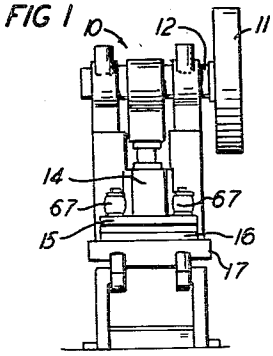
Jan. 28, 1958 F. WAHL 2,821,233

SAFETY EDGE FORMING APPARATUS

Filed Jan. 25, 1955

2 Sheets-Sheet 1

FIG 1



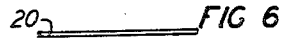


FIG 6

FIG 7

FIG 8

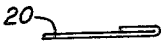


FIG 9

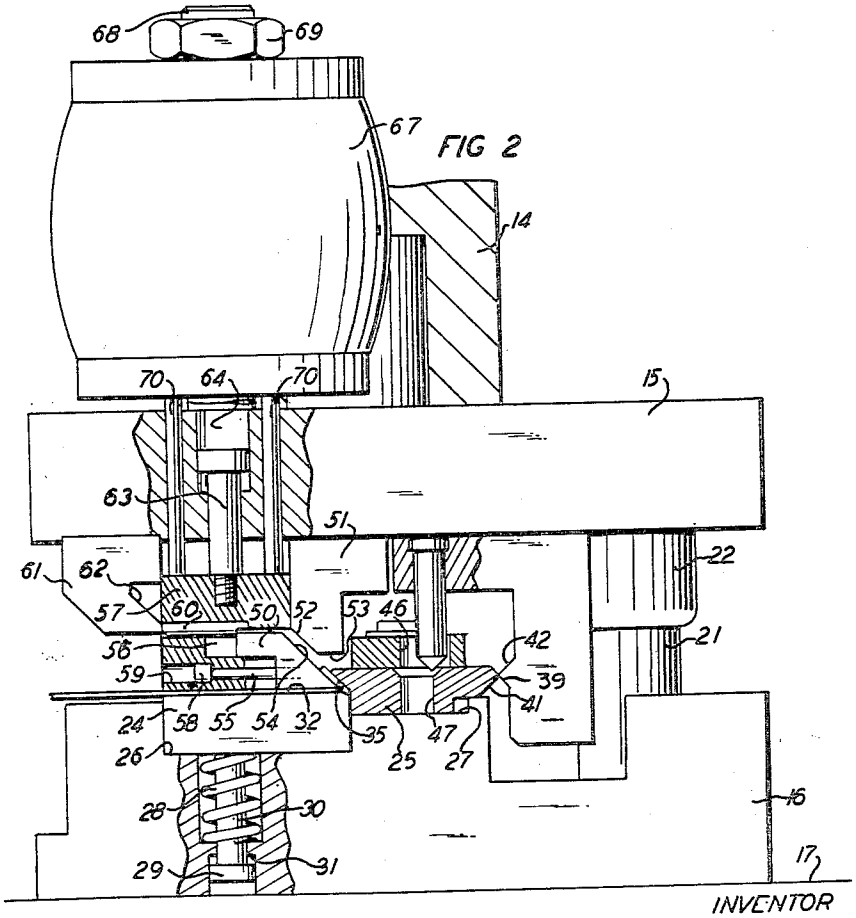


FIG 2

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SAFETY EDGE FORMING APPARATUS

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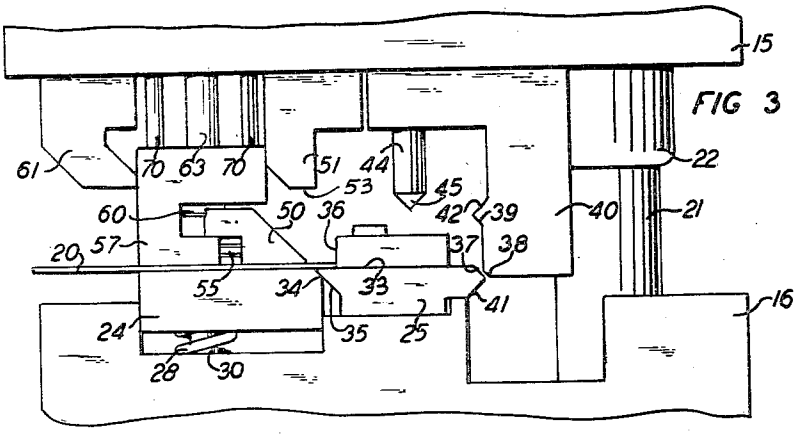

