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Van Esdonk et al.

[45] Aug. 28, 1973

[54] METHOD OF MANUFACTURING A LIGHT CONDUCTIVE PERFORATED PLATE

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[22] Filed: **Dec. 1, 1972**

[21] Appl. No.: **311,417**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 78,076, Oct. 5, 1970, abandoned.

[52] **U.S. Cl.** ..... **65/42,** 65/4, 65/50, 65/56, 65/106, 65/DIG. 7, 350/96 WG

[51] **Int. Cl.** **C03b 23/02,** C03b 23/20

[58] **Field of Search** ..... 65/42, 50, 47–49, 65/DIG. 7, 4, 106, 36; 350/96 R, 96 WG

[56] **References Cited**

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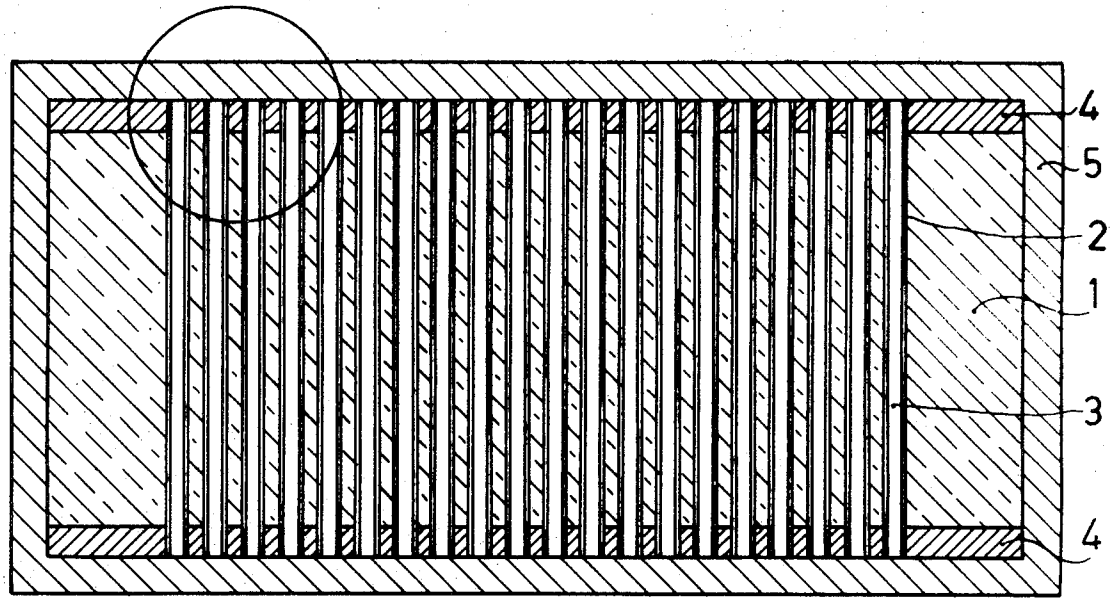
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[57] **ABSTRACT**

A method of manufacturing a perforated plate comprising placing a plurality of tubes in the holes of at least one perforated base plate, and filling the space between the tubes with a material having a lower softening temperature than that of the tubes. This formed block is then cut in a direction transverse to the tubes to form thinner perforated plates.

7 Claims, 5 Drawing Figures



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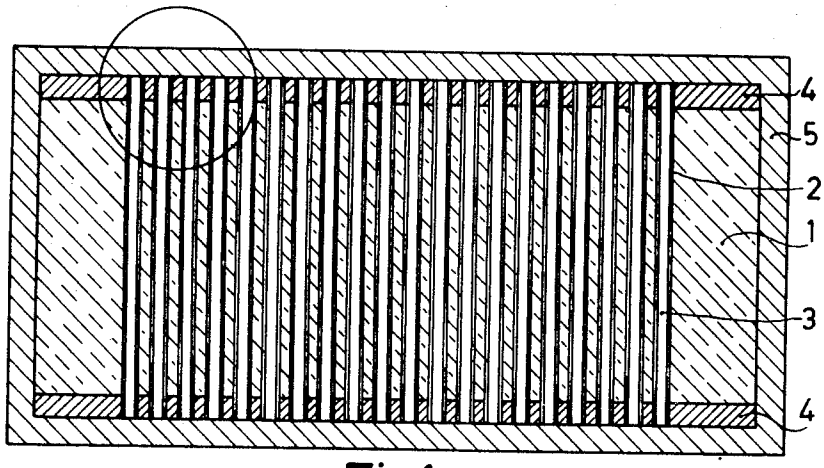


