(No Model.)

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# J. M. PRICE.

## ROLLING MILL.

No. 363,482. Patented May 24, 1887.

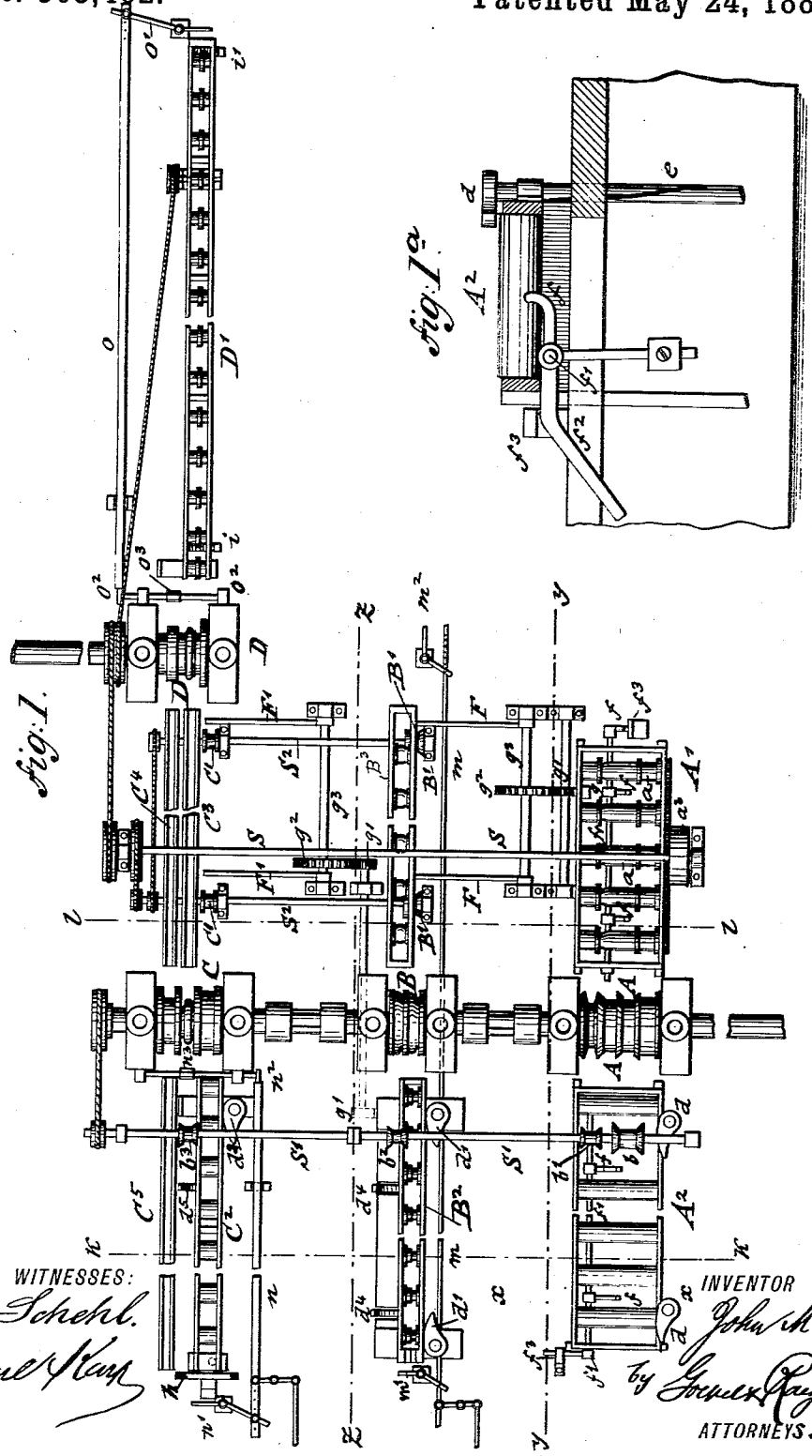


Fig. 1.



Fig. 1a.

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by Goepel & Ruegner

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(No Model.)

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# J. M. PRICE.

## ROLLING MILL.

No. 363,482. Patented May 24, 1887.

