

Feb. 23, 1960

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2,925,654

WORK PREPARATION CUTTER ATTACHMENT FOR A BUTT WELD TOOL

Filed Nov. 12, 1957

3 Sheets-Sheet 1

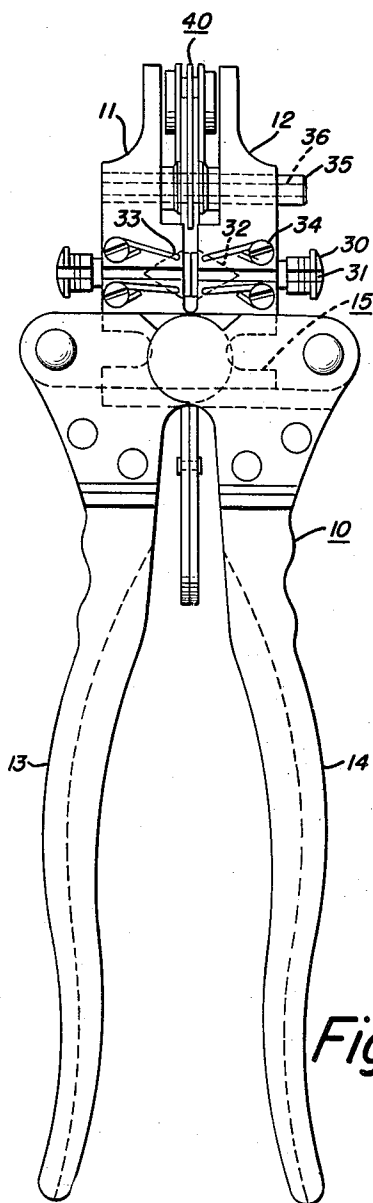


Fig. 1

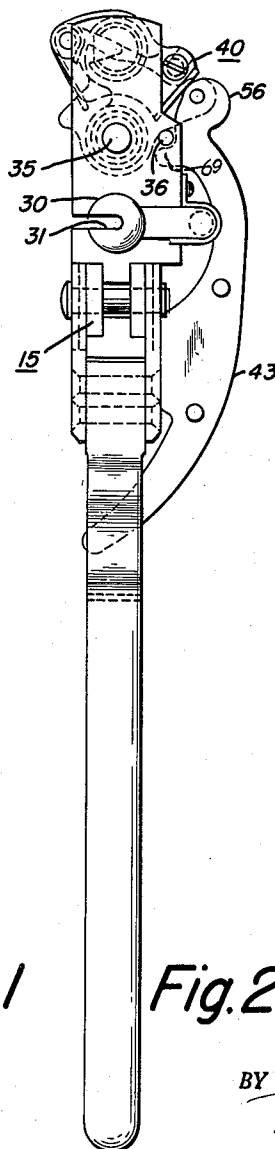


Fig. 2

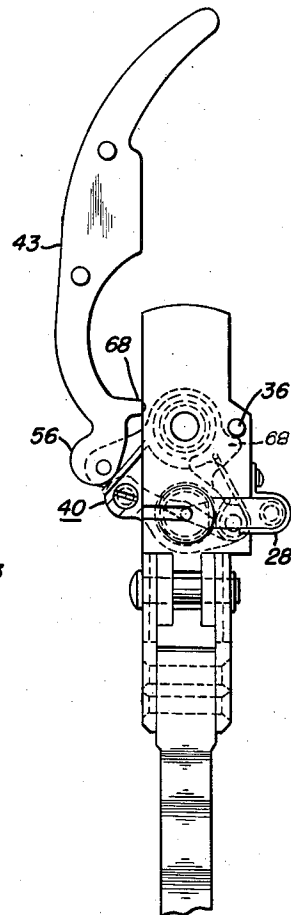


Fig. 3

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3 Sheets-Sheet 2

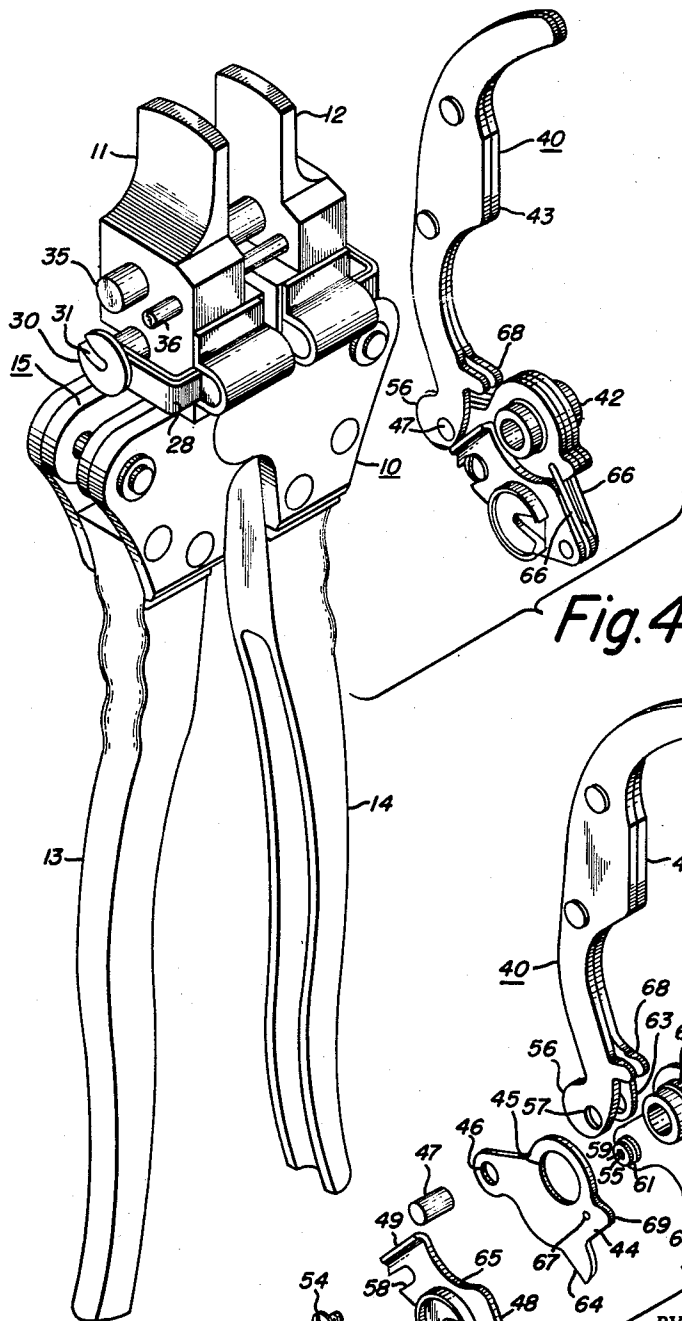


Fig. 4

