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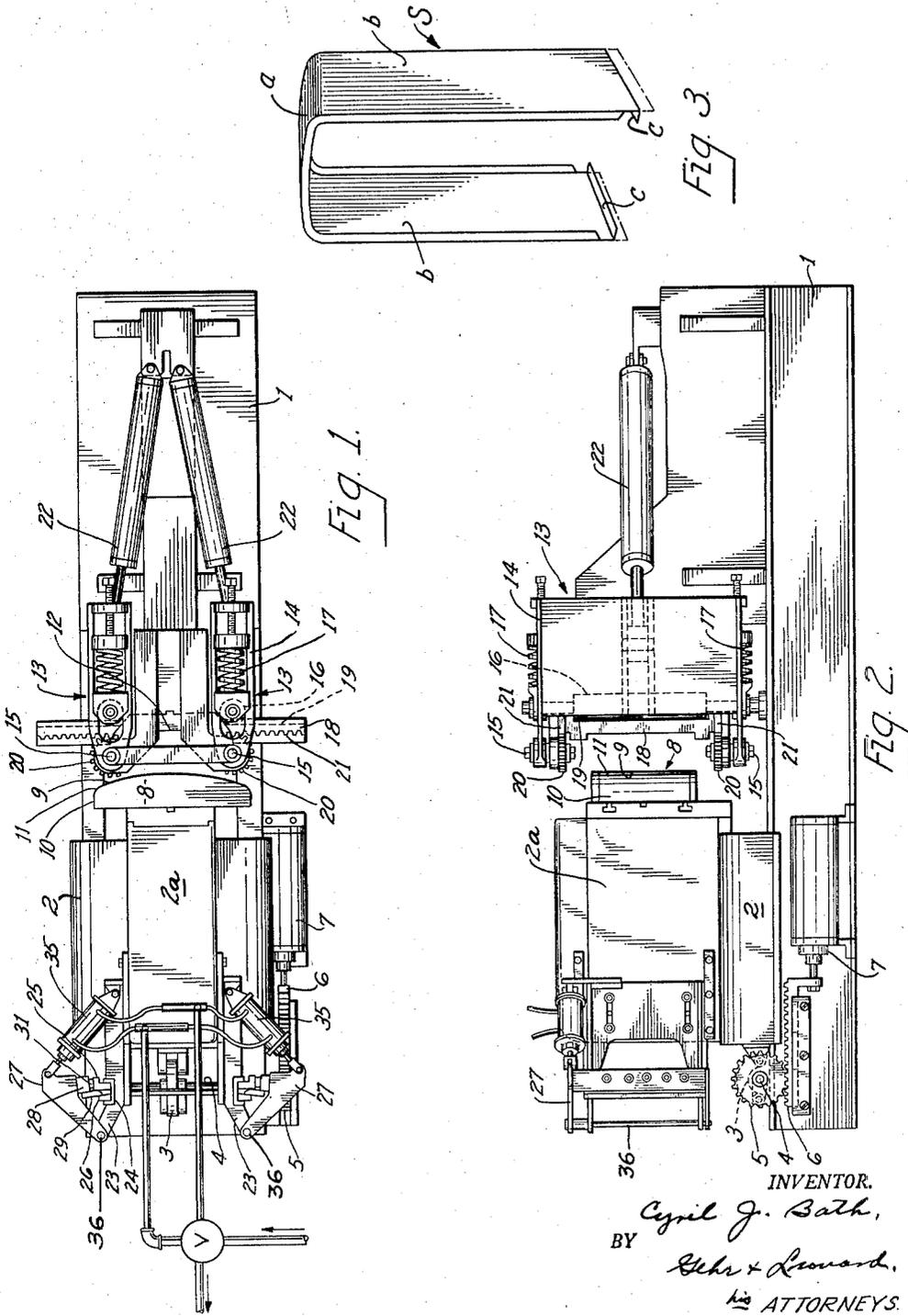
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2,552,617

