^2 are formed on either side of the web of the rail whereby the latter is adequately strengthened at its weakest point, namely, the juncture of the web and head, or base. Such fillets may be of any desired contour, and may provide any requisite thickness of metal at this point. Preferably the grooves *f* are considerably larger than the webs and flanges of the rails to be rolled, in order that there may be no possibility of binding of the rail after the rolling operation. They should be considerably flared at their ends to facilitate the insertion of the rail. Several different forms of grooves are illustrated in Fig. 1.

Certain features of the invention may be utilized with the bars in any direction, lengthwise or transverse to the direction of travel of the bed. For the specific purpose stated, however, the grooves (and the bars carried therein) are arranged obliquely, and nearly at right angles to the direction of movement of the bed, so that the roll engages the bar gradually and not simultaneously throughout its whole length. With the inclination shown the roll engages the rearmost end of the bar at about the same instant that it is freed from the foremost end. It is understood that between each two successive passages of a bar through the present machine the roll is lowered slightly so as to roll the metal progressively thinner in the successive operations. If the metal at the beginning be symmetrically arranged, and a symmetrical product be desired, the bed will be reciprocated and the metal spread at each operation, thus acting equally in each direction. If it be desired to spread the metal more in one direction than the other the roll will be lifted or the bed lowered to prevent the spreading of the metal as the bed travels in one direction. The operations may be performed on each of the bars in the bed, carrying out the complete set of operations on each before passing to the next, or all the bars carried on the bed may be subjected to the spreading action at each movement of the bed. The position of Fig. 1 supposes that the first two bars have been completed and the third bar is being spread before any of the remaining bars are altered. The surface of the product may be figured or roughened by providing a suitably figured or roughened roller or by suitably shaping the portion of the bed against which the metal is rolled. For example, in Fig. 11 the bed is shown of such shape as to produce a tapered flange, while in Fig. 1 it produces a flange of uniform thickness. The roll may be provided for example with transverse grooves which form ribs on the product, (see Figs. 5 and 6) or it may be entirely broken away at desired points so as not to alter the shape of the product at corresponding points. The machine is preferably also such as to permit of the ready substitution for the roll or for a part thereof of a suitable cutting device, or of a planer for planing cold metal or for planing the face of the bed itself when the latter becomes roughened by use. Examples of shapes for which the machine may be adapted are tee rails, guard rails, girder rails, double-head and bullhead rails, beams, channels, tees, angles, and bars of regular cross-section, all sizes and hot or cold.

This apparatus provides for the lateral flow of the metal very simply and expeditiously. It may be provided with the bed shown for securing lateral flow and also with a bed or beds for rolling the bars longitudinally, and with these two kinds of beds it can be adapted to roll almost any desired shape. The fact that it engages only the head of the bar makes it a mat-

ter of indifference whether rivets or other fastenings remain in the old metal being utilized, and in fact even if such fastenings remain on the head of the bar they may be rolled as if part of the bar, and for such products as railroad ties they would be unobjectionable. The bar is held straight throughout the rolling operation even if it be rolled longitudinally.

My invention also provides a suitable mechanism for feeding the rails or other shapes to be operated on into the grooves or other holding devices of the bed. Such a device is illustrated in Figs. 3, and 4. For each of the grooves I provide a pair of feeding rollers g g' which are adapted to seize the end of the rail and feed the same into the grooves f. Each of the rolls g g' is provided with a gear h h' respectively by which the same is rotated from any suitable source of power. I preferably provide a pair of feed rolls g g' for each of the grooves f of the bed, and so arrange such feed rolls at one side of the mill that when the bed is in its extreme position each of the grooves f will stand opposite a pair of rolls. The advantage of such construction is the most marked when rolling heated bars, the bed being thrown to its extreme limit of movement, and the heated rails being inserted simultaneously in the various grooves f by hand or by suitable mechanism adapted for such purpose. In such construction the gears of the various rolls g g' may be advantageously arranged so that they mesh with each other in the manner shown, a power gear h^2 being provided to drive the entire train. The complete feeding mechanism is preferably mounted upon a movable support, such as g^2 and a screw g^3, operated by a crank g^4, is provided for adjusting the support longitudinally of the bed. If the bed is stopped at a position which does not register with the feed rolls the latter can easily be moved to the registering position without disturbing the bed, which by reason of its weight is more difficult to adjust. To support the rails vertically during the act of insertion into the grooves f, I preferably provide a roller i which is mounted to freely rotate in the side frame of the machine, and constitutes a horizontal roll for supporting the rail along its base. It will be understood that in hot rolling the various steel shapes as they come from the furnace and are carried to the mill are apt to bend slightly in their heated condition. It is hence necessary to straighten the rail or other shape before inserting it in its groove in the bed. The device just described is admirably adapted for this purpose, so that no independent straightening means is required.

