Oct. 27, 1964 N. A. KEITH 3,154,038

METHOD OF EMBOSSING SHEET METAL

Filed Feb. 5, 1963 3 Sheets-Sheet 1

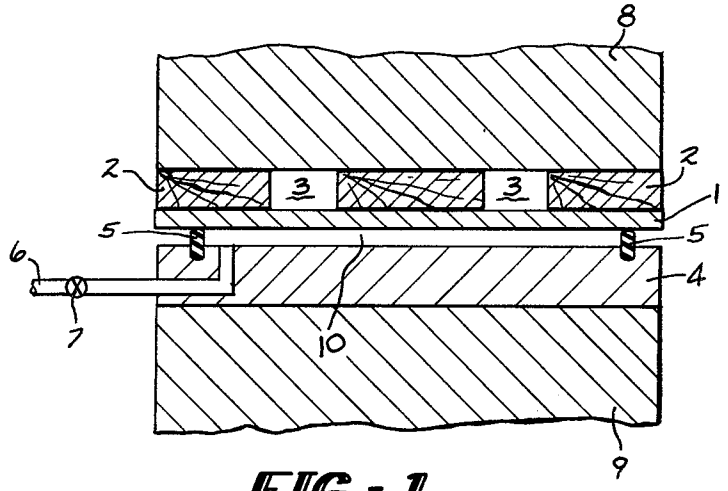


FIG - 1

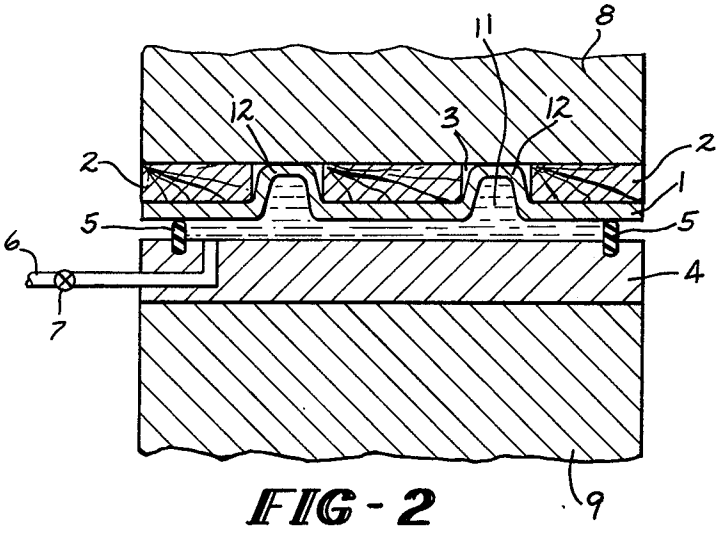


FIG - 2

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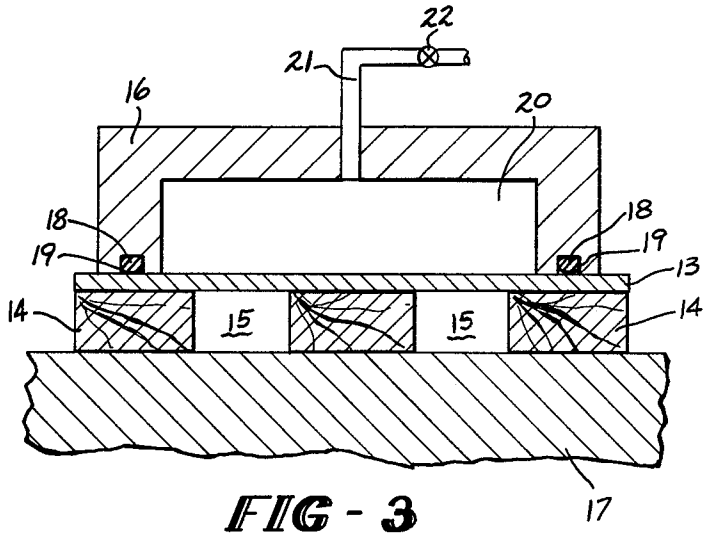


