

March 3, 1942.

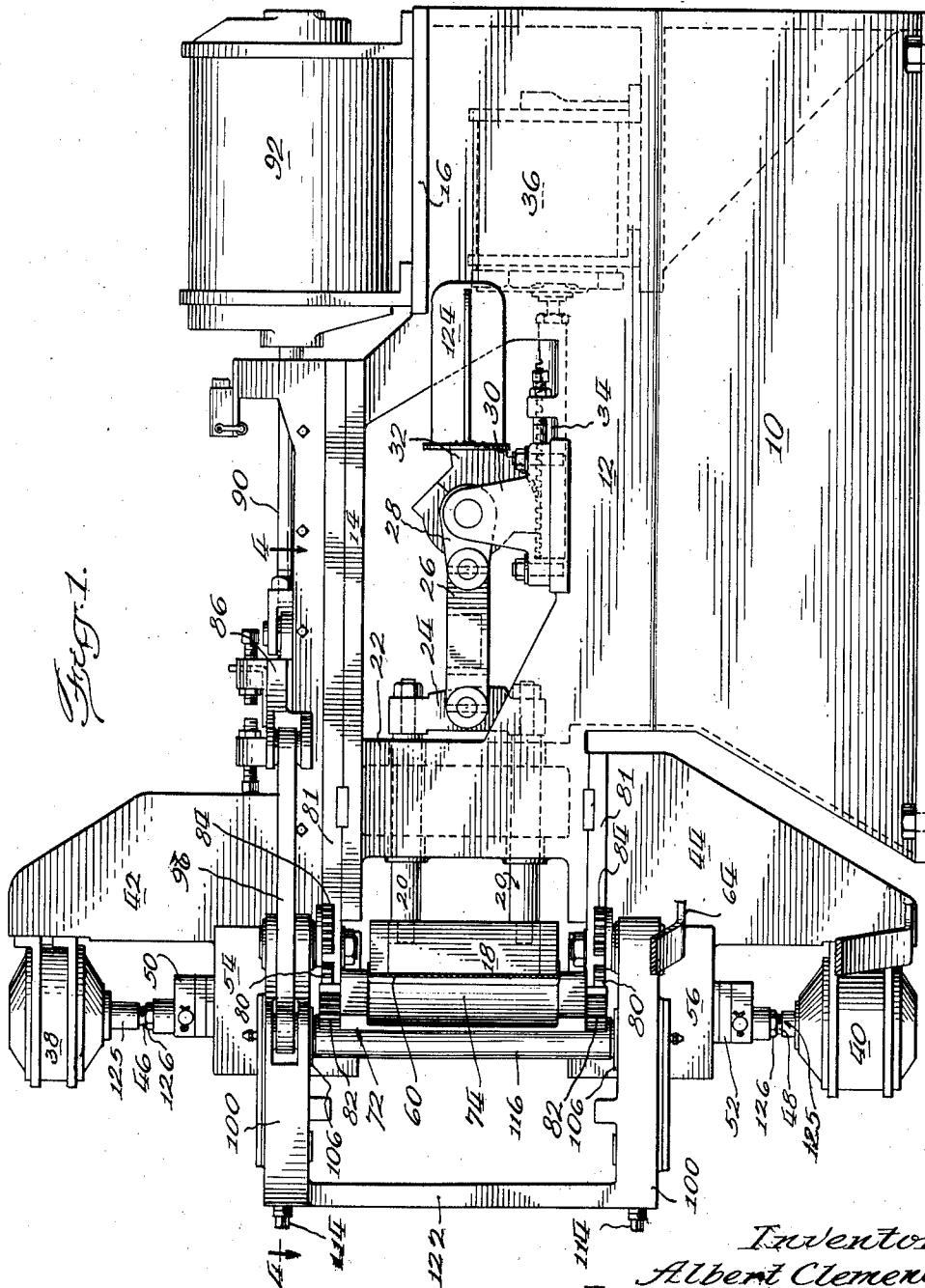
A. CLEMENTS

2,275,174

SHELL FORMING PRESS

Filed Dec. 14, 1940

6 Sheets-Sheet 1



Inventor:
Albert Clements
By
Williams, Bradley & Hinkle
Attys.

March 3, 1942.

