Feb. 20, 1962 F. O. MILLER 3,021,741

DIE SET COMPRISING PUNCHES OPERABLE IN A DIRECTION WHICH HAS AN ANGULAR RELATIONSHIP WITH THE DIRECTION OF MOTION OF THE RAM

Filed Feb. 20, 1958

4 Sheets-Sheet 1

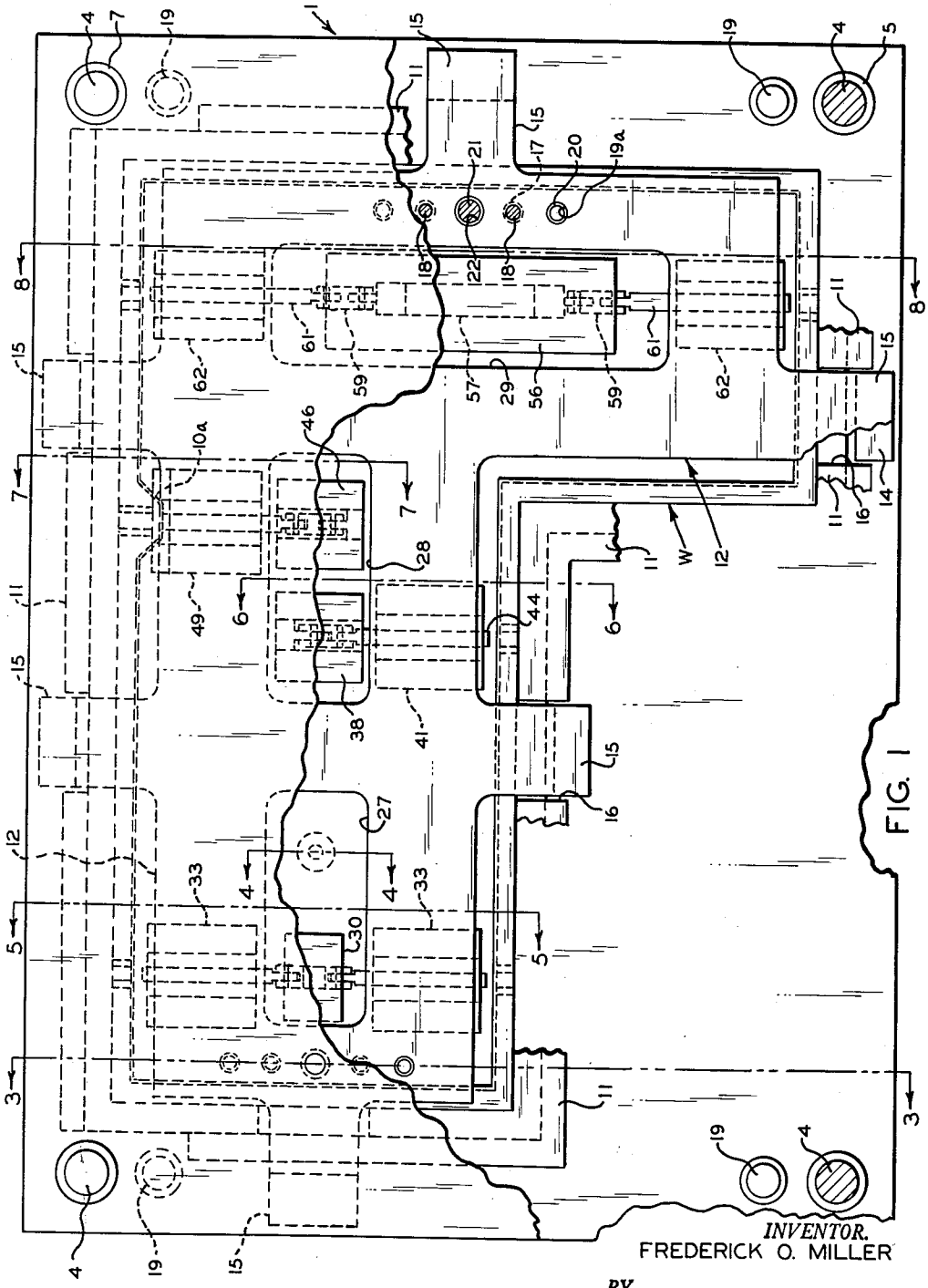


FIG. 1