FIG - 3

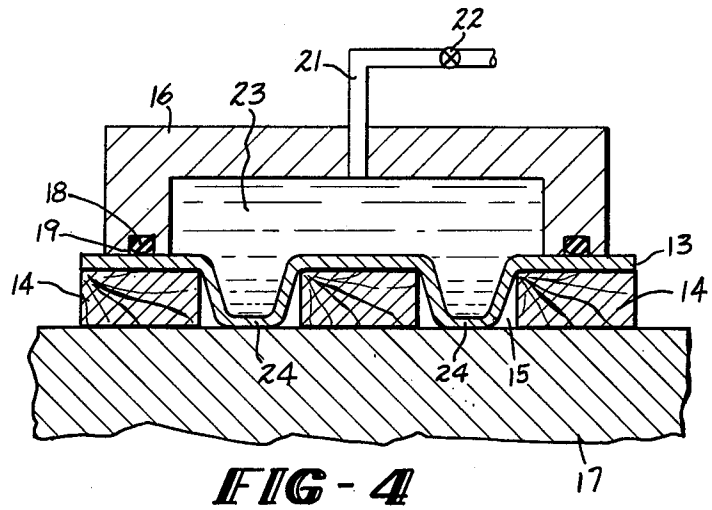


FIG - 4

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METHOD OF EMBOSSING SHEET METAL

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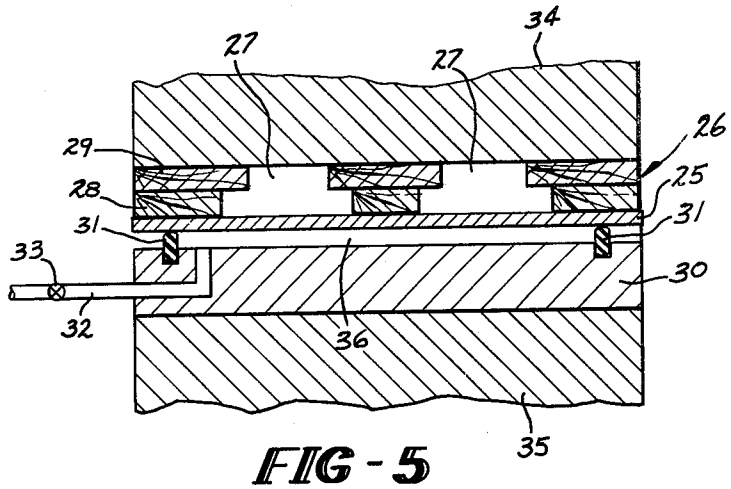


FIG - 5

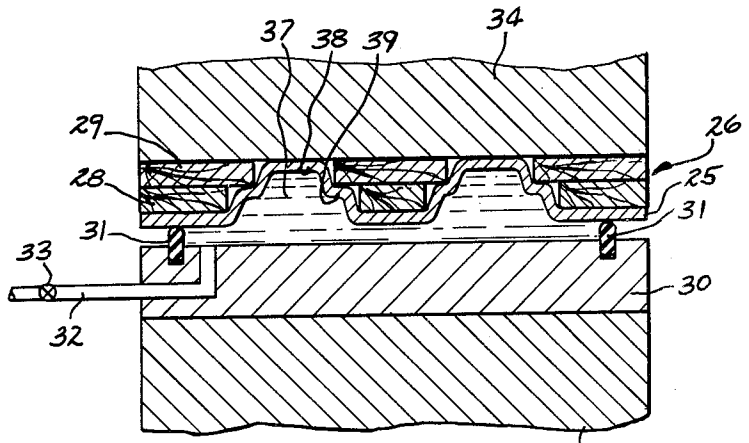


FIG - 6

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METHOD OF EMBOSSING SHEET METAL

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6 Claims. (Cl. 113—44)

The present invention relates to a method for making embossed sheet metal from a metal blank.

Heretofore, the preparation of embossed sheet metal has been subject to numerous disadvantages. One method used is to prepare dies of the mating type. This method, while effectively producing embossed products, is subject to the disadvantages of long tooling time and large expense attendant on the production of the requisite dies. In addition, the weight and handling of the dies is a problem, especially when considering larger sheets of material to be formed.

