(No Model.) 3 Sheets—Sheet 1.

J. B. BRADSHAW.

Rolling Mill.

No. 239,363. Patented March 29, 1881.

Fig: 1.

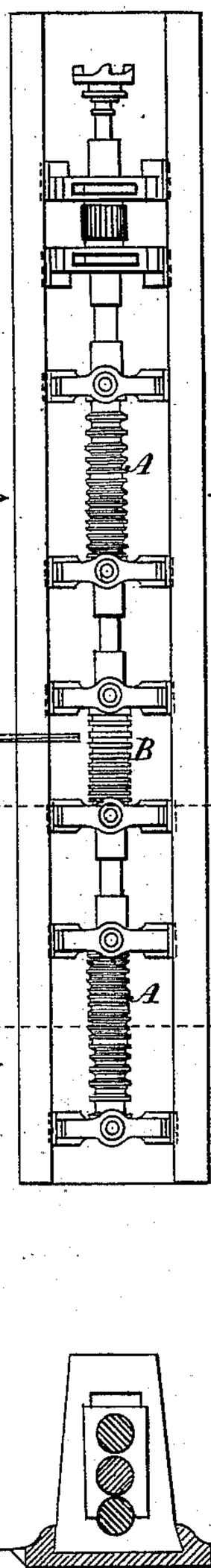
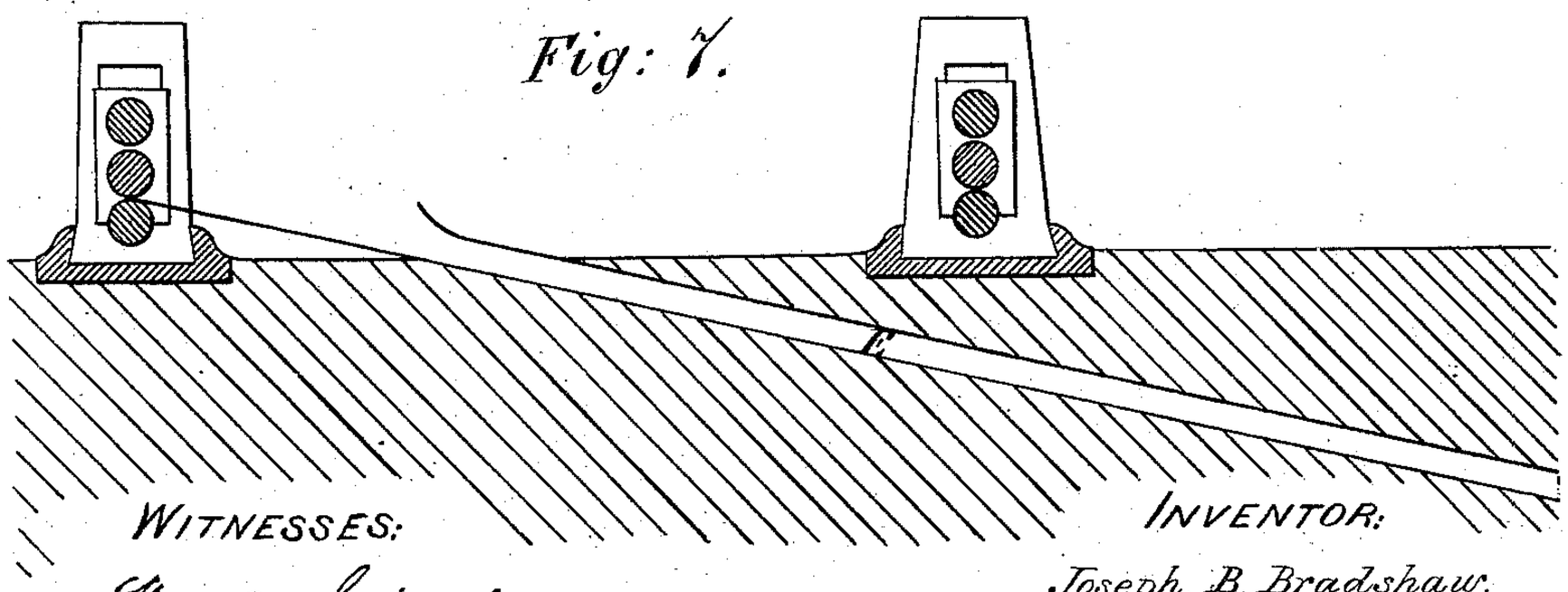


Fig: 2.

