(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 857 822 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
12.08.1998 Bulletin 1998/33

(51) Int. Cl.^{6}: **D21J 5/00**

(21) Application number: **97101959.1**

(22) Date of filing: **07.02.1997**

(84) Designated Contracting States:
DE DK ES FR GB IT NL

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(54) Liquid-permeable suction mould for use in the manufacture of articles of pulp, and method for making such a mould

(57) In a suction mould (1) comprising a mould-surface structure (4) having openings (4") allowing passage of the liquid but not of the fibres, in the form of closely spaced through-going ducts supported against the force of the suction by a backing structure (5), and adapted to be connected to a source (not shown) of sub-atmospheric pressure, for making a thin-walled article (not shown) by aspirating said slurry against the surface of the mould,
the novel feature is
that the mould-surface structure (4) and the backing structure (5) are integral parts of a common coherent body.

With this arrangement, no separate backing structure is needed, making it possible, preferably by using novel methods of selective hardening of plastic materials, to manufacture moulds quickly and at low cost, making it more economical than previously to adapt the slurry-casting machine (not shown), in which the mould (1) is used, to the quickly changing requirements of the market.

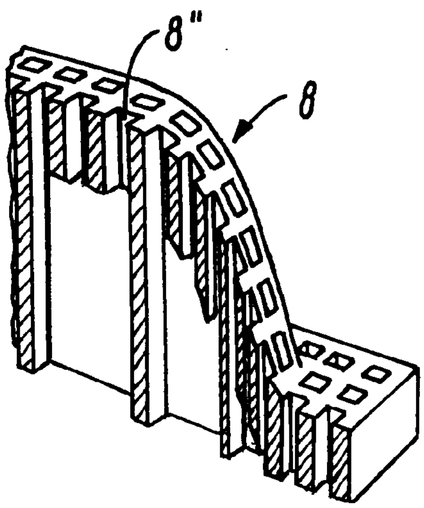

FIG.2b

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Description

TECHNICAL FIELD

The present invention relates to a liquid-permeable suction mould for use in making thin-walled articles by sucking a slurry of fibre pulp against a perforate mould surface having a shape corresponding to that of the articles to be made, said mould having through-going ducts extending from openings in said mould surface being so dimensioned as to allow passage of the liquid, but not the fibres in said slurry, to openings in an oppositely located mounting surface, adapted to have suction applied to it in order to produce said pulp article.

BACKGROUND ART

When producing articles of pulp to be used as protective packaging elements in connection with the packaging of consumer goods of the type changing in appearance frequently, typically in the course of a year or two, such as electronic equipment of the type mobile telephones, electrical household devices, video cassette recorders, etc., frequently having an irregular three-dimensional surface, it is necessary to use moulds with a complicated complementary three-dimensional mould surface, and at the same time, these moulds must be very cheap to produce due to the short life span and the relatively small-sized series of the consumer goods concerned. At the same time it is also necessary to provide a packaging product capable of satisfying the high demands of the manufacturers of consumer goods with regard to the properties of the protective packaging, such as e.g. rupture strength, zones of controlled deformation, elasticity, capability for free stacking etc., all in such a manner that the manufacturers prefer to use packaging elements made of moulded pulp rather than those conventionally made of plastic material for these packaging purposes.

The conventionally used complicated three-dimensional suction moulds have until now been manufactured by dividing the mould into a generally plane base part and a greater number of smaller spatial shape elements, the latter together constituting a shape-giving part to be placed on said base part. All the shape elements are normally and advantageously made from a metal or a plastic material and are covered with an ordinary wire gauze, e.g. a 50 mesh gauze of stainless steel having wires approx. 0.3 mm thick and openings measuring approx. 0.3 mm. Only the process of covering the shape elements with wire gauze is extremely demanding in terms of cost and resources, because it is carried out manually, i.e. one will start off with a plain wire gauze, which is cut and shaped to the three-dimensional shape desired and welded. The shape-giving part will also comprise a great number of drain holes for the liquid having a spacing of e.g. 8-10 mm.

As will be evident from the preamble of claim 1, the suction mould functions as a filter, on which fibres from the pulp are deposited to form a shell-shaped pulp article, and the moulds are used in the conventional manner in connection with making such pulp objects. Thus, the fibre-containing dispersion is sucked onto the mould surface (the surface of the gauze) on the suction mould by subjecting the mould to a vacuum and sucking a part (approximately 25%) of the liquid phase from the dispersion through the gauze and the mould surface towards the opposite side of the mould, so that the fibres in the fibre-containing dispersion are deposited on the surface of the wire gauze. The next step comprises compressing the pulp object gently between the suction mould and a transfer mould. Towards the end of this gentle compressing, the vacuum can be replaced by a gentle blast of compressed air in such a manner that the shell-shaped pulp object is loosened from the suction mould and transferred to the transfer mould, provided that a vacuum is applied to the latter at the same time. Finally, the articles are transferred by means of the transfer mould to a conveying system conveying the articles through a drying oven, after which the total liquid content in the pulp object will be approximately 8%.

A substantial advantage of using suction moulds with a wire gauze covering the shape-giving part is to be found in the fact that this gauze contributes towards the fibre slurry being sucked fairly evenly distributed across the surface of the gauze, since the vacuum being applied will to a great extent be uniformly distributed throughout the space existing between the rear side of the gauze and the surface of the shape-giving part. In other words: the existing suction moulds provided with wire gauze exhibit excellent suction-moulding characteristics.

