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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to the Securing of Deformable Sheet Metal Elements

We, THE METAL BOX COMPANY LIMITED, a Company Incorporated under the laws of Great Britain, of 37, Baker Street, London, W.1, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the securing of ductile sheet metal elements one to another and in particular, but not exclusively, to the securing of a pull tab to a container member provided with a scored removable zone.

It is usual when securing a pull tab to a container member, such as a can end, provided with a scored removable zone to provide one of the parts with an aperture which fits over a hollow rivet formed in the other part. When the apertured part has been fitted over the rivet the latter is deformed to secure the apertured part in position. These proposals are subject to a number of disadvantages, for instance the punching of the aperture leaves a burr which must be removed and this is a difficult, precise operation under mass production conditions. Should the burr not be fully removed it bears against the root of the rivet, which is the weakest point thereof, when the parts are assembled and this may lead to rupturing of the material during deformation of the rivet. Further, when the metal is drawn to form the rivet the metal is thinned and stretched causing undesirable weakening in the areas where the thinning is most pronounced. It is also necessary that the forming of the rivet and of the aperture be performed separately and the parts assembled after such forming operations.

It is a main object of the present invention to effect the securing together of two ductile sheet metal elements in a manner which avoids the above disadvantages and reduces the number of manufacturing operations.

According to the invention there is provided a method of securing one portion of ductile sheet metal to another by superimposing one on the other and clamping them around the area thereof to be secured, creating from the clamped area a substantially frusto-conical formation the sloping sides of which extend across a space formed between rigid walls, and by impact extrusion causing metal from the closed end of the frusto-conical formation to flow into said sloping sides thereby to effect deformation and interlocking thereof in said space.

One of the sheet metal portions may be the scored removable zone portion of a container member and the other of the sheet metal portions be a part of a pull tab.

Also according to the invention there is provided a container member made of deformable sheet metal and including a scored removable portion, and a deformable sheet metal pull tab secured to the scored removable portion by the method set forth above.

There is also contemplated apparatus for carrying out the method according to the invention.

In order that the invention may be clearly understood embodiments thereof will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:—

Figure 1 is a top plan of a can end constructed in accordance with the invention,

Figure 2 is an underneath plan of Figure 1,

Figure 3 is a section, to an enlarged scale, on line III—III, Figure 1,

Figure 4 is a line drawing made from a micro-photograph of two portions of sheet metal secured together by the method and apparatus according to the invention.

Figure 5 is a section illustrating apparatus according to the invention,

Figures 6 to 9 illustrate diagrammatically

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the method of and apparatus for securing a pull tab to the can end shown in Figures 1 to 3,

Figure 10 illustrates a modification to the apparatus of Figs. 6 to 9, and

Figure 11 illustrates a modification to a punch sleeve embodied in apparatus according to the invention.

Referring to Figures 1 to 4 of the drawings, a container member, shown as a can end 1 of known kind, is made of ductile metal and is provided with a scored removable zone 2 defined, in the usual manner, by a score line 3. It is to be understood that the shape of the scored removable zone may, if desired, be other than that shown in Figure 1. A pull tab 4, also made of ductile sheet metal, is secured to the scored removable zone by a method which, in accordance with the invention, does not require that either the said zone or the pull tab be provided with an aperture to facilitate the securing of the one part to the other. The pull tab, which may be of a shape other than that shown in the drawings, is interlocked with and secured to the scored removable zone by deformation 5 of the sides of a hollow portion 6 closed at one end 7 and formed by overlying portions 8, 9, Figure 3 of the pull tab and the scored removable zone. The deformation of the sides of the hollow portion is effected by impact extrusion of the end 7 into the sides of the hollow portion with the result, as can be seen from Figs. 3 and 4, that the thickness of the top overlying portions 8, 9 is reduced from the starting thickness thereof.

The method of securing the pull tab 4 to the scored removable zone 2 is illustrated in Figs. 6 to 9. A flat part of the scored removable zone 2 is laid on the face of a base member 10 supported for restricted movement against the action of a spring or springs S indicated diagrammatically in Figs. 6 and 7, and a flat part of the pull tab 4 is superimposed thereon. Above the base member 10 a parallel-sided punch sleeve 11 is supported by a press ram R for reciprocation towards and away from the base member 10 and when the scored removable zone 2 and pull tab 4 are in position on the base member, Fig. 6, the punch sleeve 11 is moved downward to clamp the scored removable zone and pull tab against the base member, Fig. 7.

