May 12, 1942. E. NIGHTINGALE 2,283,012

BENDING APPARATUS

Filed Oct. 31, 1940 4 Sheets-Sheet 1

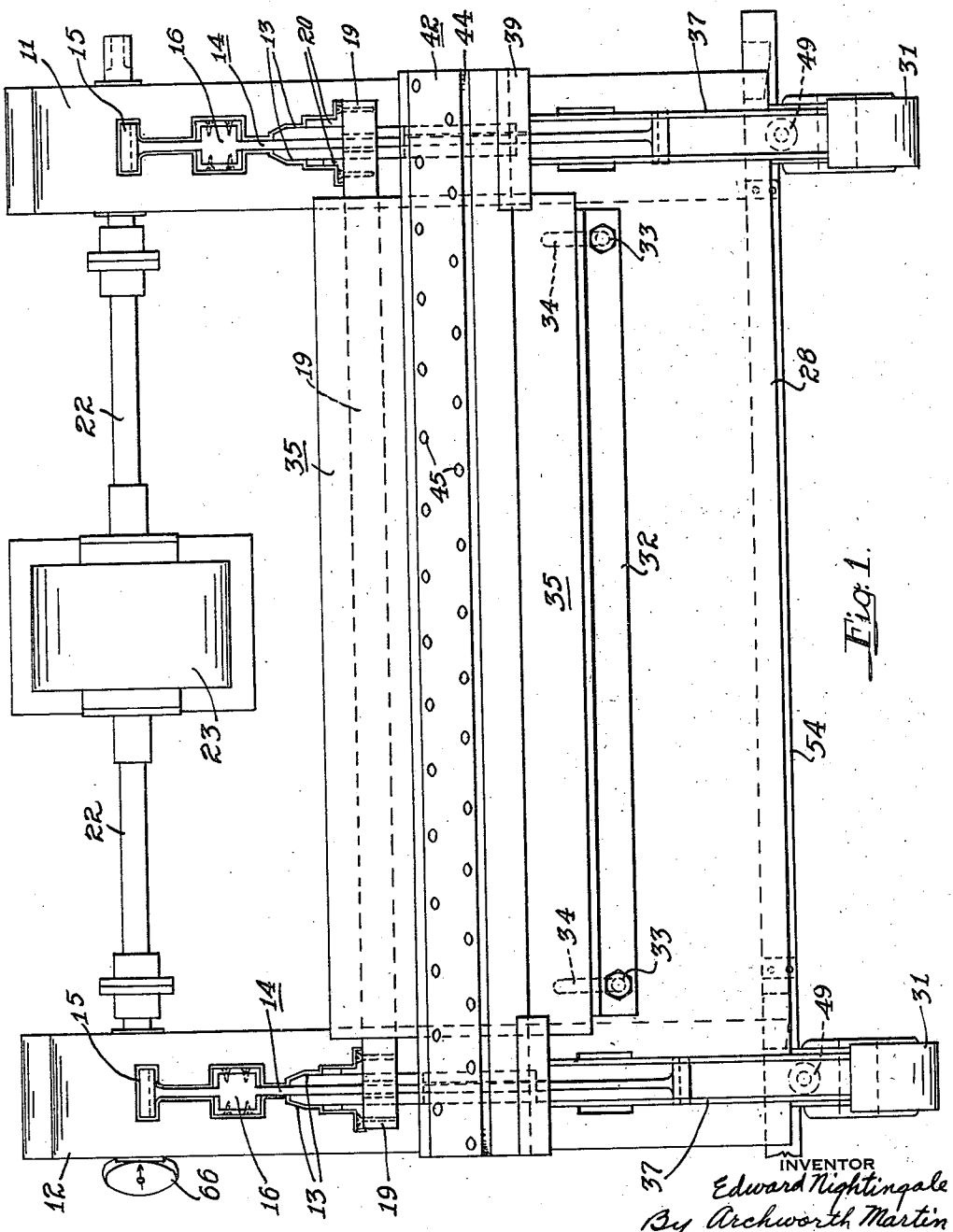


Fig. 1.

