C. GABRIEL.

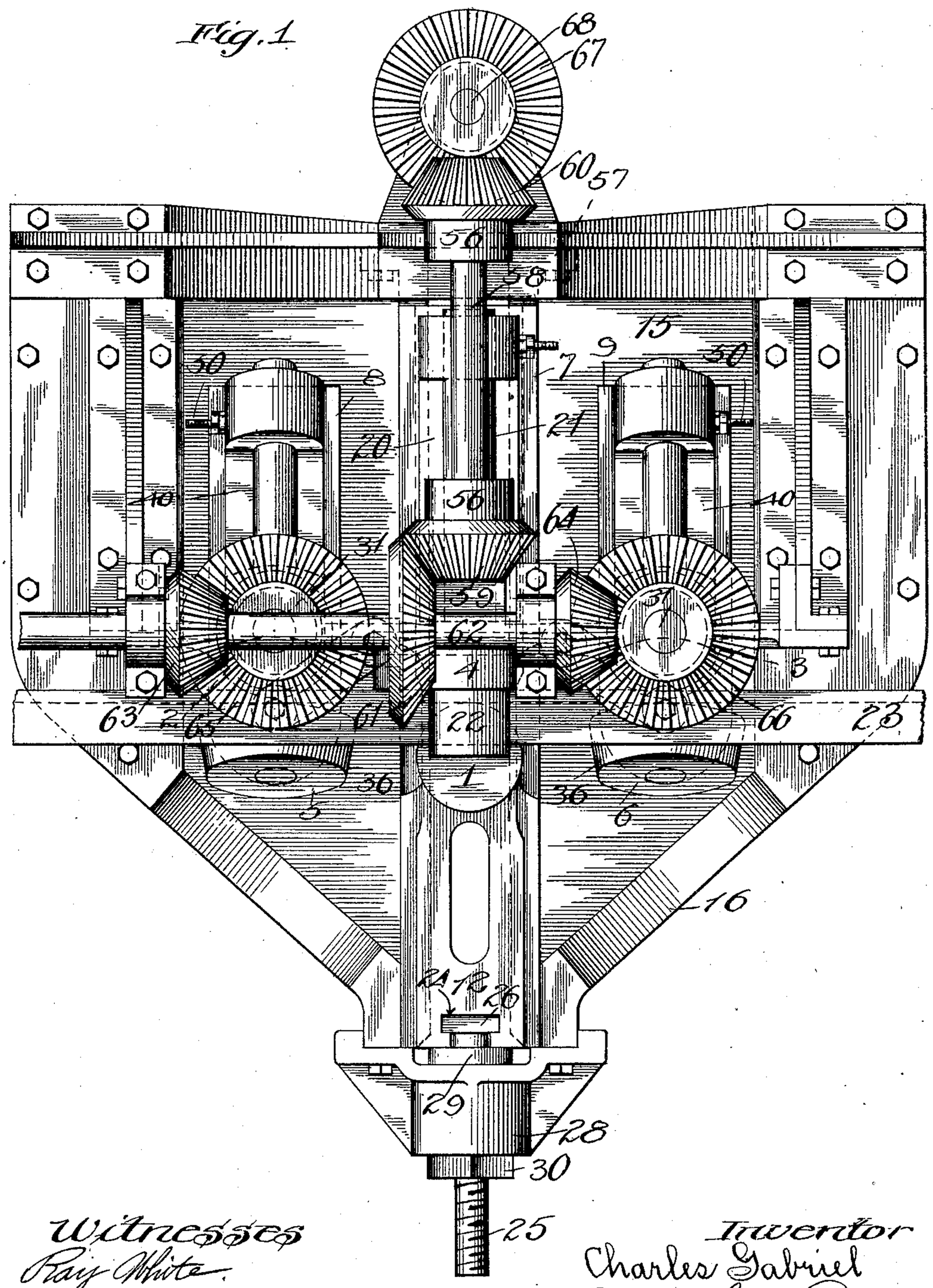
MACHINE FOR BENDING ANGLE IRONS.

APPLICATION FILED MAR. 20, 1908.

924,758. Patented June 15, 1909.

5 SHEETS—SHEET 1.

Fig. 1.



