(No Model.) 3 Sheets—Sheet 1.

H. AIKEN.

ROLLING MILL.

No. 449,511. Patented Mar. 31, 1891.

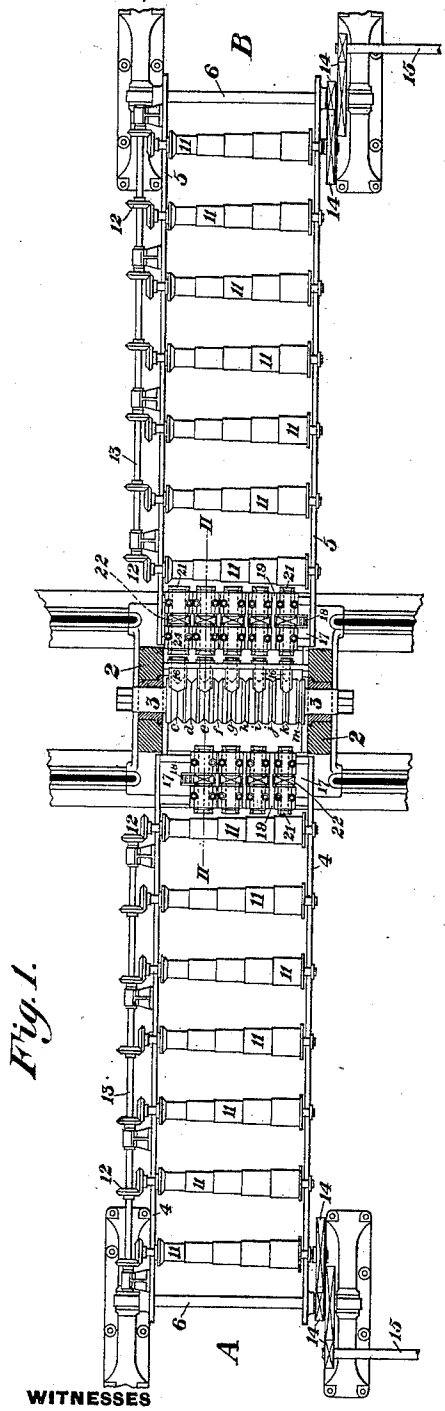


Fig. 1.

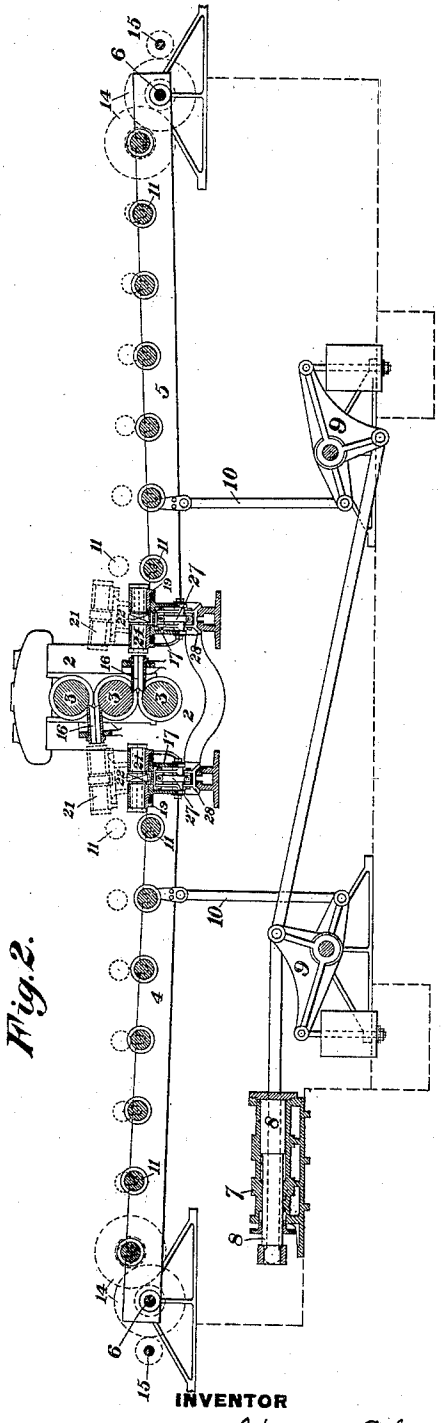


Fig. 2.

