Sept. 1, 1959 F. VITELLI 2,902,076

BENDING MACHINES

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FIG_1

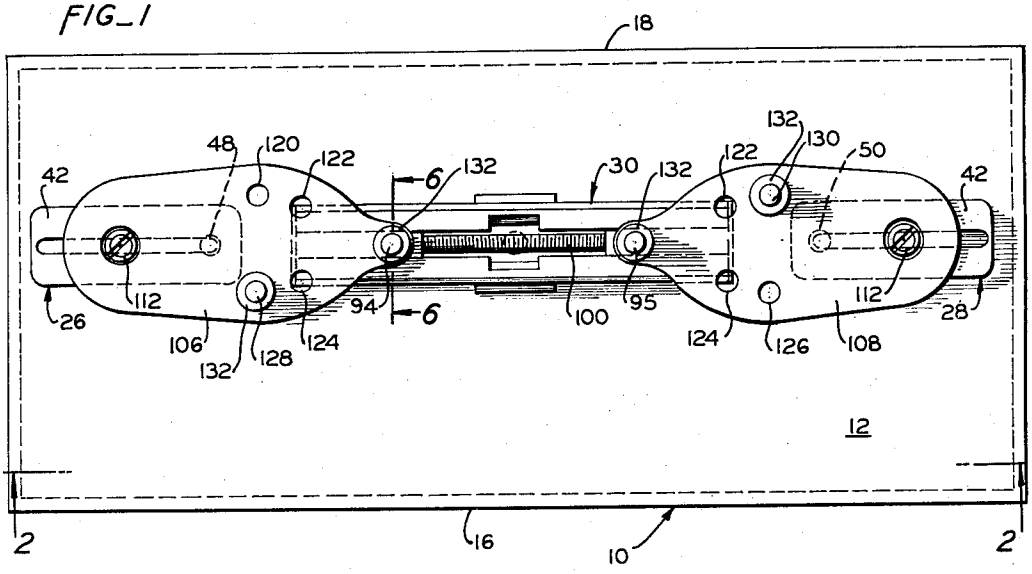
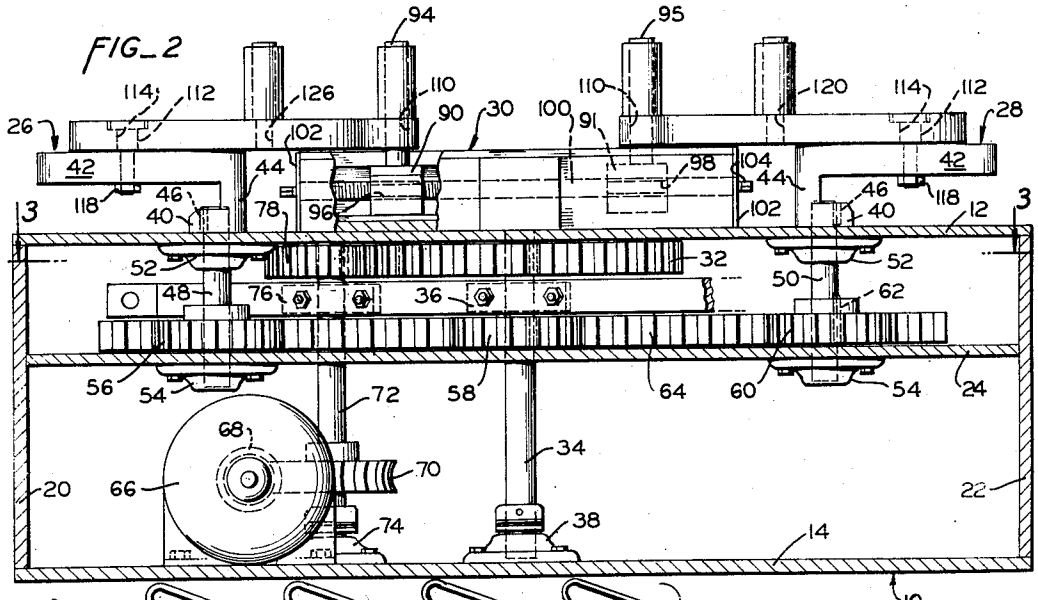


