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DuVernay

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[54] **METHOD AND CRIMPING TOOL FOR PERMANENTLY JOINING TOGETHER TWO SHEET METAL MEMBERS**

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[73] Assignee: **Auto-Craft Tool & Die Company,** Algonac, Mich.

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[52] **U.S. Cl.** ..... **113/1 N;** 29/509; 113/116 FF

[51] **Int. Cl.²** **B21D 39/03**

[58] **Field of Search** ..... 113/1 N, 116 FF; 29/509; 140/93.2

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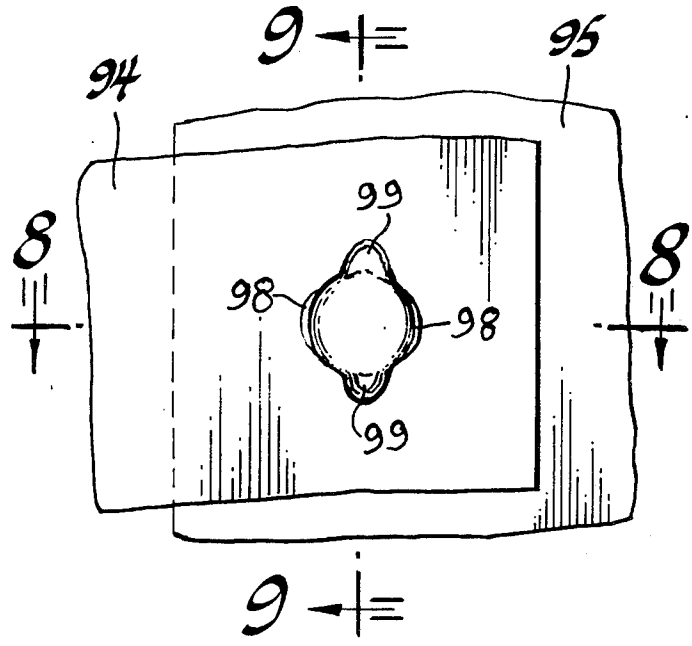
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Primary Examiner—C. W. Lanham
Assistant Examiner—Joseph A. Walkowski
Attorney, Agent, or Firm—Robert G. Mentag

[57] **ABSTRACT**

A method of permanently joining two sheet material members by placing them in an overlapping position, and simultaneously punching out a portion of each sheet member so that a portion of an uppermost sheet member is disposed in the lowermost sheet member, and said portion of the lowermost sheet member is punched out of the lowermost sheet member to a position offset therefrom, and wherein each of said portions is joined to its respective sheet member by at least a pair of locking tabs. The crimping tool of the invention includes a die means mounted on a frame member and having a first punch tool movably mounted therein. A power operated second punch tool is movably mounted on said frame member for operation with said first punch member to simultaneously punch a portion from an uppermost sheet member into an underlying lowermost sheet member and a portion from said lowermost sheet member to a position offset therefrom, and wherein each of said portions is joined to its respective sheet member by at least a pair of locking tabs.