A stationary anvil 12 co-axial with a punch 13 housed in the punch sleeve 11 is associated with the base member 10 and has a head 14 which is of lesser diameter than that of the punch 13 and is tapered, Figs. 6 to 9, in a manner such as to preserve the largest possible top area together with the sharpest possible incline. In the starting position of the apparatus the head 14 does not project beyond the face of the base member but when the punch sleeve 11 and punch 13 engage the upper face of the two superimposed pieces of

metal, Fig. 7, the resilient loading, shown as springs S1, Fig. 5, of the punch sleeve 11 reacts against the spring-loading S of the base member 10. The springs S1 for the punch sleeve 11 are stronger than the springs S and the base member 10 is forced to retract, Figs. 8 and 9. The metal portions clamped around between the base member 10 and the punch sleeve 11 are thus deformed about the frusto-conical head 14 of the anvil and the sloping sides of the hollow frusto-conical formation of the metal portions extend across the space formed by the rigid walls of the sleeve 11 and head 14, Fig. 8. In Fig. 5, the can end 1 and the pull tab 4 are, for clarity, shown slightly spaced apart. The impact of the punch 13 against the closed end 7 of the hollow frusto-conical formation causes metal from the closed end 7 to flow into the sloping sides of the hollow conical formation thus deforming and interlocking said sides as shown in Figs. 4 and 9. As the pressure is released suitable means, for example an air cylinder AC, Fig. 5, causes the punch 13 to be restored to the position thereof shown in Fig. 6, thereby ejecting the interlocked metal portions from the sleeve 11. The restoring of the base member 10 to the normal position thereof, Fig. 6, causes the interlocked metal portions to be lifted from the anvil 12.

The punch 13 is slidably housed in the sleeve 11 and the sleeve is loaded as by the springs S1 or a rubber buffer, not shown, so that pressure exerted by the sleeve 11 is not so great as that exerted by the punch 13. The springs S ensure that when the sleeve 11 and punch 13 are raised the interlocked portions are ejected from the head 14.

It will be understood that by using the method just described the two sheets of metal are interlocked and secured one to the other by a single operation and this not only simplifies the manufacturing process, as compared with the processes previously employed, but also permits the operation to be performed with the least possible disturbance to the metal, thus, also as compared with the processes previously employed, reducing work-hardening and the tendency for the metal to fracture or become brittle. The strain on the metal is further reduced by the use of the tapering anvil 12 because by the use thereof the sides of the frusto-cone formed in the metal are not required to be substantially perpendicular. Also, because there are two layers of metal over the areas 15, 16, Figure 8, of the frusto-cone, where previously a rivet was weakest, there is with a coupling formed in accordance with the invention a higher factor of safety than has been possible hitherto and this can be of considerable importance in the case of, for example, beer cans which may have a high internal pressure.

The metals from which the can end and pull tab are made may be of any suitable kind



deformable by an impact extrusion process and may be alloys of non-ferrous metals capable of extrusion under reasonably low pressures. Such metals include aluminium and aluminium alloys.

In the foregoing description there has been described the manner in which a pull tab is secured to a scored removable zone. It is, however, to be understood that the invention may be applied to the securing together of other components. For example, the method may be used for fixing handles to aluminium mugs, cups, saucepans, or drawers; for joining sheet metal in the manufacture of metal cabinets or other rectangular constructions; or in other instances in which it is required to form a metal attachment between two sheets of ductile metal where formerly riveting, or welding, or soldering was employed.

In carrying the invention into effect the preferred range of metal thickness is between 0.010 and 0.025 inch although the thickness will depend on the purpose and nature of the finished article. The tab, or handle, may be of the same thickness as that of the sheet to which it is to be secured or it may be of greater or lesser thickness; again this depends on the purpose. The preferred diameter of a finished coupling is between 3/16 and 5/16 inch but this also depends on the purpose and on the thickness of the metal. Further, the coupling may be circular, elongated, square, or of any other suitable shape. The tooling pressures are not critical but one will naturally apply the minimum required to extrude the metal used and this will vary according to the alloy and also according to the area involved.

As illustrated in the drawings, the opposed faces of the anvil 12 and punch 13 are flat but, if desired these faces may be mating convex/concave surfaces.

If desired, as shown in Fig. 10, the head 14 of the anvil 12 may be of circular cross-section of lesser diameter than that of the body of the anvil.

In a further modification of the apparatus, the anvil may be as shown in Figs. 9 or 10 and the punch sleeve portion which with the anvil forms the space in which interlocking is effected is split lengthwise, as at 18, Fig. 11, to permit lateral extension of the sleeve as the metal is forced into the sleeve about the head of the anvil, and the sleeve is provided with an annular recess 17 which together with the anvil forms the space in which interlocking takes place.

WHAT WE CLAIM IS:—

1. A method of securing one portion of ductile sheet metal to another by superimposing one on the other and clamping them around the area thereof to be secured, creating from the clamped area a substantially frusto-conical formation the sloping sides of which extend across a space formed between rigid walls, and by impact extrusion causing metal from

the closed end of the frusto-conical formation to flow into said sloping sides thereby to effect deformation and interlocking thereof in said space.

2. The method according to Claim 1, wherein one of the sheet metal portions is a scored removable portion of a container member and the other of the sheet metal portions is a part of a pull tab.

3. Sheet metal portions secured one to another by the method according to Claim 1 or Claim 2.

4. A container member made of ductile sheet metal and including a scored removable portion, and a ductile sheet metal pull tab secured to the scored removable portion by the method according to Claim 1.

