(No Model.) 5 Sheets—Sheet 1.

E. B. MEATYARD.

MACHINE FOR ROLLING I-BEAMS.

No. 347,005. Patented Aug. 10, 1886.

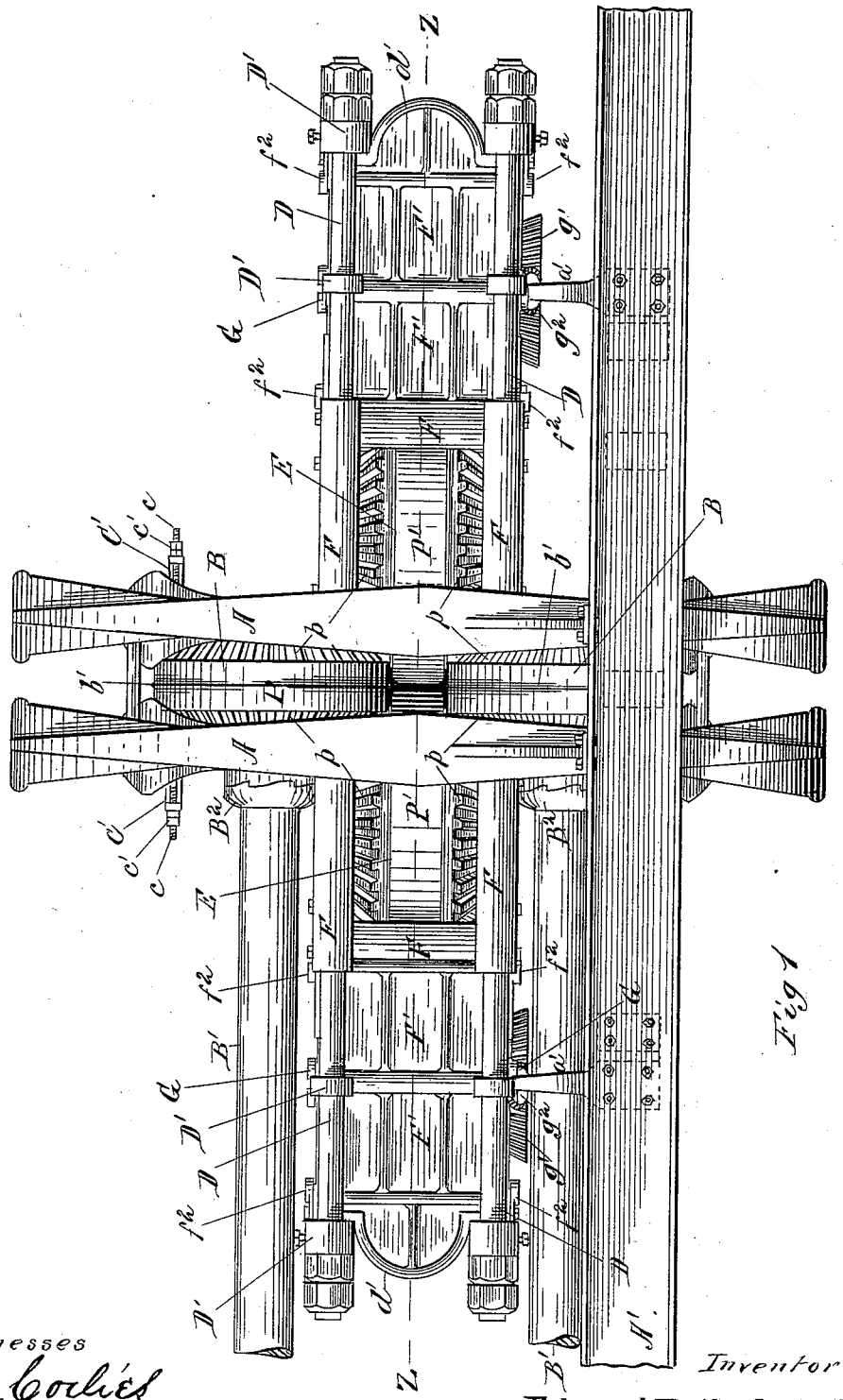

Fig 1

Witnesses
W. C. Corlies
A. M. Best

Inventor
Edward B. Meatyard
By Coburn & Thacher
Attorneys