FIG_2



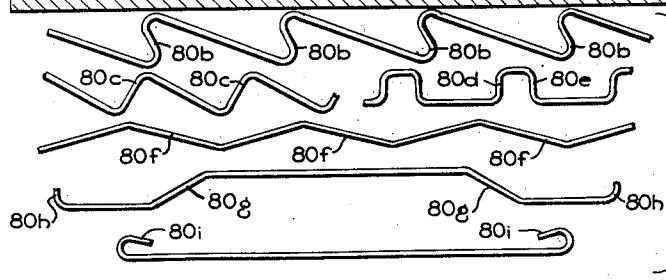


FIG_10

INVENTOR.
FRANK VITELLI

BY Naylor & Neal

ATTORNEYS

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FIG_3

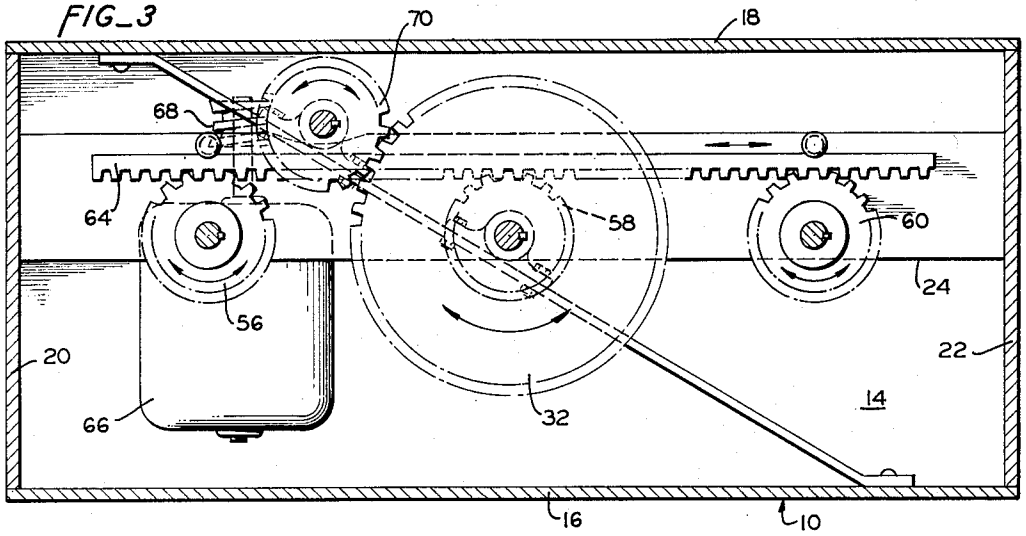


FIG_5

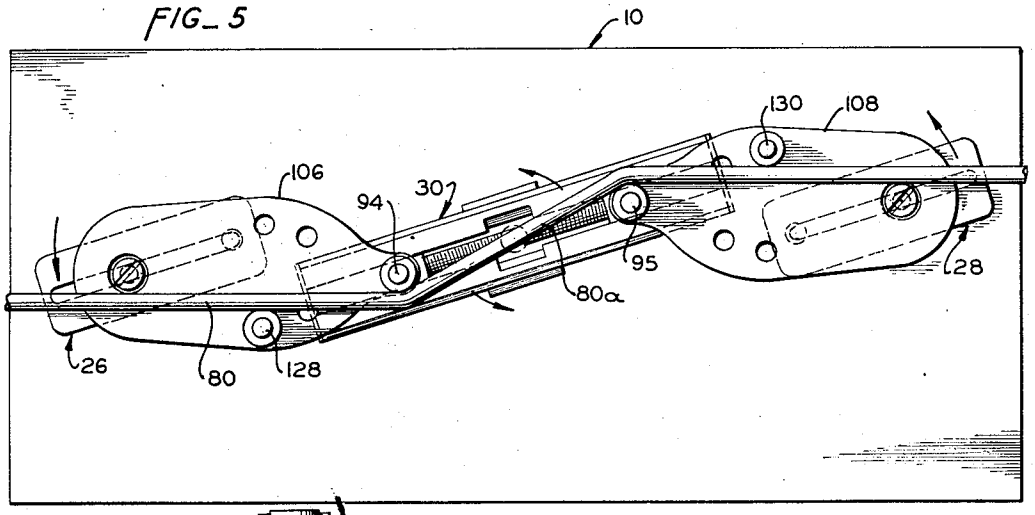
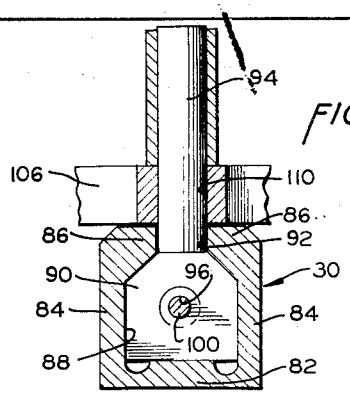


