3 Sheets—Sheet 1.

H. B. COMER.

Rolls for Rolling Iron, Steel, &c.

No. 227,737. **Patented May 18, 1880.**

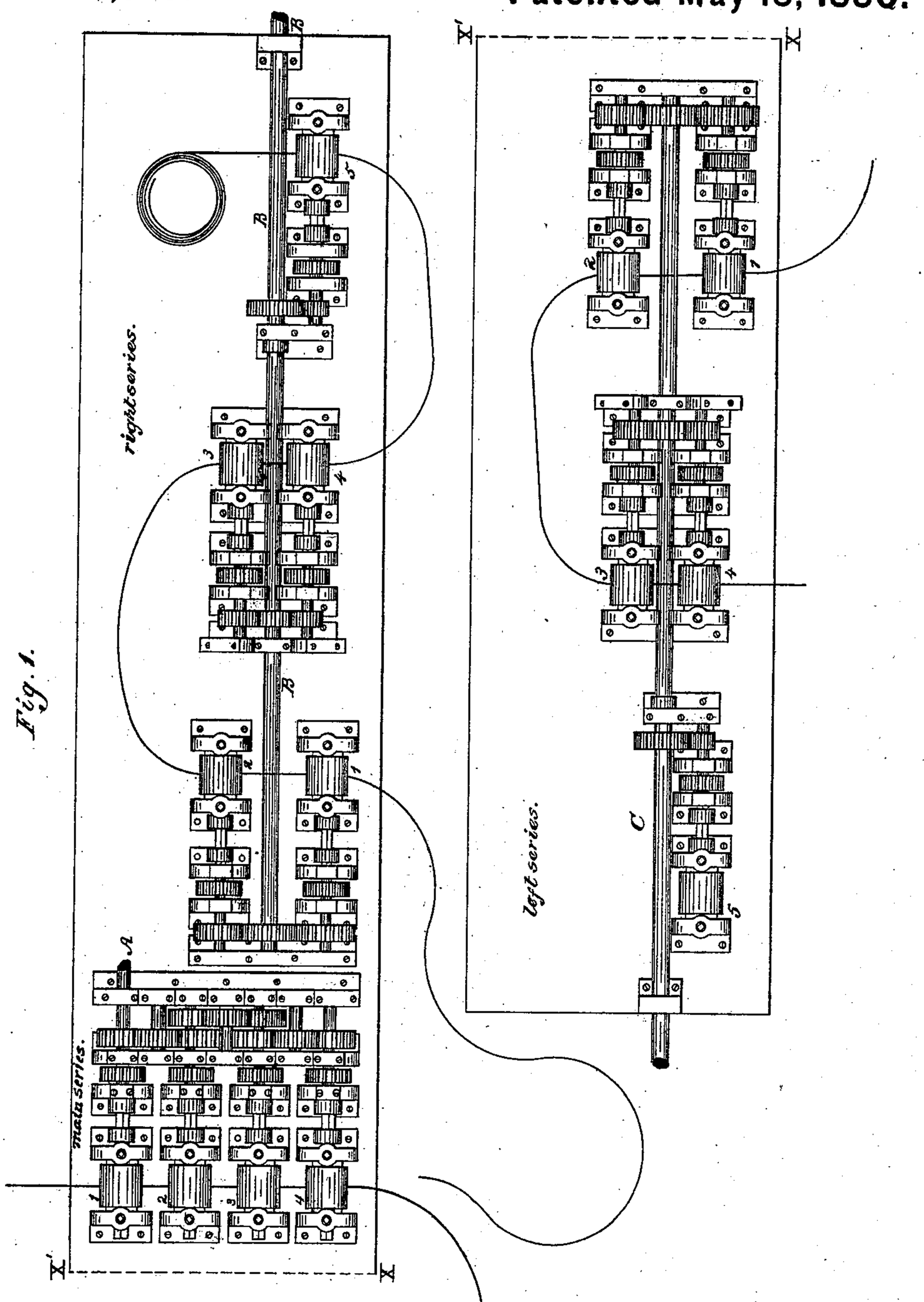

Fig. 1.