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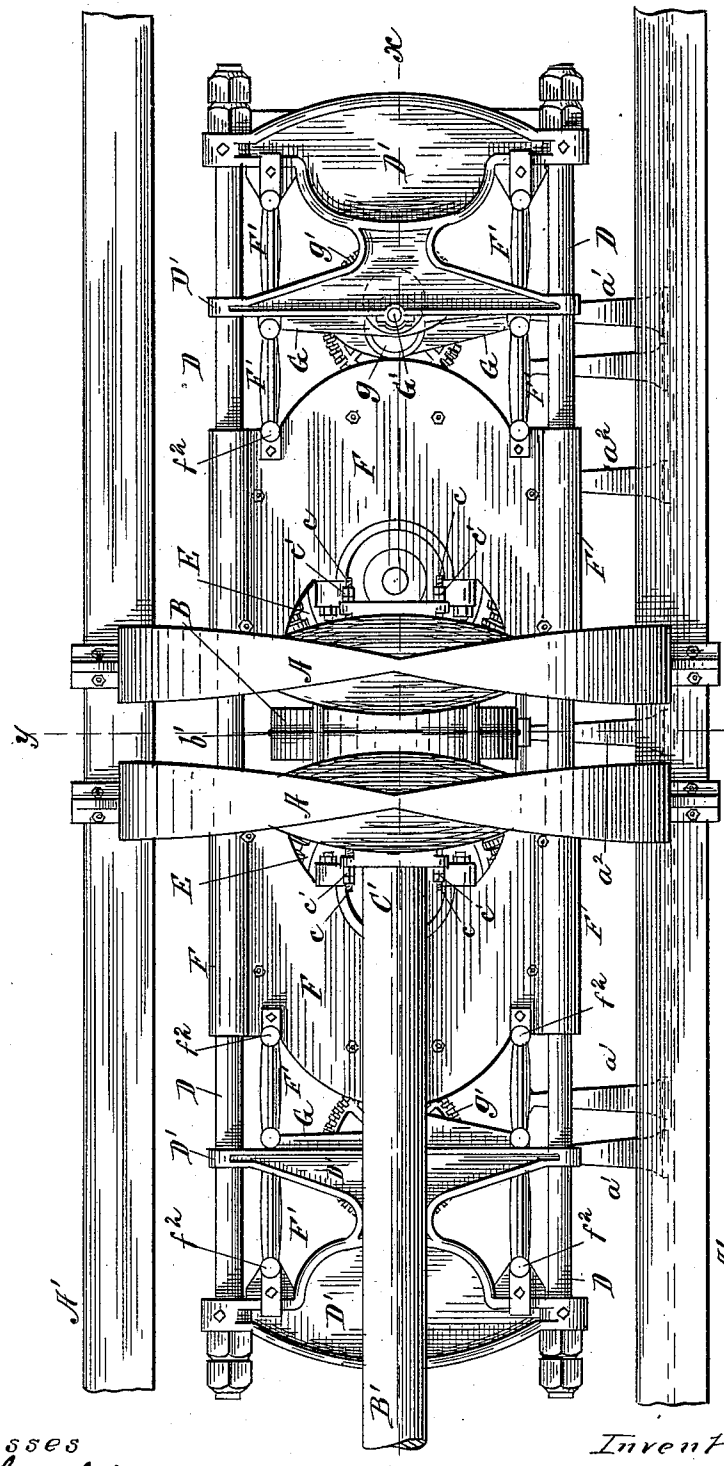

Fig 2.

Witnesses
W. C. Coales
A. M. Best

Inventor
Edward B Meatyard
By Coburn & Thacher
Attorneys

(No Model.) 5 Sheets—Sheet 3.

E. B. MEATYARD.

MACHINE FOR ROLLING I-BEAMS.