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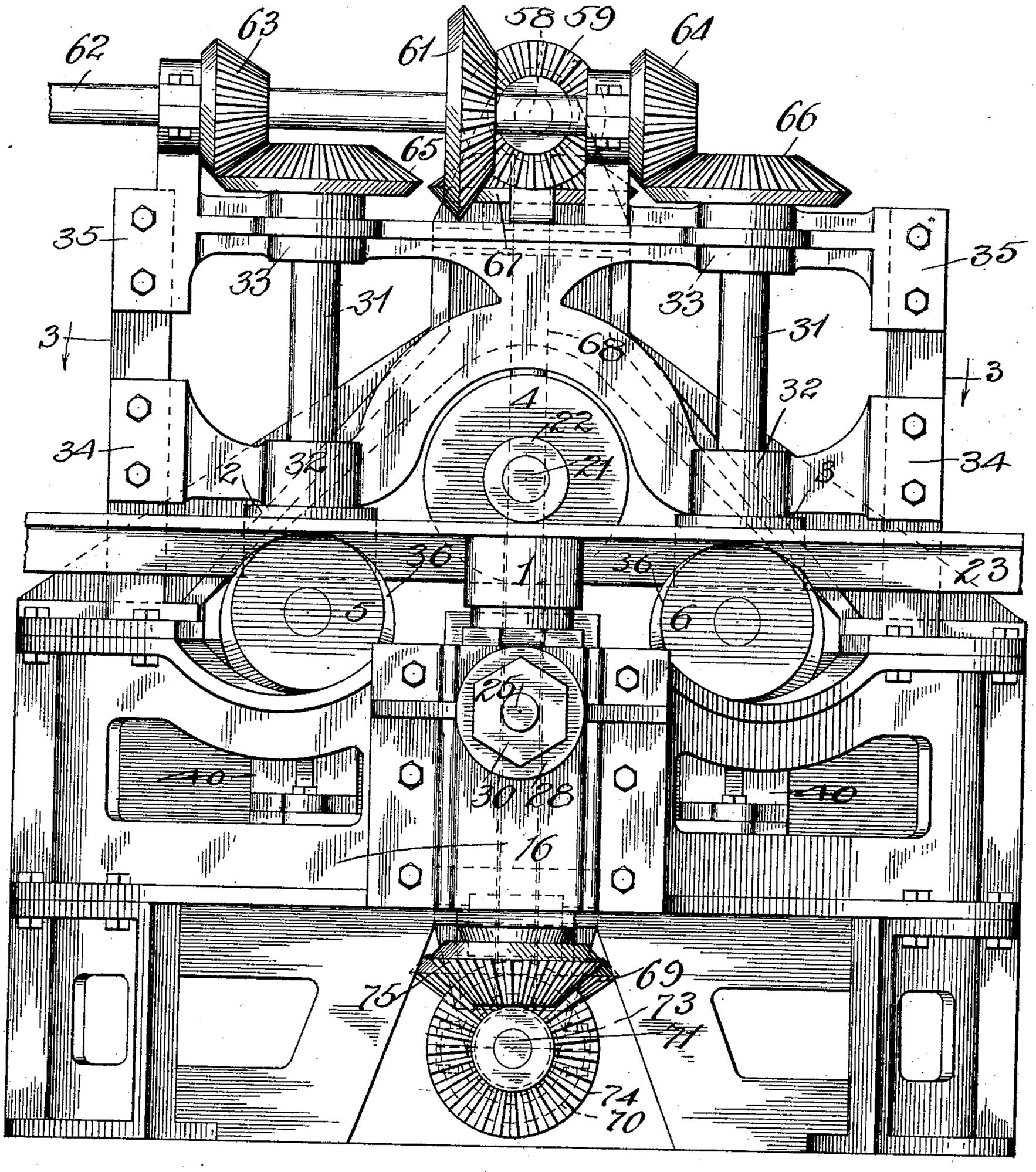
5 SHEETS—SHEET 2.

Fig. 2



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5 SHEETS—SHEET 3.

