(No Model.) 2 Sheets—Sheet 1.

C. H. READ & A. D. THOMAS.

METHOD OF AND APPARATUS FOR ROLLING GIRDER RAILS.

No. 452,732. Patented May 19, 1891.

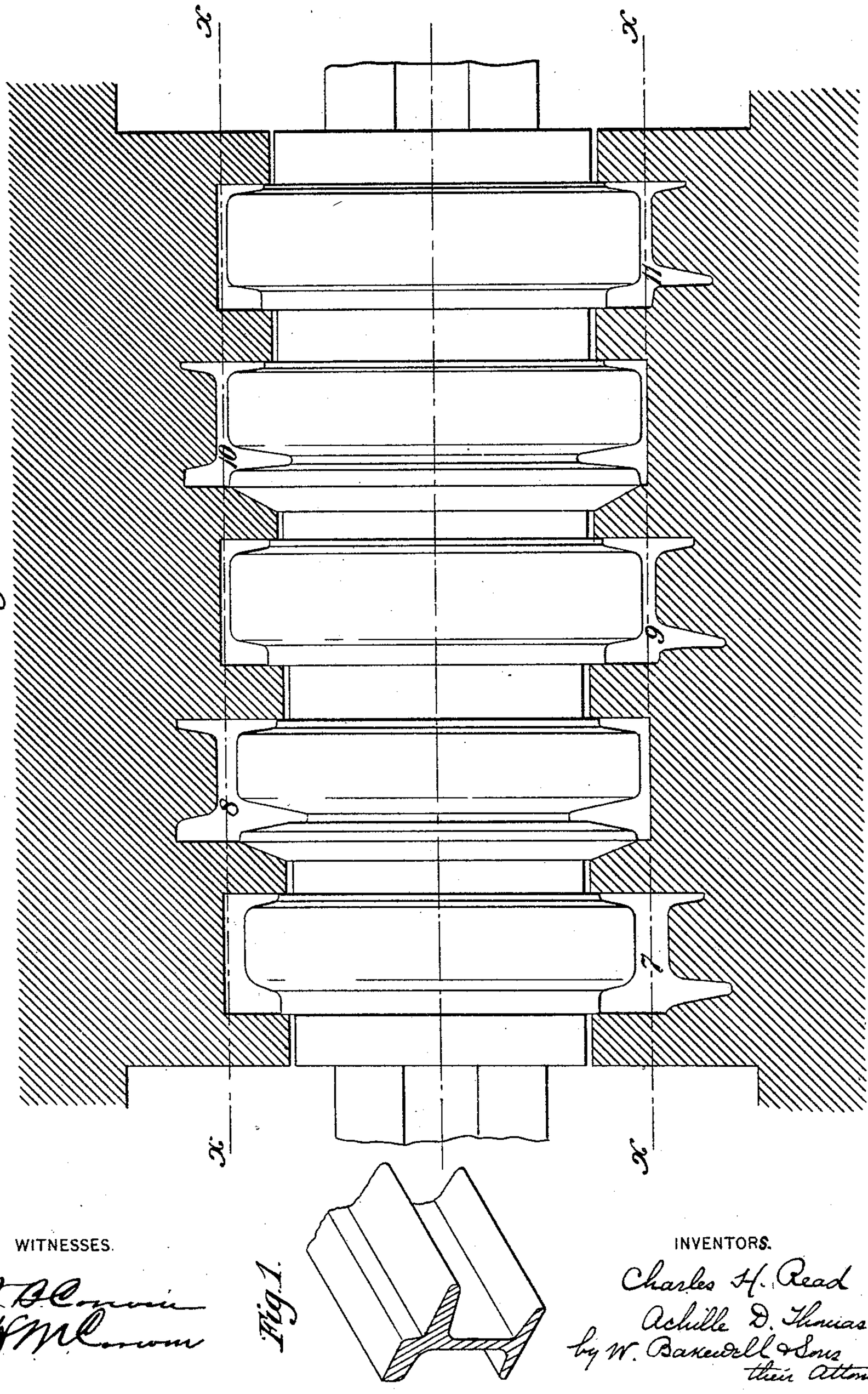

Fig. 3.

Fig. 1.

WITNESSES.