Fig.1

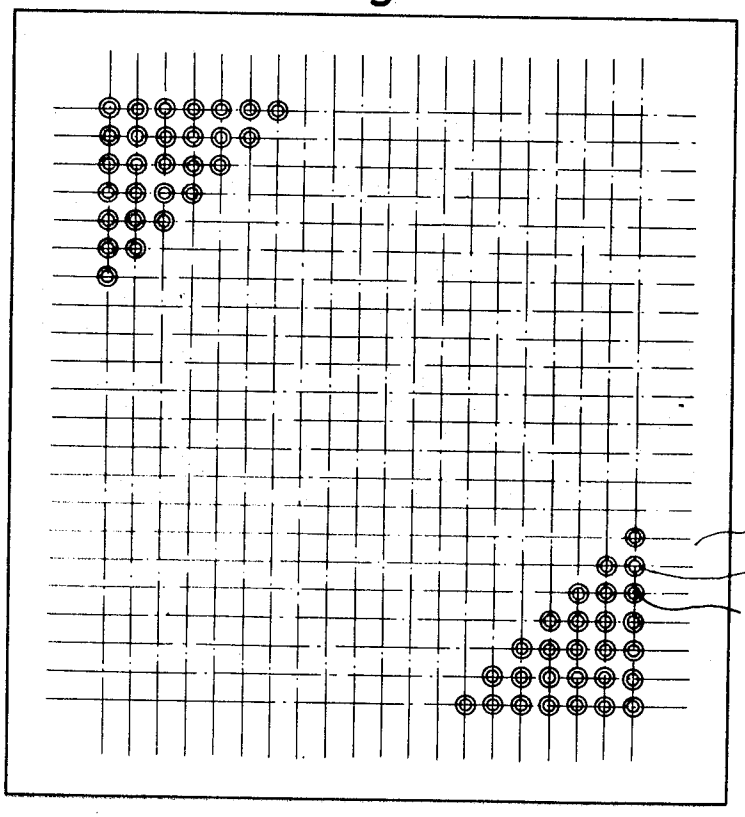


Fig.3

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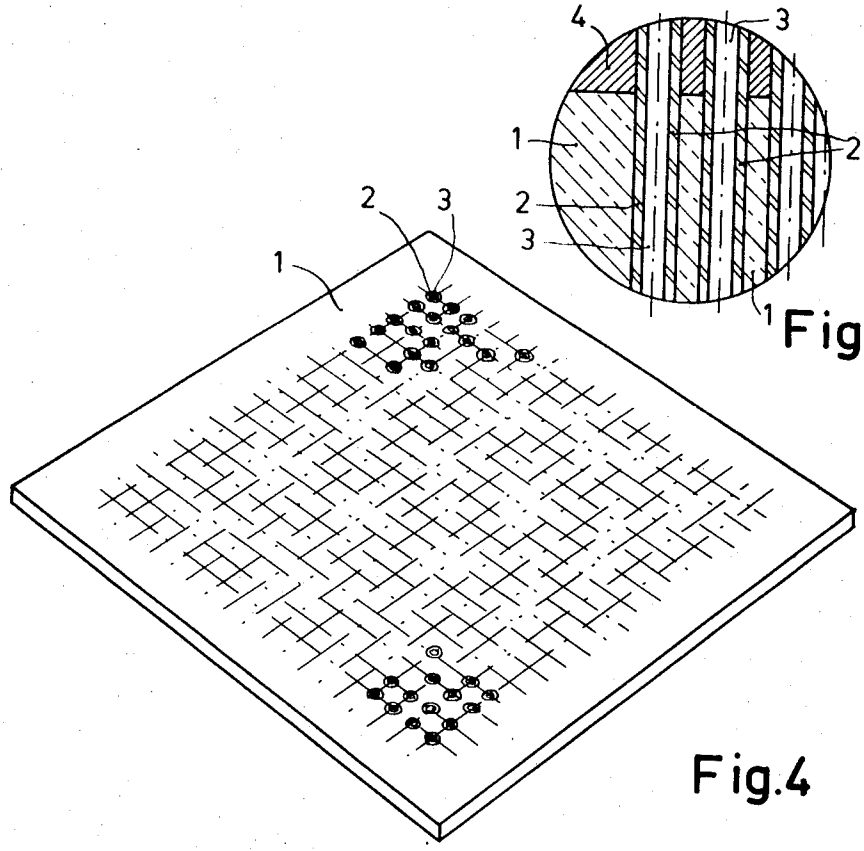