TANGENT BENDER WITH FLANGE TURNING DEVICE

Filed Oct. 12, 1949

3 Sheets-Sheet 1



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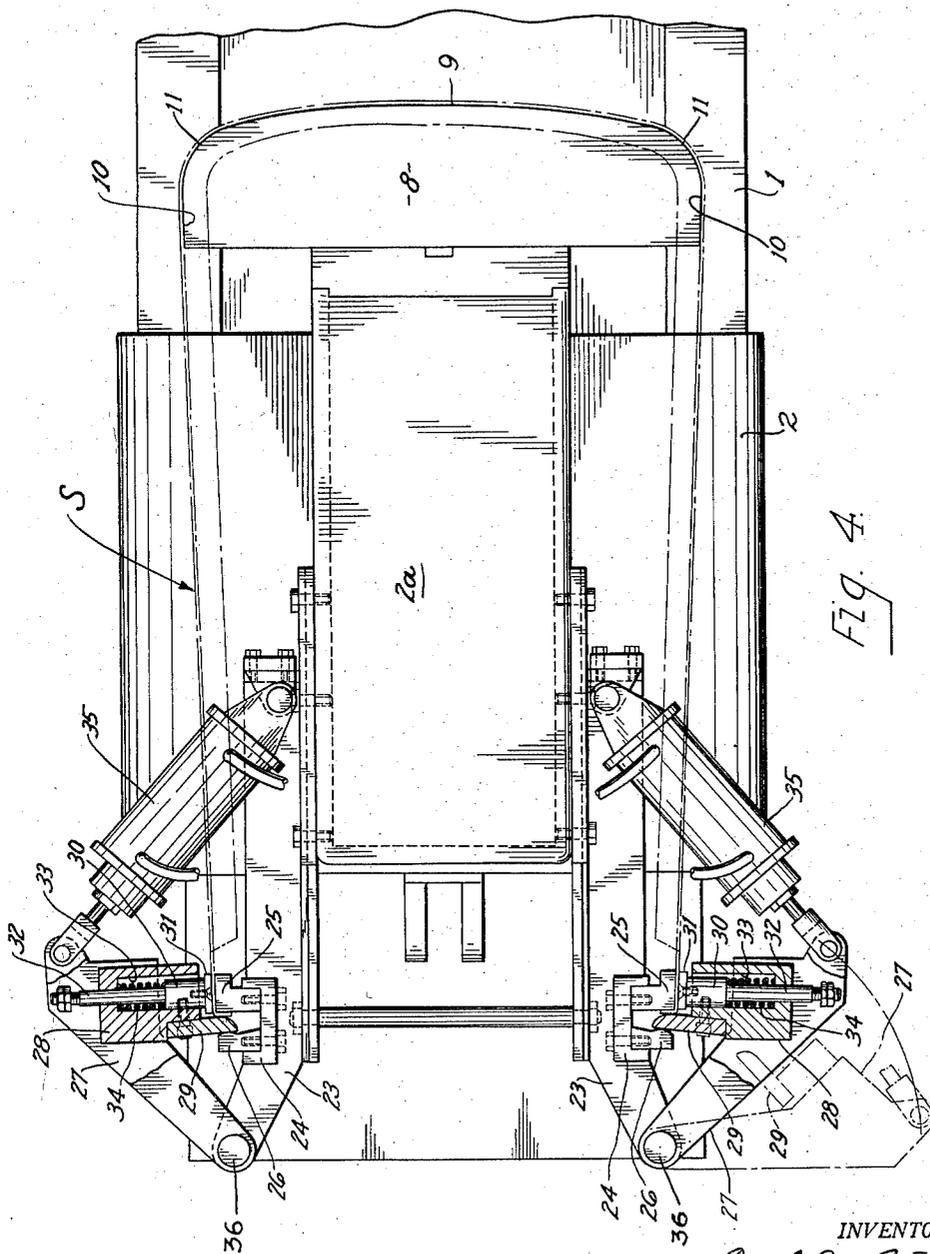
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3 Sheets-Sheet 2