Fig. 3

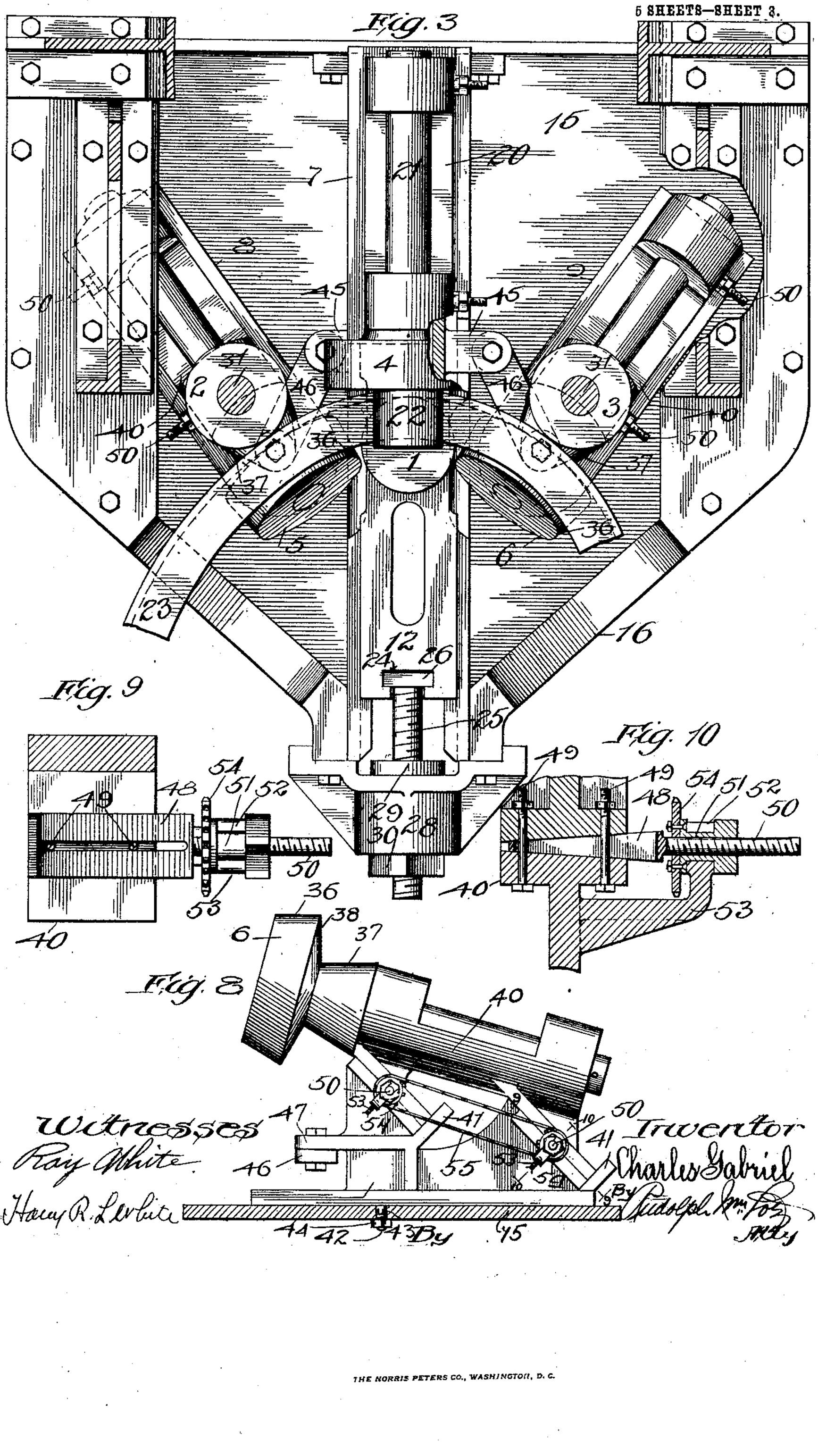

Fig. 9

Fig. 10

Fig. 8

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5 SHEETS—SHEET 4.

Fig 4.