INVENTOR
Edward Nightingale
By Archworth Martin
His Attorney

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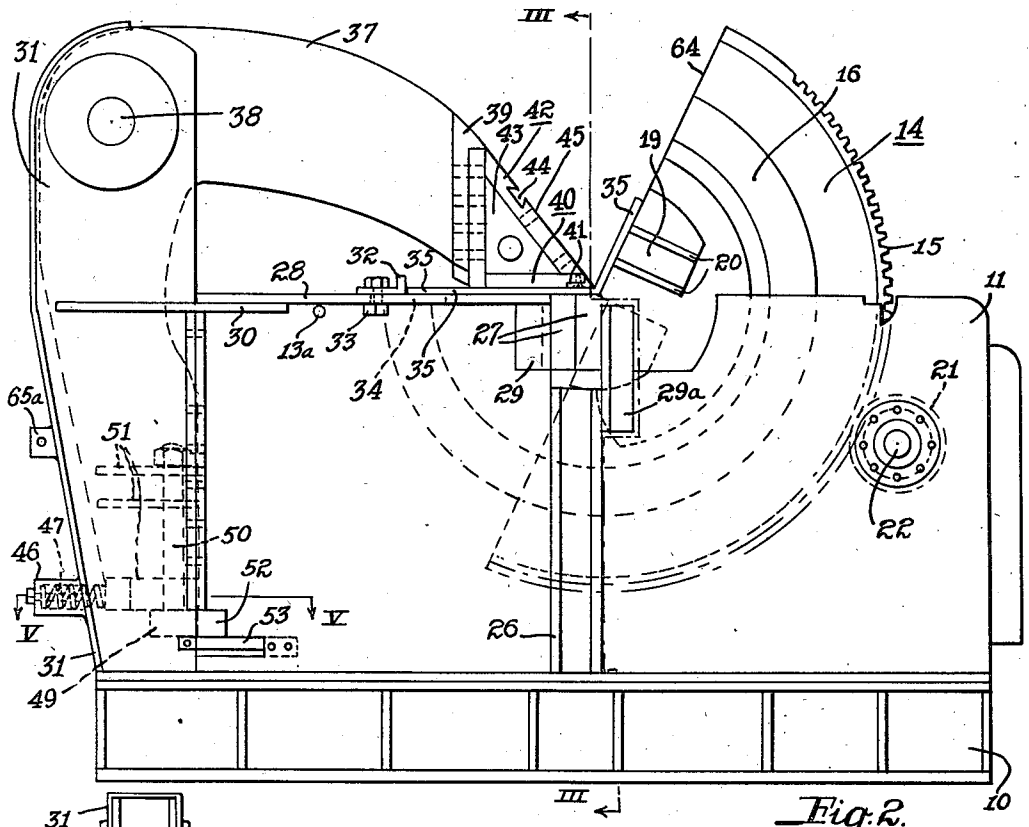


Fig. 2.

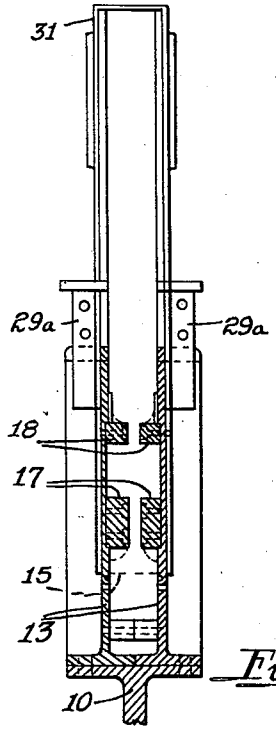


Fig. 3.

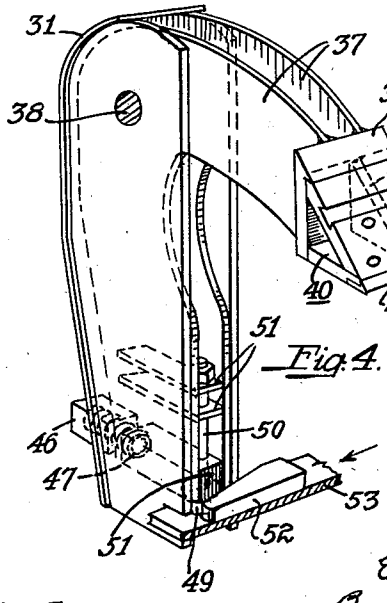


Fig. 4.

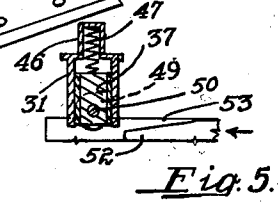


Fig. 5.

