Jan. 21, 1930. P. M. KUEHN 1,744,391

PLATE BENDING MACHINE

Filed Dec. 18, 1924 4 Sheets-Sheet 1

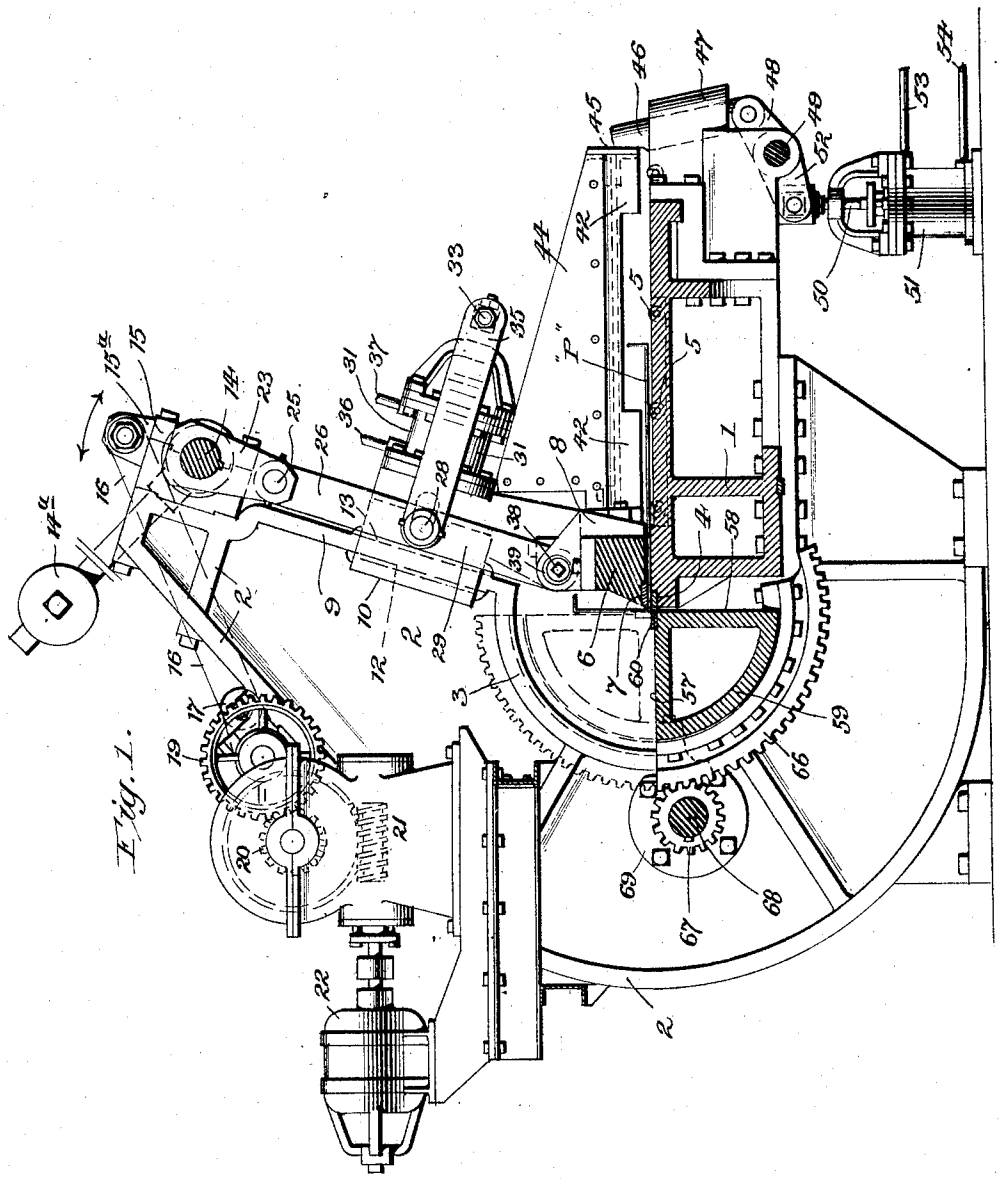


Fig. 1.

