

(No Model.)

3 Sheets—Sheet 1.

F. H. DANIELS.  
ROLLING MILL PLANT.

No. 407,177.

Patented July 16, 1889.

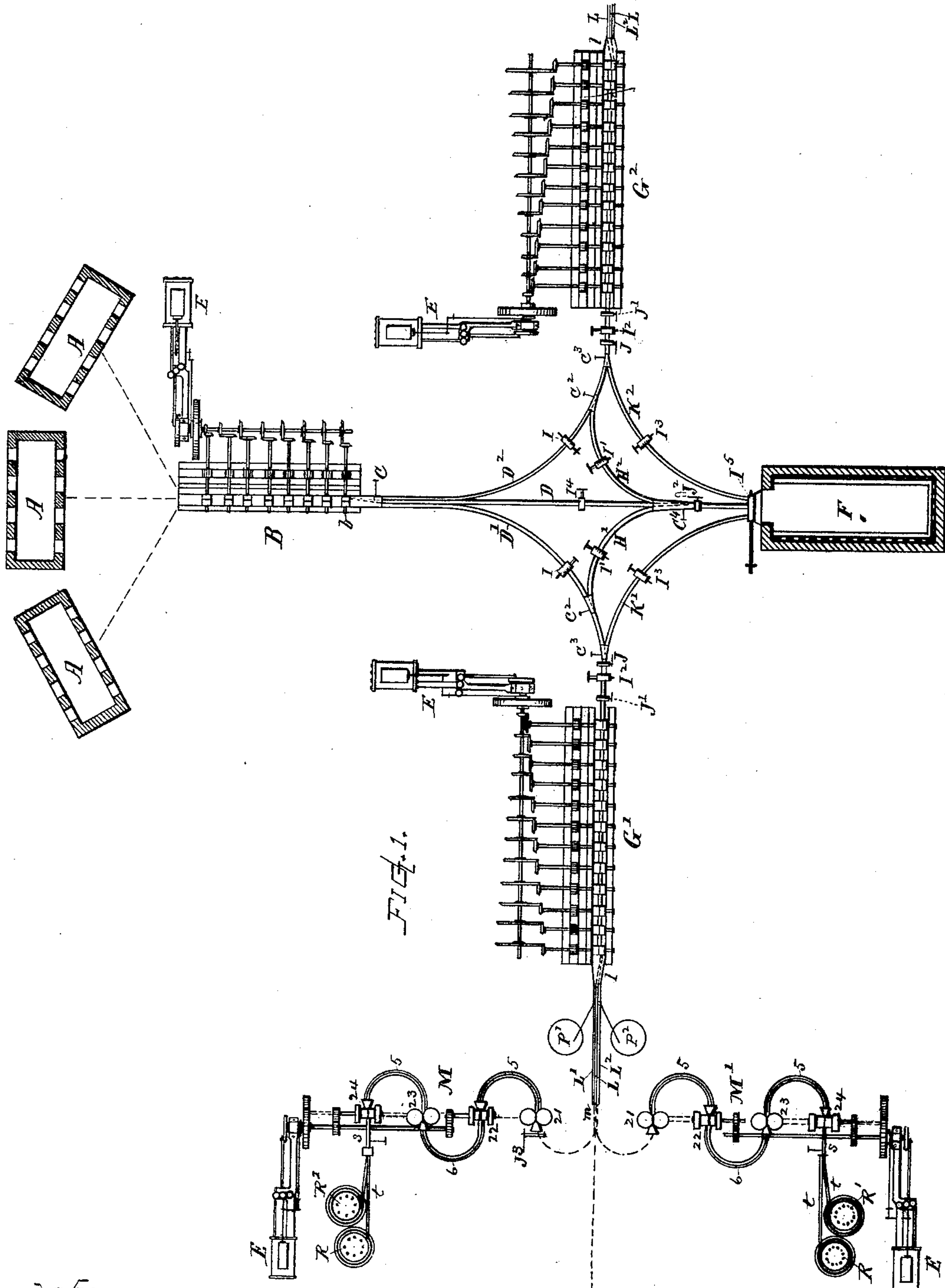


FIG. 1.