Fig.2

Fig.4

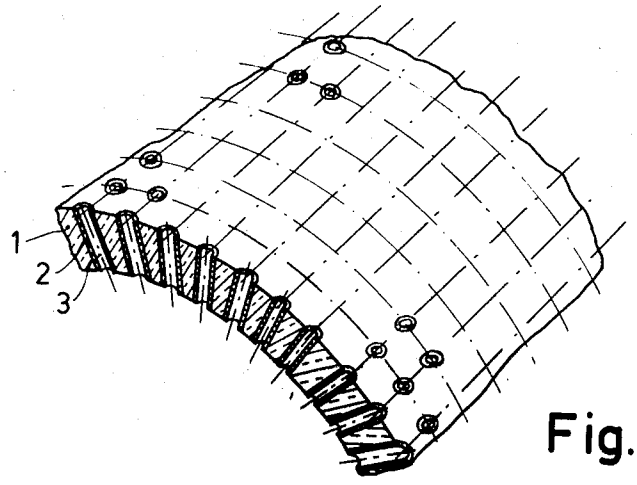


Fig.5

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METHOD OF MANUFACTURING A LIGHT CONDUCTIVE PERFORATED PLATE

The present application is a continuation-in-part of U. S. application Ser. No. 78,076, filed Oct. 5, 1970 now abandoned.

The invention relates to a method of manufacturing a perforated plate containing holes which are present at reproducible, accurately determined places, the plate consisting of an insulating material.

For certain cases, for example, picture display panels for television, it is necessary to have the disposal of perforated plates having a large number of holes provided at accurately determined places. The drilling of such holes is very time-consuming and difficult to reproduce, particularly if the material of the plate is glass or ceramic material.

In the method according to the invention the manufacture of entirely similar plates having a large number of holes and a large area becomes possible in a simple manner if a number of tubes which correspond to the number of holes and which consist of a material having a higher softening temperature than the melting temperature of the material of the plate, are placed in holes of at least one perforated base plate, the space between and around the tubes being then filled with the material of the plate. In general, when comparatively long tubes are used, said tubes will be placed between two base plates so that they are supported at either end in the holes of the base plates and can hence be better held in parallel. The base plates with the tubes will generally be placed in an enveloping mould.

Since the softening temperature of the material of the tubes is higher than the melting temperature of the material of the plate, the shape of the tubes will be maintained so that the holes of said tubes will also maintain their transverse dimensions. Thin plates can then be sawn from the formed block in a direction at right angles to the longitudinal axis of the tubes. The advantage is that only one or two base plates must be provided with accurately arranged holes, which base plates can be used many times. Tube material can be manufactured accurately in a comparatively simple manner with exactly equal inside and outside dimensions.

It has proved to be possible that the thin plates sawn from the block can be bent over a mandrel and, if desirable, can be shaped to form a cylinder having truly radially directed holes, after heating the material of the plate to the softening temperature. Tubes of ceramic material or a hard type of glass, such as Pyrex or Vycor, are advantageously used while the material of the plates may consist of readily melting glass or meltable ceramic material with a correspondingly low expansion coefficient. The difference in melting temperatures between the tube material and the surrounding glass preferably is at least 300°C. It is also possible to use tubes of a metal the coefficient of thermal expansion of which is adapted to correspond to that of the plate material. The tubes are generally made of Al_2O_3, fired and sintered at 1800°C. The filling material can be a low melting ceramic material having a composition of MnO —37% by weight, SiO_2 —50% by weight, and Al_2O_3 —13% by weight with a melting temperature of about 1275°C. In addition, the plate material may be provided between the tubes in the form of a powder or a paste.