Another method is in accordance with the process fully described in a patent to Grenell, 2,690,002, granted September 28, 1954. According to this method a foreshortened pattern of weld-inhibiting material is applied to a clean surface of a sheet of metal and a clean surface of a second sheet of metal is superimposed on this surface. The two sheets are secured together and welded in the adjacent areas not separated by weld-inhibiting material. The unjoined areas are distended by injection of a fluid pressure of sufficient magnitude to permanently distend the blank in the area of the unjoined portion. While this method is quite effective in producing articles of this type, it is expensive and time-consuming. In addition the tolerances of the rolled product can be excessive and detrimental to appearance. In addition, this type of product is frequently characterized by surface imperfections, such as roll marks and limited finishing qualities due to imperfections. This type of product is also frequently characterized by poor dent resistance since temper is difficult to control on this rolled product.

Similarly, other methods for producing embossed sheet metal are also subject to the major disadvantages of undue expense, and time consuming operations. It is especially difficult to obtain highly accurate embossments at a reasonable cost,

Accordingly, it is an object of the present invention to provide an improved method for making embossed sheet metal from a metal blank.

It is a further object of the present invention to provide a novel method as above showing marked improvement over existing methods and which is inexpensive and expeditious.

It is a still further object of the present invention to provide a process as above which readily and expeditiously produces embossed articles having extremely accurate embossments.

It is a particular object of the present invention to provide a process as above which relieves high die costs and long tooling delays.

Other objects and advantages of the present invention will appear hereinafter.

FIGURES 1 and 2 illustrate schematically a process for embossing sheet metal in accordance with the present invention.

FIGURES 3 through 6 illustrate other embodiments of the present invention.

Referring to FIGURES 1 and 2, a substantially flat metal sheet 1 is placed adjacent a template 2. Any metal sheet which is capable of being embossed or deformed may be used, such as preferably aluminum or alloys thereof, copper base alloys, steel, etc. The template has cut-out portions or embossments 3 disposed adjacent said metal sheet having a configuration desired to be imparted

to the metal sheet. It is a particular advantage of the present invention that the template can be readily and easily constructed of plywood, Masonite, formica or similar material merely by making saw cuts or attaching cut-out sections to a backing plate. Thus, the template may be made in a short period of time without large expenditures and may be easily handled and mounted. No large capital equipment is needed and the template is readily and economically produced using, for example, a hand drill and saber saw in a very short period of time. While the readily constructed templates of the present invention are preferred, the process of the present invention is also readily applicable and advantageous when used with highly machined dies.

The metal sheet, on the side opposite the template, is placed on a pressure pad or pressure chamber 4 with rubber pads or the like 5 interposed between the metal sheet and the pressure chamber in order to provide a fluid compartment sealed to the atmosphere adapted to receive a suitable fluid under pressure. The effectiveness, simplicity and versatility of the rubber gasket is highly advantageous in the present invention. The pressure chamber 4 is provided with fluid entry means, such as fluid pressure entry line 6 which may be regulated in any conventional manner, such as by valve 7.

The assembly is then clamped into air tight, contacting relationship between a pair of relatively moveable, rigid surfaces, such as co-acting sides of a press 8 and 9 and fluid is injected into the space 10 below the metal sheet via fluid pressure entry line 6 and valve 7. The fluid is injected into pressure chamber 4 at a pressure sufficient to force the portions of the metal sheet 1 adjacent the cut-out portions 3 against said cut-out portions in a manner as shown in FIGURE 2 wherein the fluid is indicated at 11. The deformation of the solid sheet 1 provides embossments 12 in the desired pattern.