WITNESSES

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(No Model.) 3 Sheets—Sheet 2.

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Fig. 4.

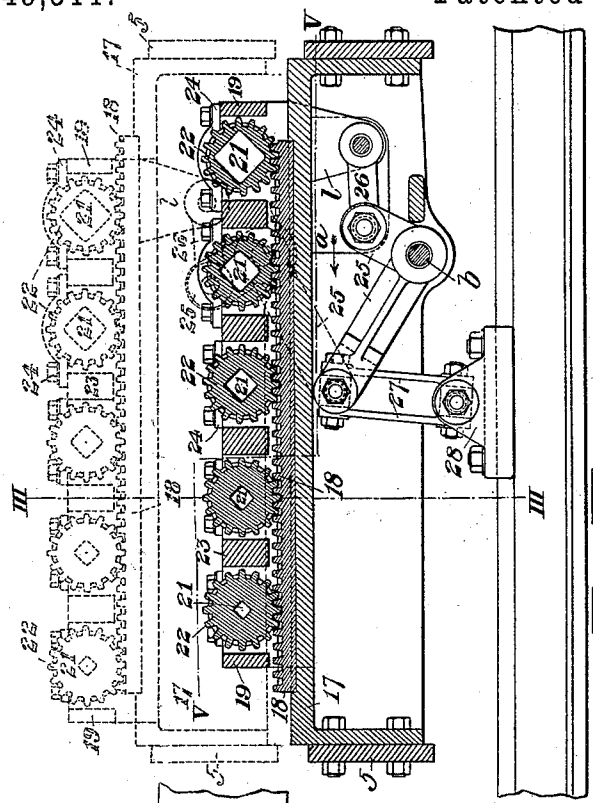


Fig. 5.

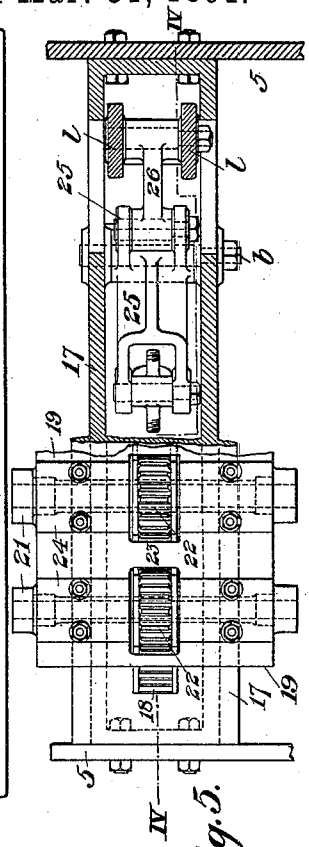
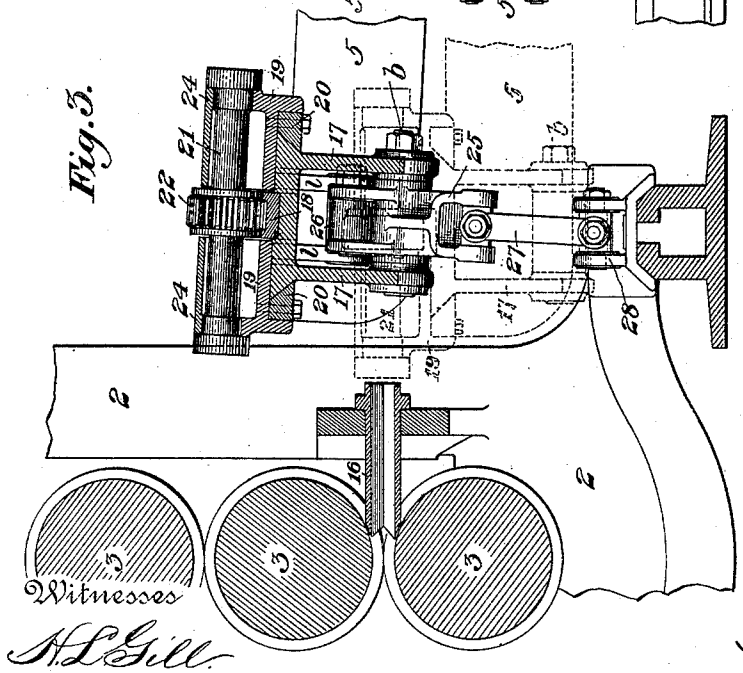


Fig. 3.