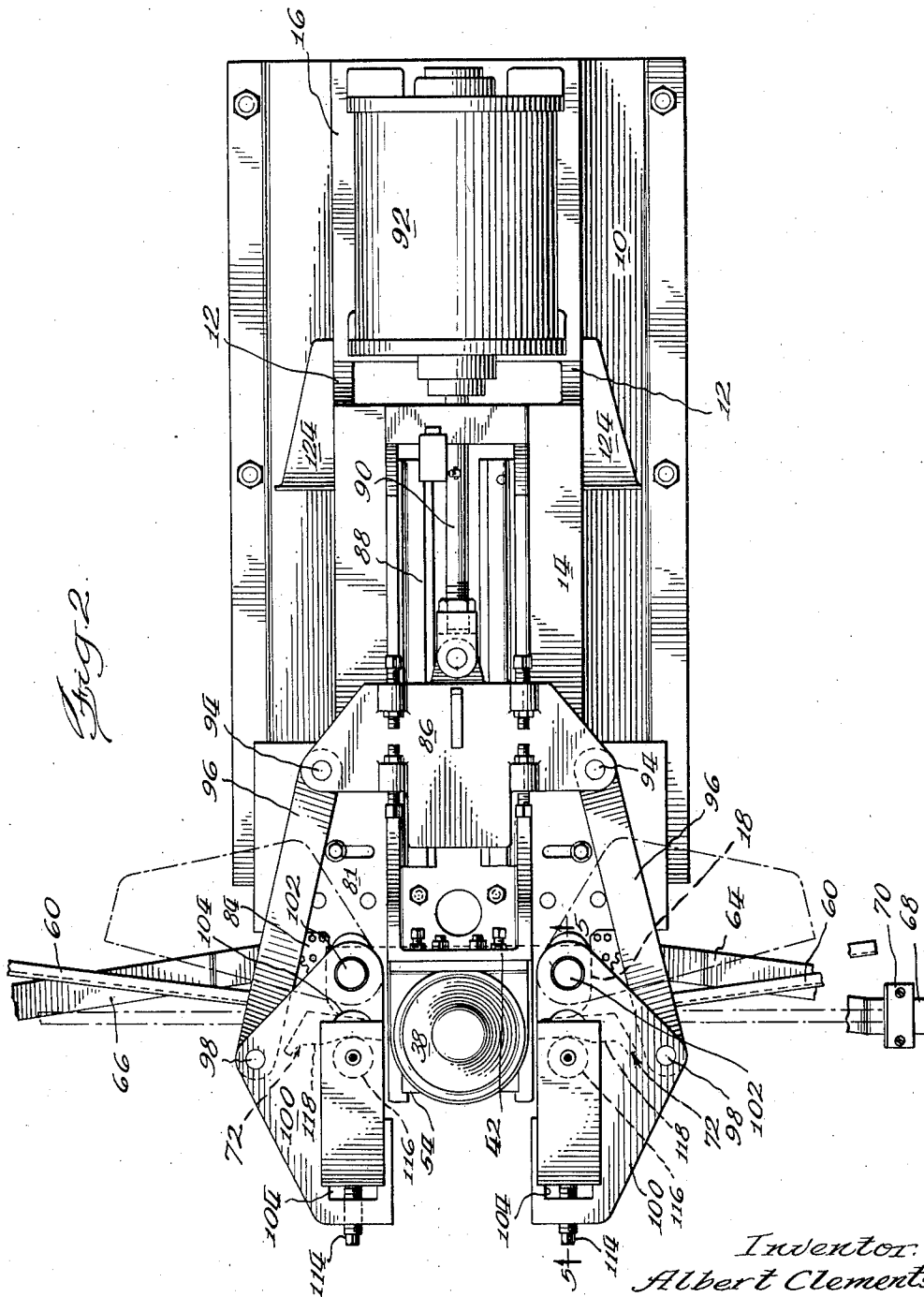
A. CLEMENTS

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SHELL FORMING PRESS

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6 Sheets-Sheet 2



Inventor:
Albert Clements
By
William, Bradbury & Hinkle
Attys.

March 3, 1942.

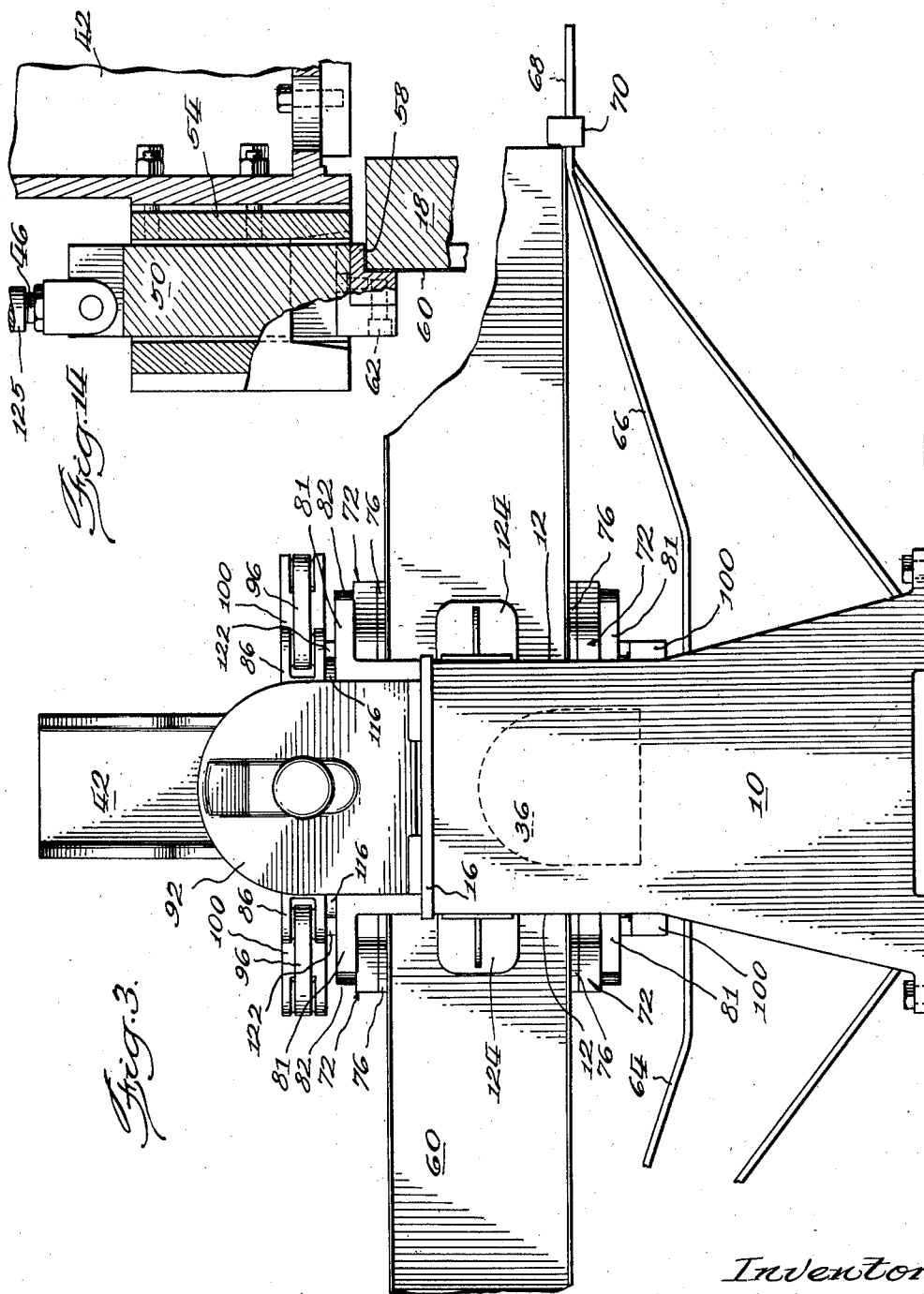
A. CLEMENTS

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6 Sheets-Sheet 3



Inventor.
Albert Clements
By
Williams, Bradbury & Hinkle.
Attys

March 3, 1942.

