

May 1, 1962

L. F. CIARLEGLIO ET AL
METHOD OF FABRICATING A PANELLED STRUCTURE
HAVING A CONDUIT THEREIN
Filed Feb. 4, 1959

3,031,746

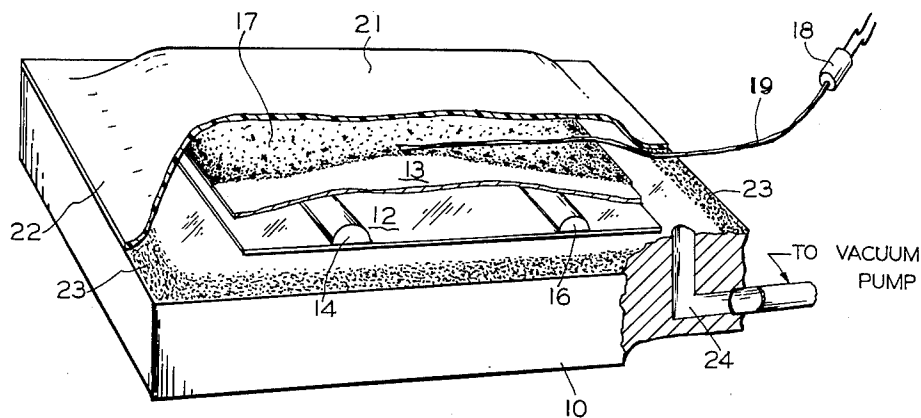


FIG-1

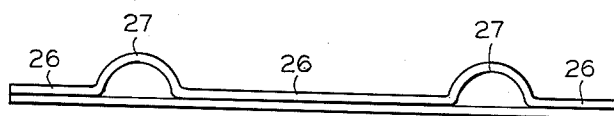


FIG 2



FIG 4

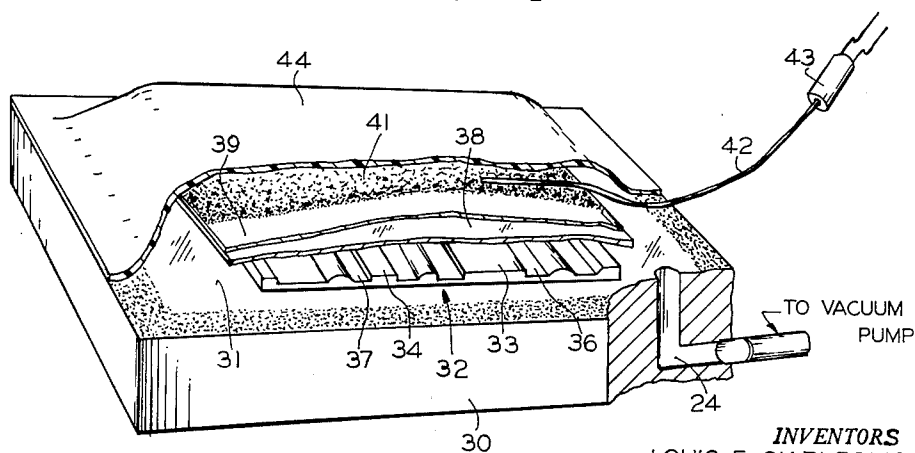


FIG-3

INVENTORS
LOUIS F. CIARLEGLIO
ALBERT J. DUFFIELD
EDWARD A. STABA
ROMEO L. SUFFREDINI
BY *R.S. Stuckler*

1

2

3,031,746

METHOD OF FABRICATING A PANELLED STRUCTURE HAVING A CONDUIT THEREIN

Louis F. Chiarleglio, Hamden, Albert J. Duffield, Woodbridge, Edward A. Staba, Higganum, and Romeo L. Suffredini, Cheshire, Conn., assignors to Olin Mathieson Chemical Corporation, a corporation of Virginia

Filed Feb. 4, 1959, Ser. No. 791,202

1 Claim. (Cl. 29-455)

The present invention relates to metal working and in particular relates to methods for fusing or welding as well as to forming to given shapes.

More particularly, the invention relates to schemes for working or welding metal where the work piece is generally in the form of a sheet or in a form wherein the ratio of surface area to thickness is high. The basic steps involved usually embrace disposing one or more work pieces parallel to one another or to a half die having a desired contour, placing an explosive in the form of a coating or in the form of a particular pattern upon or immediately adjacent one of the sheets and thereafter detonating or activating the explosive with the result that one sheet is driven toward the other or toward the forming die, as the case may be.

A particular feature of the invention is the provision of a process for fabricating a panelled structure having internal conduits.

Another feature of the invention is the provision of a process for forming or working metal utilizing explosives where the kinetic energy developed by the explosive is controlled or moderated in a novel fashion.

