(No Model.)

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M. H. C. & R. E. C. SHANN.

BENDING APPARATUS FOR SHIP FRAMES.

No. 606,306. Patented June 28, 1898.

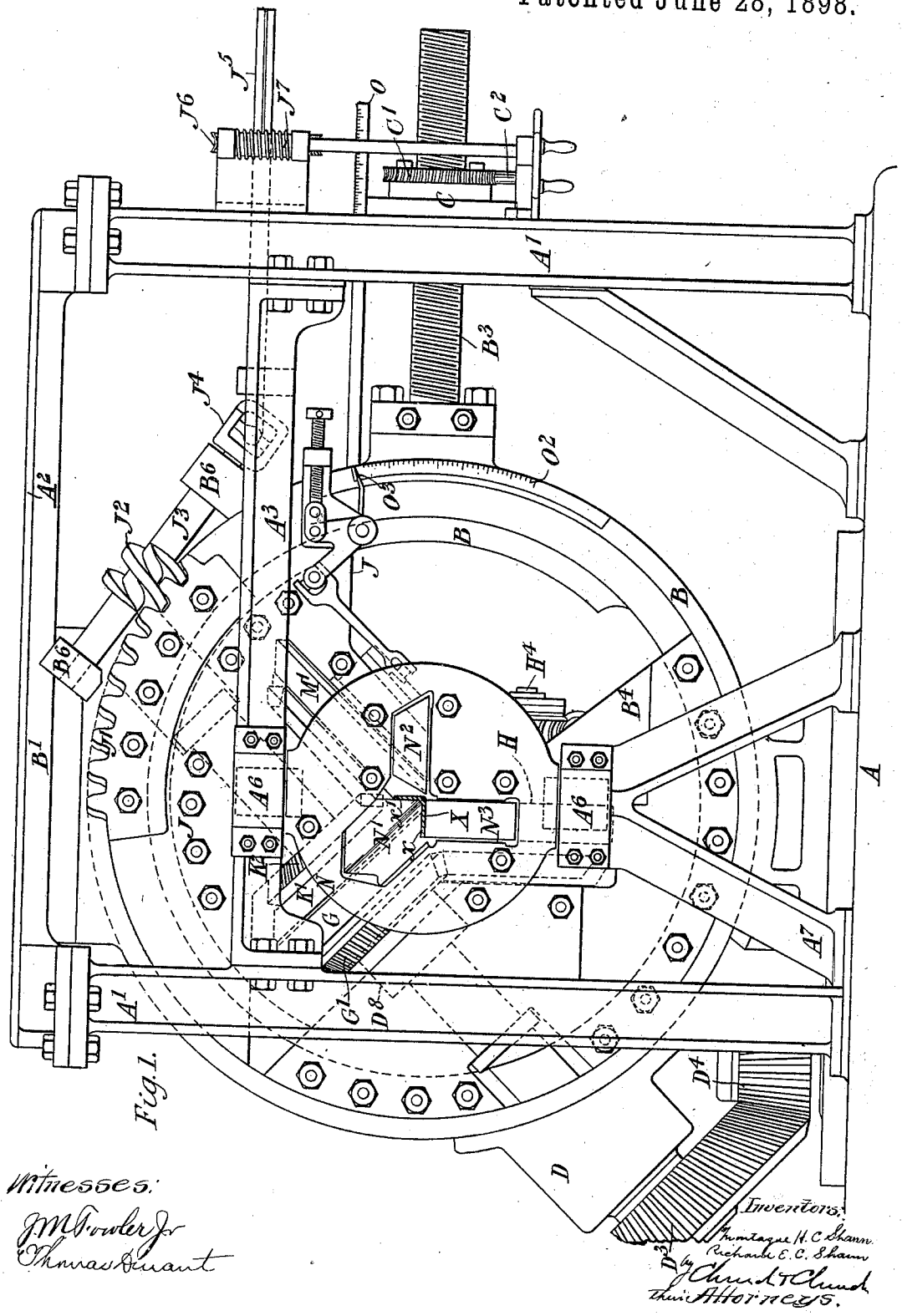


Fig. 1.