FIG 3

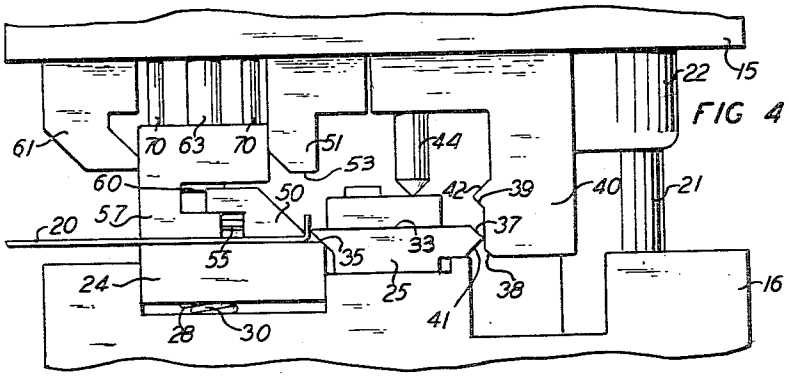

FIG 4

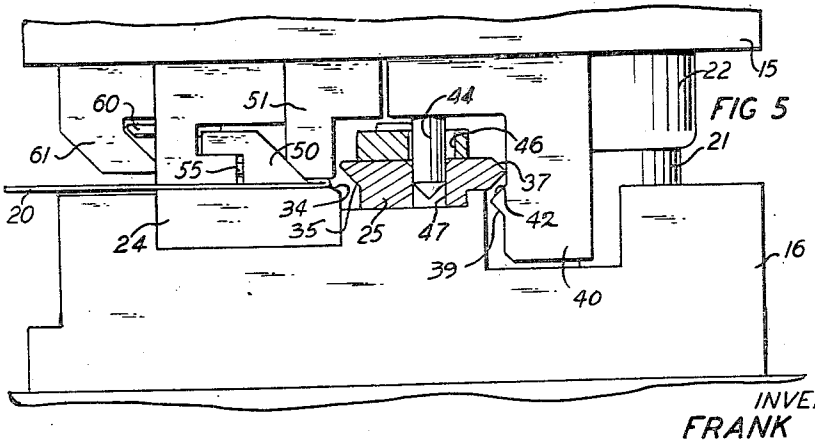

FIG 5

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United States Patent Office 2,821,233 Patented Jan. 28, 1958

2,821,233

SAFETY EDGE FORMING APPARATUS

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Application January 25, 1955, Serial No. 484,025

5 Claims. (Cl. 153—13)

This invention relates to material forming apparatus and more particularly to apparatus for forming safety edges on sheet material.

In the manufacture of sheet metal products the sheets are usually sheared or cut in such a way as to leave sharp edges which are a hazard if allowed to remain on exposed parts of the product. One of the more desirable solutions to this problem is to provide safety edges by bending a narrow width of the material adjacent the edge back upon the main strip thereby stiffening it and leaving a smooth, rounded edge free of any sharp portions. However, the cost of manufacturing such products depends largely on the handling time, the number of operations required and the complexity of the mechanism required to accomplish this result.

The object of the present invention is an apparatus which is simple in structure, efficient in operation and capable of forming a safety edge on sheet material during a single operating cycle of a press.

With this and other objects in view, the invention comprises an apparatus for forming a safety edge of sheet material wherein forming elements are positioned normally to engage the material and are moved subsequently relative to each other to bend the material.

More specifically, the apparatus includes first and second forming elements, the upper surfaces of which lie in a given plane to receive the material so that a portion of a given width adjacent the edge thereof will lie on the second forming element. First and second forming members are movable relative to the forming elements and relative to each other, through the assistance of camming means, during one-half cycle of a press, in which the apparatus is disposed, to cause bending of the leading portion of the material. The first action of the forming members and forming elements is to bend the edge portion at right angles to the main portion of the material, after which this portion will be bent further to a 135° angle and finally into a 180° angle where it will be forced back on the main portion to complete the safety edge. During the next half cycle of the press, that is, while the press is opening to its normal or starting position, the forming elements and forming members will be returned to their starting positions.

