Oct. 31, 1950 O. MUELLER 2,528,072

EXPANDING AND CONTRACTING DIES FOR DRAWING BUMPERS

Filed Feb. 16, 1946 3 Sheets-Sheet 1

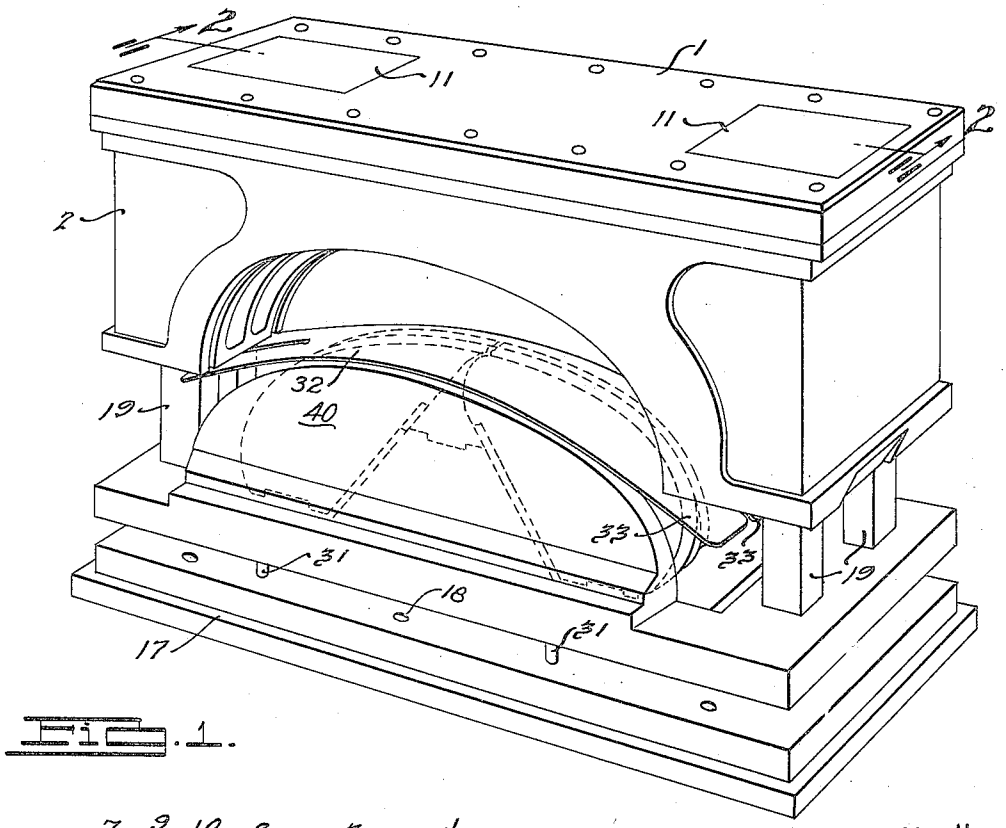

Fig. 1.

