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(54) Pre-formed sheet material for small scale manufacture

(57) The sheet preferably of metal, but alternatively of plastics or composite material, has a pattern of lines and circles etched or electrochemically milled or otherwise formed, e.g. cast or plastically deformed, to such a depth as to considerably weaken the material where so inscribed. The pattern is regular with parallel or intersecting lines and circles between the lines or at the intersections with regular spacing. The material can be used to fabricate a variety of items normally made from sheet metal, but without the need for skilled marking out, cutting, bending and drilling. Using minimum force, simple punches can make holes and cut outs and precise bends can be folded provided that the material is only deformed where the pattern is inscribed. Finished or part finished items manufactured from the inscribed sheet material can be reinforced by covering the patterned surface with thermosetting plastics material.

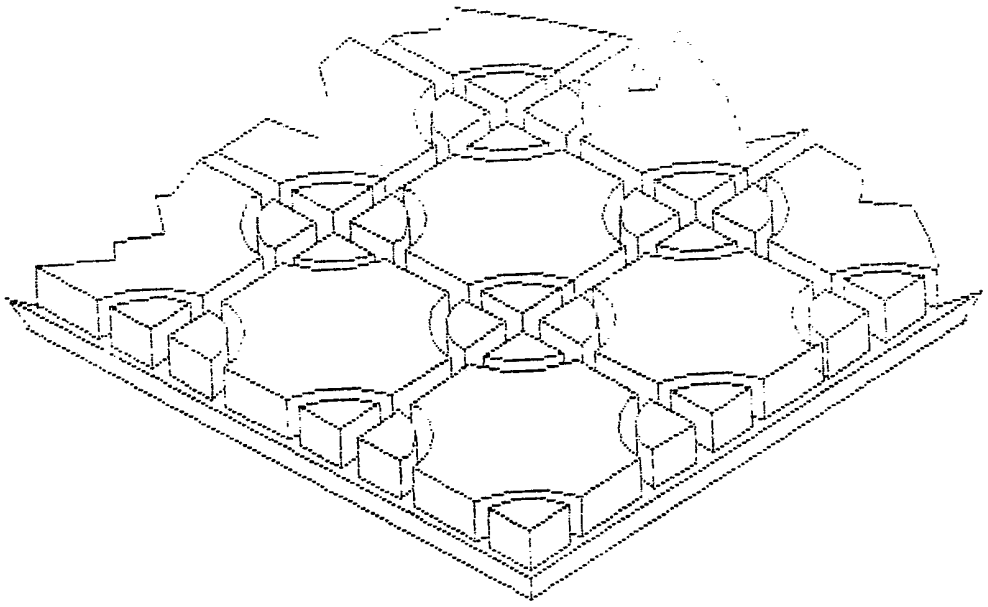

Figure 1

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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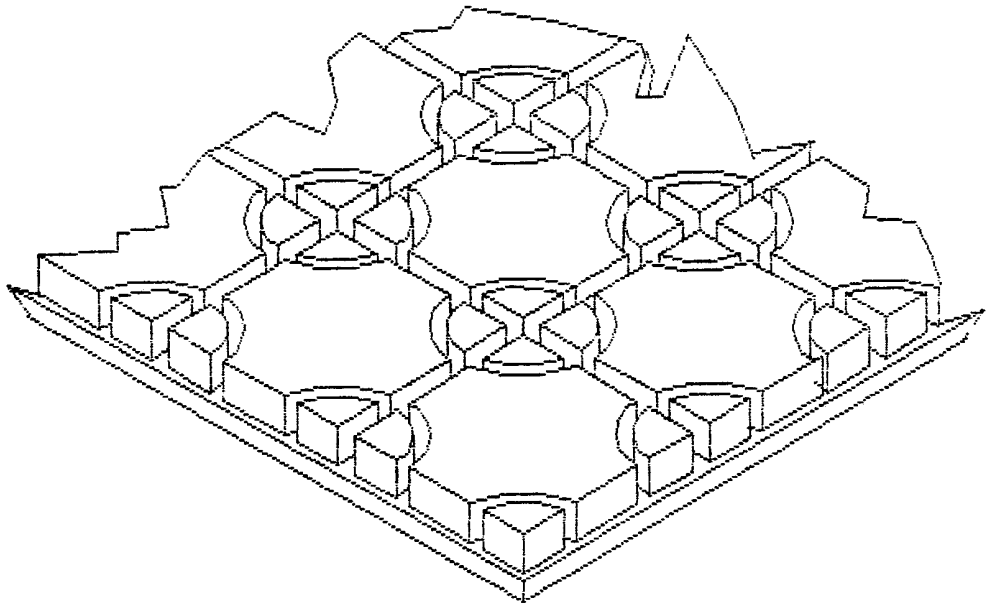