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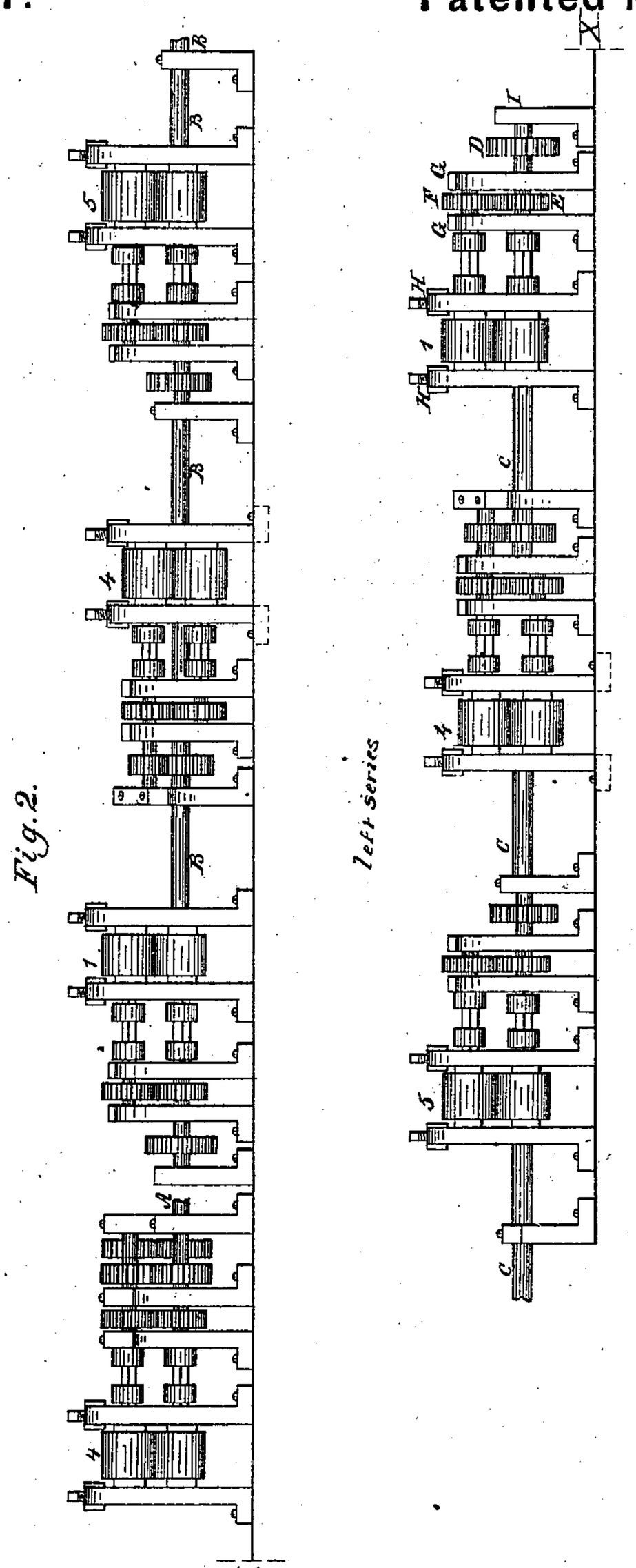

Fig. 2.

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Fig. 3.