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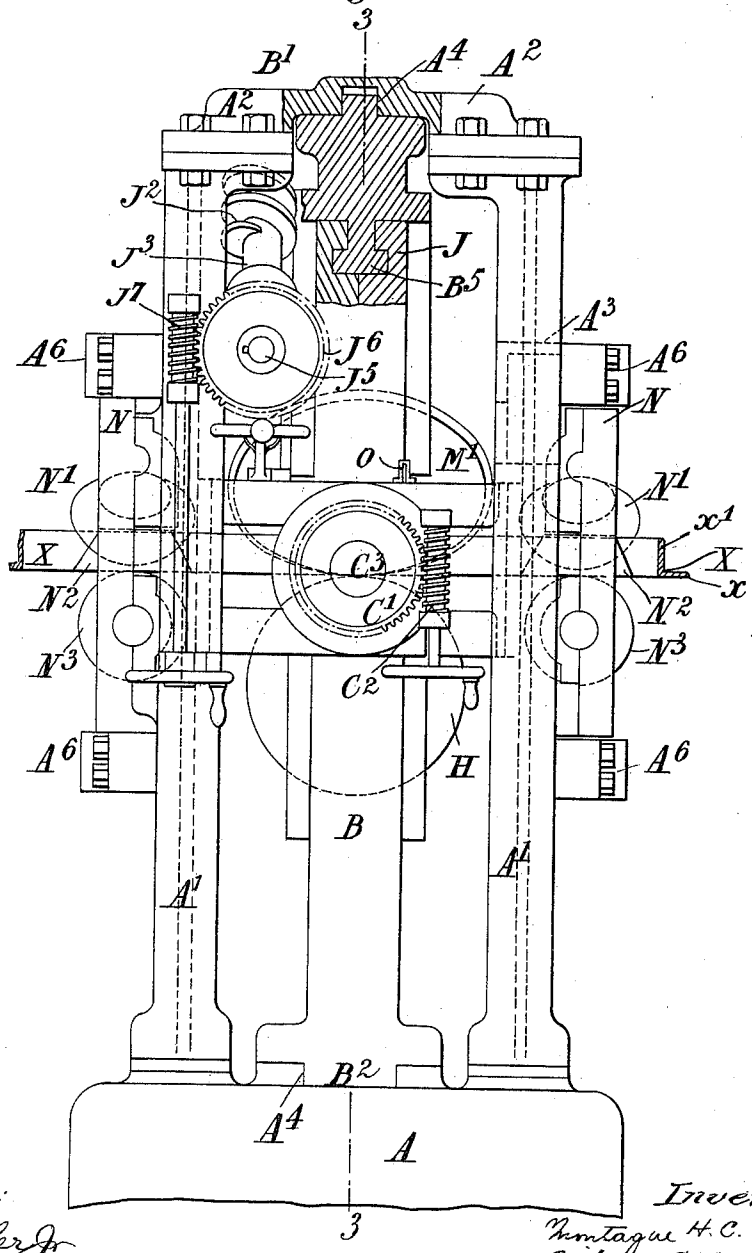
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Fig. 2.



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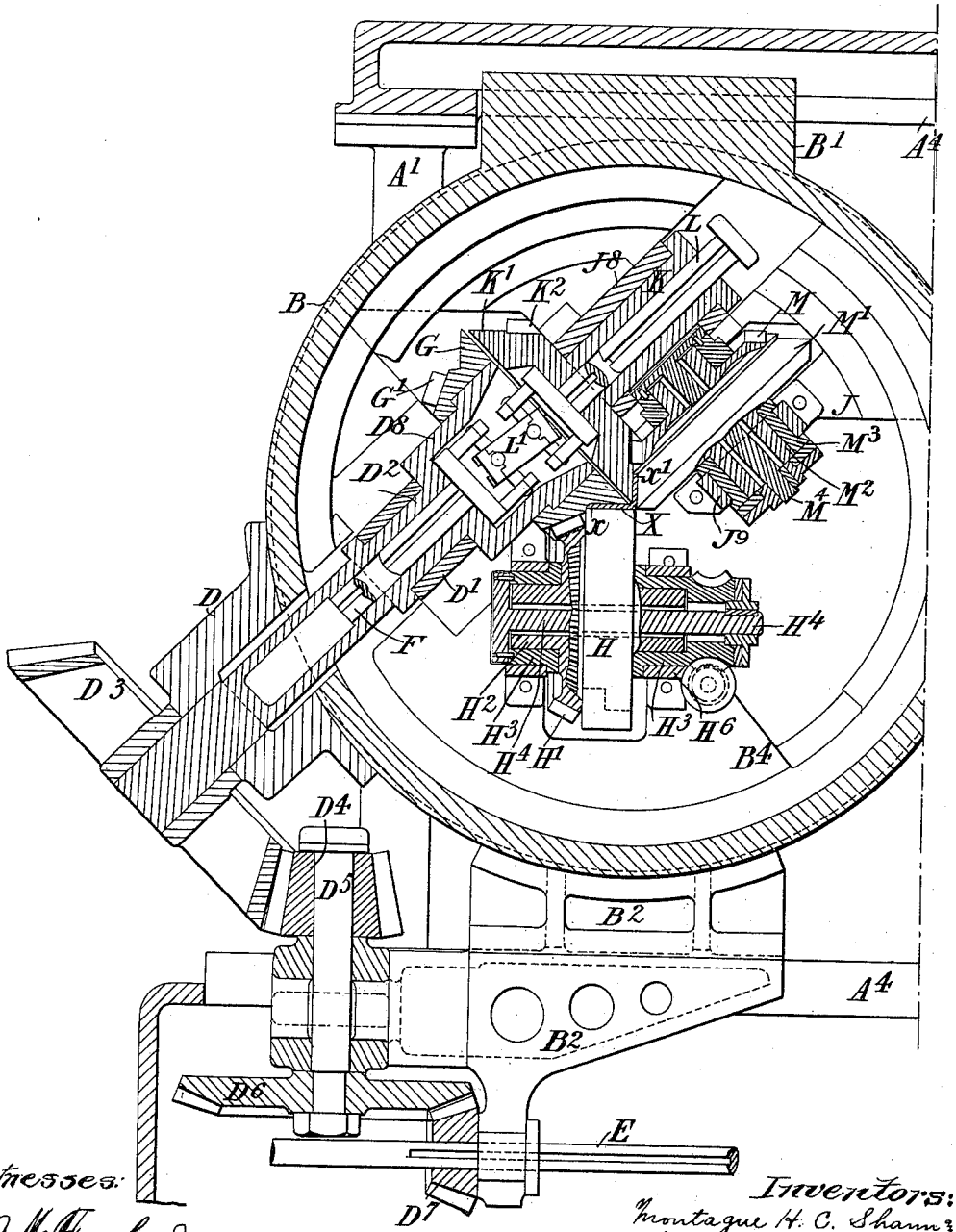
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Fig 3