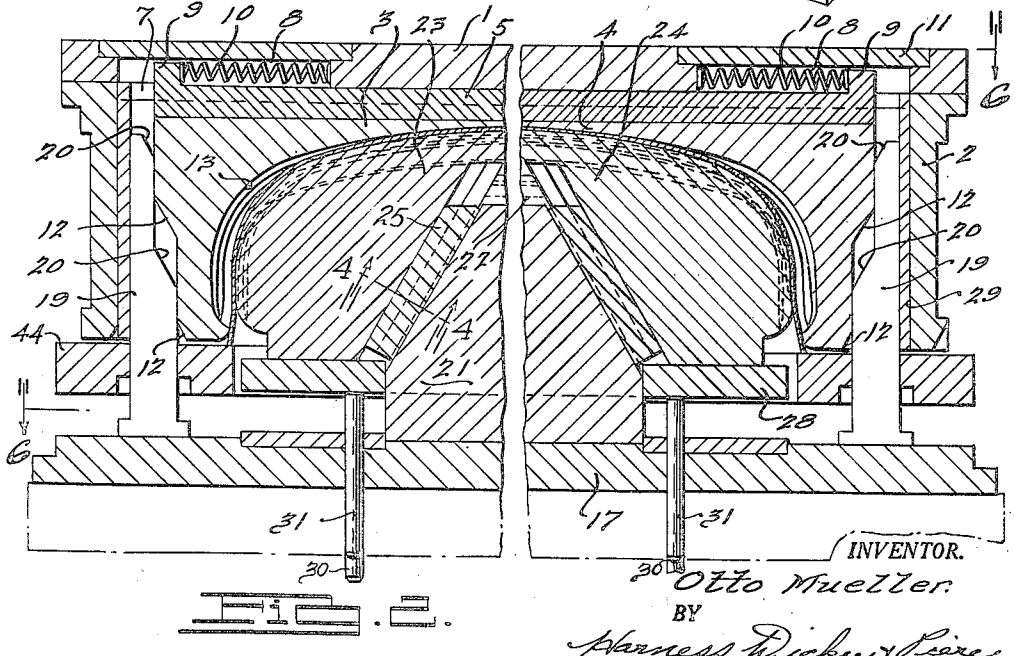

Fig. 2.

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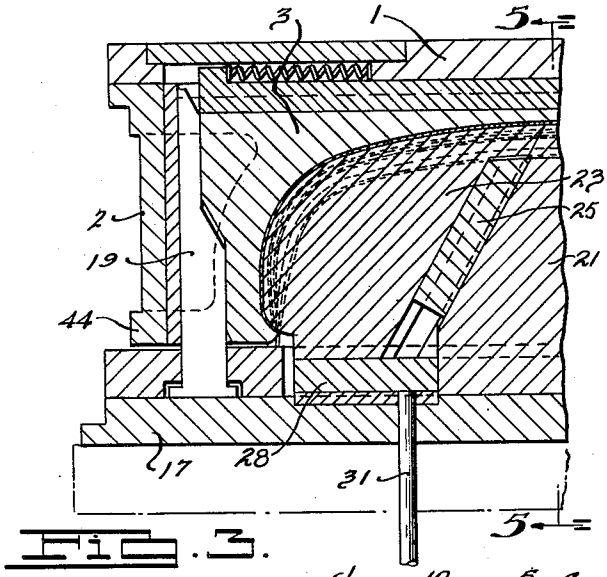

Fig. 3.

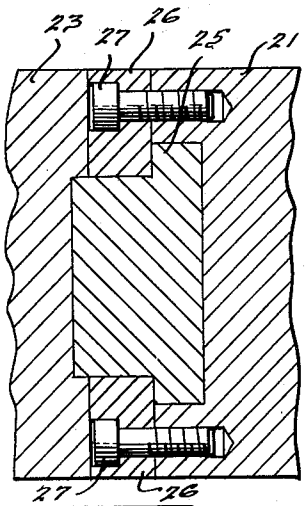

Fig. 4.

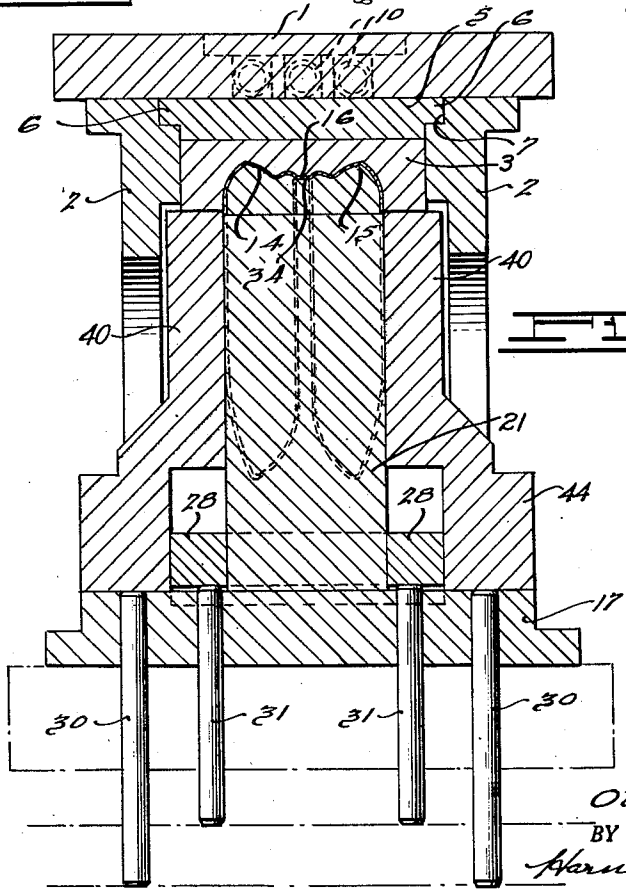

Fig. 5.