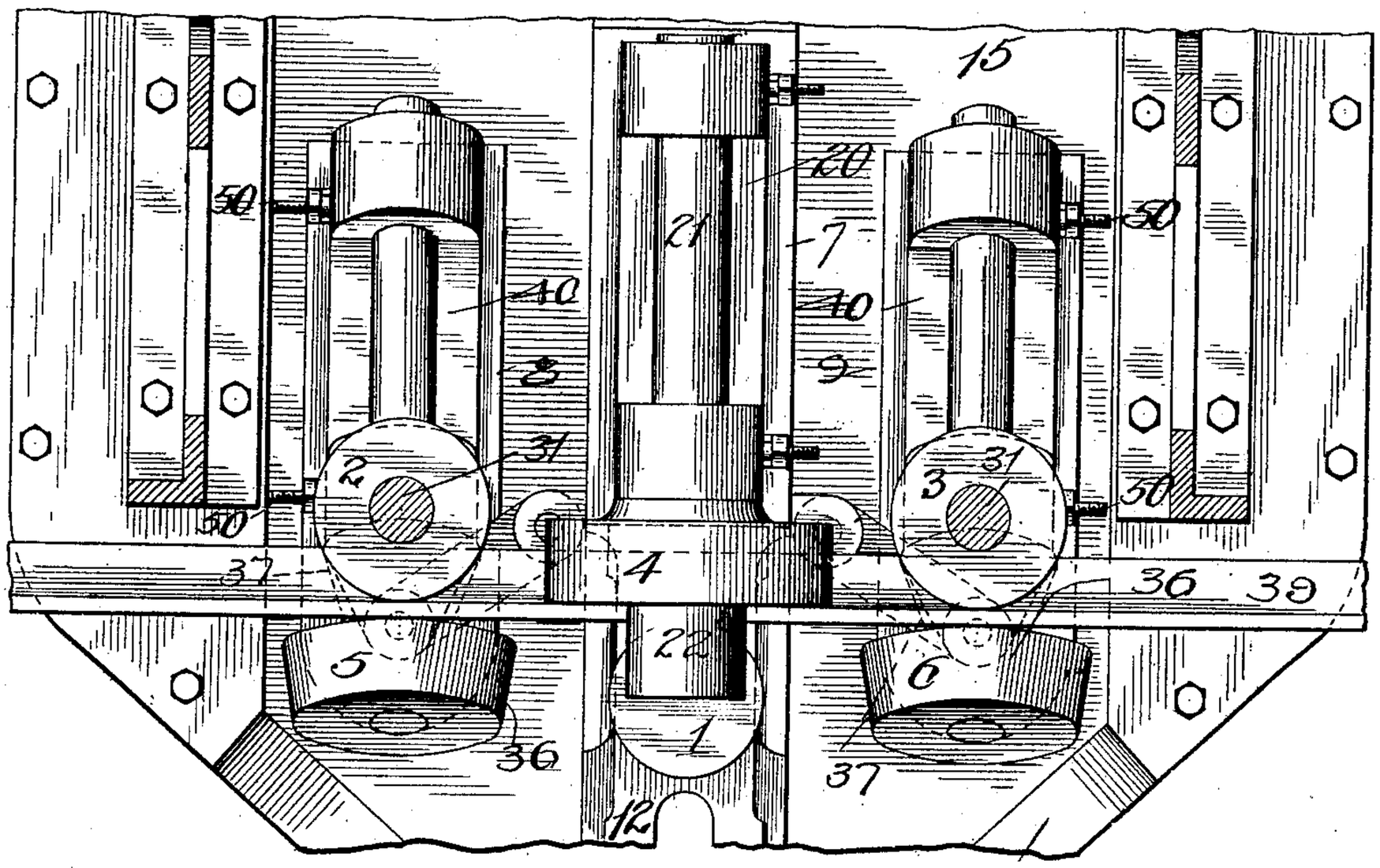
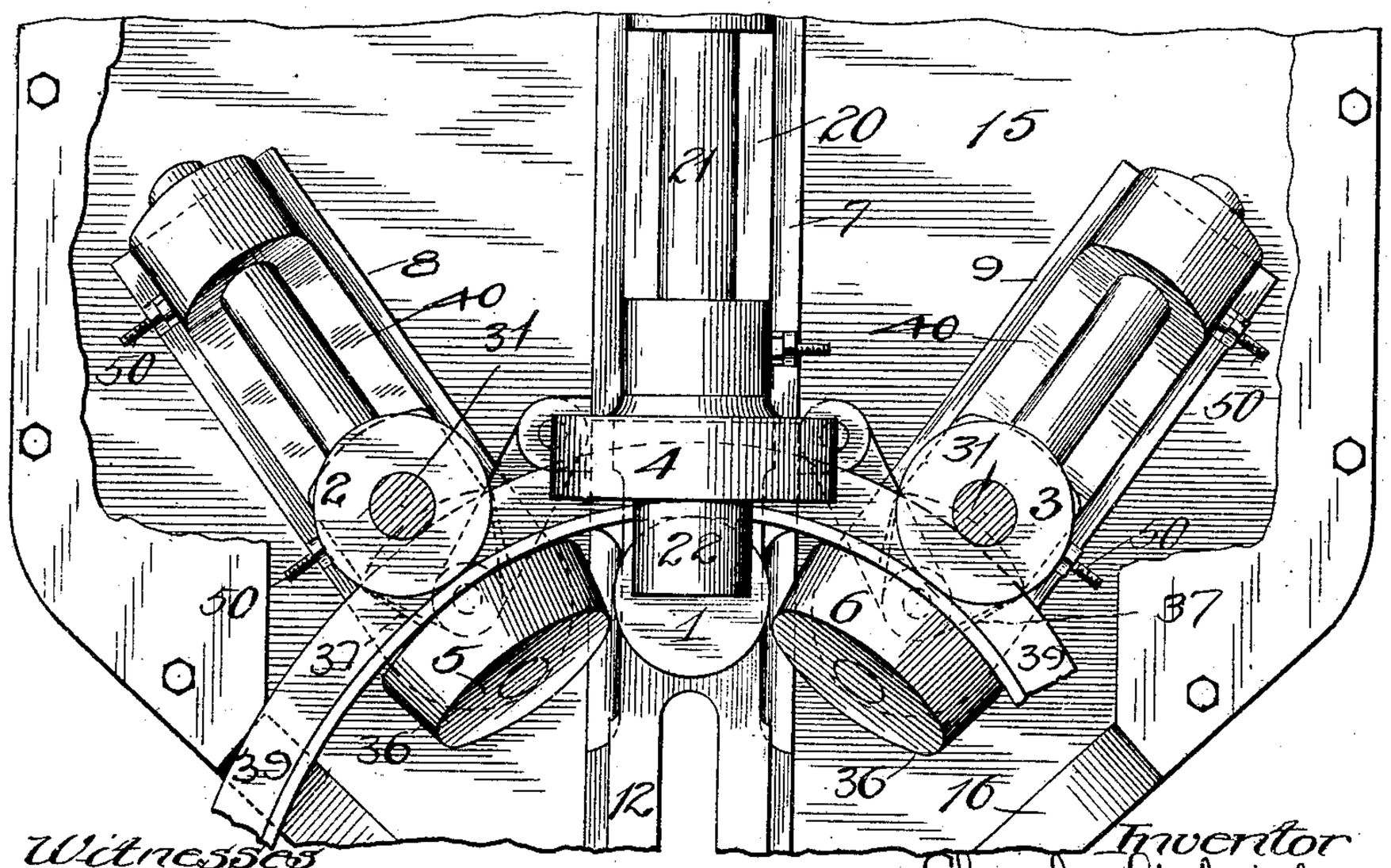