INVENTOR
Edward Nightingale
By Archworth Martin
His Attorney

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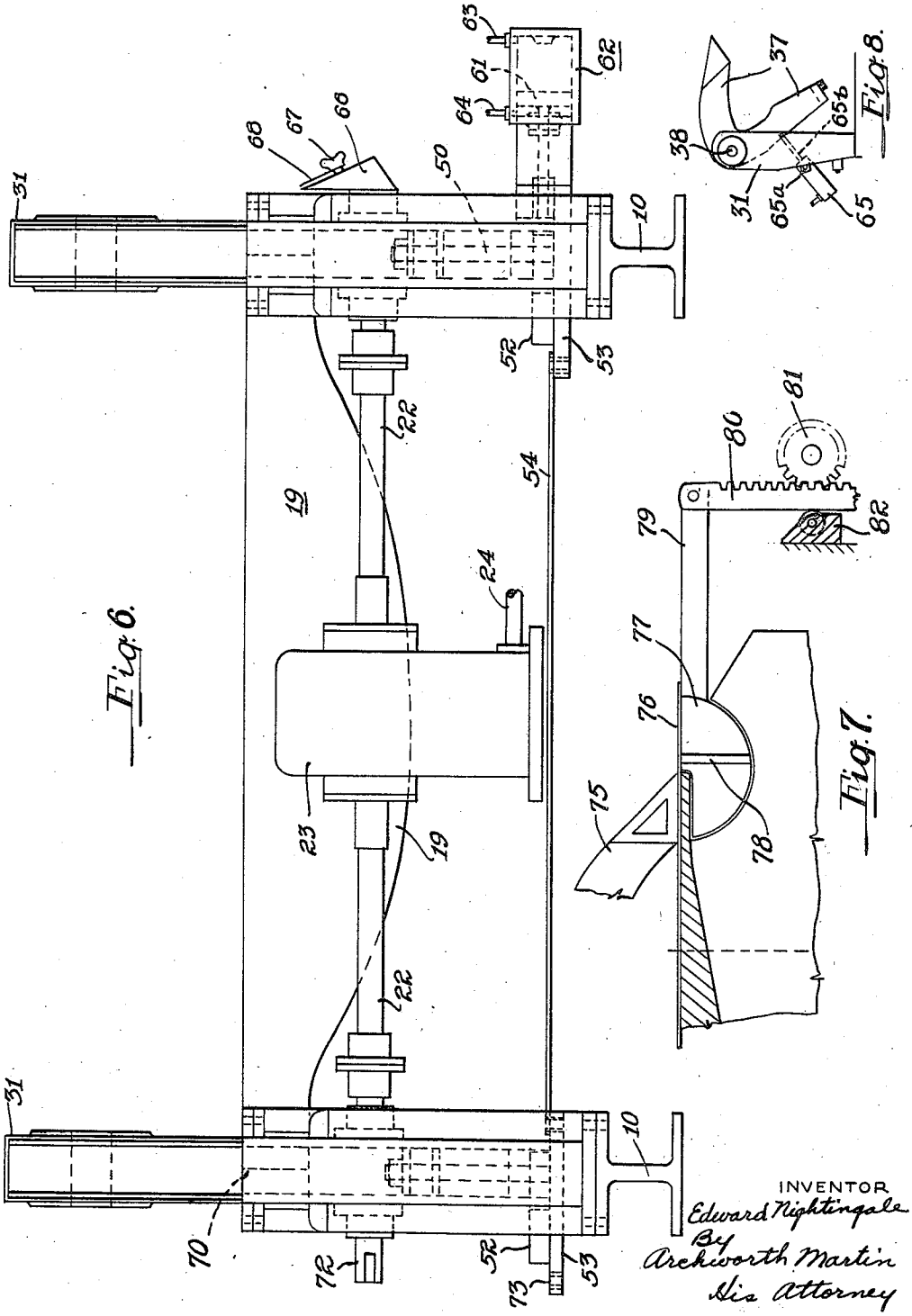


Fig. 6.

Fig. 8.

Fig. 7.