FIG_6



INVENTOR.
FRANK VITELLI

BY Naylor & Neal

ATTORNEYS

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FIG_4

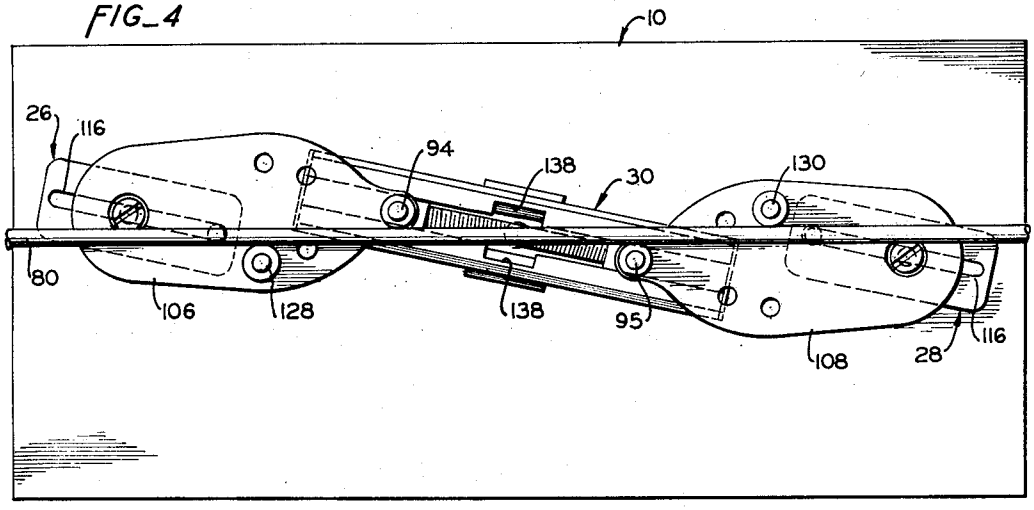


FIG_9

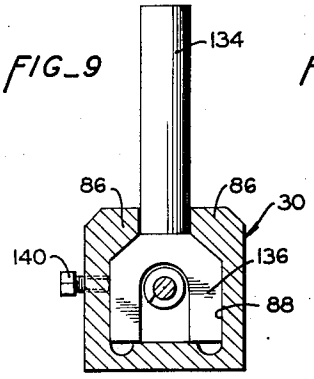
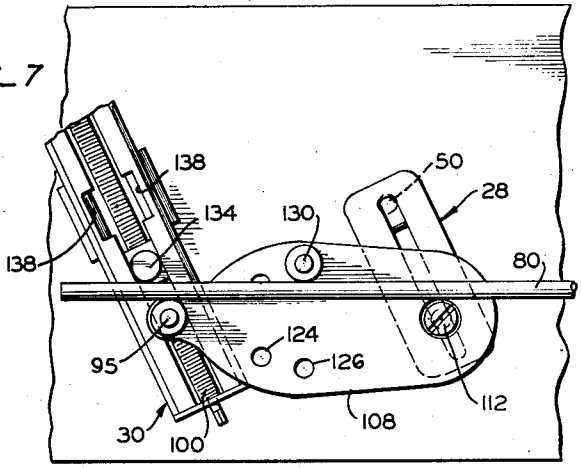


FIG_7



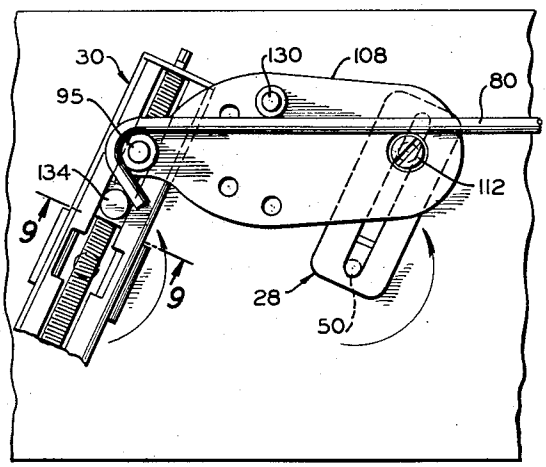


FIG_8

INVENTOR.
FRANK VITELLI

BY Naylor & Neal

ATTORNEYS

United States Patent Office 2,902,076 Patented Sept. 1, 1959

2,902,076

BENDING MACHINES

Frank Vitelli, Redwood City, Calif.