In order that the invention may be readily carried into effect, it will now be described in greater detail, by

way of example with reference to the accompanying drawings, in which

FIG. 1 is a mould with a moulded block and

FIG. 2 is an enlargement of a part shown in FIG. 1.

FIG. 3 is a plan view of a moulded block after removal from the mould shown in FIG. 1, while

FIG. 4 is a perspective elevation and

FIG. 5 is a cross-sectional view of perforated plates obtained by means of the method according to the invention.

In the method according to the invention, ceramic tubes 2 having holes 3 are placed in the holes of two base plates 4 provided accurately at the correct places and the assembly is then transferred to a mould 5. A mass 1, for example, glass or a ceramic material, is then moulded in the remaining space of the mould 5, the mass 1 filling the space between the tubes 1 entirely (FIGS. 1 and 2). After cooling and hardening of the mass 2, the block consisting of the mass 1 with the tubes 2, may be removed from the mould 5 (FIG. 3). The base plates 4 may then be removed. By sawing plates from the block in a direction transverse to the longitudinal direction of the tubes 2, thin perforated flat plates having a large number of holes are obtained, which plates can be entirely equal to one another. Such a plate is shown in FIG. 4. The base plate 4 can be used many times. In order to avoid the base plate from adhering to the material of the plate 1, a layer of a suitable material, for example Al_2O_3, may be provided on the base plates.

If desired, a plate as shown in FIG. 4 may be heated until the material 1 becomes deformable again and the plate may be bent over a mandrel (FIG. 5), if desirable even to form a cylinder. It is found that the holes remain directed truly radially. Such a bent or cylindrical plate may serve as a grid to form a large number of electron rays. In the axis of the cylinder a cathode is arranged while the tubes 2 may consist of metal and may be provided with current supply conductors. A bent plate shape is also of advantage in picture display panels having large dimensions so that it can better withstand external forces.

According to a particular example, there were employed tubes that were 30 mm long with a 1.5 mm outside diameter and a 1 mm hole diameter. Plates that were 0.7 to 8 mm thick, each plate having 400 holes, were sawn from a block that was 30 mm thick, 40 mm long, and 30 mm wide.

What is claimed is:

1. A method of manufacturing a perforated plate comprising placing a plurality of tubes in the holes of at least one perforated base plate, the number of tubes corresponding to the number of holes to be provided in said perforated plate, filling the space between said tubes with a solid material having a lower softening temperature than the melting temperature of the tubes, heating said material to a softening temperature thereof below the melting temperature of said tubes to form a block, and cutting said block transverse to the length of said tubes at a plurality of points thereby to form a thin plate comprising a plurality of apertures.

2. A method of manufacturing perforated plates as claimed in claim 1, wherein placing a plurality of tubes in the holes of at least one perforated base plate comprises positioning said plurality of tubes so that their longitudinal axes are parallel to each other.

3. A method of manufacturing perforated plates as claimed in claim 1, wherein the step of filling the space between said tubes comprises, heating said material and tubes to temperatures below the melting temperature of the tubes, and cooling said material and tubes to form a block having said tubes embedded therein.

4. A method of manufacturing perforated plates as claimed in claim 1, further comprising heating the plate to the softening temperature of its material, and bending said plate over a mandrel to form a cylindrical plate.

5. A method of manufacturing perforated plates as claimed in claim 1, wherein the material of said block and tubes comprises glass and ceramic material, respectively.

6. A method of manufacturing perforated plates as claimed in claim 1, wherein the material of said tubes comprises a harder material than the material of said block.

7. A method of manufacturing perforated plates as claimed in claim 1, wherein the material of said tubes comprises a metallic material having a coefficient of thermal expansion compatible to that of the material of the block.

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