Figure 1

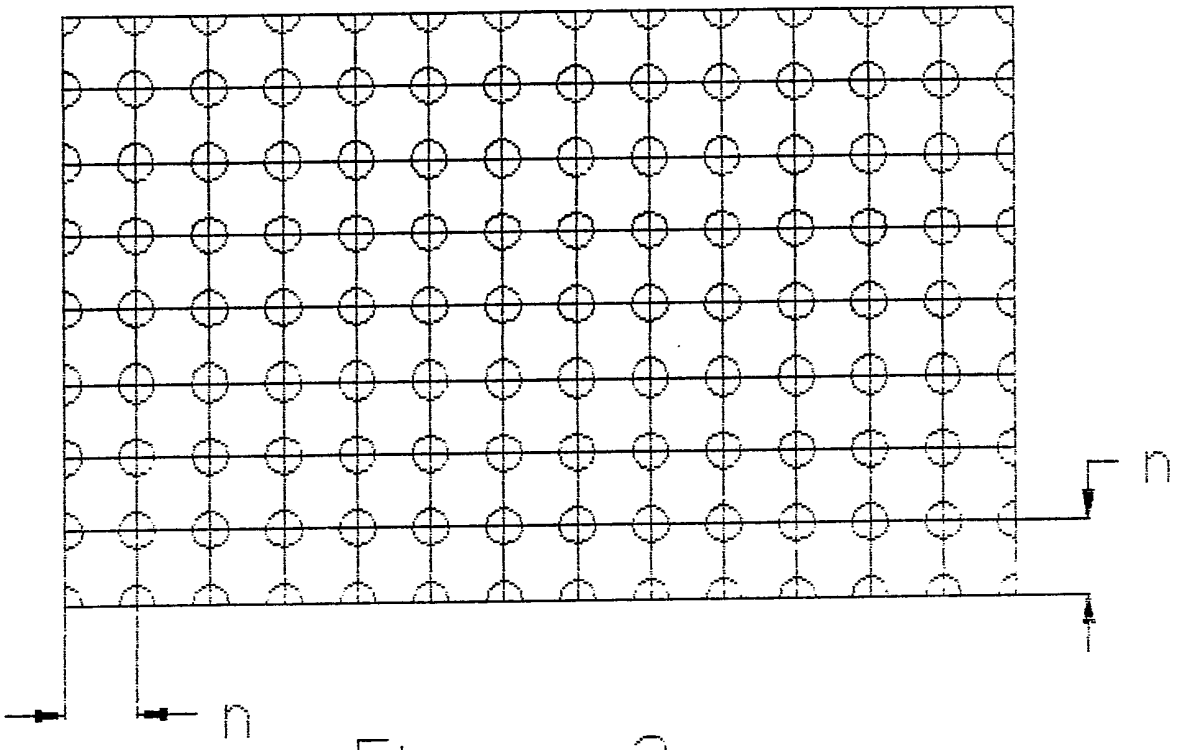

Figure 2

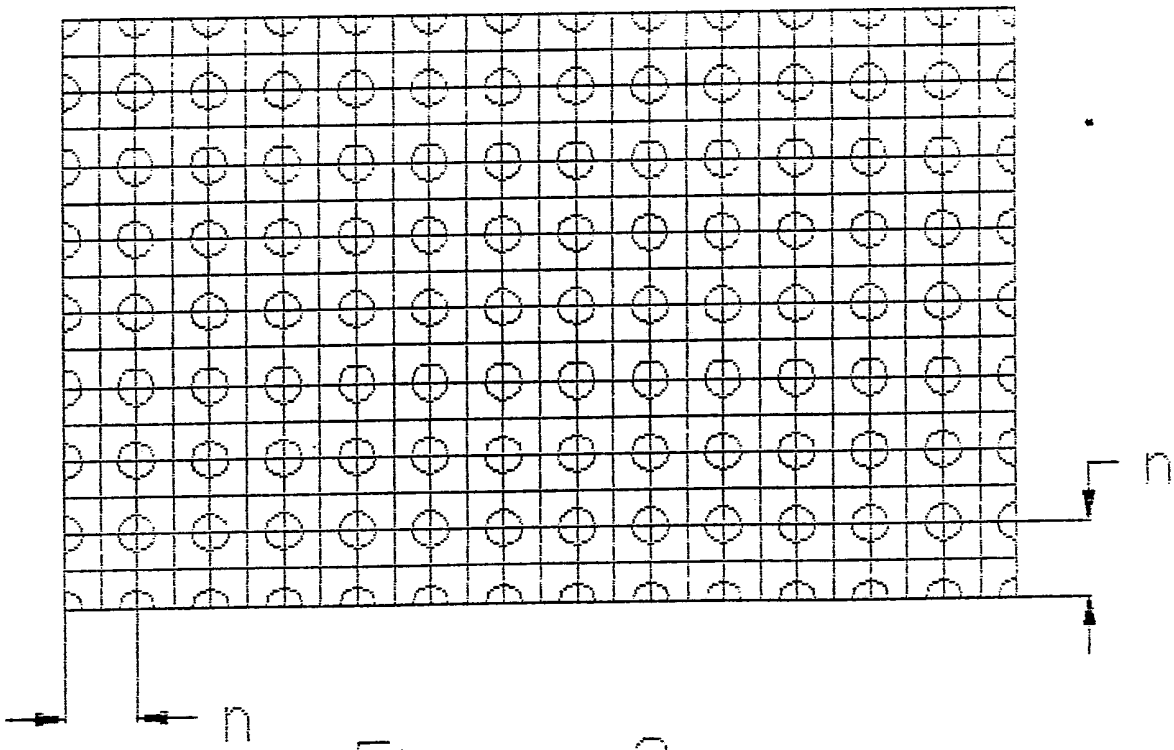

Figure 3