Fig: 7.



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(No Model.) 3 Sheets—Sheet 2.

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Rolling Mill.

No. 239,363. **Patented March 29, 1881.**

Fig: 3.

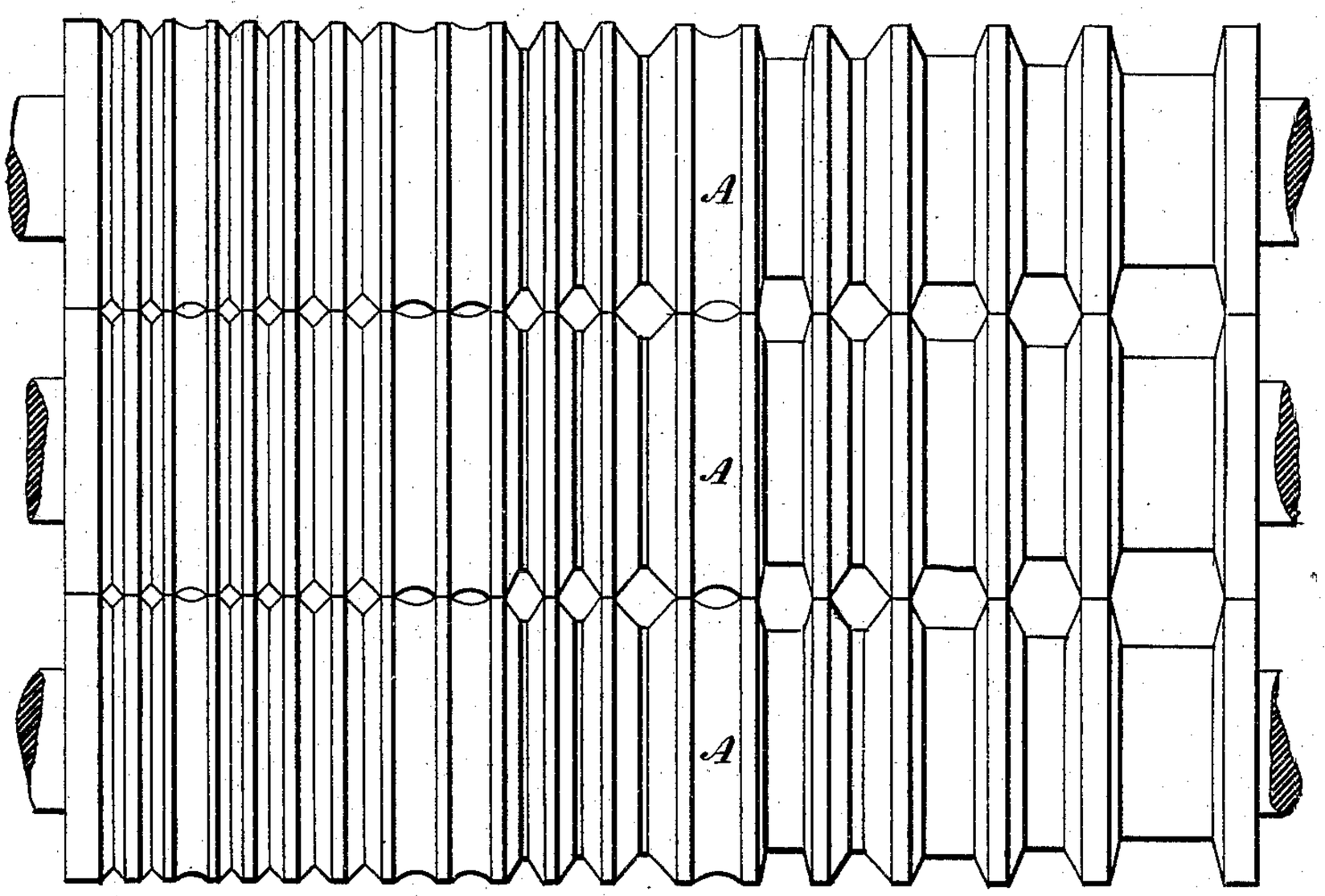
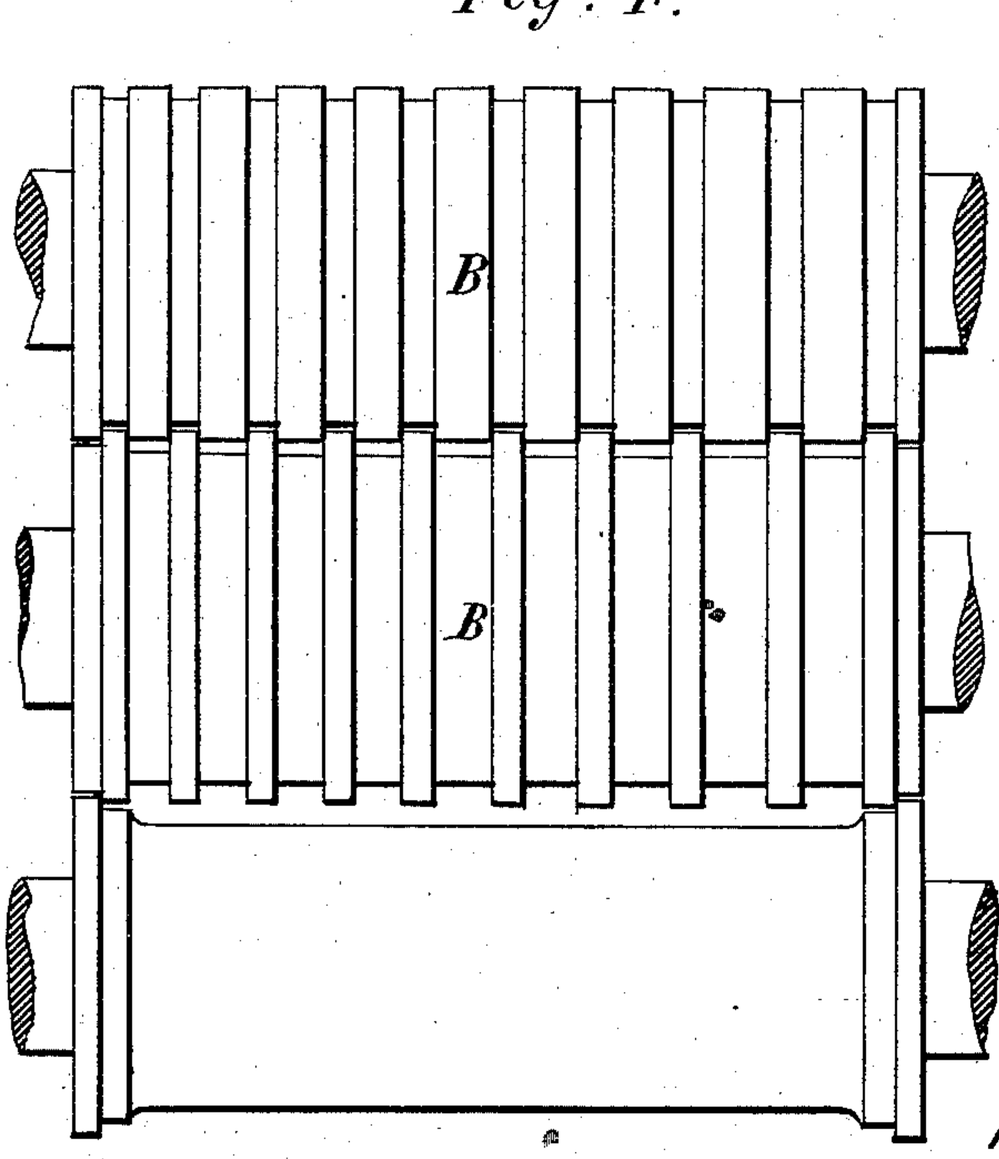