Fig. 5



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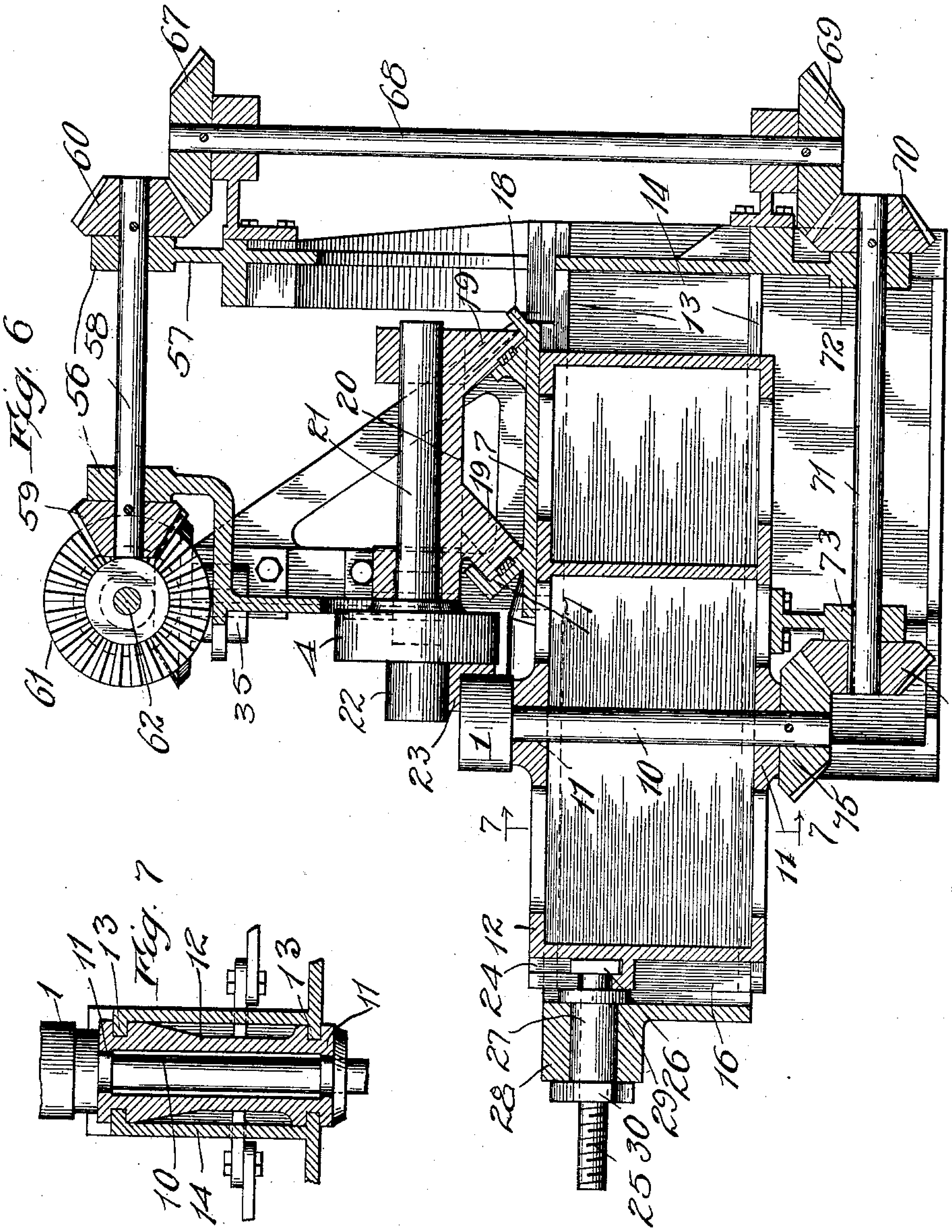
5 SHEETS—SHEET 5.



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UNITED STATES PATENT OFFICE.

CHARLES GABRIEL, OF CHICAGO, ILLINOIS.

MACHINE FOR BENDING ANGLE-IRONS.

No. 924,758. Specification of Letters Patent. Patented June 15, 1909.

Application filed March 20, 1908. Serial No. 422,272.

To all whom it may concern:

Be it known that I, CHARLES GABRIEL, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Machines for Bending Angle-Irons; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a novel construction in a machine for bending angle-irons, the object being to provide a machine whereby angle-irons may be bent to curves of any desired radius within certain limits either flange in or flange out with ease and rapidity and without necessitating a great expense of time to adjust the same to operate upon different sizes of angle-irons, and consists in the features of construction and combinations of parts hereinafter fully described and claimed.

In the accompanying drawings illustrating this invention: Figure —1— is a top plan view of a machine for bending angle-irons constructed in accordance with my invention. Fig. —2— is a front elevation of the same. Fig. —3— is a plan section of the same on the line 3—3 of Fig. —2— showing an angle-iron therein bent flange in. Figs. —4— and —5— are fragmentary plan sections similar to Fig. —3— and show the bending rolls in different positions respectively, the angle-iron shown therein being bent flange out. Fig. —6— is a central vertical longitudinal section of the machine. Fig. —7— is a detail vertical transverse section on the line 7—7 of Fig. —6—. Fig. —8— is a detail side elevation showing the pivoted supports in which the bearings of the idle rolls are mounted and the position of the guides in which said bearings are movable, the top plate of the machine being shown in section. Figs. —9— and —10— are detail sectional views showing the construction of wedges employed for adjusting the bearings of the idle rolls.

The main object of the present invention is to provide a machine for bending angle-irons to any desired curvature either flange in or flange out in such a manner that the planes of the flanges will be maintained perpendicular to each other and that all parts of the horizontal flange will lie in the same plane, the bending pressure being exerted only on the vertical flange of the angle-iron in order to prevent upsetting of the edge of the horizontal flange.