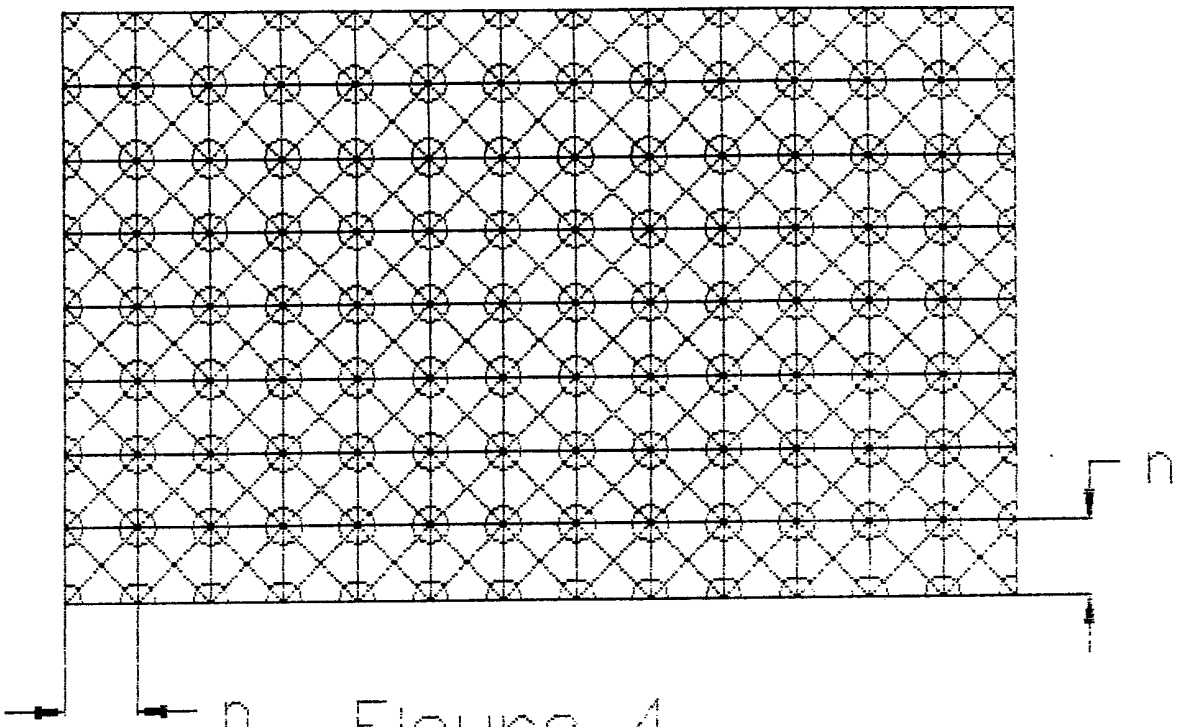

Figure 4

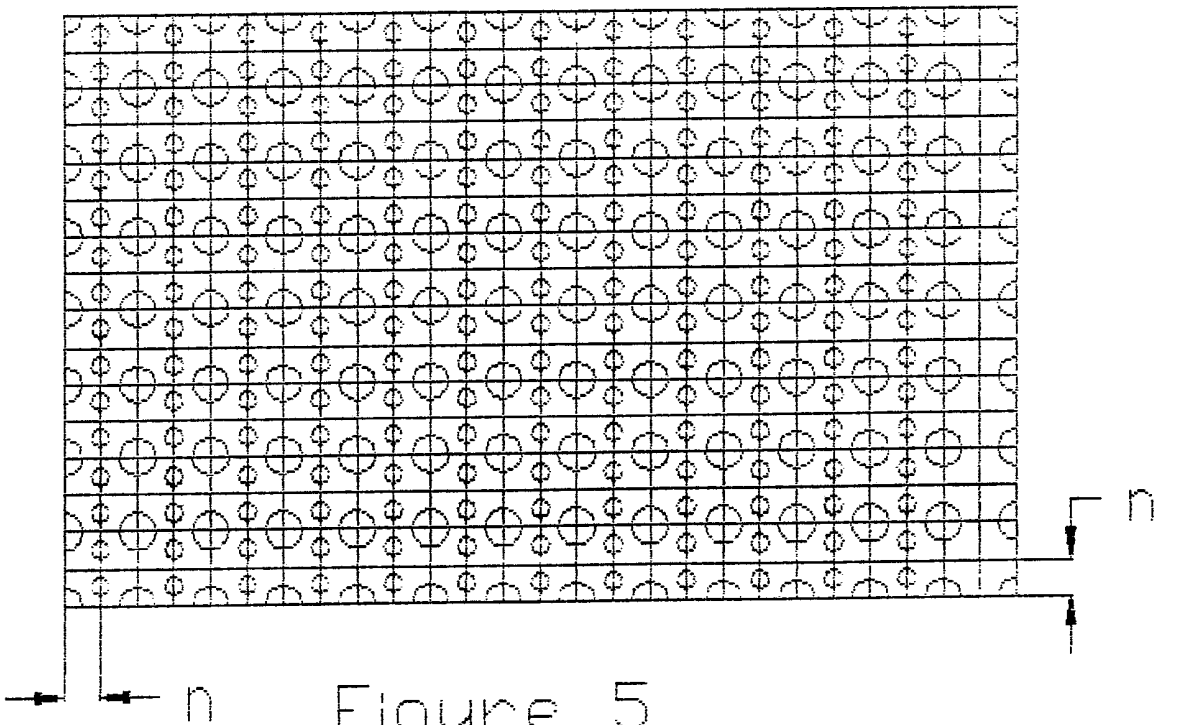

Figure 5

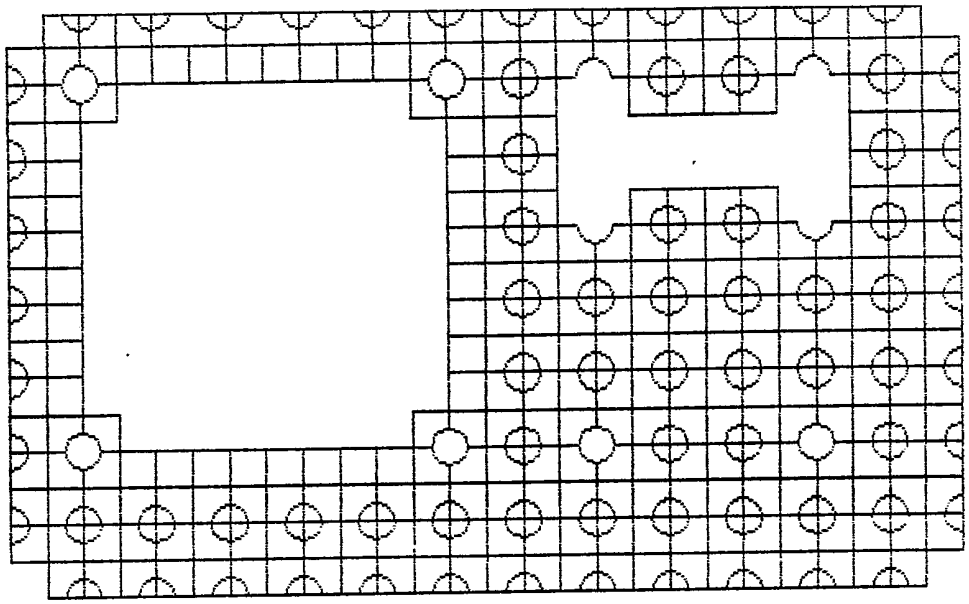