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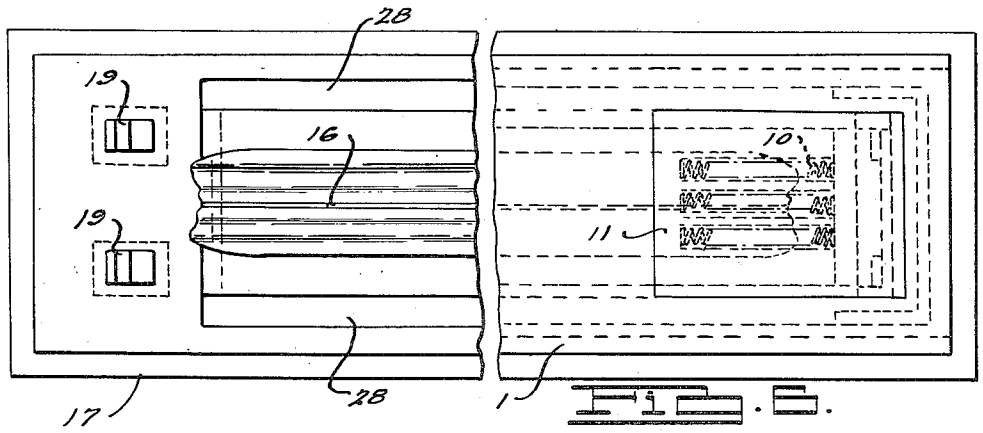

Fig. 6.

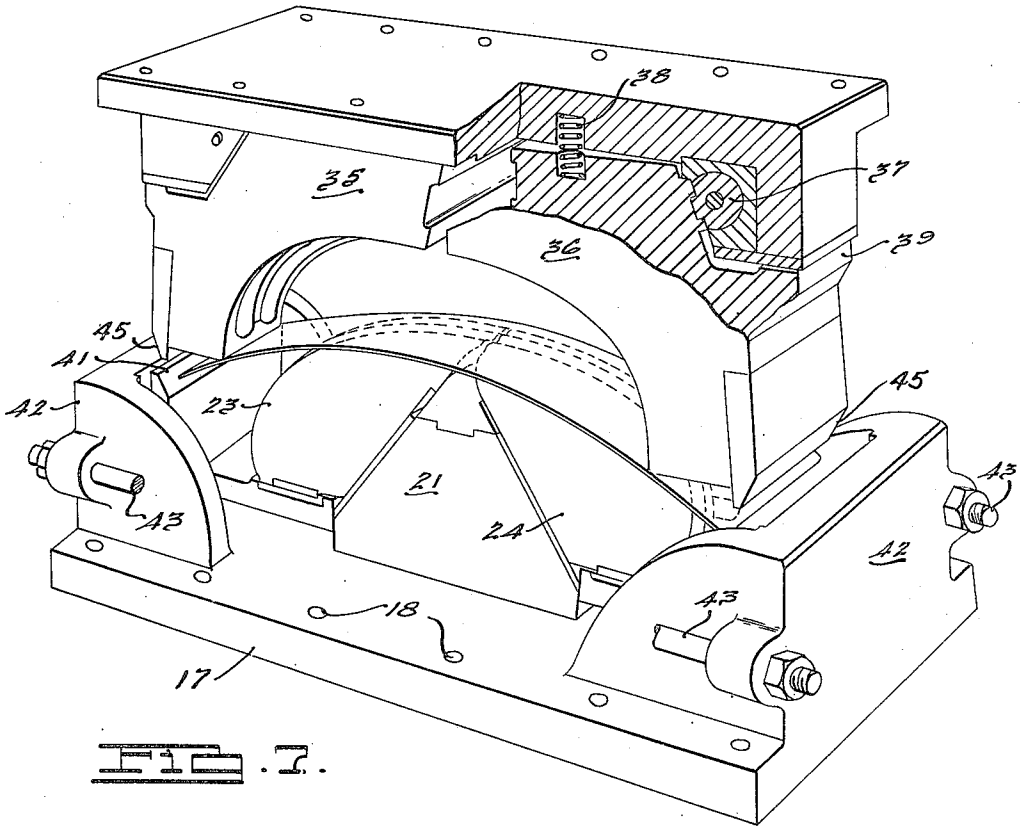

Fig. 7.