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PLATE BENDING MACHINE

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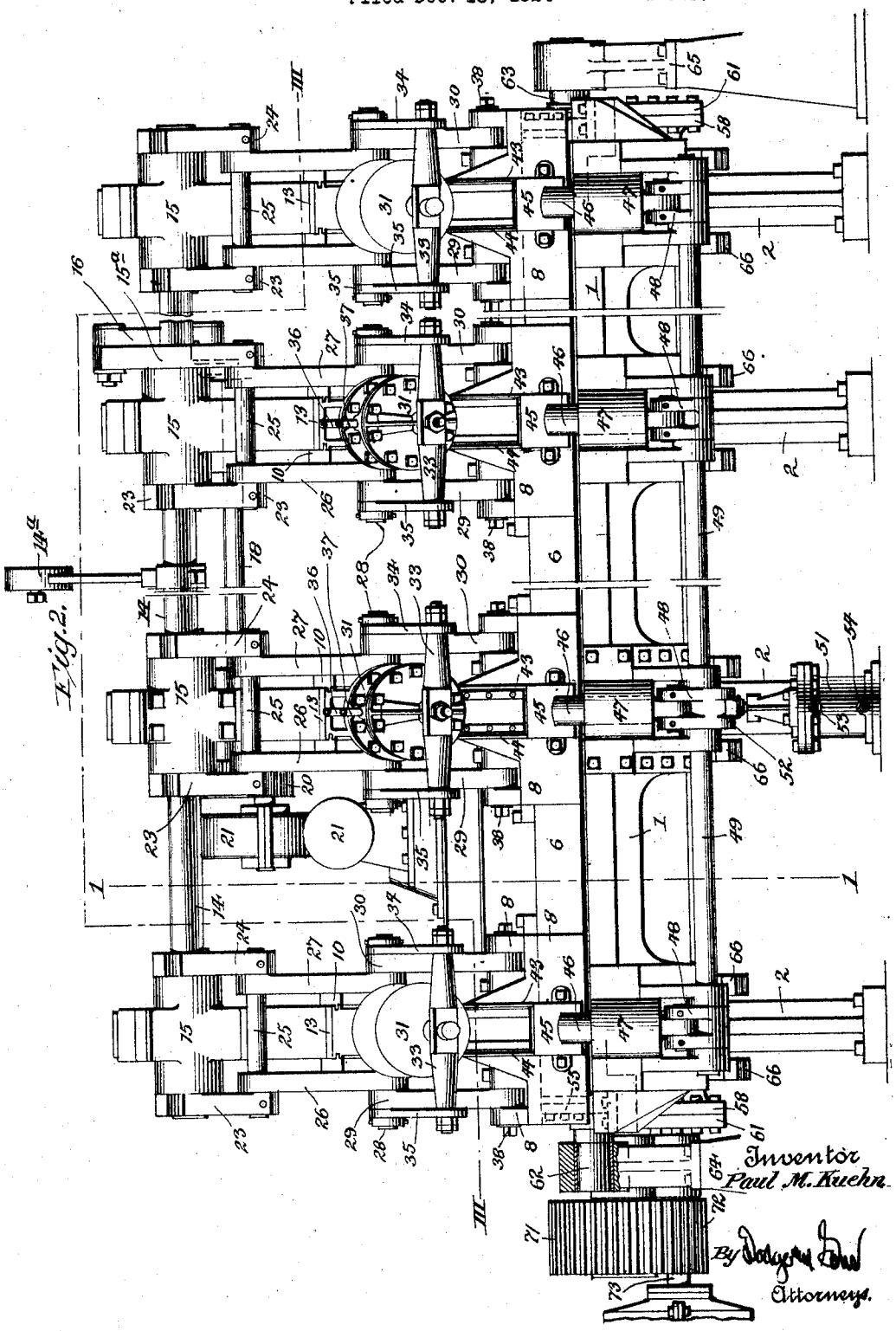


Fig. 2.