5 Claims, 10 Drawing Figures



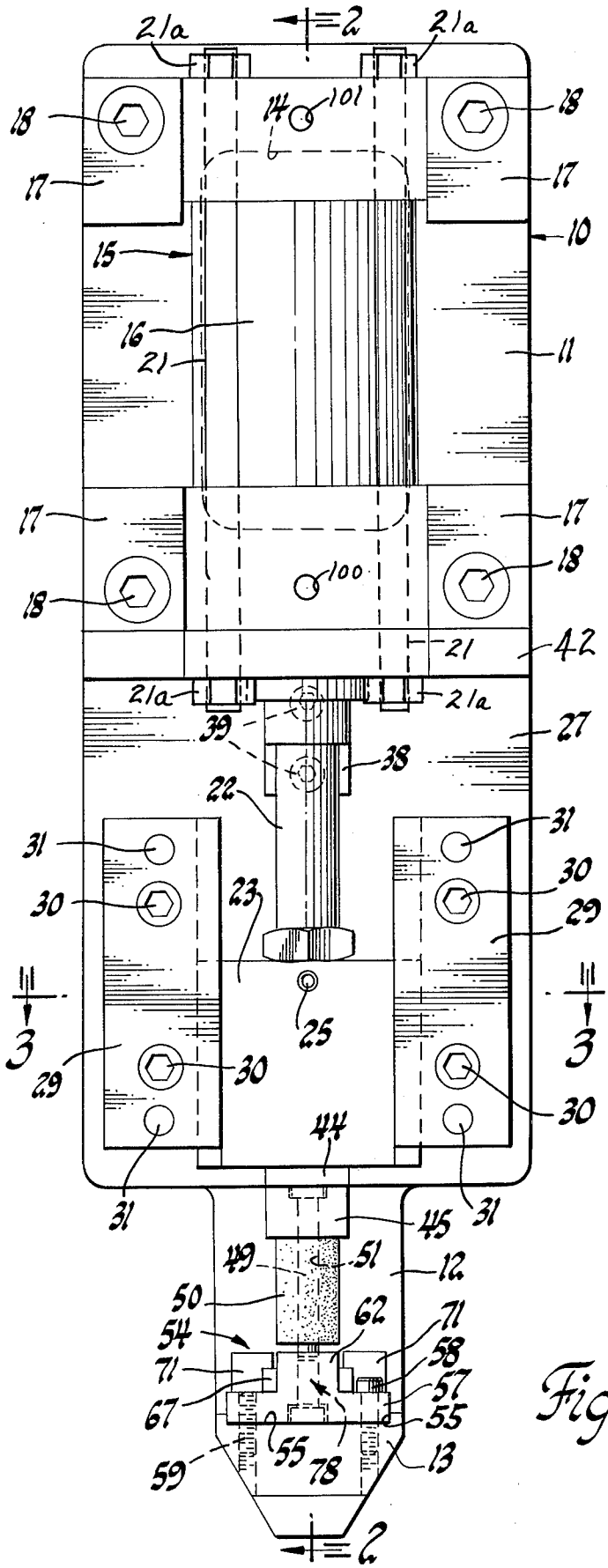

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Fig. 1

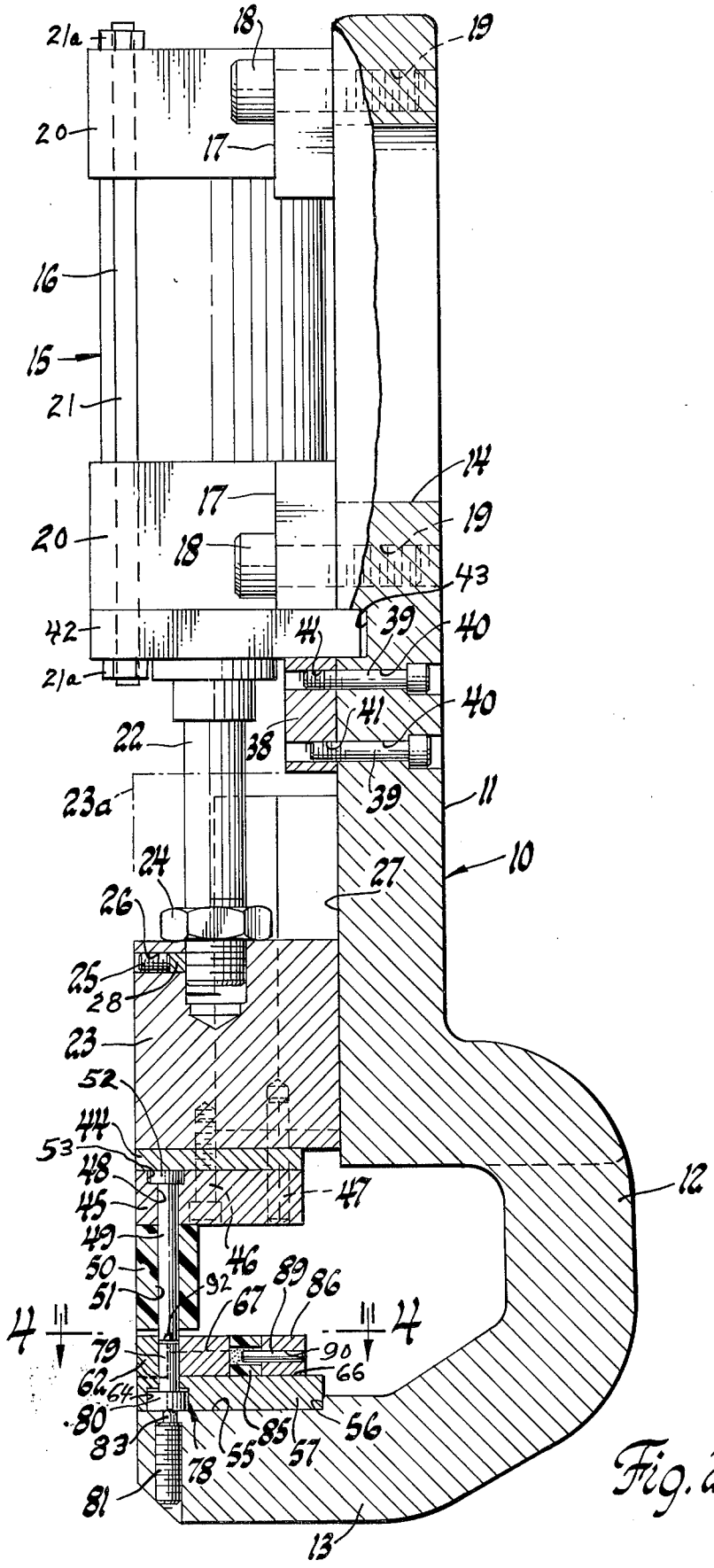

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Fig. 2

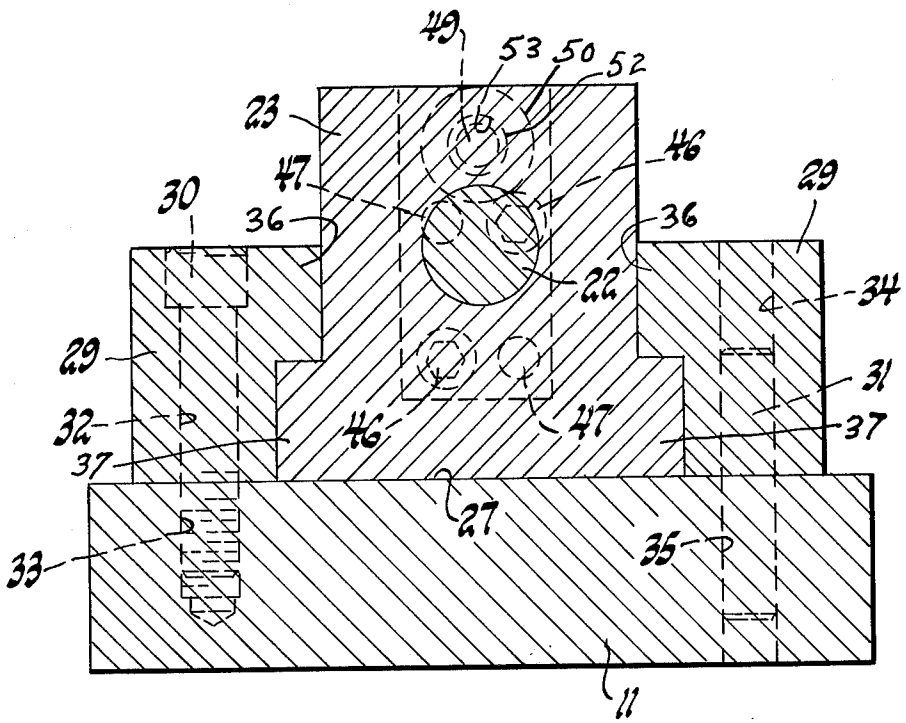


Fig. 3

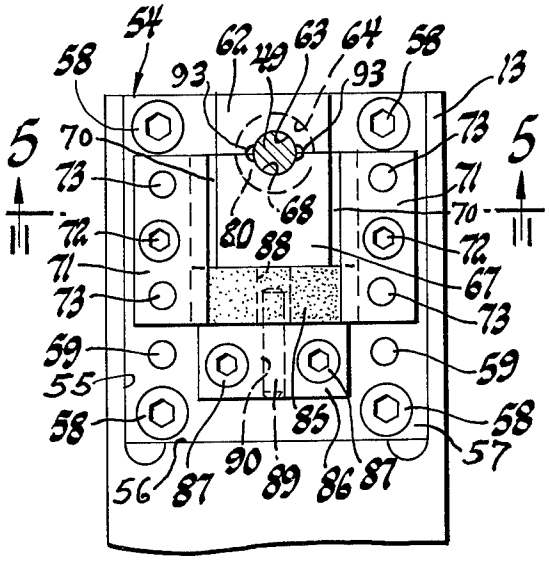


Fig. 4

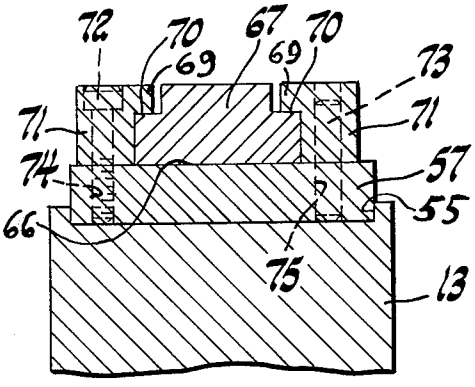


Fig. 5

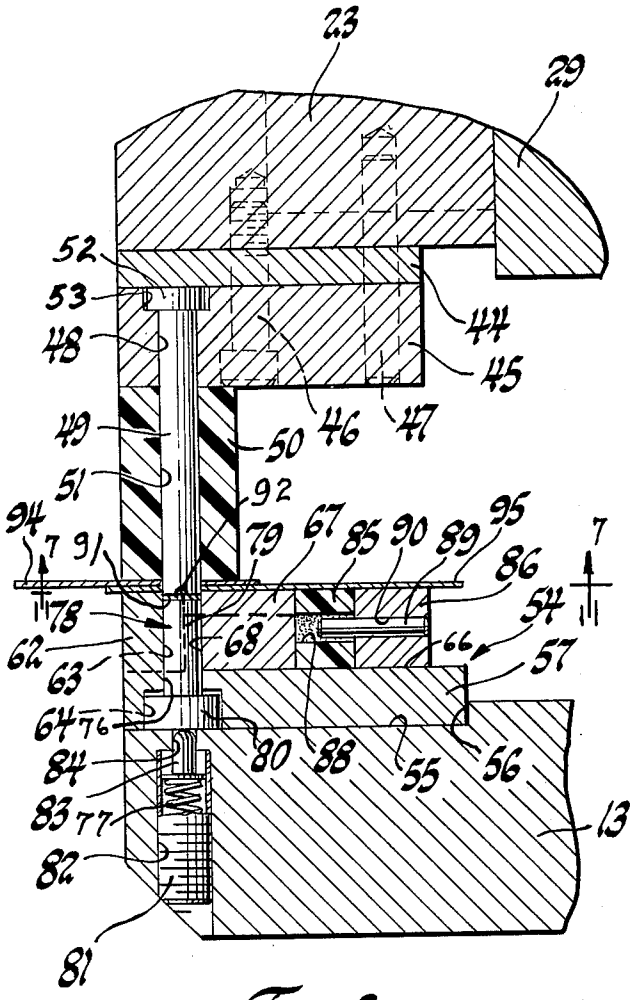


Fig. 6

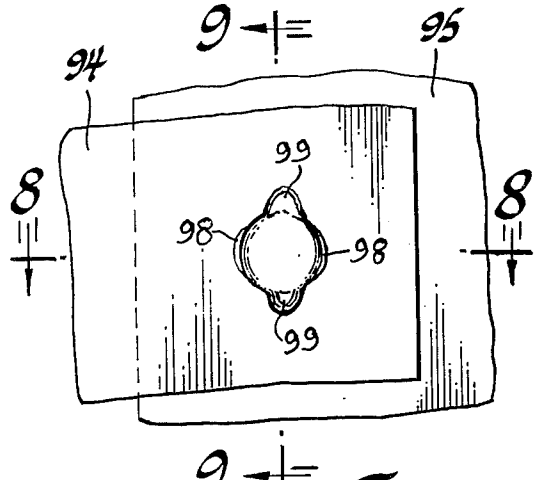


Fig. 7

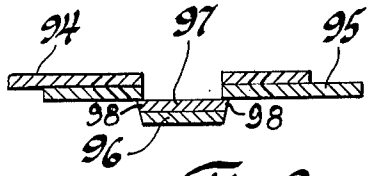


Fig. 8

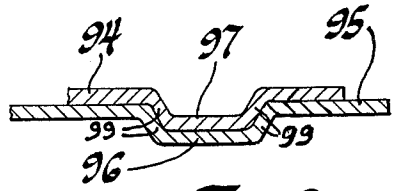


Fig. 9

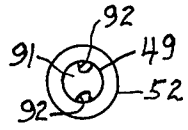


Fig. 10

METHOD AND CRIMPING TOOL FOR PERMANENTLY JOINING TOGETHER TWO SHEET METAL MEMBERS

SUMMARY OF THE INVENTION

This invention relates generally to the crimping art, and more particularly to a novel and improved method and crimping tool for permanently joining together two sheets of material.

Heretofore, in order to permanently join two sheets of the same type of metal it was necessary to use some form of welding, as, for example, spot welding. However, spot welding does not solve the problem of permanently joining two dissimilar materials together, as, for example, sheet metal and aluminum.

In view of the foregoing, it is an important object of this invention to provide a method and means for permanently joining two sheet members together, regardless of the material from which they are made.

It is another object of the present invention to provide a method of permanently joining two sheet material members together by a mechanical connection or clinching structure.

