July 19, 1949. L. B. GREEN 2,476,595

EXPANSIBLE DIE PUNCH FOR BENDING FLANGED WORK WITH TANGENT BENDING APPARATUS

Filed Feb. 22, 1945 4 Sheets-Sheet 1

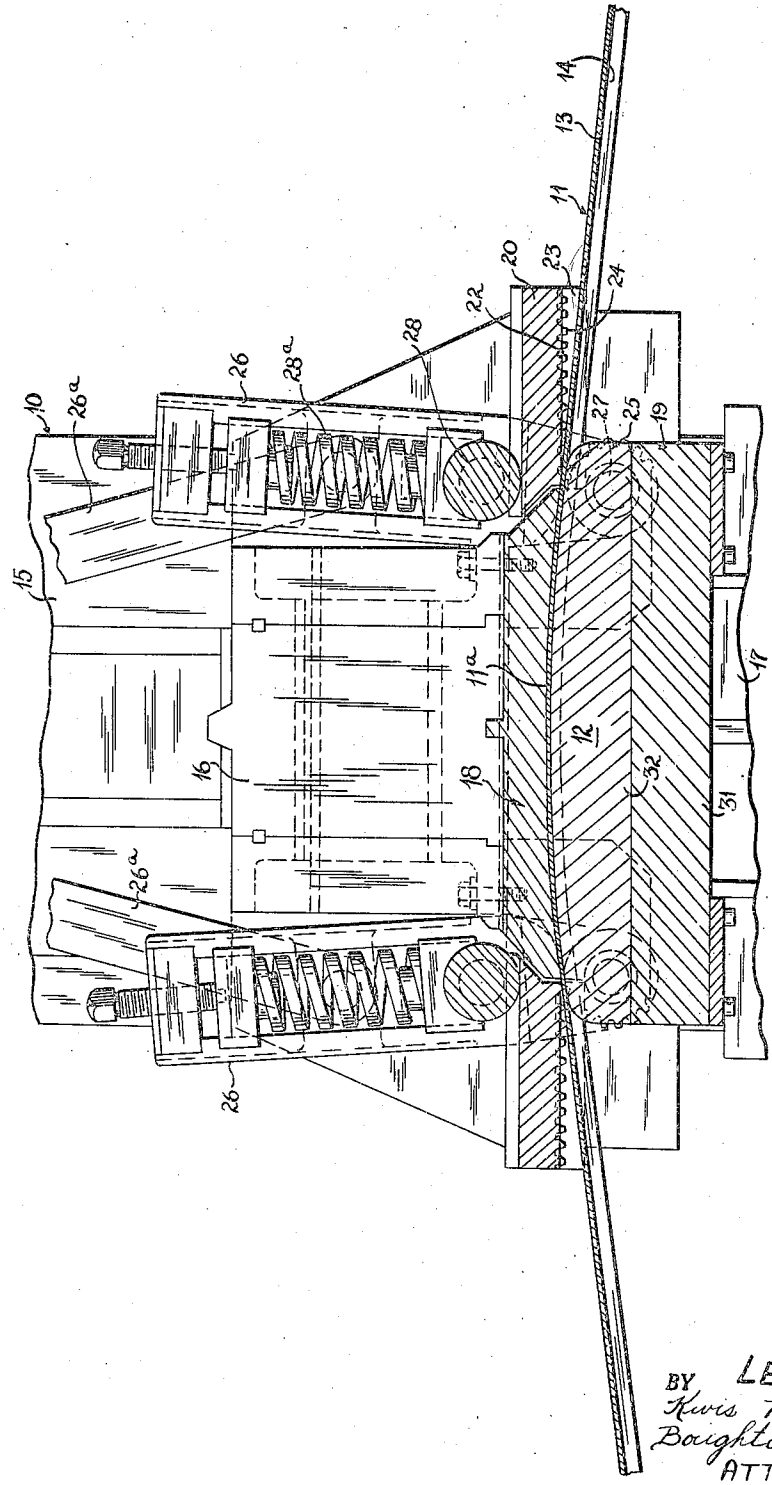


FIG. 1

INVENTOR.