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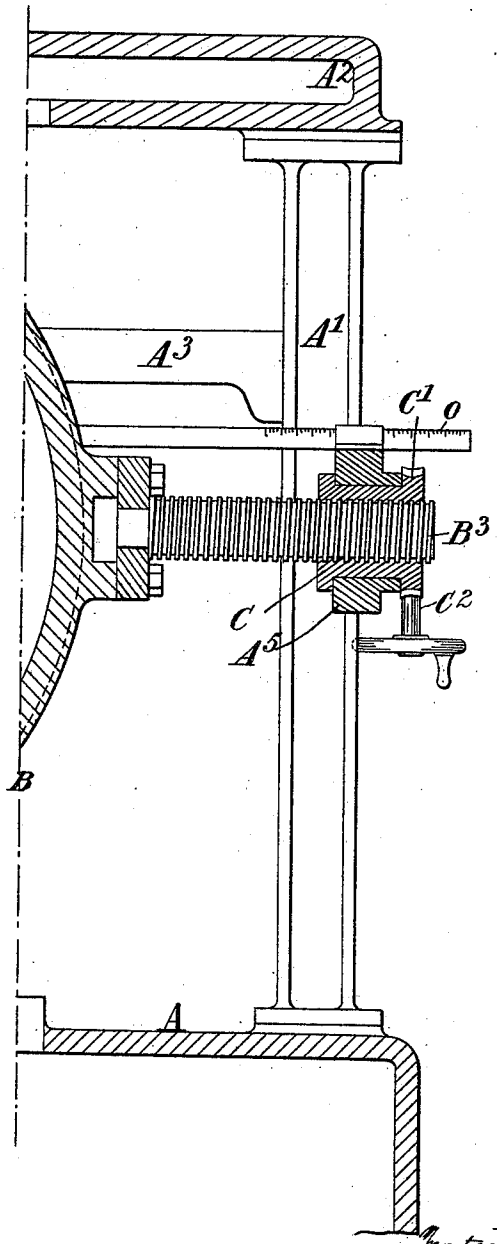
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Fig. 3a



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BENDING APPARATUS FOR SHIP FRAMES.

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Fig. 5.