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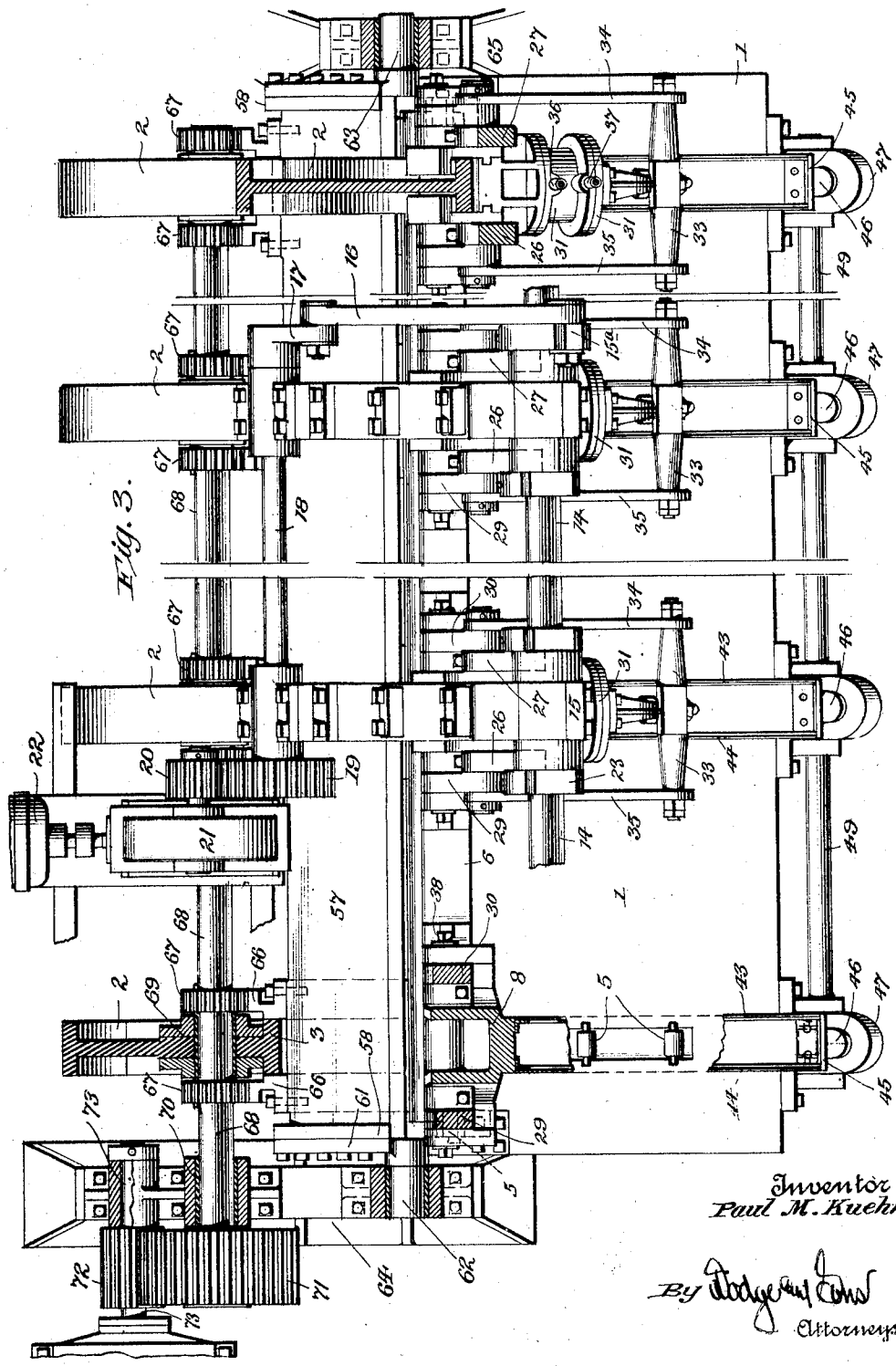


Fig. 3.

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PLATE BENDING MACHINE

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Fig. 4.

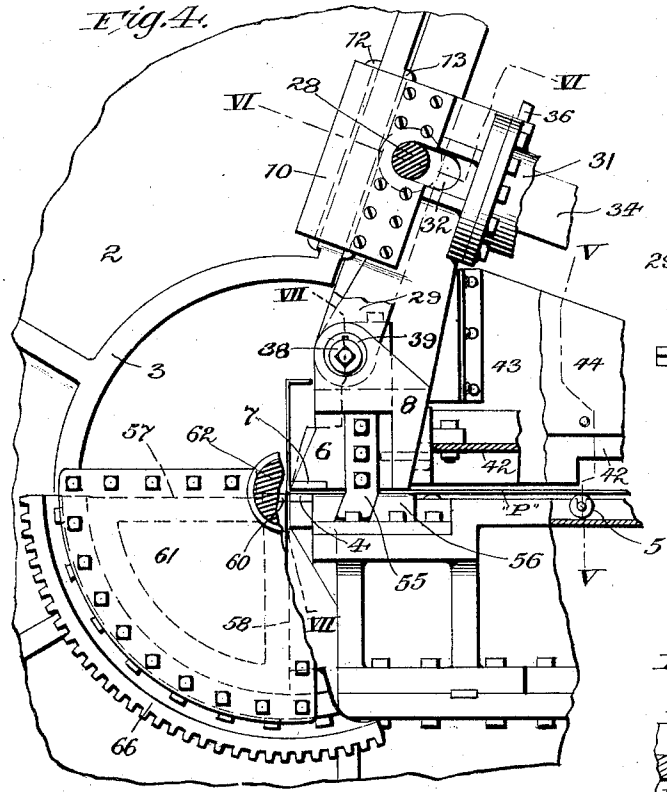


Fig. 5.