BY LEE B. GREEN

Kwis Hudson

Boughton & Williams

ATTORNEYS

July 19, 1949. L. B. GREEN 2,476,595

EXPANSIBLE DIE PUNCH FOR BENDING FLANGED WORK WITH TANGENT BENDING APPARATUS

Filed Feb. 22, 1945

4 Sheets-Sheet 2

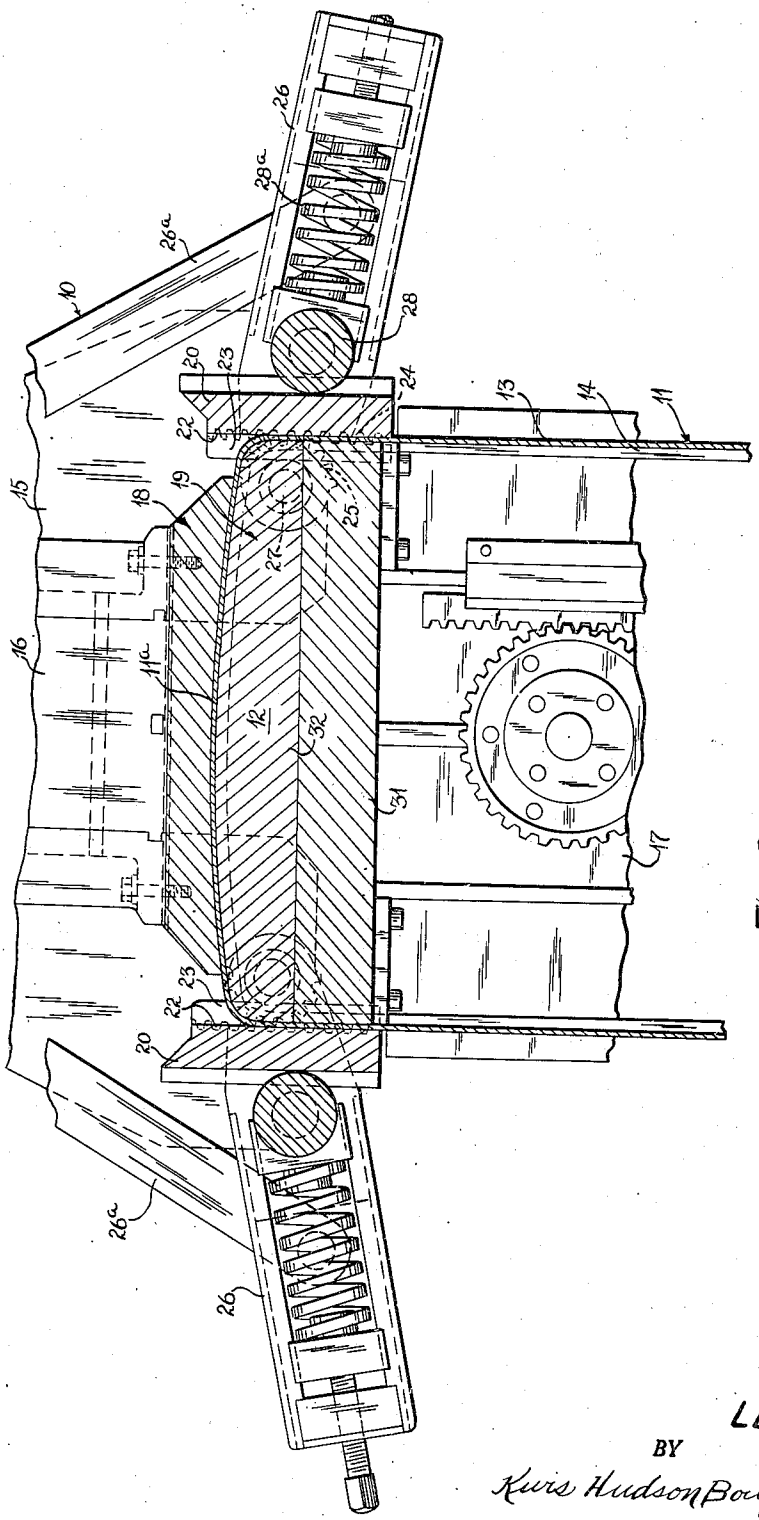


FIG. 2

INVENTOR.
LEE B. GREEN

BY
