Sept. 22, 1970 R. E. ROPER 3,530,272

METHOD AND APPARATUS FOR FORMING SHEET METAL CORNER MEMBERS

Original Filed April 15, 1966 5 Sheets-Sheet 1

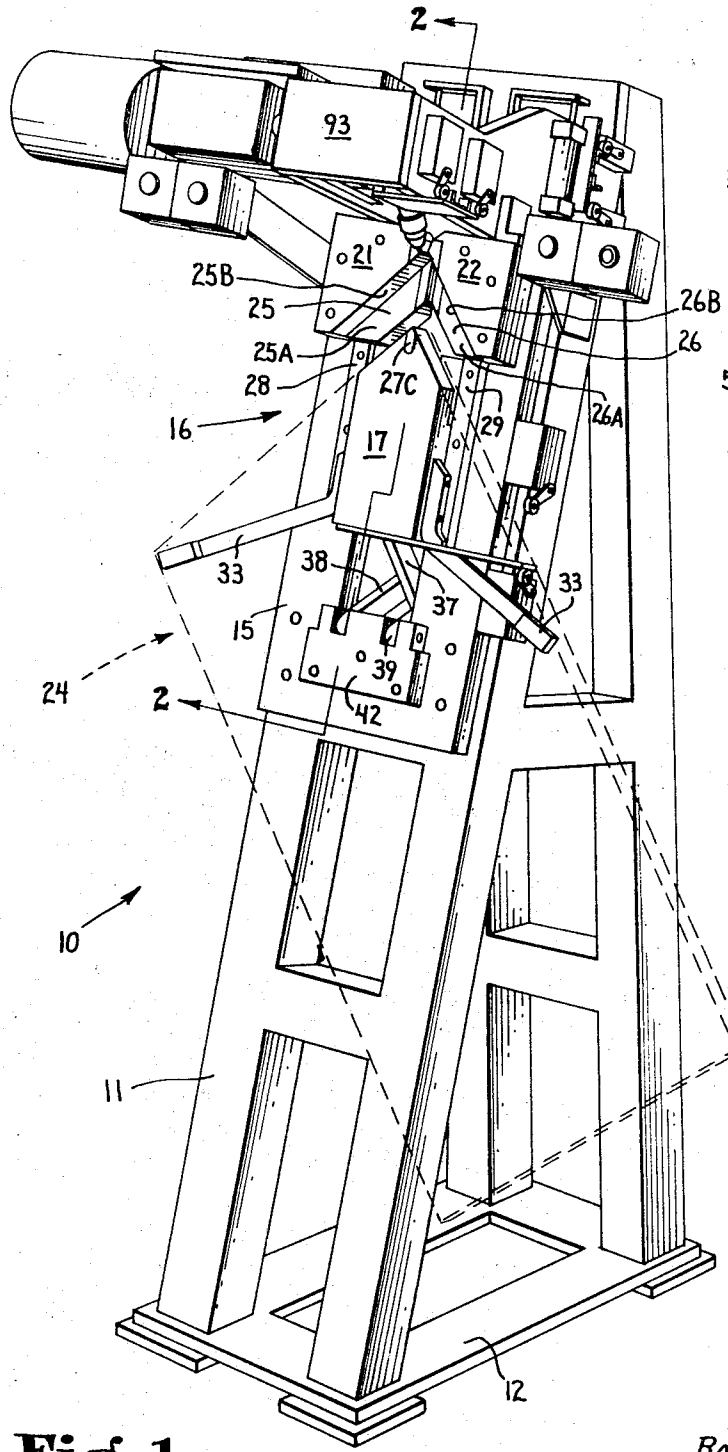


Fig. 1.

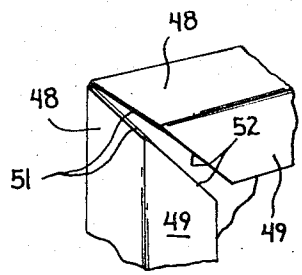


Fig. 5.

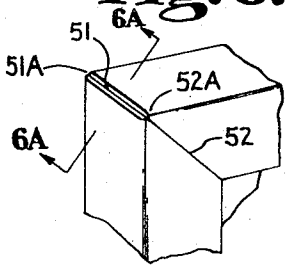


Fig. 6.

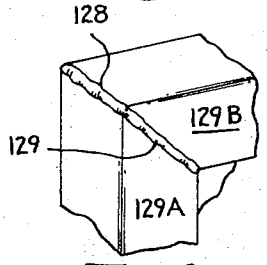


Fig. 7.

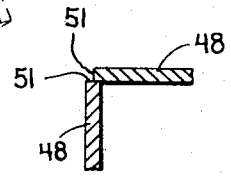


Fig. 6A.