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Fig 3

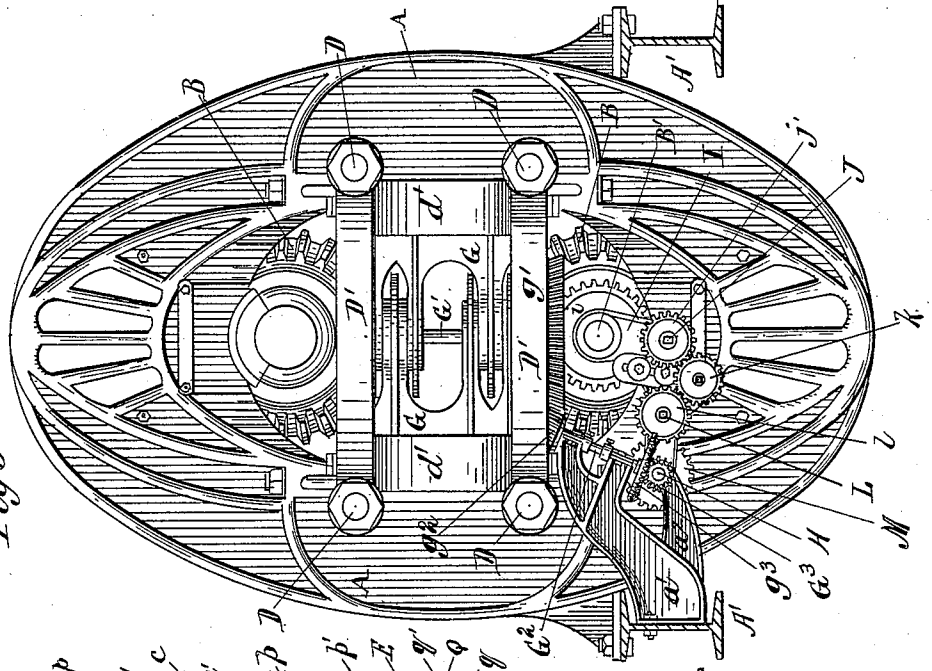
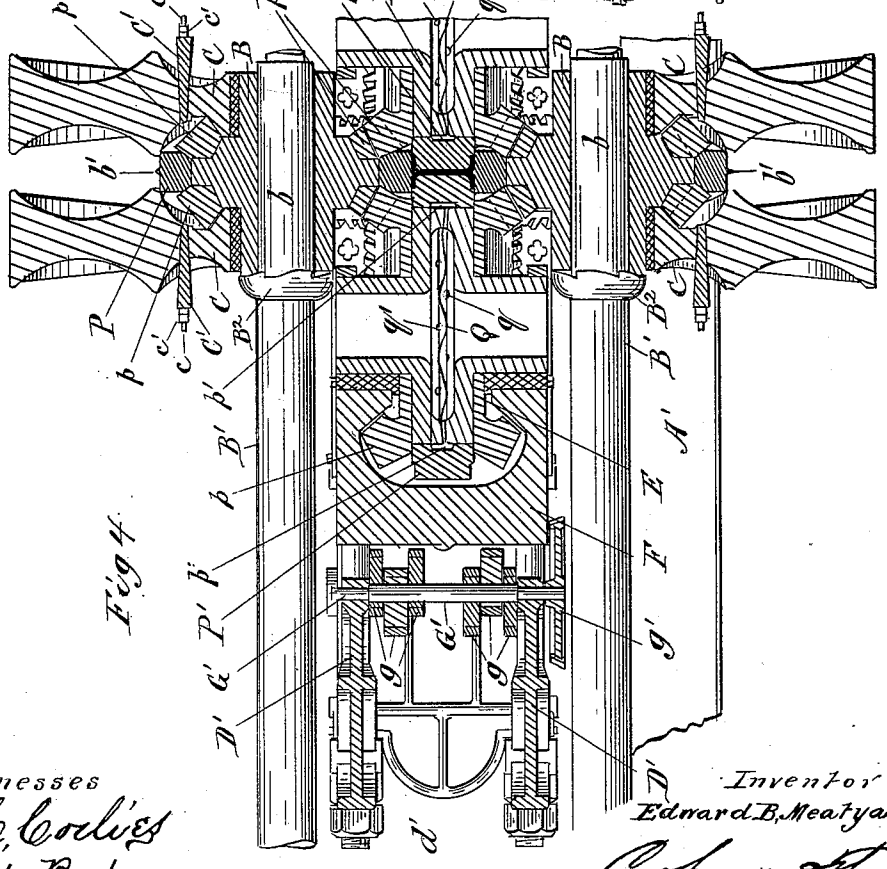


Fig 4.



Witnesses
W. C. Corlies
A. M. Best.

Inventor
Edward B. Meatyard
By Coburn & Thacher
Attorneys

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E. B. MEATYARD.

MACHINE FOR ROLLING I-BEAMS.