INVENTOR
Edward Nightingale
By
Arckworth Martin
His Attorney

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BENDING APPARATUS

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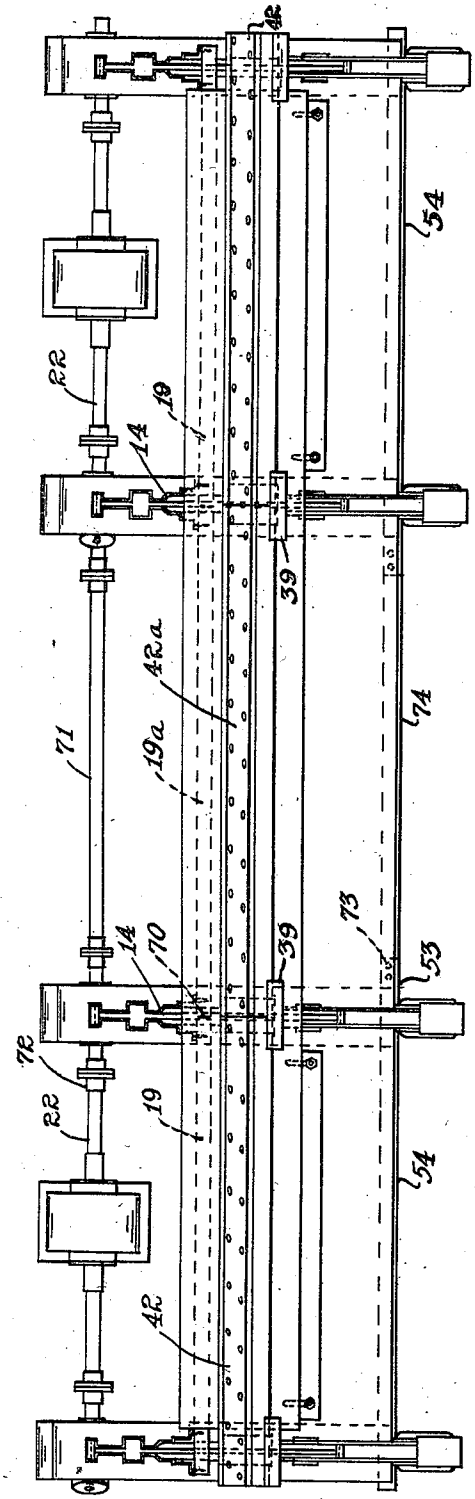


Fig. 9.

INVENTOR
Edward Nightingale
By Archworth Martin
His Attorney

Patented May 12, 1942

2,283,012

UNITED STATES PATENT OFFICE

2,283,012

BENDING APPARATUS

Edward Nightingale, Haysville, Pa.

Application October 31, 1940, Serial No. 363,645

3 Claims. (Cl. 153—16)

My invention relates to bending machines and more particularly to machines for bending metal plates, bars and the like. One object of my invention is to provide a machine that will bend plates of very great length (along the line of bend) with great accuracy and without the springing of the bending dies that is frequently encountered in large bending machines.

Another object of my invention is to provide a bending machine of such form that the work can readily be slid into bending position.

Still another object of my invention is to provide a bending machine that is of simple form and capable of exerting great bending forces without the necessity of employing motors of excessively great horse power.

A further object of my invention is to provide a bending machine unit capable of convenient attachment to other units, so that the units may work in unison on work pieces of very great length.

Some of the forms which my invention may take are shown in the accompanying drawings wherein Figure 1 is a plan view; Fig. 2 is an end elevational view; Fig. 3 is a view taken on the line III—III of Fig. 2; Fig. 4 is a perspective view of one of the hold-down elements of Figs. 1 and 2, with certain of its associated parts; Fig. 5 is a sectional view taken on the line V—V of Fig. 2; Fig. 6 is a front view of the machine; Fig. 7 is a view showing a modification of a portion of the operating mechanism of Figs. 1 and 2; Fig. 8 is a view showing rocking means for the work-gripping arms in addition to the spring of the other figures, and Fig. 9 shows a manner in which two bending machines can be connected to work as one.

Referring first to Figs. 1 to 6, I provide foundation beams 10 that extend forwardly and rearwardly for supporting the housings for the hold-down and bending elements. Two of these housings 11 and 12 are provided at the front side of the machine, and each comprises side plates 13 (Fig. 3) that are rigidly secured to their respective base beams 10 and serve to partially enclose and support an oscillatory bending member 14 which is of approximately semi-circular form and is provided with gear teeth 15. Each semi-circular disc 14 is provided with an arcuate rib or thickened portion 16 that fits between and is supported by ribs 17 and 18 that are formed on the inner walls of the side plates 13, whereby the discs 14 are supported for rocking movement in the housings 11 and 12. Each of the discs 14 is provided with a rectangular slot reinforced by angles 20 secured to the sides of the disc, for the reception of a bending bar 19 which, as shown more clearly in Fig. 6, is of widened dimension near its mid portion, so that such mid portion will not be sprung or flexed under bending stresses. Clockwise movement of the members 14 is limited by stops 13a.

