(No Model.) 4 Sheets—Sheet 1.

E. NORTON & J. G. HODGSON.

MANUFACTURE OF METAL BARS OR RAILS.

No. 406,946. Patented July 16, 1889.

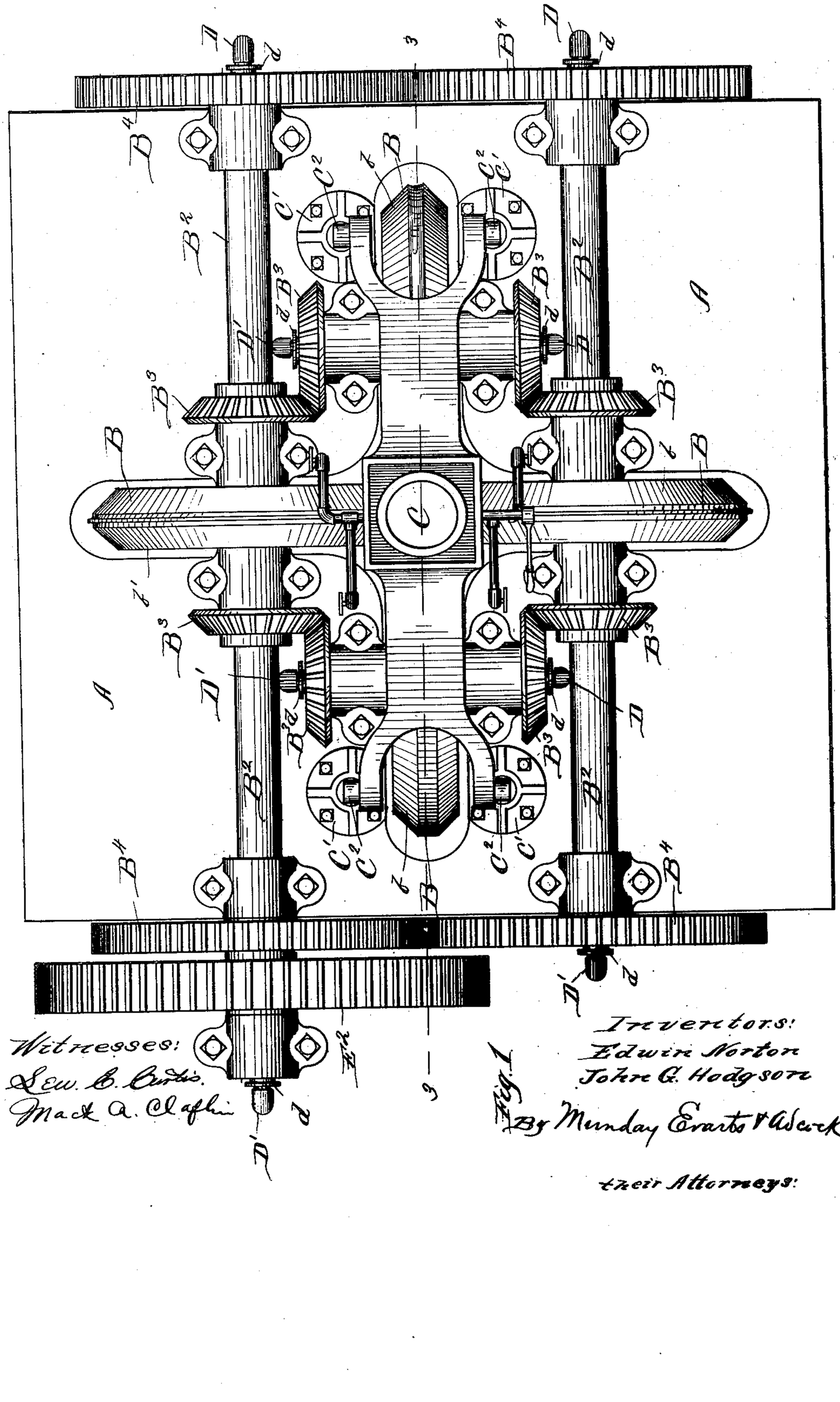

Fig. 1.