Kuis Hudson Boughton & Williams
ATTORNEYS

July 19, 1949. L. B. GREEN 2,476,595

EXPANSIBLE DIE PUNCH FOR BENDING FLANGED WORK WITH TANGENT BENDING APPARATUS

Filed Feb. 22, 1945

4 Sheets-Sheet 3

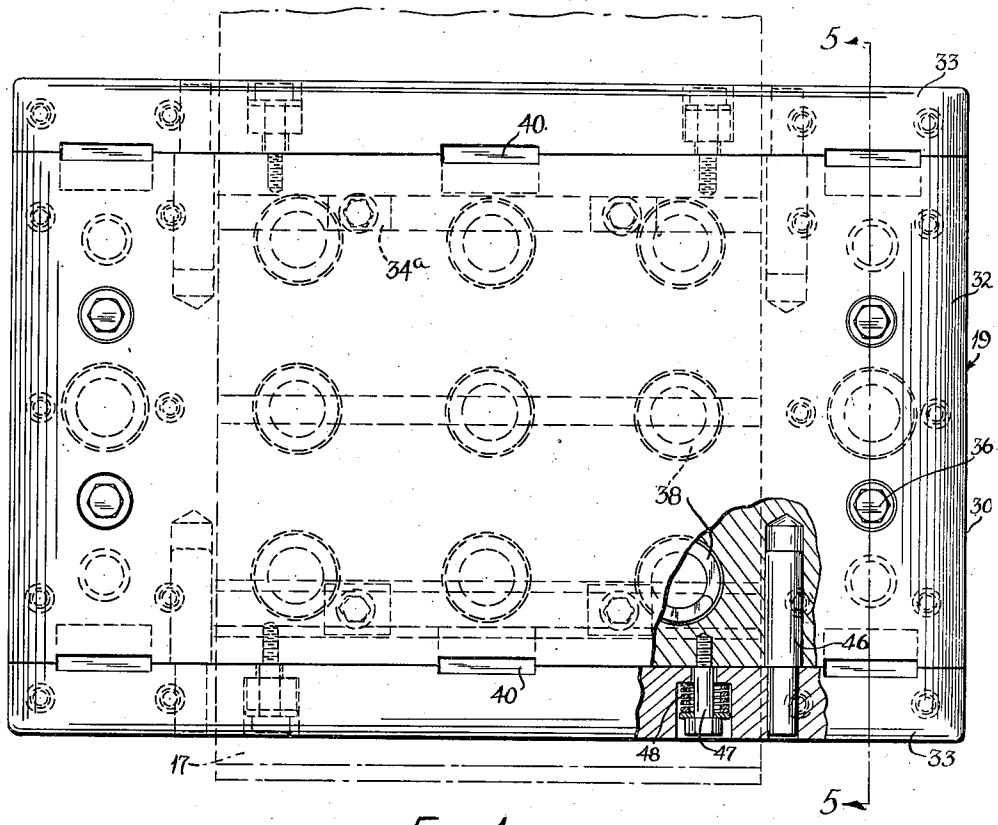


FIG. 4

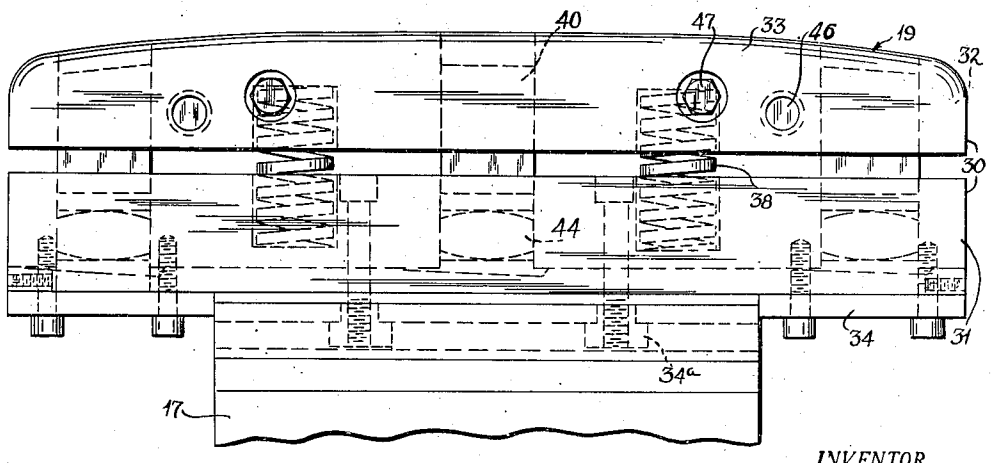


FIG. 3

INVENTOR.