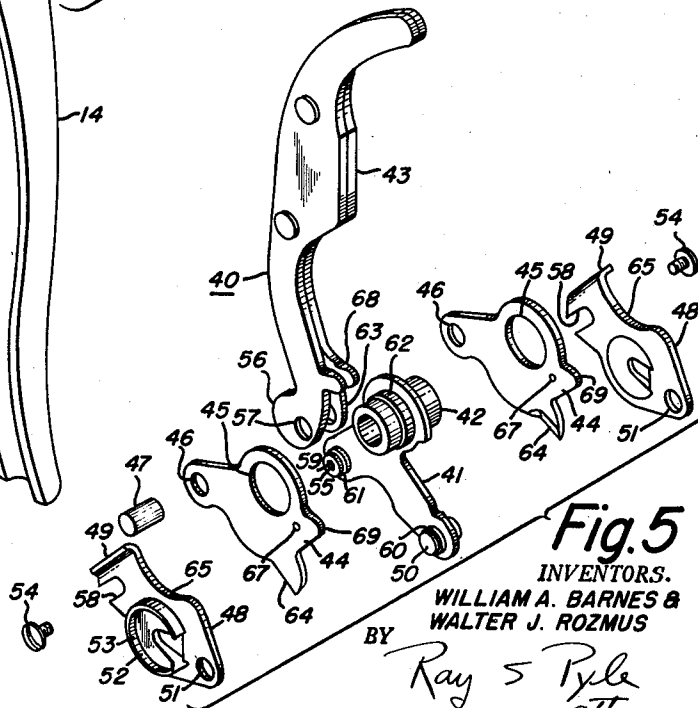


Fig. 5

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3 Sheets-Sheet 3

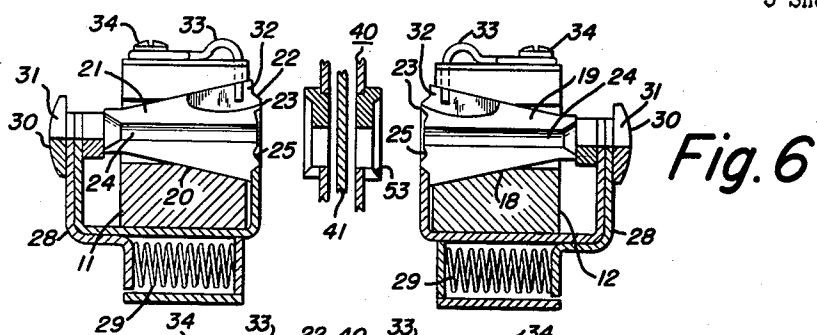


Fig. 6

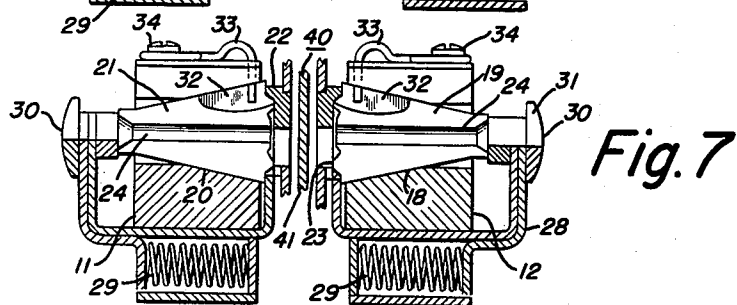


Fig. 7

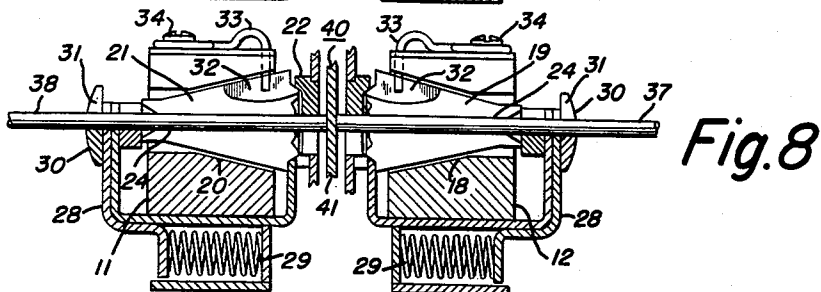


Fig. 8

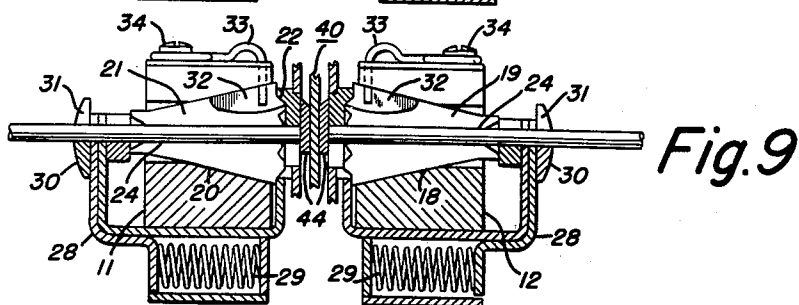


Fig. 9

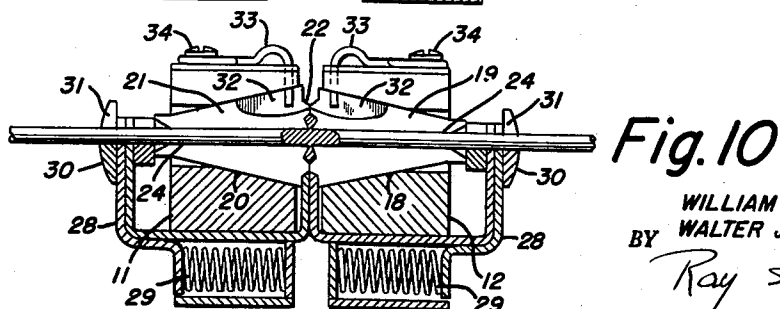


Fig. 10

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WORK PREPARATION CUTTER ATTACHMENT
FOR A BUTT WELD TOOL

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Application November 12, 1957, Serial No. 695,986

4 Claims. (Cl. 30—124)

This invention relates in general to preparation of metal members for uniting by controlled conditions of pressure and confinement of flow to produce a solid phase bond at a temperature less than the normal welding temperature thereof, and relates more specifically to a cutting tool for the performance of such preparation.

