Jan. 24, 1961 W. A. DI MARCO ET AL 2,969,544

CONTOURED ARTICLE

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Fig. 1.

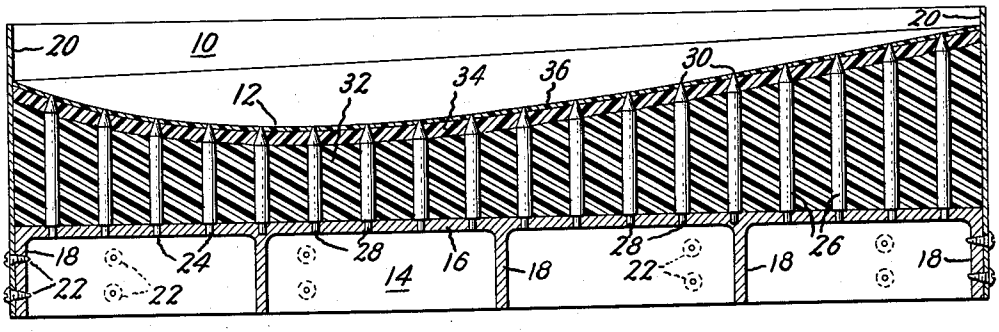


Fig. 2.

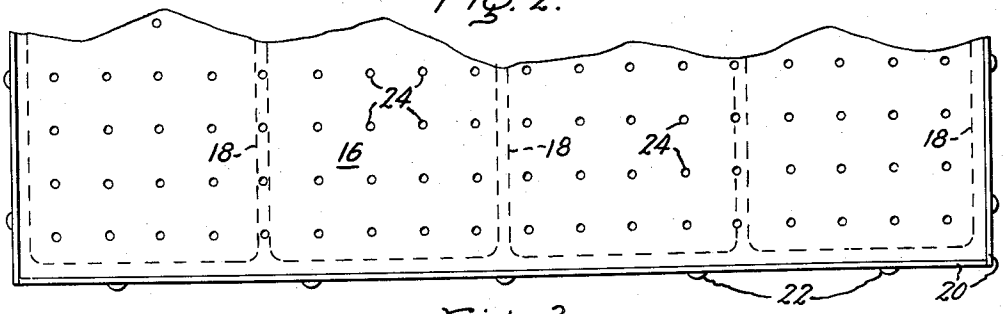
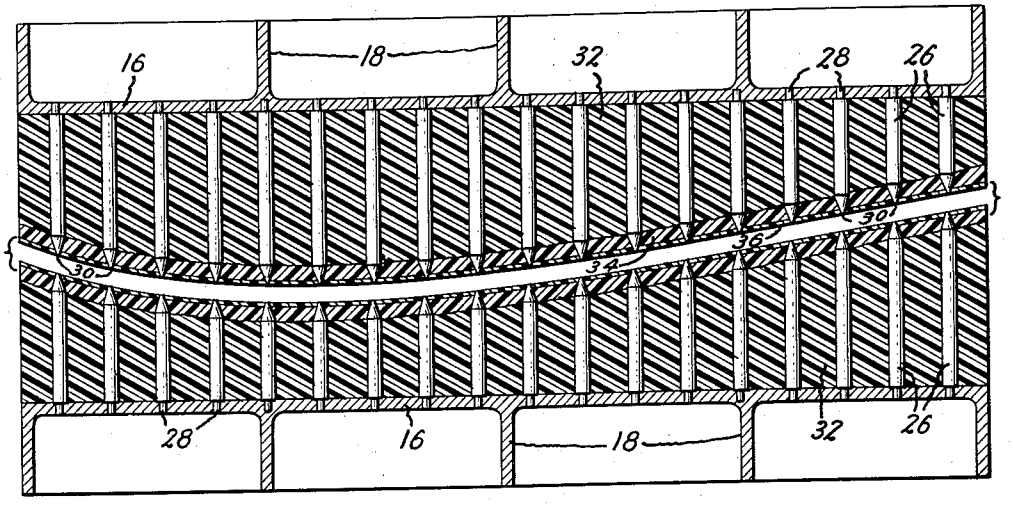


Fig. 3.



Inventors:
William A. DiMarco,
Leverne G. Hoag,
by Roe D. McBurnett
Their Attorney.

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CONTOURED ARTICLE

William A. Di Marco, Tyler, Tex., and Leverne G. Hoag, Pittsfield, Mass., assignors to General Electric Company, a corporation of New York

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1 Claim. (Cl. 343—912)

This invention relates to the manufacture of articles having accurately contoured surfaces, and more particularly is directed to new and improved accurately contoured articles such as radiant energy reflectors.

Heretofore it has been the common practice to fabricate master and experimental radar antenna forms by processes involving manual carving or machining of a blank to the desired surface configuration, or processes in which the form is built up piece by piece using shaped laminae and like materials. All these known processes require skilled operators and are tedious and costly to practice, particularly when the article is large in size or its surfaces have complex curvature as is the case in many radar antenna designs. These and other disadvantages of the prior forming methods have rendered economically unfeasible the otherwise desirable practice of fabricating a number of experimental antennas each differing slightly in surface contour from the others, for determining the optimum antenna contour by actual performance measurements.

It is accordingly the principal object of this invention to provide new and improved accurately contoured articles, which are characterized by maximum economy and simplicity of construction and are adapted to production of articles of large size and complex curvature. It is also an object of the invention to provide articles such as radar antenna forms and molds therefor.