A further feature of the invention is the provision of a process for fabricating conduit structure, such as those used in heat exchangers or evaporators, utilizing explosives.

An additional feature of the invention is the provision of a process for fabricating a sheet metal blank in accordance with a predetermined contour, pre-formed in a die, where the die structure utilized is a one part die.

Before discussing the details of the particular embodiments of the invention, it is well to point out that the prior art is replete with schemes for welding or forming metal utilizing explosives. However, the present invention utilizes a new phenomenon observed in the course of experimental work in connection with the development of apparatus and processes for welding and forming explosively.

It is well known that when two sheet metal blanks have been disposed so that one sheet is firmly supported on a rigid base while the second sheet is arranged generally parallel but spaced apart by suitable spacers, such as by lengths of drill rod or the like, the application of an explosive force to the upper sheet drives the sheet towards the lower sheet with explosive violence.

It has been observed that fusion of the two sheets occurs only in the areas where the upper sheet has been unsupported. For example, the areas of the sheet that are separated by an air gap fuse with one another while the areas of the sheet that bear upon the drill rod are not fused or welded.

It has been theorized that this local or regional fusion occurs because in the unsupported areas, sufficient kinetic energy is developed by virtue of the spaced condition of the sheets to permit an exceedingly high velocity to develop in these areas of the sheet so that upon impact the kinetic energy acquired or developed by the moving region of the blanks is immediately converted into heat energy with resulting surface fusion.

In contrast, the regions of the blank which are disposed in contact with the spacer cannot develop kinetic

energy because motion is prevented by the spacer, thus there is no sudden conversion of kinetic energy into heat.

Thus, it has been observed that where welding is desired, it is merely necessary to provide an air gap between the two sheets; correspondingly, in those regions where no welding is desired, it is necessary to inject a spacer in the form of a rigid or semi-rigid member having the desired shape of contour. Upon activation of the explosive those regions of a pair of plates which straddle an air gap are welded or fused while those regions which straddle a spacer member are not fused to one another nor are they fused to the spacer.

Another phenomenon has been observed particularly in connection with forming a single sheet against a half die where the half die is formed with a contour to be transferred or impressed upon the blank. In a situation where the contoured die contains ribbed or raised portions and intermediate valleys or grooves, there has been a tendency for welding to occur when welding is not desired. That is, in those areas of the die wherein an air gap exists between the die face and the surface of the blank or work piece, fusion sometimes occurs while in the regions of the die in which there are projections which bear upon or come just short of bearing upon the blank, welding does not occur.

Accordingly, the present invention deals with a method for eliminating welding where only a forming operation is desired even though there is substantial gap between the blank and valleys or grooves in the contoured die.

A process embracing certain principles of the present invention may include the steps of disposing a pair of panels in generally parallel arrangement, spacing the panels apart by interposing therebetween at least one spacer element so that certain parts of both panels bear upon the spacer while other regions thereof straddle an air gap, placing an explosive over one panel, activating the explosive effective to create a force which drives the panels into fused or welded contact only in the regions thereof straddling an air gap.

Another embodiment of the invention may include the steps of providing a half die formed with a desired contour, said contour including raised portions and recessed portions to define lands and grooves or the like, disposing a deformable blank of sheet material over the die, disposing an inertia member above the blank, placing an explosive material in contact with or immediately adjacent the inertia member and activating the explosive material with the result that the blank and the inertia member are driven towards the forming die, said inertia member being effective to attenuate or moderate motion of the blank towards the die to preclude fusion or welding between the blank and the die.

Other features and advantages of the present invention will become apparent from the succeeding specification when read in conjunction with the appended drawings in which:

FIG. 1 shows a typical fixture which may be utilized in practicing one embodiment of the present invention;

FIG. 2 is a sectional view of a panel structure containing conduits formed in the fixture of FIG. 1;

FIG. 3 shows an additional fixture utilized in practicing another embodiment of the present invention; while,

FIG. 4 is a sectional view of a formed blank shaped in accordance with the contour of the half die of FIG. 3.

Referring now in detail to the drawings, there is shown in FIG. 1 a base plate 10 having a generally flat surface 11 on which there is disposed the lower panel of a pair of panels 12 and 13. Note that the panel 12 lays flat on the surface 11 and the panel 13 is spaced therefrom vertically by the spacer elements 14 and 16. The spacer elements can take a variety of shapes and forms and may be fabricated from rigid, semi-rigid material, metallic or

3

plastic, including low melting compositions. In the disclosed embodiment, the spacers 14 and 16 comprise lengths of half round metallic bar stock.

The upper panel 13 is coated with an appropriate explosive 17 and is fixed with a detonator 18. The complete assembly including the panels, explosive coating and a detonating fuse 19 are enclosed in a flexible diaphragm 21 which engages the base block 10 around the periphery thereof, as at 22, and is rigidly attached thereto by an appropriate adhesive sealing compound indicated by the reference numeral 23. It has been found that a rubber or plastic sheet material provides a satisfactory diaphragm especially where the forming is accomplished under fluids such as water.