Other objects and advantages will be apparent from the following detailed description when considered in conjunction with the accompanying drawings, wherein:

Fig. 1 is a front elevational view of a press embodying the invention;

Fig. 2 is an enlarged side elevational view of the apparatus and the press at the end of the second bending portion of the half cycle, portions being shown in section;

Fig. 3 is a side elevational view of the apparatus shown in its normal or starting position;

Fig. 4 is a view of the structure shown in Fig. 3 at the end of the first bending portion of the half cycle;

Fig. 5 is a view of the structure shown in Figs. 3 and 4 illustrating the apparatus in the closed position at the completion of the forming half cycle of the press;

Fig. 6 is a fragmentary and elevational view of the material when first fed to the apparatus;

Fig. 7 is an end elevational view of the material after the first forming portion of the apparatus;

Fig. 8 is an end elevational view of the material after the completion of the second forming portion of the apparatus, and

Fig. 9 is an end elevational view of the material at the completion of the forming operation of the apparatus.

Referring now to the drawings, attention is directed first to Fig. 1 which illustrates a press **10** selected for the apparatus and including the conventional driven flywheel **11** connected in the usual manner through a one revolution clutch (not shown) to a crank shaft **12** which is operatively connected to a reciprocable ram **14**. An upper tool holder **15** fixed to the ram **14** and stationary tool holder **16** is mounted upon a bed **17** of the press **10**.

The tool holders **15** and **16** are of suitable sizes depending largely upon the widths of materials **20** to be processed by the apparatus. Furthermore, the conventional guide rods **21** carried by the tool holder **16** and receivable in bushings **22** of the tool holder **15** may be employed to assure relative positions of the tool holders at all times and particularly the relative positions of the tools held thereby.

The tool holder **16** has first and second forming elements **24** and **25** which are disposed in recesses **26** and **27** of the tool holder **16**. The element **24** is urged upwardly by a series of springs **28** (only one of which is shown) this upward movement being limited by heads **29** of screws **30** (only one of which is shown) mounted from beneath, in the first forming element **24**. The heads **29** will be held normally against like stops **31** to position the upper surface **32** of the forming element in a plane with the upper surface **33** of the second forming element **25**. The edges **34** and **35** of the elements **24** and **25** are tapered for engagement with each other while in the normal starting position shown in Fig. 3.

The second forming element **25** carries a work stop **36** which determines the width of the leading edge portion of the material to rest on the second forming element and to be utilized in the formation of the safety edge. The second forming element has a tapered surface **37**, which is to be engaged and controlled by surfaces **38** and **39** of a camming element **40**, and a tapered undersurface **41**, which is to be engaged by a surface **42** of the camming element. The camming element **40** is mounted on the undersurface of the tool holder **15** and carries a pin **44** with a conical lower end **45** positioned to enter an aperture **46** in the stop **36** and an aperture **47** with a tapered upper end in the second forming element **25**.

First and second forming members **50** and **51** are supported by the tool holder **15**, the second forming member **51** being fixed to the undersurface of the tool holder and having a cam surface **52** and a forming surface **53**. The cam surface **52** is parallel with and adapted to engage the forming surface **54** of the first forming member. The first forming member **50** is supported by a series of pins **55** and adapted for sliding movement in a recess **56** of a pressure pad **57**. Only one pin **55** is shown in the drawings in Fig. 2 but any desired number of these pins may be employed with their enlarged head portions **58** slidable in apertures **59** to serve, not only in assisting in supporting the first forming member **50** but in determining the initial operating position of this member. A series of pins **60** (only one of which is shown), slidably disposed in suitable apertures in the pressure pad **57**, cooperate to control the positioning of the first forming member **50** in cooperation with a camming member **61** and its cam surface **62** mounted on the undersurface of the tool holder **15**.

The pressure pad **57** is supported by a series of screws

63 (only one of which is shown); these screws being disposed in apertures 64 in the tool holder 15 to maintain the pressure pad with the first forming member at predetermined positions with respect to the other forming member and forming elements, and to permit movement of the pressure pad and first forming member relative to the tool holder 15.