Witnesses

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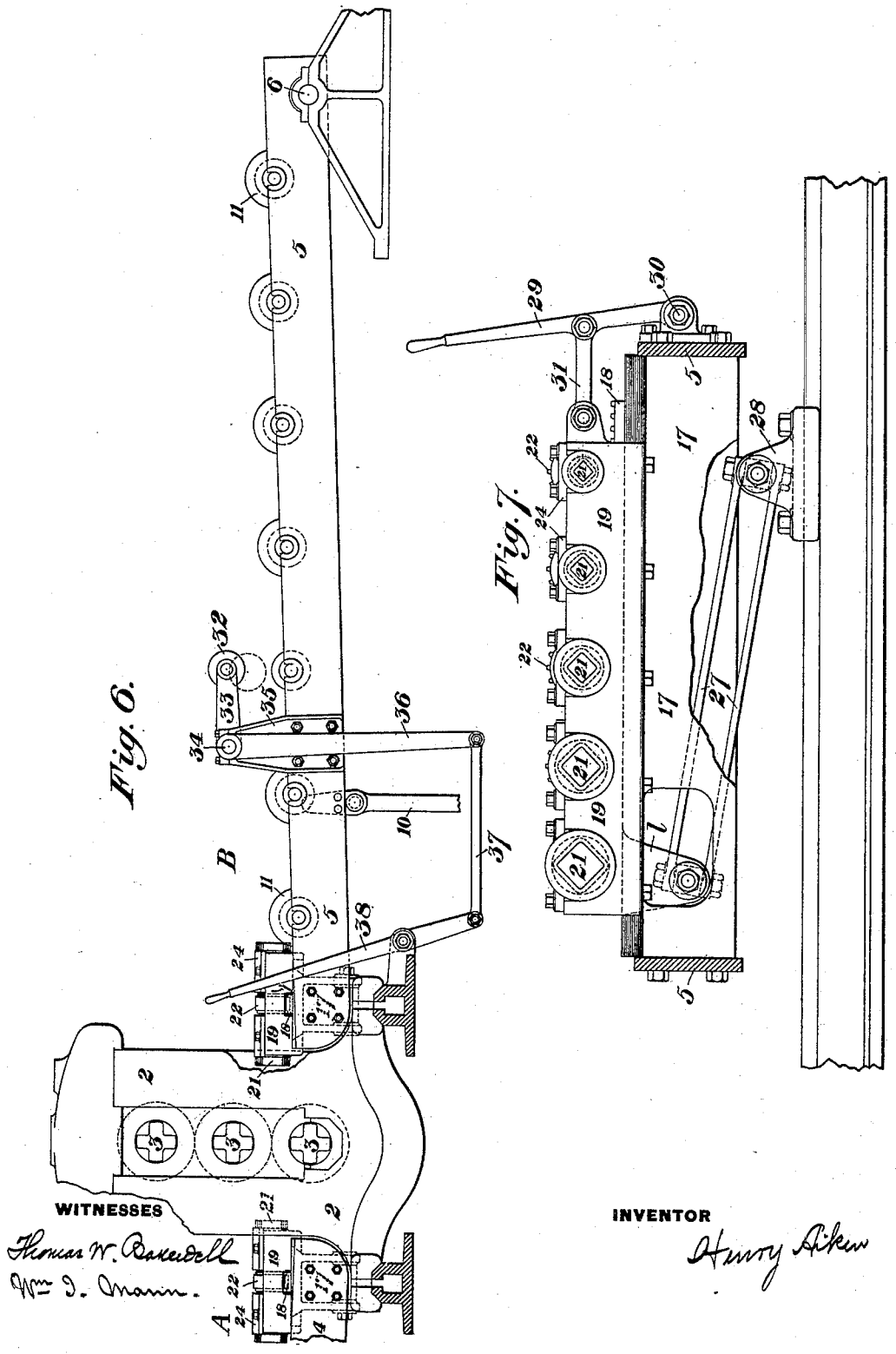
THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 3 Sheets—Sheet 3.

H. AIKEN.

ROLLING MILL.

No. 449,511. Patented Mar. 31, 1891.



THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

HENRY AIKEN, OF PITTSBURG, PENNSYLVANIA.

ROLLING-MILL.

SPECIFICATION forming part of Letters Patent No. 449,511, dated March 31, 1891.