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Fig 5

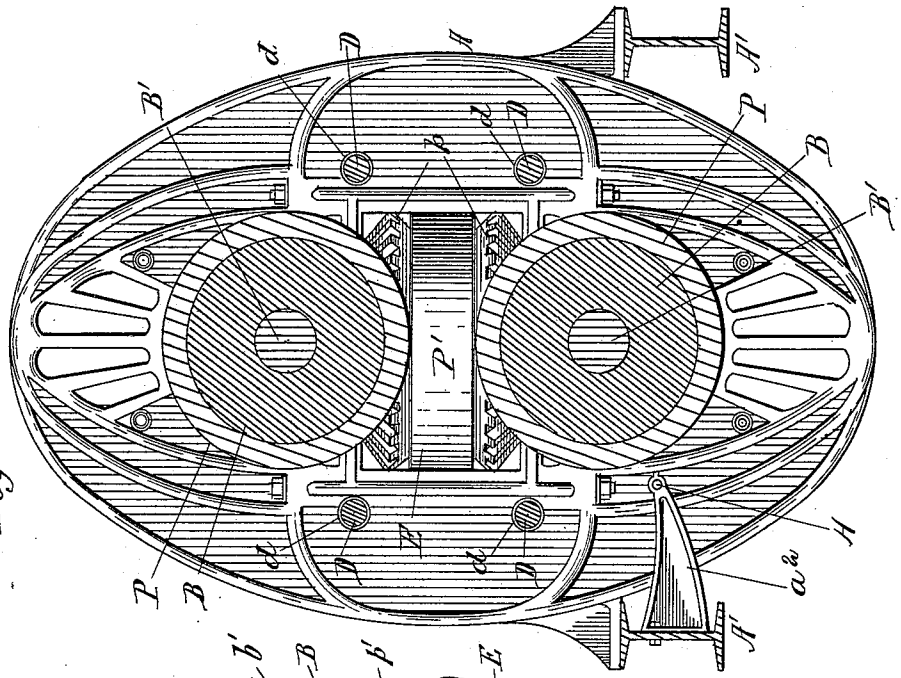
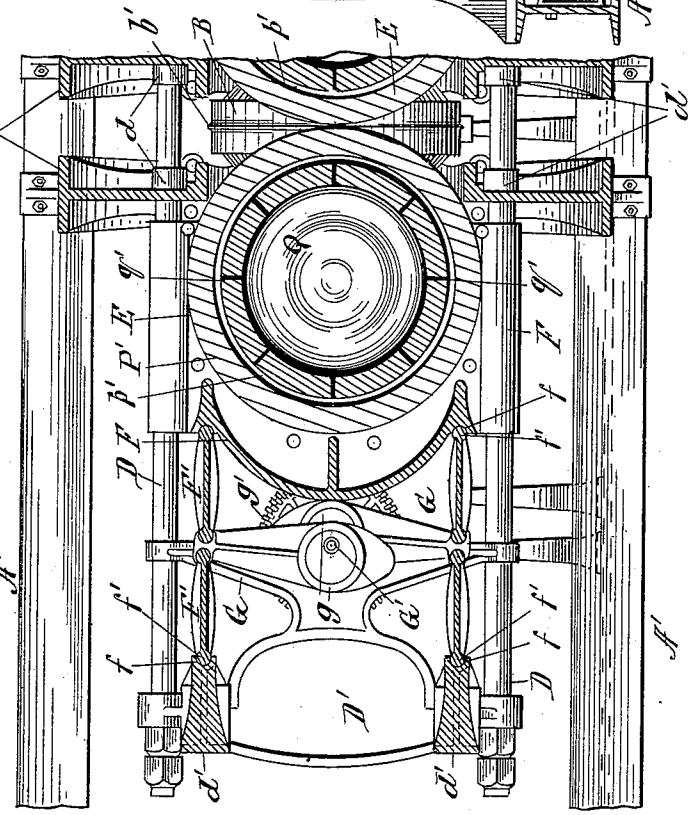


Fig 6



Witnesses
W. C. Corlies
A. M. Best

Inventor
Edward B. Meatyard
By Cushman & Darby
Attorneys

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E. B. MEATYARD.

MACHINE FOR ROLLING I-BEAMS.

No. 347,005. Patented Aug. 10, 1886.