Application February 26, 1957, Serial No. 642,596

7 Claims. (Cl. 153—20)

This invention relates to improvements in bending machines of the type which are used for the bending of concrete-reinforcing bars, or rods.

The subject bending machine constitutes an improvement in many ways over the bending machine invented by me and forming the subject matter of U.S. Patent No. 1,863,513, now expired. The machine hereinafter described enables the attainment of all of the objects and advantages mentioned in said patent concerning the earlier machine and in addition makes possible the attainment of further objects and advantages which are very important from the standpoints of efficiency and speed of operation.

Concrete-reinforcing bars are employed in sizes up to one inch in diameter and sixty feet in length. Bars of this size weigh about 160 pounds. It is customary to provide such bars with multiple bends, with one or two bends being formed at a time. The bending of a bar into the desired form thus calls for a plurality of operations of the bending machine and manual repositioning of the bar with respect to the bending elements of the machine between successive bending operations.

Other things being equal, the desirability for commercial use of one bending machine over another is dictated by the time required to complete the bending of a bar into a predetermined pattern. The operational time required is in direct proportion to the manual labor required to manipulate and reposition the bar to condition it for the successive bending operations.

In the case of some bending machines, as for example, the aforementioned machine of my invention, the manual labor required for bar manipulation is considerable and in some instances is excessive to the point where it is not profitable to employ the machine. One inherent disadvantage of this earlier machine is that the bar is bodily swung around during the formation of a bend. This not only requires that sufficient free space be provided adjacent the machine to prevent the swinging bar from striking anything, but also requires that the bar be lifted and reversely swung manually before it is advanced in the machine for the next bending step. A further limitation of this earlier machine is that it is necessary to turn the bar over manually in order to position the bar to receive a bend which is reverse in direction to that of the preceding bend imparted to the bar. It is when the desired bar bending pattern consists of bends in both directions that it becomes particularly unprofitable to competitively employ this earlier machine.

Among the principal objects and advantages of this invention are the following: the provision of a bending machine in which a bar remains parallel with the longitudinal axis of the machine at all times during a bending operation; and the provision of a bending machine adapted to impart reverse bends to a bar without the necessity of manually turning the bar over in the machine to position it to receive such reverse bends.

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with the drawings forming part of this specification, and in which:

Figure 1 is a top plan view of a bar bending machine embodying the invention;

Figure 2 is an enlarged view in front elevation taken along lines 2—2 of Figure 1, i.e. with the front wall of the casing removed;

Figure 3 is a view taken along lines 3—3 of Figure 2;

Figure 4 is a top plan view of the machine having a bar positioned therein for a bending operation;

Figure 5 is a further top plan view showing the bar after it has received what may be either a partial or a full bend;

Figure 6 is an enlarged detail view in section taken along lines 6—6 of Figure 1;

Figure 7 is a partial top plan view of the machine showing the orientation of parts of the machine and of a bar therein prior to the imparting to the end of the bar a hook, or 180° bend;

Figure 8 is a view corresponding to that of Figure 7, but showing the position of the machine parts and the bar near the end of the hook-bending operation;

Figure 9 is an enlarged detail view in section taken along lines 9—9 of Figure 8; and

Figure 10 is a composite view showing by way of example a plurality of bent bars which may be formed by the subject machine.

With immediate reference to Figures 1–3, the machine is provided with a suitable supporting frame which may be in the form of casing 10 having top and bottom walls 12 and 14, front and back walls 16 and 18, end walls 20 and 22, and horizontally disposed plate member 24. Supported on top wall, or plate, 12 for rotative movement are a pair of alike brace members 26 and 28 and a bar member 30. Bar member 30 is fixedly secured to a gear 32 which extends through an opening formed in plate 12 and is fixedly secured to a shaft 34, the latter extending through plate member 24 and being supported for rotation by a suitably mounted journal member 36 and by a bearing support 38 secured to wall 14. The brace members 26 and 28, which are comprised of foot portions 40, table portions 42 and vertically extending web portions 44, have the foot portions 40 thereof fixedly secured, as by keys 46, to the upper ends of shafts 48 and 50. The shafts 48 and 50 extend through plates 12 and 24 and are supported for rotation by bearing supports 52 and 54 secured, respectively, to walls 12 and 24.