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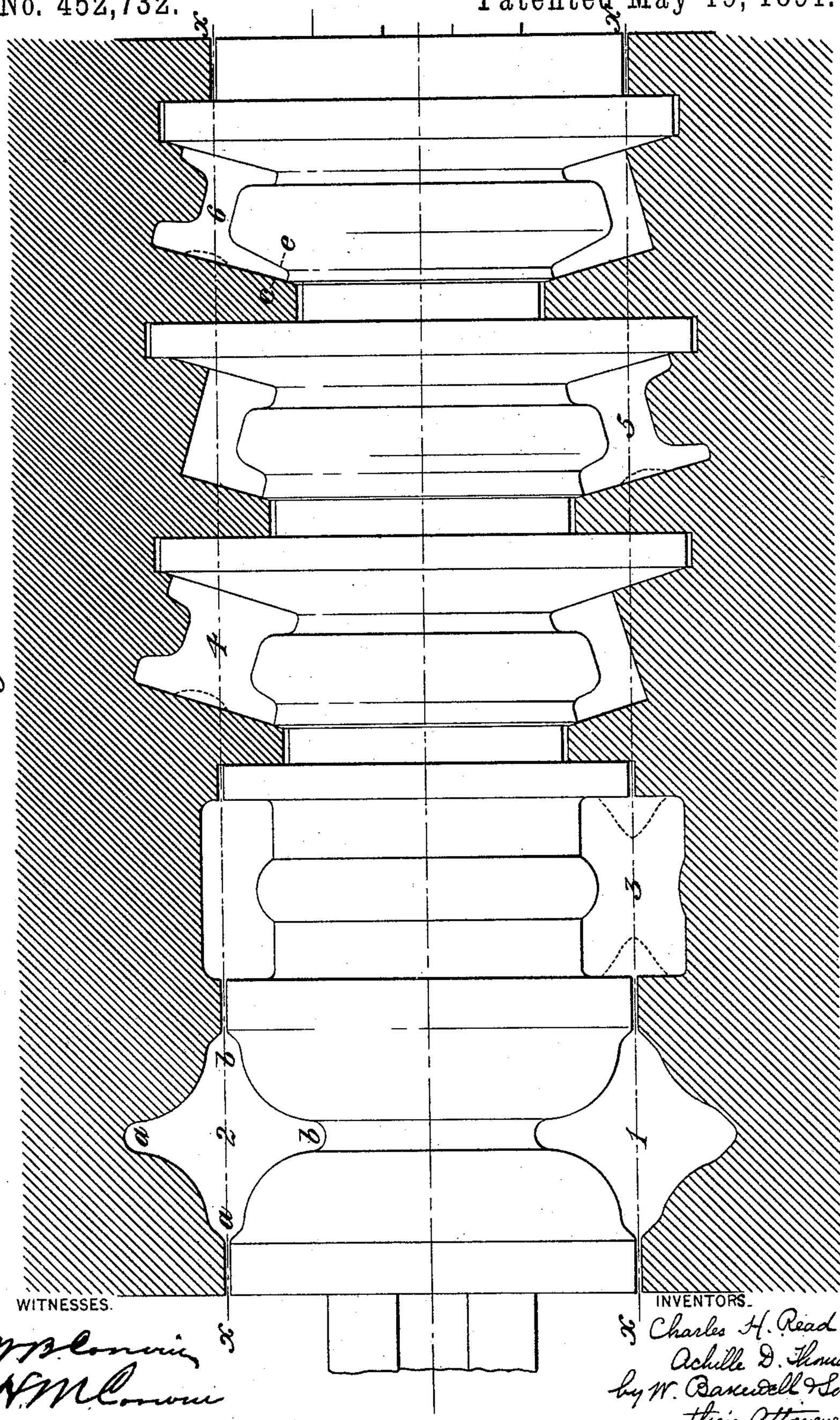

Fig. 2.

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UNITED STATES PATENT OFFICE.

CHARLES H. READ AND ACHILLE D. THOMAS, OF PITTSBURG, PENNSYLVANIA; SAID THOMAS ASSIGNOR TO SAID READ.

METHOD OF AND APPARATUS FOR ROLLING GIRDER-RAILS.