Among the more characteristic limitations in connection with the manufacture of pulp articles using conventional suction moulds with a wire gauze made to conform to the shape-giving part will be found partly that it may be difficult to produce mould surfaces with sharp transitions between the individual shape elements, since it must be possible to secure the gauze between the individual shape elements, partly that it is impossible to produce pulp objects with angles of less than approximately 8°, due to the tendency of the gauze to catch and hold that part of the fibre mass entering into and getting wedged in the wire crossings of the gauze. To this must be added that the total flow-cross-sectional area of the shape-giving part for a given mould area normally only constitutes approximately 3% of the area of the shape-giving part.

Other types of moulds, such as e.g. sand or particle moulds, are known. These types of moulds are based on the common feature that the mould material is normally constituted by a material, which in the initial state is in the form of loose particles, such as e.g. sand, quartz-containing material, aluminium powder and the like. These materials are used in several different particle sizes and shapes (cubic etc.), and the smallest particle sizes are normally used for forming the mould surface of the shape-giving part so as to give this surface an as even and uniform structure as possible. These moulds are made by placing a replica of the object to be manufactured in a mould box, after which the mould material is poured onto the replica with the smallest particles first, after which the larger particles are poured in until the mould box is full. The most common methods for solidifying the mould material are to cause the individual particles to be wedged together or to add a binder to the mould material before pouring it into the mould box, after which it is allowed to set, normally requiring approximately 24 hours. A substantial disadvantage with these types of moulds is, however, that they can relatively quickly be clogged in their internal structure and can only be purged to a limited extent because of the special structure with particles having a relatively low mechanical strength.

A recent development in this technology is disclosed in GB-A-2,283,966 and GB-A-2,284,380 (Bowater Plc). The latter describes with reference to its Figure 11 a mould made by supporting a mesh (22) on a shaped support (20) The mesh may be ordinary wire mesh (gauze), or made by stereolithography (SLA = Stereo Lithographic Application), whereas the support may be made as a bonded stack of plastics-coated paper or other layers, which may be formed with drainage apertures, the contours of which are defined by a laser.

These moulds do, however, tend to suffer from the drawbacks referred to in connection with the sand or particle moulds described above, such as low mechanical strength making it difficult to purge the mould without causing damage to it. Further, their manufacture is relatively complicated and time-consuming.

Another recent development is described in EP-A2-0,719,894 (Sintokogio, Ltd.). In the suction mould described in this publication, the part of the mould comprising the mould surface is a reticulate resin shell, metallized for reinforcement and mounted on a support member of considerable thickness and having passages for the liquid aspirated through the reticulate shell during the process of making a pulp article.

These moulds are also complicated to manufacture, thus increasing the cost of the articles made with such moulds.

DISCLOSURE OF THE INVENTION

On the background of the above, it is the object of the present invention to provide a mould of the kind referred to initially, in which the limitations referred to above are substantially eliminated, and with which it is possible to achieve suction-moulding characteristics at least corresponding to those that can be achieved with the conventional suction moulds provided with wire gauze, as well as to provide a method for manufacturing such a mould.

This object is achieved with a mould of the type described initially, according to the present invention further being characterized in that the mould is a one-piece element with a thickness as measured between said mould surface and said mounting surface sufficient to give ability to said element as such the requisite mechanical strength and withstand the forces created by the greatest difference in pressure between said two surfaces.

With this arrangement, it is possible not only to achieve a mould surface, onto which the shell-shaped pulp object is to be moulded, which in the surface regions between the individual ducts presents itself as mutually aligned, and thus not overlapping or crossing each other as in the conventional wire-gauze moulds. Further, the flow rate through the ducts - all else being equal - will be very much higher than that through the openings in the wire gauze. Moreover it is possible to avoid pulp fibres being caught in the crossing points of the wire gauze as mentioned above, thus making it possible to manufacture pulp articles with angles less than the above-mentioned normal angle of approximately 8°. This is of great importance with regard to minimizing the external dimensions of the articles, this especially being a factor when the pulp articles are to be shipped and later used, e.g. as protective packaging devices, elements or inserts. Making the mould in the form of a self-supporting coherent body will, of course, improve the manufacturing process.

It will be possible to manufacture the mould as such as a one-piece structure that can be produced in a uniform manner and hence also within very small dimensional tolerances. To this must be added a hitherto unknown high quality in the suction-moulding characteristics, an extremely uniform and even suction being achieved, this again meaning that the pulp articles can be manufactured with smaller variations in size than has been possible to achieve with the conventional moulds. The ducts in the coherent body are continuous and preferably open at two ends but are not necessarily connected to each other, e.g. they form individual through-going passages that may be connected to the device for applying vacuum, possibly also pressure.

When, as set forth in claim 2, the one-piece mould element has approximately the same thickness over its entire surface as measured between said mould surface and said mounting surface, the flow resistance can be made substantially equal for all points on the mould surface.

When, as set forth in claim 3, the one-piece mould element has sections with greater thickness for reinforcing said sections of the mould, it is possible to make moulds with a large surface area while retaining the requisite mechanical strength needed to withstand the pressure difference.