WITNESSES  
*Louis H. Wilson*  
*S. R. Barton*

INVENTOR  
*Fred. H. Daniels*  
By *Chas. H. Purleigh*  
Attorney

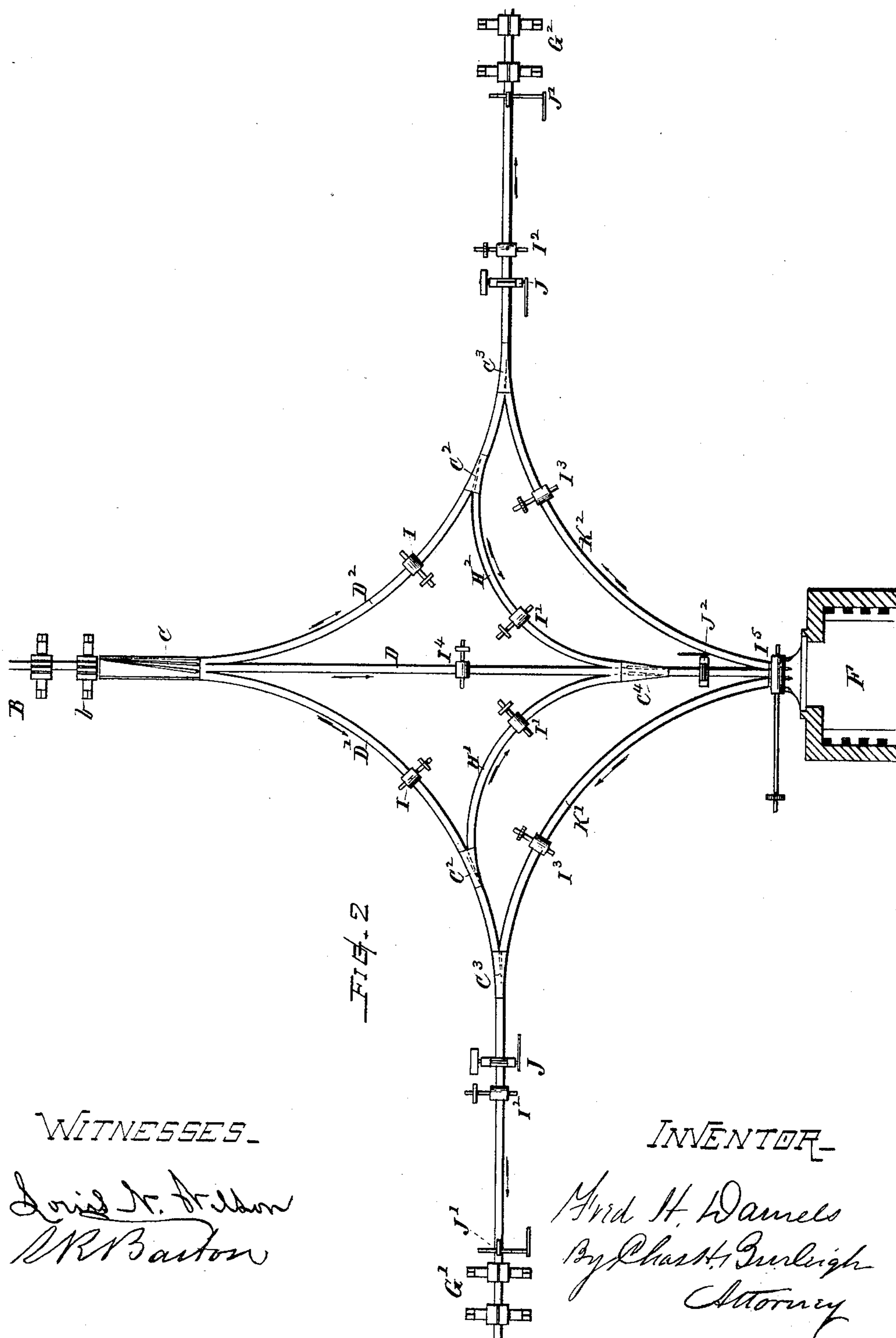
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WITNESSES.