This application is a continuation-in-part of William A. Barnes et al., United States application Serial No. 408,078, filed February 4, 1954, which application has been abandoned in favor of this application.

The union of two metallic members by the use of controlled cold flow of the metal structures is relatively recent accomplishment insofar as reducing the basic principles to a practical and usable procedure is concerned. It has long been known that metal can flow at room temperature under proper conditions of loading. It is possible that the uniting, or welding, of two metal objects by controlled application of high pressure at room temperature has been known. However, the reduction of this knowledge to a practical level has only been recently accomplished. United States Patent No. 2,522,408 was granted to Sowter for his development in pressure welding.

Some metals will actually diffuse in such manner that a polished section of the union will not reveal a distinct junction between the two original members. Other metals have a distinct line dividing the original members. It has not definitely been determined what the nature of the union is in this line. It is definitely established, however, that an exceptionally strong union is produced between the two original members whether or not there is an actual diffusion. It is not the concern of the present invention whether the union is achieved by actual diffusion or some other phenomena of metal union, but rather with the means to obtain a desired result. Accordingly, in this specification and in the claims, reference will be made to a union between members caused by controlling cold flow of the metal structures, or to a pressure weld. It is not intended that this invention should be limited by the choice of words to describe the junction between the members.

The formation of a pressure weld at temperatures less than normal temperatures requires careful preparation of the surfaces to be welded. The surfaces to be welded must be clean and are preferably carefully formed to assure parallelism as the welding process is commenced, and thereby assure uniform pressure across the entire area to be welded. Additionally, the amount of material presented to a welding region defined by first and second pairs of welding dies is relatively critical.

Therefore, one of the principal objects of this invention is to provide a workpiece conditioning and preparation cutter for trimming workpieces to be butt welded to a predetermined length of projection with respect to the gripping and forming dies of the tool.

Yet another object of this invention is to locate a workpiece conditioning and preparation cutting tool with

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respect to the workpiece by seating the tool on the die holding the workpiece, and thereby provide a mechanism which readily and accurately may assure the pressure of an appropriate amount of material to be welded after a condition and preparation cut has been made.

Another object of this invention is to provide a shear-type workpiece conditioning and preparation cutter having opposed changeable die engaging seats to seat upon the face surfaces of opposed butt weld workpiece holding dies for alignment of the conditioning device and workpieces with respect to the dies both with respect to axial alignment and distance from the face of the dies.

Other objects and a fuller understanding of the invention may be had by referring to the following specification and claims, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a front elevational view of a tool for butt welding workpieces by confined flow of the metal under high pressure, and a workpiece conditioning and preparation cutter to service the workpieces prior to being united;

Figure 2 is a side elevational view of the tool and the preparation cutter showing the cutter in an active or storage position;

Figure 3 is a view similar to Figure 2 with the conditioning of and preparation cutter pivoted to a cutting or service position between the dies;

Figure 4 is a perspective partially exploded view of a welding tool with the conditioning and preparation cutter shown separate therefrom to better illustrate the details of construction of the cutter;

Figure 5 is an exploded view of the conditioning and preparation cutter;

Figure 6 is the first in a series of operational illustrations of the cone dies of the butt weld tool and the portion of the conditioning and preparation cutter which locates the cutter and dies with respect to one another, the parts being in the initial position prior to locating and loading with workpieces;

Figure 7 illustrates the closing of the dies upon the conditioning and preparation cutter to cause relative alignment thereof prior to loading with workpieces;

Figure 8 illustrates the slight backing-off motion to relieve the dies for loading, but maintaining interconnection of the parts;

Figure 9 illustrates the loaded dies and the conditioning and preparation cutter fully engaged, with the cutting members of the device just past the workpiece cutoff position; and,

Figure 1 illustrates the final position of the dies, after the conditioning and preparation tool has been removed and a union of the workpieces has been produced.