A further object of the invention is to provide means whereby the machine is easily adjusted to receive angle-irons of various dimensions, and also a single adjusting device whereby the relative positions of all bending rolls are simultaneously adjusted to coact with each other to bend the angle-iron to the curve of the desired radius.

Further objects of the invention will appear from the following description.

The machine comprises mainly three driven rolls 1, 2 and 3, disposed on vertical shafts, the shaft carrying the roll 1 being journaled in a bearing by means of which said roll 1 is moved laterally, and three idle rolls 4, 5 and 6 between which and said driven rolls the angle irons are engaged, the shafts of said idle rolls being journaled in bearings supported on movable carriages 7, 8 and 9 respectively. The carriage 7 is movable longitudinally together with the bearing of the roll 1 and the carriages 8 and 9 are capable of swinging and are connected by means of links with the carriage 7 disposed midway between the same so as to move in unison therewith, thus enabling all of the rolls to be simultaneously adjusted to proper relative positions to coact to produce the desired result by means of a single adjusting device, all as will be hereinafter described in detail. This constitutes the most essential feature of the invention.

The roll 1 is cylindrical and vertically disposed having a flat upper face. The shaft 10 of said roll 1 which is preferably integral therewith is journaled in the upper and lower walls of an elongated box 12 which is provided adjacent its upper and lower ends with parallel guide grooves in which the flanges 13 of the guide plates 14 between which said box 12 moves, is received. The said guide plates 14 are preferably integral with the platform 15 of the frame of the machine, and extend centrally longitudinally of the same, the said frame being substantially rectangular in plan and having a V-shaped extension 16. On said box 12 the carriage 7 is rigidly mounted, the latter being equipped with guides 17 and 18 in which the shoes 19 of the bearing 20 are movable in a direction disposed at an angle of forty-five degrees to the horizontal plane in which the axis of the roll 4 is disposed, the direction of movement being such however

as to maintain the said axis in the same vertical plane as that of the roll 1, the shaft 21 of said roll 4 being journaled in said bearing 20. The said roll 4 is stepped, having reduced cylindrical forward ends 22 between which and the upper end of the roll 1 the horizontal flange of the angle-iron 23 is received when the latter is to be bent flange in, the other flange being received between the cylindrical face of said roll 1 and the front face of the roll 4 from which the portion 22 projects.

The direction of movement of the bearing 20 in the guides 18 is such that operating faces of the roll 7 are simultaneously moved equidistantly from the coacting faces of the roll 1 so that angle-irons of various sizes and thickness of flanges may be received between said rolls. On the forward end of said box 12 is an extension 24 in which is a T-shaped recess into which a screw-shaft 25 projects at one end, the latter being equipped with a square head 26 engaging the side walls of the wider portion of the recess to hold said screw-shaft against rotation relatively to said box. The said screw-shaft passes through the threaded sleeve 27 journaled in a bearing 28 in the free end of said V-shaped extension 16 of the frame, and is held against longitudinal movement relatively to the latter by means of the flanges 29 and 30 at its ends, said flange 30 being polygonal to receive a wrench by means of which said sleeve is turned to impart longitudinal movement to said screw-shaft and thereby to said box 12. The rolls 2 and 3 are also vertically disposed and cylindrical and have flat lower faces, the shaft 31 thereof being integral therewith and journaled in bearings 32 and 33 in the crossbars 34 and 35 respectively, which at their ends are secured to uprights of the frame. Said rolls 2 and 3 are disposed at either side of the roll 1 and equidistantly therefrom but the shafts thereof extend upwardly instead of downwardly therefrom. Coacting with said rolls 2 and 3 are the idle rolls 5 and 6 the axes of which are disposed at an incline to the axes of said rolls 2 and 3. Said rolls 5 and 6 are each stepped to provide faces 36 and 37 rotating in horizontal planes at their highest points, said planes being disposed at different elevations, to provide an intermediate face 38 which at its highest portion rotates in a vertical plane and coacts with the cylindrical face of the roll 2 or 3. The vertical flange of the angle-iron 23 is received between the latter and the opposing face 38 of the roll 5 or 6 respectively, the faces 37 of the latter coacting with the lower faces of the rolls 2 and 3 to receive the horizontal flange of the angle-iron 39 to be bent flange out, and the vertical flange of the angle-iron being always engaged by the same vertical faces of the rolls. The horizontal flange is engaged by different horizontal faces according to whether it is to extend inwardly or outwardly with relation to the vertical flange.

The bearings 40 in which the shafts of the rolls are journaled, are similarly movable at an angle of forty-five degrees in the guides 41 of the carriages 8 and 9 each of which is capable of swinging laterally on a pivot 42 consisting of a threaded projection on the carriage passing through an opening 43 in the platform 15 and having a nut 44 on its lower end said projection being disposed in vertical alinement with the axis of the roll 2 or 3 and also in vertical alinement with the axis of the roll 5 or 6 supported by said carriage. The axes of the rolls 2 and 5 lie in and are always maintained in the same vertical plane by this means as will be obvious. It is essential also, however, that the said vertical plane in which the last named axes lie (and likewise the plane in which the axes of the roll 3 and 6 lie) should extend substantially radially of the curvature to be imparted to the angle-iron. To effect this I have devised a very simple means comprising projections 45 on both sides of the box 12 which are pivotally connected at their other ends with links 46 pivotally connected at their other ends with projections 47 at the forward ends of the said carriages 8 and 9. The length of said links and the relative disposition of the pivots of the same have been carefully located so that a given degree of longitudinal movement of the box 12 will swing the said carriages sufficiently to cause the vertical plane of the axes of the rolls 5 and 6 to extend substantially radially of the curvature to be imparted to the angle-iron.