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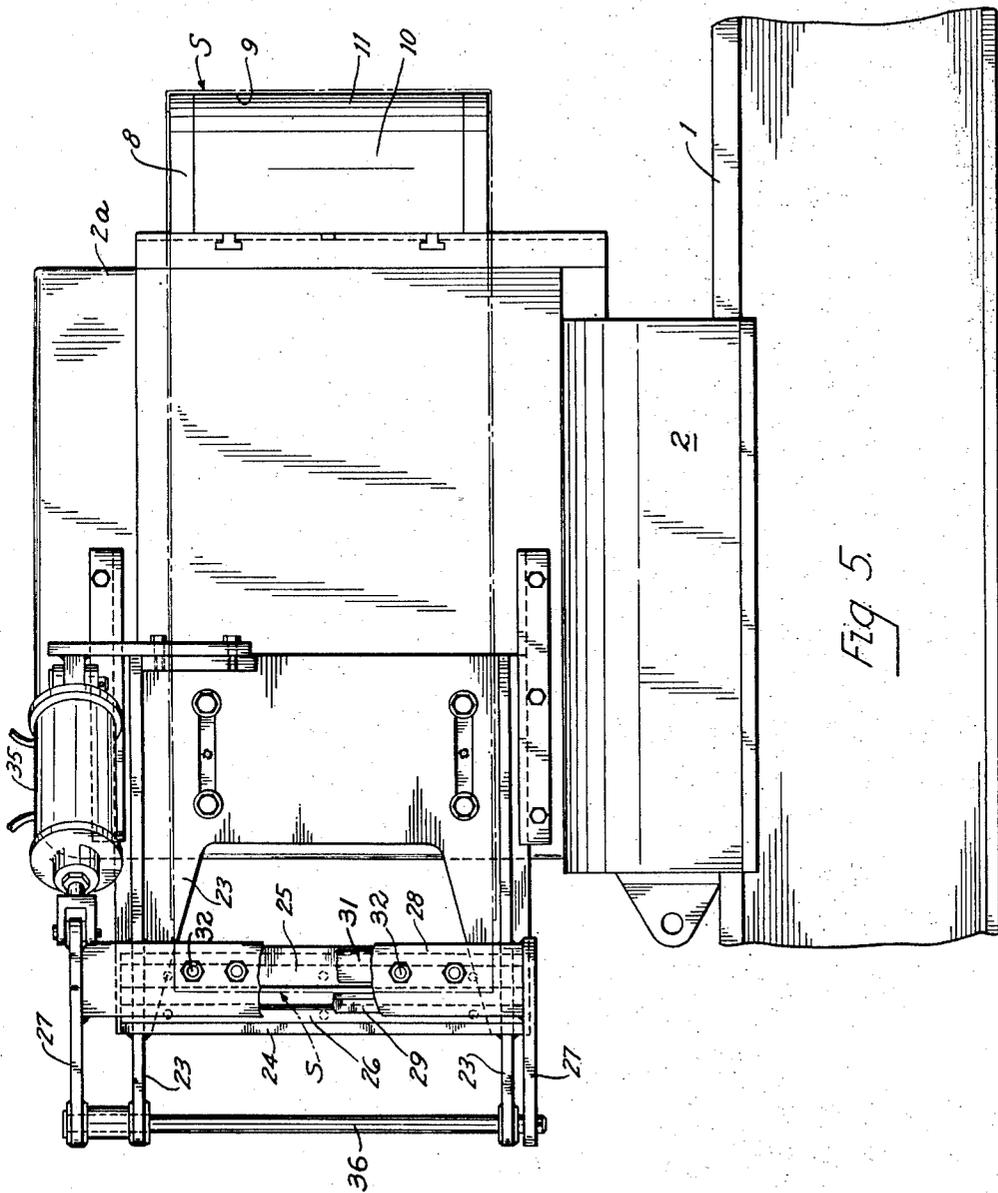
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TANGENT BENDER WITH FLANGE TURNING DEVICE

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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TANGENT BENDER WITH FLANGE TURNING DEVICE

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5 Claims. (Cl. 153-12)

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This invention relates to tangent benders and the like and particularly to an apparatus for folding over the free ends of a formed piece of sheet stock while it is held in the forming dies of the tangent bender.

Tangent benders at present are employed principally in forming sheet steel cabinet structures such, for example, as cabinets for domestic refrigerators, electrical equipment, and the like. In forming such cabinets on the tangent benders, a mid-portion of the sheet is gripped between male and female pressure forming dies and formed into the top wall of the cabinet and, while the formed mid-portion is so gripped, the overhanging end portions of the sheet are engaged by wing dies which bend them around the rounded lateral margins of the male die to a position alongside the lateral faces of the male die, thus providing the side walls of the cabinet. In many cabinets, the bottom wall is a separate sheet of metal secured, usually by welding, to inturned or "foot" flanges at the bases of the side walls. Heretofore, the inturned flanges have been formed by separate and independent apparatus.

In accordance with the present invention, these flanges are turned in while the piece is held fixedly by the main and wing dies after the formation of the top and side walls thereby.

The present invention comprises essentially a power operated mechanism mounted on the tangent bender and arranged so that, while the side wall portions of the formed piece are held alongside the male die by the wing dies, it can be operated to engage and turn in the free end margins of the formed piece to form the inturned "foot" flanges, the mechanism being self-adjusting for reasonable variations in length and gauge of the sheet.