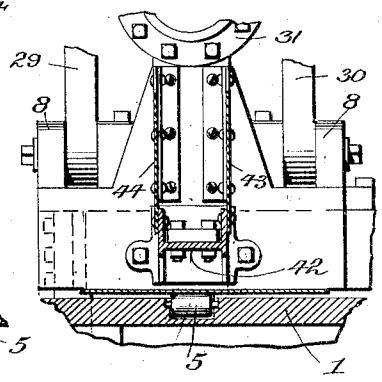


Fig. 6.

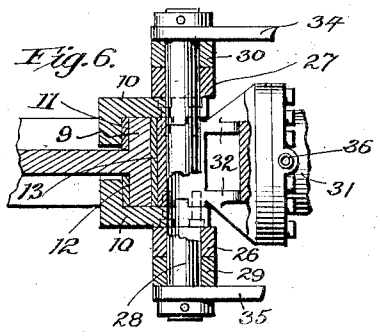


Fig. 7.

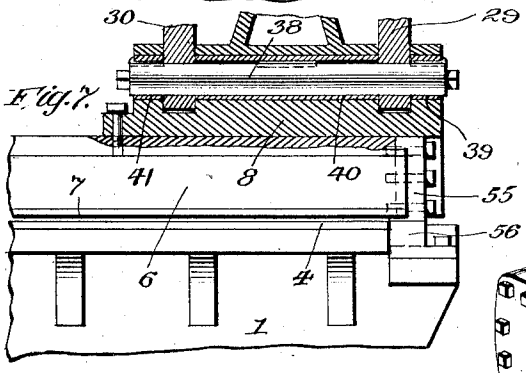
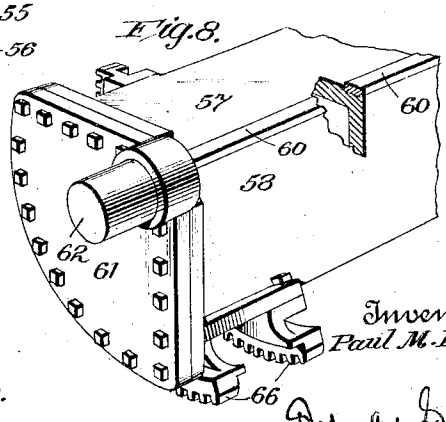


Fig. 8.



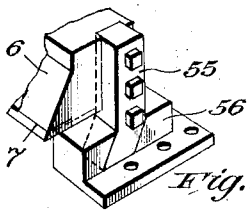


Fig. 9.

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UNITED STATES PATENT OFFICE

PAUL M. KUEHN, OF BALTIMORE, MARYLAND, ASSIGNOR TO THE BARTLETT HAYWARD COMPANY, OF BALTIMORE, MARYLAND, A CORPORATION OF MARYLAND

PLATE-BENDING MACHINE

Application filed December 18, 1924. Serial No. 756,789.

This invention pertains to plate bending machines and has for its main object the production of a machine wherein long and heavy metal plates may be accurately bent to form with ease and facility.

In the fabrication of certain structures, such as large gas holders, and particularly holders of the so-called "waterless type", the use of large and heavy plates is desirable from an economical point as well as from a constructional view. The machine hereinafter set forth provides a means whereby such large plates may be expeditiously and accurately brought to the desired form.

The machine is illustrated in the annexed drawings, wherein:

Fig. 1 is a vertical sectional view taken on the line I—I of Fig. 2;

Fig. 2, a front elevation of the machine partly in section;

Fig. 3, a sectional top plan the line of section being denoted by III—III of Fig. 2;

Fig. 4, an end elevation, partly in section, showing certain details of the bed, the plate clamping mechanism and the bending jaw;

Fig. 5, a detail sectional view on the line V—V of Fig. 4 illustrating a portion of the movable clamping frame;

Fig. 6, a similar view on the line VI—VI of Fig. 4;

Fig. 7, a longitudinal vertical section on the line VII—VII of Fig. 4 illustrating the adjustable eccentric employed to vary the effective spacing between the clamping jaws;

Fig. 8, a perspective view, partly broken away, of a portion of the oscillating bending jaw or former; and

Fig. 9, a detail perspective view of one of the guides for the upper jaw and its cooperating member.