It is of course necessary after each complete rolling operation that the finished shape shall be removed from the mill. In practical operation the feed rollers g g' are adapted to act as ejecting devices through the medium of the fresh blank during the operation of feeding in the latter. The advancing end of the blank engages the rear end of the finished rail and forces it out at the opposite side of the bed, as illustrated in Fig. 3. Suitable means may however be provided for drawing the finished rail out of the groove instead of pushing it out as illustrated.

Power may be applied to the mill to cause a relative movement of the bed and roll, either through the roll or the bed. Preferably both are positively driven, and preferably in the same direction and at the same rate of speed. Figs. 5 and 6 illustrate one form of driving mechanism. In these figures j is a suitable horizontal rack which is carried in a guide j' and which is reciprocated by any suitable motor (not shown) through the medium of a pitman connection j^2. The rack j serves to rotate first forward and then backward a gear k mounted upon a shaft k' which carries suitable pinions l l' which mesh with racks m m' carried by the bed B upon its under side. Mounted above the gear k is a gear n of the same diameter, which is mounted upon a shaft n' connected directly with the roll A, as best seen in Fig. 5. By this construction as the bed B is reciprocated the roll A is positively driven at the same surface speed as the bed. To permit of vertical adjustment of the roll A the shaft n' is made of considerable length, and is constructed with an intermediate section n^2 which is connected to the remaining sections n^3 n^4 by wabbler-boxes n^5 of usual construction.

Any suitable means for supporting and guiding the bed in its reciprocatory movements may be employed. Where the mill is designed for comparatively light work the guides o shown in Figs. 1 and 2 will ordinarily be sufficient for the proper support of the bed. If the mill is designed for heavy rolling I preferably provide a series of supporting rollers p which contact with the under surface of the bed and practically form a horizontal roller bearing for the latter for the full limits of its travel, as shown in Fig. 7. If the rollers p are used in connection with the longitudinal guides o the rollers will be suitably grooved or recessed to receive the guides. I also prefer to provide some means for rigidly supporting the bed at a point below and in line with the roller A, as at this point the greatest downward thrust is exerted against the bed during the rolling operation. To this end I provide a heavy roll q which is shown in Fig. 5 as formed integrally with the shaft k'. The roll q is grooved or recessed as shown to receive the guides o, but it is obvious that it

may be a continuous roll extending the entire width of the bed. In any event it is preferably of a diameter which approximates the diameter of the pinions l l' so that the periphery of the roll moves at the same surface speed as the under side of the bed B. It is also desirable in some cases to provide a means for resisting any tendency toward upward bending of the roll A. This may be done in various ways, as for instance that illustrated in Fig. 7 wherein a secondary roll A^4 is mounted directly above the main roll A, and serves to prevent any distortion of the latter under the excessive strains to which it is subjected. Another method of accomplishing substantially the same result is that illustrated in dotted lines in Fig. 2 wherein the roll A is tapered from its middle toward its ends to an extent which compensates for any deflection of the roll, it being understood that such deflection is most pronounced at the middle of the latter, and is imperceptible, if present at all, at its ends.

The apparatus as thus described is suitable for the practicing of my improved process as herein set forth. Such apparatus is however susceptible of considerable development and wide modification. Its particular form will depend largely upon the character of work which the mill is intended to perform. I have illustrated several developments of the invention in Figs. 8, 9 and 10.

In the construction shown in Fig. 8, instead of a single roll A I have illustrated three rolls A' A^2 A^3 which are designed to act upon the rail in the order named. By adjusting the rolls successively at decreasing distances from the bed each rail may be operated upon three times during a single movement of the bed. In such construction however (if the bed is a flat one) the return stroke of the bed would be an idle movement unless the rolls were readjusted. In this construction there are preferably provided three supporting rolls q' q^2 q^3, as shown in Fig. 8, one beneath each of the rolls A' A^2 A^3.