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METHOD AND APPARATUS FOR FORMING SHEET METAL CORNER MEMBERS

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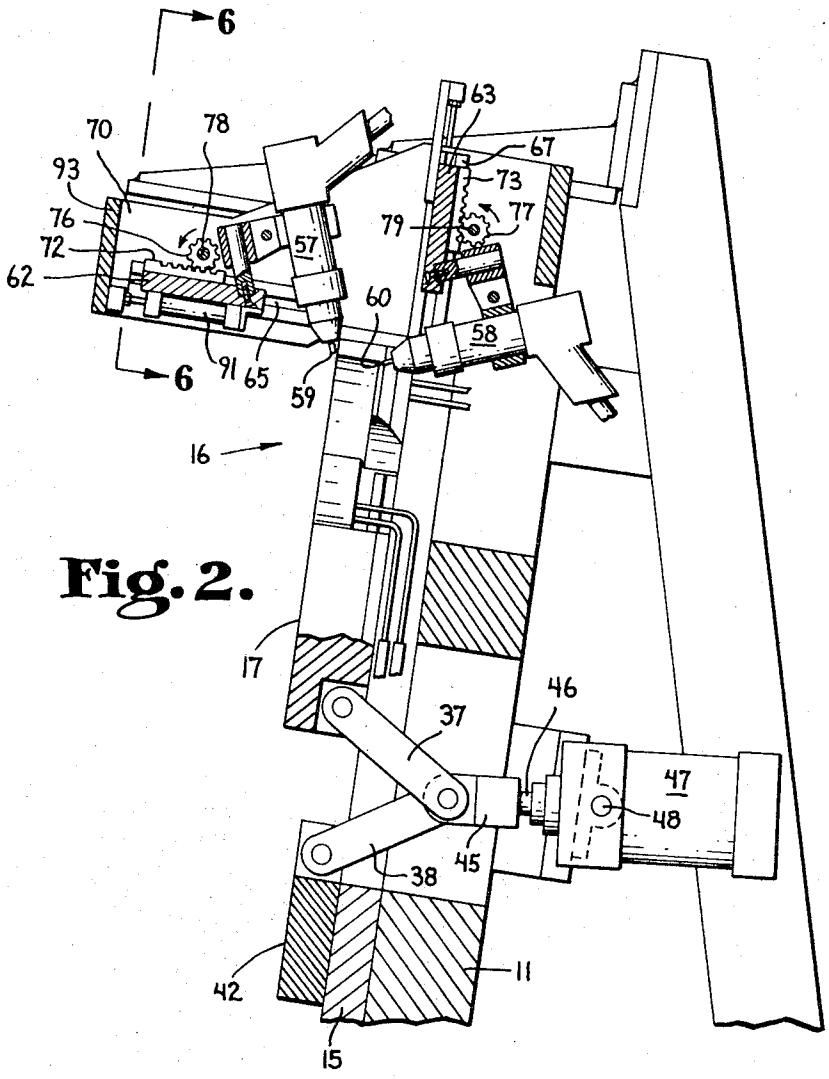


Fig. 2.

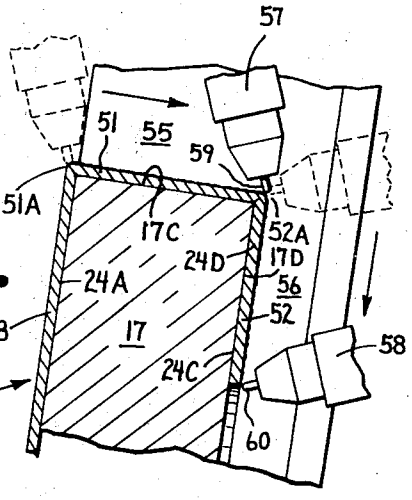


Fig. 3.