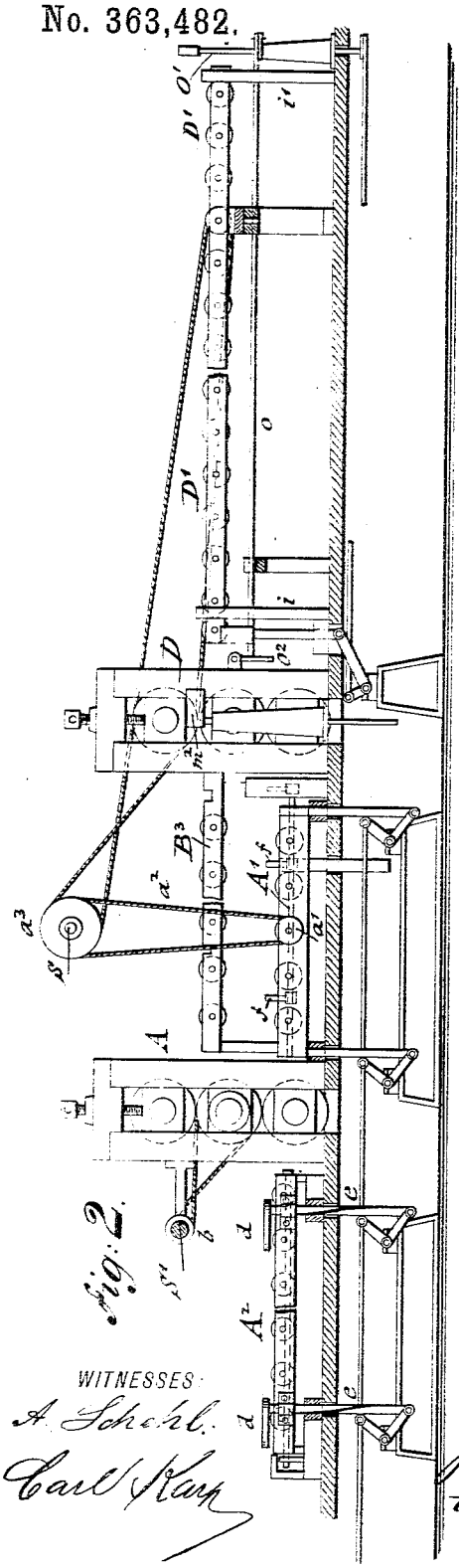


Fig. 2.

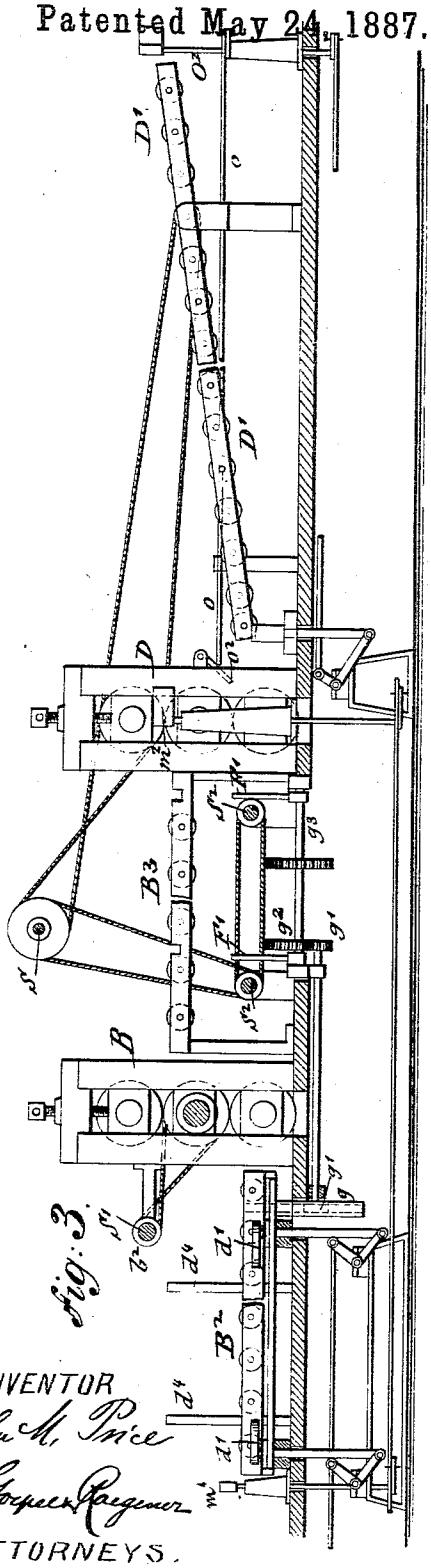


Fig. 3.

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(No Model.) 5 Sheets—Sheet 3.

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## ROLLING MILL.

No. 363,482. Patented May 24, 1887.