(No Model.) 4 Sheets—Sheet 2.

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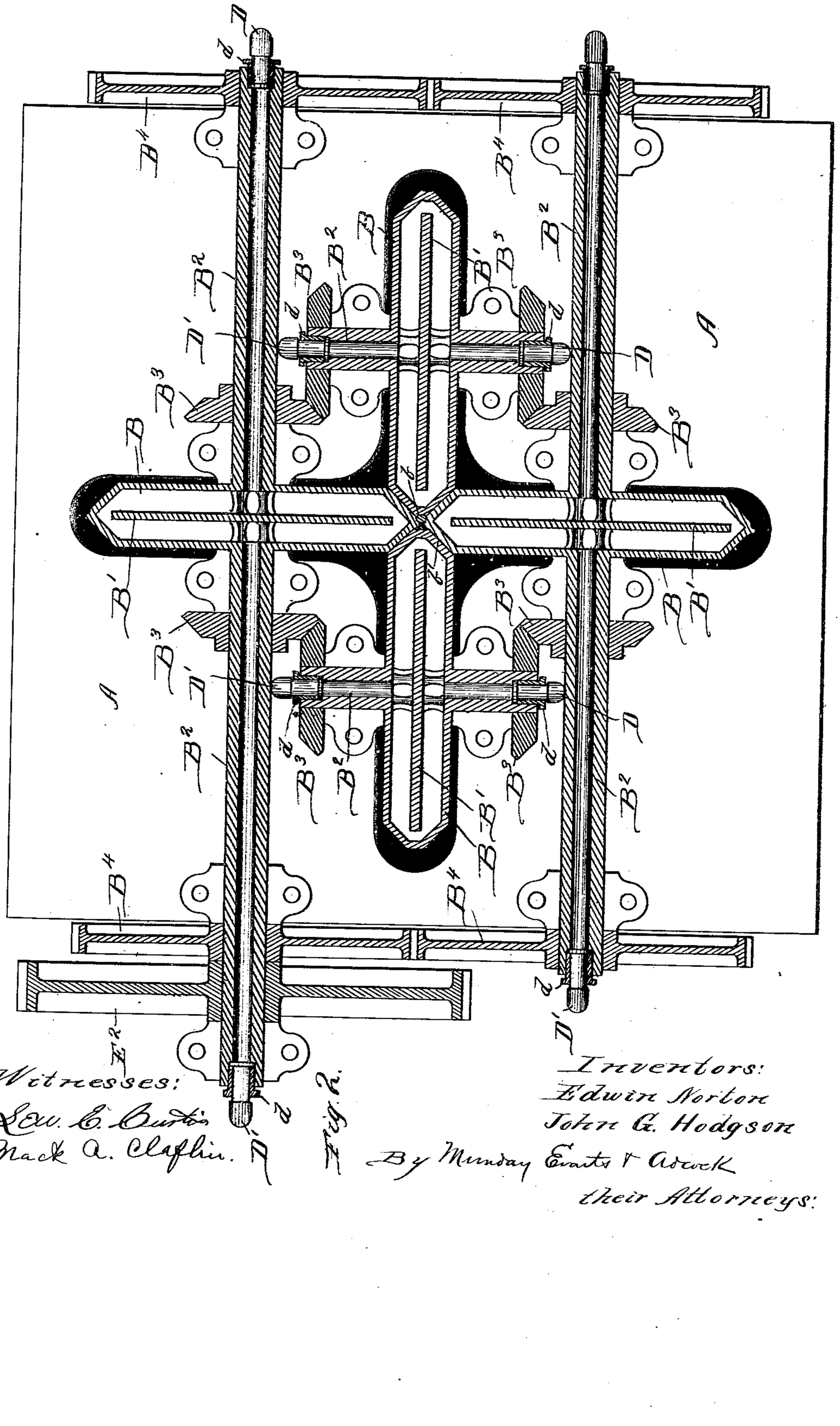

Fig. 2.

Witnesses:
Lew. E. Curtis
Mack A. Claflin.

