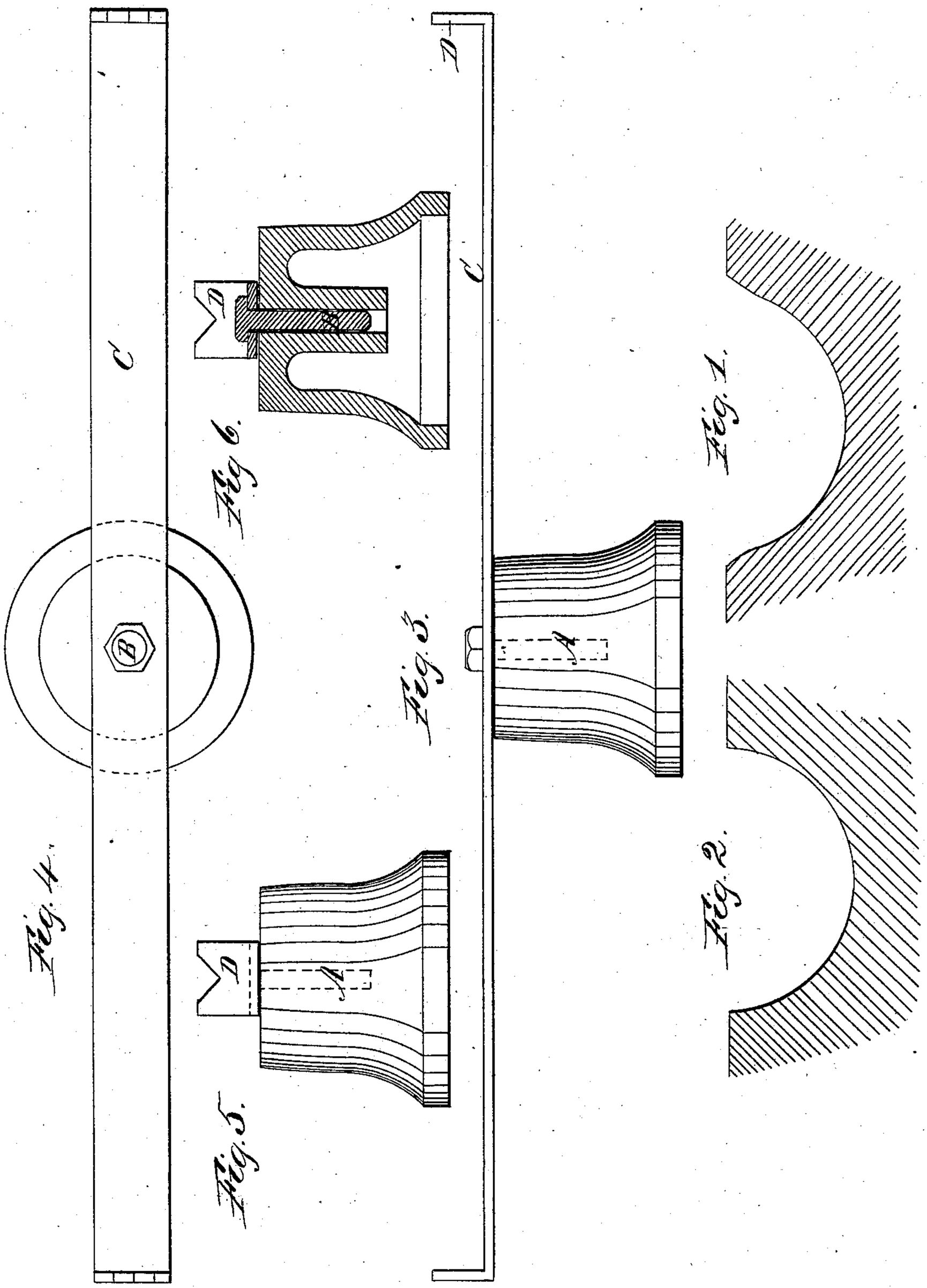
(No Model.)

L. MILLER & F. BISHOP.

ART OF ROLLING METAL BARS.

No. 256,584. Patented Apr. 18, 1882.



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ART OF ROLLING METAL BARS.