A further development of my invention is illustrated in Figs. 9 and 10 wherein I combine a pair of my improved mills with a single motor device, such for instance as the cylinder s and piston s' shown, which are connected with the respective beds by piston rods s^2 s^3. Preferably in such construction the mills are arranged lengthwise in line with each other, and the motor is located between the mills in such manner as to move the beds thereof in unison. In this construction the parts are so proportioned that when the roll of one mill has completed its operation on one rail and is moving off the same, the roll of the other mill is just beginning its operation upon another rail. By this means a substantially even stress is placed upon the various parts of the device and an even demand upon the driving power so that the beds move evenly past the rolls and undue shocks are avoided. The intermediate motor may be of any suitable type, utilizing steam, electricity or other motive fluid, but I prefer to use hydraulic power to operate the device, and the cylinder s may be taken as being the cylinder of any suitable hydraulic motor, passages s^4 s^5 being provided for the inlet and egress of the water. It will be understood that these passages lead to any suitable valve mechanism, which may be under manual or other control, and which acts to admit the fluid to one side of the piston and to permit it to exhaust from the other side in accordance with the movements desired for the beds. It is preferable to provide a yielding member against which the bed may contact at the extreme positions of the latter, so as to avoid any undue shock to the parts. Such a member is shown at t, and comprises a spring buffer, designed to be struck by the bed at the end of its stroke, two of such devices being provided, one at each end of the mill. The same construction may of course be used with a single mill.

Many modifications of the apparatus are possible without departing from the invention. Any suitable support for the steel shape to be rolled may be used, such support being preferably in the form of a reciprocating bed, and while I have herein illustrated a bed which is substantially flat, it will be understood that the shape of the latter may be altered quite radically without departing from the invention. For example, it may be of concave or convex form, and have appropriate semi-rotary movements, or it may be in some cases advisable to construct it as a drum having a complete rotation. But in any case it should not act as a roll in the sense that there is any substantial movement between the metal shape and the face of the bed. Instead of the grooves shown any suitable means for mounting the shape upon the bed may be employed, depending upon the character of the work to be done. Such means should be capable of properly holding the shape upon the bed, which term includes any limiting or confining of the movement of the shape in the direction desired. The supporting means preferably provides a wall which is adjacent to the shape, over which a part of the latter may be rolled. If the shape is to be rolled in both directions a wall will ordinarily be provided on each side thereof. It will be understood that the roll or the bed (or both) may have any suitable forming face, by which term I mean any deviation in the contour of the parts from that which is adapted to produce a flat product. While many features of my improved apparatus are especially adapted for the transforma-

tion of old or worn rails into useful products, such as ties and the like, it will be understood that such a use constitutes only a part of the capabilities of my invention, the latter having a broad field of usefulness in many operations which are entirely distinct from that just referred to. Steel shapes of almost any description may be operated upon, including bars, ingots, billets, or the like, whether of new or old steel. While for economic reasons I prefer to use old rails for the specific purpose of making railroad ties, it will be understood that any material of suitable shape may be employed for this purpose. New but imperfect rails or "seconds" so-called may also be economically utilized if desired.

Where the work is highy heated, or for any other reason is quite soft, there is danger of the web being upset in its groove to such an extent as to cause the work to stick fast. Under these conditions the removal of the work would naturally be a difficult matter. Also the formation of the bed with grooves cut in the solid metal would be a very expensive operation. The chilling of the bed too would be expensive. I propose therefore in some cases to hold the work by means of two separable parts. These can be pressed together during the rolling operation and can be subsequently released to permit the easy withdrawal of the work. Such an arrangement would obviously be of advantage whether used in connection with the bed described or with any other suitable apparatus. Preferably the roll is utilized for pressing the two parts together to hold the work. For example, as shown in Figs. 12 to 15, the bed B may be provided on its upper face with a slightly dove-tailed, broad groove 1. The work is held between successive sections 2 extending obliquely across the bed and having each on its under side a tongue 3 fitting the groove 1 so that each of the sections 2 may slide along on the top of the bed in a longitudinal direction. The vertical side faces of the sections 2 are so remote that two adjacent faces provide a groove *f* such as is shown in Fig. 12 (or, of course, a groove of any other desired form). A number of sections 2 may obviously be formed much more cheaply and accurately than a complete bed of a single integral piece of metal, and they may be fastened firmly in place after being slid along on the top of the bed to their proper location. Preferably, however, they remain loose as far as movement longitudinally of the bed is concerned, and are held in place by plain, solid end pieces 4 which are also provided with tongues 3 fitting in the groove 1 and which are free to move longitudinally except for the mechanism hereinafter described.