Fig 7

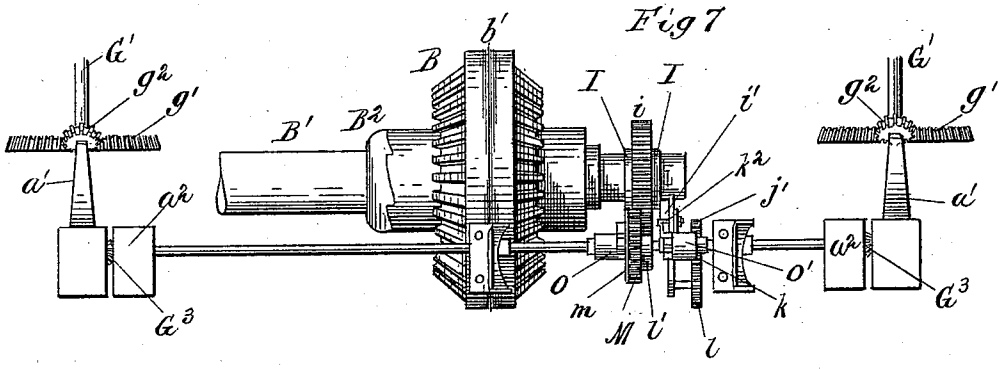


Fig 8

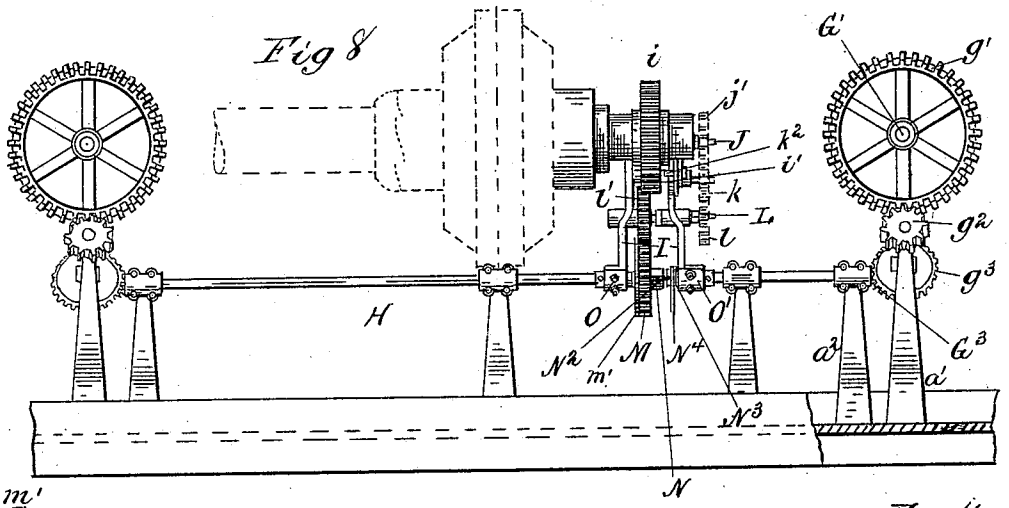


Fig 10

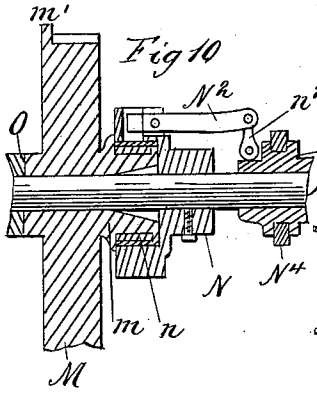


Fig 9

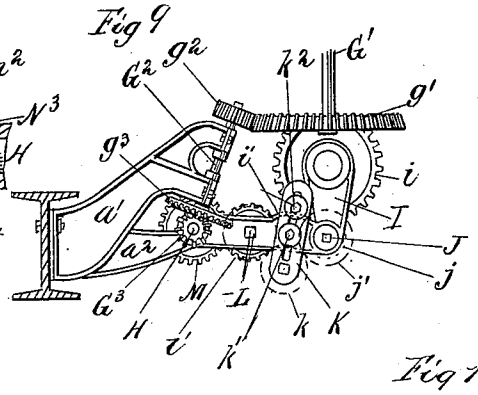


Fig 11

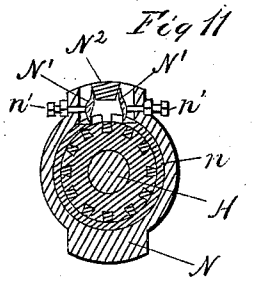


Fig 12

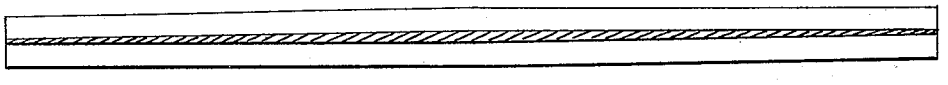
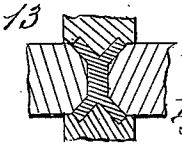


Fig 13



Witnesses
W. C. Corlies
A. M. Best

Inventor
Edward B Meatyard
By Coburn & Thacher
Attorneys

UNITED STATES PATENT OFFICE.

EDWARD B. MEATYARD, OF LAKE GENEVA, WISCONSIN.

MACHINE FOR ROLLING I-BEAMS.

SPECIFICATION forming part of Letters Patent No. 347,005, dated August 10, 1886.

Application filed September 24, 1885. Serial No. 178,108. (No model.)

To all whom it may concern:

Be it known that I, EDWARD B. MEATYARD, a citizen of the United States, residing at Lake Geneva, in the county of Walworth and State of Wisconsin, have invented a certain new and useful Improvement in Machines for Rolling I-Beams, of which the following is a specification, reference being had to the accompanying drawings, in which—

Figure 1 is an elevation of an apparatus embodying my invention; Fig. 2, a plan view of the same; Fig. 3, an end elevation; Fig. 4, a sectional view taken on the line *x x* of Fig. 2; Fig. 5, a sectional view taken on the line *y y* of Fig. 2; Fig. 6, a sectional view taken on the line *z z* of Fig. 1; Fig. 7, a detail plan view showing the toggle-operating mechanism; Fig. 8, an elevation of the same; Fig. 9, an end view of the same; Fig. 10, a longitudinal sectional view of the clutch; Fig. 11, a transverse sectional view of the same; Fig. 12, a central longitudinal plan section of a finished beam, and Fig. 13 a view illustrating one of the steps in the manufacture of the same.

Like letters refer to like parts in all the figures of the drawings.