Inventors:
Edwin Norton
John G. Hodgson
By Munday Evarts & Adcock
their Attorneys:

(No Model.)

4 Sheets—Sheet 3.

E. NORTON & J. G. HODGSON.

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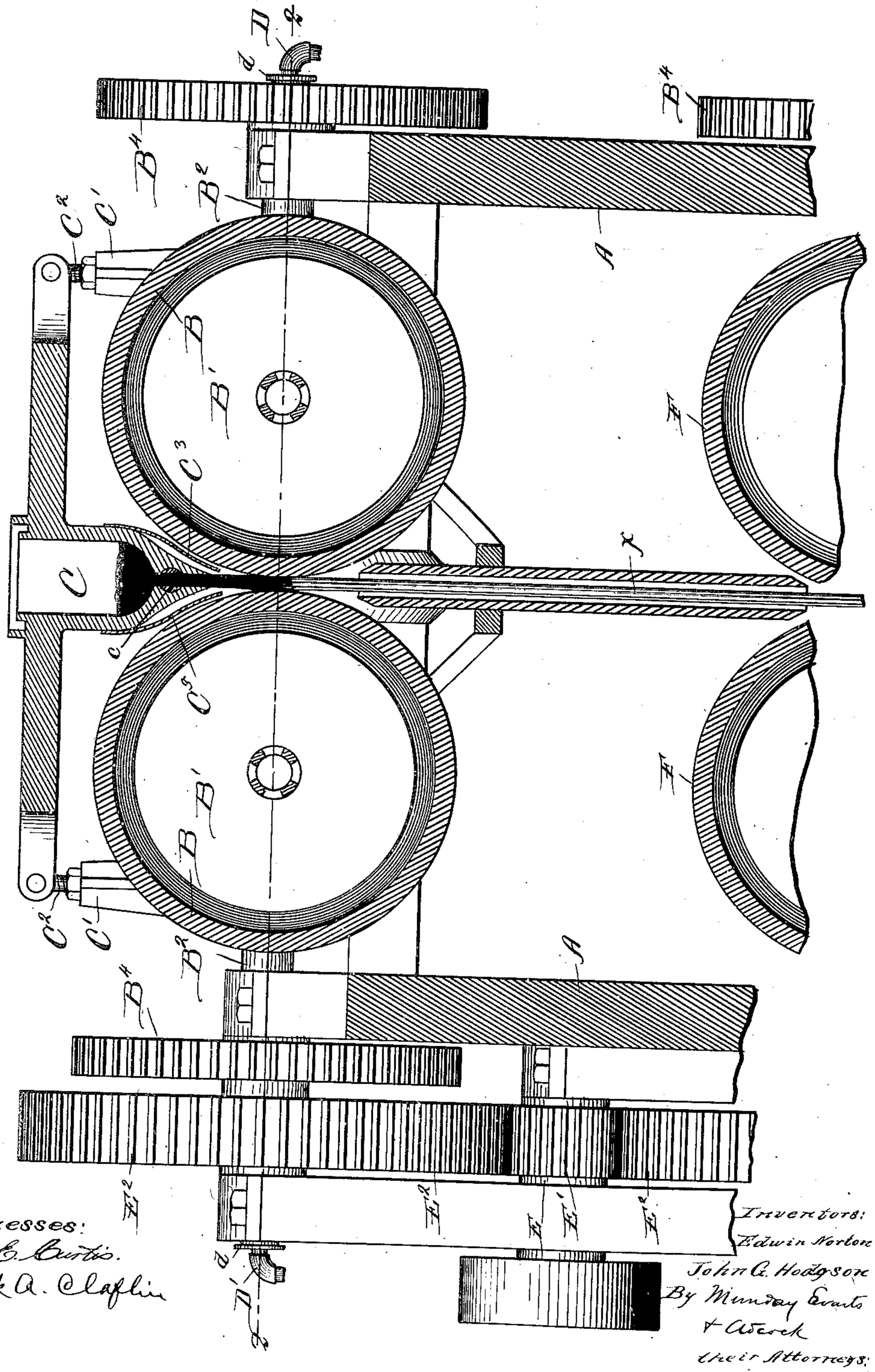

Fig. 3.