BY LEE B. GREEN

Kuris Hudson Boughton & Williams

ATTORNEYS

July 19, 1949. L. B. GREEN 2,476,595

EXPANSIBLE DIE PUNCH FOR BENDING FLANGED WORK WITH TANGENT BENDING APPARATUS

Filed Feb. 22, 1945

4 Sheets-Sheet 4

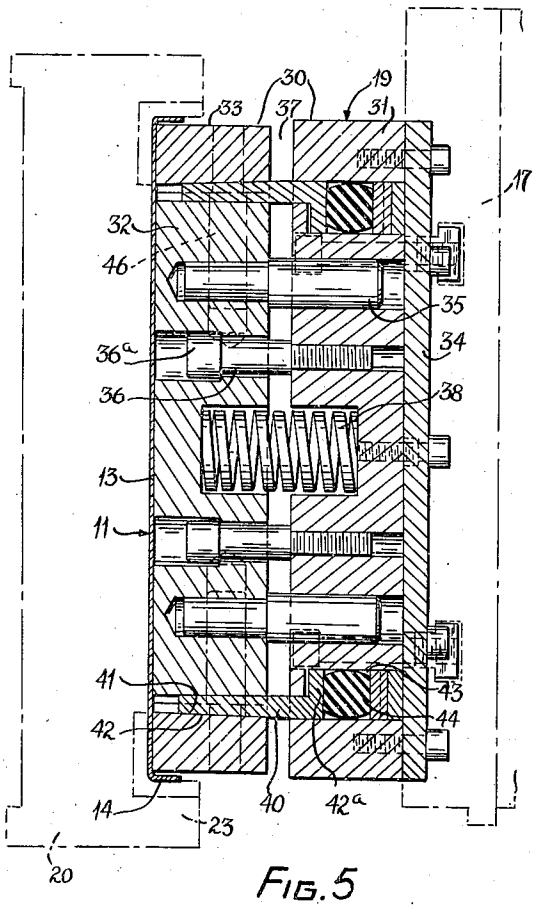


FIG. 5

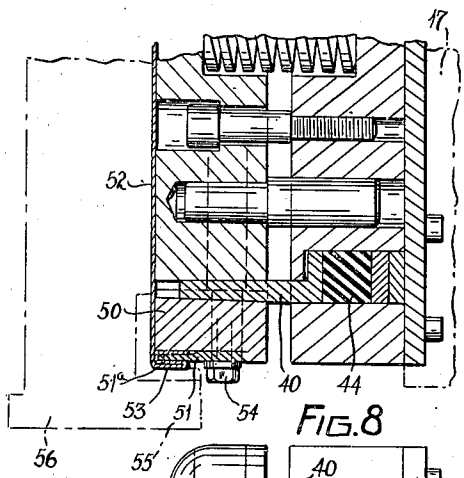


FIG. 8

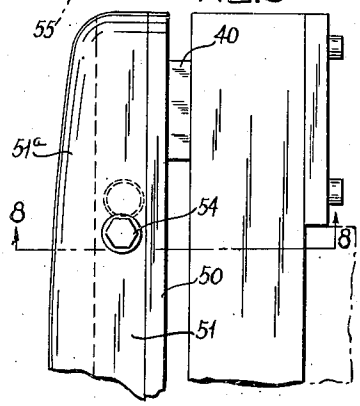


FIG. 7

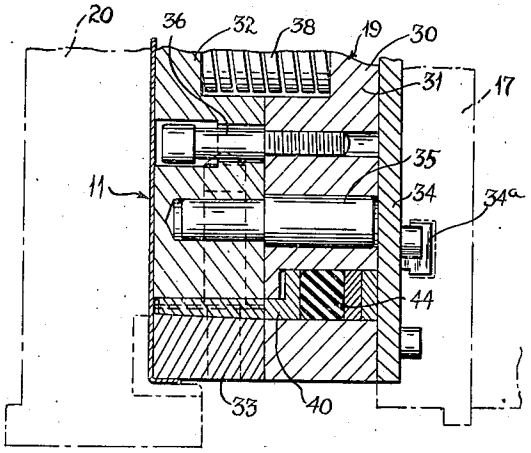


FIG. 6

INVENTOR.

BY LEE B. GREEN

Kuis Hudson Boughton & Williams

ATTORNEYS

Patented July 19, 1949

2,476,595

UNITED STATES PATENT OFFICE

2,476,595

EXPANSIBLE DIE PUNCH FOR BENDING FLANGED WORK WITH TANGENT BENDING APPARATUS

Lee B. Green, Lakewood, Ohio

Application February 22, 1945, Serial No. 579,264

8 Claims. (Cl. 153—33)

1

This invention relates to metal working apparatus and aims to provide an improved construction for metal working apparatus of the kind disclosed in my earlier Patent No. 2,287,933, granted June 30, 1942.