In said figures, 1 denotes the bed of the machine preferably formed as a single heavy casting which is mounted upon, secured to, and supported by a series of frame members 2 which stand in spaced relation to each other throughout the length of the machine. Such members are preferably formed as single castings and are provided with strengthening ribs to ensure stability and rigidity of structure.

Said members extend upwardly from one side of the bed and in the preferred arrangement their upper ends slightly overhang the same. It is to be understood, however, that such arrangement is not essential to the underlying principles of the invention. Each member, as will be seen, is provided or formed with a semi-circular recess defined by a heavy flange or rib 3 formed on the body of the member.

The bed 1 at that edge adjacent the recess is provided with a steel clamping jaw 4 formed as a bar extending the length of the bed and seated and secured within a recess formed in the bed,—such jaw lying flush with the upper surface of the bed so that a plate to be bent may be readily pushed along over the bed and projected beyond the jaw over a bending or turning element which will presently be described. To facilitate the positioning of the plate the bed will preferably be provided with a series of rollers 5 let into the upper surface thereof.

The plate to be bent is clamped down upon the inner edge of the bed 1 and its jaw 4 by a clamping bar 6 having let into and secured to its lower face at its inner edge a plate 7 preferably formed of hardened steel. The outermost edge of said plate and the adjacent face of the clamping bar are inclined slightly from the vertical, (see Figs. 1 and 4). Said bar is secured to a series of heavy slides or carriages denoted generally by 8, said slides or carriages each extending upwardly adjacent the forward inclined face of the upper portion of its adjacent frame 2 which at such portion is formed with a flange 9, (see Fig. 6). Hook-shaped cheek plates 10 secured to the upper portion of the carriage extend around the flange and together with interposed wear or bearing plates 11, 12, and 13 hold the carriage to the guide flange while permitting the carriage to be raised and lowered, carrying the clamping jaw or bar 6 therewith.

The various slides or carriages 8 are designed to be raised and lowered as one and means is likewise provided for imparting a clamping action to the bar. To this end a rocker shaft 14 mounted in bearings 15, one

secured to the upper end of each of the frames 2, is employed. Said shaft (see Figs. 1 and 3) has secured to it a crank arm 15ª which in turn is connected through a pitman 16 to a crank 17 secured to one end of a drive shaft 18. Said shaft has secured to its opposite end a gear 19 which meshes with a pinion 20, the latter deriving its motion through a worm drive 21 driven by an electric motor 22.

Shaft 14 adjacent each of the bearings 15 has secured thereto, a pair of downwardly extending arms 23 and 24 in the outer ends of which is mounted a cross bar or shaft 25. The shaft 25 is mounted in the outer end of said arms and pivoted thereon is a pair of links 26 and 27, said links in turn being pivoted to a second shaft 28. Said shaft also has pivotally connected thereto a second pair of links 29 and 30 which links at their lower ends, are pivotally connected to the carriage 8. The links 26—27 and 29—30 form a toggle through which the final clamping action between the bed plate and the clamping bar or jaw 6 is effected. In operation the oscillation of the shaft 14 through the driving means heretofore described raises and lowers the carriages or slides 8 and the jaw 6 attached thereto. The parts are so proportioned that when a plate is imposed on the table and the jaw 6 lowered thereon, the toggles will not come to straightened position, and I therefore provide means tending to straighten the toggles and to thereby force and hold the jaw 6 down upon the plate. To this end each carriage 10 has secured to it a cylinder 31 and the carriage is cut away or formed with a recess 32, (see Figs. 4 and 6) to permit the shaft 28 to be moved laterally. To the piston rod working in the cylinder there is secured a cross head 33, and a pair of links 34 and 35 are pivotally connected to the ends thereof, said links extending inwardly toward the carriage and being attached to the shaft 28. Pipes 36 and 37 are connected into opposite ends of the cylinder and serve to control the flow of fluid under pressure into and from the cylinder. When the jaw 6 is lowered upon the plate, it may be forced down thereon and held in such position by imparting an inward movement to the links 34 and 35 which as will be seen tends to straighten the toggle and to hold it in such position so long as pressure is exerted on the piston tending to move it inwardly.

To effect an adjustment in the effective length of the toggles, the lower ends of each pair of links 29 and 30 (see Fig. 7) are pivotally secured to the slides or carriages 8 through a shaft 38 having squared ends to facilitate its being turned for adjustment in its bearing. The shaft has keyed to it three eccentric sleeves or bushings 39, 40, and 41 which fit snugly within a bore formed transversely of the carriage 8. By turning the shaft the effective length of the toggle may be lengthened or shortened, the shaft retaining its angular adjustment through friction between the parts.