A. CLEMENTS

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6 Sheets-Sheet 4

44 Inventor:
Albert Clements
By
Williams, Bradbury & Hunt
Attys.

March 3, 1942.

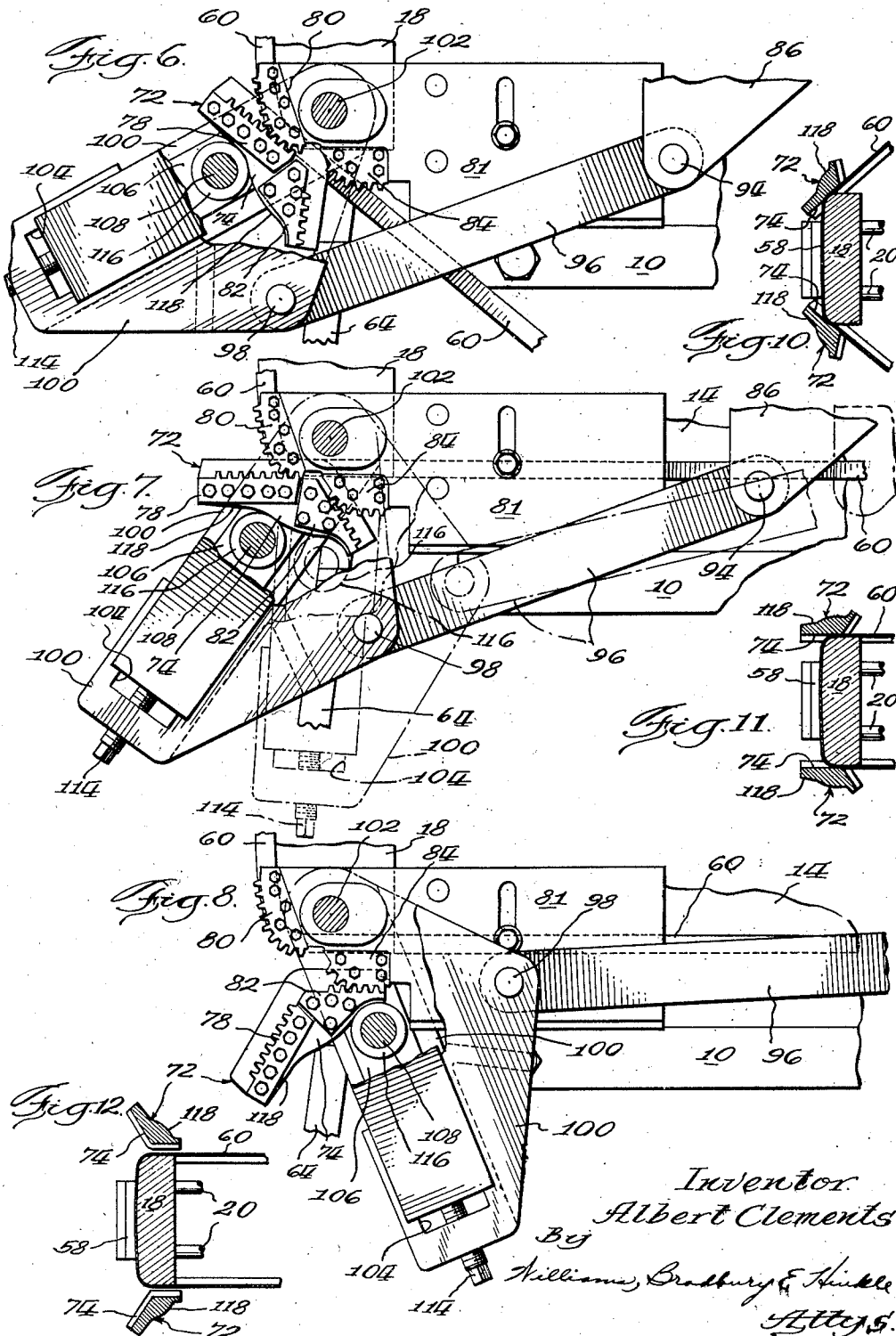
A. CLEMENTS

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6 Sheets-Sheet 5



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A. CLEMENTS

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6 Sheets-Sheet 6

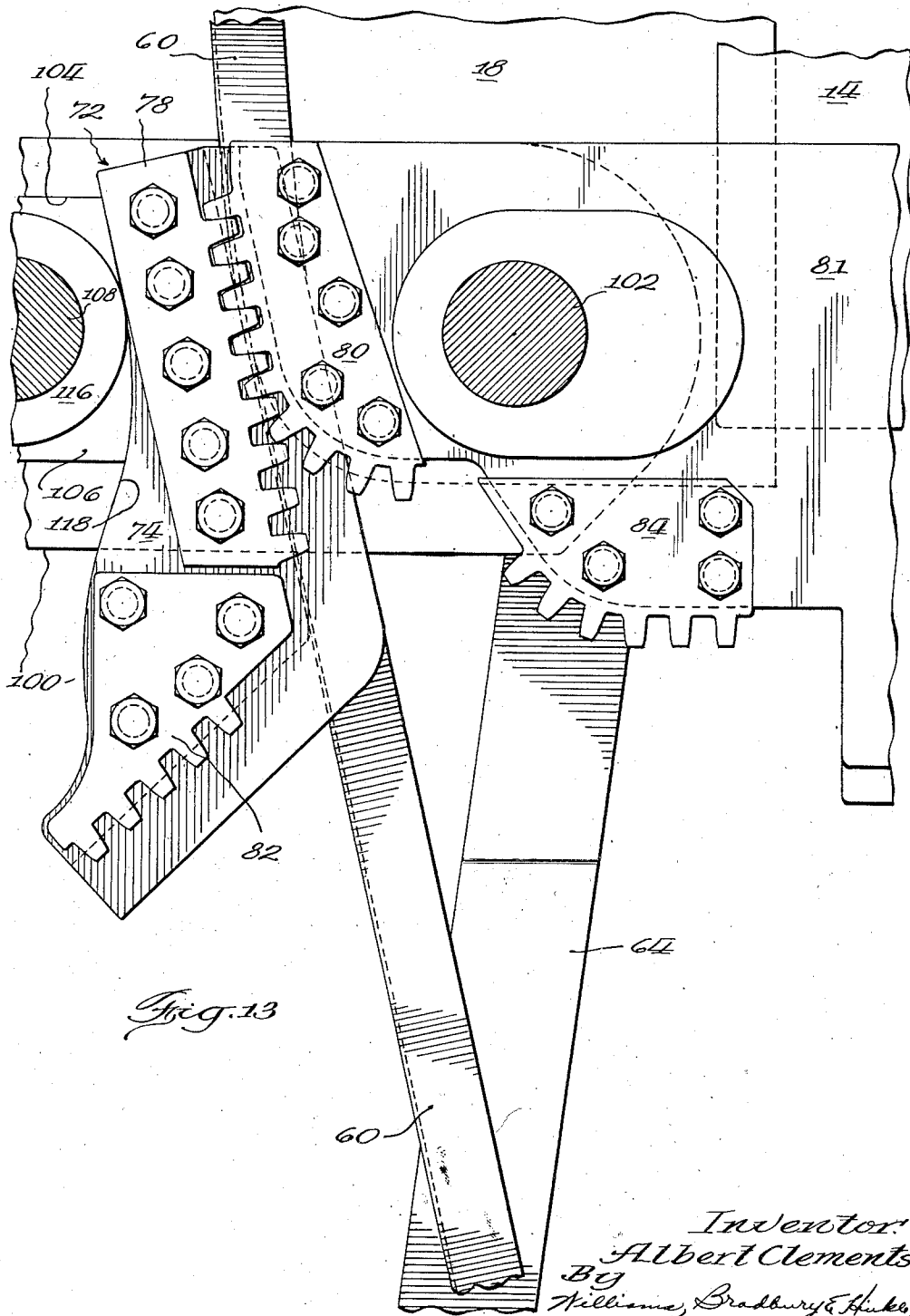


Fig. 13

Inventor:
Albert Clements
By
William, Bradbury & Hulse,
Attys.

UNITED STATES PATENT OFFICE

2,275,174

SHELL FORMING PRESS

Albert Clements, Berwyn, Ill., assignor to Verson
Allsteel Press Company, Chicago, Ill., a corpo-
ration of Delaware

Application December 14, 1940, Serial No. 370,129

6 Claims. (Cl. 153—12)

The present invention relates to what may be termed shell forming presses and is particularly concerned with the provision of a machine for forming the top and side panels of such objects as refrigerator cabinets from a single piece of sheet metal.

In the past refrigerator cabinets and similar articles have commonly been fabricated by forming the top, sides, front and back from separate sheets, the sheets usually being bent at the edges where necessary on press brakes. These several sheets are then assembled and welded together to form the completed four sided cabinet. With the machine of the present invention, however, the manufacture of cabinets is simplified and the cost of their manufacture reduced by semi-automatically bending a single comparatively long piece of sheet metal to form the top of the cabinet and the two sides. Separate front and back panels are then welded to the U-shaped member formed by the present machine to complete the cabinet structure.

With the above in mind, it is an object of my invention to provide an improved machine for simplifying the manufacture of sheet metal objects, such as refrigerator cabinets and the like.

An additional object of my invention is to provide a novel machine for bending a long strip of sheet metal to form the top and side panels of a metal cabinet or like object.

Still another object of my invention is to provide a novel machine of the above type which is almost completely automatic in operation and which requires the attention of only a single workman for its operation.

Yet another object of my invention is to provide a novel machine into which a strip of sheet metal may be inserted and which will upon the actuation of a control, press the sheet metal strip around a forming die to form the top and side panel of a metal cabinet and which will in continuation of its automatic operation, retract the forming members, and strip the formed sheet metal member from the forming die so that it may be easily removed and replaced with a second sheet to be similarly formed.