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4 Sheets-Sheet 2

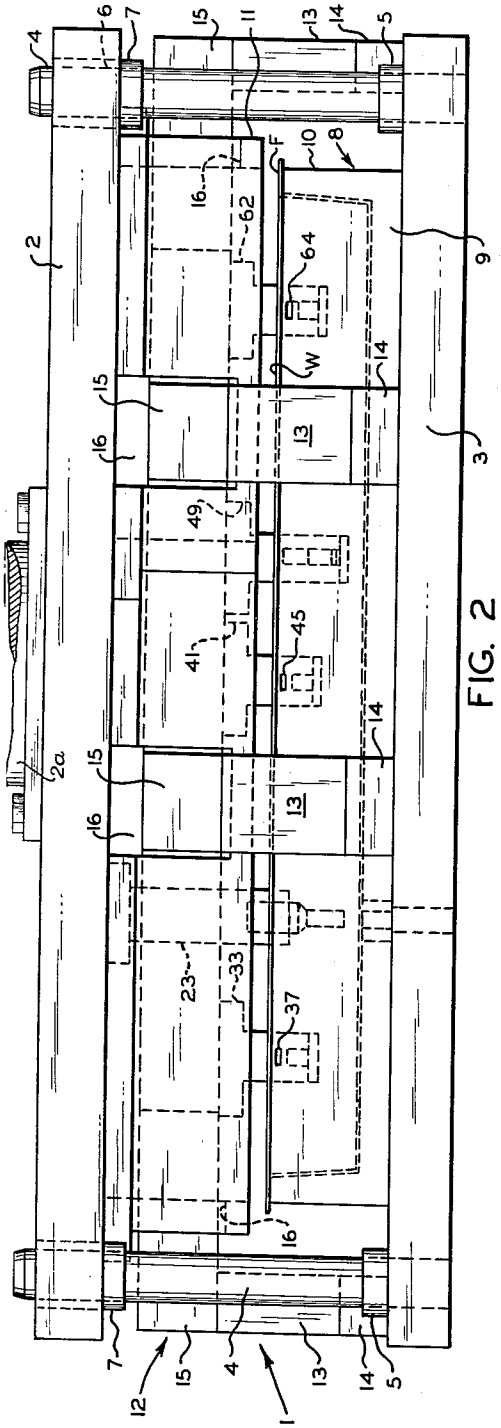


FIG. 2

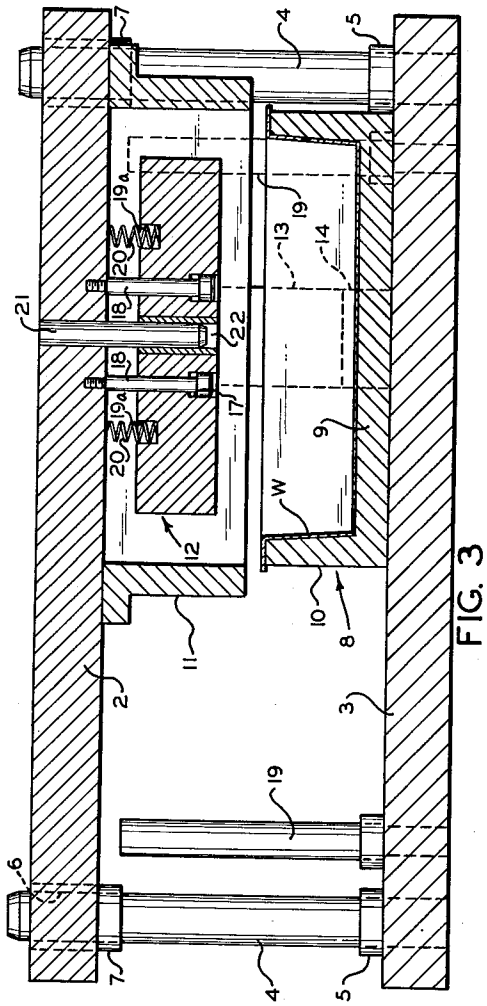


FIG. 3

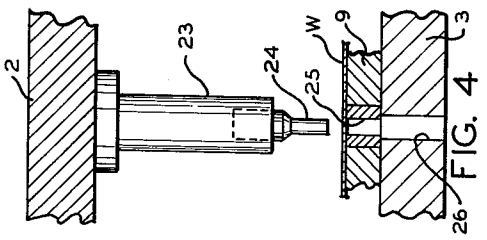


FIG. 4

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4 Sheets-Sheet 3