When, as set forth in claim 4, the one-piece mould element has stiffening ribs near the mounting surface, it is possible to achieve the requisite mechanical strength while retaining the possibility of influencing the flow resistance pattern.

When, as set forth in claim 5, said ducts extend substantially mutually parallel, it is possible to achieve a simple build-up of the coherent body, making it possible to manufacture the latter in a simple manner.

When, as set forth in claim 6, said ducts extend substantially at right angles from said mould surface, it is achieved that the risk of fibres passing through is reduced.

When, as set forth in claim 7, the mould comprises at least two regions, of which first regions bordering on the mould surface comprise ducts, while second regions not bordering on the mould surface comprise reinforcement ribs extending from said first regions to said mounting surface, it is possible to obtain an integrated mould with which it is possible to achieve a flow distribution providing the required thickness distribution in the pulp product being made using the mould.

When, as set forth in claim 8, the material used for manufacturing the mould is constituted by a metal or a plastic material, preferably the same material for all regions of the body, it is possible to manufacture the mould in a material that is suitable in connection with the production of so-called RPT patterns (Rapid Prototyping Techniques), including the use of SLA technology (Stereo Lithographic Applications), a method comprising building a three-dimensional pattern layer by layer and using irradiation to make a part of a liquid material set while the material is contained in a tank or the like.

When, as set forth in claim 9, the ducts extending from the mould surface at least at the mould surface have transverse dimensions of between 0.2 and 2 mm and are spaced from each other at distances of between 0.1 and 0.8 mm, it is achieved that each of the parts, in which these ducts are formed, comprises a mechanically stable body having almost the same strength as a compact body of the same overall shape.

When, as set forth in claim 10, the openings in the mould surface, from which the ducts extend, have a total cross-sectional area of 10-80%, preferably approximately 50% of the corresponding total mould-surface area, it is possible to achieve a hitherto unknown dewatering speed, i.e. if desired, the period of pulp deposition can be reduced substantially.

The present invention also relates to a method for manufacturing a suction mould according to the invention, and this method is characterized by the use of a material, preferably a settable material, that can be built up layer by layer by causing successive layers to set according to a predetermined pattern in such a manner that the layers co-operate to form a mould having the desired shape including said ducts, and then removing the un-set material. One way of doing this would be to use a settable plastic material, that can be made to set by means of irradiation and by irradiating said material while controlling the irradiation in space and time so as to make the material set layer by layer. The irradiation can e.g. be carried out by means of a laser beam, ultraviolet radiation or infrared radiation. A suitable method for use when making such a three-dimensional object is the so-called SLA technology (Stereo Lithographic Application), e.g. of the type disclosed in US-A-5,071,337. Thus, a mould manufactured by using this technology will be dimensionally highly stable and hence simple to reproduce in a number of exactly equal copies, making it possible to manufacture thin-walled pulp objects of a quality hitherto unseen. To this must be added that the time of manufacture for such a suction mould produced using the SLA technology may be reduced considerably relative to the time of manufacture for a conventionally constructed suction mould with wire gauze, constituting up to several weeks.

By carrying out the method in such a manner, that the thin-walled article is designed by using a conventional computer-aided-design programme for automatic data processing, and that the basic data thereby provided are converted to a set of complementary basic data for use in connection with manufacturing the mould with ducts in a suitable manufacturing apparatus, it is possible to use the set of basic data in connection with the forming of at least parts of the suction mould in a suitable manufacturing apparatus of the type referred to above.

Further embodiments of the mould and the method of making it are set forth in claims 14-16 and 13, respectively, and their effects are explained in the following detailed part of the present description.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following detailed part of the present description, the invention will be explained in more detail with reference to the exemplary embodiments of suction moulds according to the invention shown in the drawings, in which

Figure 1 is a diagrammatic sectional elevation of an exemplary embodiment of a suction mould manufactured according to the invention,
Figures 1a and 1b are partial views in perspective of the suction mould of Figure 1,
Figure 2 in the same manner as Figure 1 shows a second exemplary embodiment of a suction mould according to the invention,
Figures 2a and 2b are partial views in perspective of the suction mould of Figure 2,
Figures 3-5 in the same manner as Figures 1 and 2 show further exemplary embodiments of a suction mould according to the invention,
Figures 3a-6a are partial view in perspective of the suction mould of Figures 3-6, respectively,
Figure 7 diagrammatically shows various cross-sectional geometries for the suction ducts in a suction mould according to the invention, and
Figures 8-11 illustrate further possibilities for imple-

menting the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As will be evident from the drawing, a number of exemplary embodiments of a suction mould according to the invention is shown.

Figures 1-1b show an example of a suction mould 1 with a cellular mould 2. The reference number 3 indicates a conventionally used mounting surface, upon which the suction mould 1 can be placed and which communicates with a suction and pressure chamber device, respectively (not shown). As will further be evident from the figure, the integrated mould 1 shown is made from the same material throughout and comprises material elements 2', connected to each other so as to form a great number of through-going suction ducts 2". In the example shown, these suction ducts 2" extend parallel to each other, opening at one end to the mounting surface 3 and at the other end at the surface of the mould 1, i.e. the surface, upon which the fibre pulp is to be deposited.