SPECIFICATION forming part of Letters Patent No. 452,732, dated May 19, 1891.

Application filed January 12, 1891. Serial No. 377,467. (No model.)

To all whom it may concern:

Be it known that we, CHARLES H. READ and ACHILLE D. THOMAS, both of Pittsburg, in the county of Allegheny and State of Pennsylvania, have inventeds a new and useful Improvement in Methods of and Apparatus for Rolling Girder-Rails, &c., of which the following is a full, clear, and exact description.

Our improvement relates to the formation by means of rolls from a bloom or bar of iron or steel (usually the latter) of girder-rails or other similar articles of irregular shape in cross-section, and the parts of which are thin relatively to the thickness of the bar from which they are made. Various methods of operation and conformations of rolls for this purpose have been used, or proposed to be used, with greater or less success; and the object of our invention is to overcome the difficulties which are encountered in rolling such articles, to simplify the process by reducing the number of passes necessary to be used, and also to secure better results by avoiding the necessity of using the dummy-pass at all on account of the practical difficulty of effecting a lateral expansion of metal (and especially of steel) when passing through the rolls.

In the accompanying drawings, Figure 1 is a perspective representation of a portion of a girder-rail. Fig. 2 is a view of a three-high set of rolls, the middle roll being in side elevation and the other two in longitudinal section. Fig. 3 is a similar view of another set of three-high rolls.

Like symbols of reference indicate like parts wherever they occur.

Roughing-rolls are those in which the bar or piece of iron or steel from which the rail or other article is to be made is changed in cross-sectional shape on its passage through the several passes until it receives a shape differing essentially from that of the initial bar and similar, excepting in the relative thickness and size of the parts, to the final shape of the finished article, while the finishing-rolls are those in which the same general shape of the article is preserved in the successive passes, the relative thickness or the dimensions of the parts being gradually altered until the desired final shape is attained.

In the formation of articles of irregular shape—such as girder-rails—it becomes necessary that the metal should be considerably widened at the upper part forming the head and tram, and also at the lower part forming the foot or flange of the rail, while the intermediate portion or web is very much reduced.

In the shaping of iron and steel by passing it through grooved rolls the natural tendency is to elongate the metal without materially increasing its depth or width, and it has been found very difficult successfully to increase the width of a steel-bar by rolling. In order to accomplish this, grooves or passes are made in the rolls which compress the metal vertically, or at right angles to the axes of the rolls, and permit it to expand laterally in a direction parallel thereto. Such passes are ordinarily called "dummy-passes," while those passes which compact the metal laterally and allow it to expand or thicken vertically are called "edging-passes." We shall so use these terms in this specification.

It is manifest by looking at the shape of a girder-rail (shown in Fig. 1) that a rectangular bar of steel would require to be very greatly widened at top and bottom in order to assume the shape shown in that figure. This has heretofore been effected largely by the use of dummy-passes in the roughing-rolls, either consecutively or alternately; but as such use involves the lateral expansion of the metal in the rolls it is difficult of successful operation; besides it is obviously impossible to spread the metal both at the head and foot of the rail by means of a dummy-pass.

The accompanying drawings show the use of three-high rolls; but it will be understood by those skilled in the art that a pair of two-high rolls might be used with the same passes.

In the drawings the passes are numbered consecutively from 1 to 11, and we wish it to be understood that we do not confine ourselves to the use of the same number of passes either in the roughing or finishing rolls. The part of the rolls is designated in each case by the line *x x*.

Starting with a rectangular piece of iron or steel at a proper heat, it is introduced into pass No. 1 with two opposite angles in a vertical line. Pass No. 1 is of the shape known as "Gothic." By this pass each of the four