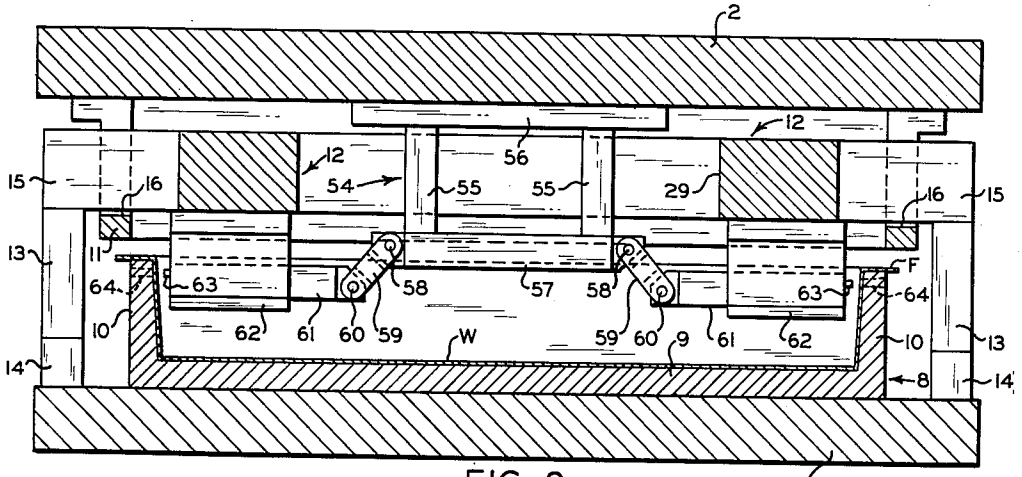


FIG. 8

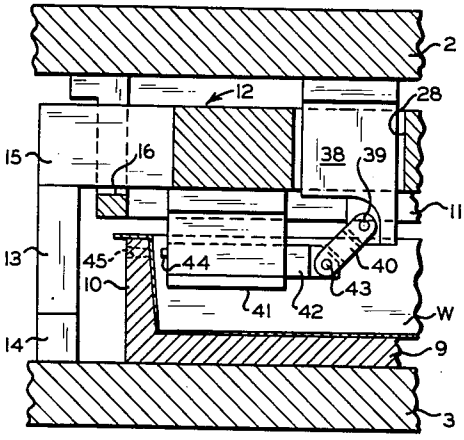


FIG. 6

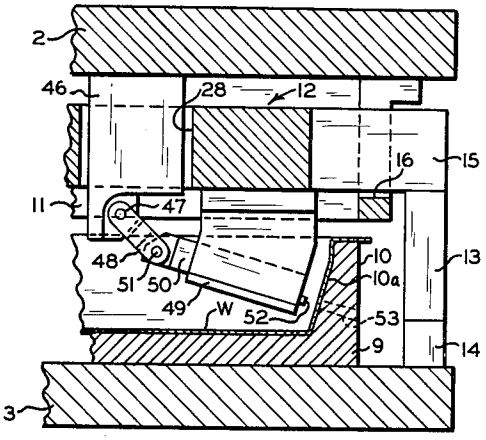


FIG. 7

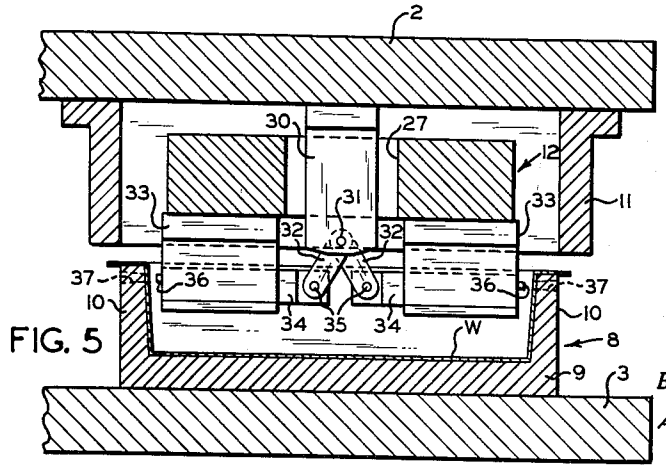


FIG. 5

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4 Sheets-Sheet 4