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METHOD AND APPARATUS FOR FORMING SHEET METAL CORNER MEMBERS

Original Filed April 15, 1966 5 Sheets-Sheet 3

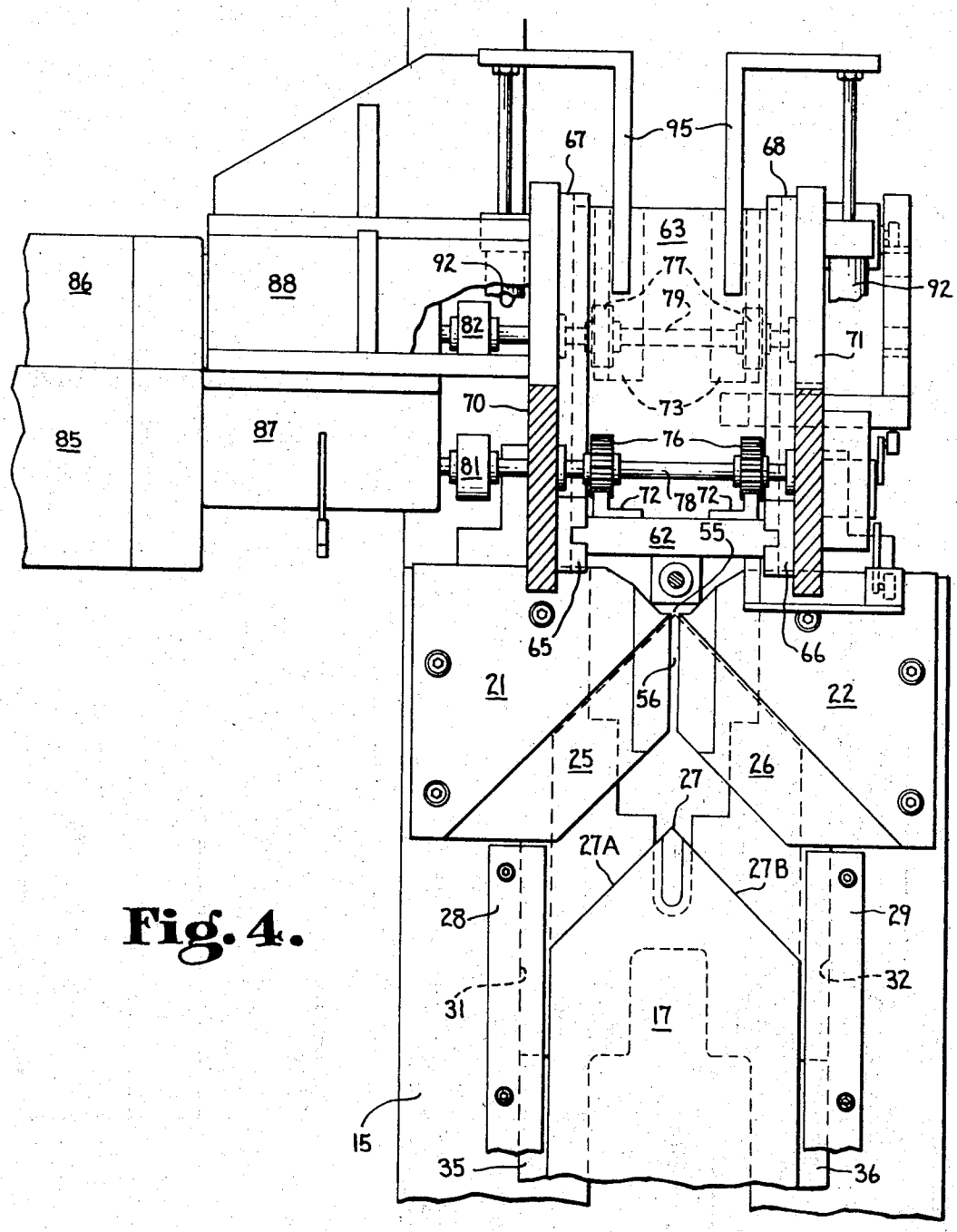


Fig. 4.

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METHOD AND APPARATUS FOR FORMING SHEET METAL CORNER MEMBERS

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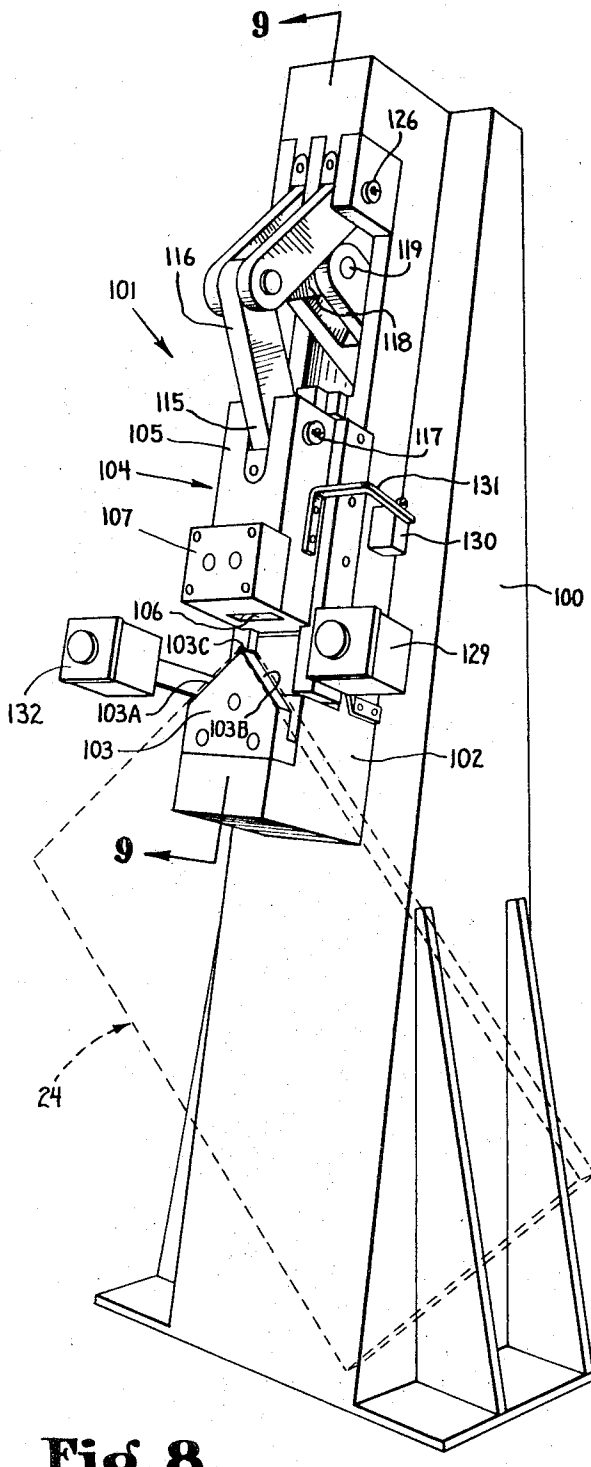