Fig: 4.



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(No Model.) 3 Sheets—Sheet 3.

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Fig: 5.

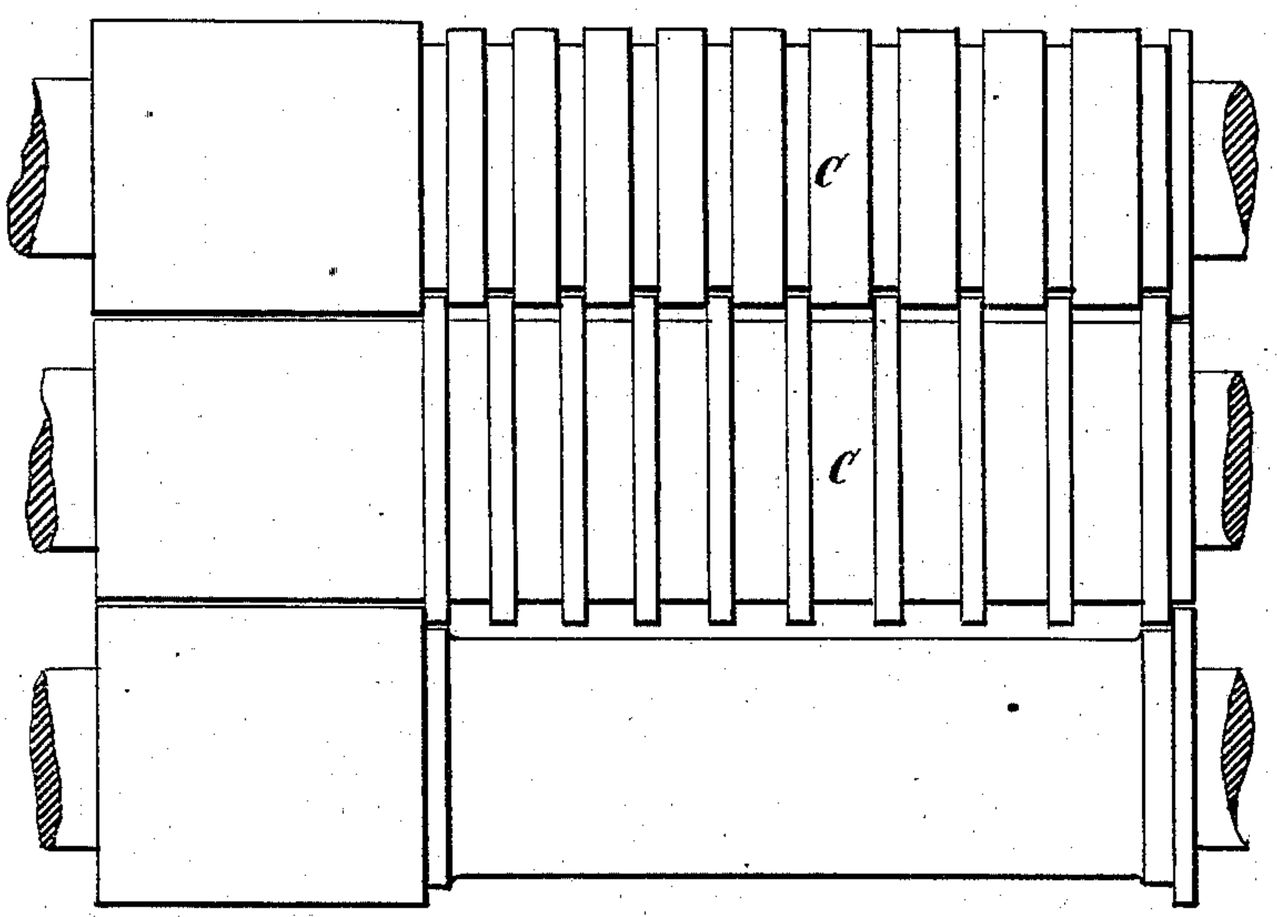
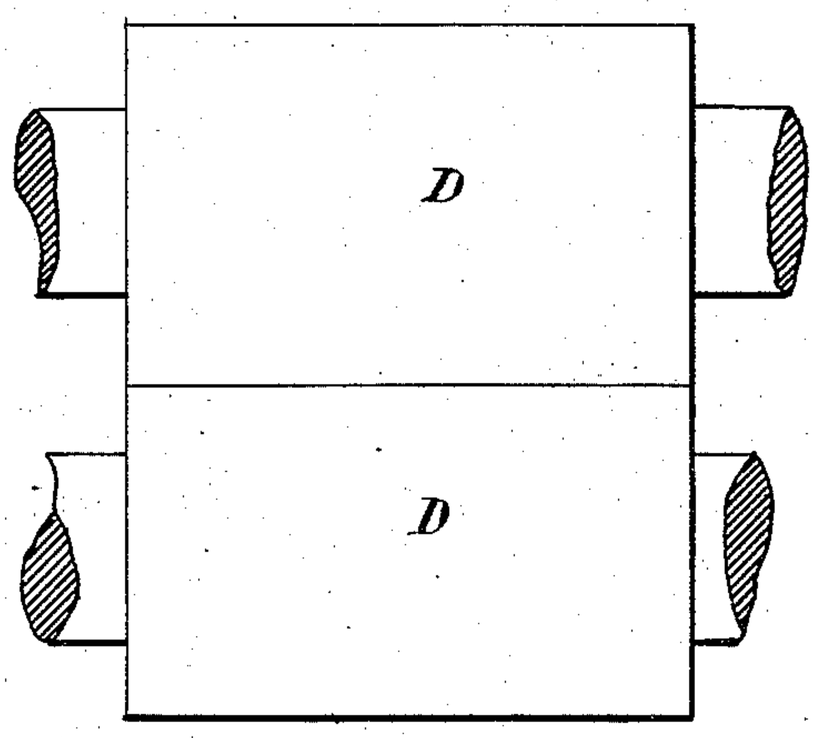