It is still another object of the present invention to provide a crimping tool for fastening at least two sheets of material together which includes a frame member, die means having a workpiece supporting station for supporting at least two overlapping sheets of material thereon, a first punch tool mounted in said die means and being normally biased against the lowermost sheet of material mounted on said die means, and being movable a predetermined distance away from the lowermost sheet of material during a crimping operation, a second punch tool movably mounted on said frame member for engagement with the uppermost sheet of material mounted on said die means, and power means mounted on said frame member and being operatively connected to said second punch tool for moving the second punch tool against said sheets of material on the die means and to punch a portion from the uppermost sheet of material into the lowermost sheet of material for crimping the two sheets of material together.

Other features and advantages of this invention will be apparent from the following detailed description, appended claims, and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view of a crimping tool made in accordance with the principles of the present invention.

FIG. 2 is a longitudinal, elevational view, partly in section, with parts broken away, of the crimping tool structure illustrated in FIG. 1, taken along the line 2—2 thereof, and looking in the direction of the arrows.

FIG. 3 is an enlarged, horizontal section view of the crimping tool structure illustrated in FIG. 1, taken along the line 3—3 thereof, and looking in the direction of the arrows.

FIG. 4 is a fragmentary, horizontal view of the crimping tool structure illustrated in FIG. 2, taken along the line 4—4 thereof, and looking in the direction of the arrows.

FIG. 5 is an elevational view of the structure illustrated in FIG. 4, taken along the line 5—5 thereof, and looking in the direction of the arrows.

FIG. 6 is a fragmentary, elevational, section view of the crimping tool of the present invention, and showing

the lower end of the structure shown in FIG. 2 in an enlarged condition, and with parts broken away.

FIG. 7 is a horizontal view of the structure illustrated in FIG. 6, taken along the line 7—7 thereof, and showing two pieces of sheet metal crimped together by the crimping tool of the present invention and in accordance with the method of the present invention.

FIG. 8 is a view of the joined metal members of FIG. 7, taken along the line 8—8 thereof, and with the two sheet metal members turned 90° to a position perpendicular to the plane of the drawing.

FIG. 9 is a section view of the two joined metal members of FIG. 7, taken along the line 9—9 thereof, and with the two sheet metal members turned 90° to a position perpendicular to the plane of the drawing.

FIG. 10 is a bottom end view of the round crimping punch employed in the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and in particular to FIGS. 1 and 2, the numeral 10 generally designates a crimping tool frame. As best seen in FIG. 2, the crimping tool frame includes a plate-like portion, on the front end of which is integrally formed a U-shaped portion 12 which is narrower than the portion 11, as shown in FIG. 1. Integrally attached to the U-shaped portion 12 is a base portion 13. The plate-like frame portion 11 is provided with an opening 14.

As shown in FIGS. 1 and 2, a suitable fluid cylinder, generally indicated by the numeral 15, is fixedly mounted on the frame portion 11. The fluid cylinder 15 may be of any suitable type, as for example, a pneumatic cylinder. The fluid cylinder 15 includes a cylinder or body 16 which is enclosed by the usual end closure members 20. A pair of attachment arms 17 are integrally attached to each of the end closure members 20, as by welding. A machine screw 18 is mounted through a suitable hole in each of the attachment arms 17 and is threadably engaged in a bore 19 in the frame portion 11, for securing the fluid cylinder 15 to the frame portiton 11. The cylinder end closure members 21 are fixedly secured on the cylinder 15 in the usual manner, as by a plurality of tie rods 21 and lock nuts 21A.

As best seen in FIG. 2, the fluid cylinder 15 is provided with the usual cylinder rod 22 which has its outer end threadably mounted in a suitable threaded bore in a punch head or punch carrier 23. The cylinder rod 22 is locked to the punch head 23 by a suitable lock nut 24. The punch head 23 is further secured to the outer threaded end of the cylinder rod 22 by a metal locking member 28 which is mounted in the inner end of a threaded bore 26 in the punch head 23, and against the threaded end of the cylinder rod 22. A locking screw 25 is threadably mounted into the bore 26 for forcing the locking member 28 against the threaded end of the cylinder rod 22.

As shown in FIGS. 2 and 3, the punch head 23 is slidably mounted on the front surface 27 of the frame portion 11 for sliding movement between the solid line crimping position shown in FIG. 2 and the raised inoperative broken line position designated by the numeral 23a in FIG. 2.

As shown in FIG. 3, the punch head 23 is slidably mounted between two retaianer members 29, each of which is provided with an inwardly extended shoulder 36 that extends over a mating flange 37 along the adjacent side of the punch head 23, for sliding engagement

thereof. Each of the retainer members 29 is fixed to the frame portion 11 by a pair of machine screws 30 and a pair of dowel pins 31. Each of the machine screws 30 extends down through a suitable bore 32, through the respective retainer member 29 and into threaded engagement with a threaded bore 33 in the frame portion 11. The dowel pins 31 are each operatively mounted in a dowel hole 29 in the retainer members 29 and in an aligned dowel hole 35 formed in the frame portion 11.