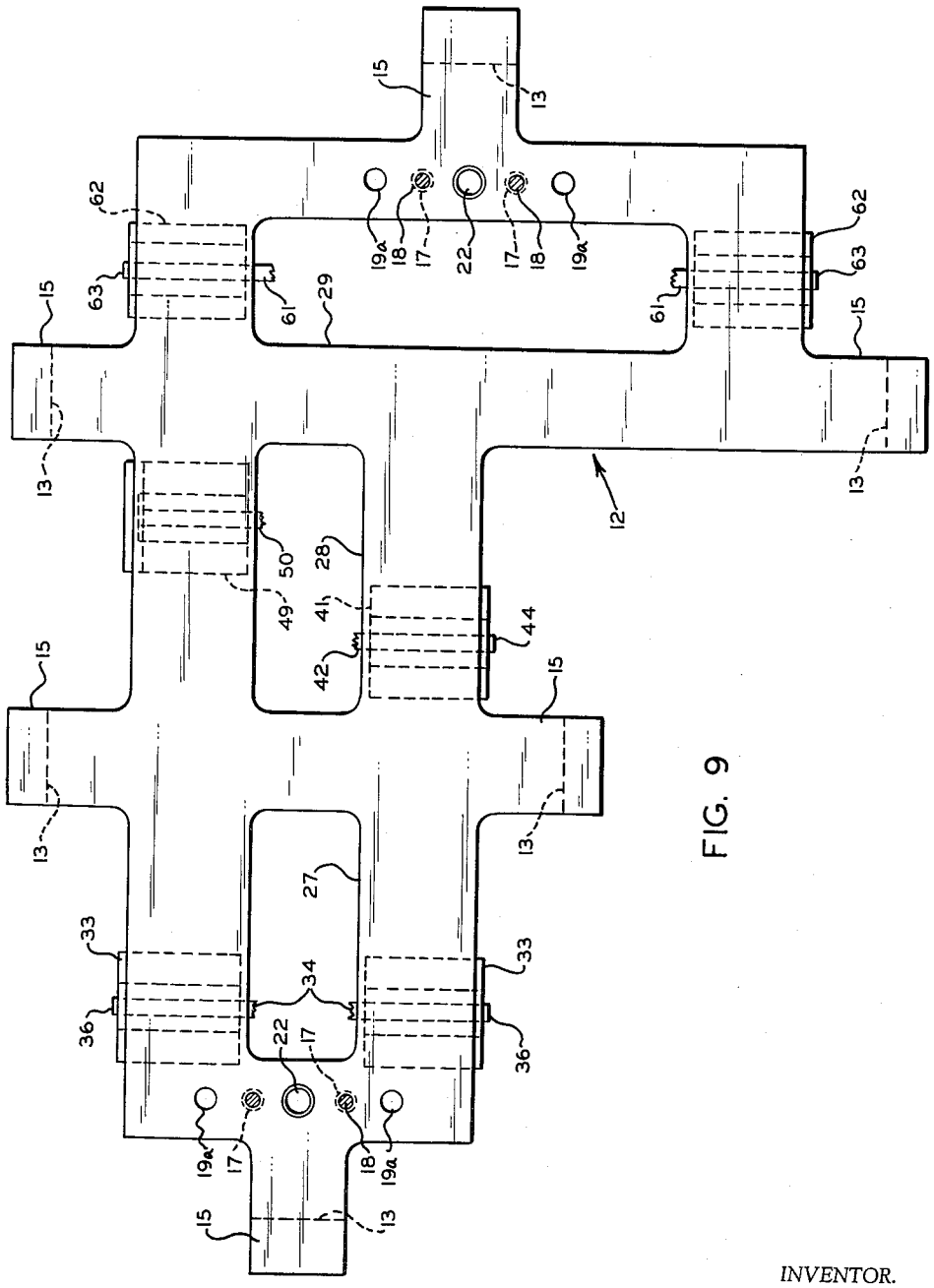


FIG. 9

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3,021,741

DIE SET COMPRISING PUNCHES OPERABLE IN A DIRECTION WHICH HAS AN ANGULAR RELATIONSHIP WITH THE DIRECTION OF MOTION OF THE RAM