Figures 1a and 1b show at an enlarged scale a segment of the suction mould 1 shown in Figure 1. In the exemplary embodiment shown, the suction ducts have a square cross-sectional shape, for which reason the material elements 2', forming together a coherent mould structure, can have a width M_3 of 0.1-2 mm, a thickness M_1 of 0.2-2.0 mm and a total length M_2 of e.g. 1.0-100.0 mm, preferably 1.0-20.0 mm.

Figures 2-2b show a second exemplary embodiment of a suction mould 1 according to the invention. In broad outline, the mould shown is similar to the one described above, but differs from it by comprising two distinct structures, viz. a mould-surface structure 4 and a backing structure 5. It should be noted, however, that the two structures 4 and 5 are integral parts of the common coherent body constituting the mould 1.

Figures 2a and 2b again show square-shaped suction ducts like those in the example of Figure 1a. As shown, the ducts 4" have width dimensions S_1, S_2 of approximately 0.2-2.0 mm and a length N_a of approximately 1.0-20 mm in the region of the mould constituting the cellular structure 4. A special feature of this exemplary embodiment is that reinforcement ribs are arranged in the backing structure 5 with suction ducts 5", the latter then opening towards the mounting surface. The width dimensions of the suction ducts 5" become S_a, S_b, while the length normally becomes (M_2-N_a), in which M_2 is the total height of the mould and N_a is the height (length) of the mould-surface structure 4.

Figure 3 shows an exemplary embodiment, that can be regarded as derived from that shown in Figure 2 by removing the latter's backing structure 5. In this embodiment, the requisite mechanical strength may be provided by shaping the mounting surface (cf. 3 in Figure 1) so as to fit snugly and support the lower side of the mould-surface structure 4, or by making the latter from such a material, such a thickness and such dimensions of the ducts 4", that it is self-supporting.

As illustrated in Figures 4 and 4a, it is also contemplated that the suction mould 1 can be provided with a mould-surface structure 6 and a backing structure 7, in which especially the suction ducts 6" in the mould-surface structure 6 exhibit a special feature, as one end of them, opening towards the pulp object to be manufactured at the surface of the structure, extends substantially at right angles to the mould surface at any given point on the mould 1. With this arrangement, the suction holes in the surface of the mould will have the smallest possible extent, thus reducing the proportion of fibres being sucked into the ducts.

In principle, the invention can be used to form any kind of three-dimensional mould, in Figure 2b exemplified in the form of a body 8 with suction ducts 8" and having steep side surfaces. In addition to the square cross-sectional shape of the suction ducts shown, a skilled person can, of course, choose cross-sectional shapes with different geometries, such as oval, rectangular, triangular, hexagonal etc., and as shown in Figure 7, each duct may be "sub-divided" into a number of different cross-sectional shapes.

As will be evident when comparing Figure 5 to Figures 3 and 4, the embodiment shown in Figure 5 is a combination of features from said Figures 3 and 4.

Figures 6 and 6a show an embodiment, in which the ducts extend in three directions at right angles to each other. This embodiment could be realized by first making a block having such sets of ducts throughout its volume, after which the block would be machined to remove surplus material, e.g. leaving a mould like the one shown in these Figures, although it is preferred to use a computer-based method of material deposition.

Figure 8 illustrates the possibility of using automatic data processing to provide a mould with ducts of a desired shape. In this case, a computer programme representing the mould surface in three spatial dimensions is combined with a mesh programme, so that a mesh of suction openings will be provided in the mould surface, continuing into suction ducts extending through the mould-surface structure. The combined programme can be used to control a computer-controlled processing machine to make moulds with suction openings in the form of regular triangles or other polygons, continuing into suction ducts extending at any desired angle, including a right angle, from the mould surface.

Figure 9 shows an example of a mould, in which the ducts in the steep sides have relatively small transverse dimensions, e.g. 0.2 mm, whereas the ducts in the top and base parts have relatively larger transverse dimensions, e.g. 0.5 mm. The ratio may be as high as 1:10. With this arrangement, the patterns formed in the pulp article will be less conspicuous, thus improving the visual appearance of the product.

Figures 10 and 10a show an example of a mould, in which parallel groups of ducts extend in two directions forming an angle with each other and forming angles with the base of the mould differing from 90°. The two groups may be mutually offset so as to avoid the various ducts intersecting each other, and the various ducts may have different transverse dimensions. Such a mould could also be manufactured in the manner indicated above with reference to Figures 6 and 6a, although in this case also, the method of using computer-based deposition referred to above is preferred.

Figure 11 illustrates the possibility of encoding the co-ordinates for the openings desired in the mould surface by using a computer programming for a five-axes machining or processing programme. When the co-ordinates have been determined, the normal is raised, at the same time indicating the direction of the ducts at right angles to the mould-surface.

LIST OF PARTS

M_1	thickness
M_2	total length/height
M_3	width
N_a	length/height
S_a	width dimension
S_b	width dimension
S_1	width dimension
S_2	width dimension
1	suction mould
2	cellular mould component
2'	material element
2"	suction duct
3	mounting surface
4	mould-surface structure
4"	suction duct
5	backing structure
5"	single suction duct
6	mould-surface structure
6"	suction duct
7	backing structure
7"	single suction duct
8	body
8"	suction duct

Claims

1. Suction mould (1) for use in making thin-walled articles by sucking a slurry of fibre pulp against a permeable mould having a shaped surface corresponding to that of the articles to be made, said mould having through-going ducts (Figures 1-3-5) extending from openings in said mould surface being so dimensioned as to allow passage of the liquid, but not the fibres in said slurry, to openings in an oppositely located mounting surface, adapted to have suction applied to it in order to produce said pulp article, **characterized** in that the mould is a one-piece element with a thickness as measured between said mould surface and said mounting surface sufficient to give said element as such the requisite mechanical strength and ability to withstand the forces created by the greatest difference in pressure between said two surfaces.