Fig: 6.



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UNITED STATES PATENT OFFICE.

JOSEPH B. BRADSHAW, OF ROTHERHAM, COUNTY OF YORK, ENGLAND.

ROLLING-MILL.

SPECIFICATION forming part of Letters Patent No. 239,363, dated March 29, 1881.

Application filed June 9, 1880. (No model.) Patented in England January 4, 1878.

To all whom it may concern:

Be it known that I, JOSEPH BETTS BRADSHAW, a subject of the Queen of Great Britain, residing at Rotherham, in the county of York, England, have invented certain new and useful Improvements in Rolling-Mills for the Manufacture of Merchantable Iron and Steel, (for which I have received Letters Patent in England, No. 59, dated January 4, 1878;) and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

This invention has for its object improvements in rolling-mills for the manufacture of merchantable iron and steel.

In rolling merchantable iron and steel bars, light rails, or hoops, a train of rolls consisting of two distinct sets of rolls, which, however, are coupled together, is now commonly used, and in the case of hoops and the smaller sizes of bars a third set of finishing-rolls is sometimes added. The first set are what are known as "bolting-rolls," and the second set as "strand-rolls;" but as the name of the latter probably differs in different districts, and with different classes of work, I shall hereinafter call this second set "strand-rolls," meaning the rolls adjoining the bolting-rolls, into which the iron is introduced immediately after leaving the bolting-rolls.

The bolting-rolls receive the pile or billet or bloom (I shall hereinafter say "pile" only, but meaning any form in which the iron is delivered from the furnace to these rolls) from the heating-furnace, and do the rough work of bolting down the pile until it reaches a size convenient for entering the strand-rolls. The drafts—that is, the difference in size between the largest and the next groove, and so on in these rolls—are very great, and every groove is usually roughened in some manner, in order to give a firmer grip on the iron as it passes through these grooves.

The strand-rolls receive the iron from the bolting-rolls, and the metal here begins to assume its finished shape and dimensions, and, except in the case of hoops and smaller sizes of bars, before referred to, the iron is usually finished in these rolls. The drafts in these rolls are not nearly so great as in the bolting-rolls, and it is usually sufficient to roughen the first groove only (indeed in some cases of lighter work it is not necessary to roughen the first groove) of each size in the rolls, the remaining grooves of each respective size being quite smooth.

The finishing-rolls are in the case of hoops known as "hard" rolls, and are simply a pair of plain, hard-chilled rolls, and in the case of bars are known as "guide" rolls, and are used chiefly for the smaller sizes of round and square iron, which are directed to their place in these rolls by guides. These are supplementary rolls, and would be used under my arrangement exactly as under the present system—viz., by adding them to the train at the end of the strand-rolls when necessary. They are always used in the case of hoops.

The working capacity of the strand-rolls is invariably greater than that of the bolting-rolls, and it would be so to a greater extent than it actually is were it not that these rolls, being usually driven at the slow speed which is necessary in the case of the bolting-rolls, they cannot, on this account, take more than a given length before the iron becomes too cold to finish, and the length is invariably less than that which the bolting-rolls could take with ease. The passes between the strand-rolls (except the first groove, when that groove is roughed) and between the finishing-rolls (when the latter are used) might usually be performed at a much higher rate of speed than that of the bolting-rolls. This being so I save much labor, and am able to roll bars, hoops, and light rails in much greater lengths than heretofore, thereby saving considerable expense in the crop ends by arranging the rolls in the following manner, as is illustrated by the plan on Sheet I of the drawings: I arrange in one line three sets of rolls, all of which are coupled together. Two of these sets of rolls are what are known as "bolting-rolls," and may be two or three high, according to the description of work they are required to do. I believe, however, that it is in all cases preferable that the bolting-rolls should be three high, and the third set, which is in the middle between the two sets of bolting-rolls, are strand-rolls, and may be two high only, a spindle being used to connect the other two rolls of the two sets

of bolting-rolls when these are used three high. All these rolls have a number of grooves turned in them, suitable for a variety of sizes and descriptions of work; but these strand-rolls are not intended to complete the operations of the ordinary strand-rolls, for which other rolls are provided, but they are used to commence these operations by one passage only between them of the billets produced by the adjacent sets of bolting-rolls; or these commencing strand-rolls may also be three high to admit of the metal making two passages between them. The second set of strand-rolls is placed immediately in front of the first set, and at such a distance as to allow room for the delivery in front of them of the bar from the first set, and the ordinary operations of these rolls are completed by repeated passages between the rolls so placed.

In order to provide the additional set of bolting-rolls with heated piles, I employ a larger number of furnaces, or furnaces of larger capacity, than where only one set of bolting-rolls is used, as at present. I also make the piles supplied to the bolting-rolls of much larger dimensions than is usual, which causes the bar, on reaching the second set of strand-rolls, to be of considerable length; and in order to enable these rolls to complete their operations on the heated bar before it has cooled too much, and also to enable them to receive, without hindrance to the bolting-rolls, the additional bars produced by two sets of these rolls, I cause them to be driven at about double the speed of the first set.