The invention applies generally to the preparation of workpieces for their union by pressing them longitudinally together in what is termed a butt weld, as distinguished from the union of pieces in side-by-side or crossed relationship such as joining roofing sheets or grill work. Butt welding includes a wide variety of work, including the end to end joining of wires or rods, the joining of wires to terminals, and similar operations. The illustrated tool 10 is adapted primarily for the joining of wires, and can readily be adapted for other common butt weld operations.

The tool 10, in the environmental and illustrated embodiment, consists generally of two carriages 11 and 12 driven toward and away from one another through a fixed work cycle path by means of handles 13 and 14 operating through a linkage 15. The linkage 15 may be any suitable toggle linkage mechanism adapted to provide little movement but extremely high pressure at the end of the work cycle stroke, thus producing the required extreme pressure necessary for the cold butt welding of

workpieces. The tool 10 is similar in most respects to copending application Serial No. 348,069, filed April 10, 1953, and entitled Cold Weld Butt Tool.

The illustrated tool 10 is used for the butt welding of two longitudinal wires of corresponding size in end to end relationship, and accordingly the dies and cooperating apparatus in each of the carriages 11 and 12 are substantially identical. As better illustrated in Figures 6 through 10, the carriage 11 is provided with conical cavity 20 and the carriage 12 with cavity 18. A conical split die 19 resides within the cavity 18 and split die 21 in the cavity 20.

The split dies are adapted to be wedged into the cavities and to thereby grip a workpiece by contraction of the die sections. Considered as a unit, the dies are each provided with a face projection 23 defined by tapered guide surfaces 22. A recess 25 similar in many respects to the "flash gutter" of a drop forge die, is provided in the face of each die. A workpiece holding cavity 24 opens centrally of recess 25 and extends longitudinally along the axis of the die, a portion of the holding cavity 24 being formed in each of the sections of the split die. The cavity 24 is made slightly smaller than the workpiece to be held by the die, and, consequently, wedging of the conically formed dies into the conically formed cavities will cause the dies to grip down upon the workpiece and hold the workpiece with a grip which becomes tighter as the pressure is increased. However, the taper of the dies and the cavities is above that which will form a wedging action to lock the dies in the cavities and resist release of the workpiece.

Workpieces may be inserted into the dies from the rear once the dies are loosened from the cavities, but the flash which is formed in making the weld, and quite often the length of the workpieces, prevents removal along the same route. Therefore, the dies are split to permit the dies to part and the workpiece to be removed laterally.

The split dies are provided with cam surfaces 32 on each section extending at an angle to the horizontal axis of the dies, as best illustrated in Figure 1 of the drawings. Cams 33, shown in the preferred embodiment as wire fingers, are held on the surface of the carriages by means of screws 34 and extend down between the split dies to contact the cam surfaces 32. When the split dies are retracted within the cavities and thereby closed upon a workpiece, the cams 33 contact the cam surfaces 32 near the front of the dies at the widest portion of the cam track defined by surfaces 32. Therefore, any movement of either of the split dies which is forward relative to the associated carriage will cause the sections of the split dies to be forced apart by coaction of the cam surfaces 32 and the cam 33.

In order to actuate the dies for removal of workpieces and to facilitate the insertion of workpieces into the dies, actuation devices 28 are provided to contact both the front and back end of the dies. Each actuation device 28 has a spring 29 to urge the actuation device to a holding position wherein the die is snug in its cavity, as illustrated in Figure 6. A convenient finger button 30 is adapted to receive pressure from the hand of the operator and force the device 28 forward. As actuation device 28 moves forward, the die associated therewith is moved out of the cavity, as illustrated in Figure 8, to release the grip upon a workpiece. A notch 31 in button 30 aids in guiding a workpiece for insertion into the holding cavity 24.

Thus, as the actuation device 28 is moved in a forward direction by pressure upon the button 30, the dies are moved to a parted position, which opens the workpiece holding cavity 24 for easy insertion of workpieces, and to permit the removal of workpieces in a lateral direction from the tool after they have been united by the tool.

The improvement of this invention is largely incorporated in the construction and operation of a condition-

ing and preparation cutter 40, and the cooperation of this cutter 40 with the split dies 19 and 21.