Figure 6

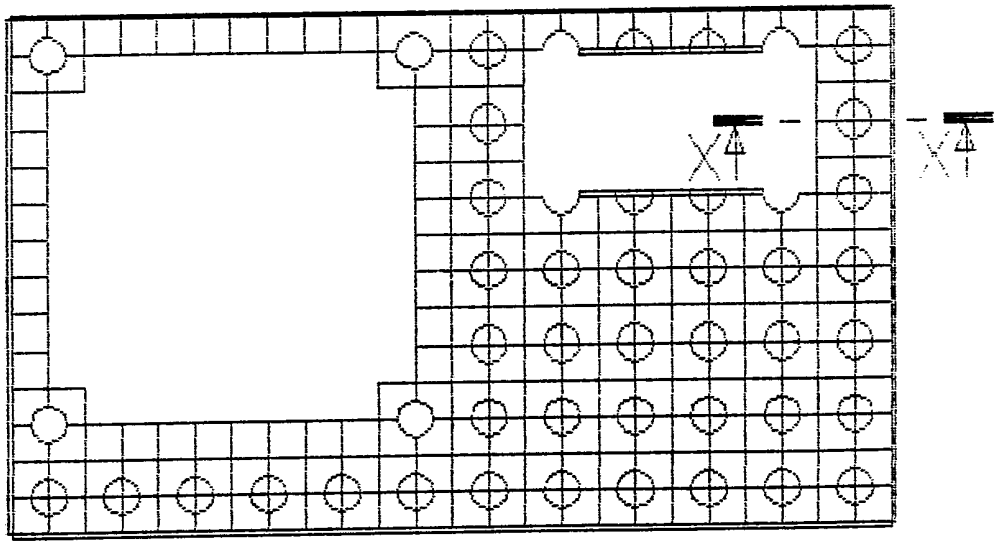

Figure 7

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Section X-X of Figure 7