As shown in FIGS. 1 and 2, a U-shaped retainer plate 42 is seated in a transverse slot 43 adjacent the cylinder rod end of the fluid cylinder 15. The front attachment arms 17 abut the U-shaped retainer plate 42. The U-shaped retainer plate 42 is held between the front attachment arms 17 and an abutment plate 38. The abutment plate 38 is secured to the frame portion 11 by a pair of machine screws 39 which are mounted in a pair of bores 40 in the frame portion 11 and which are threadably engaged in a pair of threaded bores 41 in the abutment plate 38.

As shown in FIGS. 2 and 6, a backing plate 44 is carried on the lower face of the punch head 23. A retainer plate 45 is mounted on the lower face of the backing plate 44. The backing plate 44 and the retainer plate 45 are secured as a unit to the lower face of the punch head 23 by a pair of machine screws 46 and a pair of dowel pins 47. As shown in FIGS. 2 and 6, the retainer plate 45 carries an elongated cylindrical punch tool 49 which is slidably mounted through a bore 48 formed through the retainer plate 45. The punch tool 49 is provided with a head 52 that is seated in an annular recess 53 formed in the upper face of the retainer plate 45. The punch tool 49 is disposed on an axis which is parallel to the axis of the cylinder rod 22, but which is offset in a direction outwardly from the front face 27 of the frame portion 11. The punch tool 49 is slidably mounted through a bore 51 formed axially through a cylindrical member 50 which is made from a suitable resilient material as, for example, a block of urethane. The resilient member 50 is secured to the outer face of the retainer plate 45 by any suitable means, as by a suitable adhesive.

The numeral 54 in FIGS. 4 and 6 generally designates the die means employed in the invention. The die means 54 is seated in a recess 55 that is formed on the upper side of the frame portion 13. A retainer plate 57 is seated in the recess 55 and abuts the inner end wall 56 of the recess 55. As shown in FIG. 4, the retainer plate 57 is fixed in place by a plurality of suitable machine screws 58 and dowel pins 59. As shown in FIGS. 4 and 6, the retainer plate 57 is provided with an integral, upward extension 62 which is aligned with the resilient member 50 and which is provided with a half round bore 63.

As best seen in FIGS. 4 and 6, the retainer plate 57 is provided with an annular recess 64 in the lower face thereof for the reception of the head 80 of a cylindrical die tool indicated by the numeral 78. The die tool 78 is provided with a cylindrical body portion 79 which extends upwardly through a bore 76 in the retainer plate 57 and into sliding engagement with the half round bore 63. A movable retainer plate 67 is slidably mounted on the upper surface 66 of the retainer plate 57 and is provided on the front end thereof with a half round bore 68 which is disposed in a complementary posititon with the half round bore 63 to form a complete bore for slidable engagement with the tool body 79.

As shown in FIGS. 4 and 5, the movable retainer plate 67 is provided with a shoulder 70 along each side thereof. The retainer plate 67 is secured in a slidable condition on the retainer plate 57 by a pair of retainer bars 71 and each has an inwaradly extended flange 69 that slidably engages one of the shoulders 70 on the retainer plate 67. The retainer bars 71 are secured in place on the retainer plate 57 by a plurality of suitable machine screws 72 and dowel pins 73. The machine screws 72 are threadably mounted in threaded bores 74 on the retainer plate 57. The dowel pins 73 extend through the retainer bars 71 and into operative engagement in dowel holes 75 in the retainer plate 57.

As best seen in FIG. 6, the annular recess 64 in the retainer plate 57 has a depth larger than the thickness of the head 80 on the punch tool 78 to permit axial movement of the punch tool 78. As shown in FIG. 6, the punch tool 78 is in the depressed position which it attains when the punch tool 49 has reached the end of its punching travel or has bottomed out. The punch tool 78 is normally biased upwardly into an inoperative position before the punching operation by the following described means.

As shown in FIG. 6, the punch tool spring means includes a cylindrical, tubular member 81 which functions as a spring carrier and which is threadably mounted in a bore 82 which is formed in the frame portion 13. The bore 82 is axially aligned with the punch tools 49 and 78. As viewed in FIG. 6, the lower end of the spring carrier 81 is closed, and a coil spring 77 is operatively mounted in the carrier 81, through the open upper end thereof. The spring 77 normally biases upwardly an inverted T-shaped pressure finger or pin 83 which is slidably mounted through a bore 84 so as to engage the lower end of the punch tool head 80 for maintaining a normal, upward spring bias on the punch tool 78.