Louis St. Wilson  
NR Boston

INVENTOR\_

Wm H. Daniels  
By Chas. H. Burling  
Attorney

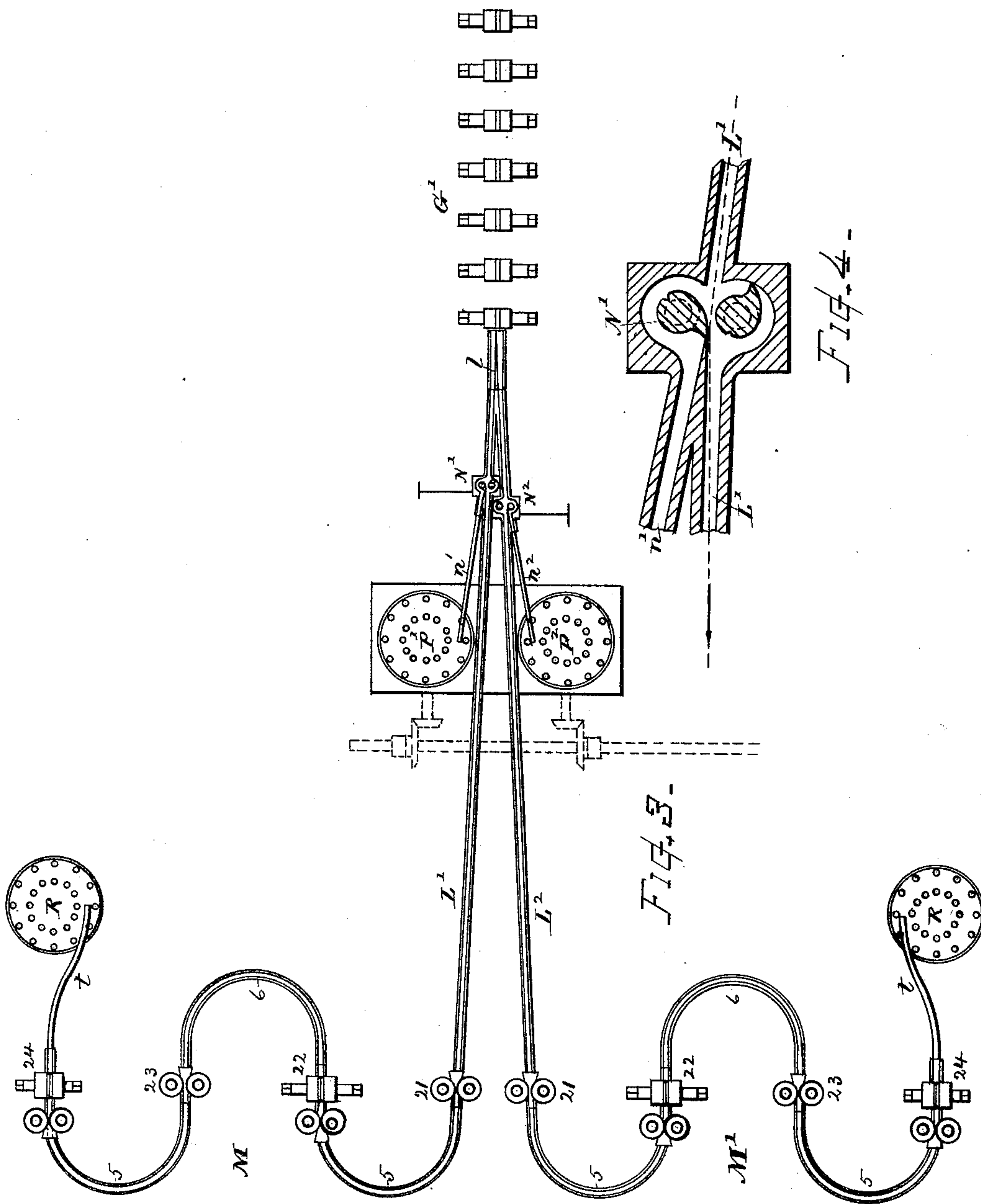
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3 Sheets—Sheet 3.

F. H. DANIELS.  
ROLLING MILL PLANT.

No. 407,177.

Patented July 16, 1889.



WITNESSES—  
*Louis H. Alden*  
*J. R. Barton*

INVENTOR—  
*Fred H. Daniels*  
By *Chas. H. Burleigh*  
Attorney



# UNITED STATES PATENT OFFICE.

FRED H. DANIELS, OF WORCESTER, MASSACHUSETTS.

## ROLLING-MILL PLANT.

SPECIFICATION forming part of Letters Patent No. 407,177, dated July 16, 1889.

Application filed January 31, 1889. Serial No. 298,290. (No model.)