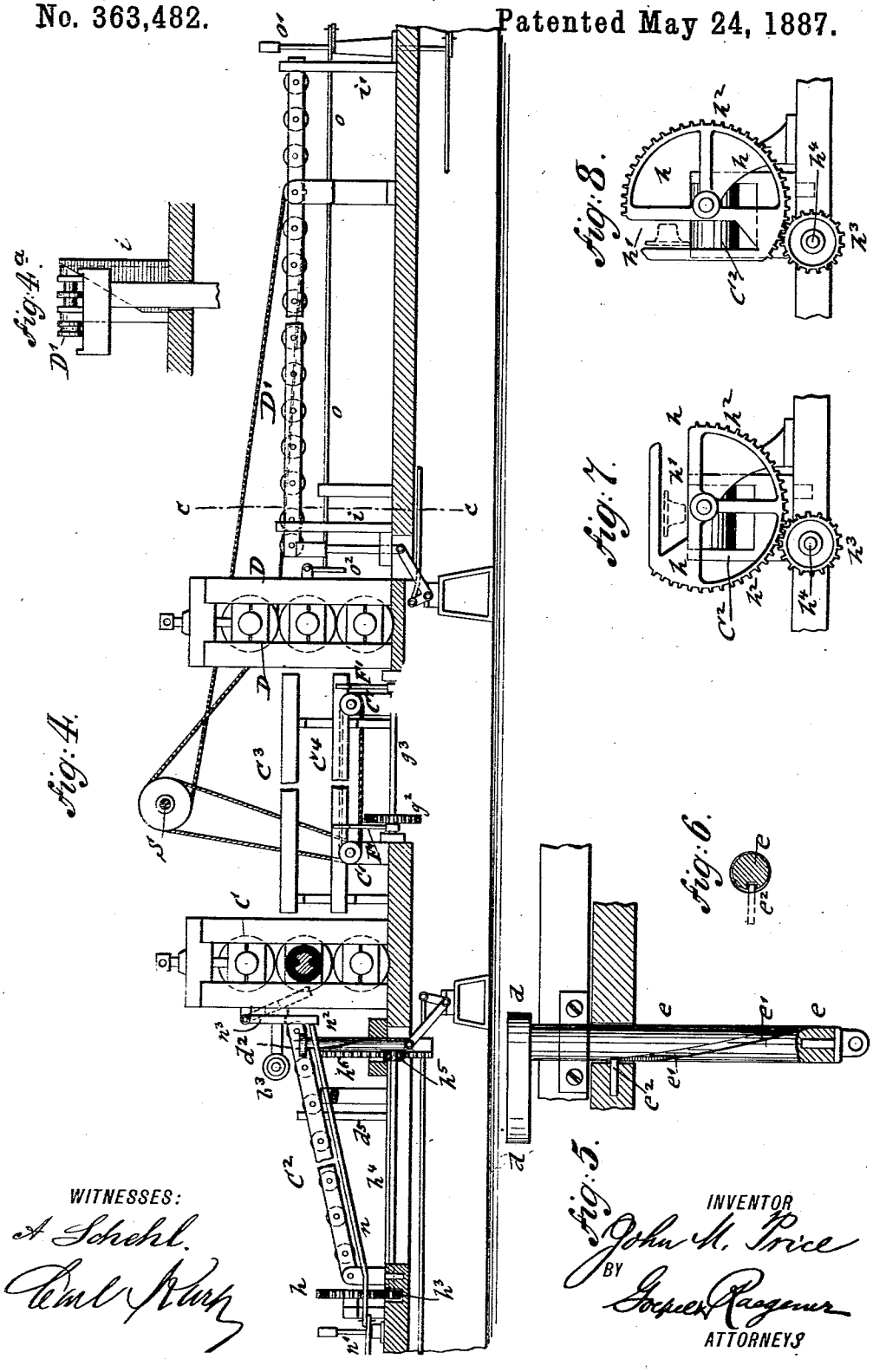


Fig. 4.



Fig. 4a.



Fig. 8.



Fig. 7.



Fig. 6.



Fig. 5.

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# J. M. PRICE.

## ROLLING MILL.

No. 363,482. Patented May 24, 1887.

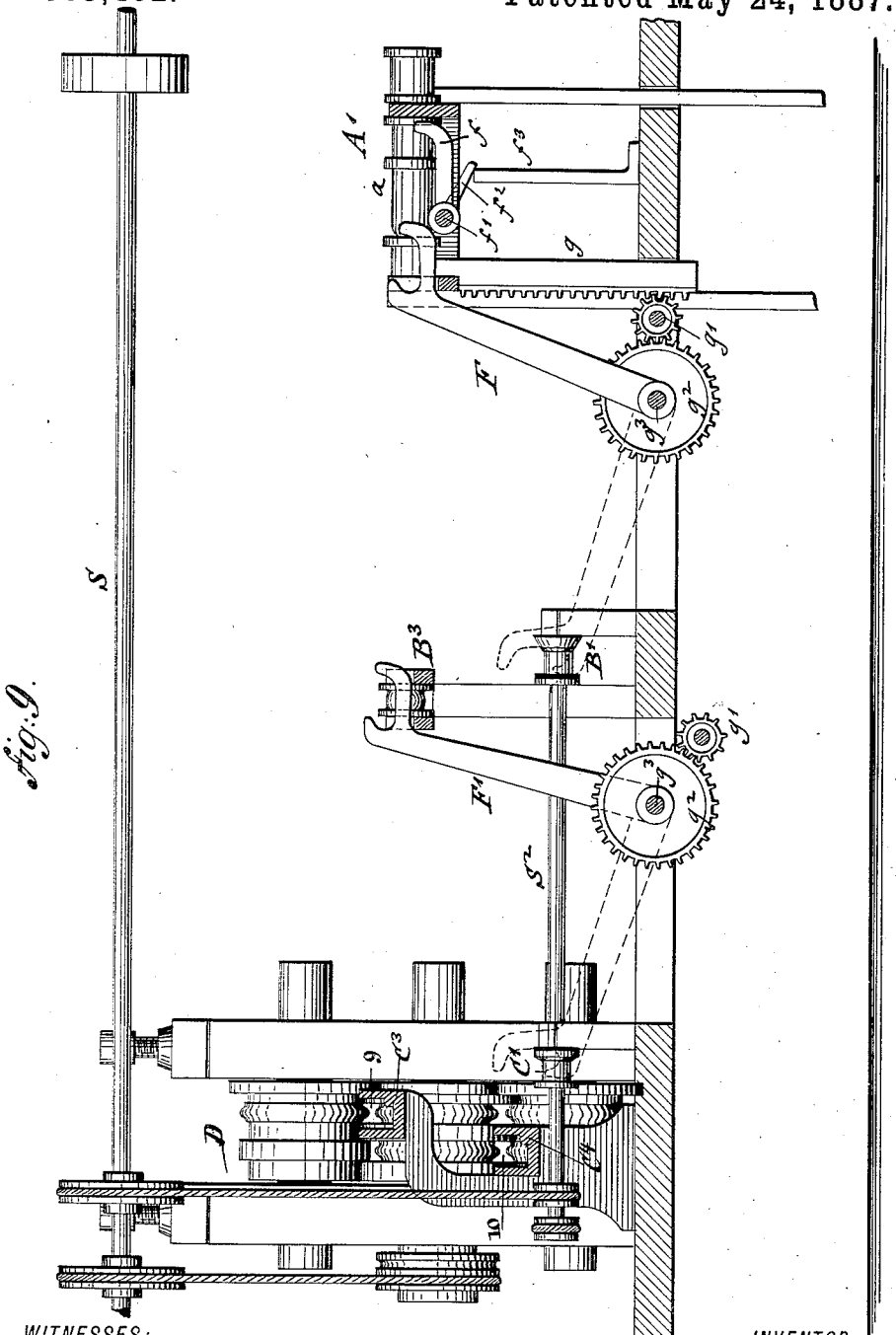



Fig. 9.