An additional object of my invention is to provide a novel machine adapted to accomplish the above outlined objectives and which requires the actuation of only a single control for forming the sheet metal member and the actuation of a single additional control to reset the machine for a subsequent forming operation.

An additional object of my invention is to provide an improved machine for forming cabinet

tops and side panels joined thereto or similar articles and which is readily adjustable to form different sized sheet metal members of this general type.

Other objects and advantages of my invention will appear more fully from the following description and from the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

In general, the machine of the present invention clamps the central portion of a sheet metal blank between the end of a slightly convexly bowed generally rectangular die member and a pair of edge supporting dies. The rectangular die member is positioned against the sheet on the side which is to form the inside surface of the top of the cabinet. The actuation of a manual control then causes a pair of wings, one on each side, to be folded around the edges of the rectangular die member to bend the sheet at both sides at substantially right angles to the central portion of the sheet thus forming the side panels of the cabinet. These wings first fold inwardly to a position at right angles to the top of the cabinet and upon continued motion in the same general direction are later folded away from the die member so that at the end of their stroke they are no longer in contact with the faces of the sheet metal blank.

At the completion of their stroke, the wings automatically actuate a control which causes retraction of the edge supporting dies and the rectangular die member, thus permitting the formed shell to be withdrawn endwise away from the machine. Upon the actuation of a second manual control, the wings and the edge supporting dies return to their original position and the machine is conditioned for a successive folding operation. It will be seen from the above that only the following steps are necessary for complete operation of the machine. First the blank is properly located in the machine. Secondly, the actuation of a control, which may be a foot pedal or hand lever, causes the machine automatically to move through a forming cycle. Thirdly, when the machine stops, the operator removes the completely formed blank and actuates a second control which automatically returns the machine to its starting position.

