May 15, 1951 C. J. BATH 2,552,616

MULTIPLE TANGENT BENDER

Filed Aug. 11, 1949 4 Sheets-Sheet 1

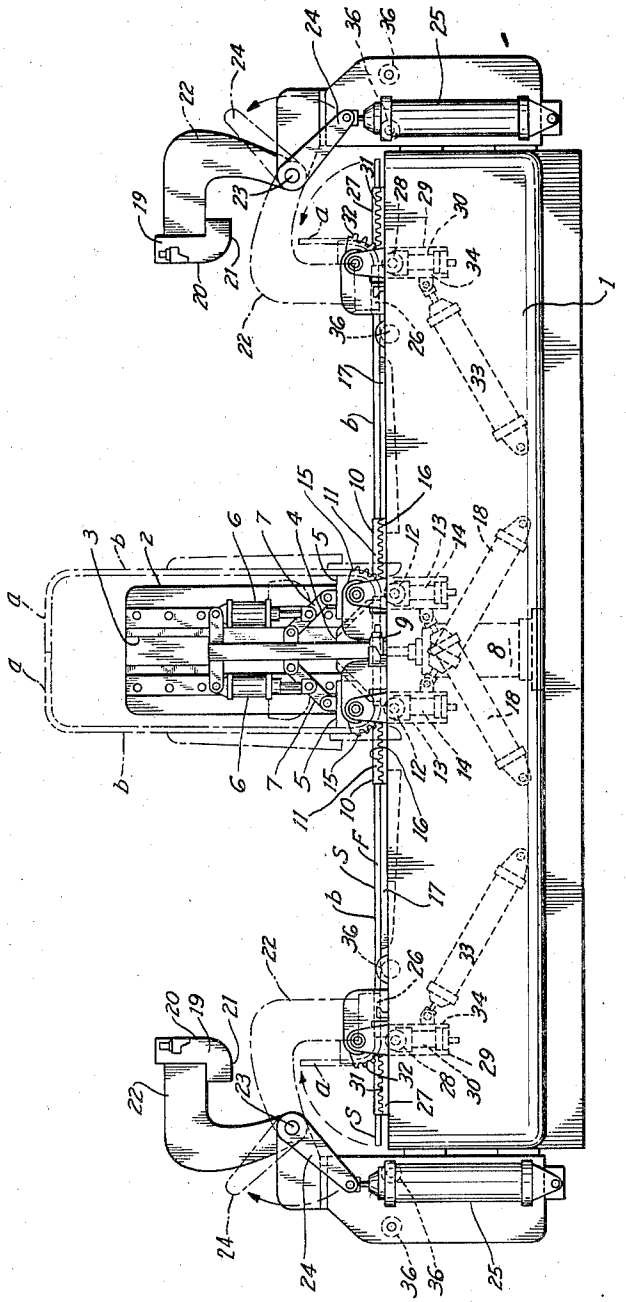

Fig. 1.

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MULTIPLE TANGENT BENDER

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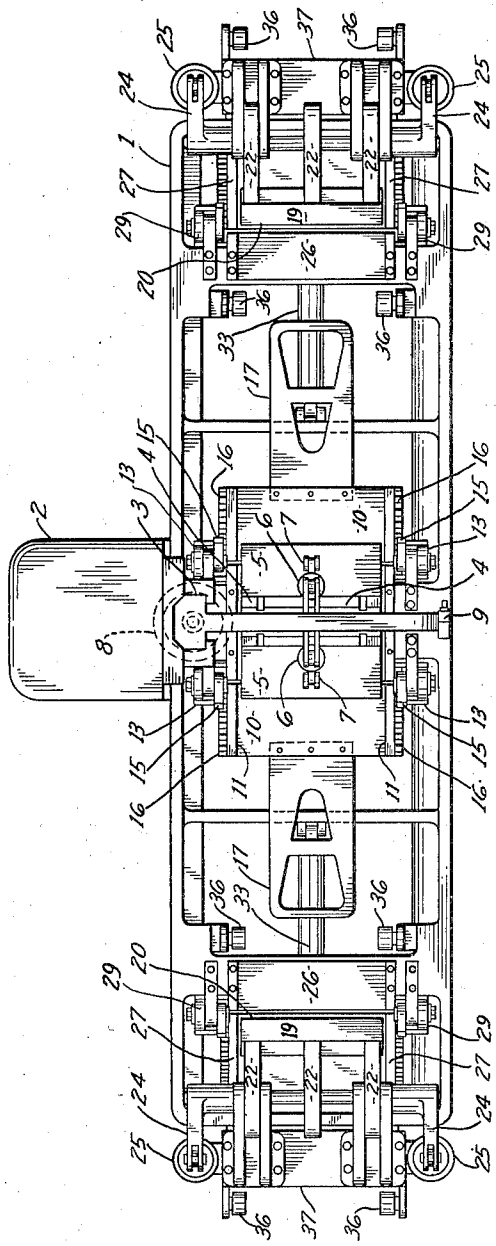