Two rubber cylinders 67 provide a resilient pressure means for the pad 57. The cylinders 67 are disposed concentric with threaded rods 68 mounted in the tool holder 15 and provided with suitable nuts 69 so that the combined forces created in the cylinders 67 may be varied. Sets of pins 70 slidably disposed in apertures in the tool holder 15 are interposed between the rubber cylinders 67 and the pressure pad 57.

Considering the operation of the apparatus, let it be assumed that the press and the apparatus are in open positions, shown in Fig. 3, and that a sheet of material 20 has been fed to the apparatus with its leading edge engaging the stop 36. In following the actions of the forming elements and forming members during closing of the press to complete the forming half of the operating cycle of the apparatus, definite motions are imparted to the forming elements and members to produce the series of forming steps illustrated in Figs. 6 to 9 inclusive.

During the first portion of the closing half cycle, the pressure pad 57, through the cooperation of the first forming member 50, force the material against the first forming element 24, and, through the counter-acting forces of the springs 28, the material is gripped sufficiently to prevent movement thereof relative to the pressure pad and first forming element. During the first forming action the edge portion of the material is given a right-angle bend (shown in Figs. 4 and 7). To accomplish this, there is a combination of motions including the downward movement of the first forming element 24 relative to the second forming element 25, to start the right-angle bend and a lateral motion of the second forming element 25, produced by the camming element 40 through the surfaces 37 and 38 to complete the right-angle bend. This lateral motion or movement of the second forming element 25 brings about a pushing or rolling action on the edge portion of the material to more readily produce the right-angle bend without undue stress, not only on the material but on the second forming element. During this first forming portion of the operating half cycle, the first forming member 50 cooperates with the first and second forming elements in providing the mandrel-like edge determining the line along which the material is to be bent. The first forming member provides another function wherein the tapered surface 54 parallel with the surface 35, cooperates therewith during action of the cam surface 39 on the surface 37 causing additional lateral movement of the second forming element, to complete the second forming portion of the operating half cycle, illustrated in Figs. 2 and 8, where the 135° bend is formed.

As soon as this bend is completed, there is an arrangement of surfaces 41 and 42 permitting return lateral movement of the second forming element brought about through entrance of the pin 44 in the aperture 47 as shown in Figs. 2 and 5. This action includes the lateral movement of the second forming element out of the path of the second forming member 51 for the final forming portion of the half cycle of the press and apparatus. During this portion of the operating half cycle, the surface 52 of the second forming member 51 will engage the surface 54 of the first forming member 50, moving the first forming member laterally to the left until the surface 54 of the first forming member is free of the edge portion of the material so that the surface 53 may engage this portion and complete the 180° bend thereof to form the safety edge (as shown in Figs. 5 and 9).

During the initial forming (shown in Figs. 4 and 7), the main force on the material by the forming member and the forming element 25 is vertical. The forming member 50 moves downwardly while the forming element 25 is stationary to start the bend, after which, during continued downward movement of the forming member 50 the forming element 25 moves laterally a short distance to move the end of the material into a right angle position. During this action there is no need to hold the forming member 50 against lateral movement. However, during the central forming (shown in Fig. 8), the pins 60 cooperate with the cam member 61 to hold the first forming member 50 in its forming position (as shown in Figs. 2 and 8), but as the tool holder 15 continues its downward movement and the first forming element 24 is seated in its recess 26, the pins 60 are aligned with the open portion of the cam element 61 so as to be moved laterally (as shown in Figs. 5 and 9) during lateral movement of the first forming member 50 by the second forming member 51 during the final forming action.

When the press is moved into open position and the apparatus completes the second half of the operating cycle, the first forming element 25 is returned to its starting position by the spring 28. The forming members 50, carried by the pressure pad 57 moves vertically therewith under the forces of the rubber cylinders 67. During the return of the forming member 50 the camming member 61 causes the pin 60 to move the forming member laterally to its starting position. During vertical movement of the camming element 40 the forming element 25 is moved to the left beyond its starting position, but, after the camming element moves above the forming element 25 (Fig. 3) the tapered edge 34 of the element 24 will engage the tapered edge 35 of the element 25 to move the element 25 to the right into its starting position. At the completion of the operating cycle the formed strip of material may be removed from the apparatus and successive strips located therein for forming safety edges thereon during successive operating cycles.