The base block 10 is provided with a conduit 24 communicating with the interior of the diaphragm and with a vacuum pump (not shown) so that the area under the diaphragm may be evacuated if desired.

The explosive fusion and forming is accomplished in the fixture of FIG. 1 wherein upon activating the detonator 18, the fuse 19 is operative to activate the explosive coating 17. Immediately the regions of the panel 13 which are unsupported begin to accelerate and are driven towards the corresponding regions of the plate 12 so that upon impact therewith, kinetic energy developed, quickly converts into heat energy and fusion occurs between these regions of the panels 12 and 13.

In contrast, the regions of the panel 12 which bear upon or are close to the spacers 14 and 16 do not develop as much kinetic energy and consequently do not develop enough heat energy to fuse to the spacers.

After the explosive coating has been activated, the spacer members 14 and 16 are removed and paneled structure having a cross sectional configuration as shown in FIG. 2 is fabricated. The areas labelled 26 represent occurrences of fusion between the panels 12 and 13 while the intervening conduits 27 result after removal of the spacer members.

Referring now to FIG. 3, there is shown a base block 30 having a flat surface 31 on which there is disposed a half die indicated generally by the reference numeral 32.

The half die is formed with a ribbed or irregular contour comprising a plurality of raised portions such as at 33 and 34 with intervening depressions or grooves 36 and 37. Disposed over the die is a blank of deformable sheet material such as sheet material 38. Disposed above the blank 38 is an inertia member or inertia block 39.

Although the inertia member in the disclosed embodiment of the invention comprises a sheet of lead, it is anticipated that a wide variety of materials may be utilized depending upon the particular sheet material being formed, the explosive utilized and the conformation of the half die block.

The inertia block is coated with explosive material 41 and is fixed with an appropriate fuse 42 in turn connected with a detonator 43.

The process may be conducted under a head of fluid if desired.

As in the arrangement of FIG. 1, the complete assembly embracing the half die, the blank to be formed and the inertia member, is enclosed within a diaphragm 44 in the same general way as described with respect to FIG. 1.

Upon activating the explosive, the force generated tends

4

to drive the blank 38 towards the half die so that the blank takes the configuration of the die to produce the cross section shown in FIG. 4.

Ordinarily those portions or regions of the blank 38 which are spaced from the surface of the forming die by an air gap will fuse or tend to fuse to the die while those regions of the blank which bear upon or are disposed very close to the die will merely be formed and remain free of the die.

However, by virtue of the introduction of the inertia member the explosive force is moderated and the mass of the block reduces the velocity with which the blank approaches the die so that sufficient kinetic energy is never developed to bring about fusion upon impact of the blank with the die.

The energy absorbed by the inertia block is applied to the work piece in a more sustained way as against a sudden shock so that a satisfactory reproduction of the die is achieved without rupture of the blank or without fusing the blank to the die.

Obviously an inertia block may be fabricated of a wide variety of materials and as stated previously must be selected in accordance with the characteristics of the metal being formed, the intricacy of the die pattern and the explosive utilized.

Here again, the process may be conducted under a head of fluid and may be evacuated, if desired.

It is anticipated that a wide variety of modifications and changes may be devised in the several embodiments of the disclosed invention without departing from the spirit and scope thereof.

What is claimed is:

A method of fabricating a paneled structure having a conduit therein comprising the steps of disposing a pair of metallic panels in a generally parallel arrangement, spacing the panels apart by interposing therebetween at least one spacer element so that certain regions of both panels bear upon the spacer while other regions thereof straddle an air gap, coating one panel with a high explosive, submerging the spaced panels in a fluid, sealing the panels in an enclosed flexible diaphragm, evacuating the space beneath the sealed diaphragm, activating the explosive effective to create a force which drives mating portions of the panels which straddle the air gap into fused or welded contact and thereafter removing the spacer element effective to develop a conduit within the paneled structure.

References Cited in the file of this patent

UNITED STATES PATENTS

1,355,224	Gravell	Oct. 12, 1920
2,169,937	Wempe	Aug. 15, 1939
2,385,083	Kemerer	Sept. 18, 1945
2,628,417	Peyches	Feb. 17, 1953
2,648,125	McKenna et al.	Aug. 11, 1953
2,703,297	MacLeod	Mar. 1, 1955
2,707,825	Sowter	May 10, 1955
2,754,572	Johnson	July 17, 1956
2,779,279	Maiwurm	Jan. 29, 1957
2,894,322	Clair	July 14, 1959
2,948,957	Sawyer	Aug. 16, 1960
2,969,758	Howlett et al.	Jan. 31, 1961