Witnesses:
Lew. E. Curtis.
Mack A. Claflin

Inventors:
Edwin Norton
John G. Hodgson
By Munday Evarts & Adcock
their Attorneys.

(No Model.)

4 Sheets—Sheet 4.

E. NORTON & J. G. HODGSON.

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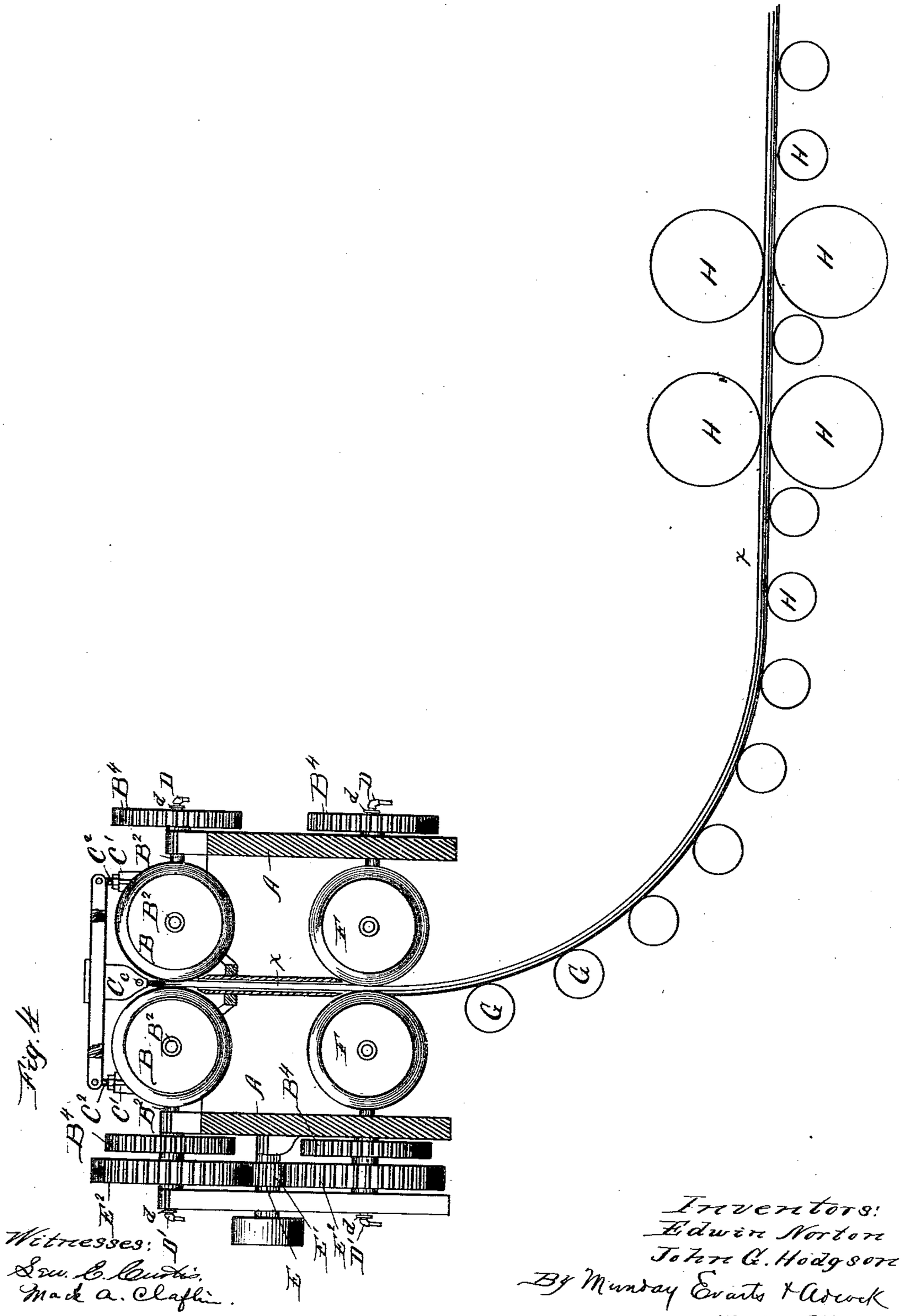

Witnesses:
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Inventors:
Edwin Norton
John G. Hodgson
By Munday Evarts & Adcock
their Attorneys:

UNITED STATES PATENT OFFICE.