5. Apparatus for securing one portion of ductile sheet metal to another, comprising a base member having an anvil associated therewith, and a punch sleeve located above the base member and housing a punch of greater diameter than and co-axial with the anvil, said base member, anvil, punch sleeve, and punch being movable relative one to the other in timed relation in a manner such that areas of superimposed portions of sheet metal to be secured are, following location thereof between the base member and punch sleeve, clamped around by pressure exerted on the sheet metal by co-operation between the base member and punch sleeve, the clamped areas are pressed into the punch sleeve by the anvil to effect deformation thereof to a substantially frusto-conical form the sloping sides of which extend across a space formed between the punch sleeve and the anvil, and the punch by impact extrusion causes metal from the closed end of the frusto-conical formation to flow into said sloping sides thereby to effect deformation and interlocking thereof in said space.

6. Apparatus according to Claim 5, wherein the base member is supported for restricted movement relative to the anvil against the action of a spring or springs and the end of the anvil which is directed towards the punch is located so as, in the starting position of the apparatus, not to project beyond the face of the base member which is directed towards the punch sleeve.

7. Apparatus according to Claim 5 or Claim 6, wherein the end portion of the anvil which co-operates with the punch sleeve to form said space is of frusto-conical form.

8. Apparatus according to Claim 5 or Claim 6, wherein the end portion of the anvil which co-operates with the punch sleeve to form said space is of circular cross-section of lesser diameter than that of the body of the anvil.

9. Apparatus according to Claim 5 or Claim 6, wherein the portion of the punch sleeve which with the anvil forms said space is split lengthwise thereof to permit lateral extension of the sleeve and is provided with an



deformable by an impact extrusion process and may be alloys of non-ferrous metals capable of extrusion under reasonably low pressures. Such metals include aluminium and aluminium alloys.

In the foregoing description there has been described the manner in which a pull tab is secured to a scored removable zone. It is, however, to be understood that the invention may be applied to the securing together of other components. For example, the method may be used for fixing handles to aluminium mugs, cups, saucepans, or drawers; for joining sheet metal in the manufacture of metal cabinets or other rectangular constructions; or in other instances in which it is required to form a metal attachment between two sheets of ductile metal where formerly riveting, or welding, or soldering was employed.

In carrying the invention into effect the preferred range of metal thickness is between 0.010 and 0.025 inch although the thickness will depend on the purpose and nature of the finished article. The tab, or handle, may be of the same thickness as that of the sheet to which it is to be secured or it may be of greater or lesser thickness; again this depends on the purpose. The preferred diameter of a finished coupling is between 3/16 and 5/16 inch but this also depends on the purpose and on the thickness of the metal. Further, the coupling may be circular, elongated, square, or of any other suitable shape. The tooling pressures are not critical but one will naturally apply the minimum required to extrude the metal used and this will vary according to the alloy and also according to the area involved.

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1. A method of securing one portion of ductile sheet metal to another by superimposing one on the other and clamping them around the area thereof to be secured, creating from the clamped area a substantially frusto-conical formation the sloping sides of which extend across a space formed between rigid walls, and by impact extrusion causing metal from

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2. The method according to Claim 1, wherein one of the sheet metal portions is a scored removable portion of a container member and the other of the sheet metal portions is a part of a pull tab.

3. Sheet metal portions secured one to another by the method according to Claim 1 or Claim 2.

4. A container member made of ductile sheet metal and including a scored removable portion, and a ductile sheet metal pull tab secured to the scored removable portion by the method according to Claim 1.

5. Apparatus for securing one portion of ductile sheet metal to another, comprising a base member having an anvil associated therewith, and a punch sleeve located above the base member and housing a punch of greater diameter than and co-axial with the anvil, said base member, anvil, punch sleeve, and punch being movable relative one to the other in timed relation in a manner such that areas of superimposed portions of sheet metal to be secured are, following location thereof between the base member and punch sleeve, clamped around by pressure exerted on the sheet metal by co-operation between the base member and punch sleeve, the clamped areas are pressed into the punch sleeve by the anvil to effect deformation thereof to a substantially frusto-conical form the sloping sides of which extend across a space formed between the punch sleeve and the anvil, and the punch by impact extrusion causes metal from the closed end of the frusto-conical formation to flow into said sloping sides thereby to effect deformation and interlocking thereof in said space.

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8. Apparatus according to Claim 5 or Claim 6, wherein the end portion of the anvil which co-operates with the punch sleeve to form said space is of circular cross-section of lesser diameter than that of the body of the anvil.

9. Apparatus according to Claim 5 or Claim 6, wherein the portion of the punch sleeve which with the anvil forms said space is split lengthwise thereof to permit lateral extension of the sleeve and is provided with an

annular recess which together with the anvil forms said space.

- 5 10. Apparatus for securing one portion of deformable sheet metal to another, constructed and arranged to operate substantially as herein described with reference to the accompanying diagrammatic drawings.

- 10 11. A can end made of ductile sheet metal and provided with a scored removable zone defined by a score line, and a pull tab made of ductile sheet metal and secured to the scored removable zone by a hollow portion

closed at one end thereof, said hollow portion being pressed out of overlying portions of said zone and pull tab and inter-locked and secured by impact extrusion of the closed end of the hollow portion into the sides thereof with resultant lessening of thickness of said closed end from that of the starting thickness thereof.

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