Fig. 2.

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MULTIPLE TANGENT BENDER

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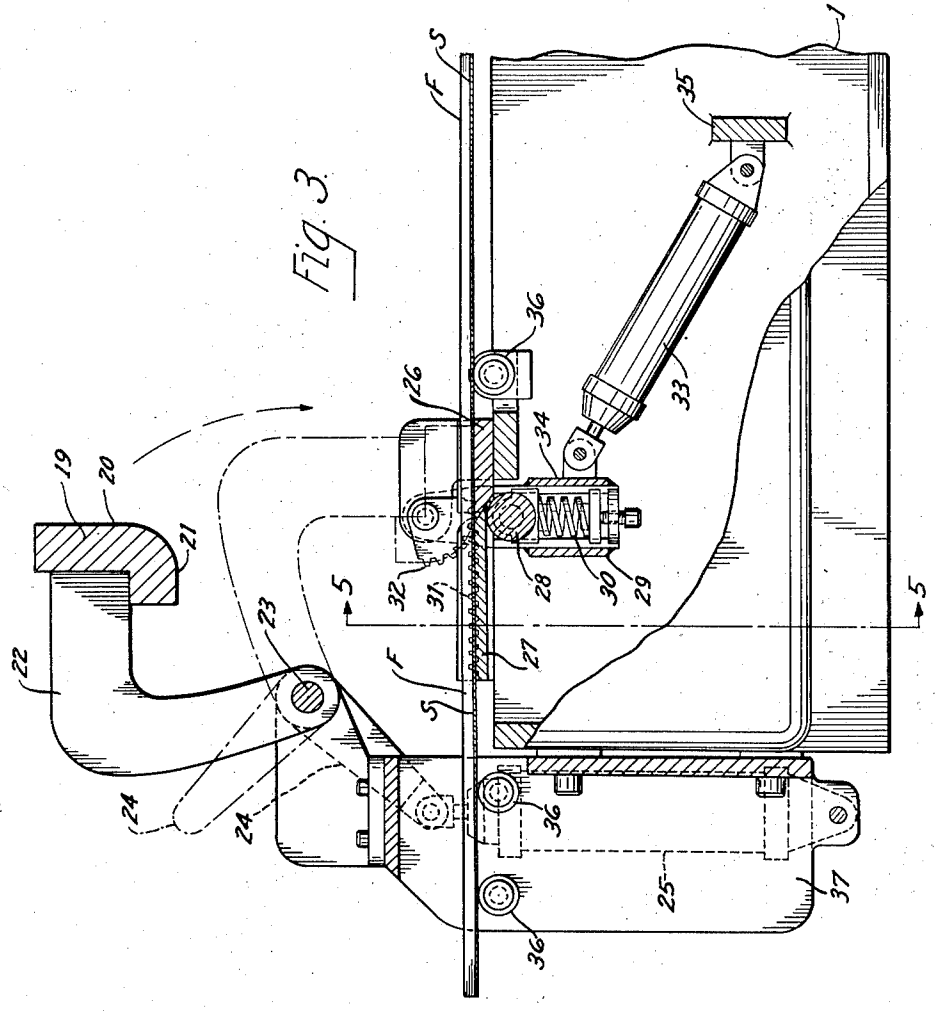
Fig. 3



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May 15, 1951 C. J. BATH 2,552,616