My invention relates to apparatus for rolling I-beams, its object being to produce a beam in which all the metal shall be worked to an equal extent by the rolls in the operation of shaping the same, and in which the metal shall be disposed in the most advantageous manner, so that the beam shall have the maximum strength for its dimensions.

To these ends my invention consists in certain novel features, which I will now proceed to describe, and then particularly point out in the claims.

In the drawings, in which I have shown my invention practically carried out in one form, A indicates the supporting-frames for the upper and lower rolls. These frames are arranged in duplicate, being preferably elliptical in their general form, as shown, and supported on beams A′, or in any other suitable manner. The upper and lower rolls are mounted in these supporting-frames, and are identical in construction, though reversely arranged. Each roll B is mounted on a driving-shaft, B′, being connected to it by a suitable clutch, B^2, or in any other suitable manner, so as to revolve with the shaft. That portion of the roll which immediately surrounds the shaft is formed into an extended sleeve, B, which bears upon a journal-box, C. Each journal-box is mounted to slide vertically in suitable ways in the frame A, a wedge, C′, being interposed between the outer end of the journal-box and the frame, and lateral screws *c*, secured to the frame, extend through lugs on the wedge and receive nuts *c′* on their outer ends, by means of which the wedge can be forced inward to adjust the journal-box to take up the wear.

Mounted in the supporting-frame A are four rods, D, held in position by collars *d*, as shown in Fig. 6 of the drawings. These rods extend some distance on each side of the frame A, and have their several extremities connected and supported by means of tie-pieces D′ at each end, secured to the rods in any suitable manner. These rods and tie-pieces form a supporting-frame, on which are mounted the housings of the side rolls, which slide upon the rods, being moved from and toward each other during the rolling of each beam, as hereinafter set forth. These rolls and their operating mechanisms are identical, although reversely arranged, and for this reason the construction of one only will be described, it being of course understood that the same description is equally applicable to the other.

Each of the side rolls, E, is mounted in a housing, F, supported so as to slide on the rods D. To the outer end of the housing, at each side thereof, is attached one end of a pair of toggles, F′, the other extremity of which is connected to the uprights *d′* of the tie-pieces D′. These connections are preferably made in the manner shown in the drawings, suitable half-round seats, *f*, being formed in the housing and uprights, as shown in Fig. 6 of the drawings, to receive the correspondingly-shaped end ribs *f′* of the toggles, which latter are retained in these seats by means of caps f^2, fitting over the projecting ends of the ribs *f′*, and bolted to the housing and tie-piece. By this means the toggles can readily be detached when desired.

The toggles are operated by means of levers G, to which their abutting ends are pivoted, as shown in Fig. 6 of the drawings, the levers

being themselves actuated by means of eccentrics g, attached to a shaft, G′, mounted in the tie-piece D′. On the shaft G′ is mounted a bevel-wheel, g', with which meshes a bevel-pinion, g^2, on the upper end of a shaft, G^2, mounted in a bracket, a', secured to one of the beams A′. On the lower end of the shaft G^2 is a pinion, g^3, with which meshes a pinion, G^3, on a counter-shaft, H, mounted in brackets a^2, secured to one of the beams A′.

The counter-shaft H is driven from one of the drive-shafts B′—in this instance from the lower one—by means of the following mechanism: I represents a frame constructed in two sections hinged together and mounted loosely upon the drive-shaft. On the drive-shaft is mounted a gear-wheel, i, which meshes with a pinion, j, on one end of a shaft, J, mounted in the frame I. On the outer end of the shaft J is a second pinion, j', which operates, by means of an intermediate pinion, k, mounted as hereinafter described, a pinion, l, on one end of a shaft, L. The other end of the shaft L is provided with a pinion, l', which meshes with a pinion, M, on the counter-shaft H. The pinions j' and l are detachably mounted on their shafts, and pinions of various sizes may be substituted for those shown, in order to vary the rate of speed of the counter-shaft H relatively to that of the drive-shaft B′. The intermediate pinion, k, is also removable for the same purpose, and in order to accommodate itself to the various sizes of pinions j' and l it is mounted upon a slotted arm, K, adjustably secured to the frame I by means of clamp-screws k' k^2. The former passes through the slot in the arm and takes into the frame I, while the latter also passes through the slot, and has its inner end bent at right angles to catch over the edge of the frame I, as shown in Fig. 7, the frame being provided at this point with a curved projection, i', on which the clamp-screw k^2 travels. It will be seen that the arm K can, by reason of this construction, be adjusted to any desired position, so as to cause the pinion k to mesh with the different pinions on the shafts J and L, and when so adjusted may be clamped in position by means of the clamp-screws k' k^2. The pinion M is mounted loosely on the shaft H, and is connected to it to cause it to revolve by means of a suitable clutch. The clutch shown in the present instance is a well-known form of friction-clutch, consisting of a hub or case, N, secured to the shaft and provided with a split ring, n, embracing the hub m of the pinion M. N′ are levers supported on adjustable fulcra, consisting of set-screws n' and engaging the ends of the ring n. N^2 is a lever pivoted in the hub or casing N, and having its inner beveled end arranged to bear against the levers N′, while its outer end is connected by a link, n^2, to a sleeve, N^3, sliding on the shaft H and operated by a suitable lever, N^4. When the sleeve is moved toward the pinion, the beveled end of the lever N^2 causes the levers N′ to tighten the ring n in an obvious manner, the ring being loosened by a reverse movement of the sleeve. Collars O and O′ are secured on the shaft H, the ends of the bars which form the frame I being loosely mounted on these collars. The collar O bears against the pinion M and prevents its lateral displacement in one direction, while a flange, m', on the pinion bears against the pinion l' and prevents displacement in the opposite direction.