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5 Sheets—Sheet 5.

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## ROLLING MILL.

No. 363,482. Patented May 24, 1887.

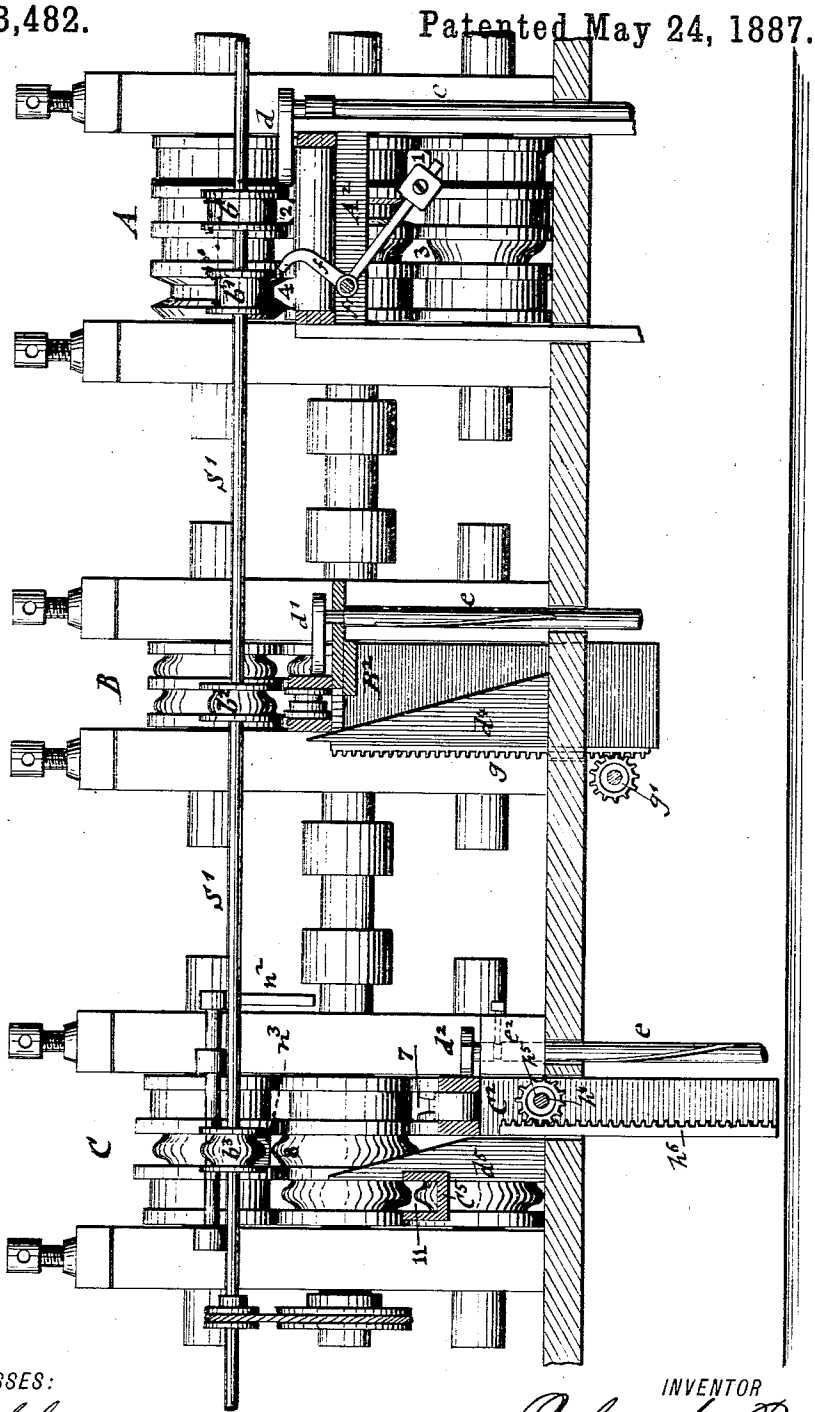


Fig. 10.

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# UNITED STATES PATENT OFFICE.

JOHN M. PRICE, OF NEW YORK, N. Y., ASSIGNOR OF TWO-THIRDS TO GEORGE T. PRICE AND HOPKIN WILLIAMS, BOTH OF SAME PLACE.

## ROLLING-MILL.

SPECIFICATION forming part of Letters Patent No. 363,482, dated May 24, 1887.

Application filed January 18, 1887. Serial No. 224,679. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN M. PRICE, of the city, county, and State of New York, have invented certain new and useful Improvements in Rolling-Mills, of which the following is a specification.

This invention relates to improvements in rolling-mills of that class in which a pile or ingot of iron or steel is passed through a number of successive passes of several sets of rolls, so as to be rolled out into a rail of twice the length of a common rail, and finally divided into two rails of normal length each.