MULTIPLE TANGENT BENDER

Filed Aug. 11, 1949 4 Sheets-Sheet 4

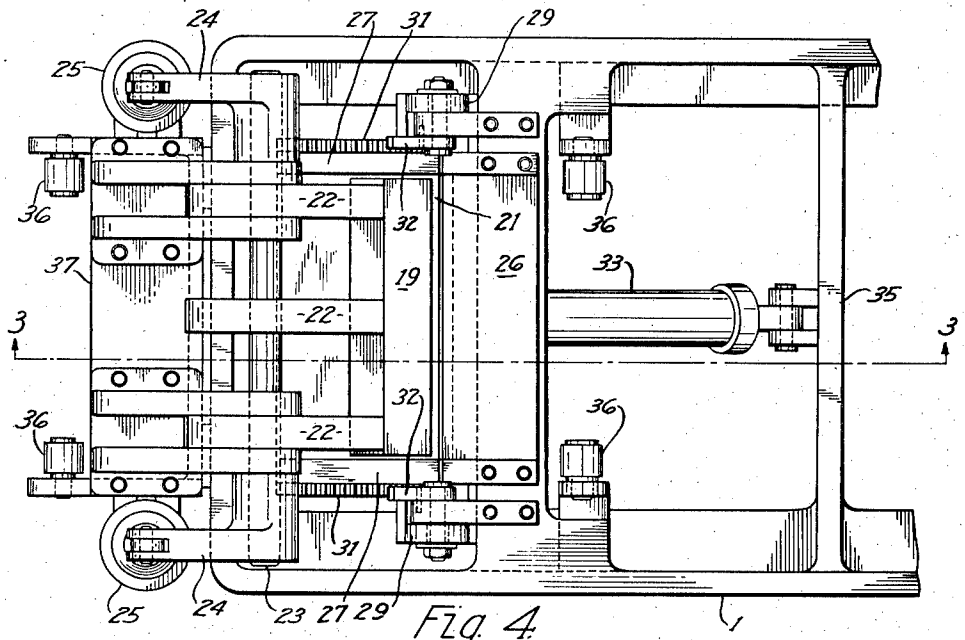

Fig. 4.

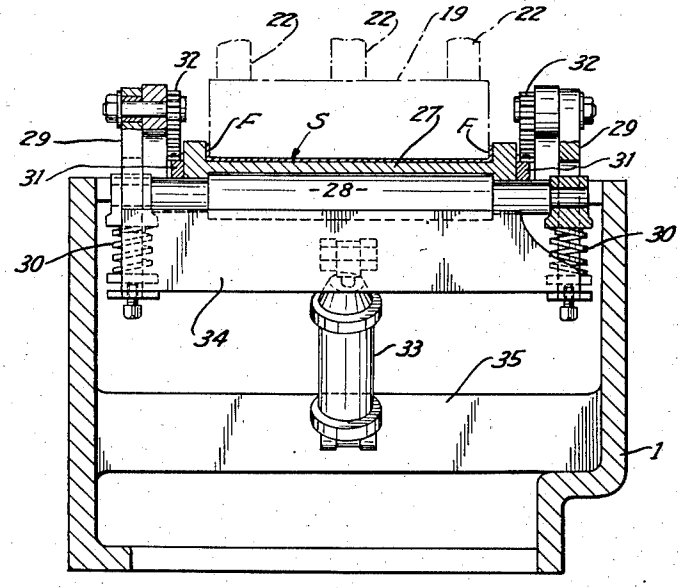

Fig. 5.

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UNITED STATES PATENT OFFICE

2,552,616

MULTIPLE TANGENT BENDER

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Application August 11, 1949, Serial No. 109,681

2 Claims. (Cl. 153—46)

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This invention relates to an improved tangent bender for forming sheet metal stock and particularly to one which not only greatly facilitates the feeding of the stock and removal of the formed piece but also is capable of forming in the sheet stock a number of bends in addition to those that can be formed with prior machines, whereby more complicated structures and more nearly completed articles can be produced efficiently.

The tangent bender of the present invention is one in which sheet metal stock, particularly sheet metal stock having upturned flanges along its lateral margins, may be fed into the machine from either end of the machine and supported, with its flat face horizontal, beneath a collapsible main forming die, adapted to be lowered onto the sheet from above, and above primary rocking wing dies which can be rocked upwardly to bend portions of the stock upwardly and lay them against the upright working faces of the main forming die, and also beneath overhanging end forming dies which can be swung down onto the sheet near its ends and which have upright working faces and above secondary wing dies which can be rocked upwardly to bend end portions of the sheet stock upwardly and lay them against the upright working faces of the end forming dies, the end forming dies being adapted to be swung upwardly and toward the main forming die in a manner such as to free them from the formed end portions of the sheet stock and remove them from the path of subsequent movement thereof without scuffing the formed surfaces of the stock.