2. Mould according to claim 1, **characterized** in that the one-piece mould element has approximately the same thickness over its entire surface as measured between said mould surface and said mounting surface (Figures 3, 5, 6).

3. Mould according to claim 1, **characterized** in that the one-piece mould element has sections with greater thickness for reinforcing said sections of the mould (Figure 1).

4. Mould according to claim 1, **characterized** in that the one-piece mould element has stiffening ribs near the mounting surface (Figures 2, 4).

5. Mould according to claim 1, **characterized** in that said ducts (2";4",5") extend substantially mutually parallel.

6. Mould according to claim 1, **characterized** in that said ducts (6") extend substantially at right angles from said mould surface (Figures 4, 5).

7. Mould according to claim 1, **characterized** in that it comprises at least two regions (Figure 2: 4,5) (Figure 4: 6,7), of which first regions (4;6) bordering on the mould surface comprise ducts (4";6"), while second regions (5;7) not bordering on the mould surface comprise reinforcement ribs extending from said first regions to said mounting surface.

8. Mould according to any one or any of the claims 1-7, **characterized** in that the material used for manufacturing the mould is constituted by a plastic or metal material, preferably the same material for all regions of the body.

9. Mould according to any one or any of the claims 1-8, **characterized** in that the ducts (2";4"; 6") extending from the mould surface at least at the mould surface have transverse dimensions (S_1,S_2) of between 0.1 and 2 mm and are spaced from each other at distances (M_1) of between 0.2 and 2.0 mm.

10. Mould according to any one or any of the claims 1-9, **characterized** in that the openings in the mould surface, from which the ducts (2";4";6") extend, have a total cross-sectional area of 10-80%, preferably approximately 20-50% of the corresponding total mould-surface area.

11. Method of manufacturing a suction mould according to any one or any of the claims 1-10, **characterized** by the use of a material, preferably a settable material, that can be built up layer by layer by causing successive layers to set according to a predetermined pattern in such a manner that the layers co-operate to form a mould having the desired shape including said ducts.

12. Method according to claim 11, **characterized** in that the thin-walled article is designed by using a conventional computer-aided-design programme for automatic data processing, and that the basic data thereby provided are converted to a set of complementary basic data for use in connection with manufacturing the mould with ducts in a suitable manufacturing apparatus.

13. Method according to claim 12, **characterized** in that a computer programme representing the mould surface in three spatial dimension is combined with a mesh programme, so that a mesh of suction openings will be provided in the mould surface, continuing into suction ducts extending through the mould-surface structure.

14. Mould according to any one or any of the claims 1-10, **characterized** in that the transverse dimensions of ducts extending through mould parts in which the mould surface extends substantially parallel to the base of the mould are substantially, e.g. up to 10 times, larger than those of the ducts extending through mould parts, in which the mould surface forms an angle with said base (Figure 9).

15. Mould according to any one or any of the claims 1-10 and 14, **characterized** in that the ducts are arranged in groups of mutually parallel ducts, the ducts of each group extending in a direction forming an angle with that in which the ducts of another group or other groups extend (Figures 10 and 10a).

16. Method according to any one or any of the claims 11-13, **characterized** by the following steps:

a) encoding the co-ordinates for the openings desired in the mould surface by using a computer programming for a five-axes machining or processing programme, and
b) raising the normal to said surface at said openings to indicate the direction in which the ducts extend from said surface (Figure 11).