It is to be understood that the above described arrangements are simply illustrative of the application of the principles of the invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. The combination with a press having a bed and a ram reciprocable through single cycles toward and away from the bed, of upper and lower tool holders mounted respectively on the ram and bed of the press, a first forming element with a sheet material supporting surface supported by the lower tool holder for vertical movement and normally urged to position the surface in given horizontal plane, a second forming element supported by the lower tool holder, having a sheet material supporting surface lying in the plane and movable on the lower tool holder in a path parallel with the plane, a pressure pad carried by the upper tool holder and adapted to hold the sheet material on the first forming element and move the material and first forming element downwardly, a first forming member supported by the pressure pad for lateral movement relative to and having a tapered surface extending downwardly to a forming edge normally located in a forming position and cooperating with the second forming element to form a bend in the material beyond a right angle bend, a second forming member carried by the upper tool holder and having a tapered surface adapted to engage the tapered surface of the first forming member and thereby move it laterally away from the bent portion of the material and having a horizontal surface subsequently cooperating with the first forming element to finish the bend and form a closed safety edge on the material, and means movable with the upper tool holder to move the second forming element laterally free of the path of the second forming member.

2. The combination with a press having a bed and

a ram reciprocable through single cycles toward and away from the bed, of upper and lower tool holders mounted respectively on the ram, and bed of the press, a first forming element with a sheet material supporting surface supported by the lower tool holder for vertical movement and normally urged to position the surface in given horizontal plane, a second forming element supported by the lower tool holder, having a sheet material supporting surface lying in the plane and movable on the lower tool holder in a path parallel with the plane, a pressure pad carried by the upper tool holder and adapted to hold the sheet material on the first forming element downwardly, a first forming member supported element and move the material and first forming element downwardly, a first forming member supported by the pressure pad for lateral movement relative to and having a tapered surface extending downwardly to a forming edge normally located in a forming position and cooperating with the second forming element to form a bend in the material beyond a right angle bend, a second forming member carried by the upper tool holder having a tapered surface adapted to engage the tapered surface of the first forming member and thereby move it laterally away from the bent portion of the material and having a horizontal surface subsequently cooperating with the first forming element to finish the bend and form a closed safety edge on the material, means movable with the upper tool holder to move the second forming element laterally free of the second forming member, and means to cause the first and second forming elements and the first forming member to return to their respective starting positions.

3. The combination with a press having a bed and a ram reciprocable through single cycles toward and away from the bed, of upper and lower tool holders mounted respectively on the ram and bed of the press, a first forming element with a sheet material supporting surface supported by the lower tool holder for vertical movement and normally urged to position the surface in a given horizontal plane, a second forming element supported by the lower tool holder, having a bending edge disposed between a tapered bending surface and a sheet material supporting surface lying in the plane, the second forming element being movable between its first and second bending positions on the lower tool holder in a path parallel with the said plane, a pressure pad having a lower surface parallel with the plane, carried by the upper tool holder and movable therewith to cause movement of the material with the first forming element downwardly, a first forming member having a tapered side surface and a bottom surface disposed in alignment with the bottom surface of the pressure pad to cooperate therewith to move the material and the first forming element and to cooperate with the tapered surface in forming a bending edge, means carried by the pressure pad to support the first forming member for movement parallel with the plane relative to the pressure pad and for movement of its bending edge into and out of a bending zone relative to a bending position adjacent the bending edge of the second forming element whereby downward movement of the pressure pad with the first forming member and the first forming element relative to the second forming element will cause a right angle bend in the material by the bending edges, means movable with the upper tool holder to cause lateral movement of the second forming element into its second bending position to cause the tapered surfaces of the second forming element and the first forming member to bend the material beyond the right angle bend, a second forming member mounted on the upper tool holder for movement therewith and having a tapered surface, to engage the tapered surface of the first forming member to thereby move the bending edge of the first forming member out of the bending zone, and a lower surface to cooperate with the first forming element to finish the bend and form a closed safety edge on the material, and means carried by the upper tool holder to engage and move the second forming element from its second bending position to its first bending position in advance of the second forming member.