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5 Claims. (Cl. 83—618)

This invention relates to die sets for use in punch presses and the like and more particularly to an improved die set capable of performing several operations simultaneously upon molded plastic work pieces.

Apparatus constructed in accordance with the invention is particularly adapted for use in the manufacture of molded refrigerator door liners formed of material such as polyethylene, styrene, and the like and which must be trimmed to size and provided with openings therein to accommodate means for securing the liner to a refrigerator door and to enable attachments to be fixed to the liner. Heretofore, it has been necessary in many instances to place a molded refrigerator liner or the like between a set of shearing dies and then transfer the trimmed liner to another press fitted with punches. In most, if not all, refrigerator liners, holes must be punched in the liners in both vertical and lateral directions and it has been customary heretofore to provide separate die sets for the vertical and lateral punching operations. The necessity of providing multiple sets of dies has entailed considerable expense not only insofar as the cost of the dies is concerned, but also because of the time lost in having to transfer a work piece from one punch press to others.

Various kinds of die sets have been proposed heretofore which are adapted to operate upon a work piece in both vertical and horizontal directions, but none of the known die sets is adapted to trim a work piece in addition to performing the other two operations. Moreover, known die sets of the kind adapted to translate vertical movement of the dies into lateral movement of a punch or the like rely upon sliding cams to effect the desired result. The use of sliding cams is objectionable from at least two points of view, namely, the cost of machining and other operations necessary to produce the cams, and the wear to which the cam surfaces are subjected during operation of the apparatus. Another objection to known cam actuated die mechanisms resides in the reliance, at least in part, upon springs and similar devices to extract a punch from its co-operating die after a work piece has been pierced. In the use of apparatus of this kind, it is not unusual for a punch to bind or stick within the work piece or the die because of the nature of the material being operated upon or due to some slight mis-alignment of the punch and its die. If the punch should stick, then there is considerable likelihood of damage either to the punch or to the die, or both, upon operation of the press to separate the parts of the die set.

An object of this invention is to provide an improved die set construction adapted to trim an article such as a molded refrigerator door liner and pierce the latter in a number of directions in the same operation.

Another object of the invention is to provide positive actuating means to project and retract punches from their associated dies.

Still a further object of the invention is to provide a die set construction of the kind referred to in which the actuation of the lateral punches is effected by link means of simple and inexpensive construction.

Other objects and advantages of the invention will be pointed out specifically or will become apparent from the following description when it is considered in conjunction

with the appended claims and the accompanying drawings in which:

FIGURE 1 is a top plan view of a die set constructed in accordance with the invention, certain parts being broken away;

FIGURE 2 is a front elevational view of the die set shown in FIGURE 1;

FIGURE 3 is a sectional view taken on the line 3—3 of FIGURE 1;

FIGURE 4 is a sectional view taken on the line 4—4 of FIGURE 1 and illustrating a vertical punch;

FIGURE 5 is a sectional view taken on the line 5—5 of FIGURE 1 and illustrating a toggle link actuating device for operating a pair of lateral punches;

FIGURE 6 is a sectional view taken on the line 6—6 of FIGURE 1 and illustrating a single lateral punch operated by a link mechanism;

FIGURE 7 is a sectional view taken on the line 7—7 of FIGURE 1 and illustrating apparatus similar to that shown in FIGURE 6 except that the lateral punch is arranged to be actuated along a non-horizontal line;

FIGURE 8 is a sectional view taken on the line 8—8 of FIGURE 1 and illustrating a pair of lateral punches operated by a link device; and

FIGURE 9 is a top plan view of an intermediate member which is interposed between the plates of the die set.