EDWIN NORTON AND JOHN G. HODGSON, OF MAYWOOD, ASSIGNORS TO SAID NORTON, AND OLIVER W. NORTON, OF CHICAGO, ILLINOIS.

MANUFACTURE OF METAL BARS OR RAILS.

SPECIFICATION forming part of Letters Patent No. 406,946, dated July 16, 1889.

Application filed April 11, 1889. Serial No. 306,863. (No model.)

To all whom it may concern:

Be it known that we, EDWIN NORTON and JOHN G. HODGSON, citizens of the United States, residing in Maywood, in the county of Cook and State of Illinois, have invented a new and useful Improvement in the Art of Manufacturing Metal Bars or Rails, of which the following is a specification.

By the method or process heretofore generally in use for manufacturing railroad-rails and other metal bars the molten metal is first cast into an ingot, which is then reheated and rolled and rerolled until reduced to the required size and shape. By this method the molten metal is not subjected to compression in the mold while it is in the act of setting, though it is well known to those skilled in the art that the compressing of the molten or setting metal while it is yet in the fluid or setting state tends to greatly improve the character and quality of the steel produced and to give the castings or ingots a very dense, solid, and homogenous structure; and where, as heretofore, the metal is cast in a closed mold confined on all sides, excepting at the top or runner, air or gases confined in the molten metal have little opportunity to escape, so that it is difficult in this way to produce an ingot entirely free from air-holes and imperfections. The rolling and rerolling to shape of the finished bar or rail tends to densify the metal to a greater or less extent; but this rolling operation does not entirely remove the flaws or imperfections produced in the ingot at the time it is cast. The manufacture of metal bars or rails by this old process also involves considerable time, labor, and expense in the several steps of the process, and requires an extensive and costly plant of machinery.

The object of our invention is to provide a more simple and expeditious method or process of manufacturing metal bars or rails, one whereby the molten metal will be compressed or subjected to pressure while it is still in the fluid or setting state, whereby the air or gases in the metal will be free to escape therefrom as the metal is compressed and set, so as to thus densify and improve the quality of the metal, render it free from flaws, air-holes, or imperfections, and of a solid and homogeneous structure, and thereby increase the strength, durability, and wearing qualities of the rails or bars produced.

Our invention consists in the method or process which we employ to accomplish this result—that is to say, it consists in pouring a continuous stream of molten metal from a suitable vessel and simultaneously compressing, setting, and shaping the metal by its contact with chilling and compressing surfaces or rolls, which confine or surround the stream on all sides as it passes such continuously-moving chilling surfaces or rolls. The chilling surfaces or rolls which shape, compress, and set the metal, and thus convert the molten stream of metal into a metal bar or rail, travel or move at the same surface speed as the velocity of the flowing stream of molten metal, so that the molten metal will not dam up or collect between the rolls, and so that the molten metal or bar produced will come in contact with the rolls or chilling-surfaces only at a single point, so to speak, at a time.

By our invention the metal bars or rails, it will be thus seen, are produced directly from the molten metal, and without first casting the metal into an ingot and heating and rolling and rerolling it; and as the molten metal is poured in a continuous solid stream into what may be termed a continuously revolving or traveling metal chilling and compressing mold, which comes in contact with only one point, or a very limited length of the metal stream or bar at a time, and is continuously traveling in the same direction with the stream or bar, point after point in the whole length of the metal stream or bar coming successively in contact with this traveling or revolving compressing and chilling mold, the metal bars or rails are of course produced in continuous lengths, and the process or operation is continuous so long as the stream of metal flows.