The apparatus disclosed in this earlier patent is for the purpose of carrying out a cold bending operation on flanged metal sheets or bars so that various fabricated metal structures, such as refrigerator cabinets, curved frame members or the like, can be produced directly from such flanged metal sheets or bars. The improved metal working apparatus hereinafter described is similar to that of my earlier patent but embodies novel means by which buckling or wrinkling of the flange of the workpiece can be more effectively prevented, and by which the shaping of certain portions of the workpiece to the desired form can be more smoothly and accurately carried out.

Another object of the present invention is to provide improved apparatus of this character having die mechanism which includes an expansible die member and in which novel means is employed for producing the expansion of the die member.

The invention can be further briefly summarized as consisting in certain novel combinations and arrangements of parts hereinafter described and particularly set out in the claims hereof.

In the accompanying sheets of drawings

Fig. 1 is a partial sectional plan view taken through the die mechanism of bending apparatus constructed according to the present invention, the view showing the workpiece being clamped by the die mechanism and about to be subjected to the bending operation.

Fig. 2 is a similar partial sectional plan view but showing the die mechanism and workpiece at the completion of the bending operation.

Fig. 3 is a detached top plan view of the expanding punch member of the die mechanism.

Fig. 4 is a detached front elevation of the punch member, with portions thereof broken away.

Fig. 5 is a vertical sectional view taken through the punch member on line 5—5 of Fig. 4 and showing the punch member before being expanded.

Fig. 6 is a partial vertical sectional view similar to Fig. 5 but showing the punch member in its expanded condition.

Fig. 7 is a partial plan view of a modified form of the expanding punch member; and

Fig. 8 is a partial vertical sectional view taken on line 8—8 of Fig. 7.

As one example of the metal working operations which the improved apparatus 10 is capable of performing, Figs. 1 and 2 show a workpiece 11 being acted upon by the die mechanism 12 of this improved apparatus. The workpiece 11 as here shown is an elongated sheet metal body having a web portion 13 and longitudinal edge flanges 14. Fig. 2 shows the workpiece 11 as having been bent to substantially U-shape to form the body or shell of a refrigerator cabinet. During the bending operation, portions of the web 13 are bent out of the plane of the web, while the flanges 14 are bent within their own planes.

2

As explained more in detail in my earlier patent, the apparatus 10 comprises in general a frame 15 which includes a stationary die support 16, and a ram 17 which is reciprocably movable relative to the die support. The die mechanism 12 includes a concavely curved die member 18 suitably mounted on the stationary die support 16 and a convexly curved punch member 19 carried by the reciprocable ram 17. The die mechanism also includes a pair of wing members 20 which are rockably movable about portions of the punch member 19 for bending the outwardly extending portions of the workpiece 11 around the latter to the substantially U-shape shown in Fig. 2.

The cooperating portions of the die and punch members 18 and 19 may have any desired form or shape, such as the curved contour shown in this instance and which is appropriate for forming or shaping an intermediate section 11a of the workpiece 11 to a curved shape or contour corresponding with that desired for the top of a refrigerator cabinet or shell. When the ram 17 is moved toward or closed against the stationary die member 18 by appropriate power means such as that shown in said earlier patent, these die members clamp intermediate portion 11a of the workpiece 11 therebetween and shape or form such clamped portion to the desired contour mentioned above. Immediately following the closing of the die members 18 and 19 and the clamping of the workpiece 11 therebetween, the wing members 20 are rocked about the punch member 19 from their initial position shown in Fig. 1 to their closed or final position shown in Fig. 2. This movement of the wings 20 bends the outwardly or laterally extending portions of the workpiece into the substantially parallel relation shown in Fig. 2, during which portions of the web 13 are bent out of their own plane and the flanges 14 are bent within their own planes.

As shown in the drawings and explained more fully in said earlier patent, the wing members 20 have flat working faces 22 for engagement with

the web 13 of the workpiece 11 and angular flange portions 23 which cooperate with the flanges 14 of the workpiece and hold the latter against wrinkling or buckling during the bending operation. Relative slipping between the wing members 20 and the punch member 19 is prevented by cooperating gear rack and sector elements 24 and 25 provided respectively on the wing members and the frame 15. The wing members 20 extend through and are movable in yokes or carriers 26 which have pivotal connection 27 with the frame 15. The wing members are rocked by imparting swinging movement to the carriers 26 as by means of power actuated pivoted links or arms 26a connected therewith. During the swinging of the carriers 26, pressure is applied to the backs of the wing members 20 by means of rollers 28 to which pressure is constantly applied by suitable compression springs 28a.