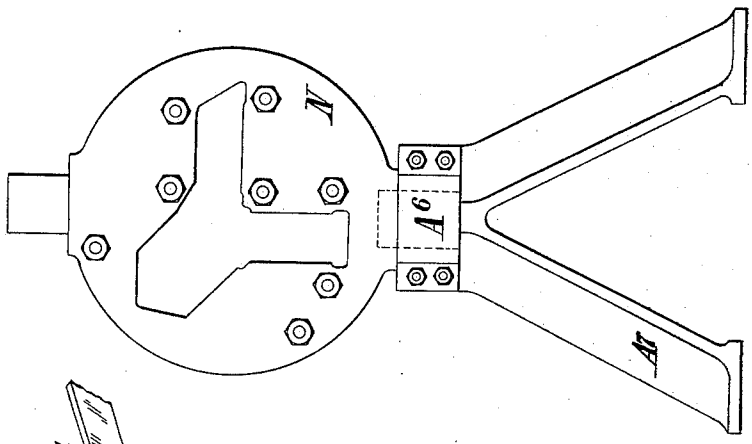
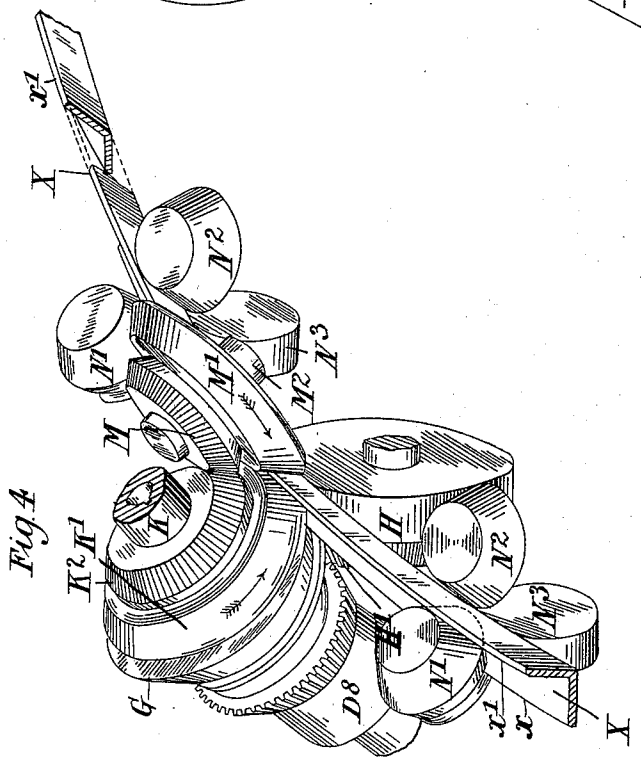


Fig 4



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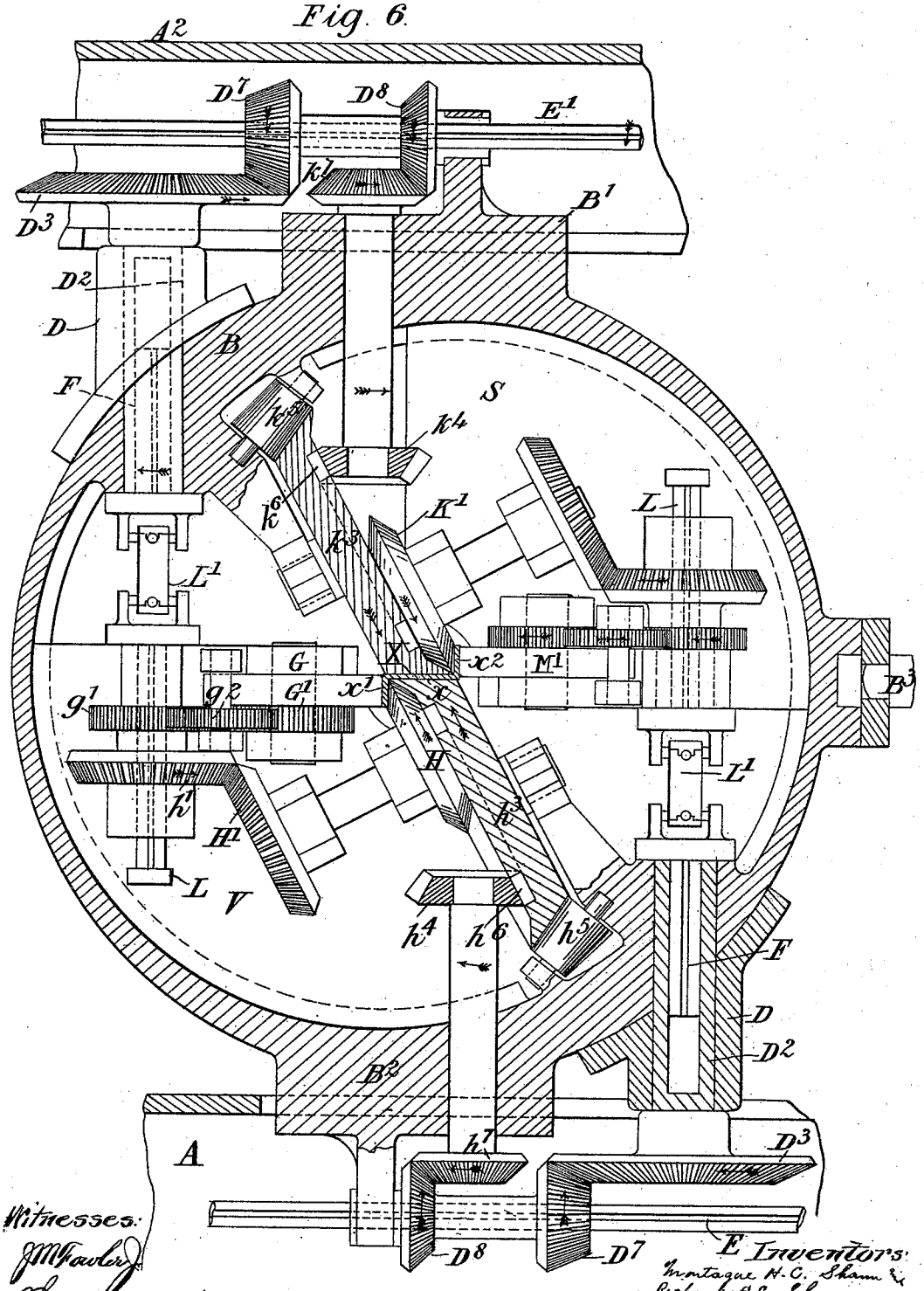
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BENDING APPARATUS FOR SHIP FRAMES.