The principal objects of the present invention will be apparent from the following description wherein reference is made to the drawings, in which:

Fig. 1 is a top plan view of a tangent bender and the flange turning device of the present invention combined therewith;

Fig. 2 is a side elevation of the tangent bender and device illustrated in Fig. 1;

Fig. 3 is a perspective view of a typical formed cabinet piece which may be produced on the apparatus illustrated in Figs. 1 and 2;

Fig. 4 is an enlarged top plan view of the main male forming die and carriage of the tangent bender and flange turning device associated therewith, the latter being shown partly in section for clearness in illustration; and

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Fig. 5 is an enlarged side elevation of the structure shown in Fig. 4, part thereof being broken away for clearness in illustration.

The tangent bender with which the present device is combined may be such as disclosed in U. S. Patent No. 2,287,933, issued June 30, 1942, or in my copending application Serial No. 109,682, filed August 11, 1949, now United States Patent No. 2,515,326, issued July 18, 1950.

For purposes of illustration, the tangent bender and device are shown and described as arranged for forming a single sheet of metal to provide the top wall, integral side walls, and integral foot flanges of a domestic refrigerator cabinet.

The tangent bender comprises a rigid frame 1 on which is mounted a reciprocable carriage 2 the upper portion of which provides a support 2a for supporting a male forming die. The carriage 2 may be driven by a crank 3 which is mounted on a crankshaft 4 which is rotatable by a gear 5. The gear 5 is oscillated by a suitable rack 6 which is driven in opposite directions, selectively, by a double acting fluid pressure operated piston and cylinder assembly 7 which may be controlled by the usual manual valve. Mounted on the support 2a is an upright male die 8 having a forwardly exposed upright forming face 9 and upright lateral faces 10 which join the face 9 by rounded corner portions or lateral margins 11, and which extend a short distance lengthwise of the path of the die 8.

Mounted in fixed position on the frame 1 is a stationary female die 12 having a concave upright forming face complementary to the face 9 of the male die.

The dies 8 and 12 are the main forming dies of the tangent bender. As more fully described in said United States Letters Patent No. 2,287,933, the support 2a is mounted on the carriage 2 for rotation about an upright axis so that the die 8 may be swung from operating position, in which it faces endwise of the frame and is aligned with the die 9, to an unloading position in which it faces transversely of the frame 1. Thus the support 2a is movable relative to the frame lineally and rotatively selectively.

Secured on the frame 1 for swinging motion about upright axes are wing dies 13 of which the pivotal axes are arranged adjacent the opposite lateral edges of the female die. Since the wing dies are the same in form and function, one only will be described in detail. Each wing die comprises an upright hollow frame 14 mounted for swinging action about upright pivots 15 which are carried by the frame in fixed position relative

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to the female die. Mounted at its upper and lower end in the frame 14 for rotation about an upright axis and for bodily movement transversely of and parallel to its axis is a spring pressed roller 16 which is urged by its springs 17 toward the pivotal axis of the frame 14. In the frame 14 is a wing die plate 18 which has a forward or working face and which is provided on the rear or opposite face with a shallow transverse channel 19 in which the roller 16 is engaged for rolling along and oscillating the plate while at the same time supporting it against vertical displacement by an upper radial shoulder of the roller.

Mounted in fixed position on the frame 1 are gear segments 20 which are arranged to engage suitable racks 21 at the upper and lower margins of the forward face of the plate 18 for guiding the plate and constraining it to rock in the proper path in relation to the male die. Upon swinging of the frame 14 from the retracted position shown in Figs. 1 and 2 outwardly from the female die, the roller 16 revolves the plate 18 about the rounded portions 11 of the male die into a position in which it lies alongside the lateral forming face 10 of the male die.

Suitable double acting piston and cylinder assemblages 22 are connected to the frames 14, respectively, for swinging them to and from operating position. These assemblages are connected in a conventional hydraulic or pneumatic circuit for control by the usual common valve so as to operate, concurrently, in opening and closing directions, selectively.

Thus in order to form the piece illustrated in Fig. 3, a length of sheet stock S is gripped at its longitudinal mid-portion between the male die 8 and the female die 12 and formed into the top wall portion, designated as *a* in Fig. 3, of the cabinet. While gripped in this condition, the wing dies are operated to bend or fold the laterally extending portions of the metal which overhang the lateral margins of the female die around the rounded portions 11 of the male die and alongside the portions 10, thus providing the side walls, designated as *b* in Fig. 3, of the cabinet.