*To all whom it may concern:*

Be it known that I, FRED H. DANIELS, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented certain new and useful Improvements in Rolling-Mill Plants for Making Wire Rods and Similar Products, of which the following, together with the accompanying drawings, is a specification sufficiently full, clear, and exact to enable persons skilled in the art to which this invention appertains to make and use the same.

In making fine rods from heavy bars or blooms at a single heat there arises a practical difficulty in timing the working of billets so as to preserve their heat at a uniform condition in the several runs of rods and a second difficulty in maintaining the heat of the billets when a delay takes place in the operation of the second train, or any delay that necessitates the lying idle of the heated metal at any intermediate stage in the process of reduction. Another difficulty is the increase of waste caused by the stopping or interruption of the product at some intermediate stage of its reduction or before it has passed through the finishing-train.

The objects of my present invention are, first, to provide a plant for making wire rods and similar products that will produce rods of small size in large quantities and with comparatively small percentage of waste or loss of product, and in which hand labor is in a great measure dispensed with, so that the plant can be operated by a comparatively small number of attendants.

Another object is to provide facilities for taking care of the product at different stages of reduction in case of any interruption in the reducing operation or derangement in the normal working of the mechanism at any part of the plant, so that said product is preserved in available shape and condition to be subsequently worked or utilized as a merchantable article instead of going to waste.

Another object is to provide, in combination with the rod-reducing trains, their leading conductors, and the billet-feeding appliances a supplemental furnace or chamber and auxiliary conductors and feed mechanism for di-

verting and receiving product from the regular conductors and for the temporary storing and reheating of billets, and provided with facilities for subsequently feeding the billets to the rod-reducing trains, or either of them, as occasion requires.

Another object is to overcome or avoid excess of waste product by rolling a rod of merchantable form and of moderately large section in the second rolling-train and providing between such second train and the finishing-train switching-cutters and a reel or reels for instantly severing, diverting, and coiling the product in the event of its becoming stopped before passing the third or finishing train.

These objects I attain by mechanism arranged and organized for operation substantially as explained in the following description, the particular subject-matter claimed being hereinafter definitely specified.

In the drawings, Figure 1 is a plan diagram showing the general disposition of mechanism as employed in my improved plant for making wire rods, the finishing-trains and reels for one wing of the apparatus being omitted on this drawing to bring the figure within the limit of the drawing-sheet. Fig. 2 is a plan view illustrating the arrangement of the conductors, switches, feed-rolls, and shears as employed between the first and second rolling-trains and the supplemental furnace. Fig. 3 is a plan view showing a modified arrangement of finishing-trains and reels for completing the reduction and coiling of the rods after they pass the second reducing trains, and also showing mechanism for shifting and automatically coiling the rods at a partial stage of their reduction. Fig. 4 is a horizontal section of the cutting and switching devices for throwing off the rods in case of derangement in the running of the finishing-train.

In referring to parts, A denotes the furnace or furnaces for heating the blooms or material from which the rods are to be formed.

B indicates the first train of reducing-rolls, which is herein termed the "billet-mill," and which preferably consists of eight pairs of rolls (more or less) arranged and suitably geared for working in "continuous" order for reducing a bloom of any desired size down to



a bar or billet of about one inch diameter, more or less.

C indicates a switch or guide for directing the product from the last rolls *b* of the first reducing-train or billet-mill B into any one of the several conductors D, D', or D<sup>2</sup>, one of which conductors D leads to a supplemental receiving chamber or furnace F, and the others D' and D<sup>2</sup> lead, respectively, to second rolling-trains G' and G<sup>2</sup>, which I herein term "rod-mills," and conduct the billets or partially-reduced product from the last rolls *b* of the billet-mill B into the pass or groove of the first pair of rolls of said rod-mills or second rolling-trains.

H' H<sup>2</sup> indicate return-conductors leading backward from the conductors D' and D<sup>2</sup> toward the delivery end of the conductor D, and through which the product can be fed backward after it has passed switch C<sup>2</sup> and directed into the supplemental furnace F.

K' K<sup>2</sup> indicate conductors that lead from the furnace F and join the conductors D' and D<sup>2</sup> in front of the respective rod mills or trains G' and G<sup>2</sup>, and through which the billets can be delivered from said supplemental furnace into the respective rod-mills. The conductors are in substance the same as H' H<sup>2</sup>; but for some reasons it is preferable to duplicate the conductors from F to G' G<sup>2</sup>, as shown in Fig. 1.