Application filed December 30, 1889. Serial No. 335,355. (No model.)

To all whom it may concern:

Be it known that I, HENRY AIKEN, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Rolling-Mills, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a plan view of a set of rolls and their feed-tables provided with my improved guides, the roll-housings being shown in section. Fig. 2 is a vertical longitudinal section on the line II II of Fig. 1. The figures on the second sheet of the drawings are on a larger scale. Fig. 3 shows in longitudinal section the rolls and the guides, the section being on the line III III of Fig. 4. Fig. 4 is a cross-sectional view of the guides, the section being on the line IV IV of Fig. 5. Fig. 5 is a plan view of the guides, partly in section on the line V V of Fig. 4. In Figs. 2, 3, and 4, dotted lines are employed to show the guides shifted in position from one pass of the rolls to the next. Fig. 6 is a side view, on a larger scale, of the rolls and guides and one of the feed-tables, this figure being designed to illustrate one of the parts of the apparatus which could not clearly and conveniently be represented in Figs. 1 and 2. Fig. 7 is an end view of the guides, the feed-table being in cross-section. This figure illustrates a modified form of the mechanism for shifting the guides laterally.

Like symbols of reference indicate like parts in each of the figures.

Heretofore in the operation of rolls for rolling rods or bars of iron or steel, in which the metal is reduced by alternate back and forth passes it has been the most common practice to employ men to stand on opposite sides of the rolls to receive the metal as it is delivered, to turn it one-fourth round for the purpose of effacing the fins produced at the preceding pass, and to reinsert it again into the guides to pass in the reverse direction. The position of these men is somewhat dangerous, the work is arduous, and adds considerably to the cost of manufacture. Their presence at the rolls also causes a practical limit to the production of the mill. They cannot give attention to more than one rod passing through one stand of rolls at once, since any greater number would so crowd the space about the rolls that the men would not have sufficient room to perform their duties safely and efficiently.

It is the object of my invention to provide improved mechanical means for performing this work of receiving, guiding, and delivering the metal, thus cheapening the cost of the product by diminishing the number of men necessary to be employed to tend the rolls, and increasing the output by enabling a number of rods or metal pieces to be passed through the different grooves or passes of the rolls at the same time. By use of my improvement, which I am about to describe, I obtain all the advantages derived from the removal of this work from the uncertain care and limited capacity of human labor and putting it in charge of a reliable and surely-acting machine.

To describe my improvement generally, I employ, in connection with a set of three-high rolls and their feed-tables, a series of guide-boxes mounted on each of the tables, so as to move vertically therewith, between the lower and the upper passes of the rolls. The series of guides are provided with mechanism by which on the rise and fall of the tables they are partially rotated, and also automatically moved laterally and reciprocally—that is to say, on the rise of the table the guides on one side are moved a short distance in one direction and the guides on the other side in the opposite direction, and vice versa on the descent of the table. On first passing through the rolls the metal rod is received by one of the guides, and when the feed-table is elevated, carrying the guide and rod with it, the guide is partially rotated and is automatically shifted laterally to move the metal to the next pass and to turn it in proper position to enter. On its emerging from the other side of the rolls it enters one of the second series of guides. On the descent of the tables it is automatically shifted laterally in the same direction, and on emerging enters the second of the first-named series of guides, and so on until the metal has traversed all the passes of the rolls and has been completely reduced.

The precise nature of the mechanism employed will be explained in the following description, and, although I show particularly the application of my invention to three-high rolls with vertically-moving feed-tables, it will be understood that it is not limited thereto,

and that it may be applied to use in connection with two-high rolls, which are reversed after each pass of the metal.

Referring now to the drawings, 2 represents the housings of a three-high set of rolls 3, which are arranged and constructed in the usual way, being provided with series of grooves successively diminishing in diameter and of proper relative shape, the metal being passed through between the bottom and middle rolls, then lifted and passed in the reverse direction through the next succeeding pass between the top and middle rolls.

For the purpose of transferring the metal from the lower to the upper passes I employ vertically-movable feed-tables 4 and 5, which may be of any of the well-known forms. The feed-tables, which I have shown in the drawings for the purpose of illustration, are pivoted at their rear ends on cross-shafts 6, on which they are radially movable in a vertical direction. A table of this class is known as a "tilting" table; but it will be understood that for the purposes of my invention tables movable vertically in a different manner may be employed.