A die set formed in accordance with the invention is designated generally in the drawing by the reference character 1 and comprises an upper or ram plate 2 having one or more rods 2a bolted or otherwise fixed to the plate (see FIGURE 2) and adapted to secure it to the platen of the press for movements therewith. Movements of the ram plate 2 towards and away from the work supporting bed or base plate 3 may be guided by guide posts or pins 4 secured at their lower ends to suitable supports 5 fixed on the bed plate 3 and adapted to have their upper ends received in co-operable guide openings 6 in the ram plate 2. If desired, the openings 6 may be provided with conventional bushings 7.

Fixed in any suitable manner to the bed plate 3 is a die block indicated generally by the reference character 8 and including a base 9 from which upstanding side walls 10 extend. The inner surfaces of the die block 8 are so formed as to enable a work piece W such as a plastic liner for a refrigerator door to be supported by the block 8 in a position to be trimmed and pierced by apparatus yet to be described. Preferably, the upper ends of the side walls 10 are so constructed as to provide a part of the shearing apparatus.

To the lower surface of the ram plate 2 is secured as by welding or the like a shearing member 11 which has a configuration in plan corresponding to the configuration of the die block 8, but being slightly larger than the latter so as to enable the die block to be telescoped within the shearing member 11 upon movement of the ram plate 2 towards the base plate 3. The shearing member 11 is so constructed that upon telescoping movement of the parts 8 and 11, the adjacent surfaces of these parts will shear flashing from the flanges F of the work piece W so as to trim the work piece to size.

Interposed between the plates 2 and 3 is an intermediate plate or member 12 having a plurality of openings therein for a purpose presently to be explained. As is best shown in FIGURES 1 and 9, the intermediate member 12 has a number of laterally projecting parts 15 which extend through openings 16 in the shearing member 11. Secured to the under surface of the parts 15 are a plurality of blocks or stops 13 which depend from the plate and are adapted to bear against co-operating stops 14 fixed to the upper surface of the bed plate 3. Alternatively, the blocks 13 and 14 could be consolidated into single elements and secured either to the plate 3 or to the member 12.

At various places the intermediate member **12** may be provided with counter-sunk openings **17** (see FIGURE 3) in which headed bolts **18** slideably may be received. The ram plate **2** may be provided with threaded openings for reception of the threaded ends of the bolts **18** by means of which the intermediate member **12** is carried by the ram plate **2** in such manner as to enable the parts **2** and **12** to move downwardly together until such time as the stop means **13** and **14** arrests downward movement of the intermediate member **12**. Upon the arresting of downward movement of the member **12**, the ram plate **2** will be capable of downward movement relative to the member **12** until such time as the lower surface of the plate **2** strikes the upper surface of a number of stop posts **19** having their lower ends mounted on the bed plate **3**.

Preferably, the upper surface of the intermediate member **12** is recessed in a number of places as at **19***a* (see FIGURE 3) for reception of a plurality of springs **20** which bias the member **12** in such direction as to assist gravity in maintaining the plate **2** and the member **12** in spaced apart relation. At various points the ram plate **2** is provided with downwardly extending guide pins **21** which have their lower ends received in openings **22** formed at corresponding places in the intermediate member **12** to guide the movements of the latter relative to the plate **2**.

At any desired number of places, work fabricating means, such as punches, for piercing a work piece W in the plane of movement of the ram plate **2** may be provided and in each instance the punch means may comprise, for example, a post **23** (see FIGURE 4) secured at its upper end to the lower surface of the ram plate **2** and being fitted at its lower end with a punch **24** of known construction. Below each punch **24** the die block **8** will be equipped with a die **25** adapted to co-operate with the punch **24**, and the bed plate **3** will be provided with an opening **26** through which a slug from the work piece W may be discharged.

Referring now to FIGURES 1 and 9, the illustrated intermediate member **12** is provided with three openings therein identified by the reference characters **27**, **28**, and **29**. Considering firstly the opening **27** and referring to FIGURE 5, the opening **27** accommodates a post **30** secured at its upper end to the lower surface of the ram plate **2**. At the lower end of the post **30** is secured a pivot pin **31** on which is pivotally mounted a pair of links **32**. Welded or rigidly secured to the lower surface of the intermediate member **12** is a pair of slide housings **33**, the housings being arranged on opposite sides of the opening **27** in the member **12**. Mounted within each housing **33** is a reciprocable slide **34** and corresponding ends of the slides are pivotally connected to the links **32** by means of pins **35**. The opposite end of each slide **34** is fitted with a work fabricating device such as a punch **36**. Opposite each of the punches **36** the walls **10** of the die block **9** are provided with openings **37** adapted to receive the associated punch **36**.