No. 606,306. Patented June 28, 1898.

Fig. 6.



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UNITED STATES PATENT OFFICE.

MONTAGUE HERBERT CHURCHILL SHANN AND RICHARD ERNEST CHURCHILL SHANN, OF SHOREHAM, ENGLAND.

BENDING APPARATUS FOR SHIP-FRAMES.

SPECIFICATION forming part of Letters Patent No. 606,306, dated June 28, 1898.

Application filed August 7, 1897. Serial No. 647,458. (No model.)

To all whom it may concern:

Be it known that we, MONTAGUE HERBERT CHURCHILL SHANN and RICHARD ERNEST CHURCHILL SHANN, subjects of the Queen of England, residing at Shoreham, England, have invented certain new and useful Improvements in or Relating to Bending or Setting of Ship-Frames and the Like, of which the following is a specification.

This invention relates to the bending or setting of frames, girders, and the like, particularly ship-frames.

In carrying the invention into effect we employ any suitable framework to carry one or more sets of bending-rolls. These rolls are arranged to bear upon all the faces of the section to be set, the apparatus being adapted to operate upon all ordinary sections, and the bar being fed endwise through the several successive sets simultaneously. The rolls or their bearings are carried adjustably in the general framework, so that the rolls can be turned to lie in various planes. Usually one set of rolls will be moved together about a common center, so that all the rolls of that set will occupy the same relative positions to each other in whatever plane they may lie. However, the relation between the various rolls of the same set may be varied. We place the rolls so that each face of the section to be rolled is met or blocked by a working face of the roll. The working faces of the rolls preferably lie at angles to the axes around which each rotates. With this arrangement each roll lies at an angle with the face which it operates upon instead of perpendicular thereto. The rolls are shaped and set so that the spaces between them have substantially the shape of the section of metal passing through them. In adjusting the rolls we prefer to take the web of the section as a starting-point and arrange the rolls some of them to support the web in its appropriate plane and others to have their working faces at the particular angle to the web to which it is desired to bend or set the flange. To impart the necessary set, the rollers are adjusted to the commencement of the bar, and their relative position can be varied during the passage of the bar or section between them as may be necessary to impart the varying set to the different parts. In adjusting the rolls we prefer to take each root or junction of the flange and web as a center about which the rolls are moved.

In a previous patent, No. 581,375, dated April 27, 1897, we have described apparatus for curving and setting ship-frames in which we employed various sets of rolls adapted to be varied in their relations to each other. The construction and arrangement of the rolls varied from that of the present invention; but we may employ the present rolls in conjunction with adjusting devices for the several series, such as those described in the former specification. Such a machine will be capable not only of beveling the bar—that is to say, altering the angle between its web and flange or flanges—but also of bending and twisting the bar, as described in the specification of the said prior application for patent.

The invention will be best understood by reference to the accompanying drawings, in which—

Figure 1 is a front elevation of one of our improved machines for bending or setting angle-iron. Fig. 2 is an elevation of the right-hand end of Fig. 1, shown partly in vertical section. Figs. 3 and 3^a are views of two adjoining portions of the bending mechanism, together constituting a vertical section of the machine on the line 3 3 of Fig. 2. Fig. 4 is a diagrammatic view illustrating the manner in which the bending and setting are effected. Fig. 5 is a view of a detail of Fig. 1. Fig. 6 is a view similar to Fig. 3, illustrating an alternative construction of machine in which the relation between the various rolls of the same set can be varied, as desired, either while the machine is at rest or while those rolls are operating on a bar. The particular example illustrated is one which is adapted to operate on Z-bars.