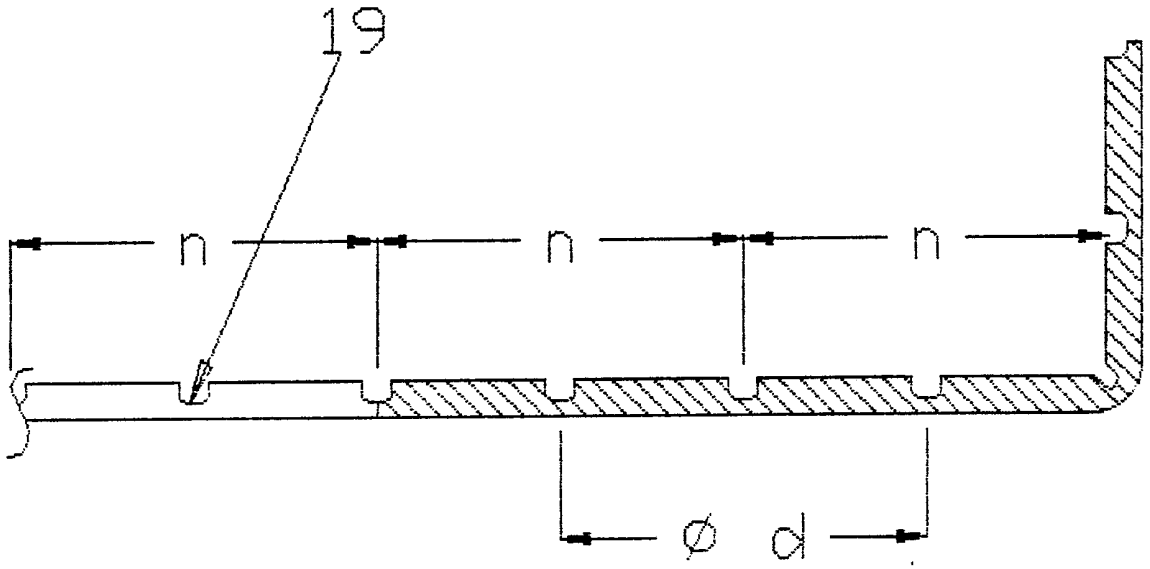

Figure 8 (Scale 10:1)

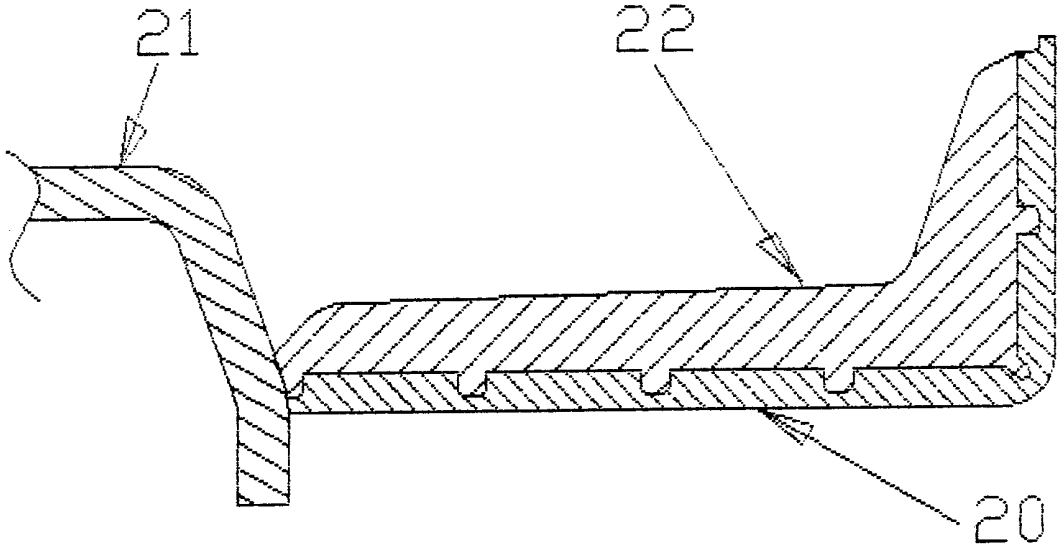

Figure 9 (Scale 10:1)