To assist in raising the slides and the allied parts and thus relieve motor 22, shaft 14 may be provided with suitable counterweighted arms as 14ª, Fig. 1.

To hold the jaw 6 against rearward or retrograde movement, or rearward spring, I provide each slide or carriage 8 with an outwardly extending frame produced from an H-shaped channel bar 42 (see Fig. 5) and two side plates 43 and 44 bolted to the upper flanges thereof. Said bar and plate are securely fastened to the slide or carriage and extend outwardly over the table 1. The lower flanges of the bar 42 will be preferably cut away throughout a portion of their length (see Fig. 1) in order to accommodate the upturned flange of a plate, as indicated at P, when such a plate may be positioned in the machine preparatory to bending or flanging its opposite edge.

The bar or beam 42 at its outer end has secured to it a substantial bearing block 45 adapted to co-operate with a retractable abutment shown as plunger 46. Said plunger is mounted for reciprocation in a bearing formed in a casting 47, the bearing inclining toward the table at its upper end. That face of the plunger which stands next to the block 45 is beveled so that as the plunger is moved upwardly it has the effect of crowding the frame forwardly thereby ensuring alinement of the forward edges of the bar 4 secured to the table and the bar 7 secured to the clamping jaw 6. Plunger 46 is pivotally connected at its lower end to a rocker arm 48 secured upon a rocker shaft 49 carried in bearings formed in the casting 47. Motion is imparted to said shaft from the piston rod 50 of a power cylinder 51, the rod being connected to the shaft through a rocker arm 52, which will preferably be formed as one with one of the rocker arms 48 (see Fig. 2). Pipes 53 and 54 connected into the cylinder serve to convey the fluid under pressure to and from opposite ends of the cylinder.

Control means, preferably located at a central point, will be manipulated by the operator to effect actuation of the motor cylinder 51 as well as the motor cylinders 31.

It will of course be understood that the plungers, or, as they may be termed, abutment members, will be lowered when a plate is being positioned and be left lowered until the clamping jaw is lowered and forced down upon the plate through the actuation of the toggle mechanism. When this is accomplished the abutments will be raised preparatory to the upward bending of that portion of the plate which projects outwardly from between the bed and clamping jaw. To ensure alinement of the clamping elements there is secured to each end of the jaw 6 (see Figs.

4, 7 and 9), a guide bar 55, the lower end whereof is inclined forwardly, standing in parallelism with the guides for the carriages or slides 8, said end, when the slides and the jaw 6 are lowered, entering a correspondingly inclined socket formed in a block 56 secured to the bed of the table.

Extending in front of the inner edge of the table and longitudinally thereof within the semi-circular openings in the frame members 2, is the oscillating bending element. It is preferably of the form best shown in Figs. 1 and 8, the body whereof is formed as a single casting having two flat faces 57 and 58 standing at right angles to each other and connected by a rounded element or face 59; in other words it is quadrant shaped in cross-section. A hardened steel bar 60 is preferably secured upon that edge of face or apron plate 57 which is adjacent face 58, the bar in this instance lying slightly above the face 57. At its ends the body is flanged and plates 61 are secured thereto. Stub axles or trunnions 62 and 63 extend out from the ends and are supported in suitable bearings formed in columns 64 and 65, Fig. 3.

Secured to the curved or arcuate face 59 of the bending member is a series of curved racks 66, said racks being arranged in pairs and meshing with pinions 67 secured to a shaft 68, said shaft being supported in bearings 69 formed in the frame members 2 and in a bearing 70 in column 64. The racks and pinions are arranged to each side of the frame members 2 and the racks bear against and are guided by the ribs 3 thus supporting the bending elements which are held up thereby to the work. Shaft 68 has secured to it a gear 71 which meshes with a pinion 72 secured to a reversible motor shaft 73, which is also supported in a bearing in standard 64.

When a sheet to be bent is positioned, the parts are in the position shown in Fig. 1 and the operator will start the motor and thus cause a rotation of shaft 68 in a counter-clockwise direction. This will cause the bending element to rotate in a clock-wise direction and carry the end of the sheet which overlies its surface upwardly until the desired angular bend, 90° or less, is effected. In Fig. 1 the bending element is shown in dotted lines as having been moved up to its full extent and the plate, the edge whereof had been previously flanged, is bent at right angles.