Fig. 8.

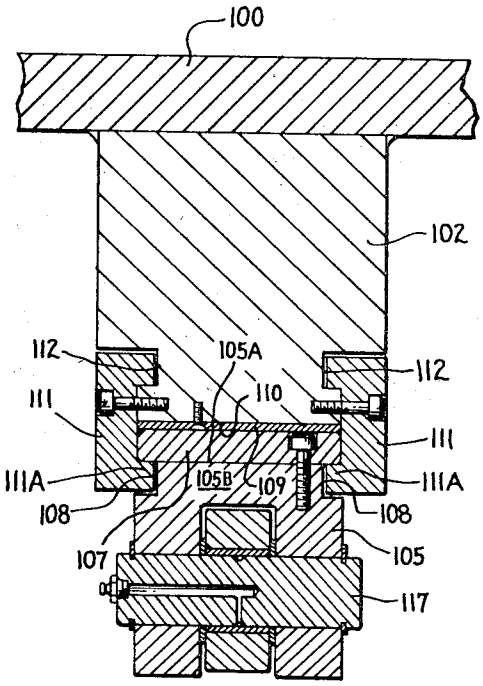


Fig. 10.

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METHOD AND APPARATUS FOR FORMING SHEET METAL CORNER MEMBERS

Original Filed April 15, 1966 5 Sheets-Sheet 5

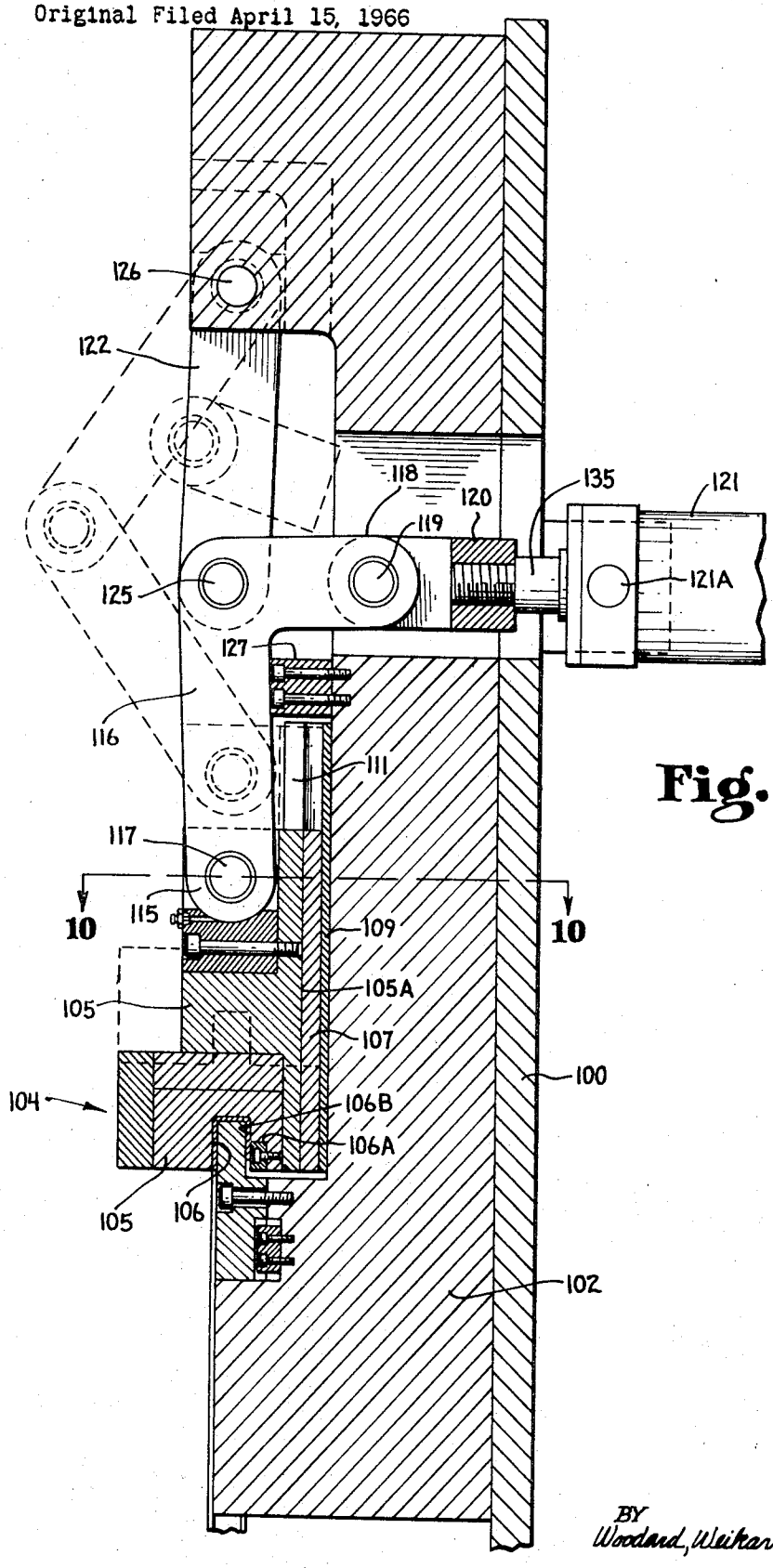


Fig. 9.

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3,530,272

METHOD AND APPARATUS FOR FORMING SHEET METAL CORNER MEMBERS

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Original application Apr. 15, 1966, Ser. No. 542,896, now Patent No. 3,440,711, dated Apr. 29, 1969. Divided and this application Oct. 4, 1968, Ser. No. 785,416
Int. Cl. B23k 9/12
U.S. Cl. 219—125 1 Claim

ABSTRACT OF THE DISCLOSURE

An apparatus for automatically positioning and simultaneously welding the vertical and horizontal junctions of a sheet metal corner. A first clamp member and a pair of second clamp members are shaped complementarily to the sheet metal corner to hold it and to hold together the portions of the corner to be joined. A pair of welding guns are mounted for reciprocal movement through perpendicular paths adjacent the sheet metal corner and between the pair of second clamp members for fusing the corner together.

This is a division of application Ser. No. 542,896, filed Apr. 15, 1966, now Pat No. 3,440,711 granted Apr. 29, 1969.

The present invention relates to method and apparatus forming the corners of sheet metal panels such as refrigerator doors, freezer doors and the like.

One presently used method of fabricating panels from sheet metal includes notching the corners of a sheet metal blank and making a first inner bend at right angles to the center section. Next a second bend or fold is made a distance outwardly from the first bend corresponding to the desired panel thickness. The second fold thus forms a flange substantially parallel to the center section of the blank. The corner notches of the blanks are so shaped as to provide an abutting joint along each corner of the folded panel and a mitered joint joining the side flanges and end flanges. The joints are then welded, brazed or fuzed and subsequently hand worked by grinding and other operations in preparation for painting, plating, or other final decorative or protective finish. One disadvantage of the above described method of fabrication is the time consumed in hand finishing the corners of each panel and the unavoidable non-uniformity of contour resulting therefrom.