The expanding die member, which in this instance is the punch member 19, is more fully illustrated in Figs. 3 to 6, inclusive, from which it will be seen that this member comprises a body 30 having cooperating main sections 31 and 32 which have relative closing and separating movement in the direction of the reciprocating movement or axial travel of the ram 17. The body 30 also includes a pair of laterally movable work engaging sections 33 which are carried by the body section 32 and which cooperate with the angular or flange portions 23 of the wing members 20.

The body section 31 of the punch member 19 is provided with a backing plate or plates 34 and dovetail elements 34a by which the punch member is mounted on the reciprocating ram 17. The body section 32 is disposed in front of the body section 31 and is supported by the latter by means of the dowel pins 35 and the connecting screws 36. When the die mechanism 12 is in its open condition with the punch member 19 separated from the stationary die member 18, the body section 32 is spaced from the body section 21 a distance represented by the intervening space 37. A plurality of compression springs 38 disposed between the body sections 31 and 32 constantly urge the body section 32 away from the body section 31 but permit relative closing of these body sections when the punch member 19 clamps the workpiece 11 against the die member 18. The movement of the body section 32 away from the body section 31 is limited in extent to the desired width of the space 37, by means of the heads 36a of the retaining screws 36.

The work engaging sections 33 of the punch member 19 are movable transversely to the direction of reciprocating movement of the ram 17 so that the punch member can be expanded in the wing members 20 when the die mechanism 12 is closed. The expanding of the punch member in the wing members 20 causes the flange or flanges 14 of the workpiece 11 to be clamped or pressed against the angular portions 23 of the wing members, and this clamping pressure is maintained during the rocking or swinging of the wing members. The pressure thus applied to the flange portions 14 of the workpiece 11 during the bending operation, effectively prevents buckling or wrinkling of the flanges and also results in the corner portions or junctions of the flange and web portions 13 and 14 of the workpiece being more smoothly and accurately formed to the desired shape.

This transverse movement or expansion of the work engaging sections 33 of the punch member 19 is produced by tapered elements or wedges 40

which are carried by the body section 31 and extend forwardly into the body section 32. As best seen in Figs. 5 and 6 of the drawings, the wedges 40 have tapered faces 41 which cooperate with tapered faces 42 of the work engaging sections 33, so that upon relative closing movement between the body sections 31 and 32 the work engaging sections will be wedged outwardly or expanded against the angular portions 23 of the wing members 20.

The wedges 40 are mounted in the body section 31 so as to have limited relative axial movement therein and for this purpose the outer or rearward ends of the wedges have head or hook portions 42a which are slidably retained in recesses or guideways 43 of the body section 31. The shifting of the wedges 40 in the body section 31 is opposed and limited by resilient means preferably in the form of bodies or blocks 44 of yieldable rubber disposed in the guideways or recesses 43.

During the closing movement of the punch member 19 the forward body section 32 engages the workpiece 11 to clamp the same against the die member 18 and is held by the latter against further forward movement. Continued closing movement of the punch member causes the body section 31 thereof to close relative to the body section 32 and this results in the wedges 40 being moved forwardly in the body section 32 to expand the work engaging sections 33 in the manner explained above. The forward movement of the wedges is resisted by their cooperation with the sections 33 and the actuating thrust which is transmitted to the wedges through the rubber blocks 44 causes more or less compression or distortion of these blocks. The yielding of the blocks 44 during the expanding action of the wedges 40 is desirable and results in a smooth and progressive expansion of the work engaging sections 33, thus preventing these sections from being moved outwardly too suddenly, which would cause a seizing or gripping action and might result in tearing or scoring the workpiece or breakage of the apparatus. The rubber blocks 44 also provide a safety means which will yield and permit axial movement of the wedges 40 in the event that the thickness of the workpiece, or any other interfering means, prevents or limits the expanding movement of the sections 33.

The work engaging sections 33 may be connected with the body section 32 in any suitable way, such as by means of the dowel pins 46 and the retaining screws 47. Compression springs 48 disposed around the screws 47 normally urge the work engaging sections 33 toward the body section 32 and serve to shift the work engaging sections inwardly for contracting the punch member 19 when the wedges 40 are retracted relative to the body section 32. When the bending operation has been completed and the wing members 20 have been returned to their initial position shown in Fig. 1, the ram 17 is retracted so as to move the punch member 19 away from the stationary die member 18 and release the workpiece 11. This opening or retracting movement of the punch member 19 causes the body sections 31 to separate from the body section 32 while the latter is being held against the workpiece by the compression springs 38. This separating movement of the body section 31 causes the wedges 40 to be moved in a rearward or retracting direction so as to permit the work engaging sections to be shifted inwardly or retracted by the compression springs 48.