To lift the feed-tables, there is the usual hydraulic cylinder 7, whose plunger 8 is connected by counterbalanced bell-crank levers 9 and lifting-rods 10 to the feed-tables, so that movement of the plunger in one direction shall elevate both tables on their axes 6, and that movement of the plunger in the other direction shall simultaneously lower the tables. Each of the tables is provided with a suitable number of feed-rollers 11, which are connected by pinions 12, a counter-shaft 13, and gearing 14, with a power-shaft 15, by which they are driven. I prefer that the feed-rollers should not be cylindrical in form, but that they should be stepped as shown in Fig. 1, the different steps corresponding in diameter to the positions or sizes of the several passes of the rolls with which they co-operate in feeding and receiving the metal.

At the delivery side of each of the passes is a fixed guide 16, which is secured to the housing in the manner shown in Fig. 3. To co-operate with these guides in receiving, turning, and shifting the metal piece, I employ other guides, the use of which forms the principal feature of my invention, and the preferable arrangement and construction of which are clearly shown in detail in the figures on Sheet 2 of the drawings.

17 is a frame which is fixed transversely to the inner end of the frame of each of the feed-tables, and is provided with a fixed rack 18.

19 is a sliding carriage, which is preferably made of a single casting, shaped as shown in Figs. 3, 4, and 5, and set on the frame 17, so that it may be capable of being shifted laterally thereon. The construction of the parts used for this purpose is shown in Fig. 3, the edges of the frame 17 being beveled, and the carriage 19 being provided with slide strips or bars 20, which bear against said edges. Along the middle of the carriage 19 is a slot or cavity, made to clear and to expose the surface of the rack 18. At the sides of the carriage are upright flanges, forming journal-bearings, in which are journaled the necks of hollow guide tubes or boxes 21, which are so situate as to be directed toward the rolls. The number of these guide-boxes depends upon the number of passes or grooves of the rolls.

In the drawings I show four guides on one side and five on the other side of the rolls. At the middle of each of the guides is formed an encircling pinion or spur wheel 22, which meshes with the toothed rack 18, and is provided at its sides with collars, which ride on flanges at the sides of the rack. The carriage 19 is provided with suitable cross-ribs 23 to impart strength to it, and the journals of the guides are covered and confined by cap-plates 24. The interiors of the several guides are of shape corresponding to the shape of the metal piece to be passed through them, and are of successively decreasing sizes, corresponding to the sections of the roll-passes from which the metal is delivered to them. The extent of motion of the carriage 19 on the frame 17 is equal to the lateral distance from one pass of the rolls to the next. This motion may be effected by means of a hand-lever or otherwise, but in the figures on the first and second sheets of the drawings I illustrate means for performing this work automatically.

25 is a bell-crank lever pivotally secured at *b* to the frame of the feed-table and connected by a link 26 to lugs *l* on the sliding carriage 19, and by a link 27 to a fixed post 28 beneath the feed-table. As shown in Figs. 3, 4, and 5, the link 27 is connected to the end of the lever 25 by a double or universal joint, and to the post 28 by a similar joint, the purpose being to cause the link to adapt itself in position to the vertically-radial motion of the feed-table.

The operation of this device in shifting the sliding carriage laterally on the feed-table is as follows: Fig. 4 shows the parts as they are when the feed-tables are at their lowest position with the guides 21 opposite the passes between the middle and bottom rolls. When the feed-tables rise to the position shown by dotted lines in Fig. 4 and by full lines in Fig. 3, the corresponding upward motion of the fulcrum of the bell-crank lever of each will cause motion of this lever in the direction of the arrow *a* in Fig 4, thus moving the sliding carriage of one feed-table 4 on its frame to the left, and moving the sliding carriage of the other feed-table 5 to the right. The parts are so proportioned in size that the extent of this motion shall be equal to the lateral distance from one pass of the rolls to the next, and the effect will therefore be to move each of the guides from a position opposite to one pass between the lower and middle rolls to

the next pass in lateral position between the upper and middle rolls. In consequence of this lateral motion of the sliding carriage on its frame, the gearing of the pinions 22 with the rack 18 will cause said pinions and the guides to which they are fixed to rotate, and the diameters of the pinions are so related to the length of travel of the carriage that this travel shall just be sufficient to rotate the several guides one quarter on their longitudinal axes.