SPECIFICATION forming part of Letters Patent No. 256,584, dated April 18, 1882.

Application filed January 7, 1881. (No model.)

To all whom it may concern:

Be it known that we, LEWIS MILLER and FREDERICK BISHOP, both of Akron, in the county of Summit and State of Ohio, have invented certain new and useful Improvements in Rolling Metallic Bars, of which the following is a specification.

Our improvement relates to the manufacture of that class of round iron bars that are designed to be used for shafting, &c., without subsequent turning; and our invention consists in a process whereby we are enabled to produce by the method of hot-rolling a polished bar round in cross-section and without taper.

Heretofore bars having a round cross-section and no taper have only been produced in two ways to our knowledge—viz., by first rolling round iron bars in the ordinary way and then turning them in a lathe to make them true, or by the process known as "cold-rolling." The first of these resulted in the production of a round bar of tolerable accuracy as to roundness and gage; but the turning off, besides the increased expense, caused by the operation, weakened the bar, because the outer skin is always the strongest and hardest part of a bar, owing to the greater amount of compression the outer fibers receive during the process of rolling, &c., and this skin being removed by the turning, the bar was much weakened.

The cold-rolling process, although not liable to the objection referred to above, is objectionable, because, first, of the heavy and expensive machinery necessary to carry out the process, owing to the great pressure necessary to be exerted in rolling the iron cold; secondly, the surface on the cold-rolled iron was not polished, as hereinafter referred to; thirdly, the difficulties of producing a straight shaft were very great; and, fourthly, a shaft made from such cold-rolled iron was liable to be made crooked by being warped or sprung in cutting key-seats. This latter effect is by many supposed to be due to the fact that under the enormous pressure exerted in cold-rolling the outside fibers of the bar running lengthwise are under a certain tensile strain in the direction of the length of the bar; and although when the bar is in the state in which it left the rolls the tensile strain is alike on all sides, yet when the strain is removed from one side, as in cutting a key-seat, the strain predominates on the opposite side and the shaft becomes crooked.

In attempting to overcome the difficulties connected with these processes of producing round iron bars the process of hot-polishing was devised, which is described in the patents of J. S. Seaman, numbered 57,388, 155,760, 158,133, and 192,460, in which the bars or shafting, after being broken down in the roughing-rolls, have been passed transversely through grooved finishing-rolls to give them their form, and then passed, while still hot, longitudinally through what are called "polishing-rolls," by which a surface was formed on the bars that was excessively hard and of a high polish, peculiarly adapting said bars for shafting, as the surface thus formed is one of the best for wearing now known, while the axis of the bars was kept straight by the polishing-rolls. Besides this, it is supposed that the action of the polishing-rolls caused the outer fibers of the iron to assume a spiral direction, which is advantageous for two reasons: First, it lessens the friction on its bearing of a shaft formed of such iron, because the fibers were nearer in the direction of the revolving motion of the shaft than they would be when arranged lengthwise thereof; second, the cutting of keyways does not affect the straightness of the bar, as in the case of a cold-rolled bar.

The grooved finishing-rolls above referred to were what is known as "two-high" rolls, having from ten to twenty transverse grooves, more or less, which were all of the ordinary U shape, with the ends of the arms turned outward, as shown in Figure 1 of the drawings, which represents a two-inch groove of the shape formerly used. The size of these grooves gradually decreased from one end of the rolls to the other, until the grooves on one end formed an opening of about the diameter of the finished bar. Through these grooves, beginning with the largest, the bar was successively passed while in a high degree of heat from the same side of the rolls, with the same end first, and with a quarter-turn between each pass, until the groove was reached of the size the bar was to be, through which it was passed about three times, and it was then ready for the polishing-rolls. It was found that the polished

bar, when completed, was imperfect in two respects: First, the bar was tapered; second, it was oval in section.