A guide pin 35 extends between the carriages 11 and 12 and aids in holding the carriages perfectly aligned in their relative movements regardless of the load placed on the carriages by lateral forces in producing the butt weld. The conditioning and preparation cutter 40 employs the guide pin 35 as a convenient pivot upon which it is mounted. The conditioning and preparation cutter 40 is illustrated in its assembled form in Figure 4 of the drawings, but may be better understood by referring to Figure 5. The device 40 is illustrated in its form adapted to simultaneously prepare the workpieces in both of the split dies 19 and 21 of the tool 10. Since dies 19 and 21, in the illustrated embodiment are substantially identical, the device 40 is substantially identical on both sides. The basic concept of location of the workpiece preparation cutter with respect to the die, and proper spacing of the conditioning action from the face of each of the dies, is fully incorporated in the cutter 40.

With reference to Figure 5, the cutter 40 employs a center plate or stop member 41 with a bearing 42. Bearing 42 is mounted upon the guide pin 35 and therefore provides a convenient mounting for the entire device 40 with respect to the tool 10. In Figures 1 and 2 of the drawings the device 40 is illustrated as being pivoted around the pin 35 to a storage position. In Figure 3 it is illustrated in the operative position.

First and second shear blades 44 and first and second shear anvils are provided. Conditioning and preparation of the end of one of the workpieces is brought about by the combination of one of the shear blades 44 and the associated shear anvil 48. Each blade 44 has a hole 45 which fits over the external surface of bearing 42. Accordingly, each blade 44 is pivotable about the bearing 42.

Each shear anvil 48 is mounted on the side of the associated blade 44 opposite from the center plate 41. The shear anvils 48 are fixed with respect to the plate 41. Since the shears 44 are identical and since the shear anvils 48 are identical, the remainder of the description will, for convenience, be written as if there were only one of each. An anchor pin 50 and an anchor threaded pin 55 are provided to lock the shear anvil 48 in the proper spaced working position with respect to plate 41. A hole 51 in anvil 48 fits snugly upon the anchor pin 50, and a slot 58 of the anvil 48 fits over the external surface of threaded pin 55. Pin 55 has an internal threaded bore 59. An anchor screw 54 is adapted to threadably engage the bore 59 and hold the anvil 48 in the desired fixed relationship with respect to the plate 41. The pin 50 has a spacer shoulder 60, and the pin 55 has a spacer shoulder 61 adapted to hold the anvil 48 a distance from the surface of plate 41. The external surface of bearing 42 has a shoulder 62 to hold the shear blade 44 at a predetermined spaced relationship with respect to the surface of plate 41. Therefore, since the blade 44 and anvil 48 are both held at fixed distances with respect to the plate 41, they are held at a preselected relationship with respect to one another.

The shear blade or cutter member 44 is driven through a limited pivotal movement with respect to anvil 48 and plate 41 by means of a drive lever 43. Drive lever 43 is illustrated as having a yoke end 63 with aligned holes 57. The blade 44 has a drive end with a hole 46 therein. The drive ends of both blades 44, in the illustrated double construction, fit snugly into the yoke end 63 of the drive lever 43. A pin 47 extends through holes 46 and 57 to complete the pivotal joint.

The yoke end 63 is formed to provide a cam 56. The shear anvil 48 has a portion 49 adapted to present a pressure plate upon which the cam 56 can ride. The holes 57 in the yoke end 63 are eccentric with respect to the outer surface of cam 56, and accordingly by rotating the handle 43 from the position illustrated in Figure 4,

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around the pin 47, the blades 44 are caused to pivot about the bearing 42 and move the shear edges 64 thereof through a cutting movement with respect to the shear anvils 48.

The shear anvil 48 is constructed of a plate 65 and a cutter and guide insert 52. The insert 52 is provided with tapered guide surfaces 53 adapted to cooperate with the similar surfaces 22 on the face of the split dies. The insert 52 may be sweated or peened into the plate 65, or otherwise suitably mounted.

One of the desirable features of this invention is the exchangeable nature of the shear anvil 48. Because various size workpieces will require various sizes of split dies, it has been found to be desirable to provide the surfaces 22 in various sizes according to the nature of the work being done by the particular split dies. According to this invention, the conditioning and preparation cutter 40 may be quickly adapted to any die held by the tool 10 simply by loosening the screw 54 and removing the anvil 48 from the pin 50. Thereafter the proper size shear anvil 48 suitable for a particular die may be attached to the cutter 40 in place of the one removed. Thus, the cutter 40 can be made suitable for a particular set of dies in a moment's time, rather than attempting to make a universal device which does not give desired performance on any size, and at best would be an unsuitable compromise.