The adjustment of the rolls 4, 5 and 6 relatively to the rolls 1, 2 and 3 to accommodate angle-irons of different thicknesses is preferably effected by means of wedges 48 inserted between the lower faces of the shoes or projections of the bearings and the opposing faces of the guides, said faces being oppositely inclined to correspond with the taper of said wedges, the latter being longitudinally slotted to permit the passage of bolts 49 by means of which the bearings are firmly held in position on the carriages after being properly adjusted. Said wedges are equipped with threaded projections 50 at one end which pass through the threaded sleeves 51 journaled in U-shaped recesses 52 in the free ends of arms or brackets 53 of the carriages, said sleeves being provided with flanges at their ends to hold the same against longitudinal movement relatively to the said arms or brackets. The sleeves 51 actuating each pair of said wedges are preferably geared to each other by means of sprockets 54 and chains 55 in an obvious manner and for obvious reasons.

The rolls 1, 2 and 3 are driven as follows: Journaled in bearings 56 disposed upon crossbars 35 and 57, is a horizontal shaft 58 ex-

tending longitudinally of the machine and which is suitably geared to a source of power, preferably a reversible electric motor. This shaft carries bevel pinions 59 and 60 at its ends, said bevel pinion 59 meshing with the bevel gear 61 on the horizontal shaft 62 which in turn carries bevel pinions 63 and 64 meshing with the bevel gears 65 and 66 on the upper ends of the shafts 31 of the rolls 2 and 3. The bevel pinion 60 meshes with the bevel gear 67 on the upper end of a vertical shaft 68 carrying a bevel gear 69 at its lower end which meshes with the bevel pinion 70 on the horizontal shaft 71 journaled in a bearing 72 in the lower part of the frame, and in a bearing 73 carried by said box 12. On said shaft is a bevel pinion 74 which is slidable thereon, but rotatably rigid therewith, and meshes with the bevel gear 75 on the lower end of the shaft 10, all of said driven rolls serving to move the angle-iron in the same direction.

The frame may be of any suitable shape and reinforced in any suitable manner to impart the desired strength.

The angle-irons are bent cold and, hence, the bending thereof must be gradual. Accordingly, the rolls after having primarily been adjusted to accord with the thickness of the angle-iron to be operated upon, are primarily relatively positioned as shown in Fig. —1— and the straight angle-iron inserted so as to pass between the rolls of each three pairs 2—5, 1—4 and 3—6 respectively. The sleeve 28 is then operated to move the box 12 slightly rearwardly so as to slightly bend the angle-iron and the machine is then started and the angle-iron passed through and a slight curvature imparted thereto throughout its length. Usually a number of said angle-irons are to be bent to the same radius, and accordingly, the entire lot are similarly treated, all being passed through the machine in the same direction successively. After passing the last of the lot through the rolls are left in the last position and the angle-irons again inserted, the rolls adjusted to impart smaller radius and the motor then reversed, the radius being thus gradually increased until the desired smallest radius has been imparted to all of the angle-irons. It will be noted that the flanges of the latter are maintained by the rolls always perpendicular to each other or vertically and horizontally respectively so that buckling of the horizontal flange is impossible, and further that all pressure is exerted on the faces in contra-distinction to the edges of the flanges, this being very essential as pressure exerted on the edges upsets the latter and is very objectionable.

The machine is very simple and efficient and very easily adjusted and operated.

I claim as my invention:

1. In a machine of the kind specified, the combination with three driven rolls engaging opposite faces of the web of an angle iron, the end and middle rolls being relatively movable to bend said web, of idle rolls disposed in coactive relation to said driven rolls to confine the said web therebetween, said driven and idle rolls being equipped with surfaces disposed transversely to the web engaging surfaces and serving to confine the flange of the angle-iron to prevent distortion thereof during the bending operation.

2. In a machine of the kind specified, the combination with three driven rolls adapted to engage the web of an angle-iron on opposite sides thereof, rotating on axes extending parallel with the plane of the web, the middle and end rolls being relatively adjustable to distort said web, of idle rolls coacting with said driven rolls to confine said web between opposed surfaces, said idle rolls rotating on axes extending angularly to the axes of said driven rolls, said driven and idle rolls having surfaces extending transversely to the web engaging surfaces thereof and engaging opposite sides of the flange of the angle iron to confine the same and prevent distortion thereof.

3. In a machine of the kind specified, the combination with three driven rolls adapted to engage the web of an angle iron on opposite sides thereof, rotating on axes extending parallel with the plane of the web, the middle and end rolls being relatively adjustable to distort said web of idle rolls coacting with said driven rolls to confine said web between opposed surfaces, said idle rolls rotating on axes extending angularly to the axes of said driven rolls, said driven and idle rolls having surfaces extending transversely to the web engaging surfaces thereof and engaging opposite sides of the flange of the angle iron to confine the same and prevent distortion thereof, and adjusting means disposed in operative relation to said idle rolls to move them toward and away from said driven rolls to accommodate angles of various thicknesses.