Rotative movement of like degree and direction is imparted to shafts 48 and 50 by shaft 34 by means comprising alike gears 56, 58 and 60 secured, respectively, to shafts 48, 34 and 50, as by keys 62, and a rack 64 slidably and guidably disposed on plate 24 in mesh with gears 56, 58 and 60.

Means are provided to impart rotative movement to gear 32 and shaft 34 in either direction, said means comprising, for example, a reversible motor 66, a screw shaft 68 driven by said motor, a gear 70 in mesh with shaft 68, a shaft 72 supported for rotation by bearing and journal supports 74 and 76 and having fixedly secured thereto the gear 70, and a gear 78 secured to shaft 72 and in mesh with gear 32. Suitable controls, not shown, are provided so that the operator of the machine may stop and start the motor 66 and control the degree and direction of rotation of brace members 26 and 28 and bar member 30.

It will be seen from the foregoing description that when shaft 34 is caused to be rotated in either direction shafts 48 and 50 are rotated in the same direction and to the same degree, and that thus the brace members 26 and 28 and the bar member 30 are at all times maintained in parallelism with each other (see Figures 4 and 5). This rotative movement in parallel of the brace and bar members is utilized through means now to be described to

bend steel bars, such as those indicated by the reference numeral **80**.

The bar member **30** is formed of integral bottom and side walls **82** and **84** and inwardly directed lip portions **86** defining therebetween a guideway **88** for a pair of pin blocks **90** and **91** and a slot **92** for the extension therethrough of pins **94** and **95** which are integral with said blocks **90** and **91**. The blocks **90** and **91** are provided with internally threaded bores **96** and **98** having opposite hand threads, and a shaft **100** having thread sections of opposite hand extends through said block bores in threaded engagement therewith. Bar member **30** is provided with end closure plates **102** removably secured thereto. The reduced diameter ends of shaft **100** extend through apertures formed in said end plates, and said shaft ends terminate in non-round end portions **104** adapted to be engaged by a wrench, or the like, for the purpose of rotating the shaft and thereby adjustably moving the pin blocks **90** and **91** toward or away from the midpoint of bar member **30**.

A pair of alike rod support plates **106** and **108** are jointly supported on brace members **26** and **28** and bar member **30**. The pins **94** and **95** extend through apertures **110** formed in plates **106** and **108** adjacent their inner ends. Said plates are adjustably connected to the table portions **42** of brace members **26** and **28** by multi-diametral pins **112** which extend through apertures **114**, formed in the plates adjacent their outer ends, and elongated slots **116** formed in said table portions **42**. Plate apertures **114** are counterbored so that the upper ends of pins **112** may be recessed within the plates **106** and **108**. The pins **112** are clamped to the plates by tightening the nuts **118** which are threadably engaged with the lower ends of the pins. When the nuts are so tightened, brace members **26** and **28** and the pins **112** may be freely rotatively moved relative to plates **106** and **108**.

The plates **106** and **108** are each further provided with apertures **120**, **122**, **124** and **126**, all of the same diametral size. Apertures **122** and **124** are disposed equidistantly from the longitudinal axes of plates **106** and **108** and from the axes of pins **94** and **95**. Apertures **120** and **126** are likewise disposed equidistantly from the longitudinal axes of plates **106** and **108** and from the axes of pins **94** and **95**. The apertures **120**, **122**, **124** and **126** in each plate have their axes disposed on the arc of an imaginary circle, the center of which is located along the longitudinal axis of the plate. Secondary rod bending pins **128** and **130** are selectively and removably inserted within one of the four apertures **120–126** of the plates **106** and **108** in accordance with the diameter of the rod being worked, with the direction of bend to be given the rod, and with the radii desired for the ends of the bend. The bending pins **94**, **95**, **128** and **130** may be provided with removable sleeves **132** for further control of the radii of the ends of a bend.