The operation of the apparatus in rolling metal is as follows: The metal billet being properly heated, is placed on the feed-table 4 at the side of the rolls marked A in Fig. 1, and the feed-rollers being driven carry the metal up to the rolls, where it is introduced by the workmen into the pass *c* between the bottom and middle rolls. On its egress at the other side B of the rolls, the metal passes through the fixed guide 16 opposite the pass *c* and thence into and through the adjacent guide 21. When the rear end of the rod has passed through the fixed guide, but before it has passed through the guide 21, the feed-rollers on the table 5 are stopped, and the tables are then lifted, as shown by dotted lines in Fig. 2. The effect of this lifting is to elevate the guide 21, containing the end of the metal piece to the level of the upper passes of the rolls, and by operation of the rack and pinions and the bell-crank lever above described to shift the said guide laterally into a position opposite the upper pass *d* of the rolls and to turn it a quarter round, thereby turning also the metal piece on its longitudinal axis. The feed-rollers of the table 5 being then started, carry the piece through the guide 21 into the pass *d*, thence through the fixed guide 16 opposite thereto, and into and through the end one of the series of guides 21 on the side A of the rolls, which by lifting of the feed-table has been shifted laterally into proper position to receive the same. The piece is thus carried through by the rolls until its rear end has passed the fixed guide and is within the guide 21. The feed-tables are then lowered, thus bringing the end guide 21 of the series on the side A opposite the pass *e* and turning the metal rod, as before explained. The piece is then fed forward through the pass *e*, through the fixed guide opposite thereto, and through the second guide 21 of the series on the side B, which guide, by descent of the feed-table, has been brought opposite to this pass of the rolls. When the piece is past the fixed guide, the tables are again raised, thus bringing the second guide 21 on the side B of the rolls opposite to the pass *f*, and on reversal of the feed-rollers the piece is carried through said pass into the second guide 21 of the series on the side A, which guide has been automatically brought into proper position to receive the metal. The operation is thus continued by passing the metal successively back and forth at each pass, automatically shifting it laterally and turning it axially until it reaches the last pass *m* of the rolls, from which it is received in its finished state by the feed-table 5.

From the foregoing description it will be noticed that the operation of the apparatus in receiving, delivering, and guiding the metal is entirely automatic, the only labor required in tending the rolls being the work of a shearsman, who cuts off the billet to proper length and inserts it into the first pass, and of another man who manipulates the valve by which the feed-tables are raised and lowered. It will be apparent, also, that as no manual attention need be given to the metal, and as the rods travel in parallel lines a number of billets may be reduced in the rolls at the same time. The operation of the mill in this way may be continued without intermission, the metal pieces following each other in succession, and I am thus enabled not only to save expense in reducing the number of mill hands, but also to augment the output of the mill to a very large extent. These and other advantages of my improvement will be appreciated by those skilled in the art.

As distinguished from other means devised heretofore for feeding the metal to the rolls automatically, my invention is an improvement, because, owing to the fact that the laterally-movable guides are adapted to be mounted on vertically-movable feed-tables, they can be applied without difficulty to feed-tables of the kind now in common use. The mechanism is also very efficient, and is simple in construction. It is also an improvement in respect of the conjoint use and operation of the feeding and turning devices on both sides of the rolls.

The form of invention which I have just described is that which I deem to be the best suited for practical mill-work. It will be understood, however, that my invention is not limited strictly to the details of construction of the parts described, since in many ways they may be modified by the skilled mechanic without departing from the scope of the invention, which covers, broadly and generally, the items set forth in the several claims. Thus, in Fig. 7 I show a form of the invention in which I dispense with the use of a bell-crank lever for shifting the sliding carriage laterally, and employ instead thereof a single long link 27, connecting the lug *l* on the sliding carriage to the post 28. The upward motion of the feed-table, causing the link 27 to swing radially on the axis of the post, will induce the necessary lateral motion of the sliding carriage. I also show in the same figure mechanism by which this lateral motion is not accomplished automatically by rise and fall of the feed-table, but independently, by means of a hand-lever 29, which is pivoted to the feed-table frame at a point 30, and is connected by a link 31 to the sliding carriage. In the use of this form of the apparatus, at each vertical motion of the table a workman moves the lever so as to shift the

carriage to the proper extent. The link 27 should be then disconnected, and while this arrangement does not afford all the advantages in labor-saving of the automatic apparatus shown in the figures on Sheets 1 and 2, I consider the same within the scope of my invention. This form of the invention is well adapted to use in connection with a reversing two-high mill without rising and falling feed-tables.