4. In a machine for bending angle irons, a middle and two end pairs of bending rolls engaging the web and flange of the angle iron to be bent, one roll only of each pair being driven, the driven rolls engaging the web of the angle iron on opposite sides thereof and rotating on axes disposed parallel with the plane of said web, carriages supporting the idle rolls of the end pairs, said carriages being pivotally movable on axes coincident with the axes of rotation of the driven rolls of the end pairs, and adjusting means imparting movement to said roller pairs to distort the web of the angle iron, said means actuating said carriages to angularly shift the said idle rolls of the end pairs in accordance with varying radii of curvature of said angle iron.

5. In a machine of the kind specified, a

middle and two end pairs of bending rolls adapted to engage the web and flange of an angle iron, one roll only of each pair being driven and engaging the web of the angle iron on opposite sides, the axes of rotation of said driven rolls being parallel with the plane of the web, the axis of rotation of the idle roll of each pair extending angularly to the axis of the driven roll thereof, carriages supporting the idle rolls of the end pairs, said carriages swinging on pivots coincident with the axes of the driven rolls of said pairs, means for adjusting the relative positions of said roller pairs to distort the web of the angle iron, said adjusting means actuating said carriages to angularly shift the latter to maintain the axes of said idle rolls of the end pairs, radially disposed relatively to the curvature of the angle iron.

6. In a machine of the kind specified, the combination with two driven rolls having their peripheral and lateral surfaces rotating in common planes respectively, and a driven roll disposed midway between the first named rolls and having peripheral and lateral surfaces disposed in coactive relation to the corresponding surfaces of the latter, the said surfaces of said middle roll engaging the angle iron on opposite faces from those engaged by said first named rolls, of idle rolls corresponding in number with and having peripheral surfaces coacting with the peripheral and lateral surfaces of said driven rolls to receive and act upon both flanges of an angle-iron, and means common to said driven and said idle rolls to simultaneously shift the relative positions of outer and middle sets of rolls to distort the angle-iron.

7. In a machine of the kind specified, the combination with three driven rolls each provided with surfaces disposed at an angle of ninety degrees to each other and adapted to simultaneously engage both flanges of an angle-iron, one flange thereof being engaged on opposite sides by the outer and middle rolls respectively, and three idle rolls having similarly disposed surfaces engaging the other faces of the flanges of the angle-iron, of means common to said driven and said idle rolls for simultaneously shifting the relative positions of the middle and outer rolls to distort the angle-iron.

8. In a machine of the kind specified, the combination with three driven rolls each provided with surfaces disposed at an angle of ninety degrees to each other and adapted to simultaneously engage both flanges of an angle-iron, one flange thereof being engaged on opposite sides by the outer and middle rolls respectively, and three idle rolls having similarly disposed surfaces engaging the other faces of the flanges, of the angle-iron, said idle rolls being adjustable toward and away from said driven rolls at an angle of forty-five degrees to the axes of the latter to accommodate angle-irons of various thicknesses between said rolls, of means common to said driven and said idle rolls for simultaneously shifting positions of the middle and outer rolls to distort the angle-iron.

9. In a machine of the kind specified, the combination with two driven vertically disposed cylindrical rolls mounted upon the lower ends of vertical shafts and having plane horizontal lower faces, the shafts of said rolls being journaled in fixed bearings, a middle stepped cylindrical vertically disposed roll disposed upon the upper end of a vertical shaft and having a plane horizontal upper face and shoulder disposed at different elevations, the shaft of said middle roll being journaled in a bearing movable in a plane adapted to maintain said middle roll always equidistant from the first named rolls, idle rolls having peripheral surfaces coacting with the vertical and horizontal faces of said driven rolls, the shafts of the two outer idle rolls being journaled in bearings swinging on pivots concentric with the axes of said outer driven rolls, the shaft of the middle idle roll being journaled in a bearing fixed with relation to the bearing of the shaft of the middle driven roll, and connection between the latter, whereby said bearings of the outer idle rolls swing the latter, whereby all of said idle rolls are maintained in coactive relation to said driven rolls.

10. In a machine of the kind specified, the combination with three driven vertically disposed cylindrical rolls, the outer and middle rolls being relatively so disposed that when the peripheral surfaces of said outer rolls engage the outer face of the vertical flange of an angle-iron the inner face of the horizontal flange rests upon the end surface of the middle roll and the inner face of the vertical flange is engaged by the peripheral face of said middle roll, the position of the latter being shiftable in a direction to distort said vertical flange, of idle rolls coacting with said driven rolls and adjustable relatively to the latter simultaneously with said middle roll to distort said angle-iron, said idle rolls coacting with said driven rolls to maintain proper relative position, whereby said horizontal flange is bent simultaneously with said vertical flange.

In testimony whereof I have signed my name in the presence of two subscribing witnesses.

CHARLES GABRIEL.

Witnesses:

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