Considering now the opening **28** and referring to FIGURE 6, a post **38** having its upper end rigidly secured to the lower surface of the ram plate **2** extends through the opening **28** and carries at its lower end a pivot pin **39** on which is pivotally mounted a link **40**. At one side of the opening **28** the member **12** has rigidly secured to its lower surface a slide housing **41** similar to the housings **33** and in which is slideably mounted a slide **42**. One end of the slide **42** is pivotally connected to the link **40** by means of a pin **43** and its other end is fitted with a punch **44** adapted to be received in a die opening **45** in the wall **10** of the die block **8**.

Referring now to FIGURE 7, the opening **28** also may accommodate a post **46** secured at its upper end to the lower surface of the ram plate **2** and carrying at its lower end a pin **47** on which is pivoted a link **48**. The lower surface of the member **12** adjacent to the opening **28** may

have welded or otherwise secured thereto a housing **49** in which is slideably mounted a slide **50** pivotally connected at one end by means of a pin **51** to the link **48** and equipped at its other end with a punch **52** adapted to be received in a die opening **53** formed in the wall **10** of the die block **8**. The devices shown in FIGURES 6 and 7 are generally similar to one another, but differ in that the slide **42** is adapted to be reciprocated along a path substantially normal to the plane of movement of the ram plate **2**, whereas the slide **50** is adapted to be reciprocated along a path which lies at an angle less than 90° to the plane of movement of the ram bed **2**. In connection with the slide **50** and its associated punch **52**, the inner surface of the wall of the die block **8** should be so formed as to be substantially perpendicular to the plane of movement of the punch **52**. Such an arrangement is shown at **10***a* in FIGURES 1 and 7.

Referring now to FIGURE 8, the opening **29** is of such size as to accommodate a post **54** comprising a pair of spaced blocks **55** secured at their upper ends to a plate **56** which, in turn, may be welded or otherwise suitably secured to the lower surface of the ram plate **2**. The lower ends of the blocks **55** may be rigidly secured to a bar **57** on the opposite ends of a pair of pivot pins **58**. Pivoted on each of the pins **58** is one end of a link **59** and the other end of each of the links is pivoted as at **60** to a slide **61** mounted for reciprocating movements in a housing **62** which may be welded or otherwise fixed to the lower surface of the member **12**. The other end of each of the slides **61** is fitted with a punch **63** adapted to be received in an opening **64** in the wall **10** of the die block **8**.

To condition the apparatus for operation, the ram plate **2** is connected to the ram or platen of a punch press or the like and the bed plate **3** is connected to the bed of the press in the usual manner. The press then may be operated to raise the ram plate **2** and the movement of the latter will be transmitted to the intermediate member **12** via the bolts **18** so as to enable a work piece W to be interposed between the upper and lower portions of the die set in readiness to be operated upon by the punches of the dies. If desired, the bolts **18** may be replaced by flanges at the lower ends of the posts **30**, **38**, **46** and **55** which may underlie the edges of corresponding openings in the member **12**.

When the work piece has been positioned between the dies, the ram of the press may be actuated to lower the ram plate **2** and the intermediate member **12**. Conjoint movement of the members **2** and **12** will continue until such time as the stop blocks **13** on the member **12** engage the blocks **14** on the bed plate **3** at which point the downward movement of the intermediate member **12** ceases. Downward movement of the ram plate **2**, however, continues under the influence of the ram and against the force of the springs **20** until such time as the lower surface of the ram plate **2** bears against the upper surfaces of the stop pillars **18**. During the downward movement of the ram plate **2** relative to the intermediate member **12** the vertical punches **24** will pierce the bottom wall of the work piece W and the posts or blocks **30**, **38**, **46**, and **54** will be moved downwardly relatively to the slide housings **33**, **41**, **49**, and **62**, respectively. The relative movement of the post **30**, the slide housings **33**, and the member **12** will actuate the toggle links **32** to project the slides **34** and their associated punches **36** toward the walls **10** of the die block **8** to pierce the walls of the work piece W. Movement of the block **38** relative to the slide housing **41** and the member **12** will cause movement of the link **40** to project the slide **42** and its associated punch **44** towards the wall **10** so as to pierce the side wall of the work piece W. Similarly, the slides **50** and **62** are projected towards the walls of the die block **8** in response to relative downward movement of the ram plate **2** and the intermediate member **12** so as to enable the punches **52** and