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UNITED STATES PATENT OFFICE

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EXPANDING AND CONTRACTING DIES FOR DRAWING BUMPERS

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Application February 16, 1946, Serial No. 648,057

6 Claims. (Cl. 113—48)

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This invention relates to die structures, and particularly to a die set for simultaneously forming a sheet of metal into one or a plurality of bumpers having a central portion for extending across the car and end portions curved therefrom and extending longitudinally of the car at each side thereof.

No difficulty was experienced heretofore in forming bumpers from a sheet of metal since the bumpers were manufactured to extend laterally across the car with a slight curve at the ends. The present day automobiles are provided with bumpers which not only extend laterally across the car, but which are provided at each end with curved portions which are extended parallel to the sides of the car, both at the front and rear thereof.

When practicing the present invention, a die set is employed which forms the laterally extending portion of the bumper as well as the end portions which extend longitudinally of the car body with a single stroke of the press. The die set has a male die portion formed in two parts so as to operate on angularly disposed slides to move outwardly when forced downwardly by the operation of the press. The female die portion of the set is also made of two parts, each being mounted to slide or pivot inwardly as the case may be, upon its downward movement. In this manner, the arcuate end portions of the bumpers may be formed as the female portion of the die moves downwardly and inwardly to a desired position as the male portion of the die moves downwardly therewith and outwardly to form the metal of the sheet into a predetermined contour with the female die. Upon the upward movement of the female die, the parts of the male die portion move inwardly toward each other and the parts of the female die portion separate to permit the finished bumper or bumpers to be removed from the die set. The die set herein illustrated is of such width as to form two bumpers upon each stroke of the press and the sheet of metal may be so shaped before being placed in the die as to require no trim upon the completion of the two bumpers except for the removal of a web portion connecting the central part of the bumpers. The shape of the sheet if preformed takes into consideration the stretching and drawing of the metal during the die operation so that the edge of the metal will be drawn in to what would normally be the trim line so that no trimming is required on any edge of the bumpers except, as pointed out hereinabove, that required

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for removing the web left between the plurality of bumpers if more than one is drawn with each operation of the press.

Accordingly, the main objects of the invention are: to provide a die set having a male die portion provided with a pair of sliding parts which are moved laterally when forced downwardly during the forming operation into engagement with a female die portion made in two parts which are movable toward each other during the forming operation; to provide a die set embodying two-piece male and female die portions, the female die pieces being moved inwardly toward each other by the operation of cams during their downward movement, which movement produces the movement of the male die parts outwardly of each other into engagement with the sheet of material and the female die pieces; to preform a sheet of metal to provide a blank from which one or a plurality of bumpers are drawn without requiring a trim operation except for the web left between the bumpers after the forming operation if more than one is formed by the die set; to provide a die set which is capable of forming a sheet of metal into a predetermined contour laterally and also longitudinally during a single operation of the press; to provide die sets for forming a sheet into right angular relationship with a predetermined cross sectional shape having movable parts which cooperate with each other to be in proper position to form the sheet and to release the formed sheet upon the separation of the die elements of the set; and, in general, to provide a die set for forming a sheet of metal into right angular relationship with a predetermined contour which is simple in construction, positive in operation and economical of manufacture.