Consequently, an important object of the present invention is to provide improved method and apparatus for forming the corners in sheet metal panels.

A further object of the present invention is to provide method and apparatus for forming the corners of sheet metal panels which compared to presently known procedures drastically reduces man hours of finishing labor.

A further object of the present invention is to provide method and apparatus for forming the corners of sheet metal panels which produces formed corners accurately and uniform in contour.

Related advantages of the invention are that by eliminating skilled labor to complete the corner forming operation, an automated assembly line for door forming is made possible, expensive labor costs are avoided, and rejected parts due to poor workmanship are substantially reduced.

Other related objects and advantages will become apparent as the description proceeds.

One embodiment of the method of the present invention comprises the steps of bending a notched sheet metal blank to form a rectangular panel having abutting edges

forming the corners, clamping the abutting edges together, fuzing the abutting edges to a solid metal corner, and then forming the fuzed corner between a pair of dies.

One embodiment of the apparatus of the present invention might include a welding jig with a movable clamp element for holding the edges of a door corner seam in abutting relationship, a pair of welding guns disposed at right angles to one another and arranged to fuze the seams while held by said jig into a solid metal corner, a stationary punch element supporting the interior surfaces of a door corner and a movable die aligned therewith, said punch and die being arranged to compress the fuzed seam and adjacent metal into a smoothly contoured finished form ready for painting or plating.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims.