4. The combination with a press having a bed and a ram reciprocable through single cycles toward and away from the bed, of upper and lower tool holders mounted respectively on the ram and a bed of the press, a first forming element with a sheet material supporting surface supported by the lower tool holder for vertical movement and normally urged to position the surface in a given horizontal plane, a second forming element supported by the lower tool holder, having a bending edge disposed between a tapered bending surface and a sheet material supporting surface lying in the plane, the second forming element being movable between its first and second bending positions on the lower tool holder in a path parallel with the said plane, a pressure pad having a lower surface parallel with the plane, carried by the upper tool holder and movable therewith to cause movement of the material with the first forming element downwardly, a first forming member having a tapered side surface and a bottom surface disposed in alignment with the bottom surface of the pressure pad to cooperate therewith to move the material and the first forming element and to cooperate with the tapered surface in forming a bending edge, means carried by the pressure pad to support the first forming member for movement parallel with the plane relative to the pressure pad and for movement of its bending edge into and out of a bending zone relative to a bending position adjacent the bending edge of the second forming element whereby downward movement of the pressure pad with the first forming member and the first forming element relative to the second forming element will cause a right angle bend in the material by the bending edges, means movable with the upper tool holder to cause lateral movement of the second forming element into its second bending position to cause the tapered surfaces of the second forming element and the first forming member to bend the material beyond the right angle bend, a second forming member mounted on the upper tool holder for movement therewith and having a tapered surface, to engage the tapered surface of the first forming member to thereby move the bending edge of the first forming member out of the bending zone, and a lower surface to cooperate with the first forming element to finish the bend and form a closed safety edge on the material, means carried by the upper tool holder to engage and move the second forming element from its second bending position to its first bending position in advance of the second forming member, and a projection carried by the upper tool holder and adapted to hold the first forming member with its bending edge in the bending zone during the intermediate, beyond right angle, bending of the material and to free the first forming member for movement out of the bending zone by the second forming member for a final bending operation.

5. The combination with a press having a bed and a ram reciprocable through single cycles toward and away from the bed, of upper and lower tool holders mounted respectively on the ram and bed of the press, a first forming element with a sheet material supporting surface supported by the lower tool holder for vertical movement and normally urged to position the surface in a given horizontal plane, a second forming element supported by the lower tool holder, having a bending edge disposed between a tapered bending surface and a sheet material supporting surface lying in the plane, the second forming element being movable between its first and second bending positions on the lower tool holder in a path parallel with the said plane, a pressure pad having a lower surface parallel with the plane, carried by the upper tool holder and movable therewith to cause movement of the material with the first forming element downwardly, a first forming member having a tapered

side surface and a bottom surface disposed in alignment with the bottom surface of the pressure pad to cooperate therewith to move the material and the first forming element and to cooperate with the tapered surface in forming a bending edge, means carried by the pressure pad to support the first forming member for movement parallel with the plane relative to the pressure pad and for movement of its bending edge into and out of a bending zone relative to a bending position adjacent the bending edge of the second forming element whereby downward movement of the pressure pad with the first forming member and the first forming element relative to the second forming element will cause a right angle bend in the material by the bending edges, means movable with the upper tool holder to cause lateral movement of the second forming element into its second bending position to cause the tapered surfaces of the second forming element and the first forming member to bend the material beyond the right angle bend, a second forming member mounted on the upper tool holder for movement therewith and having a tapered surface, to engage the tapered surface of the first forming member to thereby move the bending edge of the first forming member out of the bending zone, and a lower surface to cooperate with the first forming element to finish the bend and form a closed safety edge on the material, means carried by the upper tool holder to engage and move the second

forming element from its second bending position to its first bending position in advance of the second forming member, and a projection carried by the upper tool holder and adapted to hold the first forming member with its bending edge in the bending zone during the intermediate, beyond right angle, bending of the material and to free the first forming member for movement out of the bending zone by the second forming member for a final bending operation, the projection also being adapted to move the first forming member to the bending zone during upward movement of the upper tool holder.

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