In the drawings:

Fig. 1 is a side elevation of a machine comprising a preferred embodiment of my invention;

Fig. 2 is a plan view of the machine shown in Fig. 1;

Fig. 3 is a rear end elevation of the machine, the rear of the machine being the end to the right in Fig. 1;

Fig. 4 is a horizontal sectional view taken on the line 4—4 of Fig. 1, looking downwardly as indicated by the arrows with a portion of the machine broken away more clearly to disclose the formation and orientation of the machine elements beneath the surface;

Fig. 5 is a fractional vertical sectional view taken in the direction indicated by the arrows along the line 5—5 of Fig. 4;

Figs. 6, 7 and 8 are fractional views showing successive stages in the movement of the folding wings in the formation of the bend at the juncture at the top and side panels of the cabinet;

Fig. 9 is a diagrammatic view showing the position of the folding wings just prior to the commencement of a folding operation;

Figs. 10, 11 and 12 are similar diagrammatic views showing the positions of the wings and the shape of the blank during successive stages of the folding operation and are comparable respectively to the positions of the wings shown in Figs. 6, 7 and 8;

Fig. 13 is a plan view on an enlarged scale as compared to the other figures showing in greater detail one of the folding wings and its associated mechanism;

Fig. 14 is a fractional vertical sectional view taken in the direction indicated by the arrows along the line 14—14 of Fig. 4.

The present machine frame is comprised of a base 10 intended to be secured to the floor of the building within which the machine is housed, and which carries an open box type structure having side members 12. The forward portion of the upper edges of the side plates are connected by a top plate 14 which serves to support a portion of the operating mechanism. At their rearward ends, the side plates 12 are similarly connected by a top plate 16 at a somewhat lower level than the forward top plate 14.

Near the forward end of the machine a rectangular die member 18 of proper size to fit the interior of the top portion of the cabinet to be formed is secured to the ends of four rearwardly horizontally extending rods 20. These rods are at their mid-portions slidably mounted in and extend through a built up block 22 formed in the frame, while their rearward ends are connected to a crosshead 24. This crosshead in turn is connected by means of a pivoted link 26 to a crank 28 journaled transversely of the machine in pillow blocks 30. The crank is rotated by means of a sector gear 32 secured thereto and which meshes with a slidably mounted horizontal rack 34 connected at its rearward end to a movable piston in a pneumatic cylinder 36. Thus by permitting air to enter the forward portion of the pneumatic cylinder 36, the piston therein is moved rearwardly and carries with it the rack 34. This rack rotates the sector 32 and swings the crank into dead center position between the center of rotation of the crank and the point at which the link 26 is pivoted to the crosshead 24, thus thrusting the die member 18 forwardly.

In this position with the link 26 in dead center position, very little load is put upon the pneumatic cylinder 36 during the subsequent operation of folding the side panels of the cabinet. By exhausting the air from the forward portion of cylinder 36 and admitting air to the rearward portion of this cylinder, the piston therein is thrust forwardly and thus through the medium

of the rack 34, sector 32, crank 28 and link 26, retracts the die member 18 to its rearward position. As will be explained more fully subsequently, the die member 18 during its rearward movement cannot carry with it the formed sheet metal member inasmuch as the ends of this member abut against stops soon after rearward movement of the die member is initiated. Thus the rearward movement of the die member 18 strips the sheet metal member from the die and permits the formed sheet metal member easily to be withdrawn from the forward end of the machine.

At the forward end of the machine, upper and lower vertically acting pneumatic cylinders 38 and 40, respectively, are outriggered beyond the die member 18 upon upwardly and downwardly extending pedestals 42 and 44, respectively, these pedestals in turn being secured to the machine frame. Piston rods 46 and 48 extending downwardly and upwardly, respectively, from the pneumatic cylinders 38 and 40 are connected to vertical slides 50 and 52, respectively, that extend substantially the width of the die member 18. As shown in greater detail in Fig. 14, these slides are mounted to reciprocate in jibways 54 and 56 secured to the pedestals 42 and 44, respectively. The lower edge of the slide 50 carries an edge supporting die member 58 that overlaps a portion of the top edge and forward face of the die 18, thus holding the sheet metal blank in place when the die 18 is in its forward position. Before the sheet metal member is inserted into the machine, it is intended that the longitudinal edges of the sheet will be bent at right angles in a press brake to form supporting flanges. As shown in Fig. 14, the edge supporting die 58 in conjunction with the slidable die 18 maintains the upper flanged edge of the blank indicated at 60 so that the subsequent folding of the sheet metal member will not straighten out the flanged edge previously formed in a press brake.

Although it is not shown in the drawings, the lower slide 52 carries an edge supporting die identical with the upper die 58 for the purpose of similarly supporting the lower edge of the blank during the bending process.

Thus when air is admitted to the upper portion of pneumatic cylinder 38 and the lower portion of pneumatic cylinder 40, the slides 50 and 52 are moved toward each other, thus bringing the upper edge supporting die 58 and the lower edge supporting die, not shown, into such positions that when the forming die 18 is moved forwardly, it will carry the blank into position with the flanged edges of the blank wedged between the edge supporting dies and the die member 18. This is the position assumed by the edge supporting dies and the die member 18 just prior to the bending movement of the folding wings. The sheet is therefore rigidly supported at its edges and it has been found that with the sheet thus supported, no support of the sheet at its central top portion is necessary, since the bending movement of the wings will draw the blanks smoothly over the face of the die member 18.

If it is intended that the top of the finished cabinet is to be slightly bowed convexly, then the die member 18 should have a bowed face and similarly the edge supporting dies should be somewhat curved so that the die member 18 will act in conjunction with the edge supporting dies to bow the blank at its central portion prior to the folding movement of the wings.

After the wings have completed their folding movement and have been retracted from the face

of the blank, air is exhausted from the outward ends of cylinders 38 and 40 and admitted to their adjacent ends, thus moving slide 50 upwardly and slide 52 downwardly and retracting the edge supporting dies to positions above and below the die member 18. With the edge supporting dies in their retracted positions, it will be seen that the formed cabinet shell may be slid endwise from the front of the machine.

For convenience in manufacture and to enable the machine to be adapted to form cabinets of different sizes, the edge supporting dies 58 are formed separately and of harder material and are secured in the slides 50 and 52 by means of cap screws 62 in a well known manner.