Feeding-rolls are arranged in the lines of conductors, as indicated at I, I', I<sup>2</sup>, I<sup>3</sup>, and I<sup>4</sup>, for advancing or retracting the billets, as desired, and feed-rolls I<sup>5</sup> are arranged adjacent to the furnace F to assist the entering and withdrawing of the billets. Shears or cutters are provided at J for severing or cutting off the crop ends of the billets before introducing them to the rod-mill. Shears J' are provided for severing the billet and stopping the feed thereof in case any derangement occurs in the working of the rod-mill or second trains. Shears J<sup>2</sup> are provided in the conductor D for trimming or cutting the billets before introducing them into the furnace or chamber F. Switches C<sup>2</sup>, C<sup>3</sup>, and C<sup>4</sup> are provided at the junctions of these several conductors for changing the lines of the conductor-channels to allow the billets to take the direction required. The rod-mills or second trains G' and G<sup>2</sup> preferably each comprise some twelve pairs of rolls (more or less) disposed for operation in continuous order, their intermediate guides and operating-gearing being arranged in suitable well-known manner. The two rod-mills are best located at the right and left of the system of conductors and at suitable positions for respectively receiving bars or billets either from the billet-mill B or from the furnace F, as occasion may require.

Beyond the foot of each of the rod-mills or second rolling-trains I provide finishing-mills or third rolling-trains M M', each of which preferably consists of a series of pairs of rolls 21, 22, 23, and 24, arranged for oper-

ating in "Belgian" order—that is, for the looping out of the rod at opposite sides of the mill between the several pairs of rolls, said finishing-trains being disposed in relation to the rod-mill in the manner illustrated.

Conductors L L' L<sup>2</sup> are provided for guiding the rods from the last pair of rolls in the rod-mill down to the finishing-trains, and a switch *l* is arranged therein for directing the rod into either of said conductors, so that it will go to the right or left finishing-train.

In Fig. 1 the conductors are shown as terminating with an open end at *m*. In this instance an attendant seizes the end of the rod with tongs and feeds it to the rolls 21, while in Fig. 3 the conductors are shown as leading directly to the pair of rolls 21. In this latter instance the end of the rod is automatically fed into the finishing-train.

The finishing-trains are provided with repeater-guides 5 and 6, that automatically direct the end of the rod about the curve of its loops and into the pass of the succeeding pair of rolls. If in any instance desired, feed-rolls can be used in the line of repeaters, as indicated in Fig. 3.

In practice a cutter or shear is preferably arranged in front of the first rolls 21 of the finishing-trains, by means of which the rod can be severed to stop its feeding into said rolls in case it becomes tangled or choked at any part of said finishing-train.

In a separate application for Letters Patent of even date herewith I have described in detail the construction of a rolling-mill suitable for employment as finishing-trains M M', and as the special constructive features of said mill are claimed in my said separate application and not in this present application a more particular description herein is not necessary.

N' N<sup>2</sup> indicate cutting and switching mechanisms arranged in the line of the conductors L' L<sup>2</sup>, and from which branch guide-pipes *n'* *n*<sup>2</sup> lead to automatic reels P' P<sup>2</sup>, into which the rod can at any time be instantly directed by bringing the cutter and switch into action. The constructive details of the operating mechanism for bringing the cutting and switching heads into action can be substantially the same as described in my Letters Patent No. 370,688, or of any suitable arrangement, and as such operating mechanism is not a feature of my present invention it need not be herein more fully described. In some instances, if it is desired, the switching-cutters N' N<sup>2</sup>, branch guides *n'* *n*<sup>2</sup>, and reels P' P<sup>2</sup> can be omitted from the plant. In such case the rods can be sent down the conductor L and coiled on the reel V in the event of any derangement occurring in the proper running of the finishing-trains M or M'.

R R' indicate reels for automatically coiling the finished rods, which are fed thereto from the finishing-rolls 24 through the guide-pipe *t*, a switch S being employed, if two or



more reels are used, so as to direct alternate rods to the different reels in well-known manner.

A reel V is provided for winding up "cob-  
bles" or incomplete rods that from any cause fail to pass through the mills to final completion.