The construction of the rolls which I prefer is as follows: Each roll has secured to it gear-wheels p, by means of which it meshes with the two adjacent rolls, so that those of the side rolls are driven by the top and bottom rolls. The periphery of each roll is constructed in a separate piece to facilitate renewal and repair. The top and bottom rolls have each a band or ring, P, shrunk or bolted onto the body of the rolls, or otherwise suitably secured. The side rolls have each a similar band or ring, P′, similarly secured, but provided with a groove, p', on its inner side. The side rolls are hollow internally, as shown in Figs. 4 and 6 of the drawings, the internal space being divided centrally by means of a transverse diaphragm, Q, which is corrugated in order to enable it to accommodate itself to the expansion and contraction of the roll. The internal space in the roll communicates with the groove p' by means of a series of passages, q, on each side of the diaphragm. Water, being forced into the internal hollow of the roll from below in any suitable manner, will pass through the lower passage, q, into the groove p', and thus keep that portion of the roll cool. The water then passes back through the upper series of passages, q', and out through the upper end of the roll, which is provided with a suitable discharge-pipe. By this means the side rolls are prevented from overheating, which will tend to loosen the connection between the several parts of which they are composed and otherwise render them unfit for their work. A similar cooling device may be applied to the top and bottom rolls; but I do not consider this necessary, since these rolls are only exposed to a rolling friction against the heated metal, whereas the side rolls are exposed not only to this rolling friction, but also to a sliding friction along their side edges, which tends to heat them very rapidly. The top and bottom rolls are provided with a central peripheral rib, b', for the purposes hereinafter stated.

In the operation of constructing an I-beam, I first take the ordinary ingot and form it into a flat bar of suitable dimensions in an ordinary rolling-mill. This bar is then passed through rolls similar in construction to the one above described, but having the side rolls at a fixed distance from each other, a section of the rolls and of the bar produced thereby being shown in Fig. 13 of the drawings. This bar is then introduced into the machine hereinbefore described, where it is given its final shape at a single pass. As soon as the bar is introduced, the pinion M is connected to the

counter-shaft H by means of the clutch, and the toggles are operated to draw the side rolls apart gradually until half the length of the beam has passed through the rolls, when the rolls are gradually brought to their first position, the eccentrics which operate the toggles making one-half of a revolution during the passage of the entire beam. The movement of the side rolls from and toward each other can be readily regulated by means of the differential gearing which connects the drive-shaft B′ and the counter-shaft H, so that beams of any desired length may be rolled. This differential gearing is provided for the purpose of causing the movement of the side rolls to correspond to the length of the beam which it is desired to roll. For instance, if a twelve-foot beam is to be operated upon, it is obvious that a certain combination of gearing at this point must be employed, in order to cause the eccentrics which operate the movable rolls to make half a revolution during the passage of the twelve-foot beam through the mill. Now, it is obvious that if a twenty-foot beam is to be rolled the eccentrics must be moved slower, and this is accomplished by changing the differential gears by the substitution of gears of the proper size in the proper position, the construction heretofore pointed out permitting such a substitution. It is obvious that in order to enable the mill to roll beams of the various lengths which are desirable a great number of changes in the differential gearing must be provided for, and the greater number of gears in the train the greater will be the number of different speeds available for the eccentrics which operate the movable rolls relatively to the rate of speed of the rolls themselves. For instance, the permutations of which six gear-wheels are capable will give seven hundred and twenty different speeds, while those of seven gear-wheels will give five thousand and forty. Any number of gears suitable to the purpose for which the machine is to be employed may be used. By reason of the motion imparted to the side rolls an increased width is given to the beam at its central portion, where such a width is most desirable. Theoretically the sectional area of the flanges should be greater and that of the web less at the center than at the ends; but for economical reasons I deem it advisable to adopt the construction shown, in which the total depth of the beam is kept constant, while the width is varied. The reverse construction—that is to say, a constant width with a varying depth—may be obtained by causing the top and bottom rolls to recede and advance and keeping the side rolls stationary; but this is an obvious modification of the construction shown and described.