After the desired bend is effected, abutments 46 are lowered, the toggle broken, and the slides or carriages raised thereby carrying the clamping bar away from the plate, fully freeing the same. By having the bar move rearwardly as it moves upwardly it will clear the sheet or the previously flanged edge of the up-bent portion thereof.

With a machine constructed in accordance with the showing herein, plates of a length of approximately 30 feet and of a thickness of one-quarter of an inch have been successfully flanged and bent and this with a degree of accuracy which enables them to be employed in structures where neatness of fit is an essential.

The degree of accuracy which obtains with the use of this machine is primarily due to the utilization of the frames which are somewhat closely spaced, and which prevent or reduce any spring in the clamping member and bending mechanism or apron plate. These frames not only brace the apron plate or bending element but also hold the clamping bar or girder 6 against spring owing to the fact that the carriages or slides which are directly secured to the girder or bar co-act with the frame members so that the structure may be said to be tied up by the frame members, the bending apron plate imposing a thrust upon the members in a direction opposite to that which is imposed upon the bar or beam 6.

The length of the machine may of course be varied, it being essential only to the production of accurate work that a sufficient number of frames be employed to prevent the springing action.

By the utilization of the frames closely spaced, the spring in the structure is reduced to a minimum, and the spring of the clamping member and the bending mechanism never exceeds the small amount of spring which may possibly obtain between the frames which in actual practice have been spaced four feet ten inches from center to center.

What is claimed is:

1. In a plate bending machine, the combination of a fixed table; a clamping jaw; means for raising and lowering said jaw; means for applying pressure to the jaw when the same is lowered into clamping position with reference to the table; means, exerting a wedging action on the jaw, for preventing retrograde movement of the jaw when in such position; an oscillating bending member; and means for actuating the latter.

2. In a plate bending machine, the combination of a table; a clamping jaw adapted to co-operate with the table to clamp the plate to be bent; means, embodying toggle mechanism to raise and lower said jaw; means acting to straighten said toggle and to thereby exert a final clamping action; and means for bending the end of a plate held between the bed and jaw.

3. In a plate bending machine, the combination of a table; a clamping jaw adapted to co-operate with the table to clamp the plate to be bent; means, embodying toggle mechanism to raise and lower said jaw; fluid actuated means acting to straighten said toggle and to thereby exert a final clamping action; and means for bending the end of a plate held between the bed and jaw.

4. In a plate bending machine, the combi-

nation of a table; a clamping jaw adapted to co-operate with the table to clamp the plate to be bent; means, embodying toggle mechanism to raise and lower said jaw; means acting to straighten said toggle and to thereby exert a final clamping action; means for preventing retrograde movement of the jaw when in such position; and means for bending the end of a plate held between the bed and jaw.

5. In a plate bending machine, the combination of a table; a clamping jaw adapted to co-operate with the table to clamp the plate to be bent; means, embodying toggle mechanism to raise and lower said jaw; fluid actuated means acting to straighten said toggle and to thereby exert a final clamping action; means for preventing retrograde movement of the jaw when in such position; and means for bending the end of a plate held between the bed and jaw.

6. In a plate bending machine the combination of a table; a clamping jaw; means for moving the same into clamping relation with a plate imposed upon the table; means for bending the sheet so clamped; and a retractable abutment acting at the rear of the jaw for preventing retrograde movement thereof during the bending of the sheet.

7. In a plate bending machine, the combination of a table; a series of frames arranged in spaced relation to each other along one side of the table, said frames extending upwardly above the table and overhanging the same; a clamping jaw adapted to co-operate with the table; a slide mounted upon each frame and secured to the jaw; a shaft extending along the upper portion of the frames; means for oscillating the shaft; toggle mechanism interposed between said shaft and each of the slides; and means acting to bend a plate held in position on the table by the jaw.

8. In a plate bending machine, the combination of a table; a series of frames arranged in spaced relation to each other along one side of the table, said frame extending upwardly above the table and overhanging the same; a clamping jaw adapted to co-operate with the table; a slide mounted upon each frame and secured to the jaw; a shaft extending along the upper portion of the frames; means for oscillating the shaft; toggle mechanism interposed between said shaft and each of the slides; means acting to straighten the toggles and to thereby securely clamp the plate; and means acting to bend a plate held in position on the table by the jaw.

9. In a plate bending machine, the combination of a table; a series of frames arranged in spaced relation to each other along one side of the table, said frames extending upwardly above the table and overhanging the same; a clamping jaw adapted to co-operate with the table; a slide mounted upon each frame and secured to the jaw; a shaft extending along the upper portion of the frames; means for oscillating the shaft; toggle mechanism interposed between said shaft and each of the slides; a power cylinder carried by each slide; means connecting the piston of each cylinder with the adjacent toggle, said means serving to straighten the toggles and to thereby firmly clamp the plate; and means acting to bend a plate held in position on the table by the jaw.