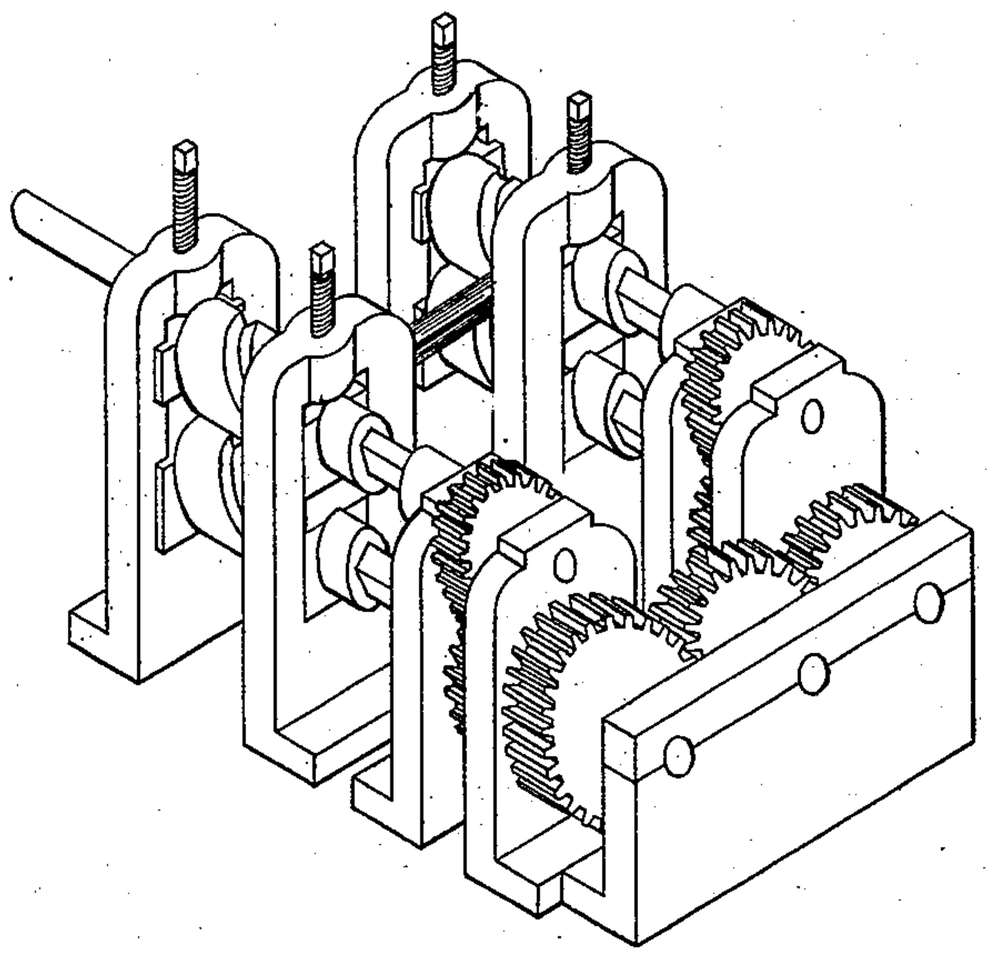


Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

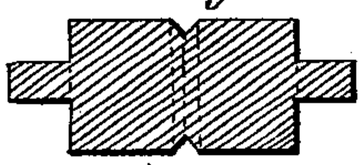
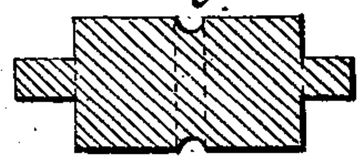


Fig. 8.



Witnesses:

Chas. H. Fowler

F. S. Blanchard.

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UNITED STATES PATENT OFFICE.

HENRY B. COMER, OF PHILADELPHIA, PENNSYLVANIA.

ROLLS FOR ROLLING IRON, STEEL, &c.

SPECIFICATION forming part of Letters Patent No. 227,737, dated May 18, 1880.

Application filed November 14, 1879.

To all whom it may concern:

Be it known that I, HENRY B. COMER, of Philadelphia, State of Pennsylvania, have invented certain new and useful Improvements in Rolls for Rolling Iron, Steel, and other Metals; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the annexed drawings, making part hereof.

The nature of my invention will fully appear from the following specification and claims.

The object of my invention is to increase the capacity of the mills, and also by securing many and rapid passes of the metal through the rolls while it is at a high heat to improve the quality of the rolled product. One of its objects is to produce a mill which will successfully and economically roll either steel or iron wire rods to small sizes.

In the drawings, Figure 1 is a plan view of my improved mill; Fig. 2, an elevation of the same, the two points X X being joined; Fig. 3, a perspective view of one section thereof, showing two pairs of rolls set in front of each other in separate housings, showing also the gearing by which they are operated; Fig. 4, a perspective view of my square guide, the end shown being that end of the guide which delivers the rod to the oval-grooved rolls; Fig. 5, a longitudinal sectional view of the same, showing the twist; Fig. 6, an end view of the oval guide; and Figs. 7 and 8, longitudinal sectional views of square and oval grooved rolls, respectively.

My mill may be said to be composed of a main line of rolls and two wings of the same.

In the drawings, I have shown one wing broken off upon account of the great length of the figure. The two points X′ X′ of the two sections in Fig. 1 are intended to be joined, and the points X X adjoin.

I have numbered the rolls of the main line or series from 1 to 4, those of the right wing or series 1 to 5, and those of the left wing or series also from 1 to 5, No. 5 pair of rolls in each wing being the finishing-rolls of that wing.