It has been generally supposed that the first defect above referred to (the taper) was caused by the fact that the end of the bar which last passed through the rolls became cooler than the first end before it became acted on by the rolls, and therefore harder, and thus less susceptible to the pressure of the rolls than the warmer forward end, and various devices have been tried to keep both ends of the bar at the same temperature at the time they were acted on by the rolls. We have discovered, however, that the taper of the bar is due principally to the fact that the advancing pressure of the finishing-rolls on a bar to give it its form and size causes the metal of the bar to apparently flow back toward the rear end of the bar and accumulate there, so as to make that end of the bar larger than the other, and thus give the bar a taper.

The second defect in the bar above referred to (the oval section) we have found to be due to the fact that the grooves in which the bar was formed were of the shape shown in Fig. 1, whereby the pressure of the rolls tended to force the bar out at the extremities of the arms of the grooves, and thus give it an oval form. These defects could not be cured in the polishing-rolls, which are incapable of materially changing the form of the bars, and hence the bars made by the Seaman process, although very desirable for some purposes, were defective in two most essential features, viz: They were not round and they were tapering, which made them practically useless for line-shafting and many other applications which have constituted their principal availability since our process was introduced. Besides this, the inequality of the gage and the oval section resulted in great loss to the manufacturer, as the polishing-rolls would tear and shiver the bar, owing to the inequality of pressure caused by its being larger at one end than the other and by its oval section. So much was this the case that it was practically impossible to construct the bars of piled iron, as the polishing-rolls would rend the oval or tapered bar to pieces where the different layers of the piled iron were joined, and the use of blooms or homogeneous iron instead of piled iron was necessitated, which of course materially increased the expense; but even with blooms the polishing-rolls frequently so damage the oval or tapering bars that they are useless.

To overcome these difficulties we have invented a process for producing by hot-rolling a bar or shaft which can be used in machinery without being turned in a lathe and without having its surface in any way altered, whereby we obtain a bar having the smooth, hard, and polished surface produced by the Seaman process, and two characteristics which were unknown in such a bar before—viz., a substantially uniform gage throughout the entire length of the bar in contradistinction to a tapering gage, and a bar whose section at any point is practically circular in contradistinction to being oval. Such being the novel feature of the bar produced by our process, its value as applied to machinery evidently can hardly be overestimated, especially where the bar is to be applied to line-shafting. Furthermore, by our process any kind of iron—bloomed or piled—can be used for the bar, better results can be obtained from piled iron than could formerly be had with blooms, and the polishing-rolls are prevented from damaging the bar in the manner heretofore referred to.

In practicing our process we employ the ordinary polishing-rolls above referred to and two-high finishing grooved rolls of the ordinary construction above described, with the exception that the same have specially-prepared grooves in the form of the arc of a circle almost as long as a semicircle, through which the bar is passed last before entering the polishing-rolls. Fig. 2 represents a cross-section of one of said semicircular two-inch grooves as used by us. We take the bar after it has been broken down in the ordinary roughing-rolls, and while hot, as heretofore, pass it through the finishing grooved rolls, beginning with the largest grooves and using the grooves successively until the smallest groove is reached, which will be of the semicircular form above described, the bar being turned a quarter round after each pass. Through the last semicircular groove the bar is passed a number of times—generally three times—and just before it has passed through the groove the last time is reversed, so that the opposite end of the bar first enters the rollers from the end which had been first entering the rolls in the other passes. Sometimes, in extra cases, it may be found necessary to reverse the bar and roll it in reversed position a number of times; but generally we have found that it is sufficient to reverse it once and in the manner above stated.

In the above manner we obtain a bar ready for the polishing-rolls which is of substantially uniform gage throughout, and which is as nearly as possible circular in section. As we understand it, the reason that the bar is of equal gage is that the bar has received its final size and shape before its final passage through the last groove of the finishing-rolls, with the exception that it is tapered, so that when it is reversed and put through the last groove again the size and shape of the bar are not changed, with the exception that the taper of the bar is obliterated by causing the excess of metal at the larger end apparently to flow or crowd in front of the pressure of the rolls toward the smaller end.

For the above reason care should always be taken to reverse the bar between its passage through the last grooves, because if it is materially reduced in size or shape after its gage has been equalized by being reversed the taper

will tend to return. After the bar has been treated by the finishing grooved rolls, as above stated, we pass it longitudinally through the polishing-rolls, where it receives its polish, after which it is complete.