The rod mill or train  $G^2$ , Fig. 1, is in practice provided with delivery-conductors  $L$   $L'$  and finishing-trains—such as  $M$   $M'$ —which are disposed for operation in relation to such rod mill or train  $G^2$  in the same manner as above described, and with automatic reels, guides, switches, and repeaters substantially like those shown in connection with the train  $G'$ .

Suitable motors or engines E are provided for operating the rolling-mills and apparatus appertaining to the working plant, and any convenient arrangement of belts, gears, or other connections can be employed for transmitting the power and motion from such motors to the operated mechanism.

The several conductors or guideways arranged between the billet-mill, rod-mills, and supplemental furnace are preferably inclosed in a non-radiating or heat-retaining covering in a manner substantially similar to that described in my Letters Patent No. 390,285, whereby the heat of the billet will be maintained with as little loss as possible during its passage from one stage of reduction to the next, or to and from the storage receptacle or furnace. The conductors  $L'$   $L^2$  are likewise inclosed with non-radiating material, protecting and maintaining the heat of the rod while passing therethrough.

The operation of my improved rolling-mill plant in the production of wire-rods is substantially as follows: The bloom or material, after being properly heated in the furnace A, is transferred from said furnace and fed into the billet-mill or first rolling-train B, whereby it is reduced from its original size to a bar or long billet of about one inch square, (more or less,) in which condition it runs from the rolls  $b$  into one of the conductors  $D'$  or  $D^2$ , its forward end advancing to the shears J, by means of which the crop end is cut off. The billet is then advanced by means of the feed-rolls I into the rod-mill or second rolling-train, wherein it is reduced by the usual alternate square and oval passes, so that it issues from the last rolls of said rod-mill, preferably, with a round section of about three-eighths inch diameter, more or less. This rod advances down one of the conductors L, and its end is fed to the rolls 21 of the finishing-train, and then follows automatically around the repeaters 5 and 6 and through the several pairs of rolls to the end of the finishing-train, and thence through the guide-pipe  $t$  into the reel R or  $R'$ , by means of which it is automatically coiled. The quantity of material contained in a single bloom is greater than that ordinarily desired in a single coil of finished

rod for convenience of handling. Therefore the rod or billet, when passing the shears  $J'$ , or at some convenient stage in the reducing operation, is preferably severed at one or more places and the separate parts switched to the different finishing-trains, one part to the train M and another to the train  $M'$ , and so alternating.

In the normal running of the plant billets, as they issue from the billet mill or train B, are alternately sent to the right and left rod-mills, the output of the billet-mill B being calculated to supply the plurality of rod-mills with material, while each of the rod-mills is calculated to supply its respective plurality of finishing-trains, thus keeping the mechanism in effective operation, while affording time for the rods to run clear of any part of the apparatus before another rod is ready to enter the same.

In the event of a cobble in one of the rod-mills or second trains, or any temporary derangement in the working that would prevent one or the other of the rod-mills taking its share of the output from the billet-train B, then the billets that would normally go to said rod-mill are directed by way of the conductor D, cut into suitable lengths by the shears  $J^2$ , and deposited for temporary storage and maintenance of their heat within the furnace F. In case a billet has partly passed into the second train at the time the cobble or derangement occurs, then the billet is immediately severed by an attendant working the shears  $J'$  at the head of the rod-mill, and the portion of the billet within the conductor is, by aid of the feed-rolls  $I^2$  and  $I'$ , drawn back through the return-conductor  $H'$  or  $H^2$  and run into the storage chamber or furnace F. The billets deposited in the chamber or furnace F can, when the derangement is righted, be withdrawn and guided through the conductor  $K'$  or  $K^2$  or back through  $H'$   $H^2$  to either of the second trains  $G'$  or  $G^2$ , and this can be done when convenient, or when any delay occurs in the working of the first train B, as when adjusting or shifting rolls or guides in said train or other short delays which in practice occur at varying intervals of time.

In the event of a cobble or any derangement in the finishing-train M or  $M'$  the automatic cutter and switch  $N'$  (or  $N^2$ , accordingly as it is in the right or left train) is brought into action, which instantly severs the rod issuing from the second rolling-train, and directs the following portion into the intermediate reel  $P'$  or  $P^2$ , where it is coiled up in proper condition to be utilized as a rod of large diameter and not wasted, while the portion cut off and not passed through the finishing-train can be picked up from the floor and coiled upon the reel V.