A is the shaft driving the pinions or cog-wheels of the main line; B, the shaft driving the pinions of the right wing, and C that which drives those of the left wing.

In practice the main line of rolls (1, 2, 3, and 4) will be composed of about nine pairs of rolls, instead of four, as shown—that is, there will be about four or five pairs of rolls in this main line set in front of or before what in the drawings constitutes the No. 1 pair of rolls. I have shown but four pairs in the main line for convenience of illustration, since the space for showing a complete drawing of my apparatus is so limited. All my rolls are grooved, as described in my Letters Patent dated March 29, 1859, and March 24, 1874—that is, pair of rolls No. 1, which receives the square billet of metal from the furnace, has an oval groove. The second pair has a square groove, and so on. The grooves are alternately oval and square down to No. 4 in my right wing, which is an oval, the finishing pair, No. 5, having a round groove. The same is true with respect to the left wing of my present device. Pair No. 4 has an oval groove and finishing pair No. 5 a round groove, whereby the finishing pair of rolls in each instance leaves the wire rod as perfectly round as may be.

In the above-mentioned patents I have also fully described the guides, Figs. 4, 5, and 6, which take the metal being rolled from one pair of rolls and guide it into the next pair.

In my present invention I omit guides between the last pair of the main series and the first pair of each wing; and I also omit guides in each wing between Nos. 2 and 3 and between Nos. 4 and 5 pairs of rolls. Between those pairs of rolls where I use guides I employ the straight twisted guide (not curved—see Fig. 5) described fully by me in my above-mentioned Letters Patent of March 29, 1859. All the pairs of rolls of the main line have guides from pair to pair.

My present invention does not relate to the said guides or rolls, upon which I have made no improvement, but relates most particularly to the general arrangement of my rolls, and my said Letters Patent are sufficient to enable those skilled in the art to make and use my grooves and guides. These grooves are of constantly-diminishing size in each successive pair of rolls, following the course which the wire rod takes from the No. 1 pair of rolls of the main line to the finishing pair of rolls in each wing.

The bloom of metal, as it leaves the furnace

ready to be inserted in the rolls, is a "square billet," so termed. It is a square bar of metal, and if of iron is at a white, welding, or cinder heat; if of steel it is of such a heat as is suitable for the quality of steel being rolled. Those familiar with the art will be well acquainted with the necessary degree of heat to be used.

When, as in practice, I employ nine pairs of rolls in the main line I run my No. 1 pair of rolls at a speed of about thirty to thirty-five revolutions a minute. I increase the speed of each pair of rolls of my main line progressively about one-quarter in each successive pair of rolls to take up the continuous increase in the length of metal caused by the rolling. The first pair of rolls of the right wing (No. 1 in the drawings) runs at about the same speed as the last pair of rolls of the main line, No. 2 pair runs one-quarter faster than No. 1 pair, No. 3 one-quarter faster than No. 2, and so on, increasing to the finishing-rolls. The first pair of rolls of the left wing I also run at about the same speed as the last pair of rolls of the main line, and the subsequent pairs of this wing are arranged as to relative position and speed the same as the right wing—viz., a continuous increase of speed (about one-quarter in each successive pair) from No. 1 pair in the drawings to the finishing-rolls.

The billet from the furnace—say of steel—is placed in the first pair of rolls of the main line. It then passes without further handling through all the rolls and guides of the main line. The rolls of this line run at a very high rate of speed, and the billet thus receives (in practice) nine passes in a very short time, and while it retains its high heat it is seized by an operative as its first end comes out the last pair of rolls of the main line, and this end is placed in the first pair of rolls of the right wing—that is, in No. 1 pair of rolls in the drawings. It passes through Nos. 1 and 2, and as its first end comes out of No. 2 it is seized by an operative and placed into No. 3 pair and goes through No. 4 pair. An operative seizes it again as it comes through No. 4 pair and passes it into the finishing-rolls No. 5, after which it is reeled up a finished wire rod ready for drawing. As soon as the latter end of the first billet of steel disappears between the first pair of rolls of the main line the first end of the second billet is inserted in said first pair of rolls. This billet follows up the first, and immediately after the last end of the first billet leaves the last roll of the main line the first end of the second billet appears, and this is seized by the operative stationed there and passed between the first pair of rolls of the left wing—viz., No. 1 pair in the drawings. This rod is then handled in the left wing exactly as the first is handled in the right wing, and as soon as the last end of the second billet disappears between the first pair of rolls of the main line a third billet is inserted, and so on continuously. The billets, as they come from the main line, are placed first in one wing and then in the other alternately.