A hydraulic cylinder may be substituted for the lever 29.

In Fig. 6 I show in connection with one of the feed-tables a device which may be used in feeding the metal rod to the rolls or withdrawing it therefrom when the rod is so elongated that it does not rest on the feed-rollers with sufficient weight or for a sufficient part of its length to enable the feed-rollers to exert the proper traction. This device consists of an idle-roller 32, pivoted to arms 33, which extend from a cross-shaft 34, journaled in suitable brackets 35 of the feed-table, said shaft being connected by a lever 36 and link 37 to a hand-lever 38, by motion of which the roller may be moved down toward one of the feed-rollers situate directly below the same. If, as stated above, the rod is so elongated and flexible that the feed-rollers do not act properly thereon, the lever 38 is moved so as to depress the roller 32 upon the rod and to force it against the opposite feed-roller, thus causing the latter to exert a friction on the rod. The consequence of this friction is that the feed-roller, being driven, will positively draw the rod to or from the rolls, as the case may be.

I believe this device, consisting of an idle-roller movable into contact with the metal on the driven feed-rollers for the purpose of causing the latter to exert a traction thereon is broadly new, and desire to cover it as of my invention, whether it be used in connection with my improved automatic guides or not.

I claim as new—

1. The combination, with rolls, of a vertically-movable feed-table adapted to be used in conjunction therewith and a guide situate on the feed-table and movable laterally thereon, substantially as and for the purposes described.

2. The combination, with rolls, of stationary guides opposite the passes thereof and turning guides which are movable laterally into register with the stationary guides, substantially as and for the purposes described.

3. The combination, with rolls, of a series of laterally-movable guides set on opposite sides of the rolls, and mechanism connected therewith and adapted to shift said guides respectively in opposite directions, substantially as and for the purposes described.

4. The combination, with rolls, of vertically-movable feed-tables on opposite sides of the rolls, guides carried by each of said tables, and mechanism connected with the guides and adapted to shift the same laterally in respectively opposite directions as the tables are moved, substantially as and for the purposes described.

5. The combination, with the rolls, of a vertically-movable feed-table, guides mounted on the table and laterally movable thereon, and a mechanical connection between said guides and a point off the table, whereby vertical motion of the table will shift the guides laterally, substantially as and for the purposes described.

6. The combination, with rolls, of a laterally-sliding carriage set opposite thereto, turning guides mounted thereon, a rack, pinions connecting the guides and rack, and mechanism for moving the carriage laterally, whereby on such lateral motion the guides will be shifted and by action of the rack and pinions will be turned, substantially as and for the purposes described.

7. The combination of rolls, stationary guides opposite to the passes thereof, a series of laterally-movable guides, and mechanism connected therewith and adapted to shift said movable guides laterally into register with the stationary guides and to transfer the metal to the several roll-passes, substantially as and for the purposes described.

8. The combination, with rolls, of vertically-movable feed-tables on opposite sides of the rolls, guides carried by said tables, and mechanism connected with the guides and adapted to turn and shift the same laterally in respectively opposite directions as the tables are moved, substantially as and for the purposes described.

9. The combination, with rolls, of a vertically-movable feed-table, a laterally-movable carriage mounted thereon, turning guides on the carriage, a mechanical connection, substantially as described, between the carriage and a point off the table, whereby when the table is moved vertically the carriage will be shifted automatically, and gearing by which on shifting the carriage the guides will be turned, substantially as and for the purposes described.

10. The combination, with three-high rolls having vertically-movable feed-tables on both sides thereof, of stationary guides at the upper passes on one side of the rolls and at the lower passes on the other side, and laterally-movable guides carried by the table and adapted to shift the metal and to deliver it to the stationary guides, substantially as and for the purposes described.

11. The combination, with the feed-table having driven feed-rollers, of a roller journaled in bearings movable toward the feed-rollers to engage the metal thereon, substantially as and for the purposes described.

In testimony whereof I have hereunto set my hand this 16th day of December, A. D. 1889.

HENRY AIKEN.

Witnesses:
W. B. CORWIN,
T. W. BAKEWELL.