63 to pierce the walls of the work piece W. The movement of the ram plate 2 towards the bed plate 3 also enables the shearing member 11 and the upper edge of the die block 8 to co-operate to trim flashing from the work piece.

When the ram of the press has completed its downward travel, the work piece W will have been trimmed to the size of the die block 8 and will have been pierced both vertically and laterally in accordance with the number and arrangement of the vertical and lateral punches. In this connection, it is pointed out that the number and arrangement of the vertical and lateral punches shown in the drawings are illustrative only, and that the arrangement and number of the punches employed may vary greatly.

Upon the completion of the forming operations, the ram of the press may be actuated to raise the ram plate 2. Raising of the ram plate 2 will cause movement of the latter relative to the intermediate member 12 and the bed plate 3 until such time as the heads of the bolts 17 engage the bases of the counterbores 19*a* in the intermediate member 12, or until the flanges on the link carrying posts engage the member 12, whereupon the plate 2 and the intermediate member 12 will move upwardly conjointly. During the initial upward movement of the ram plate 2 the vertical punches 24 will be withdrawn from the die block 8 and the work piece W and the several links 32, 40, 48, and 59 will be actuated to effect positive withdrawal of the associated lateral punches from the die block 8 and the work piece W. The relative movement of the ram plate 2 and the intermediate member 12 will be assisted by the springs 20, but it is important to note that the withdrawal of the lateral punches from the die block and the work piece is not dependent solely on the springs. As a result, there is no possibility of the lateral punches sticking either in the die block or in the work piece and the likelihood of damage to the punches, the die block, or the work piece is eliminated.

The provision of lateral slides and link means for actuating the slides enables considerable savings to be effected since these parts can be manufactured much more quickly and cheaply than can parts such as cams or the like. The inexpensiveness of these parts of the apparatus coupled with the ability of the die set to trim and punch, both vertically and laterally, a work piece in one operation of a single machine materially decreases the cost of manufacturing such articles such as plastic refrigerator door liners or the like.

The disclosed embodiment is representative of a presently preferred form of the invention, but is intended to be illustrative rather than definitive thereof. The invention is defined in the claims.

I claim:

1. A die set comprising a work supporting base member; a ram plate; means for moving said ram plate in directions toward and away from said base member; guide means reacting between said member and said plate to guide the movements of the latter; an intermediate member interposed between said base member and said ram plate; lost motion means connecting said intermediate member solely to said plate for sequential movement of said intermediate member concurrently with and relative to said plate arresting means interposed between said base member and said intermediate member for engagement therebetween in response to concurrent movement of said plate and said intermediate member toward said base member to arrest further movement of said intermediate member toward said base member, said lost motion means permitting further movement of said ram plate toward said base member and relative to said intermediate member upon the arresting of movement of the latter; work fabricating means movably supported by said intermediate member for movement laterally of the directions of movement of said ram plate; and link means positively interconnecting said fabricating means and operable solely in response to relative movement of said ram plate and said intermediate member to move said fabricating means relatively to said intermediate member.

2. The construction set forth in claim 1 including cooperable shearing means carried by said ram plate and said base member operable to shear a workpiece located therebetween.

3. The construction set forth in claim 1 wherein said work fabricating means is supported on said intermediate member for movements in a plane substantially normal to the directions of movement of said ram plate.

4. The construction set forth in claim 1 wherein said work fabricating means is supported on said intermediate member for movements in a plane less than 90° removed from the directions of movement of said ram plate.

5. The construction set forth in claim 1 including second work fabricating means mounted on said ram plate for movements therewith in the directions of movement of said ram plate.

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