The cabinet to be formed from the piece illustrated in Fig. 3 is one in which the back wall is to be welded into place and a separate bottom wall is to be provided. For connecting the bottom wall to the lower ends of the side walls *b*, the terminal margins of the side walls are turned inwardly to form foot flanges *c*, these margins, before being turned in to form the flanges *c*, being indicated by dotted lines in Fig. 3.

The present invention has to do particularly with the device for turning in the terminal margins of the sheet to form the foot flanges, or so-called "feet" of the piece. It is desirable to turn in both flanges concurrently and for this purpose one of the flange turning devices of the present invention is provided at each side of the machine. Since they are the same in form and function one only will be described in detail.

Referring particularly to Figs. 4 and 5, each device comprises a longitudinal bracket 23 mounted on the side of the support 2*a* and having an upper and lower supporting portion. Secured at its top and bottom to the upper and lower portions of the bracket 23 is an upright die holder 24 in which is carried an upright flanging die 25 and an upright buttress 26. The buttress is spaced from the die 25 in a direction away from the male die 8. The die 25 has an outward lateral work supporting face and an end working face

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and is positioned laterally of the tangent bender so as to be engaged on its lateral work supporting face by a portion of the workpiece near its end when the workpiece is held against the surface 10 of the male die by the wing die. Generally the side walls *b* are bent slightly inwardly by the wing dies beyond the normal position they are to assume in the finished cabinet for compensating for the usual spring back of metal when released by the wing dies and allowance for this position is made in positioning the die 25.

Mounted on the bracket 23 for swinging movement about a common upright axis are auxiliary frames comprising upper and lower rocker arms 27 which are secured in fixed relation to each other by a suitable rigid die carrier 28. Secured to the carrier 28 is a movable flanging or flange turning die 29 which is positioned in upright position and is arranged, upon swinging of the arms 27 inwardly toward the longitudinal mid-portion of the tangent bender, to enter the space between the die 25 and the buttress 26. The die 25 is so arranged that the cooperating die 29, upon passing between the die 25 and buttress 26, engages the terminal margin of the stock S and bends it around the rearward corner of the die 25 and lays it against the rear working face of the die 25. The entry end of the die 29 is rounded, as illustrated, so as to apply the bending pressure gradually and exert the full pressure on the margin after it is turned in to form the foot flange. The buttress 26 prevents deflection of the die 29 and retains it in the proper operating position.

In order to form an accurate bend it is necessary that the workpiece be held firmly against the lateral working face of the die 25 and for this purpose hold-down devices are provided. These devices as best illustrated in Figs. 4 and 5, are mounted in the carriers 28.

Each hold-down device comprises a plurality of hold-down plungers 30 which are arranged in an upright row and each of which has an operating pad 31 for engagement with the stock and a guiding pin 32. The plungers 30 are mounted for endwise reciprocable movement in suitable bores 33, respectively, in the carrier 28. Operating springs 34 are interposed between the inner end walls of the bores 33 and the associated plungers for urging the plungers outwardly of their bores to an extended position but permitting their retraction into their bores against the force of the springs upon engagement of the pads 31 with the workpiece when the workpiece is resting on the lateral working face of the die 25.

It is to be noted that since the arms 27 are arranged to rock about a fixed upright axis, the die 29 and the plungers 30 follow an arcuate path when moving with the arms. This is advantageous in connection with the die 29 since it makes it convenient to bend the flange *c* of the stock to slightly less than a right angle to the side wall *b* thus compensating for spring back. However, the arcuate path normally would impose on the plungers a longitudinal component of travel relative to the stock after the engagement of the pads 31 with the workpiece and before they were moved, by continued swinging of the arm, into fully retracted position in their bores. In order to retain the benefits of the arcuate swing of the arm for the die 29 and compensate for the longitudinal travel which would so result, the bores 33 are made slightly oversize to provide a loose fit with the plungers 30. The bores through which the pins 32 extend also may be made slightly oversize for the same purpose. Thus the component