An important feature of the invention is the arrangement of the machine so that a horizontally disposed sheet of stock having marginal flanges along its lateral edges can be fed into it from either end and supported initially in horizontal position and then bent normal to its plane successively at a plurality of locations so as to form the sheet into integral top, sides and bottom of a cabinet with continuous integral peripheral flanges at the open front and rear of the resultant structure.

A more specific but important feature of the invention resides in the end forming dies and the manner and means by which they are moved into and out of operating positions.

Other objects and advantages will become apparent from the following description wherein reference is made to the drawings illustrating a preferred embodiment of the invention, and in which:

Fig. 1 and Fig. 2 are a side elevation and top

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plan view, respectively, of the tangent bender, a sheet of stock being shown supported in Fig. 1 in position for forming;

Fig. 3 is an enlarged fragmentary longitudinal, vertical sectional view of the left end portion of the tangent bender illustrated in Fig. 1, and is taken on line 3—3 of Fig. 4, the sheet of stock to be formed being shown therein in position for forming;

Fig. 4 is an enlarged top plan view of the left end portion of the machine illustrated in Fig. 1, the stock to be formed being omitted; and

Fig. 5 is a fragmentary vertical cross sectional view taken on line 5—5 of Fig. 3.

Referring to the drawings, the tangent bender comprises an elongated hollow frame 1 which is generally open at the top and to one side of which, preferably at the longitudinal mid-portion, is connected an upright main die support 2. The support 2 and frame 1 may be cast metal and integral with each other.

Mounted for vertical sliding movement in guideways 3 on the support 2 is a collapsible main forming die 4 having movable die segments 5 each of which has a downwardly exposed working face and an upright end working face exposed toward the adjacent end of the frame 1, the working faces preferably being joined by a curved portion. Each of the segments 5 is mounted on the die 4 for movement relative thereto concurrently upwardly and toward the other segment 5 to a collapsed position and in the reverse direction to normal position. Suitable fluid pressure operated piston and cylinder assemblages 6 are provided, one for each segment, and are connected to the main die 4 generally and to their respective segments 5 by suitable linkage 7 and are operable to hold the segments 5 in normal downward outward operating position and to retract the segments 5 to the collapsed position, respectively. The segments 5 are preferably of a width, transversely of the tangent bender, to fit between the upwardly facing flanges along the lateral margins of the sheet stock, described hereinafter, with slight operating clearance. The main forming die 4, including its segments 5 and their operating assemblages, may be moved as a whole vertically to a raised position and to a lowered position, selectively, by means of a fluid pressure operated piston and cylinder assemblage 8 which may be mounted within the frame 1. The assemblage 8 may be either pneumatically or hydraulically operated, as also may be the assemblages 6 and other piston and cylinder assemblages herein described.

The main forming die 4, when in lowered position, is adapted to engage the upper surface of the stock in spaced relation to the ends of the stock so that the portions of the stock beyond the area engaged can be bent upwardly about the curved face portions of the segments 5 and laid against the upright end faces thereof. A suitable manual or air operated detent 9 is provided for latching the main forming die in its operating position, the cooperative parts of the detent being secured on the main die 4 and the frame 1, respectively. For bending the stock upwardly against the upright faces of the segments 5, main wing dies 10 are provided.

Each of the wing dies 10 is in the form of a flat plate having a flat upper operating face and raised margins 11 for engaging the flat face and flanges of the stock, respectively. Each is floatingly supported on a spring pressed roller 12 which engages a channel of the underface of the wing die 10, the roller 12 and channel being nearly coextensive in width with the wing die. Each roller 12 is mounted at its ends in a frame 13 which is pivotally mounted on the frame 1 for swinging movement about an axis extending transversely of the frame 1. The mounting of the roller 12 is such that the roller is movable, transversely of its axis, in the frame 13 toward and away from the pivotal axis of its frame 13. Each roller 12 is urged toward and against its associated die 10 by a spring 14 of which the pressure may be adjusted.