The finishing grooved rolls are supplied with water in the usual manner, and the polishing-rolls and the bar as it passes through them are supplied with water, as heretofore.

In rolling large and heavy bars or shafting, auxiliary mechanism—such as a turn-table, overhanging swivel, chain, or other equivalent device—may be needed to assist in reversing the bar. The best form of turning or reversing device known to us is represented in drawings Fig. 3, which represents an elevation of the same; Fig. 4, which represents a plan view of the same; Fig. 5, which represents a cross-section of the same; and Fig. 6, which represents a cross-section of the same. Said turning device as represented in said figures may be described as follows: It consists of a block of iron, A, having a vertical hole through its center, into which is fitted the pin B. Resting on said block of iron, and pivoted thereto by the pin B, which passes through a hole in its center, is a flat bar, C, turned up at its ends, as at D D, said portion D D being provided with V-shaped grooves to receive the bar being rolled. This reversing device is placed in the rear of the bar-train of grooved rolls on the opposite side of the rolls from the main roller's position, or, as it is technically termed, "on the catcher's side." The bar being rolled is passed through the grooved rolls by the main roller to the catcher. The catcher, as the bar passes through the rolls, brings it directly over the reversing device, and, dropping it into the V-shaped openings, swings the table or flat bar C round, and thus reverses the bar being rolled, after which the catcher passes the bar over the rolls to the main roller again, and the operation is repeated.

It will be noticed that by reversing the bar during its passages through the smallest groove of the finishing-rolls the reversing takes place after the bar has been reduced to substantially its ultimate gage, which is of primary importance, since, if subsequently to the reversing the gage of the hot bar is materially reduced, the taper will not be eradicated. This is one feature in which our process in the finishing-rolls is distinguishable from the processes which have heretofore been carried on in reducing iron of other shapes than round by means of three-high roughing-rolls, where the iron passed in the reverse direction through each succeeding reducing-groove.

Another feature in which our process differs from the use of three-high rolls heretofore practiced lies in the fact that our finishing-rolls produce round bars, which, being without the taper or oval section, are in a condition to receive the full benefits of the succeeding step of the process, which was never attempted and would not have been possible with the bars of other forms than round, which have been heretofore reduced in three-high rolls.

Another distinguishing feature of our process is that the bars go directly from the rolls where the reversing is accomplished to the polishing-rolls without any intermediate rolling, such as would have been necessary if the reversing were performed as in the old three-high roughing-rolls.

We are also aware that round rods have been rolled between rolls whose last groove was substantially semicircular in form in contradistinction to the above-described U-shaped form; but bars which were subsequently polished in the polishing-machine were never to our knowledge finished in rolls having the semicircular grooves. They were always finished in rolls having U-shaped grooves, and therefore the peculiar utility of such semicircular grooves, in connection with the polishing-rolls, had never been discovered and their combined action on a bar had never been devised.

We do not claim in this division of this application that part of our improvement which refers to the passing the bars through circular grooves in the finishing-rolls; nor do we here claim the article produced by our improvement, as we claim these parts of our invention in separate divisions of this application.

We claim as our invention—

1. As an improvement in the art of hot-rolling bars, the method of producing a bar or shaft having a smooth hard surface and uniform gage, so that it may be used in machinery without being turned, which consists in passing the bar, after it has been reduced to substantially its ultimate gage in the finishing-rolls, again through said rolls in a reversed direction, substantially as described.

2. As an improvement in the art of hot-rolling bars, the method of producing a bar or shaft having a smooth, hard, and polished surface and uniform gage, so that it may be used in machinery without being turned, which consists in passing the bar, after it has been reduced to substantially its ultimate gage in the finishing-rolls, again through said rolls in a reversed direction, and then through the polishing-rolls, substantially as described.

3. In combination with the rolls for rolling shafting or bars, the turning mechanism for reversing the bar between its passage through the rolls, substantially as described.

In testimony that we claim the foregoing we have hereunto set our hands this 18th day of March, A. D. 1879.

LEWIS MILLER.
FREDERICK BISHOP.

Witnesses:
E. W. STUART,
C. P. HUMPHREY.