Figures 4 and 5 illustrate the imparting of a bend to a rod, or bar, **80**. In comparison with Figure 1, it will be seen that the bar element **30** and brace members **26** and **28** have been rotated slightly in a clockwise direction to reach the positions they occupy in Figure 4. Such prepositioning movement of these elements is called for in order to enable the straight rod **80** to be placed on the plates **106** and **108** so that the pins **94** and **130** are disposed on one side of the rod and the pins **95** and **128** on the other side. With the rod so positioned in the machine, the previously described shaft and gear train is actuated to rotate bar member **30** and brace members **26** and **28** in a counter-clockwise direction, as indicated in Figure 5, to impart the bend **80***a* to rod **80**. In Figure 5, the angle of the bend **80***a* with respect to the rod is about 30°, but it will be appreciated that the angle of the bend may be made to approach 180° if desired.

When the desired angle of a bend has been reached, the machine is stopped. Parts **26**, **28** and **30** are reversely rotated to the slight degree necessary to free the rod. The rod is lifted. The parts **26**, **28** and **30** are moved into position for the next bending step, and the rod is then advanced and lowered into place in the machine. If the next bend is to be identical with that previously made, the parts will be returned to their Figure 4 position and the bend length-controlling distance between the primary bending pins **94** and **95** will be maintained the same. If a different length of bend is desired, the pins **94** and **95** are accordingly moved either toward or away from each other by rotation of screw shaft **100** after the nuts **118** have been loosened to allow pins **112** to slide within the slots **116**. Following the desired adjustment of pins **94** and **95**, the nuts **118** are again tightened. If the subsequent bend is to be a reverse one, i.e. made by rotating the parts **26**, **28** and **30** in a clockwise direction, the pins **128** and **130** are inserted, respectively, in plate apertures **120** and **126** (or **122** and **124**, as the case may be) and the parts **26**, **28** and **30** are rotated slightly in a counter-clockwise direction so that the bar may be positioned between the sets of bending pins, with pins **94** and **130** being below the rod and pins **95** and **128** being above the rod (with reference to Figures 1, 4 and 5).

During operation of the machine, the longitudinal axes of plates **106** and **108** remain parallel with the longitudinal axis of the machine. Hence, the rod is not rotatively swung relative to the machine during the bending operation, but is instead deformed by a force couple into offset parallel body portions (which in turn are parallel with the axis of the machine) interconnected by bent portions, such as **80***a*. The manual labor required to manipulate the rod between bending steps to position it for the ensuing bending step is thereby reduced to a minimum.

Figure 10 shows, by way of example, a number of shapes of bent bars which may be readily produced by this machine. The bends **80***b* of the topmost rod are greater than 90° and they are unidirectional, i.e. made by successively rotating the bending elements in the same direction of rotation. The bends **80***c* of the next rod shown are 90° and are uni-directional. The bends **80***d* and **80***e* of the next rod are 90° but are bi-directional, i.e. made by successively rotating the bending elements in opposite directions. The bends **80***f* of the following rod are likewise uni-directional. Bends **80***g* of the next rod are bi-directional, and the rod is further provided with semi-hook end bends **80***h*. The last shown rod is provided with full hook end bends **80***i*.

Hook bends, such as **80***h* and **80***i* may be imparted to rods by means which may be readily installed in the machine for that purpose and thereafter removed. Such means comprise an auxiliary pin **134** carried by a pin block **136**, the latter being complemental in cross-sectional shape with the channel **88** defined in bar member **30** and being downwardly insertable into said channel through an opening defined by cutaways **138** formed in lip portions **86** of member **30**. Pin block **136** is bifurcated to adapt it to straddle screw shaft and to be slidably positioned within member **30** adjacent one of the primary bending pins **94** and **95**. When the block **136** has been positioned as desired within bar member **30**, it is secured in this position by means such as set screw **140** (Figure 9).

Figures 7 and 8 illustrate how a hook bend, such as **80***i*, may be imparted to a rod end. Figure 7 shows the rod prepositioned with respect to bending pins **95**, **130** and **134**. When parts **30** and **28** are rotated in a counter-clockwise direction (as indicated in Figure 8) for 180°, a 180° hook bend is imparted to the end of the rod. It will be appreciated that the machine would normally be provided with two such auxiliary pins **134**, the other being positioned adjacent the other primary bending pin **94**, so that the trailing end of one bar and the leading end of a following bar may be simultaneously provided with such hook bends.