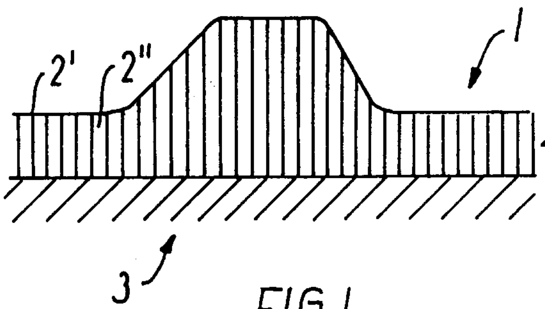

FIG. 1

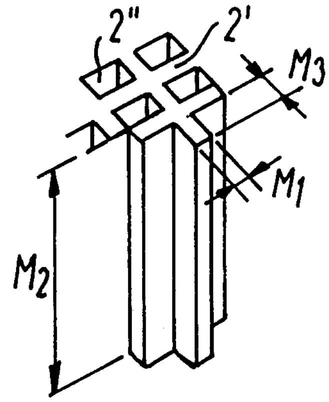

FIG. 1a

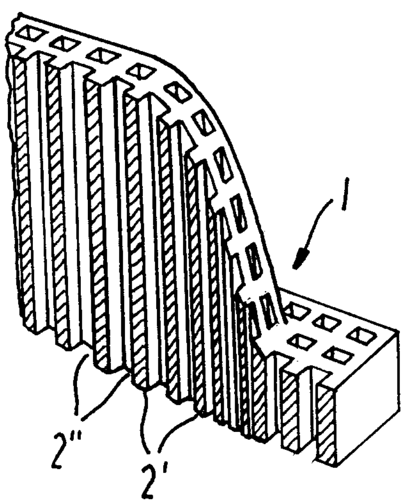

FIG. 1b

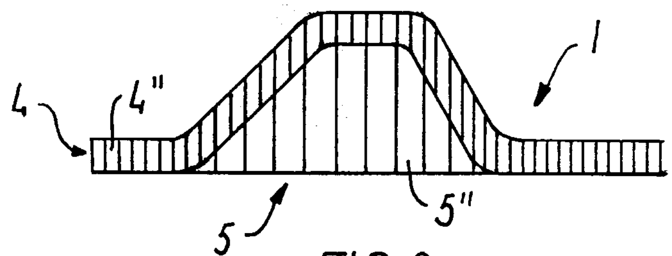

FIG. 2

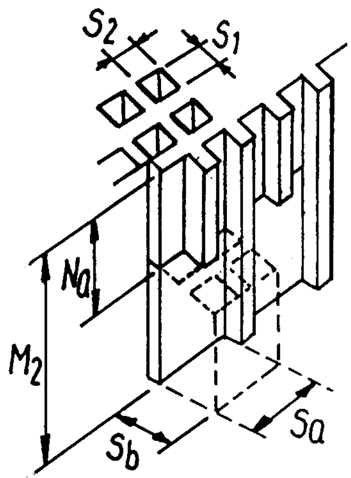

FIG. 2a

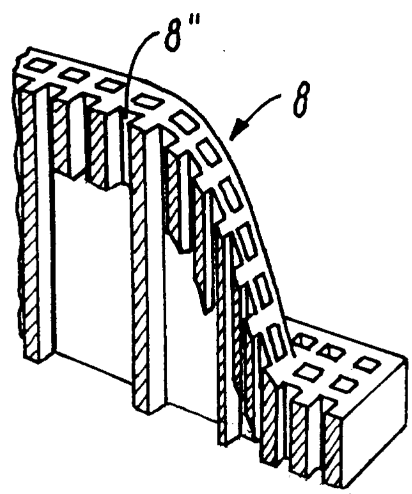

FIG. 2b

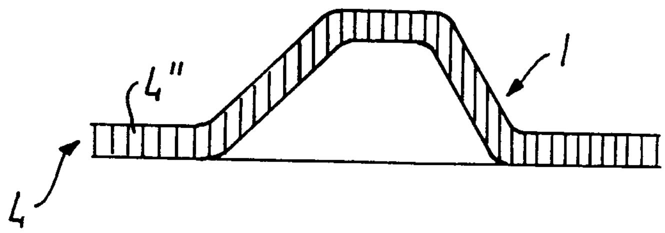

FIG.3

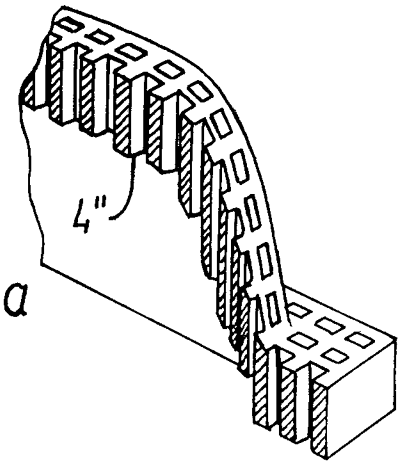

FIG.3a

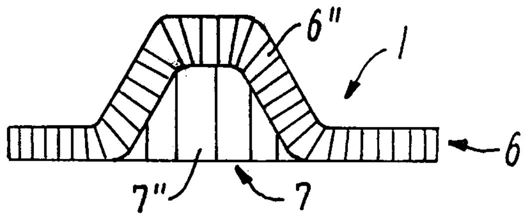

FIG.4

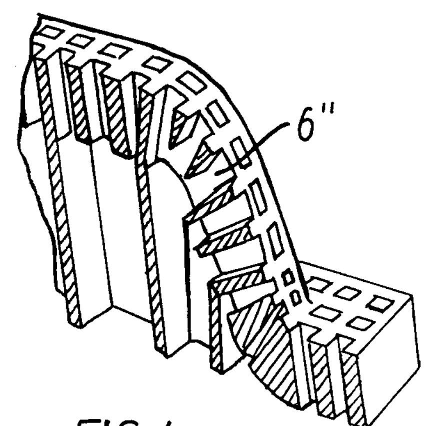

FIG.4a

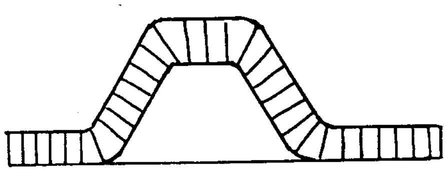

FIG.5

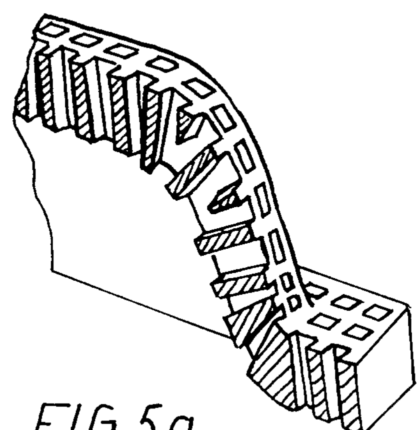

FIG.5a