FIG. 1 is a perspective view of corner fuzing apparatus forming a part of the present invention.

FIG. 2 is a vertical section taken generally along the line **2—2** of FIG. 1 and viewed in the direction of the arrows.

FIG. 3 is an enlarged fragmentary section similar to FIG. 2 through clamping mechanism forming a part of the corner fuzing apparatus of FIG. 1, the parts being shown in a position corresponding to the completion of the fuzing operation.

FIG. 4 is an enlarged fragmentary front elevation of the apparatus of FIG. 1.

FIGS. 5, 6 and 7 are perspective serial views of the workpiece generally illustrating the unclamped, clamped and fuzed appearance, respectively of a panel corner.

FIG. 6A is a section taken along the line **6A—6A** of FIG. 6 in the direction of the arrows.

FIG. 8 is a perspective view of punch and die apparatus forming a part of the present invention.

FIG. 9 is an enlarged fragmentary vertical section taken generally along the lines **9—9** of FIG. 8 and viewed in the direction of the arrows but showing the parts in a different operating position than in FIG. 8.

FIG. 10 is a horizontal section taken along the line **10—10** of FIG. 9 and viewed in the direction of the arrows.

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawing and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

Referring now to the drawings and particularly to FIGS. 1–7, there is shown fuzing apparatus **10**, consisting of a frame **11** mounted upon a base **12**. A plate **15** is fixedly mounted to the front face of the frame and is located at the upper portion thereof. The plate **15** has affixed thereto clamping means generally referred to by numeral **16**. Clamping means **16** consists of a movable clamp member **17**, mounted for vertical reciprocation on plate **15**, and stationary clamp members or halves **21** and **22** fixedly mounted to plate **15** in alignment with clamp member **17**. Clamp halves **21** and **22** have recesses **25** and **26**, respectively, formed therein. The recesses **25** and **26** are defined by forwardly facing surfaces **25A** and **26A** and downwardly facing surfaces **25B** and **26B**. The surfaces **25B** and **26B** have a transverse dimension corresponding to the thickness of a panel to be fuzed and extend at a 90° angle to one another.

The upper end of movable clamp member **17** includes two surfaces **27A** and **27B** which form a 90° angle relative

to one another and meet at an apex or junction **27**. The apex **27** is formed by an insert **27C** made of copper or some other metal incompatible with the metal of the workpiece to prevent fuzing of the workpiece to the member **27C**. A door panel **24**, indicated by broken lines in FIG. 1 and in solid lines in FIG. 3, is placed on movable clamp member **17** so that the panel is supported from one corner by the surfaces **27A** and **27B** of the clamp member **17**. The thicknesses of clamp member **17** corresponds to the inside dimension of the door panel. In other words, the thickness of the member **17** is equal to or slightly less than the distance from the inner face **24A** of the panel front **24B** to the inner face **24C** of the parallel back flange **24D**.

Guide tracks **28** and **29** are fixedly mounted to plate **15** and are recessed at **31** and **32** (FIG. 4), so as to slidably receive tongues **35** and **36** of movable clamp **17**, thereby guiding clamp member **17** as it moves upwardly into clamping registry with clamp halves **21** and **22**. Fixed to the clamp member **17** are wings **33** which function to support the panel **24** so that it does not swing on the clamp member during movement thereof. One end of a lever arm **37** is pivotally secured to the inside face of movable clamp **17** at the lower portion thereof. Lever arms **38** and **39** are pivotally secured to bearing block **42** which is fixed to plate **15**. The opposite ends of levers **37**, **38** and **39** are pivotally secured to a cleaves **45** fixed to the piston **46** of an air cylinder **47**. Cylinder **47** is pivotally mounted at **48** to frame **11**.

The clamping means thus far described receives one corner of a panel which has been preformed to the condition illustrated in FIG. 5. This preforming can be accomplished by any suitable folding or bending apparatus to form inner terminal portions **48** and outer terminal portions **49**. It will be noted that the edges **51** and **52** of the terminal portions **48** and **49** are to some degree separated and/or out of alignment. Extension of piston **46** leftwardly, as viewed in FIG. 2, causes clamp member **17** to move upwardly into clamping engagement with clamp halves **21** and **22**. Referring to FIGS. 6 and 6A, a panel corner pressed between clamp member **17** and clamp halves **21** and **22** will have terminal portions **48** partially overlapping and firmly pressed together and terminal portions **49** aligned and abutting and firmly pressed together. with the panel in this position, the contacting edges **51** will be exposed between clamp halves **21** and **22** at **55** (FIG. 4) and the contacting edges **52** will be exposed between clamp halves **21** and **22** at **56** (FIG. 4).