Alternatively, in a manner after FIGURES 3 and 4, the metal sheet 13 is clamped over a template 14 having cut-out portions 15 therein corresponding to the embossments to be formed upon deformation of the solid metal sheet 13. The clamping of the metal sheet 13 is accomplished by means of co-acting press 16 which is suitably mounted to conventional reciprocating means, not shown, for raising and lowering the section 16 to and away from mating or operational relationship with reciprocal press 17. Press 16 is maintained in sealing relationship with the metal sheet by means of an O-ring 18 mounted in an annular groove 19 as shown in the drawings to facilitate the sealing desired for the formation of the embossments. The solid sheet metal member extends beyond the peripheral edges of the co-acting press section 16 leaving a portion of the solid metal sheet 13 exposed for clamping within the O-ring 18 of the co-acting press section 16. Co-acting press 16 is further provided with a fluid compartment 20 for receiving and containing a suitable fluid, such as water, air or the like from conduit 21 valve 22 connected to a suitable source of fluid and in connecting relationship with compartment 20. In operation, fluid under high pressure, for example, water at approximately 1500 to 3000 lbs./sq. inch or more, is introduced into fluid chamber 20 on the side opposite template 14. The pressure of the fluid 23 as shown in FIGURE 4 in the sealed pressure chamber 20 against the metal sheet 13 deforms the metal in the areas adjacent the cavities of the cut-out portions 15 in the template 14 and continues to deform the metal until the respective solid metal layer reaches the top of the cut-out portions 15 of the template 14. This deformation of the solid sheet metal member provides embossments 24 in the sheet metal 13.

The modification of FIGURES 5 and 6 shows how the process of the present invention may be simply adapted

to obtain pattern designs in more than one height without the necessity of expensive milling machine operations in a contour type die. This particular advantage of the present invention is accomplished by constructing the cut-out portions of the template in a plurality of layers, each successive layer thereof having a smaller cross section, with the cut-out portion immediately adjacent the metal sheet having the largest cross-section. This may be applied to pattern designs of two or more heights.

As shown in FIGURES 5 and 6, metal sheet 25 is placed adjacent template 26, said template having cut-out portions 27 in two layers constructed by adhering a smaller cross-sectional stratum of plywood 28 to a larger cross-sectional stratum of polywood 29. As shown in FIGURES 1 and 2, the metal sheet, on the side opposite the template is placed on a pressure pad or pressure chamber 30 with rubber pads 31 interposed between the metal sheet and the pressure chamber and with fluid pressure entry line 32 and valve 33.

The assembly is then clamped into air tight, contacting relationship between a pair of relatively moveable, rigid surfaces, such as co-acting sides of a press 34 and 35, and fluid is injected into the space 36 below the metal sheet via fluid entry line 32 and valve 33 at a pressure sufficient to force the portions of the metal sheet 25 adjacent the cut-out portions 27 against said cut-out portions in two heights as shown in FIGURE 6 wherein the fluid is indicated at 37. The resulting embossments consist of an uppermost, smaller cross-sectional embossment 38 and a lower, larger cross-sectional embossment 39.

In an example in accordance with the procedure of FIGURES 1 and 2, a double cross design was produced utilizing 1100 aluminum of a thickness of 0.060 inch. A pressure of 1200 p.s.i.g. was used. The forming or embossing template consisted of 0.125 inch thickness 1100 aluminum material cut out in two sheets. Water pressure was introduced into the fluid chamber at a pressure of 1200 p.s.i.g. and the pressure released. The resultant embossed metal sheet had an embossment depth of 0.250 inch.

It is to be understood that various modifications will be readily apparent, for example, the pressure may be affected by the use of an intensifier or the pressure could be generated by the pressing action against liquid pads. Sharper and more distinct patterns can be obtained by the use of higher pressures. Naturally, the depth and shape of the embossment for various gauges and materials would be determined by pressure, pattern cross-section, etc. The template may be cut out from sheet metal or plywood, etc., of a thickness which is the desired embossed pattern height. By adjusting the pressure used to distend the metal the amount of pattern flatness and the pattern transition can be varied as related to the yield strength, elongation and thickness of the material being distended. An additional advantage of the present invention is that any fluid may be readily and conveniently used, i.e., a compressible or non-compressible fluid, such as a gas or a liquid.

In accordance with the present invention, a container may act as a pressure pad thus causing the metal sheet to be formed into the template when the pressure is exerted. The panel to be formed becomes one side of the pressure chamber and is tightly held against a pressure chamber by a press or any other mechanical device known to the art. The template is also pressed tightly against the panel on one side and the bed of the press on the other. A mechanical seal between the pressure pad and workpiece is thus obtained by the direct forces applied. A wide variety of metal workpieces may be employed, the only requirement being that the metal workpiece be capable of being deformed by the application of pressure.