Pinions 21 are journaled in the housings 11 and 12 and mesh with the gear teeth 15, these pinions being secured to a shaft or shafts 22 driven from suitable reduction gearing indicated at 23, which reduction gearing may conveniently be of the double worm type. The reduction gearing is driven from a shaft 24 of a motor (not shown). The motor will preferably be of the reversing type, whereby the pinions can be driven in both directions, to effect oscillation of the bending element 14.

Posts 26 are provided on the beams 10, for supporting anvil bars 27, the bars extending from the post 26 at one end of the machine to the post at the other end of the machine, and are braced by angles 29 and 29a on the housings and the posts 26. A plate 28 is supported at its front edge by the angles 29 and its rear edge is supported upon brackets 30 that are carried by a pair of rear housings 31, one of these housings being mounted on each of the beams 10 at the rear ends of such beams. A stop bar 32 of angular form is supported upon the plate 28 by bolts 33, the plate 28 being provided with slots 34 of a desired length to permit of adjustment of the stop 32 forwardly and rearwardly of the machine, in accordance with the point at which it is desired to position a work piece 35 for bending. The bar 32 could obviously be adjusted by horizontal screws mechanically driven.

Hold-down arms 37 are provided at the ends of the machine, each arm being pivotally supported by a pin or shaft 38 in its associated housing 31. These arms at their inner ends carry brackets 39 that serve as supports for a hold-down or bending bar 40 that extends from end to end of the machine. A hardened steel strip 41 is secured by suitable screws, to the underside of the bar 40. The bar 40 may be welded or otherwise secured to a bar 42 that extends the full length of the machine and may in turn be welded at its ends to the brackets 39, and stiffener blocks or plates 43 are welded between the members 39, 40 and 42 to strengthen the same and to form connecting diaphragms when adding units in end-to-end relation as hereinafter referred to.

The plate 42 may suitably be of increased width

at its mid portion as is the plate 19 shown in Fig. 6, in order to provide still greater resistance to flexing or springing under bending stresses. The bar 42 is shown as having a key-way slot 44 and holes 45 that may be employed in shearing attachments or the like (not shown).

A spring casing 46 is secured to each of the housings 31 to serve as a seat for a spring 47 that extends through the adjacent wall of the housing and seats against the lower end of the adjacent hold-down arm 37, to bias such arm in a counter-clockwise direction and thus lift the inner end thereof from the work piece 35 a slight distance at the completion of a bending operation.

In order to hold down or clamp the work upon the anvil 27, I provide a roller 49 that is journaled on a shaft or bolt 50, which is carried by webs 51 formed interiorly of each arm 37. Each roller 49 is engaged by a cam block 52, the cam blocks being provided on slidable bars 53 connected by bars 54 that are disposed near the front of the machine. It will be seen that as the bars 53 are slid from the position indicated in Fig. 5 toward the position shown in Figs. 2 and 4, that the blocks 52 will exert a camming action on the rollers 59, causing the arms 37 at the ends of the machine to be rocked in a clockwise direction to hold the work piece on the anvil 27, and that when the bars are retracted to the position shown in Fig. 5, the cam blocks 52 are out of the path of the rollers 49, so that the arms 37 can be tilted clockwise a desired distance clear of the work piece. The bars 53 have connection with a piston 61 contained within a cylinder 62 to which fluid pressure is admitted and exhausted through pipes 63 and 64 to effect reciprocatory movements of the bars 53.

In Fig. 8 I show a cylinder 65 pivotally mounted on a wing or flange 65a that is carried by one of the housings 31. A piston is contained within the cylinder and has a piston rod connected to the hold-down arm 37. Fluid pressure is admitted to the rear side of the piston to swing the arm from the position of Fig. 2 to that shown in Fig. 8. This distance is much greater than that to which it will be swung by the spring 47, and will be required where that portion of the work piece which extends rearwardly of the bar 40 is angular or of other than flat form, so that the work piece can be inserted and removed.

When the parts of the machine are in position to receive a piece of work, the upper edges 64 of the bending elements 14 are retracted to a horizontal position as in Fig. 1. At this time, the camming bars 53 are also retracted, so that the springs 47 may maintain the hold-down arms 37 in released position. Thereupon work may be slid across the upper edges of the housings 11 and 12 into position against the stop 32, from a furnace or other source. The motor which drives the shaft 24 is then energized to set the transmission mechanism in motion to rock the bending elements 14 toward the position shown in Fig. 2. The motor will be stopped at the point where the desired angularity of bend has been made on the work piece 35. It will be seen that various degrees of bend may be provided, either less or greater than 90°. A suitable limit switch or combined limit and reversing switch mechanism 66 is provided, which has a turn button 67 and an indicator hand 68 that may be adjusted so that the motor will automatically be stopped at the desired degree of bend. This limit and reversing switch may be of various well-known forms and is operated by the shaft 22, when said shaft has turned the desired number of revolutions.