To provide for the increase in length of the bar in the second set of strand-rolls, a channel or gutter is formed, passing beneath the first train of rolls. In some cases I provide a carrier or guide, along which the bar is passed from one set of strand-rolls to the other set, and this carrier or guide is of such a form that the bar passing along it becomes reversed in position—that is to say, what was the top surface of the bar at one end becomes the bottom surface at the other end. The carrier or guide is for this purpose made of an angular section, and is twisted in the course of its length. A straight carrier or guide will also, in some cases, be employed. In the same line with the second set of strand-rolls, and coupled with them, are the finishing-rolls, one passage between which completes the work. When, however, as may be the case in some descriptions of work, the strand-rolls in the second set of rolls are formed with their grooves capable of finishing the work the adjacent finishing-rolls are not used.

In the drawings, Figure 1 is the slow-speeded train, and Fig. 2 the high-speeded train, in plan. Fig. 3 is a view in elevation of suitable slow-speeded or bolting rolls. Fig. 4 is a similar view of the slow-speeded or commencing strand-rolls in the bolting-roll train. Figs. 5 and 6 are like views of the high-speeded or following strand-rolls and the finishing-rolls, respectively; and Fig. 7 is a sectional view of the apparatus arranged as in Figs. 1 and 2.

A A are the two sets of bolting-rolls, either two or three high. The grooves shown are such as are suitable for use in producing merchant hoop-metal of various sizes.

B represents the strand-rolls containing the first stranding-grooves, and between which the metal passes once only. These rolls are two high with spindle passing beneath the lower roll to couple the bolting-rolls when these are three high. These rolls B, as already mentioned, may be three high, and the metal then is passed twice between them.

C represents the following strand-rolls, containing the remainder of the grooves. The metal is passed twice or oftener between these rolls.

D are the finishing-rolls, employed when such rolls are requisite, and then the metal makes one passage between them. These rolls and the strand-rolls C are driven at a higher rate of speed than the rolls A and B. Fig. 6 represents the rolls D separately drawn to the larger scale.

E is the channel provided to permit the metal to pass back beneath the first train of rolls. The channel or tunnel E, represented by dotted lines in Figs. 1 and 2, is also seen in Fig. 7, which is a sectional elevation corresponding to Figs. 1 and 2. The purpose of this channel is to accommodate the bar after it has been elongated by the rolls C, and to permit this long bar to be brought to the finish-rolls D without interfering with the work going on at A B. It is an essential feature. Were it not used it would be necessary to increase the distance between the two trains A B and C D, resulting in chilling the metal and increasing the labor.

F is the twisted angle-iron carrier for turning over flat bars in their passage between the rolls B and C. The bar first rests against one side of the carrier, and in its passage it is turned by the continually-increasing inclination of the side until it falls over onto the other side, so that the bar is turned right over before it is again presented to the rolls. It will thus be seen that all the passes in which the draft is great, or which require roughened grooves, are performed by rolls which are coupled together and driven at a low speed. Similarly all the passes which admit of being performed at a high speed take place between other rolls coupled together and driven independently of the slow-speeded rolls. Then having thus increased the producing power of the strand-rolls, and relieved them of some of their work, I effect a compensation by throwing upon them the product of two sets of bolting-rolls. But, further, there is nothing now to prevent an increase in the size of the pile supplied to the bolting-rolls, and as the pile does not become a bar of very great length during the operation of bolting down, this increase does not materially retard its progress

in passing through these rolls. The iron or steel under operation would thus be rolled out in much longer lengths than heretofore. I therefore increase the size of the pile at the bolting-rolls, and am able to do so because I get through the operations of the strand-rolls so much more quickly than the old system.