Thus upon swinging the frames 13 about their pivotal axes upwardly, the rollers 12 roll along the undersurfaces of their associated main wing dies 10 under the influence of the springs 14 and rock the dies 10 from horizontal position until they are parallel to the end faces of the die segments 5, the end faces of the latter and the stock laid thereagainst by the wing dies being the factors limiting the final forming position of the wing dies 10.

The channels in the upper working faces of the dies 10 are preferably just sufficient in width to accommodate the stock.

In order to guide the wing dies as they are moved from a starting position to final forming position, suitable gear segments 15 are secured non-rotatably to the frame 1 and engage cooperative racks 16 formed on the lateral margins of the upper faces of the dies 10.

Extension or supporting tables 17 are provided on the dies 10 to support the portion of the stock overhanging the outer ends of the dies 10.

For swinging the frames 13 upwardly and retracting them, fluid pressure operated piston and cylinder assemblages 18 are provided, one end thereof being pivotally connected to the frame 1 and the other end being pivotally connected to its associated frame 13.

Beyond the dies 10 toward the ends of the frame 1 from the main die 4 are end forming dies 19.

Each forming die 19 has a bottom face 20 and an end working or forming face 21 joined with the face 20 by a curved portion. Each die 19 extends transversely of the frame 1 and is of such length, transversely of the frame 1, as to lie between the lateral marginal flanges of the stock with slight operating clearance.

Each die 19 is adapted to engage the upper flat face of the stock with its face 20 when in operating position and to be moved upwardly and clear of the stock to a retracted position.

In order to support the dies 19 for movement into and out of operating position, each die 19 is supported fixedly at its ends on cranks 22.

Each crank 22 is mounted for rocking movement about a shaft 23 which is supported by the frame 1.

The cranks 22 have crank arms 24 at the ends which are swivelly connected to pistons, respectively, of fluid pressure operated piston and cylinder assemblages 25. The assemblages 25 and arms 24 are arranged, laterally of the frame 1, beyond the lateral limits of the stock so as not to interfere with the insertion of the stock through the ends of the tangent bender. Thus the dies 19 are arranged to swing upwardly out of operating position.

As mentioned, however, it is necessary that the dies 19 move concurrently upwardly and toward the main die 4 after the forming of the stock about the dies 19 so that the dies 19 readily become free from the formed stock and do not scuff the stock during their movement from operative to inoperative position. For this reason, the shaft 23 is disposed in a plane extending about 45° from the horizontal, said plane passing through the pivotal axis or shaft 23 downwardly toward the main die 4. Said plane (not shown) thus slopes upwardly from the intersection of the planes of die faces 20, 21 of die 19 to said pivot 23, and overhangs or extends above an associated auxiliary wing die 27. Consequently, when the dies 19 are swung upwardly, they move in an arcuate path extending upwardly and, during the initial part of their movement, toward the main die 4 at an angle of about 45° to the horizontal, and then further upwardly and away from said main die 4 to an inoperative position above the supported stock. Thus they lift immediately from the horizontal surface and the upright surface of the stock formed about the faces 20 and 21.

In order to form the sheet of stock about the faces 20 and 21 of each die, the frame 1 is provided with horizontal supporting element 26 so positioned relative to its associated die 19 that when the die 19 is in operating position the stock is clamped between the upper face of the element 26 and the face 20 of the associated die.

For each end forming die 19 there is a cooperating end wing die 27 of which the inner end portion, when the die 27 is in horizontal position, engages the underside of the outer end portion of the support 26, as best illustrated in Fig. 3. Each end wing die 27 is essentially the same in structure and operation as the main wing dies 10, having flat upper faces with upright lateral margins, as best illustrated in Figs. 3 and 5, adapted to fit the underface and outer faces of the margins of the stock. The channeled underface of each die 27 is engaged by a roller 28. The roller is mounted at its ends in bearings which slide in pivotally mounted frames 29 toward and away from the pivotal axis. Each roller is pressed firmly against its associated die 27 by springs 30 arranged one pair in each frame 29. Each end wing die 27 has racks 31 at its margins which are engaged by fixed gear segments 32 on the frame 1 for guiding the die 27 as it is rocked upwardly from a horizontal starting position about the outer end of the end forming die 19.