Having thus described an embodiment of my invention,

what I claim as new and desire to secure by Letters Patent is:

1. A rod bending machine comprising a housing having an upper wall adapted to serve as a support member, an elongated bar member and a pair of elongated brace members disposed above said wall in spaced and alignable relation with each other, said bar member being disposed between said brace members, shaft means, supported within said housing and extending through said wall, mounting said brace members and said bar member for rotation about self-contained axes of rotation, said axes being in mutual alignment with each other, drive means mutually interconnecting said shaft means operable to move said brace members and said bar member in the same direction of rotation and with the same degree of rotation, whereby said brace members and bar member are maintained in parallel relation with each other, a pair of upwardly directed primary rod bending pins adjustably carried by said bar member for movement toward and away from each other, a pair of plate members supported by said brace members and bar member, each of said plate members having a pivotal connection with one of said bending pins and having a pivotal and slidable connection with one of said brace members, and a secondary rod bending pin carried by each of said plate members intermediate the points of connection of said plate members with said brace members and with said primary bending pins.

2. A rod bending machine according to claim 1, including means for selectively positioning said secondary bending pins on said plate members.

3. A rod bending machine comprising first, second and third vertically disposed, parallel, aligned and horizontally spaced apart shafts, means supporting the same for rotation, reversible drive means connected to said shafts including means for rotating said shafts jointly in the same direction and to the same degree, first, second and third elongated lever members disposed in parallel with each other and having a fixed connection with, respectively, said first, second and third shafts and extending transversely thereto, said shafts being spaced apart equidistantly, with said second shaft being located between said first and third shafts, said second lever member being connected at its midpoint with said second shaft, said first and third lever members, when all of said lever members are in longitudinal alignment, having the ends thereof which are disposed toward said second lever member connected to their respective shafts, a first link member interconnecting said first and second lever members, said link member having a first pivotal connection with said first lever member and a second pivotal connection with said second lever member, the distance between said first pivotal connection and said first shaft being equal to the distance between said second pivotal connection and said second shaft, a second link member similar to said first link member interconnecting said second and third lever members, said link member having a first pivotal connection with said second lever member and a second pivotal connection with said third lever member, the distance between said last mentioned first pivotal connection and said second shaft being equal to the distance between said last mentioned second pivotal connection and said third shaft, and at least a pair of vertically disposed rod bending pins extending upwardly from each of said link members, the pins of each pair being spaced apart both lengthwise and crosswise of a link member.

4. A rod bending machine according to claim 3, including means for adjustably positioning the pivotal connections between said link members and said lever members towards and away from the shafts connected to said lever members.

5. A rod bending machine according to claim 4, including means for varying the distances, both lengthwise and crosswise of the link members, between the pins of each pair.

6. A rod bending machine comprising an elongated and horizontally disposed carrier member, means supporting said carrier member for rotation about a vertically disposed axis of rotation, a pair of vertically disposed rod engaging pins carried by said carrier member, one of said pins being disposed at each side of said axis of rotation, whereby a straight rod to be bent may be disposed at an angle across said carrier member and have its opposite sides engaged by said pins, the distance between said pins defining the length of the bend to be imparted to said rod, a pair of rod engaging reaction members, each of said reaction members being positionally associated with one of said pins but located at the other side of said rod with respect to said pin and in spaced relation thereto along said rod and away from the length thereof be be bent, drive means connected to the support means for said carrier member whereby said carrier member may be selectively rotated in either direction, and support and drive means for said reaction members operable simultaneously with the drive means for said carrier member to move each reaction member in a curvilinear path while preventing any relative movement between each reaction member and the pin positionally associated therewith.

7. A rod bending machine comprising support means rotatable about an axis of rotation, a pair of spaced apart primary bending pins having their longitudinal axes disposed in parallel with each other and in parallel with the axis of rotation of said support means, said pins being carried by said support means and each being adapted to travel a circular path upon rotation of said support means, a pair of secondary bending pins and movable support means therefor disposing said pins in spaced parallel relation with each other and with said primary bending pins, said secondary bending pins being each disposed adjacent one of said primary bending pins at a greater distance from said axis of rotation than said primary bending pin, said secondary bending pins being disposed at opposite sides of an imaginary plane in which the longitudinal axes of said primary bending pins are disposed, first means for rotating the support means for said primary pins about said axis of rotation, and second means operable in timed relation to the operation of said first means to move said support means for said secondary pins, and means constraining said latter mentioned support means to move curvilinearly while preventing relative movement between each primary pin and the secondary pin adjacently disposed thereto.

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