As the first pair of rolls of each wing runs at the same speed (about) as the last pair of rolls of the main line, and as the rod coming from the last pair of rolls of the main line is increased in length constantly by the operation of said last pair of rolls, it follows that the first pair of each wing will take up the rod slightly slower than it is being delivered to them, which in each case will form a loop of rod before each of said first pairs of each wing. This loop will, however, in each case be taken up by the first pair of rolls of each wing before it can have time to so cool as to materially affect its subsequent rolling. These loops will elongate with each rod until its end comes out of the last pair of rolls of the main line. There will also be loops formed between pairs of rolls 2 and 3 and between 4 and 5 of each wing; but as the speed between each of these sets of rolls is regularly increased to take up increased length the loops will be short and will not elongate.

Some of the advantages of my present system are these, viz: It is well known that in rolling a long wire rod by means of a series of rolls there is great difficulty in so arranging the relative speeds of the successive pairs of rolls one with another as not to pull the rod and destroy its fiber at some points and buckle or tend to double it up at others. In a series of fourteen, fifteen, or sixteen pairs of rolls set one before another, or in front of each other, (which number is necessary when so arranged to get a small-sized rod,) all having a progressive increase of speed from the first to the last pair, this pulling or buckling is not observable, nor is it material, since the metal is thick and strong until the rod gets to No. 9 or No. 10 pair of rolls, where it gets rather small and has lost a great deal of its heat. The quality of the metal can then be very easily injured, because, as mentioned above, it is not in great bulk and has lost its heat to a great degree.

In such a series of rolls as last-above mentioned the first several pairs of rolls have to be run at a very slow speed, so that by the progressive increase of speed to No. 15 or No. 16 pair the speed will not be so great as to preclude the proper handling of the completed rod as it comes out of the last pair of rolls. Thus the metal materially cools off in the first pass, so that by the time it reaches No. 3 pair of rolls, when the billet is of iron, it has lost its welding heat and is keenly susceptible to injury from pulling or buckling. By my plan, however, I give the metal a number of rapid passes through the first eight or nine pairs of rolls of the main line, thus getting it broken down to a very small size while it is at a high heat, and then take it out in a loop, passing it into the first pair of rolls of either wing at the same speed at which it left the last pair of the main line, and thence I increase the speed regularly to the finishing-rolls. As, after leaving the main line, my rod is passing through rolls which are not set in front of each other in a

long line, I can easily regulate the draft of the rolls in the wings whenever I see a tendency to pull or buckle the rod by loosening or tightening any single pair whenever I observe such pulling or buckling. Thus I obtain full control of the draft of my rolls from No. 9 pair to the finishing-rolls.

In each of the wings I have shown four pairs of drawing-rolls and a pair of finishing-rolls. I can, if I desire, increase these to six or eight pairs of drawing-rolls upon each side, so as to roll the rods smaller, or I can have two pairs upon one side and four or six pairs upon the other side, so as at the same time to roll the rods in one wing to a small size and those of the other wing to a larger or different size simultaneously, the arrangement of the pairs of rolls in my wings being such that I can easily remove one or more pairs or add to their number.

Each one of my shafts A, B, and C is run by a separate engine.

As has been above remarked, it is more difficult to regulate the draft of the rolls to a nicety when they are set in front of each other in a long series, as in the main line, than when they are in detached couples of pairs, as they are in the wings; and it is less material to so nicely adjust them there than it is in the pairs of rolls nearer to the finishing-rolls. There are two reasons for this: First, when the metal is receiving its passes in the first eight or nine pairs it is so heavy and stiff that it will push its way through the guides and into each successive pair of rolls, and will not be liable to buckle or bend up, and it is at so great a heat that a little pulling will not injure it much, for its malleability will be so great as to practically preclude injury. Second, the first eight or nine pairs of rolls are so far away from the finishing-rolls that great care as to draft is not so essential; but when the metal gets to the end of the first series or main line of rolls it has been rolled to so small a size as not to be so stiff, and consequently will more easily double up, and it has also become so much cooler as to be liable to be injured in quality by being pulled between the rolls.