Each end wing die 27 is rocked into final operating position by a piston and cylinder assemblage 33 which is pivotally connected at its ends to a transverse rigid tie member 34 of the frames 29 and to a rigid transverse member 35 of the frame 1.

All of the wing dies are so related that when they are in starting position, their upper faces lie in the same horizontal plane, thus acting as supporting tables for sheet stock S which is to be formed or bent and which has lateral flanges F.

To facilitate feeding the stock into the tangent bender and positioning it properly relative to the dies, supporting rollers **36** are mounted on the frame **1** in proper position to support the stock with its upper face horizontal.

As mentioned, the tangent bender is open at both ends so as to receive the stock to be formed endwise through either end as desired. Accordingly, the piston and cylinder assemblages **25** and the detachable end portions, indicated at **37**, of the frame **1**, are spaced outwardly beyond the lateral limits of the space occupied by the stock S. The same is true of the arms **24**, gear segments **32** and **15** and the main die support **2**. Thus a straight horizontal passage is provided from end to end of the bender for receiving the sheet stock.

As mentioned, this tangent bender is particular useful for bending long wide sheets to form integral top, side and bottom walls of a cabinet having substantially continuous peripheral marginal flanges at the open front and back.

Accordingly its operation is described as applied to a cabinet for a domestic refrigerator.

To form such a cabinet, the steel sheet of stock S is cut to proper length to form the top, sides and bottom of the cabinet in one piece. The lateral margins of the sheet are turned up to form flanges F which are to become the peripheral flanges of the cabinet, any holes, cut-outs and the like in the flanges being provided. If a peripheral flange inset from the edge of the sheet is desired, that margin of the sheet is doubled back on itself partway of its width and then turned normal to the plane of the sheet.

The main and end wing dies are horizontally disposed and the end forming dies **19** are raised out of the path of the stock.

The stock S, with the flanges F extending upwardly, is then fed endwise into the bender while supported horizontally until in proper position in which it lies beneath the upraised main die and upraised end forming dies **19** with its ends extending endwise of the bender outwardly beyond the end dies **19**. In the illustrative example, the juncture of the opposite ends of the stock in the finished cabinet is to be at the center of the bottom and accordingly the main die **4** is arranged symmetrically of the longitudinal center of the machine and the dies **10** are spaced equidistantly therefrom.

With the sheet stock S in place, the main die **4** is expanded and lowered, gripping the longitudinal midportion of the sheet between the die segments **5** and the upper faces of the main wing dies **10**. The main die is then latched in place by the detent **9** or otherwise.

The end forming dies **19** are lowered into place, clamping portions of the sheet stock near the ends between the dies **19** and their cooperating end wing dies **27**. The dies **19** may be latched in this position, if desired, by detents, as shown, similar to the detent **9** of the main die. The sheet is positioned laterally so that the inner surfaces of the flanges fit the lateral surfaces of the segments **5** and end forming dies **19** with slight operating clearance and the outer surfaces of the flanges fit between the margins of the wing dies with operating clearance.

The end wing dies **27** are then rocked through

the media of the assemblages **33**, frames **29**, springs **30** and rollers **28** about the curved end surfaces of the dies **19** until the end portions of the sheet are bent about the curved die surfaces and laid against the surfaces **21** of the dies **19**.

Thereupon, the end wing dies **27** are returned to normal horizontal position and the forming dies are raised by swinging them upwardly and, during the initial part of their movement, toward the main die **4** about the axis of the shaft **23** to a sufficiently elevated position to clear the path of the stock during its subsequent forming.

The stock now has upturned end portions *a* which are to form the bottom wall of the cabinet.

Next, the main wing dies **10** are rocked upwardly about the curved end surfaces of the segments **5**, bending the stock S thereabout and laying the stock on upright end faces of the segments **5**, thus providing the portions *b* of the stock which are to form the side walls of the cabinet. The length of the portions *a* and the length of the portion of the stock beneath the main forming die **4** are so related that when the portions *a* have been swung to the desired angle to the horizontal, the free ends of the portions *a* abut each other, a slight excess or deficiency in length being allowed for welding, if desired.

While the shaped stock is held in this position by the dies, the free ends of the portions *a* are welded together, thus completing the cabinet except for attachment of a back wall to one peripheral flange and a front door to the other.