My improved rolling-mill is more especially designed to diminish the number of attendants necessary to accomplish the work to such an extent that only one man is required at the first set of roughing-rolls, while the remaining operations are accomplished by automatically-operated feeding devices. By making a double length of rail the output of the mill is increased so as to be about one-third more than that of the best systems of rolling-mills heretofore in use.

In its general outlines my invention consists of three sets of three-high rolls and an extra finishing-set of three-high rolls, which furnish together eleven passes for the billet to pass through. The first set of roughing-rolls has four passes, the second set two passes, the third set three passes, and the extra set two passes, the latter set being parallel to the third set and thirty feet (more or less) from the same. The billet is fed consecutively through the passes of all the four sets by automatically-operated devices, the first set of rolls being provided at both sides with rising and falling feed-tables, and at one side with continuously-rotating feed-rollers. From the first feed-table the billet is transferred by oscillating arms to rotary feed-rollers, and through the second set of rolls to a rising and falling and laterally-shifting feed-table at the other side of the same, thence back to a stationary table at the opposite side of the second set, whence it is transferred by oscillating arms to rotary feed-rollers of the third set of rolls, from the same through the rolls to a hinged and swiveled feed-table, that is provided with means for raising and lowering the inner end, and with means for laterally shifting it. From the feed-table of the third set of rolls the rail is transferred through said set along a fixed guide-trough to the fourth or extra set of rolls and onto a swinging and laterally-shifting feed-table, which feeds the rail back again through the extra set and over a second stationary guide-trough parallel to and below the first guide-trough to the third set, and thence by a conducting-trough to the saws.

The invention consists, further, of shifting devices operated by the gradually-elongated rail, said shifting devices controlling the motive power by which the different feed-tables are raised and lowered, so as to be placed in lines with the different passes of the train, and of devices for turning the billet and rail preparatory for passing each successive pass, as will be fully described hereinafter, and finally be pointed out in the claims.

In the accompanying drawings, which fully illustrate my invention, Figure 1 represents a plan of my improved railway rolling-mill with parts broken away to show the relative disposition of the four sets of rolls required. Fig. 1ª is a detail section on a larger scale on line *x x*, Fig. 1, showing the turning device of the second feed-table of the first rolls. Fig. 2 is a sectional side elevation of the entire rolling-mill, showing the operating mechanism of the rising and falling feed-tables of the first and fourth sets of rolls. Fig. 3 is a vertical longitudinal section on line *y y*, Fig. 1, showing the feed-tables of the second set of rolls. Fig. 4 is also a vertical longitudinal section on line *z z*, Fig. 1, showing the feed devices of the third set of rolls. Fig. 4ª is a detail vertical transverse section on line *c c*, Fig. 4, showing the shifting device for the feed-table of the fourth set of rolls. Figs. 5 and 6 are details of the cam motion, by which the billet is laterally shifted on the rising and falling feed-table of the first set of rolls. Figs. 7 and 8 are end views of the mechanism employed for turning the billet through an angle of ninety degrees for the seventh pass of the third set of rolls. Fig. 9 is a vertical transverse section on line *k k*, Fig. 1, drawn on a larger scale, showing the transferring-arms and the extra set of finishing-rolls; and Fig. 10 is a vertical

transverse section on line *l l*, Fig. 1, also drawn on a larger scale and showing the first three sets of rolls of the train.

Similar letters of reference indicate corresponding parts.

The train of my improved rolling-mill is composed of four different sets of rolls, A, B, C, and D, each being three high. The first three sets, A B C, are placed in line with each other, while the fourth or extra set of finishing-rolls is placed parallel to the third set of rolls, C, and at a distance of about thirty feet from the same, so that a rail of sixty feet in length may be rolled. The first three sets of rolls receive motion from one engine, while the extra set of finishing-rolls receives motion from a separate engine.

The first set of roughing-rolls, A, is provided at opposite sides with rising and falling feed-tables A′ $A^2$, of which the feed-table A′ is arranged in the usual manner with rollers *a a*, journaled in the frame, and geared together by pinions at the ends. The other table, $A^2$, is provided with loose rollers journaled to its frame.

One of the geared roller-shafts of the feed-table A′ is provided with a pulley, *a′*, to which motion is imparted by a belt, $a^2$, and pulley $a^3$ from a transverse shaft, S, supported in bearings above the feed-table A′, so that the geared rollers of the feed-table A′ receive rotary motion when the same is in lowered position, while when the feed-table A′ is in raised position the belt $a^2$ is slackened and does not transmit motion to the rollers of the same. The rising and falling motion of the feed-tables A′ $A^2$, as well as of the feed-tables of the other sets of rolls, is accomplished by any approved means heretofore employed in rolling-mills of this class. The second feed-table, $A^2$, is operated, when in raised position, in connection with a continuously-rotating transverse shaft, S′, that extends parallel to the first three sets of rolls, and that is provided with feed-rollers *b b′* $b^2$ $b^3$, in line with the upper passes of the first three sets of rolls, said feed-rollers serving to feed the billet to the upper passes of said rolls when the feed tables arrive at their highest position. The transverse shaft S′ is supported in stationary bearings supported on brackets of the standards of the first three sets of rolls, as appears by reference to Figs. 2 and 3 of the drawings.