Fuzing or welding guns **57** and **58**, having arc tips or electrodes **59** and **60**, respectively, are fixedly mounted to movable plates **62** and **63** in such a manner that their arc tips **59** and **60** are closely adjacent the apices **51A** and **52A** (FIG. 3 and 6) of the clamped door panel corner. The fuzing guns place no new metal in the welds which they produce. The fuzing guns are commercially available items and might be, for example, Heliarc Guns Linde HW 13 manufactured by Union Carbide of Indianapolis, Ind. (Linde Division). The guns are also each provided with inert gas outlets which operate to cover the weld with inert gas when the gun is in operation. The welding circuit is made through the electrodes **59** and **60** to the copper member **27C**.

Plates **62** and **63** are guided in trackways **65** and **66** and trackways **67** and **68**, respectively, the trackways being mounted to side plates **70** and **71** which are fixedly secured to frame **11**. Each plate **62** and **63** has fixedly mounted thereto, racks **72** and **73**, respectively, which are engaged by pinion gears **76** and **77**. Pinion gears **76** are fixed to shaft **78** and pinion gears **77** are fixed to shaft **79**. Electric clutches **81** and **82** connect shafts **78** and **79** to synchronized electric motors **85** and **86** through variable gear reducers **87** and **88**, respectively. The trackways **65** and **66** extend parallel to the top surface **17C** (FIG. 3) of the clamp member **17**. Trackways **67** and **68** extend parallel to the rear surface **17D** (FIG. 3) of the clamp member **17**. The fuzing guns **57** and **58** are movable in the trackways to and from the above mentioned initial position by the operation of the motors **85** and **86**. As the fuzing guns **57** and **58** are moved from the dotted line to the full line position as illustrated in FIG. 3, the electrodes **59** and **60** will move along the edges **51** and **52**, respectively, of the door panel corner being held in clamped position by the clamp members **17**, **21** and **22**.

After the door panel **24** has been hooked on the clamp member **17**, the cylinder **47** is operable to raise clamp member **17** to the dotted line position of FIG. 4 at which time clutches **81** and **82** are energized and simultaneously high potential current provided to electrodes **59** and **60**. Also the guns **57** and **58** begin to emit inert gas. Energizing of clutches **81** and **82** couples shafts **78** and **79** to the continuously rotating output shafts of reducers **87** and **88** causing pinion gears **76** and **77** to drive plates **62** and **63** and their associated welding guns **57** and **58** rightwardly and downwardly, respectively, as viewed in FIG. 3. The arc between tips **59** and **60** and edges **51** and **52** fuzes the edges (FIG. 6) to form a solid metal corner as indicated at **128** and **129** in FIG. 7.

At the end of the fuzing cycle the fuzing guns are positioned as illustrated in solid lines in FIG. 3. When the guns reach these positions, the current to the electrodes **59** and **60** is terimnated and deenergizing of clutches **81** and **82** takes place as well as the turning off of the inert gas flow. At this time the clamp member **17** is lowered by retraction of piston **46** of air cylinder **47**. Also, at this time fuzing gun **57** is returned to the dotted line position of FIG. 3 by air cylinder **91**. The air cylinder **91** is mounted on the plate **62** and has its piston rod secured to the cross plate **93** fixed to the side plates **70**. The fuzing gun **58** is returned to the dotted line position of FIG. 3 simultaneously with the return movement of fuzing gun **57** by a pair of air cylinders **92** acting through L-shaped brackets **95** fixed to plate **63**.

Referring now to FIGS. 8, 9 and 10, the forming apparatus of this invention includes a frame **100** which mounts a punch and die generally referred to by numeral **101**. An elongated mounting block **102** has bolted thereto a punch member **103** which is provided with a pointed upper end including two surfaces **103A** and **103B** forming a 90° angle relative to one another and meeting at an apex or junction **103C**. Thus the configuration of the punch member **103** is similar to the configuration of the clamp member **17**.

A die block, generally referred to by numeral **104**, is composed of a main body portion **105** having a V-shaped recess **106** machined in its lower portion. The rear face **196B** of recess **106** is partially defined by a hardened seeel insert **106A** for a purpose described below. The rear face **105A** of body portion **105** has fixedly secured thereto a guide plate **107** which overlies a necked down portion **105B** of body **105** thus defining oppositely opening slots **108**. A bearing plate **109** is fixed to the front face **110** of mounting block **102**.

Guide track member **111** of U-shaped cross section are bolted to the sides of mounting block **102** so that one leg **111A** of the U-shape projects into slots **108** and the other leg of the U-shape is received in slots **112** formed in the sides of block **102**.