In practicing our invention the molten metal is poured in a continuous solid stream, from a suitable bowl or pouring-vessel, between a series of rolls, preferably four in number, having their axes arranged in the same horizontal plane and having a pocket or space between their peripheries at their common

meeting-point for the reception of the stream of molten metal, so that the stream of molten metal, as it passes between the rolls, will be compressed by the wedging action of the rolls and the molten metal at the same time chilled or set by contact with the rolls. The rolls are made hollow and filled with water, which is made to constantly flow through them, so as to keep them cool or at the proper temperature for chilling or setting the stream of molten metal as it flows between the rolls. The pouring bowl or nozzle is arranged directly over the common meeting-point of the series of rolls, so that the stream of molten metal will flow in a direction tangential to all the rolls. Each roll thus comes in contact with the stream of molten metal, or with the metal bar produced, only at a single point, so to speak, of its periphery at a time, thus making it practicable to easily keep the rolls cool, or at a proper temperature for chilling or setting the stream of molten metal as it passes between the rolls. The rolls are revolved at a sufficiently great surface speed, in respect to the velocity of the stream of molten metal and in respect to the space between the rolls or the size of the bar being produced, as to prevent the molten metal collecting or damming up in the space between the rolls. We thus prevent a large surface-contact between the molten metal and the chilling-rolls, which would tend to heat the rolls rapidly and render it difficult to keep them cool or at the proper temperature, on the one hand, and which, on the other hand, would tend to chill or set the molten metal before it reaches the meeting line or plane joining the axes of the rolls, and where the passage between them is most contracted, thus subjecting the apparatus to greater strain and requiring greater force to revolve the rolls, and interfering, to a greater or less extent, with the proper compression of the metal while yet in a molten or setting state.

By employing a series of rolls the fluid or setting stream of metal passing between the rolls is compressed on all sides, thus densifying or compressing the metal by the wedging action of the rolls, and this densifying or compressing action of the rolls upon the metal aids in solidifying or setting the molten metal, as well as to greatly improve the quality of the steel or metal bar produced. The compressing and rolling action of the rolls upon the fluid or setting stream of metal passing between the rolls also tends to give the metal bar a superior texture, grain, or fiber, and thereby to increase the strength of the bar produced.

Our process in its most improved or perfected form also consists in pouring a stream of molten metal and simultaneously compressing, setting, and shaping it into a bar, and then further rolling and finishing the bar as it is produced and while still at a high heat. In practicing this latter feature of our invention we preferably arrange directly between the first series of rolling, chilling, and compressing rolls or molds a second series of revolving rolls, which serve to further chill, compress, shape, and roll the rail or bar as it issues. The continuous rail or bar produced is delivered from this second series of rolls by an intermediate curved passage or conveyer, consisting, preferably, of a series of rolls arranged in a curve. As the rail or bar is conveyed out horizontally, it may, while still hot, be passed through finishing and straightening rolls and further rolled to a greater or less extent, as may be desired.

In the accompanying drawings, which form a part of this specification, we have shown at Figure 1 a plan view of an apparatus embodying four convergent rolls suitable for use in practicing our invention. Fig. 2 is a central horizontal section taken through the axes of the rolls. Fig. 3 is a vertical section taken in the line 3 3 on Fig. 1. The section of Fig. 2 is indicated on Fig. 3 by the line 2 2. Fig. 4 is a side elevation, partly in section, showing the horizontal conveyer and intermediate curved conveyer for receiving the rail or bar as it issues from the series of rolls.

Similar letters of reference indicate like parts in all the figures.

In the drawings, A represents the frame of the machine, on which is journaled a series of rolls B, preferably four in number, revolving together and having their peripheries shaped or grooved to form a passage or way *b* between them to receive the stream of molten metal as it flows down from the pouring bowl or nozzle C.