The billet is first placed on the table A′, and carried by the feed-rollers *a* to the first pass of the first or roughing set and delivered to the feed-table $A^2$ at the opposite side of the first set of rolls, which table is then in its lowermost position. The feed-table $A^2$ is then raised, and the billet moved laterally by the action of the oscillating cams *d d* (shown in Figs. 2 and 5) in line with the second pass, said cams being keyed to the upper ends of vertically-reciprocating shafts *e*, having spiral grooves *e′*, that are engaged by fixed pins $e^2$, so as to impart an axially-turning motion to said shafts and a horizontally-reciprocating motion to the cams. The billet, being thus raised and shifted on the feed-table $A^2$ into line with the second pass, is brought into contact with the feed-roller *b* of the transverse shaft S′ and fed by the same to the second pass, it being received by the feed-table A′, which has been raised simultaneously with the table $A^2$. The feed-tables A′ $A^2$ are next slowly lowered again, and the billet turned a quarter-turn by means of weighted oscillating dogs *f*, which are placed on a longitudinal shaft, *f′*, and operated by a crank-arm, $f^2$, that moves along a fixed keeper, $f^3$, during the rising and falling motion of the table A′, as shown in Figs. 1 and 9. The billet is simultaneously shifted by the dogs, so as to be brought in line with the third pass of the first set of rolls, which is at the lower part of the same.

After the billet has passed the third pass it is received by the table $A^2$, and the billet turned again through an angle of ninety degrees by similar oscillating dogs, *f f*, (shown in Figs. 1ª and 10,) and arranged in connection with the table $A^2$ while the latter is raised, so as to be placed in line with the fourth pass. By the rising motion of the table $A^2$ the billet is brought in contact with the second feed-roller, *b′*, on the transverse shaft S′, and fed into the fourth pass and to the table A′, which has been simultaneously raised. The billet is next taken up by the forked ends of transferring-arms F, which are oscillated by the falling motion of the table A′, and by a suitable gearing consisting of vertical racks *g*, attached to the frame of the table A′, pinions *g′*, and gear-wheels $g^2$ on the pivots $g^3$ of the arms F, as shown in Fig. 9. The arms F are thereby moved through a quadrant of a circle and deliver the billet, while simultaneously giving the same a quarter-turn to rotating feed-rollers B′ in line with the fifth pass of the second set of rolls, B, as shown in dotted lines in Fig. 9, said feed-rollers feeding the billet into pass five of the second set of rolls. It thus appears that the falling motion of the feed-table A′ produces the downstroke of the transferring-arms, while the rising motion produces the upstroke of the same, as indicated, respectively, in dotted and full lines in Fig. 9.

The feeding-rollers B′ are applied to horizontal auxiliary-shafts $S^2$, which are rotated by a belt-and-pulley transmission from the transverse power-shaft S, that is driven by a belt-and-pulley transmission from one of the shafts of the extra set of rolls, as shown in Figs. 3 and 4. The rollers B′ feed the billet to the fifth pass of the second set, B, by which it is transferred to a rising and falling feed-table, $B^2$, at the opposite side of the rolls, which feed-table is laterally shifted along inclined guides $d^4$ simultaneously with the rising motion of the same by laterally oscillating cams *d′ d′*, operated in the same manner as the cams *d d* of the feed-table $A^2$. The inclined guides $d^4$ serve to return the feed-table B into its former position, when the lowering motion of the same takes place. The laterally-shift-

ing motion imparted by the cams to the feed-table $B^2$ brings the billet into line with the sixth pass of the second set and in contact with the feed-roller $b^2$ on the transverse shaft S', by which the billet is passed into the sixth pass. It is then received by a stationary frame, $B^3$, having rollers, which frame is located above the feed-rollers B' and on a level with the sixth pass of the second set of rolls.

While on the stationary frame $B^3$ the billet is taken up by a second set of transferring-arms, F', which are operated by the rising and falling feed-table $B^2$ and intermediate transmitting-gearing, (shown in dotted lines in Fig. 1 and in full lines in Fig. 3,) and deposited on the rotary feed-rollers C', which are in line with pass seven of set C, as shown in dotted lines in Fig. 9, the billet being turned at the same time a quarter-turn by the transferring-arms F'. The billet, which has been changed into a rail, is then fed by the feed-rollers C', which are keyed to the auxiliary shafts $S^2$ of the feed-rollers B' into the seventh pass of the third set, C, and transferred to a feed-table, $C^2$, having rollers, which table is hinged and swiveled at its outer end, and provided at the same end with mechanism for turning the rail a quarter-turn. This mechanism (shown in Figs. 4, 7, and 8,) consists of a pivoted plate or disk, $h$, having a horizontal recess, $h'$, the lower edge of which is on a level with the rollers of the feed table $C^2$, and which is provided with a toothed segment, $h^2$, that meshes with a pinion, $h^3$, at the end of a horizontal shaft, $h^4$. At the opposite end of this shaft is located a second pinion, $h^5$, which is in mesh with a vertically-reciprocating rack, $h^6$, at the inner end of the feed-table $C^2$. This inner end is raised and lowered by suitable mechanism and operates the turning mechanism described so as to impart simultaneously with the raising of the feed-table $C^2$ a quarter-turn to the rail.