This invention may be embodied in other forms or carried out in other ways without departing from the spirit or essential characteristics thereof. The present

embodiment is therefore to be considered as in all respects illustrative and not restrictive, the scope of the invention being indicated by the appended claims, and all changes which come within the meaning and range of equivalency are intended to be embraced therein.

What is claimed is:

1. A method of embossing sheet metal comprising the steps of placing a substantially flat metal sheet adjacent a template having cut-out portions thereof disposed adjacent said metal sheet, with said cut-out portions having a configuration desired to be imparted to said metal sheet; forming adjacent said flat metal sheet, on the side opposite said template, a chamber sealed to the atmosphere and adapted to receive a fluid under pressure; and injecting said fluid into said chamber at a pressure sufficient to force portions of the said metal sheet against said cut-out portions, thereby forming embossments in said metal sheet corresponding to said cut-out portions.

2. A method of embossing sheet metal comprising the steps of: placing a substantially flat metal sheet adjacent a template of a material selected from the group consisting of plywood, Masonite, formica and sheet metal having cut-out portions extending completely therethrough disposed adjacent said metal sheet, with said cut-out portions having a configuration desired to be imparted to said metal sheet; placing a pressure chamber adjacent said flat metal sheet on the side opposite said template, said chamber having a fluid pressure inlet and being open on the side adjacent said sheet; sealing said chamber to the atmosphere by bringing said metal sheet into contacting relationship with said chamber and thereby adapting said chamber to receive a fluid under pressure; and injecting said fluid into said chamber at a pressure sufficient to force portions of the said metal sheet against said cut-out portions, thereby forming embossments in said metal sheet corresponding to said cut-out portions.

3. A method of embossing sheet metal comprising the steps of: placing a substantially flat metal sheet adjacent a template of a material selected from the group consisting of plywood, Masonite, formica and sheet metal having cut-out portions extending completely therethrough disposed adjacent said metal sheet, with said cut-out portions having a configuration desired to be imparted to said metal sheet and with said cut-out portions disposed in a plurality of layers, each successive layer thereof having a smaller cross-section, with the cut-out portion immediately adjacent the metal sheet having the largest cross-section; forming adjacent said flat metal sheet, on the side opposite said template, a chamber sealed to the atmosphere and adapted to receive a fluid under pressure; injecting said fluid into said chamber at a pressure sufficient to force portions of the said metal sheet against said cut-out portions, thereby forming embossments in said metal sheet corresponding to said cut-out portions.

4. A method of embossing sheet metal comprising the steps of: placing a substantially flat metal sheet adjacent a template of a material selected from the group consisting of polywood, Masonite, formica and sheet metal having cut-out portions extending completely therethrough disposed adjacent said metal sheet, with said cut-out portions having a configuration desired to be imparted to said metal sheet and with said cut-out portions disposed in two layers, each layer thereof having a smaller cross-section, with the cut-out portion immediately adjacent the metal sheet having the largest cross-section; forming adjacent said flat metal sheet, on the side opposite said template, a chamber sealed to the atmosphere and adapted to receive a fluid under pressure; and injecting said fluid into said chamber at a pressure sufficient to force portions of the said metal sheet against said cut-out portions, thereby forming embossments in said metal sheet corresponding to said cut-out portions.

5. A method of embossing sheet metal comprising the steps of: placing a substantially flat metal sheet between a pair of relatively moveable rigid surfaces; interposing

a template of a material selected from the group consisting of plywood, Masonite, formica and sheet metal between one face of said sheet and one of said rigid surfaces, said template having cut-out portions extending completely therethrough disposed adjacent said metal sheet, with said cut-out portions having a configuration desired to be imparted to said metal sheet; forming adjacent the other face of said sheet a chamber sealed to the atmosphere and adapted to receive a fluid under pressure; bringing said sheet, template and chamber into tight, contacting relationship by moving said rigid surfaces; and injecting said fluid into said chamber at a pressure sufficient to force portions of the said metal sheet against said

cut-out portions, thereby forming embossments in said metal sheet corresponding to said cut-out portions.

6. A process according to claim 5 wherein said fluid is water.

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