In order to facilitate the return of the shear parts to their starting position, springs 66 are mounted over the anchor pins 50 and engaged into holes 67 in the blades 44. Springs 66 are illustrated in Figure 4 but are omitted from Figure 5.

The shear blade 44 is illustrated as a simple shear having a shear edge 64, but compound blades for double action, or for galling, may be provided as set forth in application Serial No. 364,153 filed June 25, 1953, now United States Patent No. 2,779,954, issued February 5, 1957, and entitled Double Action Trimmer and Surface Preparation Tool for Solid Phase Bonding.

As a convenience for holding the cutter 40 in an inoperative position, and for aiding in the preliminary alignment of the taper guide surfaces 53 with the taper surface guide 22, a reaction guide pin 36 extends between the carriages 11 and 12 in the same manner as the main guide pin 35, but at a lateral distance therefrom, and preferably considerably smaller. The handle 43 is provided with ears 68 which cooperate with the edge surfaces of the plate 41, as best illustrated in Figure 2, to encompass the pin 36 and steady the cutter 40 in the inoperative storage position illustrated in Figure 2. The blades 44 are provided with stop portions 69 adapted to contact the pin 36 (see Figure 3), as the cutter 40 is pivoted from the storage position illustrated in Figure 2 to the active position as illustrated in Figure 3. With the stop portions 69 contacting the pin 36, the cutters and guide inserts 52 are brought to approximately the correct position of alignment between the split dies 19 and 21. The tapered nature of the guide surfaces 22 on the split dies, and the tapered guide surfaces 53 on the guide inserts 52 will then be close enough in alignment to mesh and guide the cutter 40 into perfect alignment wherein the cutting surfaces of the shear anvil 48 and the shear blade 44 contact at a position in axial alignment with the workpiece holding cavity 24 of the split dies. Thus, all tendency to twist the end of workpieces is eliminated. Even the very slightest amount of twist on the end of workpieces to be united by this method will prevent the proper union of the parts, or substantially reduce the quality of the union.

Reference to Figures 6 through 10 will better illustrate the operation of this embodiment of the invention.

In Figure 6 the carriages and dies are illustrated in the open position with the cutter 40 rotated about the guide pin 35 to a position substantially equivalent to that illustrated in Figure 3 of the drawings. Here it

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will be seen that the guide surfaces 53 are in substantial alignment with the guide surfaces 22 of the taper dies.

The first step in the operation of the tool 10 is to close the carriages 11 and 12 upon the cutter 40 by actuating the handles 13 and 14. As illustrated in Figure 7, the split dies and the cutter 40 are brought into perfect alignment by engaging the surfaces 22 and 53.

After having been brought into engagement as illustrated in Figure 7, the carriages 11 and 12 are backed off a very slight amount, but not sufficient to disengage surfaces 22 and 53. This condition is illustrated in Figure 8. The slight amount of back off, however, will permit the split dies to be moved forward with respect to the particular cavities 18 and 20, and open slightly by the coaction of the cams 33 and the cam surfaces 32. The workpiece holding cavities 24 are opened a sufficient amount to receive workpiece wires 37 and 38. Because of the slight amount which the split dies are opened in Figure 8, the wires 37 and 38 are inserted through the backs of the split dies through the notches 31 in buttons 30. It is at this particular stage of operation that the center plate 41 of the cutter 40 becomes important. The plate 41 prevents the insertion of the wires 37 and 38 to such an extent that overlapping to these wires could take place and foul the cutting action of the opposite blade and anvil.

After the wires 37 and 38 are inserted into the split die as illustrated in Figure 8, the handles are again actuated to close the carriages and drive the face projections 23 of the dies into the guide inserts 52. This action not only realigns the cutter 40 with respect to the longitudinal axis of the split dies, but also drives the split dies into their respective holding cavities and causes the dies to close upon the workpieces in a holding and gripping action. A snug pressure is maintained upon the carriages in order to hold the workpieces snugly in the dies while the cutter 40 is actuated to prepare the ends of the workpieces. It is important that the ends of the workpieces not only be cut and prepared without bending the ends thereof, but the amount of projection of the workpieces from the die face to obtain correct interflow of metal to form a weld is very critical. A recent experience has shown that a change of .002 inch in the thickness of the shearing anvil, and hence a similar change in projection on an .064 inch diameter wire was the controlling factor between failure and success of welding. Therefore, the importance of the location of the preparation cutter upon the surfaces of the holding and forming dies becomes apparent.