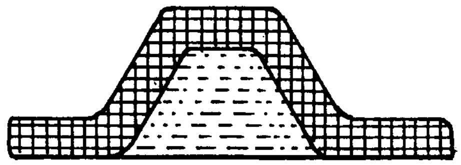

FIG.6

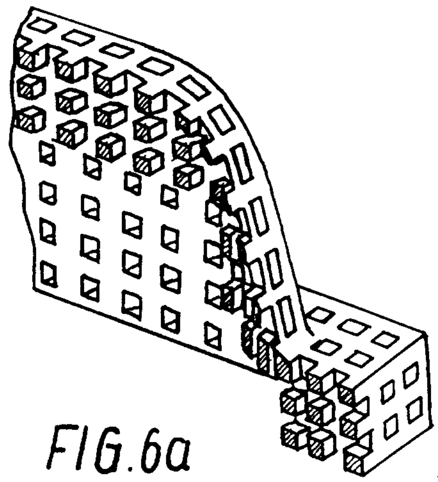

FIG.6a

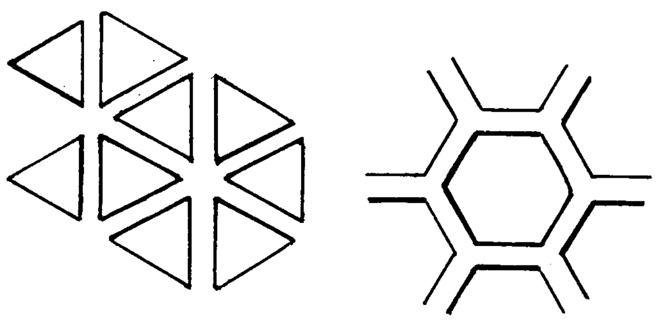

FIG.7

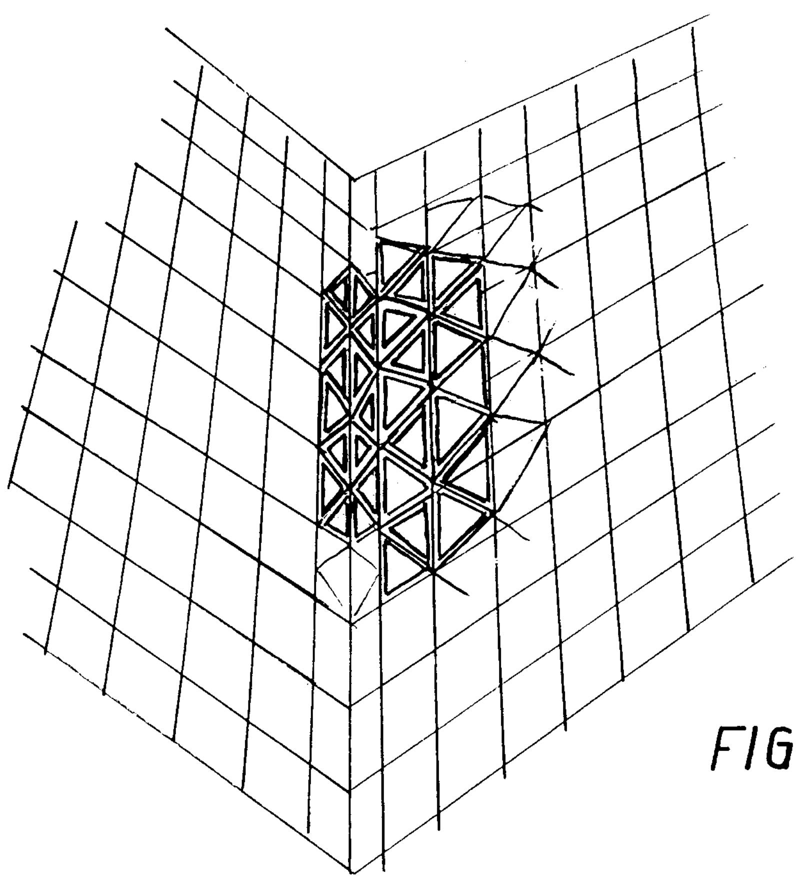

FIG.8

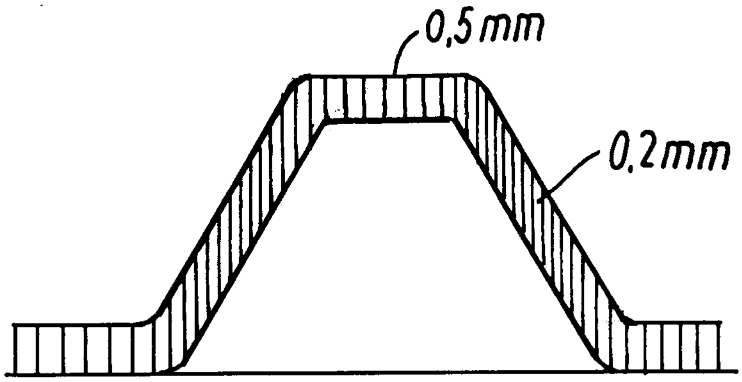

FIG. 9

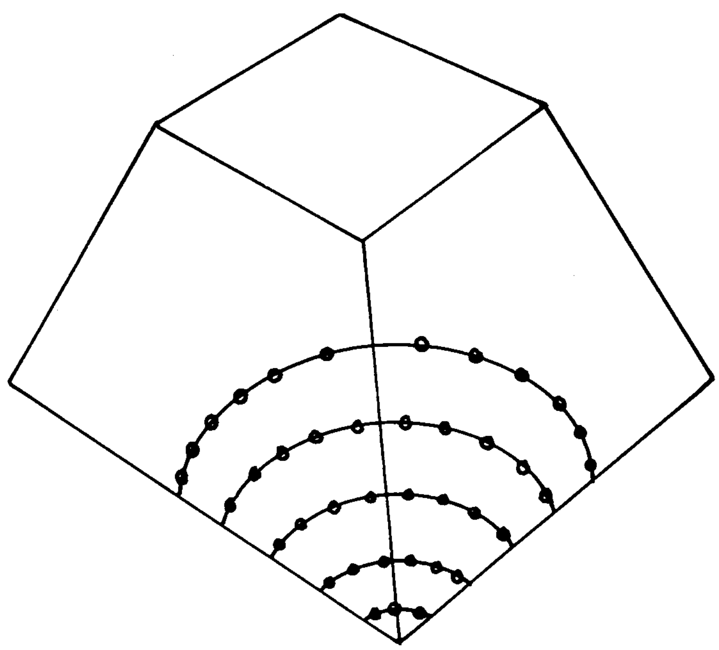

FIG. 11

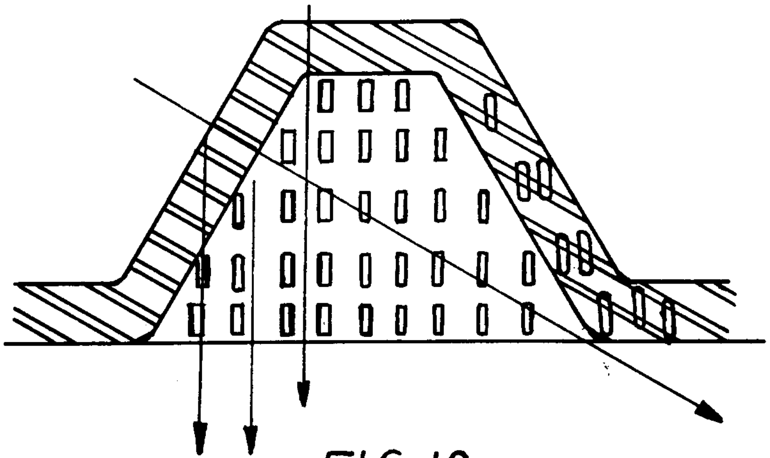

FIG. 10

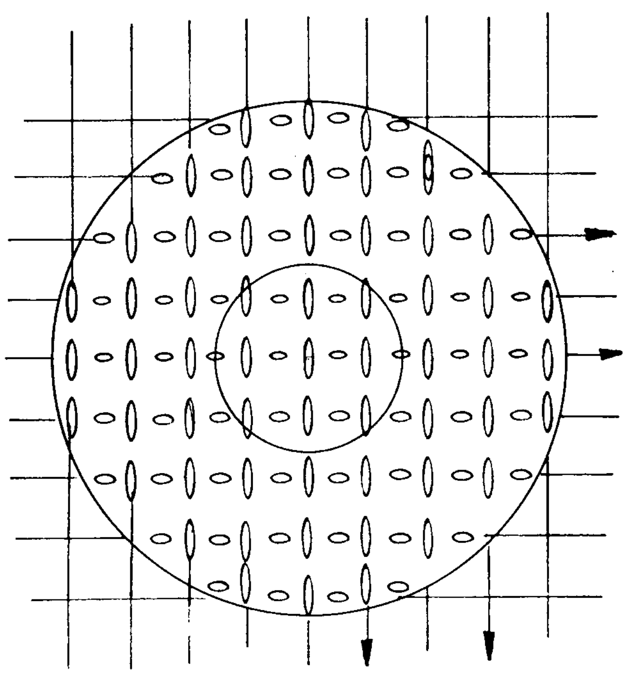

FIG. 10a

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 10 1959

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	US 2 264 146 A (CRANE NEWTON) 25 November 1941 * page 1, column 1, line 1 - page 1, column 1, line 48; claim 1; figures 8,11 * ---	1-3,5,6,8 9-12,15	D21J5/00
Y	DE 12 58 586 B (TSCHIRA & CIE) 11 January 1968 * the whole document * ---	9,10	
D,Y	GB 2 283 966 A (BOWATER PLC) 24 May 1995 * the whole document * ---	11,12	
D,Y	EP 0 719 894 A (SINTOKOGIO LTD) 3 July 1996 * the whole document * ---	15	
A	EP 0 559 491 A (NGK INSULATORS LTD) 8 September 1993 * figure 9A * -----	7	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
D21J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	9 July 1997	Guisan, T

CATEGORY OF CITED DOCUMENTS

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