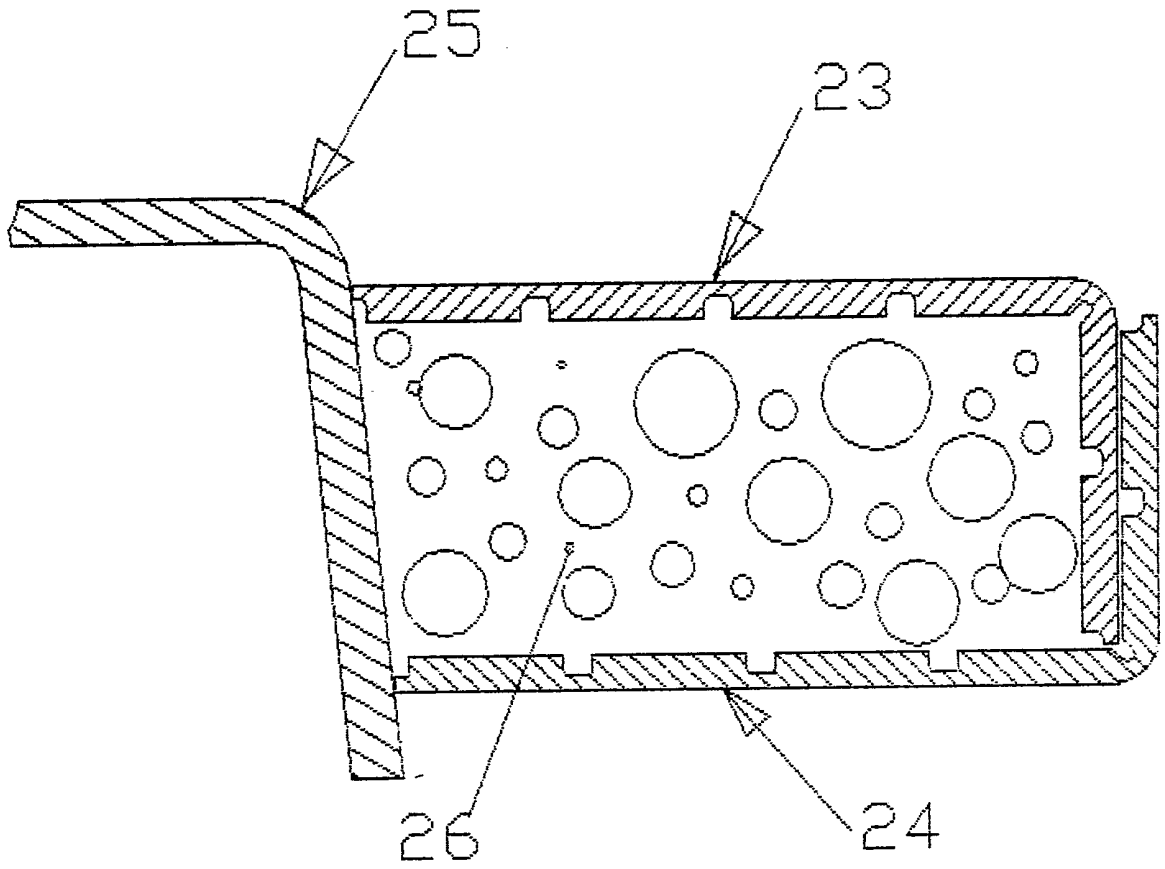

Figure 10

(Scale 10:1)

PRE-FORMED SHEET MATERIALS FOR SMALL SCALE MANUFACTURE

This invention relates to fabrication techniques using sheet materials that have been substantially pre-formed.

In many industries items that are required in small quantities are manufactured or fabricated by the manual working of sheet metals and plastics materials. The skills required to undertake this type of manufacture, which is generally known as sheet metal working, take a considerable period of training and are becoming increasingly rare. When unskilled persons attempt sheet metal or plastic fabrication, difficulties often arise in the accurate cutting out, folding of bends and the precise generation of holes and cutouts .

Sheet metal working requires the use of special machines and tools such as guillotines, punches, nibblers, drills and folding machines. The working of sheet metals can be noisy and generates much waste material and it is, therefore, usually carried out in workshop facilities designated for the purpose.

The invention is particularly concerned with the use of specially preformed sheet materials which, when manipulated with specially designed tools, can be used to manufacture a variety of goods using the minimum of sheet metal working skills and equipment when working in a clean laboratory or office environment.