Figs. 7 and 8 of the drawings show a modified construction for the punch member, which differs

from the punch member illustrated in Figs. 5 and 6, in that the work engaging sections 50 carry coextending floating bars or anvil members 51 which enable the die mechanism to operate on a workpiece 52 of the kind having its longitudinal edge flange or flanges 53 formed by doubled or folded portions of the metal. The anvil members or strips 51 are mounted on the work engaging sections 50 by means of screws 54 which permit the anvil members a limited amount of shifting toward and away from the angular portions 55 of the wing member 56.

The anvil members 51 have forwardly extending edge portions 51*a* of reduced thickness adapted to extend into the folded metal portions defining the flange 53 of the workpiece, so that these folded or double metal portions will be subjected to pressure between the sections 50 and the angular portions 55 of the wings 56 when the punch member is expanded by the wedges 40. The pressure thus applied to the doubled portions of the flange 53 of the workpiece is maintained during the bending operation so that these doubled portions can be bent in their own planes without buckling or wrinkling and without causing the doubled portions to be collapsed or pinched shut.

From the foregoing description and the accompanying drawings it will now be readily understood that the present invention provides improved apparatus for bending flanged metal sheets, bars and the like, and in which the use of an expanding punch member in the die mechanism of the apparatus more effectively holds the flange or flanges of the workpiece against buckling or wrinkling during the bending operation. It will also be seen that by maintaining pressure on the flange or flanges of the workpiece during the bending operation, the corner portions or junctions between the flange and web portions of the workpiece will be more smoothly and accurately formed to the desired shape. Likewise, it will be seen that the novel expanding means embodied in the punch member causes the pressure to be applied smoothly and gradually to the flanges of the workpiece so that seizing and scoring are substantially prevented, as well as the likelihood of breakage of the apparatus in the event that the expanding action of the punch member cannot take place.

While the improved bending apparatus has been illustrated and described in considerable detail, it should be understood that the present invention is not to be regarded as correspondingly limited in scope but should be regarded as including all changes and modifications coming within the spirit of the invention and the scope of the claims hereof.

Having thus described my invention, I claim:

1. In apparatus for shaping a longitudinally flanged metal web workpiece by bending the web out of its own plane and simultaneously bending the flange within its own plane, a pair of cooperating die and punch members adapted for relative closing movement for clamping the flanged workpiece therebetween, a third die member having an angular portion for cooperation with the flange of the workpiece and said third die member being mounted for swinging relative to said punch member so as to cooperate therewith in bending said workpiece, means operable to cause said relative closing movement between said die and punch members, means for causing swinging of said third die member, said punch member comprising a body having connected cooperating sections adapted to be moved relative to each other during said relative closing movement and another section adapted to be shifted toward said angular portion, wedge means permanently contained in said punch member and actuated by said cooperating sections for causing such shifting of the last mentioned section, and resilient means disposed in back of the wedge means and through which actuating thrust is transmitted to said wedge means.

2. In apparatus for shaping a longitudinally flanged metal web workpiece by bending the web out of its own plane and simultaneously bending the flange within its own plane, a pair of cooperating relatively reciprocable die and punch members adapted for relative closing movement for clamping the flanged workpiece therebetween, a third die member having an angular portion for cooperation with the flange of the workpiece and said third die member being mounted for swinging relative to said punch member so as to cooperate therewith in bending said workpiece, means operable to cause said relative closing movement between said die and punch members, means for causing swinging of said third die member, said punch member comprising a body having connected cooperating sections adapted to be moved relative to each other in the direction of said reciprocable movement during said relative closing movement and another section adapted to be shifted toward said angular portion, wedge means permanently contained in said punch member and actuated by said cooperating sections for causing such shifting of the last mentioned section in response to the relative movement between said cooperating sections, resilient means disposed in back of the wedge means and through which actuating thrust is transmitted to said wedge means, and spring means acting to separate said cooperating sections and retract said last mentioned section during relative opening movement between said die and punch members.

3. In bending apparatus of the character described, a plurality of cooperating relatively movable die members adapted to operate on a metal workpiece and including an expansible die member, said expansible die member comprising connected cooperating sections adapted for relative closing and separating movement, a shiftable work engageable section, wedge means permanently contained in said expansible die member and actuated by said relative closing movement for causing shifting of said work engageable section in a direction to apply pressure to the work, and resilient means disposed in back of the wedge means and through which the actuating thrust is transmitted to said wedge means.