A pair of locating members 64 and 66 are formed of bent steel members welded together and are secured to the forward portion of the lower pedestal 44. These locating members extend outwardly transversely of the machine and near their ends carry horizontal extensions 68 against which the lower edge of the sheet metal blank 60 rests. The outward extensions 68 are equipped with stops 70 which may be slid along the extensions 68 and clamped in place at the proper point. Thus, a sheet metal blank 60 may be placed in the machine with its lower edge at the ends resting upon the extensions 68 and with its ends between the two stop members 70. The height of the extensions 68 and the positions of the stop members 70 are such that when the blank is located as above described, it will be in proper position to start the cycle by moving the die member 18 forwardly.

A pair of folding wings 72 are mounted one on each side of the machine at its forward end. Since one of these folding wings and its associated mechanism is the reverse complement of the other, only one need be described. The folding wing 72 consists of a flat plate 74 somewhat wider than the blank and of sufficient length so that when moved, as later described to fold the sheet metal blank around the vertical edge of the die member 18, it will extend along the face of the blank which is to form one of the side panels of the cabinet a short distance beyond the juncture between the top and the side panel. That is, this wing must be of sufficient length to fold the sheet metal blank smoothly around the corner die, but it need not extend to the end of the blank since the greater portion of the side panel formed from the blank is straight and is not deformed by the folding process. Where the flat plate 74 comes in contact with the upper and lower edges of the blank, it is fitted with edge dies 76, which are of harder material than the plate 74. These edge dies have a surface to be brought into contact with the face of the blank and an extension at right angles thereto, which extends over the edge of the blank and holds the flange previously formed in contact with the die member 18, thus preventing the flange from being rolled outwardly during the forming operation.

The central portion of the flat plate 74 can be of considerably softer material than the edge dies 76, since it has been found that practically all of the wear is taken by these edge dies and that if the edges of the blank are properly bent by the edge dies, the central portion of the blank will take the same degree of bend with very little support from the center of the plate 74.

At its top and bottom edges the plate 74 carries a pair of identical short racks 78 which are meshed with a pair of toothed tracks 80. These

tracks consist of a portion formed as a straight rack which merges into a sector gear portion having substantially the same radius of curvature at its pitch line as the radius of curvature at the edges of the die member 18. The tracks 80 are secured to a pair of plates 81 adjustably mounted upon the machine frame and are positioned in alignment above and below the corners of the die member 18. Thus, when as shown in the drawings, the racks 78 are placed with their teeth in mesh with the teeth of the tracks 80 and the wing is rolled around toward the side of the machine, the inner surface of the wing 74 will follow the external vertical face of the die 18 at its vertical side edge. The blank, since it is positioned between these two members, will, therefore, be smoothly bent around the face of the die 18 by the movement of the wing.

The upper and lower edges of the plate 74 also carry a second set of racks 82 which extend outwardly and rearwardly away from the racks 78 at an angle of approximately 60 degrees. At the instant when the plate 74 has been rolled around into a position alongside the die member 18, the inner end of the racks 82 will mesh with a second set of toothed tracks 84 which are positioned outwardly and rearwardly of the similar tracks 80. The tracks 84 also similarly consist of sector gear portions which merge into short straight rack portions and are so positioned relative to the tracks 80 that as the last tooth on each of the racks 78 rolls into full contact with the last tooth on each of the tracks 80, the innermost set of teeth on the racks 82 will start meshing with the innermost teeth on the tracks 84. Thus, the wings in their rearward folding movement are guided first by the racks 78 and tracks 80, and after completion of the blank bending portion of their movement are swung outwardly away from the blank by the racks 82 rolling over the faces of the tracks 84. The movement of the wings, therefore, is first around the vertical side edges of the die member 18 and during this movement the blanks are folded to form the bend between the side panels and the top of the cabinet member. After having completed this folding movement, additional movement of the wings in the same general direction through the medium of the racks 82 and tracks 84 causes the wings to be rolled away from the face of the blank so that no resistance is offered by the wings to subsequent withdrawal of the blank in an endwise direction.

The actual folding movement of the wings is accomplished by a toggle arrangement comprising a crosshead 86 slidably mounted longitudinally in jibways 88 upon the top of the machine. This crosshead is moved by means of a piston rod 90 connected to a piston in a pneumatic cylinder 92 mounted upon the top plate 16. Thus air under pressure admitted to the rearward portion of the cylinder 92 will thrust the crosshead forwardly while air admitted to the forward end of the cylinder 92 will retract the crosshead 86 rearwardly of the machine.

The two ends of the crosshead 86 are pivoted by means of pins 94 to the rearward ends of links 96 which at their opposite ends are similarly pivoted by means of pins 98 to swinging yokes 100. These yokes are in turn pivoted at their rearward inner ends upon pins 102 secured to the machine frame. The pivot pin 98 is so placed relative to the pin 102 that movement of the crosshead 86 from its extreme forward position to its extreme retracted position will not at any

time bring the pin 98 into a dead center position relative to the pins 102 and 94. In Figs. 2 and 4, the above described mechanism is shown in the position it assumes when the crosshead 86 is in its extreme forward position. This is the position assumed by the yokes 100 and the associated mechanism before the commencement of a folding cycle.

The yokes 100 are provided with cut-out slotted portions 104 which extend substantially parallel to the center line of the machine and to each other when the yokes are in their forward position. Movable blocks 106 are slidably disposed within the slots 104 and journal the ends of roll shafts 108. These blocks are urged toward the pivot pins 102 by comparatively stiff coil springs 110 which in turn are backed up by movable blocks 112, the position of which can be determined by adjustment screws 114 threaded through the outer ends of the yokes. Thus, by turning the screws 114 the blocks 112 can be moved inwardly or outwardly toward or away from the pivot pins 102 to determine the compression of the springs 110 and in turn the spring pressure upon the roll shafts 108. The roll shafts 108 are formed integrally with rollers 116 which roll against cam faces 118 formed upon the outer faces of the flat plates 74.