As shown in FIGS. 2 and 4, the movable retainer plate 67 is held in place against the retainer plate portion 62 by a resilient cushion member 85 which is shown as being rectangular and as being made from a block of urethane. The cushion member 85 is in turn held in position by a retainer block 86 that is secured to the retainer plate 57 by a pair of suitable machine screws 87 (FIG. 4). A guide dowel pin 89 has one end fixedly mounted, as by a press fit, in a bore 90 in the retainer block 86, in a position perpendicular to the axis of the punch tools 49 and 78. The dowel pin 89 extends into an axial bore 87 formed through the cushion member 85. As described more fully hereinafter, the movable retainer plate 67 is movable to the right, as viewed in FIG. 2, during a crimping operation. The cushion member 85 resists such movement of the retainer plate 67 and the dowel pin 89 also functions as a positiive stop to limit the movement of the retainer plate 67.

As shown in FIG. 10, the lower end 91 of the punch tool 49 is provided with a pair of oppositely disposed notches 92. The numerals 94 and 95 in FIG. 6 designate two pieces of similar or dissimilar sheets of metal that are being joined by the crimping structure shown in FIG. 6, and in accordance with the method of the present invention. As shown in FIG. 3, the upper ends of the retainer extension 62 and the retainer plate 63 are provided with notches or washed out portions 93

that complement the notches **92** on the lower end of the punch tool **49** to permit the metal from the two sheets of metal **94** and **95** to flow outwardly from under the punch tool **49** during a crimping operation. The notches **92** on the lower end of the punch tool **49,** and the cut-out portions **93** of the retainer plate portion **62** and the retainer plate **67** are concave, as viewed in FIGS. **10** and **4** respectively.

The crimping tool of the present invention is adapted to crimp or mechanically join two of the same or of different types of metal into one united part, and it provides the same results as spot welding. The crimping tool of the present invention may be used for joining permanently a sheet of steel metal with a sheet of aluminum.

In use, the fluid cylinder **15** is operated by fluid under pressure admitted through port **100** to move the punch tool **49** upwardly, into a position where the punch carrier **23** is moved to the raised position **23***a* in FIG. **2.** A pair of sheet metal members as **94** and **95** would then be disposed on top of the retainer plate members **62** and **67** in an overlapping condition, as shown in FIG. **6.** The fluid cylinder **15** is then operated by fluid under pressure admitted through port **101** so as to move the punch tool **49** downwardly into engagement with the upper metal sheet **94.** The punch **94** continues to move downwardly until it is in the position shown in FIG. **6,** wherein the lower punch tool member **78** has been moved downwardly to the position shown in FIG. **6,** so as to bottom out the complete die portion of the crimping tool. When the punch tool **49** moves into the engagement with the sheet metal members **94** and **95,** the resilient member **50** functions as a holding member, since it will abut the sheet metal members **94** and **95** in its free state before it is compressed to the position shown in FIG. **6.** The punch tool **49** punches a metal portion **96** from the sheet metal member **95** downwardly against the lower tool **78,** and a metal portion **97** from the sheet metal member **94** downwardly on top of the metal portion **96.** The punch tool **49** does not punch out the sheet metal portions **96** and **97** from their respective sheet metal members, but moves them downwardly to a position where they are crimped together, and yet still connected to their respective sheet metal members. When the punch tool **49** bottoms out, the metal within the notches **92** on the punch tool **49** and the washed-out portions **93** on the retainer plate members **62** and **67** will flow sidewardly from under the punch tool **49** to form the locking tabs **99.** Simultaneously, there is a slight movement of the retainer plate **67** against the resilient block **85** to compress the same, and to permit sideward expansion of the metal forming the locking tabs **99.** There is also a slight expansion of the pressed-out metal portions **96** and **97** in the opposite or perpendicular direction, so as to form slightly curved projections or tabs **98.**

Experience has shown that the method of the present invention is an exonomical and efficient method for fastening together similar or dissimilar metal sheets. There are no mechanical leverages employed in the crimping tool structure of the present invention, and it is light in weight, and it can be used as a portable unit for use in a small, confined area. The crimping tool of the present invention is easy to handle, and the fastening operation is accomplished in one stroke, and without any requirement for separate fastening materials. The mechanical fastening method of the present invention is also carried out without distorting the two sheets of metal which are being joined.