It is the object of the present invention to provide, for the manufacture of items normally fabricated from sheet metals

and plastics, a kit of parts comprising specially preformed sheet materials, plastics materials for use as reinforcing or composite elements, accessories for adapting the specially preformed sheet materials to items of a mechanical, electrical and electronic nature and tools for the manipulation of said materials, which kit of parts can be used to fabricate any one of a plurality of items and in particular, boxes, enclosures, panels and structural members.

According to the present invention the improved method comprises the provision of substantially rigid sheet metal, plastic or composite material that has been inscribed by being chemically etched or electrochemically milled or otherwise machined or cast or plastically deformed with a pattern of lines and circles on at least one surface in such a way that the thickness of the sheet material is substantially reduced at the points where the pattern of lines and circles are inscribed. The pattern of lines and circles is laid out in a regular fashion with precise and even spacing between the different graphical elements and with the multiple lines either parallel, perpendicular or at regular angles to one another and the circles arranged in an array such that the centres of the circles are placed either at the intersections of lines or in the centres of any squares formed by the arrays of lines.

Material of this kind will hereinafter, for convenience, be referred to as "sheet material of the kind described" and is further illustrated by a description, by way of example, by the accompanying informal drawings, in which :-

Figure 1 is a part isometric view of one preferred form of

the improved sheet material of the kind described showing how the pattern of lines and circles is inscribed or etched into one surface, and

Figure 2 is a plan view of the preferred pattern as also shown in Figure 1 and showing lines inscribed both mutually spaced parallel to and perpendicular with one another to form a pattern of squares, and also showing circles with their centres at the intersections of the lines, arranged in an array, with the inscribed lines being spaced at a distance n, and

Figure 3 is a plan view of a second preferred pattern of lines and circles basically similar to the pattern shown in Figure 2 but with additional interstitial lines inscribed between the original lines, and

Figure 4 is a plan view of a third preferred pattern of lines and circles basically similar to the pattern shown in Figure 2 but with additional lines inscribed at angles of forty five degrees to the original lines, and

Figure 5 is a plan view of a forth preferred pattern of lines and circles basically similar to the pattern shown in Figure 2 but with additional smaller circles placed on the vertical lines.

The spacing or pitch between the lines is represented by the letter n where n is any convenient dimension but is preferably 5mm or 10mm in a metric version, or 6.35mm or 12.7mm in an imperial version of the sheet material of the kind described. The patterns illustrated in Figures 1 to 5 are intended to show by example how a variety of different patterns can be provided to suit any particular application.

The sheet material of the kind described has, thus, been considerably weakened where it has been inscribed with the pattern of lines and circles. The reduction in mechanical strength of the sheet material of the kind described at those points where it is inscribed with a pattern of lines and circles, makes the sheet material of the kind described readily workable along the lines and around the circumference of the circles of the inscribed pattern and any tensile, shearing or bending loads applied to the sheet material of the kind described will tend to act preferentially to enable the material to be cut, sheared and bent along the lines and the circumference of the circles of the inscribed pattern. Because the pattern of lines and circles is mutually inscribed at a precise fixed interval or pitch, then the sheet material thus inscribed can be cut, sheared and bent at the said precise spacing. The precise inscription of the pattern of lines and circles enables items to be manufactured without the need for accurately marking out and cutting the sheet material of the kind described.

Preferably the pattern of lines, squares and circles should be inscribed on only one side in order to present an attractive unmarked surface on the outer faces of any items manufactured from sheet material of the kind described. It has been found that the depth of the inscribed pattern of lines, squares and circles should be preferably but not necessarily greater than two thirds of the thickness of the sheet material of the kind described depending upon the type of material used. The preferred manufacturing method for sheet material of the kind described is the process of electrochemical milling.

Because the sheet material of the kind described has been considerably weakened where the pattern of lines and circles has been inscribed, the degree of force required to work the material is considerably reduced when compared to that required to work material of the original thickness and it is possible to work the sheet material of the kind described using relatively light and simple tools and machinery. Special tools provided for working sheet material of the kind described include circular punches of diameter corresponding to the diameter of the circles of the inscribed pattern and square section punches of side distance n ; the punches may be provided with a pip or small protrusion to assist in setting the punches central to a feature in the inscribed pattern. Holes, cutouts and shapes can be made by punching the sheet material of the kind described with the special punches and this procedure is simplified if the sheet material of the kind described is placed on a backing sheet of collapsible material, preferably expanded polyurethane or polystyrene foam, thus allowing the waste material to be readily detached.