Other objects and features of novelty of the invention will be specifically pointed out or will become apparent when referring, for a better understanding of the invention, to the following description taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a perspective view of a die set for forming a predetermined contour in a sheet of metal embodying features of this invention;

Fig. 2 is a sectional view of the structure illustrated in Fig. 1, taken on line 2—2 thereof with the male die parts in retracted position;

Fig. 3 is a view of the structure illustrated in Fig. 2 when the elements of the die set are moved into engaged position;

Fig. 4 is an enlarged sectional view of the

structure illustrated in Fig. 2, take on the line 4—4 thereof;

Fig. 5 is an enlarged sectional view of the structure illustrated in Fig. 3, taken on the line 5—5 thereof;

Fig. 6 is a plan view of the structure illustrated in Fig. 2 as viewed from the line 6—6 thereof; and

Fig. 7 is a view of structure similar to that illustrated in Fig. 1, showing a further form which the invention may assume.

Referring to Figures 1 to 6, the die set embodies a punch holding plate 1 secured to a punch encompassing ring 2 in which the two female die parts 3 and 4 are mounted for movement toward and away from each other. The parts 3 and 4 are each mounted upon a slide 5 having projecting flanges 6 at the sides which rest within a shoulder 7 along the top upper edge of the punch ring 2. The punch holding plate 1 is recessed at both ends at 8 and the slides 5 are provided with upwardly projecting end portions 9 which extend within the recesses 8 in the punch holder 1. A plurality of springs 10 are disposed in the recesses 8 to abut against the projecting end portions 9 of the slides 5 and against the edge of the plate at the opposite end of the recess. Cover plates 11 may be disposed over the recesses 8 for retaining the springs therewithin. The ends of the die parts 3 and 4 are offset medially of their length to provide cam surfaces 12 thereon. The inner faces 13 of the die parts 3 and 4 have a predetermined lateral contour, as illustrated more specifically in Fig. 5, to produce the cross-sectional shape of the bumpers 14 and 15 which are disposed in opposite relationship to each other. The two contours are joined by a connecting horizontal portion 16 which forms a web between the finished bumpers after the forming operation, which may be removed to separate the two bumpers from each other.

The male die portion, that portion which rests upon the bed of the machine, embodies a base 17 having a plurality of apertures 18 by which the base is secured to the bed of the press. The base supports a pair of cam pillars 19 at each end having cam surfaces 20 thereon which cooperate with the cam surfaces 12 on the female die parts 3 and 4 for moving them inwardly toward each other while compressing the springs 10 during the initial downward movement thereof. The base supports a central cam block 21 having at the upper edge thereof a part 22 constituting the central portion of the working face of the die. A pair of male die parts 23 and 24 is mounted upon the sloping cam surfaces of the cam block 21 for movement outwardly thereof during the forming operation.

Each sloping face of the cam block 21 is slotted to receive a T-shaped head 25 which is secured to the cooperating faces of each of the male die parts 23 and 24. Locking bars 26, secured to the cam block by a plurality of screws 27, extend over the projecting portions of the head 25 and retain the parts against the sloping faces of the cam block 21. A hardened plate 28 is secured to the bottom of each of the male die parts 23 and 24 for operation on similar hardened plates secured in alignment therewith on the base plate 17. Similar hardened plates 29 are provided on the inner end faces of the draw ring 2 in engagement with the adjacent faces of the cam pillars 19 to reduce wear and friction on the engaging surfaces thereof.

Two pressure pads (not shown) in the base of the press are utilized for maintaining the male die parts 23 and 24 and the draw ring 44 of the male die portion in raised position from the bed of the press. Operating rods 30 are disposed in engagement with an outer pressure pad in the bed of the machine and with the base 44 of draw flanges 40, as illustrated in Fig. 5. Operating rods 31 are disposed in engagement with the inner pressure pad and with the hardened blocks 28 of the male die parts 23 and 24, as illustrated in Figs. 2 and 5. The rods 30 are designed to have substantially twice the travel of the rods 31 so as to have the base 44 move twice the distance that the die parts 23 and 24 will move during the downward movement of the female die portion. The draw ring 2 has an arched portion at the sides which extends below and beyond the die parts 3 and 4 to permit the sheet to be placed between the dies and the finished stamping to be removed therefrom. The sheet is initially engaged by the arcuate draw flanges 40 and the female die parts before it is forced into engagement with the male die parts. The sheet will assume an arcuate shape, that of the arcuate draw flanges 40 and the female die parts 3 and 4 and may be retained thereby during the drawing operation if sufficient pressure is provided therebetween. When the sheet is preformed, the holding force is such as to permit the edges to move inwardly to the edge of the die parts during the drawing operation to have the edge conform to the position of the trim line.