One end **115** of an L-shaped lever **116** is pivotally secured to the upper end of die block **105** by pin **117**. The other end **118** of the L-shaped level **116** is pivotally mounted by pin **119** to the cleaves **120** of air cylinder **121**. Air cylinder **121** is pivotally mounted to frame **100** by pins **121A**. A pair of links **122** each have one end pivotally mounted to the elbow of L-shaped lever **116** by pin **125** and the other end pivotally secured to mounting block **102** by pin **126**. A stop block **127** is bolted to mounting block **102** in a position such as to limit or prevent the travel of lever arm **116** rightwardly past the solid line position illustrated in FIG. 9.

In operation, a door panel received from the fuzing apparatus with all its corners in the form shown in FIG. 7 is placed with one corner overlying punch member **102**. The fuzed seam **128** forming the corner edge perpendicular to the front of the panel is rough and uneven as indicated in FIG. 7. The apex of die cavity **106** corresponding to this corner edge is shaped with a smooth coreer configuration which smooths out the uneven fuzed seam **128** by plastic deformation thereof when the panel corner is formed between the punch and die cavity. Seam **129** joining the flanges of the rear face of the door panel is not exposed in the finished product inasmuch as the flanges serve as a mounting face for a separate panel forming the interior face of the door. Insert **106A** in the rear face of cavity **106** therefore functions to shear the uneven portions of the seam **129** flush with the adjacent flange surfaces **129A** and **129B** (FIG. 7).

Actuation of die member **104** is achieved by retraction and extension of the piston **135** of air cylinder **121**. The extended piston open die position is shown in FIG. 8 and in dotted outline in FIG. 9. The solid line position of FIG. 9 is, of course, the retracted piston closed die forming position of the apparatus. When the piston **135** is retracted, the lever arm **116** engages stop block **127** to stop the movement of the female forming member **106** at a predetermined spacing from the male forming member **103**. This spacing is such as to effect the desired external forming of the corner of the panel at the seam **128**.

A cycle start switch **129**, when depressed, overrides cycle stop switch **130** activated by arm **131** fixed to die block **104**. Arm **131**, moving downwardly with die block **104**, allows switch **130** to close holding the pneumatic circuit (not shown) in operative condition. A pressure switch (not shown) in the pneumatic circuit reverses the air pressure through conventional valving means to return the die block to its up position. Arm **131** engages the activating lever of switch **130** which in turn operates the air supply valve to off position. A jogging switch **132** is provided to bypass the cycling circuit enabling intermittent lowering and raising of die block **104** necessary to the accomplishment of die set up. Since the electrical and pneumatic circuit of the apparatus forms no part of the present invention, it will not be described further herein.

It will be evident from the above description that the present invention provides a method and apparatus for forming and finishing the corners of sheet metal panels which substantially reduces labor cost. It should be understood that after the welding step of this invention, the forming step in the apparatus of FIGS. 8, 9 and 10 finishes the weld to an extent making unnecessary further finishing. It will also be evident that the method and apparatus of the present invention provide a much greater accuracy and uniformity than that possible by hand finishing.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes and modifications that come within the spirit of the invention and the scope of the claim are also desired to be protected.

The invention claimed is:

1. Apparatus for fuzing corner members comprising a first clamp member having a pointed configuration conforming to the inside of a corner member to be fuzed, a pair of second clamp members each having a recess therein complementary in shape to a portion of said first clamp member, means for causing relative movement of said first clamp member against said second clamp members to clamp a corner member to be fuzed and to hold the corner member during fuzing, said second clamp members being fixed relative to one another but being spaced apart to provide therebetween an opening shaped to overlie the seam of the corner to be fuzed, welding means projecting between said second clamp members for fuzing said corner, means for moving said welding means through said opening along said seam for fuzing said corner member at said seam, said first clamp member being provided with an apex portion formed of an electrically conductive metal incompatible with the material of said corner members, said welding means being a pair of welding guns, each of said guns including an electrical terminal and an outlet for inert gas, said apex portion being grounded whereby welding of said seam can be effected by producing a voltage drop from the terminals of said guns and ground and by expelling inert gas over the terminals, said first clamp member having a pair of perpendicular surfaces which join to define said apex and having a pair of opposite surfaces extending between said perpendicular surfaces, one of said guns being reciprocal parallel to said apex and one of said guns being reciprocal parallel to one of said opposite surfaces, said means for moving said clamp members being operable to cause relative movement of said first clamp member and said second clamp members in a direction parallel to said one opposite surface, said recess of said second clamp members being L-shaped in cross section, said recess of each clamp member having one surface which is parallel to and clampingly cooperates with a respective one of the perpendicular surfaces of said clamp member, said recess of each clamp member having another surface which is parallel to and clampingly cooperates with said one opposite clamp member surface whereby said corner member may be clamped during fuzing with inner terminal portions partially overlapping one another and extending at right angles to one another and with outer terminal portions abutting one another and in alignment with one another.

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U.S. Cl. X.R.

219—158, 161; 228—44