The specific shape of the face 118 in contact with its roll 116 is not critical. It is best shown in Fig. 13, and the shape there illustrated is such that as the yoke 100 is swung outwardly around its pivot pin 102 by the aforementioned linkage arrangement, the roller as it rolls over the cam face 118 will exert a substantially constant pressure tending to urge the rack 78 against the toothed track 80. It will be appreciated that it is desirable that the pressure exerted by the springs urging the rolls against the cam plates should be substantially constant during the forming of the sheet metal member, although it is not a critical factor in the operation of the machine. It is necessary merely that the pressure be sufficient to bend the blank being formed. Because of the novel cooperation of the rack 78 rolling in contact with the toothed track 80, it will be seen that the folding wings fold around the vertical edges of the die member 18 without sliding relative thereto. Thus, there is no tendency for the wings to slip over the face of the blank being deformed.

Because the wings are forced to roll around the vertical edges of the die member 18 by the rollers 116 backed up by springs 110, it will be appreciated that the pivot pins 102 do not necessarily need to be at the center of curvature of the die edge around which the sheet metal blank is drawn, as would be necessary were the yokes 100 connected directly to the wings rather than being connected through the medium of a resilient member. Since at the end of the cycle the second racks 82 are rolled over the faces of the second toothed tracks 84, thus swinging the wings out away from the face of the sheet metal blank and consequently farther from the center of curvature of the vertical edges of the die member 18, it is preferable that the pivot pins 102 be placed somewhat rearwardly of the center of curvature of the die member edges although as has been explained, the exact position of this pin 102 is not critical.

In the arrangement shown, the single cross-head 86 is connected by means of the links 96 to the upper yokes 100 and consequently swings these yokes. It is, therefore, necessary that the

upper yokes be connected to the lower set of yokes by stiff vertical members 122 or similar structural elements.

As may best be seen in Fig. 2, a pair of stop members 124 are secured to the sides of the machine and project outwardly sufficiently to serve as abutments against which the ends of the formed shell impinge as the die member 18 is retracted. These stops 124, therefore, serve to strip the shell from the die 18 so as to permit easy manual removal of the shell at the completion of a forming operation.

In order to permit adjustability of the machine for the manufacture of shells of different dimensions, the die member 18 is removable and can be replaced by die members of different sizes and shapes. Also the slides 50 and 52 carrying the edge holding dies 58 can be adjusted to approach each other a lesser or a greater amount by adjustment of a threaded connection at 125. This adjustment is formed by threading the end of the piston rods 46 or 48 into the slides 50 and 52 and then locking the two together in any desired position by means of a lock nut 126 threaded upon the piston rod and drawn tightly against the end of the slide. Similarly also, the positions of the wings can be adjusted, since the plates 81 to which the toothed tracks 80 and 82 are secured are adjustable relative to the machine frame.

Operation

The positions assumed by the several elements of the machine prior to the start of a shell forming cycle are as follows: The die 18 is in its fully retracted position. This is accomplished by admitting air to the rearward end of cylinder 36. The rearward portion of cylinder 92 is likewise under pressure and thus cross-head 86 and the folding wings are in their maximum forward position. The upper portion of cylinder 38 and the lower portion of cylinder 40 are under pressure and thus the edge supporting dies are in their extended position, that is, the upper edge supporting die is in its maximum downward position, while the lower edge supporting die is in its maximum upward position.

With the machine thus conditioned for operation, the operator places a sheet metal blank, which consists of a rectangular strip of sheet metal, the longitudinal edges of which have been bent over in a press brake to form flanges, into the machine. The blank is positioned with the bent flanges extending rearwardly and with the lower edge of the blank resting upon the arms 68 and with the ends of the blank positioned between the gage blocks 70. With the blank thus located, the die member 18 is in a position rearwardly of the blank, while the edge supporting dies are immediately in front of the blank.

The operator then actuates a push button control which, through the medium of an electrical circuit and a solenoid operated valve, exhausts the air from the rearward end of cylinder 36 and admits air to the forward portion of this cylinder. The piston in cylinder 36 is thus urged toward the rearward end of the machine and through the medium of the rack 34, sector 32, crank 28, link 26, and crosshead 24, die member 18 is moved forwardly into contact with the sheet metal blank with the upper flange of the sheet metal blank extending slightly over the upper face of the die member 18 and similarly the lower flange extends slightly over the lower face of the die member. Continued movement of the die mem-

ber 18 in a forward direction pushes the sheet metal blank against the edge supporting die members and if both the face of the die member 18 and the edge supporting dies are bowed, the central portion of the sheet metal blank will be given a bowed configuration.

With the sheet metal blank thus tightly clamped between the die member 18 and the edge supporting dies, the die 18 or one of the movable parts associated therewith trips a limit switch which actuates a solenoid valve to admit air under pressure to the forward portion of cylinder 92 and to exhaust air from the opposite end of this cylinder. The piston in this cylinder together with its piston rod 90, crosshead 86, links 96, and yokes 100 moves rearwardly of the machine. This causes the rollers 116 to be swung around the vertical edges of the die member 18 and along the face of the cam 118. This action causes the racks 78 to roll along the toothed tracks 80, thus swinging the wings around the vertical edges of the die member 18 and against the parallel vertical faces thereof. This motion bends the blank around the semi-cylindrical edge of the die member 18 and against the parallel sides of this die member, thus completely forming the sheet metal shell. Continued rearward arcuate movement of the rollers 116 rolls the racks 82 into engagement with the toothed tracks 84 and with additional movement rolls the folding wings out of contact with the sides of the sheet metal shell.

As the wings reach their rearward position, a member on one of these wings or moving mechanism associated therewith trips a second limit switch which through the medium of a solenoid valve causes air to be exhausted from the upper portion of cylinder 38 and the lower portion of cylinder 40, and simultaneously permits air to enter the lower portion of cylinder 38 and the upper portion of cylinder 40. The pistons in these cylinders, therefore, move apart and retract the edge supporting dies into positions respectively above and below the edges of the sheet metal shell. As the corner dies move outwardly away from each other, one of these dies or moving mechanism associated therewith trips another limit switch which by means of an electrical circuit and a solenoid valve exhausts the air from the front portion of cylinder 36, and admits air to the rearward portion thereof, thus retracting the die member 18.

The die member 18 in moving rearwardly carries the sheet metal shell with it until the ends of this shell abut against the stops 124. Continued rearward movement of the die member 18 strips the die from the shell and as the die member 18 reaches its fully retracted position, the machine comes to rest.