While the feed-table $C^2$ is being raised at the inner end, it is simultaneously shifted along an inclined guide, $d^5$, by a cam, $d^2$, operated in the same manner as the cams $d$ $d'$ of the feed-tables $A^2$ and $B^2$, so as to be placed in line with the eighth pass of the third set of rolls. The inclined guide $d^5$ returns the feed-table $C^2$ to its former position when the same is lowered. By the rising motion of the feed-table $C^2$ the rail is brought below and in contact with the feed-roller $b^3$ on the transverse shaft S', and fed thereby into pass eight and delivered at the other side of the third set, C, to a stationary guide-trough, $C^3$, along which the rail is conducted directly to pass nine of the extra set of finishing-rolls D. The extra set D is about thirty feet (more or less) from the third set of rolls and parallel thereto.

From the ninth pass of set D the rail is delivered to a feed-table, D', which is hinged and swiveled at about two-thirds of its length. The inner end of the feed-table D' is raised and lowered by the usual mechanism, and moved along inclined guides $i$ $i'$, one near the inner and the other near the outer ends. The guides $i$ $i'$ are at the same side of the feed-table D', and serve to turn the same on its swivel-pin or fulcrum when being raised or lowered.

When the inner end of the feed-table D' is lowered, it is shifted simultaneously by the inclined guide $i$ at its inner end, while when it is raised it is shifted by the guide $i'$ at its outer end. As soon as the rail is delivered on the feed table D', its inner end is lowered and shifted sidewise in line with the tenth pass of the extra set D, the rail moving by gravity along the feed-table D into pass ten.

If the speed imparted to the rail should not be quick enough, it may be accelerated by giving direct motion to the rail by means of a belt-and-pulley transmission connecting the driving-shaft of the extra set with one of the rollers of the feed-table D', as shown in Figs. 1, 2, 3, and 4.

From pass 10 of the extra set D the rail passes to a second stationary trough, $C^4$, which is parallel to the first trough, $C^3$, but located at a lower level than the latter, as shown in Fig. 9. The rail passes along the second stationary trough, $C^4$, into pass eleven, or finishing pass, of the third set, it having been lengthened to about sixty feet or more. The rail is then delivered to a stationary trough, $C^5$, parallel to and sidewise of the feed-table $C^2$, and conveyed along the same to the saws, which cut it in two and trim both rails to the proper length.

The reversing of the rising and falling motion of the feed-tables A' $A^2$ of the first set of rolls is accomplished by the attendant who is stationed near the first set of rolls. The reversing of the rising and falling motion of the feed-table $B^2$ of the second set, B, of feed-table $C^2$ of the third set, C, and of feed-table D' of the extra set D, however, is accomplished by automatically-shifting mechanisms (shown in Fig. 1,) which shifting mechanisms are actuated by the rail itself, so as to reverse the motive power by which the feed-tables are operated at the proper time.

The shifting mechanism of the feed-table $B^2$ consists of a longitudinal rod, $m$, which is connected to an oscillating bell-crank lever, $m'$, one arm of which extends across the outer end of the feed-table $B^2$ into the path of the billet, so that the same, when out of the rolls B, strikes against the arm of the bell-crank lever, and thereby shifts the rod $m$. The rod $m$, being connected to the reversing-gear of the motive power by a suitable lever mechanism, (not shown in the drawings,) reverses the motive power and thereby the motion of the feed-table $B^2$. The shifting-rod $m$ is also connected at its opposite end to a second bell-crank lever, $m^2$, which is moved across the outer end of the stationary table $B^3$ by the action of the billet when on the feed-table $B^2$, so that when the billet has passed from the second set of rolls on the stationary table $B^3$ it strikes the second bell-crank lever, $m^2$, shifts the rod $m$, and again reverses the motive power. The reversing of the motive power by the bell-crank lever $m$ lowers the feed-table

$B^2$, while the reversing by the bell-crank $m^2$ causes the rising of the same, which motions take place whenever the billet arrives at a given point. The proper position of the bell-crank levers is adjusted by means of holes in the rod *m*. In a similar manner the feed-table $C^2$ of the third set of rolls is operated by a bell-crank lever, *n'*, connected to a longitudinal rod, *n*, the latter being connected to the reversing-gear of the motive power. When the rail passes from pass seven to the feed-table $C^2$, it strikes, when arriving at the outer end of the same, against the bell-crank lever *n'*, so as to reverse the motive power and raise the inner end of the feed-table $C^2$. For lowering the feed-table $C^2$ the shifting-rod *n* is operated by a pendent arm, $n^2$, (shown in Figs. 4 and 10,) which is pivoted to one of the supporting-standards of the third set of rolls, C, and which drops and strikes the shifting-rod *n* as soon as the rail has passed the eighth pass. It causes thereby the reversing of the motive power. On the shaft of the pendent arm $n^2$ is arranged in line with pass eight a second arm, $n^3$, which is carried along by the rail, and held in inclined position toward the rail by contact with the same, as shown in dotted lines in Fig. 4, but is instantly dropped as soon as the rail has passed the rolls C, so that the pendent arm $n^2$ strikes the rod *n* and shifts the same.

The reversing of the rising and falling motion of the feed-table D' of the extra set of rolls D is accomplished by a shifting-gear, which consists of a rod, *o*, a bell-crank lever, *o'*, and pendent arms $o^2$ $o^3$, which shifting devices operate in the same manner as those of the feed-table $C^2$, so as to produce the raising and lowering of the feed-table D' at the proper time by the motive power.