I have so arranged my rolls that those portions requiring the nicest adjustment, and where the rod by becoming small is most liable to injury, are each run by a separate engine—that is, each wing is run by a separate engine and the main line by still another. Now, if any accident occurs to either wing, or if operations have for any cause to be discontinued in either wing, the engine running that wing can be stopped and the iron billets then being heated in the furnace can be utilized by being run through the main line and the other wing—that is, the wing still in operation. Otherwise the billets then being heated in the furnace would be partially burned up and wasted by having to remain in the furnace until the necessary alterations and repairs were made to the defective wing.

The billet is square when it is placed between the first pair of rolls, and is by them rolled into an oval, then by the next pair into a square, then oval, and so on alternately until it reaches the round-groove finishing-rolls. During its transit from one pair of rolls to a succeeding pair it has to be partially turned or twisted, so that the greatest diameter across the billet or rod will not so enter the next pair as to be parallel to the axes of such last-named pair, for, if this were to happen, such greater diameter would be squeezed outside of the groove of the rolls and between their plain surfaces, which would "fin" the rod. To prevent this about a one-eighth turn or twist is given to the square form of the rod by the guide, while a full one-quarter twist is given to the oval. The guides are twisted to effect this—that is, they have a long spiral or slight twist inside. So long as the rod is thick and heavy it can easily push itself through these twisted guides; but when it gets small in diameter it loses its stiffness, and it is liable to buckle up. This is not so much the case with the square form of rod as with the oval form, for the reasons that the square does not have to make so much of a twist as the oval, and also that the square is more compact and strong than the partially-flattened oval. I have for these reasons so arranged my rolls in practice that the rod, each time it attains an oval form after leaving, say, the eighth pair of rolls of the main line, (it having by that time been rolled to a small size,) is carried by the hand of an operative to the next square-grooved rolls, and is thus properly inserted there, instead of having to force itself through a twisted guide in its then weak state; but I still allow the squares to force their way from pair to pair in the slightly-twisted guide required for them.

Out of a number of billets of metal from which it is intended to roll rods it will frequently happen that many will have flaws in their ends. A billet of metal having such a flaw, when placed in the rolls at a welding heat, will very often not show such a flaw until it has reached the end of the main line or series of rolls. It will show it there because, having lost its welding heat and become cooler, the compressive action of the rolls upon it will fracture or split it and force the defective end to flare out or apart in two prongs in such a manner as to preclude its entering the narrow guide which is to direct it to the next pair of rolls. It develops this defect when it is rolled down to the size of the flaw. The consequence then is that as it abuts against the end of the guide a buckle of the worst kind results, the mill must be stopped, and the spoiled rod removed. This was of such frequent occurrence in the old mill, where sixteen pairs of rolls were set before each other in line, as to cause a very material and serious waste. I obviate this liability to waste by so arranging my rolls as to permit the operative to seize the first end of the rod as it comes from the last pair of rolls of the main series in his tongs and to examine it, for he will have full time to do so

before inserting it into the first pair of rolls of either wing, and if he finds that the end of the rod is split or defective he can shear off the split part and then place the newly-perfected end into the next pair of rolls, thus saving the rod. The same opportunity occurs whenever I omit the guides between the pairs of rolls. I thus save a great deal of metal from being wasted.

By my invention the production of wire rods with one furnace is much increased over that accomplished by old methods.

The object of my loops of wire rod formed between the last pair of rolls of the main line and the first pair of rolls of each wing is to increase my production.

The fact of the first pair of rolls of each wing running at about the same speed as the last pair of the main line, coupled with the fact that said last pair constantly elongates the rod, insures a constantly-increasing loop of metal so long as the rod is passing from said last pair to the first pair of rolls of the wing. This loop lengthens out until, in practice, when the last end of the rod leaves the last pair of rolls of the main line there will be a loop of, say, one hundred and ten to one hundred and thirty feet of metal still not taken up by the first pair of rolls of, say, the right wing. Now, while the right wing is taking up that remaining one hundred and twenty feet of rod the first end of a second rod immediately following the latter end of the former rod comes out of the last pair of the main line and is immediately placed in the first pair of rolls of the left wing. This rod elongates in a loop in the same manner as the former had done. Thus, while I am finishing the first rod and while there are still, say, two hundred feet of the first rod being finished in the right wing, I am at the same time finishing the forward part of the second rod in the left wing. Two of these loops will be in front of the last pair of the main line at the same time, one growing longer as the rod elongates, the other becoming shorter as it is taken up in the wing through which it is to pass, and as soon as the latter end of the second rod leaves the last pair of the main line the first end of a third rod comes out and is placed between the rolls of the first pair of the right wing, for by the time the third rod arrives at that point the first rod will have been all taken up by the right wing, and this alternation to the respective wings is sustained continuously. I am thus enabled to be rolling and finishing hundreds of feet of wire-rod in one wing while the main line and the other wing are similarly engaged upon another rod.