4. In bending apparatus of the character described, a plurality of cooperating relatively movable die members adapted to operate on a metal workpiece and including an expansible reciprocably movable punch member, said punch member comprising connected cooperating sections adapted for relative closing and separating movement in the direction of the reciprocating movement, a plurality of work engageable sections shiftable transversely to the direction of said reciprocable movement, wedge means permanently contained in said punch member and responsive to said relative closing movement for causing shifting of said work engageable sections in a direction to apply pressure to the work, and resilient means disposed in back of the wedge means and through which the actuating thrust is transmitted to said wedge means.

5. In bending apparatus of the character de-

scribed, a plurality of cooperating relatively movable die members adapted to operate on a metal workpiece and including an expansible reciprocably moving punch member, said punch member comprising a pair of connected cooperating sections adapted for limited relative closing and separating movement in the direction of the reciprocable movement of the punch member, a pair of working engageable sections carried by one of said cooperating sections and being shiftable transversely to the direction of said reciprocable movement, wedge elements permanently contained in said punch member and carried by the other of said cooperating sections and adapted to cause such transverse shifting of said work engageable sections, and bodies of yieldable rubber disposed in back of the wedge elements and through which the actuating thrust is transmitted to said wedge elements during said relative closing movement.

6. In bending apparatus of the character described, a plurality of cooperating relatively movable die members adapted to operate on a metal workpiece and including an expansible reciprocably moving punch member, said punch member comprising a body having a pair of connected cooperating sections adapted for limited relative closing and separating movement in the direction of the reciprocable movement of the punch member, a pair of work engageable sections carried by one of said cooperating sections and being shiftable transversely to the direction of said reciprocable movement, wedge elements permanently contained in said punch member and carried by the other of said cooperating sections and having limited movement in the latter, said wedge elements extending into said one of said cooperating sections and being adapted to cause outward shifting of said work engageable sections in response to said relative closing movement, spring means for retracting said work engageable sections during said relative separating movement, and blocks of yieldable rubber carried by said other cooperating section for transmitting thrust to said wedge elements.

7. In bending apparatus of the character described, a pair of cooperating die members adapted for relative closing movement for clamping therebetween the web portion of a sheet metal workpiece having a doubled longitudinal edge flange and including an expansible reciprocably movable punch member, a third die member having an angular portion for cooperation with said doubled flange and being mounted for swinging relative to said punch member so as to cooperate therewith in bending the web portion of the workpiece out of its own plane and simultaneously bending the doubled flange within its own plane, said punch member comprising a body having cooperating sections adapted for limited relative closing and separating movement in the direction of said reciprocable movement and a work engageable section carried by one of said cooperating

sections and being shiftable outwardly transversely to the direction of said reciprocable movement for holding the doubled flange against said angular portion of said third die member for preventing buckling of said doubled flange during said bending thereof, wedge means for causing such outward shifting of said work engageable section in response to said relative closing movement, and an anvil member floatingly carried by said work engageable section and adapted for interfitting engagement with said doubled flange of said workpiece.

8. In bending apparatus of the character described, a pair of cooperating die members adapted for relative closing movement for clamping therebetween the web portion of a sheet metal workpiece having a doubled longitudinal edge flange and including an expansible reciprocably movable punch member, a third die member having an angular portion for cooperation with said doubled flange and being mounted for swinging relative to said punch member so as to cooperate therewith in bending the web portion of the workpiece out of its own plane and simultaneously bending the doubled flange within its own plane, said punch member comprising a body having cooperating sections adapted for limited relative closing and separating movement in the direction of said reciprocable movement and a work engageable section carried by one of said cooperating sections and being shiftable outwardly transversely to the direction of said reciprocable movement for holding the doubled flange against said angular portion of said third die member for preventing buckling of said doubled flange during said bending thereof, wedge means for causing such outward shifting of said work engageable section in response to said relative closing movement, an anvil member floatingly carried by said work engageable section and adapted for interfitting engagement with said doubled flange of said workpiece, and yieldable means carried by the other of said cooperating sections and disposed in back of said wedge means and through which the actuating thrust is transmitted to said wedge means during said relative closing movement.

LEE B. GREEN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,375,305	Maisel	Apr. 19, 1921
1,408,787	Weaver	Mar. 7, 1922
1,787,151	Groehn	Dec. 30, 1930
1,804,607	Groehn	May 12, 1931
2,190,423	Henricson	Feb. 13, 1940
2,198,873	Hinsdale	Apr. 30, 1940
2,287,933	Green	June 30, 1942
2,321,075	Frey et al.	June 8, 1943
2,339,032	Schlenzig	Jan. 11, 1944