10. In a plate bending machine, the combination of a table; a frame located at one edge of the table, said frame extending upwardly above the table and overhanging the same; a slide mounted on the frame; a clamping jaw secured to the slide; means for raising and lowering the slide; a frame extending outwardly from the slide over the table; means acting against said frame to prevent retrograde movement thereof when the plate is being bent; and means for bending the plate.

11. In a plate bending machine, the combination of a table; a series of frames arranged in spaced relation to each other along one side of said table, the frames extending upwardly above the table and overhanging the same; a slide mounted on the upper portion of each frame; a clamping bar secured to the slides; a shaft carried by the frames at the upper ends thereof; means for oscillating the same; toggles connecting each slide to the shaft; fluid pressure means acting to straighten the toggles; a frame secured to each slide, said frames extending outwardly over the table; a series of movable abutments carried at the outer end of the table, one in alinement with the outer end of each frame; means for raising and lowering said abutments into and out of operative relation with the frames; and means for bending a plate clamped between the bed and clamping bar.

12. In a plate bending machine, the combination of a table; a series of frames arranged in spaced relation to each other along one side of said table, the frames extending upwardly above the table and overhanging the same; a slide mounted on the upper portion of each frame; a clamping bar secured to the slides; a shaft carried by the frames at the upper ends thereof; means for oscillating the same; toggles connecting each slide to the shaft; fluid pressure means acting to straighten the toggles; a frame secured to each slide, said frames extending outwardly over the table; a series of movable abutments carried at the outer end of the table, one in alinement with the outer end of each frame; fluid pressure means for raising and lowering said abutments into and out of operative relation with the frames; and means for bending a plate clamped between the bed and clamping bar.

13. In a plate bending machine, the combination of a fixed bed having a clamping edge; a clamping bar co-operating therewith; a series of frames located adjacent the clamping edge of the bed, said frames standing in spaced relation to each other, and each frame having a substantially semi-circular recess substantially concentric with the clamping edge of the bed; clamping means reacting directly against said frames for holding said clamping bar in engagement with material supported by said bed; a bending member extending through the space formed by said recesses; and means for oscillating said member.

14. In a plate bending machine, the combination of a bed having a clamping edge; a clamping bar co-operating therewith; a series of frames located adjacent the clamping edge of the bed, said frames standing in spaced relation to each other, and each frame having a substantially semi-circular recess substantially concentric with the clamping edge of the bed; clamping means reacting directly against said frames for holding said clamping bar in engagement with material supported by said bed; a bending member, having a radial dimension approximating that of said semi-circular recesses adapted to engage the plate to be bent over substantially its entire area; racks secured to the outer face of said member adjacent the frames; and gearing co-operating with the racks to oscillate the same.

15. In a plate bending machine, the combination of a table; a clamping jaw adapted to co-operate with the table to clamp the plate to be bent; guiding means carried by one of said members and adapted to enter corresponding recesses formed in the other member whereby the jaw is brought into proper alinement with the table; means for bending the plate clamped between the jaw and the table; and means for preventing retrograde movement of the jaw upon actuation of the bending means.

16. In a plate bending machine, the combination of a table having a clamping edge; a plurality of frame members arranged in spaced relation along the clamping edge of said table; a clamping jaw adapted to co-operate with the table to clamp the plate to be bent; means interposed between said jaw and the frames for holding said jaw in proper clamping relation to the table; bending means, said means bearing against the frames and being held up to the work thereby; and means for actuating said bending means.

17. In a plate bending machine, the combination of a fixed table having a clamping edge; a series of frame members arranged in spaced relation along the clamping edge of said table; a clamping jaw co-operating with the table to clamp the plate; means interposed between said jaw and the frames to hold the jaw in place and to prevent springing of the jaw; and bending means.

18. In a plate bending machine, the combination of a table having a clamping edge; a series of frames arranged in spaced relation along the clamping edge thereof, said frames extending upwardly above the table; a clamping jaw; retractable means sustained partly by the jaw and partly by the frames and when effective reacting between the same to position and sustain the jaw against spring under stress imposed in the act of bending a plate; a bending apron mounted for oscillation adjacent the clamping edge of the table, said apron being supported by the frames and being held thereby against a springing action; and means for actuating said apron.

In testimony whereof I have signed my name to this specification.

PAUL M. KUEHN.