I am aware that in rolling-mills a train of three sets of three-high rolls operated in connection with rising and falling feed-table, dogs for turning the billet on said tables, rotary feed-rollers for moving the billet into the passes of the rolls, and oscillating arms for transferring the billet from the feed-table of one set of rolls to that of the next adjoining set have been used heretofore, and I do not desire to claim these features, broadly; but I consider as essentially new the arrangement of a fourth or extra set of finishing-rolls parallel to and at one side of the third set of rolls; also, the guide-troughs and feed-tables by which the rail is passed from the third set to the extra set and back to the former; also, the device for automatically shifting the billet on the rising and falling feed-table of the first set of rolls, the device for shifting the feed-tables of the second, third, and fourth set of rolls; also, the special mechanism by which the transferring-arms are operated and the rail is turned prior to its being fed to the eighth pass of the third set, together with other details of construction as are required for the working of the novel features described.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination of three sets of rolls arranged in line with each other, and feed devices for each set of rolls, with a set of finishing-rolls arranged parallel to and at one side of the third set, and a feed-table for said set of finishing-rolls, substantially as set forth.

2. The combination of three sets of rolls arranged in line with each other, and feed devices for each set of rolls, with a set of finishing-rolls parallel to and at one side of the third set of rolls, and stationary guide-troughs located at different levels between the third and finishing sets for conducting the rails from the passes of the third set to the passes of the finishing-set and back again, substantially as set forth.

3. The combination of three sets of rolls arranged in line with each other, and feed devices for each set of rolls, with a set of finishing-rolls parallel to and at one side of the third set of rolls, stationary guide-troughs located between the third set and set of finishing-rolls, and a rising and falling and laterally-shifting feed-table for the set of finishing-rolls, so that the rail is transferred from the passes of the third set to the passes of the set of finishing-rolls and back to the third set, substantially as set forth.

4. The combination of three sets of rolls arranged in line with each other, feed devices for each set of rolls at opposite sides of the same, oscillating transferring-arms located between the feed devices of the first and second set of rolls, and the feed devices of the second and third set of rolls at one side of said train of rolls, and a continuously-rotating transverse shaft having feed-rollers located above the feed devices at the other side of the train of rolls, substantially as set forth.

5. In a rolling-mill, the combination, with a first or roughing set of rolls, of a rising and falling feed-table having geared rollers at one side of said rolls, a rising and falling feed-table at the opposite side of the rolls, devices for shifting the billet on the second feed-table, and continuously-rotating feed-rollers above the second feed-table, substantially as set forth.

6. The combination, with the second set of rolls, continuously-rotating feed-rollers, and a stationary frame located at one side of the same, of a rising and falling feed-table located at the other side of the same, devices for laterally shifting said feed-table, and a continuously-rotating feed-roller above said feed-table, substantially as set forth.

7. The combination of the first set of roughing-rolls, rising and falling feed-tables at both sides of the same, the second set of rolls, rotary feed-rollers at one side of the same, forked transferring-arms oscillating from one of the rising and falling feed-tables of the first set to the feed-rollers of the second set of rolls, and gearing operated by the rising and falling feed-table of the first set of rolls for oscillating the transferring-arms and simultaneously the billet, substantially as set forth.

8. The combination, with the second and third set of rolls, of rotating feed-rollers and a stationary frame at one side of the second set, a rising and falling feed-table at the other side of the second set, rotating feed-rollers at one side of the third set, oscillating arms for transferring the billet from the stationary frame of the second set to the feed-rollers of the third set, and transmitting-gearing by which the rising and falling feed-table of the second set of rolls oscillates the transferring-arms between the second and third set of rolls, substantially as set forth.

9. The combination, with the second set of rolls, rotating feed-rollers, and a stationary frame at one side of the same, of a rising and falling feed-table at the other side of the same, cams for laterally shifting said feed-table, inclined guides for returning said feed-table, a rotary feed-roller above the rising and falling feed-table, and shifting devices operated by the billet for reversing the motive power of the feed-table and automatically raising or lowering the same, substantially as set forth.

10. The combination, with the third set of rolls, of a rising and falling feed-table that is hinged and swiveled at its outer end, a cam for imparting laterally-shifting motion to the inner end of the feed-table, an inclined guide for returning the feed-table, and a continuously-rotating feed-roller above said feed-table, substantially as set forth.

11. The combination of the third set of rolls, a rising and falling feed-table at one side of the same, said feed-table being hinged and swiveled at its outer end, a device for shifting the inner end of the feed-table, and a device located at the outer end of the feed-table for turning the rail simultaneously with the raising of the said feed-table, substantially as set forth.

12. The combination of the third set of rolls, a rising and falling feed-table at one side of the same, devices for shifting the inner end of the feed-table, and shifting devices operated by the rail for reversing the motive power of the feed-table and automatically raising or lowering the same, substantially as set forth.

13. The combination, with the third set of rolls, of two stationary conveying-troughs at one side of the same, a rising and falling feed-table at the other side of the same, devices for laterally shifting said feed-table, a continuously-rotating feed-roller above the same, a set of finishing-rolls parallel to and at one side of the third set of rolls, and a rising and falling and laterally-shifting feed-table at the opposite side of the set of finishing-rolls, substantially as set forth.

14. The combination, with the set of finishing-rolls, of the rising and falling feed-table that is hinged and fulcrumed to a support located between the center and outer end, means located at both ends of the feed-table for laterally shifting and returning said feed-table, and shifting devices, also located at both ends of the feed-table, for reversing the motive power of said feed-table and automatically raising or lowering the same, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

JOHN M. PRICE.

Witnesses:
PAUL GOEPEL,
MARTIN PETRY.