One great object of my having my various series of rolls operated each by a separate motor or engine is this, that often the latter end of the loop comes out of the last pair of the main line of rolls, and while the rod is being taken up by, say, the right wing and the first end of such rod is in the finishing-rolls, I can increase the speed of the motor or engine which operates that wing to a much higher rate, so as to run off the rod then in that wing very rapidly—in fact, as rapidly as is desired—because the operation of such motor is such that, no matter to what speed it is increased, the speeds of the rolls in its series are all relatively increased also, and the rod will pass through as safely as at a lower speed.

As will be apparent to any skilled mechanic, it is possible to run all three of my series of rolls by one engine by having suitable shafting and gearing, and to have such arrangements at proper points as to throw some of the cog-wheels into and out of gear, whereby one or more of my series could be stopped while the remaining series were running or operating; but I wish it to be understood that by the term "independent motors" I include such arrangements of lines of shafting as shall be thus capable of being thrown out of operation independently of the action of the remaining lines of shafting, whether that independent motor be a simple detachable transmitting device or agent for conveying power or a separate engine.

It will be observed that, in order to drive my rolls and to avoid friction, I have separate housings for my rolls and their pinions.

Looking at the No. 1 pair of rolls of the left series, Fig. 2 in the drawings, it will be observed that the rolls are in housing H, the pinions E F in housing G, and the driving-wheel D is on the same shaft as pinion E, and the outer end of this shaft has a bearing in the standard I. This cog-wheel D is driven by a cog set upon the main shaft C, and, as will be seen, drives the lower roll of pair No. 1 by a direct shaft-connection, while power is communicated to the upper roll through the pinion F, which gears into pinion E in a separate housing from the rolls, and, driving the lower roll through the intermediary of only one gear from the main shaft, I much simplify the gearing and save much friction and consequently power.

My Letters Patent of March 24, 1874, describe a system of rolling metal wherein the first series of pairs of rolls are driven at a high rate of speed, to break the metal down while it retains its high heat, and the wire is then passed into another series, which begin at a lower rate of speed than that at which the last pair of the preceding series is operated.

The pairs of rolls in each series are set end to end, there being two pairs in each housing. I therefore do not desire in this case to claim, broadly, the system of giving a number of rapid passes to the metal in the early stages of the operation and then interrupting the continuous increase of speed, but simply the means whereby I attain it when the first series are set in front of each other with straight guides between them, and the succeeding series are arranged substantially as I have described.

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

1. The combination of a main line of pairs of rolls set in front of each other, endowed with progressively-increasing velocities from the first to the last pair of the series, with two wings or branches of several pairs of rolls, each of said wings or branches being composed of a series of pairs of rolls endowed with progressively-increasing velocities from the first to the last pair of each wing, and so arranged that a rod of metal rolled in the main line can be finished in either wing, substantially as described and set forth.

2. The combination of a main line of pairs of rolls set in front of each other, connected by guides, as described, endowed with progressively-increasing velocities from the first to the last pair of the series, with a wing, wings, or supplemental series of pairs of rolls, the speed of the first pair of the wing or second series being so modified as not to take up the metal so fast as it is being delivered from the last pair of the first series, whereby an elongating loop is formed in the rod after it has received a number of rapid passes from the rolls which are set in front of each other in the first series, substantially as described.

3. The combination, with a main line or series of pairs of rolls set in front of each other, connected by guides, as described, of two wings composed of two supplemental series of pairs of rolls, the whole three series being each operated by a separate shaft, substantially as described.

4. The combination of a main line composed of a series of pairs of rolls set in front of each other, connected by guides, as described, and endowed with progressively-increasing velocities from the first to the last pair of the series, with a supplemental series of pairs of rolls, the latter series being so arranged with respect to speed that a loop in the metal being rolled will be formed between two or more of said pairs of rolls in the last-named series and between said last-named series and the first series, substantially as described.

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