A sheet of material 32, to be formed into the pair of bumpers, may have been preformed to have a pair of projecting portions 33 at each end which are spaced apart a substantial distance, providing a web 34 in the central portion of the sheet. The formed sheet is placed between the male and female die portions of the set and accurately positioned therein on the draw flanges 40. The female die portion is then moved downwardly to have the sheet engaged between the die parts 3 and 4 and the draw flanges 40 and to be arcuately formed thereby. As the female die parts 3 and 4 move downwardly, the cam surfaces 12 thereof move into engagement with the cam surfaces 20 on the cam pillars 19, and the parts are moved inwardly toward each other while compressing the springs 10. The female die parts 3 and 4 are held by the pillars against outward movement during the continued downward movement of the female die portion. Thereafter, the female die parts 3 and 4 with the sheet 32 on top of the draw flanges 40 and male die parts 23 and 24, will move downwardly as a unit. During the movement, the male die parts move on the cam block 21 downwardly and outwardly thereof to force the end portions 33 of the sheet of material against the inner face of the female die parts 3 and 4 and thereby form the end portions 33 into predetermined desired contour as the central portion is being formed. During the forming of the sheet laterally to provide the desired cross section thereto, the portion thereof initially retained between the die parts 3 and 4 and the draw flanges 40 moves therefrom so that the edges will move to the edges of the forming areas of the die parts and the trim operation on the edges is thereby eliminated.

After the completion of the downward movement of the press, the upward movement thereof raises the female die portion so that the die parts 3 and 4 may move outwardly away from the formed bumpers near the end of the upward movement. During this upward movement, the

male die parts 23 and 24 are carried upwardly therewith, because of the action of the pressure pad (not shown) on the rods 31, and thereby move inwardly out of engagement with the formed end portions 33 of the bumpers. The formed bumpers may then be removed from between the male and female die portions and the central web 34 therebetween may thereafter be trimmed to separate the two bumpers. The sheet of material 32, when formed to a contour such that the edges thereof will move inwardly during the forming operation to coincide with the finished edge of the bumpers, requires no trimming operation except for the web portion 34 which joins the two bumpers before and after the forming operation. When the sheet is not so preformed, a trim operation is required about the entire perimeter of the bumper, or similar element, which was drawn from the sheet.

Referring to Fig. 7, a further form of the invention is illustrated, that wherein female die parts 35 and 36 are hinged at 37 and urged downwardly by a spring 38 limited by stops 39. This separates the inner ends of the die so as to release the bumpers after the forming operation and permits the die parts 35 and 36 to move inwardly to encompass the male die parts 23 and 24 by the operation of the cam surface 45 with the cam surfaces 41 on the male die. The male die parts 23 and 24 operate in the same manner as described hereinabove. In this construction, the draw flanges 40 are eliminated and strength is provided to the base 17 by upwardly projecting end portions 42 which are strengthened by bars 43 which connect each of the end bosses 42 to each other across the base 17.

In either of the die sets, one or a plurality of bumpers may be formed during the downward movement of the press by the inward movement of the female die parts and the outward movement of the male die parts which shapes the sheet of material to conform to the contour of the die surfaces. While die sets have been illustrated which form two bumpers during each operation, it is to be understood that a single bumper may be formed in the same manner or a number greater than two, depending upon the number of contours for the bumpers, provided in the male and female die sets. While die sets are illustrated as being provided to form a sheet of metal into one or a plurality of bumpers, it is to be understood that the die set is not limited to the operation of drawing bumpers, but that any element having a transverse central portion and one or more end portions projecting angularly therefrom can be drawn by a die set similar to the one shown, but modified within the skill of the art to produce the similar elements.

It is to be understood that the invention is not to be limited specifically to the structure shown, as any changes which come within the scope of the claims are to be considered as included therein. It is to be understood that the die parts may be inverted, that is to say, the male die part may be carried by the downwardly movable head of the press while the female die part is supported by the bed of the press. The claims are to be construed with this in mind so that when stating that the female die part moves downward over the male die part, the statement of the downward movement is not to be taken as limiting since the movement is relative and the male die part could be the part which is moved downward with relation to the female die part.