of movement of the plungers 30 longitudinally with respect to the workpiece, due to the arcuate path of the arms, is eliminated. Instead, the pads 31 have a radial component of movement relative to the path of the arms due to the movement of the plungers transversely of the oversize bores 33. In order to swing the arms inwardly and outwardly, selectively, double acting piston and cylinder assemblages 35 are provided, one at each side of the tangent bender. These assemblies are connected in a conventional fluid pressure circuit for concurrent operation, the usual common manual control valve being provided for causing their operation in either direction, selectively. Thus when the main dies are closed and the wing dies have been operated, the metal stock is laid on the outer surface of the dies 25. When in this position the piston and cylinder assemblages 35 are operated to swing the arms 27 inwardly toward the stock. This swinging movement results first in the application of the hold-down pads 31 to the outer face of the workpiece so that the piece is pressed firmly against the outer face of the die 25 near its terminal margins. Upon continued inward movement of the arms, the pads 31 remain in firm engagement with the piece and the springs 34 are compressed, the pads maintaining the workpiece in fixed position on the dies 25 while the clearance between the plungers 30 and the bores 33 is shifted from one side to the other.

While the sheet thus is held firmly down against the outer face of the dies 25, the arm continues moving and the dies 29 engage the terminal margins of the workpiece, first bending it around the rear corner or edge of the dies 25 and then, while buttressed by the buttresses 26, pressing the bent portion firmly against the rear working faces of the dies 25.

The piston and cylinder assemblages 35 may be operated by hand valves or any suitable control mechanism so as to turn in the flanges concurrently promptly after the stock has been laid alongside the face 10 of the male die 8 and the lateral working faces of the dies 25.

It is to be noted that the pivotal axes, provided by pins 36, of the sets of rocker arms 27, respectively, are spaced endwise of the path of reciprocation of the complementary main die 8 at the opposite side of the dies 25 from the die 8, and further are spaced inwardly, transversely of said path, a short distance from the plane of the lateral faces 10 of the die 8, so that upon outward swinging of the dies 29 after formation of the flanges, the dies 29 recede, in a direction away from the die 8, from the dies 25, respectively.

After formation of the flanges, the arms 27 are swung outwardly to the position illustrated by the dot and dash lines in Fig. 4, in which position the parts are clear of the terminal ends of the formed piece of stock so that the side walls *b* may be swung relatively apart and freed from the dies 25 and the piece removed from the male die after opening of the male and female dies and rotating the support 2a to unloading position.

Having thus described my invention, I claim:

1. In a tangent bender including a frame, a stationary main forming die mounted thereon, a complementary main forming die, a support carried by the frame for movement relative thereto and supporting the complementary main die for reciprocation relative to the frame, said dies having upright forming faces adapted to engage therebetween and form a portion of a

length of stock spaced from the end of the stock while another portion of the stock extends laterally beyond the dies at one side thereof, a wing die adjacent said one side of the main dies and operable to bend the laterally extending portion of the stock about a lateral margin of said complementary main die, a flanging die mounted on said support in fixed position relative thereto and spaced from the forming dies and having an outer lateral face adapted to be engaged by the laterally extending portion of the stock, when the stock is bent about said lateral margin of said complementary main die and is held in bent condition by the wing die, a cooperating movable flanging die, supporting means on said support normally supporting the movable flanging die in an inoperative position wherein the movable flanging die is out of the path of swinging movement of the laterally extending portion of the stock and for movement from said inoperative position into cooperative relation with respect to the first flanging die for turning the end portion of the stock about the first flanging die while the stock is so held by the wing die, and power means mounted on said support for moving the movable flanging die into and out of said cooperative relation.

2. A tangent bender according to claim 1 characterized in that said supporting means comprises an upright frame and pivot means connecting the frame to the support for swinging about an upright axis.

3. A tangent bender according to claim 2 and characterized in that the pivot means is positioned so that its axis is spaced endwise of the path of the reciprocable main die at the opposite side of said first flanging die from the reciprocable main die.

4. A tangent bender according to claim 3 characterized in that said pivotal axis is positioned inwardly, transversely of the path of said reciprocable main die, beyond the plane of the lateral margin of the reciprocable main die.

5. A tangent bender according to claim 1 characterized in that further power means are provided and are operable to move the complementary main die into forming position to form the stock between the main dies and to hold the complementary main die in stock engaging position, additional power means are provided and are operable to operate the wing die for forming the stock and holding the stock along said margin while it is held between the main dies, and wherein said flanging die power means are operable to operate the movable flanging die for forming the flange while the stock is held in formed condition by the main dies and wing die.

CYRIL JOHN BATH.

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