In rolling the larger sizes of bars and hoops the relation of the finished lengths to the pile from which they are made is not so great as in the smaller sizes, and as the sizes increase the second set of strand-rolls have less relative work to perform, and I then prefer to increase the size of the bolting-rolls and first set of strand-rolls, so as to admit of a larger pile being used; and I am thus (keeping in mind that it is in the second set of strand-rolls that the bar begins to lengthen greatly) able to give more work to the second set of strand-rolls, and the length of the finished material is thus very largely increased. Indeed, in most cases I am, by this system, enabled to roll twice, and in many cases a greater number of times, the lengths of the ordinary system, and the saving of cost in the crop ends is proportionately great.

Referring to Fig. 1 of the drawings, and the the arrows 1 to 6, inclusive, marked thereon, and premising with the statement that (for facilitating the description of the working of the apparatus shown) only two passes of the metal through the bolting-rolls and through the following strand-rolls, respectively, will be referred to, the operation may be explained as follows: The arrows 1 1 and 2 2 indicate the passes or directions of travel of the metal when acted upon by the bolting-rolls. The arrow 3 indicates the direction of travel of the metal when acted upon by the slow-speeded or commencing strand-rolls B. As at least two passes are made through the bolting-rolls A A, and one only through the rolls B, it is obvious that the latter can receive alternately, or first from one and then from the other, the produce of the bolting-rolls. From the rolls B the metal passes to the following strand-rolls C, as indicated by the arrow 4, (it being of course understood that the rolls B have finished with the bar before it reaches the roll C,) and the return-pass through these rolls is indicated by the arrow 5. On the return-passes of bars through the rolls C their greatly-increased length is accommodated by the channel E, and interference with the work going on at the bolting-rolls is prevented by the passage of the end of the bar beneath said rolls. From the channel E the end of the bar last released by the rolls C is directed to the finishing-rolls D, as indicated by the sixth arrow.

The following are advantages which I obtain:

First, great saving of labor. The amount of work such a mill will be able to turn out is out of all proportion, in comparison with the present system, to the number of men required to work such a mill.

Second, great saving of time. Such a mill will turn out from twice (never less than twice) to three times, and in case of larger sizes even more, the work of an ordinary mill in a given time.

Third, saving in waste of crop ends, on account of the increased lengths in which the material can be rolled.

Fourth, economy of cost and space. In the erection of such a mill both are out of proportion to what would be required for mills capable of doing the same amount of work under the present system.

Fifth, economy of time in changing rolls. The use of two sets of strand-rolls in this form enables double the number of sizes to be introduced, and thus there is less changing of rolls. By lengthening the bolting-rolls and inserting an additional groove or grooves equivalent to those in the first set of strand-rolls, or by using what is known as a "plain part" at the end of these rolls, the first set of strand-rolls might be dispensed with; but it would be to a limited extent, and, as compared with the arrangement shown, a clumsy expedient. Also, when the nature of the work is such as to render the roughening of the first stranding-groove unnecessary, the whole of the stranding-grooves may be placed on the fast-running rolls, although even then I consider it advantageous to separate them and place the first groove on rolls in the same train with the bolting-rolls.

Having thus described the nature of my said invention, and the manner of performing the same, I would have it understood that I claim—

1. The combination, in rolling-mill apparatus for the manufacture of merchantable iron and steel from piles, of the high-speeded or following stranding-rolls C with the slow-driven or commencing train of rolls, the same being constructed and arranged as described, to operate as set forth.

2. The combination of the slow-speeded train, having two sets of bolting-rolls and the commencing strand-rolls, and high-speeded or following stranding-rolls, substantially as and for the purpose hereinbefore set forth.

3. The slow-speeded train having the bolting-rolls A A and the interposed or commencing strand-rolls B, the parallel high-speeded or following stranding-rolls, and the channel E, all combined and arranged as and for the purpose set forth.

J. B. BRADSHAW.

Witnesses:
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Clerks to Messrs. Burdekin & Co., Solrs., Sheffield.