As indicated in Figs. 1, 2, 3, and 4 of the drawings, the working or meeting faces or peripheries of the rolls B are given a shape or configuration to form an ordinary railroad-rail. They may, however, be shaped to give the space or passage *b* any desired cross-section, and thus produce a bar of any form required. The rolls B have beveled faces *b'*, which meet or roll against each other and serve as stops for the several rolls against each other, so that the space or passage *b* for the metal will always be maintained of a uniform size, and thus produce the rail or bar of a uniform cross-section throughout. The rolls B are each made hollow, and preferably with a central web B', and the shafts B^2 are also made hollow, so that the water or other cooling fluid or liquid may be made to circulate through each of the rolls for the purpose of keeping them cool or of the desired temperature. The hollow shafts B^2 are each furnished with a packing or stuffing box *d* at each end, by which they are connected with the inlet and outlet water-pipes D D'. The pouring bowl or vessel C is supported by any suitable means above the rolls B during the pouring operation, preferably by standards C', furnished with adjusting-screws C^2. The pouring-nozzle C is preferably furnished with a valve or device *c* for opening and closing the discharge-passage. The hollow shafts B^2

of the rolls are all geared together, so that they revolve or roll together at the same surface speed. The gearing employed may preferably be bevel-gears, such as indicated at B^3. Two of the shafts B^2 are also geared together by spur-gears B^4. E is the driving-shaft, having a gear E′, which meshes with a gear E^2 on one of the shafts B^2. The pouring bowl or nozzle C is furnished with a guide or shield C^3, extending down to near the meeting-point of the rolls. This is designed to prevent the metal from splattering at the beginning of the pouring operation. A greater or less number of rolls than four may be employed.

F represents a second series of rolls arranged, preferably, directly below the chilling-rolls B, and between which the bar *x* passes as it issues from the chilling-rolls B. The series of rolls F are preferably of the same form and construction as the rolls B, being hollow and having the same connections for passing water through them, so that they may operate as chilling-rolls as well as to further roll, compress, and finish the rail or bar produced. The rolls F may, however, be of any ordinary or known construction. The series of rolls F is preferably, like the series B, composed of four rolls revolving together.

G is a curved guide or conveyer consisting, preferably, of a series of rolls or idle-pulley wheels, arranged in a curved path to curve and guide the bar as it issues from the rolls F to the horizontal conveyer or series of rolls H. Some of the rolls H are preferably driven and operate to further roll and straighten the rail or bar as well as to convey it along or away. The curved guide G also affords some slack in the rail or bar between the chilling-rolls and rolls H H to compensate for difference in speed or slipping.

We claim—

1. The process of manufacturing metal bars directly from molten metal, consisting in pouring a continuous stream of molten metal and compressing, setting, and shaping the metal on all sides into a bar by contact with continuously-moving chilling and compressing surfaces or rolls traveling at an equal or greater surface speed than the velocity of the flowing stream of metal, substantially as specified.

2. The process of manufacturing metal bars directly from molten metal, consisting in pouring a continuous stream of molten metal and compressing, setting, and shaping the metal on all sides into a bar by contact with continuously-moving chilling and compressing surfaces or rolls traveling at an equal or greater surface speed than the velocity of the flowing stream of metal, and then rolling the bar as it issues and while still at a high heat, substantially as specified.

3. The process of manufacturing metal bars directly from molten metal, consisting in pouring a continuous stream of molten metal between a converging series of continuously-revolving chilling-rolls revolving together and surrounding the passing stream on all sides, and thus compressing, setting, and shaping the constantly-moving stream into a bar or rail, substantially as specified.

4. The process of manufacturing metal bars directly from molten metal, consisting in pouring a continuous stream of molten metal between a converging series of continuously-revolving chilling-rolls revolving together and surrounding the passing stream on all sides, and thus compressing, setting, and shaping the constantly-moving stream into a bar or rail, and then further rolling the bar as it issues and while still at a high heat, substantially as specified.

5. The process of manufacturing metal bars directly from molten metal, consisting in pouring a continuous stream of molten metal directly downward between continuously-revolving chilling-rolls, and thereby compressing, setting, and shaping the metal stream into a bar, then deflecting or curving the hot bar as it issues in a horizontal direction, and finally rolling and straightening it while it is still hot, substantially as specified.

EDWIN NORTON.
JOHN G. HODGSON.

Witnesses:
EDW. S. EVARTS,
H. M. MUNDAY.