The operator reaches into the front end of the machine and pulls forth the sheet metal shell and after its removal, actuates a push button for the purpose of resetting the machine. The actuation of this latter push button, through the medium of a solenoid actuated valve, exhausts the air from the lower portion of cylinder 38 and the upper portion of cylinder 40 and simultaneously admits air to the opposite ends of these cylinders, thus urging the edge supporting dies toward each other and into the positions they assume at the start of a cycle. Simultaneously, a solenoid valve causes the air to be exhausted from the forward end of cylinder 92 and to be admitted to the rearward end of this cylinder, thus swinging the yokes 100 forwardly into their start-

ing position. At this point the machine again comes to rest in its starting position and may be loaded with a second blank to be formed into a refrigerator or like cabinet shell.

Fig. 9 of the drawings shows the positions assumed by the several working elements and the sheet metal blank at the moment the die member 18 has reached its most forward position, and before the folding wings have started their rearward movement. In Figs. 6 and 10, the positions of the several elements and the sheet metal blank are shown in the positions they assume when the folding wings are approximately halfway through the folding movement. Figs. 7 and 11 show the positions assumed by these same elements at the completion of the shell folding operation, while Figs. 9 and 12 show the arrangement of the parts after the folding wings have been rotated into a position spaced from the sheet metal blank and at the end of this portion of the machine cycle.

In the drawings, no attempt has been made to show the several limit switches together with their electrical and pneumatic circuits which control the air flow to and from the pneumatic cylinders, since the location of these limit switches and the particular circuit used is largely a matter of choice and not a matter requiring invention. That is, the use of such circuits and limit switches is common practice in the manufacture of automatic or semi-automatic metal deforming machines, and the location of these switches and the circuits for causing these switches to exercise control over the machine operations are matters well within the skill of persons familiar with this art.

It will be seen that the machine of the present invention accomplishes the objects set forth at the beginning of this specification and enables the manufacture of sheet metal cabinets to be accomplished at lower cost than as has been heretofore possible.

Having described my invention, what I claim as new and useful and desire to secure by Letters Patent of the United States, is:

1. In a shell forming machine, a central blank holding member adapted to be placed against the inner face of a sheet metal blank having a flanged edge, a pair of edge supporting die members positioned in front of said blank holding member to support the edges of said blank on its outer face, means adapted when actuated to retract said edge supporting members outwardly from a position in front of said blank holding member, a pair of folding elements to fold said blank around said blank holding member, and means to retract the last said elements into a position spaced from said blank holding member and to cause actuation of the first said means so that at one point in the cycle of operation of said machine no machine parts are positioned in front of said blank holding member thus permitting the withdrawal of a formed shell endwise of said machine.

2. In a machine of the class described, a central blank holding member adapted to be reciprocated into contact with a sheet metal blank having a flanged edge, a pair of edge supporting die members to back up the edges of said blank and hold the blank in contact with the blank holding member, means adapted when actuated to retract said edge supporting members outwardly from a position in front of said blank holding member, a pair of folding elements to fold said blank around said blank holding mem-

ber, means to retract said folding elements after said folding operation into a position spaced from the sides of said blank holding member and to cause actuation of the first said means so that at the end of the folding operation no machine parts are positioned in front of said blank holding member, thus permitting the withdrawal of a formed shell endwise of the machine, and means operative after the withdrawal of said shell to cause said edge supporting members to be urged toward each other and to cause said folding elements to be moved into a position at least partially in front of said blank holding member.

3. In a shell forming machine, a blank holding die reciprocable into and out of blank holding position, a pair of blank edge supporting dies reciprocable into and out of edge supporting position, said edge supporting dies when in retracted position leaving an open space in front of said blank holding die large enough to permit the endwise withdrawal of a completed shell, a pair of folding wings adapted to fold from a position at least partially in front of said blank holding die, around the vertical front edges thereof and into a position along the sides of said die and thenceforth into a position spaced outwardly from the sides of said die, coordinated mechanism for retracting said edge supporting dies approximately simultaneously with the outward movement of said wings and means active after the retraction of said edge supporting dies and after the wings have assumed the last above stated position to cause retraction of said blank holding die to strip said die from a completed shell in contact therewith.

4. In a shell forming machine, locating means to aid in positioning a sheet metal blank in said machine, a reciprocable blank holding die, means to reciprocate said blank holding die into a position against the central portion of said blank, a pair of edge supporting dies partially in front of said blank holding die adapted to back up the edges of said blank in opposition to the blank holding die, means to retract said edge supporting dies from a position in front of said blank holding die at the completion of a forming operation, a pair of folding wings adapted to

fold from a position partially in front of said blank holding die, around the vertical front edges thereof and into a position along the sides of said die and thence outwardly away from the sides of said die, said folding wings adapted to assume the last above said position at the end of a folding operation, timed means for instituting the folding movement of said wings after said blank holding die is moved into position against the central portion of said blank and means operative at the end of the folding operation to retract said blank holding die to strip said die from a completed shell in contact therewith.

5. In a machine of the class described, a generally rectangular blank holding die member, a folding wing adapted to fold from a position partially in front of said die member around one edge thereof and into a position alongside thereof and thence into a position spaced outwardly from the side thereof, a toothed track partially throughout its range of movement, a toothed following member on said wing adapted to engage the teeth on said track continuously during the movement of said wing whereby the movement of said wing is determined by the toothed following member rolling in contact with said toothed track, a yoke adapted to swing around the beforementioned edge of said die, a roller carried by said yoke and resilient means to urge said roller against said wing so as to urge said wing toward said die and the following member thereon into engagement with said track and to cause said wing to roll around the edge of said die as said yoke is swung around the said edge.

6. In a machine wherein a wing is folded around an edge of a die element to bend a sheet metal blank around said edge, a swingable yoke, a roller carried with said yoke and resiliently urged toward said edge, a folding wing adapted to fold around said edge and be resiliently urged toward said edge by said roller, and track means to guide said wing during its movement around said edge, said track means extending generally outwardly near its rearward end to cause said wing to move away from the die element at the end of its stroke.

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