sides of the bar is curved inwardly, thus forming at each angle a curved projecting point *a a b b*. The metal is then inserted into pass No. 2, which is also a Gothic pass with somewhat greater curvature on the sides of the groove. An important step is also taken by the reduction of the smallest diameter of the bar, owing to the diminished radius of curvature of the sides of the groove. The bar then receives a quarter-turn and enters the next or third pass, which is rectangular, the groove in the rolls being somewhat wider than the depth of the pass. The upper and lower rolls have each a collar of the shape in cross-section of the arc of a circle, the versed sine of the upper collar being preferably longer than that of the under collar. The bar of metal being now entered into pass No. 3 is transformed to the shape (in cross-section) of that pass, not by the lateral expansion of the metal, nor even by the elongation of the bloom, (except perhaps slightly,) but by the bending over of the four rounded corners *a a b b*, thus flattening the bloom or bar on the upper and lower surfaces and leaving a cavity at each side. This is an important step and serves to distinguish our process from others. The recesses at the sides just mentioned serve to provide for the otherwise necessary displacement of a large amount of metal at the web of the rail, while the lower flat surface forms the under face of the flange and the upper flat surface serves to form the head and tram at the top of the rail, the curved depression on the upper side preserved by a collar in the groove serving as the initiative of the depression for the tram.

Pass No. 4 is an oblique pass, the shape of which is shown in the drawings. The functions of this pass are important, complex, and extremely effective, in that it reduces the sectional area, adds to the height of the rail, and widens the tram. This result is due in part to the angle of inclination of the pass and the points at which the rolls are caused to part—namely, the upper right-hand and lower left hand corners. This parting of the rolls above and below the center line causes live action to take effect over the entire mass that is brought in contact with the metal with the effect of rapidly reducing the web in thickness, reducing the flanges in width and thickness, spreading the metal laterally in the direction of the height of the rail, and, most important of all, arresting the tendency of the tram to be reduced or rolled toward the head and actually exerting an action that would spread it were it not confined by the limits of that portion of the groove. The total effect of this pass is advantageous in the extreme, and is another step serving to distinguish our process from all others.

Pass No. 5, while apparently the same as No. 4, is quite different in its effect, and serves to reduce still further the thickness of all the parts, without, however, adding to the height of the rail or the width of the tram. It is to a certain extent necessary as an intermediate pass preparing for and leading to pass No. 6.

In pass No. 6 that portion of the upper face of the rail which forms the tram is elongated. This is secured by the larger diameter of the upper roll at the point marked *c* than of the middle or lower roll at the point marked *e*, the effect being that the upper roll, having a greater surface speed at the point *c* than the lower or middle roll at the point *e*, causes a rubbing or drawing-out action, which results in the lengthening of the tram portion of the rail, while at the same time the web of the rail is reduced in thickness, as well as the flange somewhat in length. The "live" or effective action of the rolls in extending or widening the tram in this pass is the same in principle as that which takes place in pass No. 4 at a similar point, and were it not for the rubbing or spreading action referred to above, the rolls would reduce or "rob" back the tram toward the head, an action sought to be avoided.

The above dimensions of grooves are given by way of illustration and to aid in the description of the action of the rolls. We do not, however, intend in any way to limit our invention to the use of rolls of those dimensions or to the manufacture of girder-rails of any particular size, nor to the exact number or order of succession, or exact size or shape of the passes, or the amount of draft, as it will be apparent that the shape of the rail might be varied somewhat and that a small rail rolled on a large train would take fewer passes than if rolled in a small train or than a large rail would if rolled on a small train.

The passes described in the foregoing description and accompanying drawings are such as would be used or turned for a train having its roughing-rolls twenty-six to twenty-eight inches in diameter and for the manufacture of a six-inch-high rail.

In the next or seventh pass the formation of the step or depression on top of the rail to form the tram is commenced. As before stated, provision had been made for this by the curved depression on top of the rail, and as the bar goes through the seventh pass the step is formed by depressing the upper surface of the rail, commencing at the curved depression, which thus forms part of the tram, as shown in Fig. 3. The other passes from No. 7 to No. 10 are ordinary reducing or edging passes, which, while preserving the same general conformation, gradually reduce the thickness of the parts of the rail until the desired final shape is attained, as shown in Fig. 1.

It will be noticed that by our method of operation girder-rails may be rolled with very wide head, tram, and flanges. This is one of the special advantages of our invention resulting from dispensing with the use of the dummy-pass.

We have shown in our drawings and de-

scribed in our specification the mode of and apparatus for making what are known as "girder-rails;" but our method is equally applicable to the making of other shapes of rails, as a guard-rail, where the outer edge of the tram is turned up, or grooved rails, in which there is a groove between the head and tram.