Like letters indicate like parts throughout the drawings.

With reference, first, to Figs. 1 to 5, the rigid main frame of the machine comprises a base-plate A, four standards A′, secured to the base-plate A, a bridge-bar A^2, secured to the upper ends of the standards A′, and two bars A^3, secured to the standards A′ between the base-plate A and bridge-bar A^2.

In the upper side of the base-plate A and under side of the bridge-bar A^2 are formed guides A^4 for the reception of, respectively, a bracket B^2 and a rib or projection B', formed in one piece with or secured to a substantially circular ring B, which devices allow the ring to be moved horizontally in a direction transverse to the path in which the bar to be treated traverses the machine. This movement of the ring B is effected by means of a non-rotating screw B^3, secured to and extending radially outward from it, with which screw engages a nut C, formed in or constituting the boss of a worm-wheel C', gearing with a hand-rotated worm-shaft C^2. The worm-wheel is, by its boss C, journaled in or pivoted to a bar A^5, secured to two of the standards A', in such a manner as to admit of it being freely rotated and prevent it from moving in the direction of its axis.

To the ring B we rigidly secure bearings D D' for supporting an inclined shaft D^2, geared by bevel-wheels D^3 D^4 with a short vertical shaft D^5, Fig. 3, which in turn is geared by bevel-wheels D^6 D^7 with the first driven shaft E. The gear-wheels D^4 D^6 D^7 are supported by the bracket B^2, and the spur-wheel D^7 is connected to the shaft E by means of a feather and keyway to admit of it being moved horizontally independently of the shaft when the ring B is adjusted transversely, as hereinbefore described.

The shaft D^2 is formed hollow for a portion of its length to receive a shaft F, capable of moving longitudinally in the said shaft, but not of rotating independently of it, being provided with a feather fitting a keyway in the shaft D^2. The upper end of the shaft D^2 is enlarged so as to form a cup or socket D^8, Fig. 3, upon whose exterior is keyed or otherwise secured a conical roller G, formed in one part with a bevel gear-wheel G', which gears with a similar wheel H', formed in one with a cylindrical roller H. The roller H is formed with hollow bosses H^2, which are received in holes formed eccentrically in rotatably-adjustable bearings or bushes H^3, rigidly connected together by a shaft H^4, which passes through the bosses H^2. The bushes H^3 are mounted in bearings H^6, provided on a piece B^4, which is rigidly connected to the ring B and which also carries the before-mentioned bearing D'.

The roller H can be moved nearer to or farther from the roller G to cause the two rollers to bear with more or less pressure upon the metal bar X being operated upon between them. The movement of the bushes H^3 to shift the roller H for this purpose can be effected by mechanism such as is hereinafter described.

Within the upper part of the ring B is provided a plate or frame J, which is mounted in or on segmental guides B^5, Fig. 2, so as to admit of it being partly rotated about and concentrically with the axis of the said ring. On the frame J is secured a curved rack J', engaging with a worm J^2, mounted on a shaft J^3, this shaft being supported in bearings B^6, secured to or formed in part with the ring B. The shaft J^3 is connected by a universal or flexible joint J^4 to a horizontal shaft J^5, which is connected by a feather and groove to a worm-wheel J^6, gearing with a hand-rotated worm J^7, which, like the worm-wheel C', is mounted in bearings secured to two of the main frame-standards A'.

K, Fig. 3, is an inclined shaft which is free to rotate in a bearing J^8, rigidly secured to the above-named movable frame J, and which is formed with a passage centrally within it, as shown in Fig. 4, for receiving a shaft L, which is capable of sliding longitudinally within but not of rotating independently of the shaft K, there being a key-and-feather connection between the shafts K and L, like the connection between the shafts F and D^2, hereinbefore referred to.

The shaft K is formed in one part with or has secured to it a conical roller K' and bevel gear-wheel K^2, the latter of which gears with a bevel-wheel M, formed in part with a conical roller M'.

The shafts F and L are connected together by a universal or flexible joint L', which admits of them rotating in unison—*i. e.*, rotating with equal mean peripheral velocities—at the parts with which they act on the metal being treated whatever position the shaft L may bear in relation to the shaft F.