The prior practice of locating the workpiece with respect to a third object, and then locating the preparation cutter with respect to the third object, with the possibility of accumulative errors causing improper positioning of the preparation cutter with respect to the workpiece is eliminated by this invention. With this invention, the cutter 40 is positioned directly upon the die and accordingly there can be no appreciable error in the location of the cutting and preparation surfaces.

With the pressure maintained by the handles 13 and 14 to cause the surfaces 22 and 53 to be tightly in mesh, and the split dies holding the workpieces in a firm grip, the drive lever 43 is actuated to move the cam surface 56 along the pressure plate surface 49 and thereby pivot the blade 44 with respect to the shear anvil 48 and pass the shear edge 64 over the workpiece.

After the workpieces have been sheared and otherwise prepared by the cutter 40, the handles 13 and 14 are opened and the cutter 40 is again pivoted to its storage position as illustrated in Figure 2. There is no force tending to move the dies out of their respective cavities, and, accordingly, the pressure exerted upon the dies during the preparation and conditioning of the workpiece is sufficient to maintain the working grip on the workpieces. The handles 13 and 14 are then again moved to close the carriages and force the butt ends of the workpieces to-

gether under an extremely high pressure condition as provided by the linkage mechanism 15 and confinement of flow provided by the faces of the split dies.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form is made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. In a workpiece holding device adapted to grip a workpiece with the workpiece projecting therefrom, and which requires the workpiece to project an exact distance from the holding device, a cutting tool comprising, a back-up shear member, a travel shear member, a guide track establishing a path of work preparation movement for said travel shear member with respect to said workpiece shear member, a manual handle drive for said travel shear member, and a guide member carried by said back-up shear member having gauged surfaces and shaped in proportion to interfit with the holding device to gauge said back-up shear member in a predetermined spaced relationship relative to the holding device whereby the cutting of the workpiece by the travel shear member takes place at a predetermined distance from the workpiece holding device.

2. In a workpiece holding device adapted to grip a workpiece projecting therefrom and which requires the workpiece to project an exact distance from the holding device, a cutting tool comprising, a back-up shear member consisting of a plate having a side face seating gauge, said gauge having seat faces proportioned to fit with the holding device, a travel shear member, guide means establishing a path of movement for said travel shear member with respect to said back-up shear member, whereby a cutting of the workpiece by the travel shear member takes place a predetermined distance from the workpiece holding device.

3. In a workpiece holding device adapted to grip a workpiece projecting therefrom and which requires the workpiece to project an exact distance from the holding device, a cutting tool comprising first and second back-up shear members, each shear member consisting of a plate having a side face seating gauge, each of said gauges

having tapered seat surfaces proportioned to interfit a predetermined degree with the said holding device, first and second travel shear members, guide means establishing a cooperative path of shear movement for said travel shear members with respect to said back-up shear members, said first back-up shear member and said first travel shear member constituting a first cutting tool, said second back-up shear member and said second travel shear member constituting a second cutting tool, a handle drivingly connected to said travel shear member, and a center stop member interposed between said first and second cutting tools to limit insertion travel of each workpiece prior to performance of a cutting operation, whereby the cutting tools may be held in a relationship establishing a fixed position of workpiece preparation with respect to said holding device at one performance operation.

4. In a pair of workpiece holding devices each adapted to grip a workpiece projecting therefrom and which requires each workpiece to project an exact distance from its respective device, a cutting tool comprising first and second back-up shear members, each back-up shear member consisting of a plate having a side face seating gauge, each of said gauges proportioned to interfit with one of said holding devices, first and second travel shear members, guide means establishing a cooperative path of shear movement for said travel shear members with respect to said back-up shear members, said first back-up shear member and said first travel shear member constituting a first cutting tool, said second back-up shear member and said second travel shear member constituting second cutting tool, a handle drivingly connected to travel shear member, a center stop member interposed between said first and second cutting tools to limit insertion travel of each workpiece prior to performance of a cutting operation, said gauges each facing opposite directions, whereby the cutting tools may be held in a relationship establishing a fixed position of workpiece preparation with respect to both holding devices at one performance operation.

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