It will be appreciated that the sheet material of the kind described will lack a degree of strength and rigidity required for the satisfactory fabrication of many manufactured items and, where necessary, it is possible to reinforce the fabrications using a number of different techniques. It is intended that the sheet material of the kind described will be provided as a kit of parts that would include instructions for the fabrication of many common manufactured items including techniques for reinforcement, a set of plastic materials for reinforcing the partially

fabricated items, a number of accessories to improve the utility of the fabricated items such as bushes,corner pieces and inserts and a set of tools and equipment for the working of the sheet material of the kind described.

The techniques for using the kit of parts and the sheet material of the kind described are best described by way of illustration, by example, with reference to the following informal drawings in which,

Figure 6 shows a plan view of a typical front panel of an enclosure intended for an electronic assembly and showing how the original panel also shown in figure 2 has been punched with holes and cutouts intended for various devices and is shown as a developed sheet prior to it being bent, and

Figure 7 shows a plan view of the panel also shown in Figure 6 but illustrating how the edges have been folded along inscribed lines at right angles to form a stiffened panel, and

Figure 8 shows a part sectional view X-X at a greatly enlarged scale of Figure 7. This view illustrates the sectional geometry of the inscribed lines and circles 19, with the lines pitched at a spacing of n and the circles having a diameter of d, and

Figure 9 shows the section also shown in figure 8 where 20 is a section of the sheet material of the kind described, and 21 is a part sectional view of a bung or plug intended to blank off a hole or cutout in the panel, and 22 represents a skin or film of thermosetting plastic resin that has been applied to the inscribed side of the section of the sheet material of the kind described by casting or painting. The applied thermosetting

plastic resin will flow into inscribed grooves of the sheet material of the kind described and will increase the thickness of the composite panel thus increasing its rigidity.

Figure 10 shows another composite section of an enclosed or box structure where 23 and 24 are sections formed from panels of sheet material of the kind described, 25 is a part sectional view of a bung or plug intended to close off or fill temporarily holes or cutouts and 26 represents a material used for filling the enclosed box structure forming a composite panel. The material 26 is preferably, though not necessarily, a thermosetting plastic resin or expanded foam plastic. The finished panel thus comprises an outer skin fabricated from panels of sheet material of the kind described and an inner core of plastic material.

CLAIMS

1 A preformed substantially rigid sheet or sheets of metal, plastic or composite material that has been inscribed by being chemically etched, or electrochemically milled, or otherwise machined, or cast, or plastically deformed, with a pattern or lines and circles on at least one surface in such a way that the thickness of the sheet material is substantially reduced at the points where the pattern of lines and circles are inscribed. The pattern of lines and circles is laid out in a regular fashion with even spacing between the different graphical elements and with the multiple lines either parallel, perpendicular or at regular angles to one another and the circles arranged in an array such that the centres of the circles are placed either at the intersections of lines or in the centres of any squares formed by the arrays of lines.

The material has, thus, been considerably weakened where it has been inscribed with the pattern of lines and circles. The reduction in mechanical strength of the sheet material at those points where it is inscribed with a pattern of lines and circles, makes the sheet material readily workable along the lines and around the circumference of the circles of the inscribed pattern and any tensile, shearing or bending loads applied to the sheet material will tend to act preferentially to enable the material to be cut, sheared and bent along the lines and the circumference of the circles of the inscribed pattern. Because the pattern of lines and circles is mutually inscribed at a precise fixed interval or pitch, then the sheet material thus inscribed can be

cut. sheared and bent at the said precise spacing. The precise inscription of the pattern of lines and circles enables items to be manufactured without the need for accurately marking out and cutting the sheet material.

2 A preformed sheet material as claimed in Claim 1 but where the pattern of lines, squares and circles is inscribed on only one side in order to present an attractive unmarked surface on the outer faces of any items manufactured from the material.

3 A kit of parts comprising specially preformed sheet materials as claimed in Claim 1 and Claim 2, plastics materials for use as reinforcing or composite elements, accessories for adapting the specially preformed sheet materials to items of a mechanical, electrical and electronic nature and tools for the manipulation of said materials, which kit of parts can be used to fabricate any one of a plurality of items and in particular, boxes, enclosures. panels and structural members.

4 Special tools provided for working sheet materials as claimed in Claim 1 and Claim 2, including circular punches of a diameter corresponding to the diameter of the circles of the inscribed pattern and square section punches of side distance n ; the punches may be provided with a pip or small protrusion to assist in setting the punches central to a feature in the inscribed pattern.

5 Holes, cutouts and shapes can be made by punching the sheet materials as claimed in Claim 1 and Claim 2, with the special

the sheet material of the kind described is placed on a backing sheet of collapsible material, preferably expanded polyurethane or polystyrene foam, thus allowing the waste material to be readily detached.

6 A means of reinforcing fabrications made from preformed sheet materials as claimed in Claim 1 and Claim 2, by applying thermosetting plastic resin or expanded plastic foam to the inscribed surface of the sheet panels.

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