The roller M' is capable of being adjusted nearer to or farther from the roller K' in a manner similar to that in which the before-described roller H is adjustable in relation to the roller G. For this purpose the hollow bosses M^2 of the roller M' are mounted eccentrically in rotatably-adjustable bushes M^3, rigidly connected together by a shaft M^4, passing through the bosses M^2, and the bushes M^3 are mounted in bearings J^9, secured to the before-described frame J. The eccentrically-bored bushes M^3 and H^3 may be adjusted in a rotary direction by any suitable means.

At the front and back of the ring B and parts directly connected therewith we provide two sets of rollers N' N^2 N^3, of which the following description of one set will suffice for both: The rollers N' N^2 N^3, Fig. 1, of each set are pivoted in a plate or frame N, Fig. 5, which is itself pivoted in bearings A^6, carried one by a bar A^3 and the other by a bracket A^7, secured to the base-plate A. The roller N' is in substantially the form of a double cone and adapted to bear against the edge and inner surface of the web *x* and the inner surface of the flange *x'* of the angle-iron X when these two members are at a right angle to each other, as shown in Fig. 1. The roller N^2 is conical, the angle of its periphery corresponding with the greatest angle at which the flange *x'* is required to lie in relation to the web *x*. The roller N^3 is cylindrical and is

adapted to bear against the under side of the web x whether the flange x' is or is not perpendicular to the said web.

O is a scale-rod secured to the ring B, which, in conjunction with a suitable index, Figs. 2 and 3, serves to indicate the horizontal adjustment of the rollers G H K′ M′, and O^2 is a segmental scale also secured to the ring B, O^3 being a pointer secured to the frame J, Fig. 1, which, in conjunction with the scale O^2, serves to indicate the angular adjustment of the rollers K′ M′ in relation to the rollers G H.

The operation of the before-described apparatus is as follows: Supposing it is desired to bend the angle-iron bar only in the plane of the web x without disturbing the angular relation of the flange x' to the web, the ring B is moved horizontally by means of the worm-shaft C^2, nut C, and screw B^3, so as to bring the rollers G H K′ M′ into such a position in relation to the rollers N′ N^2 N^3 as will impart the necessary curve to the bar passed through the machine, the web x and flange x' being at all times properly supported by the rollers N′ N^3 G H K′ M′ to prevent any accidental distortion. This bending may be varied at different parts of the bar, the operator manipulating the work-shaft C^2 according to the particular curvature desired to be given to the bar in the plane of the web x. Supposing that it is desired to alter the angle of the flange x' in relation to the web x, this is effected by rotating the worm-shaft J^7 so as to cant over the rollers K′ M′ from the present position in relation to the rollers G H and N′ N^2 N^3, so that the flange x' will be angled outward from the web x, as shown at the right-hand side of Fig. 4. By the canting of the roller K′, as described, relatively to the roller G their faces will no longer be, as in Fig. 3, parallel to each other, nor will their centers be as close together as in that figure. The provision of the shafts F and L and the universal joint L′ will, however, keep the rotation of the rollers G′ K′ in unison throughout the angular adjustment of their axes of rotation and their endwise movement relatively to each other in the plane of the ring B. The worm-shaft may be operated while the bar X is passing through the machine, so that the flange x' may be at different angles to the web x at different parts of its length, according to the particular form which it is desired to give to the bar. If the rollers G H K′ M′ do not grip the bar sufficiently to move it through the machine, the "grip" may be increased by rotating the eccentrically-bored bushes H^3 M^3, aforesaid.

With reference now to Fig. 6, in which the bar X being operated upon is of Z-section, one flange x' is operated upon by a pair of rollers G H, geared together, as shown, to rotate at the desired peripheral velocity and in the desired direction by gear-wheels G′ g^2 g' and h' H′. The said gear-wheels are mounted on shafts carried in bearings upon a frame V, movable in a ring B, like the frame J of Fig. 1 and by similar means. In this example the point upon which the frame V and rollers G H turn should be at the junction of the flange x' with the web x, the inside of the ring B and the guide on which the frame V turns being of such an arc as to permit of this movement. At the opposite side of the apparatus is a pair of rollers K′ M′, similar, respectively, to the rollers H and G and carried in a frame S, adjustable like the frame V, but arranged to turn about the point of junction of the flange x^2 with the web x.

By turning either of the frames S or V with their respective rollers H G or K′ M′ about the point of junction of one or the other of the flanges with the web x the flange can be bent outward from the web to the desired angle.