It will also be seen that the plant can, if desired, be employed for the production of these larger-sized rods by setting the switches  $N'$



N<sup>2</sup> so that all rods run into the reels P' P<sup>2</sup>, the final trains M M' at such times remaining idle.

By introducing the supplemental furnace, which can receive the product from the first or billet train, and also receive product after it has been delivered to the rod-mill or second train in case said mill becomes choked, and, further, by providing facilities whereby the product can be delivered from said furnace to either of the rod-mills or second trains, I am enabled to equalize the distribution and feed of product to the several reducing-trains, so that a temporary stop or delay in one part of the mill will not interrupt the working of other portions, and also to accommodate the feed for the secondary and tertiary roll-trains, so as to utilize time to the best advantage for the rolling of a large quantity of product, while the bars or billets can be manipulated in advantageous manner for preserving their heat and for sending them forward to either of the second trains when needed.

What I claim as my invention to be secured by Letters Patent, is—

1. In the rolling-mill plant described, the arrangement of a first train of rolls, a conductor, a second rolling-train through which the product is delivered from said conductor, a second conductor through which the product is delivered from said second rolling-train, and a third rolling-train for finishing the product, all disposed and operating as and for the purpose specified.

2. In a rolling-mill plant, the arrangement, substantially as described, of a first rolling-train, a second rolling-train, a supplemental storage chamber or furnace, a conductor leading from said first rolling-train to said second rolling-train, a conductor from said first rolling-train to said storage-furnace, and a return-conductor through which the product can be withdrawn from its approach to the second rolling-train and directed to said storage-chamber, said conductors being respectively provided with switches and with feed-rolls for advancing or retracting the product, as set forth.

3. In a rolling-mill plant, the arrangement, substantially as described, of the billet-mill, a plurality of rod-mills, a supplemental furnace or receiver, a series of conductors leading from said billet-mill to the rod-mills and supplemental furnace, with a switch for directing the product to either conductor, feed-rolls and cutters in the line of said conductors, and return-conductors with feed-rolls for withdrawing the billets from the rod-mill con-

ductor for delivery to the furnace, as set forth.

4. In a rolling-mill plant, the arrangement, substantially as set forth, of the billet-mill, the rod-mill, a conductor leading from said rod-mill to said billet-mill and having feed-rolls and cutters in the line thereof, as indicated, a finishing-mill, a conductor from said rod-mill to said finishing-mill provided with a switch and cutter having a branch guide, and an automatic reel to which the rod is delivered by said branch guide, for the purpose set forth.

5. In the rolling-mill plant described, the arrangement, with a rod-mill having a train of rolls arranged in pairs for operating in continuous order, of a plurality of finishing-trains consisting of pairs of rolls with the axes of the several pairs of rolls disposed at right angles, a series of overfeed-guides for leading the end of the rod through said finishing-train, and a conductor between the rod-mill and the finishing-trains, substantially as set forth.

6. In a rolling-mill plant, the arrangement, substantially as described, of the billet-mill, the rod-mill, a conductor with shears and feed-rolls for trimming and advancing the product from said billet-mill into the rod-mill, a plurality of finishing-trains having their rolls disposed at right angles and provided with overfeed-guides, conductors from said rod-mill to said finishing-trains, a switch for directing the rod to either finishing-train, and reels for coiling the finished rods, substantially as set forth.

7. In a rolling-mill plant, the arrangement, substantially as described, of the billet-mill, the rod-mill, a conductor with shears and feed-rolls for trimming and advancing the product from said billet-mill into the rod-mill, a finishing-train, conductors from said rod-mill to said finishing-train, and a reel for coiling the finished rods, as set forth.

8. The rolling-mill plant consisting of a billet-mill, an inclosed conductor for maintaining the heat of the product of the billet-mill and for conveying it to the rod-mill, a rod-mill, an inclosed conductor for maintaining the heat of the product of the rod-mill and for conveying it to the finishing-mill, a finishing-mill, and a reel for coiling the product of the finishing-mill.

Witness my hand this 29th day of January, A. D. 1889.

FRED H. DANIELS.

Witnesses:

CHAS. H. BURLEIGH,  
ELLA P. BLENUS.