It will be seen that the method of the present invention comprises the fastening together of two sheets of metal by punching a portion from one metal sheet into a second metal sheet and simultaneously punching out a portion of the second metal sheet, and spreading at least two connecting tabs of metal sidewardly during the punching operation to provide a mechanical bond or crimping of the metal to one sheet member to the other sheet member.

The depth of the notches **92** at the other ends thereof adjacent the periphery of the punch tool **49** should be approximately equal to the thickness of the thicker of the two sheets of material to be joined. The depth of the relieved or washed-out areas **93** of the retainer plates **62** and **67** should also be equal at their inner ends, adjacent the half-bores **63** and **68,** to the thickness of the thicker of the two sheets of material to be joined. The depth of the notches **92** are greatest at the periphery of the punch tool **49** and taper concave inwardly toward the end **91** of the punch tool **49.** The washed-out areas **93** have their greatest depth adjacent the half bores **63** and **68** and taper outwardly and upwardly to the upper surfaces of the retainer members **62** and **67.**

It will be understood that the cross-sectional shape of the punch tools **49** and **78** are not limited to a circular shape but could be square, rectangular and so forth, with the notches **92** being provided on two opposite sides of any such punch tool **49.** It will also be understood that the crimping tool of the present invention could be employed for fastening together a plurality of sheet members as, for example, three or four and so forth.

While it will be apparent that the preferred embodiment of the invention herein disclosed is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change.

What is claimed is:

1. A crimping tool for fastening at least two sheets of material together, comprising:

a. a frame member:

b. die means mounted on said frame member and having a workpiece supporting station for supporting at least two overlapping sheets of material thereon including a fixed retainer plate and a movable retainer plate;

c. a first cylindrical punch tool mounted in said die means and having an operative flat end normally biased against the lowermost sheet of material mounted on said die means, and being movable a predetermined distance away from the lowermost sheet of material during a crimping operation;

d. a second cylindrical punch tool movably mounted on said frame member for engagement with the uppermost sheet of material mounted on said die means;

e. power means mounted on said frame member and being connected to said second punch tool for moving the operative end of said second punch tool against said sheets of material on the die means and to punch a portion from the uppermost sheet of material into the lowermost sheet of material for crimping the two sheets of material together;

f. the operative end of said second punch tool being flat and provided with a pair of diametrically disposed notches to form a locking tab between the uppermost sheet of material and the portion punched from said uppermost sheet of material;

g. said first punch tool being movable in conjunction with the second punch tool away from the lowermost sheet of material a distance substantially equal to the thickness of the lowermost sheet of material to allow a portion of the lowermost sheet of material to be punched therefrom when the portion of the uppermost sheet of material is punched into the lowermost sheet of material;

h. the die means being provided with a pair of diametrically disposed relieved areas which are aligned with the notches on the second punch tool and which are operative to form a locking tab between the lowermost sheet of material and the portion punched therefrom;

i. said first punch tool being normally biased against the lowermost sheet of material by a spring means; and,

j. the movable retainer plate of said die means being movable perpendicularly to the line of punching force during a punching operation to permit the portion of the material being punched out from the two sheets of material to flow laterally outward.

2. A crimping tool as defined in claim **1,** wherein:

a. said pair of diametrically disposed relieved areas on the die means are each formed partially on said fixed retainer plate and partially on said movable retainer plate.

3. A crimping tool as defined in claim **2,** wherein:

a. said fixed retainer plate is substantially L-shaped with one leg of said L-shape being secured to said frame member and having said first cylindrical punch tool slidably mounted through a bore formed through said one leg of said L-shape, and the other leg of said L-shape being disposed longitudinal of said first cylindrical punch tool, and provided with a longitudinally extended half-round bore through which said first cylindrical punch tool is slidably mounted; and,

b. said movable retainer plate is movably mounted on said one leg of said fixed retainer plate for movement perpendicular to the longitudinal axis of the first cylindrical punch tool, and being provided with a half-round bore on the end thereof adjacent said fixed retainer plate through which said first cylindrical punch tool is slidably mounted.

4. A crimping tool as defined in claim **3,** including:

a. a stop block fixed on said one leg of said fixed retainer block; and,

b. a resilient cushion member mounted between said movable retainer plate and said retainer block for normally biasing said movable retainer plate against the said fixed retainer plate, and to allow said movable retainer plate to be moved perpendicularly away from the fixed retainer plate during a punching operation.

5. A crimping tool as defined in claim **4,** including:

a. a resilient holding member operatively mounted about said second cylindrical punch tool for engagement with the sheets of material to be crimped for holding the same in place during a punching operation.

* * * * *