What is claimed is:

1. In a die for forming a sheet of material into predetermined contour along the length thereof, and on end portions which are to extend at right angles thereto, the combination of a male and female die portion, two like parts on said female die portions mounted to be biased away from each other, two like parts of the male die portions movable outwardly from each other, and means for moving the parts of the female die portion inwardly toward each other to encompass the male die parts which are thereafter moved outwardly to produce the forming operation on the end portions of the sheet which were initially formed to be disposed angularly to the central portion of the sheet when both die parts are moved together and as a unit, draw flanges adjacent to the male die parts for initially engaging the sheet with the female die parts and forming the central and end portion of the sheets to the shape of the female and male die parts as they move into forming relation.

2. A die set embodying a male and female die portion, the female die portion comprising a boxlike structure and a pair of female die parts supported in said structure for movement toward and away from each other, biasing means for urging said female die parts away from each other, a base on said male die portion, a cam block on said base having cam surfaces which diverge from each other from the top of the cam block toward the bottom thereof, two male die parts on said base having sloping surfaces engaging the sloping surfaces of the cam block for moving the die parts away from each other, draw flanges on the male die base engageable by the female die parts for initially forming and clamping a sheet of material therebetween, and means for moving said female die parts toward each other during the downward movement of the female die portion which, when engaging the sheet, the draw flanges and said male die parts, causes the male die parts to move downwardly therewith and outwardly near the end of the downward movement to form the sheet to the shape of the die parts throughout the length thereof.

3. A die set embodying a male and female die portion, the female die portion embodying a boxlike structure, a pair of female die parts supported on said structure for movement toward and away from each other, biasing means for urging said female die parts away from each other, a base for said male die portion, a cam block on said base having cam surfaces which diverge from each other from the top of the cam block toward the bottom thereof, two male die parts having sloping surfaces engaging the sloping surfaces of the cam block, and cam pillars supported on said base and positioned at the ends of the female die parts, said ends containing cam surfaces engaging cam surfaces on the pillars which operate to move the female die parts inwardly toward each other against the tension of the biasing means during initial downward movement of the female die portion, after which the male die parts move downwardly therewith and outwardly to produce the forming operation as the male and female die parts complete their downward movement as a unit.

4. A die set embodying a male and female die portion, the female die portion embodying a boxlike structure, a pair of female die parts supported in said structure for movement toward and away from each other, biasing means for urging said female die parts away from each

other, said female die parts having sheet holding faces, a base for said male die portion, a cam block on said base having cam surfaces which diverge from each other from the top of the cam block toward the bottom thereof, two male die parts having sloping surfaces engaging the sloping surfaces of the cam block, draw flanges at the side of said male die parts cooperating with the holding faces of said female die parts, cam pillars supported on said base at the ends of said female die parts, said ends containing cam surfaces cooperating with cam surfaces on the pillars which operate to move the female die parts inwardly toward each other against the tension of the biasing means during initial downward movement of the female die portion, the further downward movement thereof carrying the draw flange and male die parts downwardly therewith producing the outward movement of the male die parts and the complete forming of the sheet.

5. A die set including, in combination, a female die portion having two die parts movable toward and away from each other, a male die portion having draw flanges and two die parts movable toward and away from each other, said female and male die parts being movable into engagement with each other and thereafter as a unit, means for moving said female die parts toward each other upon the initial movement relative to the male die parts, and means for moving said male die parts away from each other as the male and female die parts move as a unit so that the die parts move into complete forming relation acting on a sheet to be formed disposed therebetween.

6. A die set including, in combination, a female

die portion having two die parts movable toward and away from each other, a male die portion having two die parts movable toward and away from each other, said female and male die parts being relatively movable into engagement with a sheet of material and movable thereafter with the material as a unit, means for moving said female die parts toward each other upon their initial movement relative to the male die parts, and means for moving said male die parts away from each other as the male and female die parts move as a unit so that the die parts move into complete forming relation acting on the sheet disposed therebetween to form it crosswise and laterally into predetermined shape.

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