When the work is to be rolled it is placed in the grooves *f* either by the feeding mechanism previously described or by any other suitable means, and the opposite end blocks 4 are pressed together, thus pressing the several sections 2 together also and holding the work firmly in place during the rolling. When the rolling is completed and the work is to be shoved out of the grooves *f* the pressure upon the end blocks 4 is released and the removal is very easy. Various mechanisms, manually operated or automatic, may be designed for this purpose. Preferably, however, the arrangement shown is used. A cable 5 (being a wire rope, chain or the like) is run over suitable guide pulleys 6 and 7, and between the two pulleys 7 it passes around a pulley 8 on the end of the roll A and which is designed to pull the rope forward at such a rate as to keep it constantly in tension during the movement of the bed. At the end of each movement the screw *b* is turned sufficiently to lift the roll A, whereupon the cable 5 is slackened and the work can be shoved out of the groove without any difficulty. When a new set of rails is shoved into the grooves the roll is again lowered, taking up the slack of the cable and putting a tension on it sufficient to hold the sections 2 close together during the entire rolling operation. In the machine illustrated the rolling operation takes place in each direction. But if it were intended to roll only in one direction, one set of guide pulleys 7 and 6 might be omitted and the end of the cable fastened to the roll and wound thereon.

The cable is preferably adjustable. For this purpose the end of the cable may be fastened to a ring or other stop 9 larger than the bore of a nut 10 through which the cable passes and which nut may be screwed into or out of a bracket 11 attached to the side of the block 4 and depending therefrom so that the cable shall be below the grooves *f*.

Instead of the supporting horizontal roll *i* in connection with the vertical feeding rolls, I may use a table 12, as indicated in Fig. 16, the table being adjustable longitudinally of the bed and simultaneously with the feeding rolls, and thus serving to support the rails which are to be fed to the bed. The table 12 is preferably provided with ribs 13 projecting from its upper surface to support the rails at three or more separated points while they are being fed.

The grooving, figuring or roughening of the work may be accomplished by interposing a suitable pattern between the work and the roll or between the work and the bed, or in both places. For example, as shown in Figs. 12 and 13, a groove in the product, at right angles to its length, may be produced by laying a cold bar 14 across the face of the latter in the desired direction, its ends being bent and dropped into slots in brackets 15 at the ends of the machine. This method

permits of greatly varying the product without changing the configuration of the principal parts of the machine, the bed and the roll. The same method may be used for punching holes. The roll may also be arranged to permit angular adjustment in a horizontal direction.

No claim is made in the present application to the process of altering elongated steel shapes herein disclosed, the same being covered by my application for patent No. 177,989, filed October 21, 1903.

What I claim is:

1. In a steel rolling mill, the combination of a plurality of beds, a plurality of rolls, each adapted to co-act with one of said beds, a motor device for moving said beds in unison, and means carried by each of said beds for holding a steel shape, said means being so spaced that the rolling of a shape on one of such beds is completed substantially coincidently with the beginning of the rolling of a shape on the other bed.

2. In a steel rolling mill, a roll, and means for supporting the work in a position to be engaged by said roll, said means comprising two separable parts and an intermediate free part, said parts adapted to be pressed toward each other and to be clamped so as to hold a plurality of elongated shapes between them in position to be rolled.

3. In a steel rolling mill, a roll, two separable parts for holding the work, and means controlled by the roll to press said parts together.

4. In a steel rolling mill, a roll, a bed, two parts carried by said bed and separable from each other for holding the work, and means controlled by the roll to press said parts together.

5. In a steel rolling mill, a roll, a bed, means for holding the work comprising separable sections having adjacent faces formed to provide when pressed together a groove for the work, and means operated by the roll for pressing said sections together.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES E. YORK.

Witnesses:
DOMINGO A. USINA,
FRED WHITE.