The main wing dies **10** are then rocked to horizontal position, the main forming die **4** is raised and collapsed, and the cabinet is removed from the main die, forwardly in Fig. 1.

Having thus described my invention, I claim:

1. In a machine of the character described, a frame, supporting means for supporting a sheet of flat stock thereon in a predetermined plane, a vertically movable upper main die having an end working face spaced from and facing one end of the frame and having a bottom face adapted to engage an upper face portion of the supported sheet in offset relation to an end of the sheet when that end is adjacent said end of the frame, a rocking main wing die adapted to rock upwardly and bend the stock between said one end of the stock and said upper main die into face to face juxtaposition with said end working face of the upper main die, an auxiliary die having an end face and a bottom face so arranged that, in one position of the auxiliary die the end working face faces toward said end of the frame and said under-working face is adapted to engage the stock between said end of the frame and said upper main die, an auxiliary rocking wing die adapted to rock upwardly and bend a portion of the stock which is between said auxiliary die and said end of the frame into face to face juxtaposition with said end working face of the auxiliary die, power means respective to said wing dies to rock the same independently upwardly to their operating positions and downwardly to inoperative positions, respectively, power means to move said upper main die downwardly into operating position and upwardly out of operating position, respectively, rigid means carried by the frame at opposite sides thereof and positioned laterally of the supporting means and extending above the level of the supporting means and spaced endwise of the frame from said auxiliary die in a direction away from said upper main die, pivot means carried by the upper end of the rigid means, an arm pivotally sup-

ported by the pivot means and supporting the auxiliary die for swinging movement from an operative position initially upwardly and toward the said upper main die and then further upwardly and away from said upper main die to an inoperative position above the supported stock such that, upon operation of the main wing die after forming of the stock by the cooperation of the auxiliary and the auxiliary wing dies the said end of the stock can be swung upwardly clear of the auxiliary die by the main wing die.

2. In a machine of the character described a frame, supporting means for supporting a sheet of flat stock thereon in a predetermined plane, a vertically movable upper main die having a working portion which is expansible and contractible endwise of the frame and which has bottom working face portions and end working faces joined to said portions by convexly curved portions, said bottom face being adapted to engage an upper face portion of the supported stock in offset relation to the ends of the stock, a pair of rocking main wing dies adapted to rock upwardly to bend the stock between said ends of the stock and said upper main die into face to face juxtaposition with said end working faces, respectively, a pair of auxiliary dies arranged at opposite ends of the frame and spaced endwise of the frame from said upper main die, each auxiliary die having a bottom face and an end working face so arranged that in one position of the auxiliary die its end working face faces toward its adjacent end of the frame and its under-working face is adapted to engage the upper surface of the stock between the adjacent end of the frame and the said upper main die, auxiliary rocking wing dies respective to the auxiliary dies, each auxiliary wing die being adapted to rock upwardly and bend a portion of the stock which is between its adjacent end of the frame and its associated auxiliary die into face to face juxtaposition with said end working face of its associated auxiliary die, power means respective to said main wing dies and said auxiliary wing dies to rock the pair of main wing dies upwardly concurrently with each other and the pair of auxiliary wing dies upwardly concurrently with each other, each pair independently of the other pair, to their operative positions and

downwardly to inoperative positions, respectively, means to move said upper main die downwardly into operating position and upwardly out of operating position, sets of rigid supports carried by the frame near the respective ends thereof, the supports of each set being positioned outwardly laterally of the supporting means at each side thereof and extending above the level of said plane and spaced endwise of the frame from said auxiliary dies, respectively, each in a direction away from said upper main die, pivot means carried by the upper ends of said sets of rigid supports, respectively, arms pivotally supported by the pivot means and supporting the auxiliary dies, respectively, the axis of each pivot means and the intersection of the planes of the faces of its associated auxiliary die when its associated die is in said position defining a plane sloping upwardly from said intersection to the pivot and overhanging the associated auxiliary wing die, said arms and pivot means being so arranged as to support their associated auxiliary dies for movement from said position of the auxiliary die to an inoperative position above the stock such that, upon operation of the main wing dies, after forming the stock about the auxiliary dies, the said formed ends of the stock can swing upwardly clear of the auxiliary dies, and power means for rocking the arms to move the auxiliary die into and out of position, selectively.

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