It will be seen that in passing the bar which forms the beam through the several series of operations just described the metal is submitted to the action of the rolls at all parts to an equal extent, and is consequently homogeneous throughout the whole beam. The rib *b′* on the top and bottom rolls is for the purpose of compacting the metal in the space which is left between the branching arms shown in Fig. 13 of the drawings, and which form the flanges of the completed beam. This space would be left untouched if a flat roll only were used, and the metal at this point would be soft and faulty.

It is obvious that various modifications in the construction and arrangement may be made without departing from the principle of my invention. For instance, although I have shown a train of differential gearing of my invention, which train I prefer to use, still it is obvious that any well-known form of differential gearing may be substituted therefor. Any approved form of clutch may be used, instead of the particular form shown, for the purpose of connecting the pinion M with the counter-shaft H. Various other modifications may be made, and I therefore do not wish to be understood as limiting myself strictly to the precise details of construction hereinbefore set forth, and shown in the drawings.

I am aware that heretofore machines have been constructed for rolling metal in which four adjustable rolls are arranged so as to operate upon the same portion of the bar at the same time. Such a construction is shown in Letters Patent No. 98,807, granted to George H. Sellers January 11, 1870, and in Letters Patent No. 318,513, granted to Joseph S. Seaman May 26, 1885, and I therefore do not wish to be understood as claiming such a construction. In neither of the constructions above pointed out, however, is any movement from and toward each other of one pair of rolls during the actual passing of the beam through the mill contemplated, provision being made merely to adjust the rolls after each pass, so as to reduce the beam by successive passes. In my construction, as hereinbefore pointed out, it will be observed that a double taper is given to the beam by the withdrawal and advance of the said rolls during the actual passage of the beam through the machine, thereby producing a beam of the most desirable shape, in which the metal is disposed in the most advantageous manner.

I am also aware that rolls for the purpose of rolling **I**-beams of tapering section are not new, a construction for the purpose of effecting this result being shown in British Patent No. 840 of 1868. In this construction, however, the side rollers are not driven positively, and are caused to move toward and from each other by means of pattern-bars of suitable shape.

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

1. In a rolling-mill, the combination of four rolls arranged in pairs, one pair driving and provided with suitable gear-teeth, and the other pair provided with gear-teeth to mesh with the first pair, and automatic mechanism to move the second pair from and toward each other during the passage of the beam through

the mill, substantially as and for the purposes set forth.

2. The combination, with the top and bottom rolls, arranged a fixed distance apart, of the side rolls capable of movement from and toward each other, and automatic mechanism for moving the said rolls positively in those directions during the passage of the beam, substantially as and for the purposes set forth.

3. The combination, with the top and bottom rolls, of the movable side rolls and toggles operated by suitable gearing to move the side rolls from and toward each other, substantially as and for the purposes set forth.

4. The combination, with the upper and lower rolls, of the side rolls mounted in movable housings, the toggles connected to the said housings and to the supporting-frame, and the levers connected to the toggles and operated by eccentrics, substantially as and for the purposes set forth.

5. The combination, with the supporting-frame and the side rolls and their housings mounted thereon, of the toggles F′, provided with end ribs, f', fitting in seats f in the housings and frame, and the caps f^2, for securing the toggles in position, substantially as and for the purposes specified.

6. The combination, with the toggles which actuate the side rolls, of the shafts G′, provided with eccentrics to operate said toggles, and the counter-shaft H, connected to the shafts G′ by suitable gearing and to one of the drive-shafts by a train of differential gearing, substantially as and for the purposes specified.

7. The combination, with the counter-shaft H and the mechanism operated thereby, of the drive-shaft B′ and a train of gearing connecting the two, the last pinion, M, of the train being loosely mounted on the counter-shaft and connected thereto by a suitable clutch, substantially as and for the purposes set forth.

8. The combination, with the drive-shaft B′, provided with pinion i, and the counter-shaft H, provided with pinion M, of the shafts J and L, provided with pinions j and l' and removable pinions j' and l, and the adjustable arm K, provided with a removable pinion, k, substantially as and for the purposes specified.

9. The combination, with the ring or band P′, having groove p', of the body of the roll, provided with an internal space divided by a transverse diaphragm, Q, and a series of passages, q, leading from the internal space to the groove on each side of the diaphragm, substantially as and for the purposes set forth.

10. The combination, with the side rolls, of the top and bottom rolls, each provided with a central peripheral rib, substantially as and for the purposes specified.

EDWARD B. MEATYARD.

Witnesses:
IRVINE MILLER,
A. M. BEST.