The unit as thus far described may suitably be of a length for bending sheets eight feet or 10 feet long. For the bending of still longer pieces, another unit of this same construction can be placed in endwise alignment but spaced from the first unit. In this instance, as shown in Fig. 9, an additional bending bar 19a will be placed in the adjacent ends of the two units, the said bending bar extending into the slots formed in the adjacent bending elements 14 and having end-to-end abutting relation with the bars 19 at 70 (Figs. 6 and 9), these inserted bending bars in effect bridging the two units, so that sheets equal in length to three of the bending bars 19 can be employed, it being understood, of course, that the two units and the three longitudinally-aligned bending bars 19 will operate in unison. Also, an intermediate shaft 71 will be connected to the end 72 of the shaft 22 in one unit and to the end of the shaft 22 carried by the other unit. The slide bar 53—54 which carries the cam blocks will be connected by an intermediate bar 74 from its end 73 to the camming bar of the adjacent unit, so that the hold-down arms of the two units can be operated in unison. Likewise, an intermediate hold-down bar 42a will be provided to bridge the space between the two units, the bar 42a extending into the brackets 39 at their ends and held therein by welding to blocks 43.

In the arrangement shown in Fig. 7, hold-down arms 75 are provided for the work piece 76, and bending elements 77 with their contained bending bars 78 are tiltably supported in the frame in a manner similar to the members 14 and 19. In this instance, however, the oscillatory elements 77 are provided with arms 79 to which rack bars 80 are pivotally connected, the rack bars being raised and lowered by pinions 81, at each end of the machine, the pinions being driven in a suitable manner as by the shaft 22. An anti-friction thrust bearing 82 is provided to back up each rack bar 80 against the thrust of its pinion 81, the bar 80 being tiltable on the bearing during up and down movements.

I claim as my invention:

1. Bending apparatus comprising a table for receiving plates and the like for bending, a pair of segmental members mounted for oscillatory movement about an axis adjacent to the forward edge of the table and normally positioned in a plane below the table, a bending bar supported at its ends by said members, adjacent to but spaced from the axis of oscillatory movement, a hold-down member positioned above the table and offset from the said axis, and means for rocking the oscillatory members in a direction to bend a plate against the hold-down member, the said means comprising spur gear teeth on the peripheral edges of the oscillatory members and spur toothed driving pinions therefor, positioned below the plane of the table on a radial line which extends at approximately 30° to the plane of the table.

2. Bending apparatus comprising a table for receiving plates and the like for bending, uprights at the rear edge of the table, hold-down arms of angular form pivotally mounted on said uprights and each having one leg extending upwardly from beneath the table and its other leg extending from the pivotal point across the table

to the forward edge thereof, means operable beneath the table, to rock the arms into and out of engagement with a plate on the table, a pair of segmental members mounted for oscillatory movement about an axis adjacent to the forward edge of the table, a bending bar carried by the segmental members, and means for rocking the segmental members and the bar, to bend the plate against the hold-down arms, the said means comprising spur gear teeth on the peripheral edges of the oscillatory members and spur toothed driving pinions therefor, the driving pinions being positioned forwardly of the table and below the plane thereof, approximately on a radial line which bisects a 90° path of bending movement by the oscillatory members.

3. Bending apparatus comprising a table for receiving plates and the like for bending, uprights at the rear edge of the table, hold-down arms of angular form pivotally mounted on said uprights and each having one leg extending upwardly from beneath the table and its other leg extending from the pivotal point across the table to the forward edge thereof, means operable beneath the table, to rock the arms into and out of engagement with a plate on the table, a pair of segmental members mounted for oscillatory movement about an axis adjacent to the forward edge of the table and normally positioned below the plane of the table, a bending bar carried by the segmental members, and means for rocking the segmental members and the bar upwardly to bend the plate against the hold-down arms, the said means comprising spur gear teeth on the peripheral edges of the oscillatory members and spur toothed driving pinions therefor, positioned below the plane of the table on a radial line which extends at approximately 30° to the plane of the table.

EDWARD NIGHTINGALE.