We have described the use of two Gothic passes as the first step of our process; but it is obvious that one might suffice, or more than two be used, or blooms with projecting corners, substantially such as produced by a Gothic pass, might be specially prepared in a separate blooming-mill, adapted to be introduced into pass No. 3 of our apparatus. In such case these prepared blooms would, if allowed to cool, be reheated before passing through our rolls.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. The method herein described of rolling flanged girder-rails, consisting substantially of the following steps, viz: first, forming a bloom or bar of iron or steel of substantially-star-shaped cross-section, having projecting edges at the four corners and a longitudinal cavity or groove between these projections on each side; secondly, flattening these four projecting edges so as to form a bar with a substantially flat upper and lower face and a deep longitudinal depression or groove on each side; thirdly, passing such grooved bar through one or more oblique passes (substantially such as passes 4 and 6 in the accompanying drawings) in a set of roughing-rolls for the reduction of the web portion and the reduction of the foot-flange and head and extension of the tram-flange of the rail, and, fourthly, finally finishing such bar into a rail of the desired shape by the gradual reducing action of the grooves of a set of finishing-rolls, substantially as hereinbefore described.

2. As a step in the process of rolling girder-rails and similar flanged articles, rolling a bloom or bar in a Gothic pass so as to form projecting corners and flattening such bloom on two sides, thus leaving a recess on the two other sides, substantially as and for the purposes described.

3. As a step in the process of rolling girder-rails and similar flanged articles, rolling a bloom or bar of star-shaped cross-section with four projecting corners, rolling down the projecting corners so as to flatten the bar at top and bottom to form a recess on each side, and forming a curved depression on top and lengthwise of the bar, substantially as and for the purposes described.

4. In the manufacture of girder-rails and similar flanged articles, passing the bloom or bar through a succession of passes in grooved rolls without the intervention of dummy-passes, substantially as described.

5. In rolling girder-rails and similar flanged articles, the method of forming the flanged portions of somewhat greater width than necessary for the finished rail in the grooves of the roughing-rolls, and finally reducing such width in the finishing-rolls, substantially as described.

6. In a set of rolls for rolling girder-rails, one or more Gothic or star-shaped passes, in combination with a groove or pass substantially rectangular in cross-section, substantially as and for the purposes described.

7. In a set of rolls for rolling girder-rails, one or more Gothic or star-shaped passes or grooves, in combination with a substantially rectangular groove or pass having a projecting curved collar inside and at the base of the groove, substantially as and for the purpose described.

8. A set of roughing-rolls for rolling girder-rails, having one or more Gothic grooves or passes, in combination with a series of grooves or passes, substantially such as are numbered 3 to 8 in the foregoing description.

9. Rolls for rolling girder-rails, provided with a series of grooves or passes having the respective configuration hereinbefore described, and illustrated by the numbers 1 to 11, inclusive, substantially as hereinbefore described.

10. In a set of rolls for rolling girder-rails, a pass such as No. 6, hereinbefore described, whereby live action is exerted on substantially the entire surface of the metal, causing reduction generally excepting on the tram, where spreading takes place owing to the rubbing motion caused by the different diameters of the two rolls.

11. In rolls for rolling flanged girder-rails, one or more oblique passes, substantially such as No. 6, in which the collar of one roll of the pair extends into the field of and forms one side of the groove in the other roll of the pair at such angle, substantially as shown, that by reason of the greater surface speed of the extended portion of the former roll as compared with that of the body of the lateral roll at that point produces a drawing-out action on that part of the rail simultaneously with a live action on all the other surfaces of the rail which are in contact with the groove surfaces of the rolls, substantially as described.

12. In rolls for rolling flanged girder-rails, one or more oblique passes, substantially such as designated Nos. 4 and 6, in which by reason of the downward pressure of the upper roll on the inclined surface of the rail and the parting of the rolls at the base of the groove the metal is not only drawn longitudinally, but also spread laterally in the direction of the height of the rail, while the tendency to reducing action on the flange of the rail is counteracted, substantially as described.

In testimony whereof we have hereunto set our hands this 3d day of January, A. D. 1891.

CHARLES H. READ.
ACHILLE D. THOMAS.

Witnesses:
THOMAS W. BAKEWELL,
W. B. CORWIN.