The invention as carried out in one form is directed to articles such as radiant energy reflectors and the like having accurately contoured surfaces, the articles of the invention being adapted to use either directly as end products or as dies and molds for producing other articles having similarly contoured surfaces. In accordance with the invention, surfaces of the desired contour are produced in steps of providing a plurality of peg mounting means distributed in geometric pattern over a base member, inserting pegs in the holes of selected lengths such that the upper ends of the pegs define a plurality of points lying in the surface contour to be produced, and filling the space between pegs with a filler material to a level with the upper ends of the pegs, whereby the surface of the filler material accurately defines the surface contour desired.

The invention will itself be more fully understood and its various objects, features and advantages further appreciated by reference to the appended claim and the following detailed description when read in conjunction with the accompanying drawing, wherein:

Figure 1 is a sectional view of an article, which may be either a mold, die or end product article, produced in accordance with the invention.

Figure 2 is a fragmentary plan view of a base member suitable for use in producing the article of Figure 1; and

Figure 3 is a sectional view through male and female die elements for press forming use, produced in accordance with the invention.

With continued reference to the drawings, wherein like reference numerals are used throughout to designate like elements, the assembly designated generally by reference

numeral **10** in Figure 1 may be either a finished article or a die or mold for forming other articles having surfaces shaped complementarily to its upper contoured surface **12**.

As shown, this contoured surface **12** is formed over a base member **14** which may take the form of a flat plate **16** having a plurality of webs **18** formed integrally with the plate or attached thereto. These webs **18** make the plate **16** more rigid and also provide surfaces for attachment of the side wall members **20**, which may conveniently be secured to ribs **18** as by screws **22**. These side walls and base plate together define an upwardly open box as shown.

Base plate **16** is provided with a plurality of peg mounting means which, in the illustrated embodiment, take the form of holes **24** distributed in geometric pattern over the surface of the plate. The exact pattern of distribution of the peg mounting means depends on which coordinate system is most convenient for use in defining the contoured surface. If this surface is defined in rectangular coordinates, then the peg mounting means may be distributed in rectangular pattern generally as best shown in Figure 2. If polar or other non-rectangular coordinate systems are to be used then the distribution of the peg mounting means on base member **16** is modified accordingly.

From the equation or other mathematical expression defining the surface contour to be produced, the altitude of the surface above base member **16** at each set of coordinates at which one of the peg mounting means is located may be determined. A peg **26** of free length equal to this altitude then is obtained, peg free length being defined as the height of the peg when mounted to the base member. Thus, where the pegs **26** are provided with reduced diameter end portions **28** as shown fitted into the holes **24** of base member **16**, then peg free length does not include the length of this reduced diameter end portion.

The pegs **26** may be made at time of use in the exact lengths necessary to define the particular surface to be produced, or if preferred the pegs may previously be made up and supplied in graduated lengths, with the length graduations being sufficiently small that pegs of any desired length may be selected directly from stock and mounted to the base member.

Preferably, each of the pegs **26** is provided with a conical tip portion **30** as best shown in Figure 1, since if the peg tips were flat they would not accurately conform to the curvature of the surface to be produced. While for maximum accuracy it would be desirable that the peg tip taper to a point, it generally is preferred to provide a very small flat at the peg tips, say one-sixteenth inch in diameter, because such flats are more readily visble than points and thus facilitate the forming operation. Being very small, these flats do not appreciably affect the accuracy or smoothness of the surface produced.

After all the pegs have been mounted to the base member, the space between pegs then is filled with any suitable bulky material such, for example, as shredded fiber glass, foam plastic, plaster, saw-dust or other like materials, as designated generally by reference numeral **32**. Since the desired finished surface itself cannot easily be formed smoothly with such rough filler materials, the bulk material preferably is filled only to within perhaps one-half inch of the tops of the pegs. Over this bulk material then is poured a settable plastic composition as indicated at **34**, which may be any suitable hot or cold setting plastic such, for example, as one of the well-known epoxy resins. This settable plastic is leveled to within a few thousandths inch short of the peg tips and then is permitted to set.

Next, a paste of the same or other settable plastic is

made and trowelled flush with the peg tips as shown at 36, after which it in turn is allowed to set. The resulting surface then may be buffed or otherwise smoothed to remove any unevenness, and if during this smoothing operation any voids occur they can readily be filled with additional plastic. The side wall members 20 then may be removed and the completed article placed in use.

If the finished article is intended for use as the backing structure of a radiant energy reflector, then its contoured surface may be metallized in any convenient manner as by metal paint, metal sputtering or evaporation in vacuo. Alternatively, a layer of metallic foil may be embedded just below the surface layer 36 of plastic.

As noted above, the article may also be used as a mold or die for producing other articles having complementarily contoured surface. This operation may be carried out by any of the conventional molding processes including hydroforming, vacuum bag and stretcher processes. Articles can also be molded directly over the form using plastics, laminates, and like materials. By producing both male and female elements as shown in Figure 3, the articles of the invention also may be used as dies in conventional press processes.

While only a specific embodiment of the invention has been shown and described, it will be understood that various other modifications may be made without departing from the invention. The appended claim therefore is intended to cover all such modifications as fall within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

An article of manufacture having an accurately contoured surface comprising a base member, a plurality of peg mounting means distributed in selective geometric pattern over a surface of said base member, a like plurality of pegs including means coacting with said base member peg mounting means to mount the pegs thereto in substantially normal relation to the base member, said pegs being of selected lengths such that the outer ends thereof together define and maintain the desired surface contour, and a body of rough filler material filling the space between said pegs to a predetermined level from the outer ends thereof, a finish layer of settable plastic coactively placed over said filler material to a level with the outer ends of said pegs, and a layer of metallic foil imbedded between said filler material and said settable plastic.

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