To support the web x and assist in forcing the bar X through the machine, two rollers h^3 k^3 are employed, they being supported at opposite sides of the web in suitable bearings on the ring B and arranged at such an angle and so shaped as to permit the rollers H and K′ to bear on the inside of the flanges of the bar. The rollers h^3 k^3 are rotated by gear-wheels h^4 k^4, which engage with sunk teeth k^6 h^6 in the faces of the rollers, so as to permit the said rollers to be rotated close to the rollers H and K′. Auxiliary rollers h^5 k^5 are mounted in bearings on the frame B and so arranged as to bear on the rollers h^3 k^3 at the side of each roller opposite to that which bears upon the work. Auxiliary rollers thus employed neutralize the tendency of the rollers h^3 k^3 to slue out of the plane in which they are placed and to stress their bearings unduly.

In this machine the driving-shaft E is duplicated, as at E′, and a bevel-wheel D^8 is employed on each for the purpose of giving motion to the gear-wheels k^7 h^7 h^4 k^4, by which the rollers h^3 k^3 are operated. The other rollers G H K′ M′ are actuated by gear-wheels D^7, arranged on the shafts E E′ and gearing with wheels D^3 on shafts D^2. The connections between the shafts D^2, on which the wheels D^3 are secured and the gearing carried by the frames V and S are universal-joint connections similar to those described with reference to the connection of the driving-shaft L in Fig. 3 with the shaft K in the same figure, the parts being correspondingly lettered, so that no further description of the driving mechanism is here necessary.

We claim—

1. In a machine such as described, the combination with the main frame, of the roller-frame having segmental guides and the supplemental roller-frame mounted in said guides and movable independently of the main roller-frame to adjust the supplemental frame angularly with relation to the work operated upon; substantially as described.

2. In a machine such as described, the combination with the main frame, of the roller-frame having segmental guides, mechanism

for moving the roller-frame horizontally the supplemental roller-frame mounted in the guides on the roller-frame and mechanism for adjusting the position of the supplemental frame angularly with relation to the work operated upon; substantially as described.

3. In a machine such as described, the combination with the main frame, of the roller-frame, having the segmental guides, the supplemental roller-frame mounted in said guides and mechanism for simultaneously adjusting the roller-frame horizontally and the supplemental frame angularly with relation to the work operated upon; substantially as described.

4. In a machine such as described, the combination with the main frame, of the frame carrying the fixed guide-rollers, the supplemental frame carried thereby and movable in an arc at right angles to the work fed through the guides, and the forming-guides carried by the supplemental frame substantially as described.

5. In a machine such as described, the combination with the main frame of the circular roller-frame, mechanism for moving said frame horizontally and guides for said circular frame; substantially as described.

6. In a machine such as described, the combination with the base-plate and bridge-bar, of the main frame having the guides therein, of the circular frame having the bracket and rib or projection thereon, received respectively in the guides of the base-plate and bridge-bar, the non-rotating screw secured to said ring, the nut with which the screw engages, the worm-wheel and shaft; substantially as described.

7. In a machine such as described, the combination with the main frame, of the circular ring, the plate or frame mounted in guides in the upper part of the ring, the curved rack mounted on the plate, the shaft carrying the worm meshing with said rack and means for rotating the shaft whereby the plate may be partially rotated; substantially as described.

8. In a machine such as described, the combination with the main frame, of the circular ring, the plate mounted in guides in the upper part of the ring, the curved rack mounted on the plate, the worm-shaft mounted on the ring, the shaft for driving said worm-shaft, the universal connection between said shafts, the worm-wheel, and the feather-and-groove connection between said worm-wheel and driving-shaft; substantially as described.

9. In a machine such as described, the combination with the main frame, of the circular ring, the hollow inclined shaft D^2 supported in bearings on the ring, the shaft F received within the shaft D^2 movable longitudinally therein but not independently rotatable, the frame J carried by the ring, the inclined shaft carried by said frame and having a central passage, the shaft K received therein, and the universal connection between the shafts K and F; substantially as described.

10. In a machine such as described, the combination with the circular ring, the hollow inclined shaft D^2, having the enlarged end, the roller carried thereby, the bevel-gear thereon, the frame at the lower portion of the ring, the roller H formed with hollow bosses, the eccentrically-bored bushes mounted in bearings on the plate within which are received the bosses of the roller, means for moving the bushes to move the roll nearer to the roller G and gear on the roller H with which meshes the gear on the roll G'; substantially as described.

11. In a machine such as described, the combination with the main frame, the roller-frame movable longitudinally therein, the fixed drive-shaft, the pinion carried by said shaft and movable longitudinally thereon the train of gearing carried by the roller-frame operatively connected with said drive-pinion; substantially as and for the purpose set forth.

In witness whereof we hereto set our hands in the presence of the two subscribing witnesses.

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RICHARD ERNEST CHURCHILL SHANN.

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