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Friebel et al.

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[54] **METHOD FOR MANUFACTURING A BASE FOR THE ENVELOPE OF AN ELECTRIC COMPONENT**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **29/626,** 29/624, 29/627, 65/59, 65/140

[51] **Int. Cl.** **H01b 13/14**

[58] **Field of Search** 29/626, 627; 65/DIG. 7, 54, 59, 138, 139, 140, 102, 319, 320, 321

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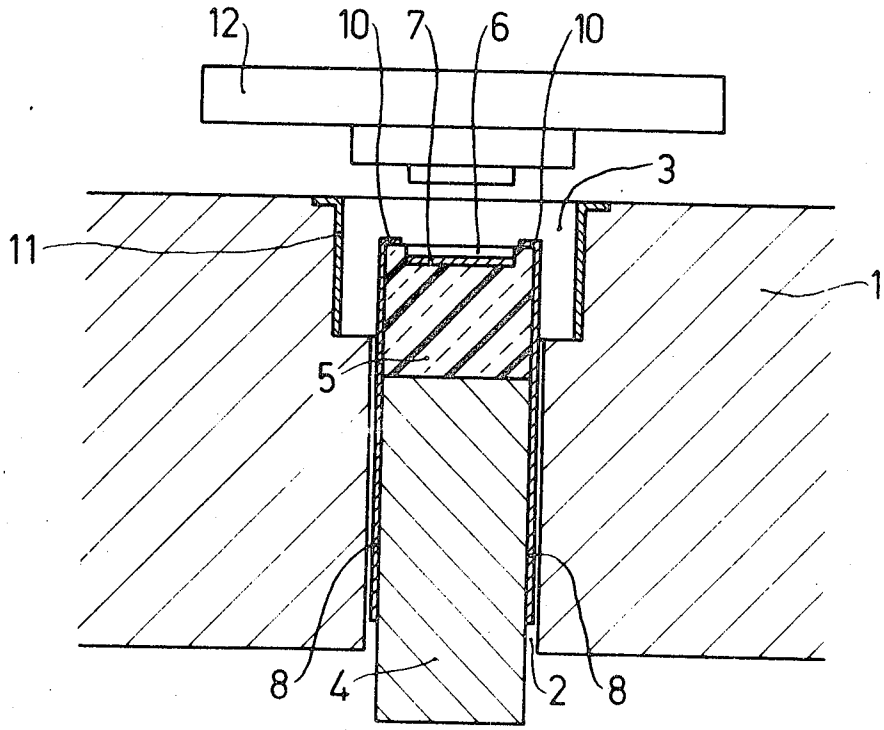
[57] **ABSTRACT**

A method of manufacturing a base for the envelope of an electric component, for example a semiconductor device, in which a pressure member is provided on one side in the cavity of a jig, which cavity has an approximately rectangular cross-section, after which a member of insulating material which softens upon heating is placed on the pressure member from the other side where a chamber of a larger cross-section is present which communicates with the cavity, after which of a conductor grid the conductors of which are supported at one end by a strip and are bent at their other end transverse to the plane of the grid the ends connected to the strip are inserted into a narrow slot between the pressure member and the wall of the cavity until the bent ends of the conductors bear on the insulating member after which the chamber is closed by a closure plate, the jig is heated and a force is exerted via the pressure member, in which the bent ends of the conductors are forced against the closure plate by the insulating member and a part of the softened insulating material is forced between the conductors in the direction of the side walls of the chambers so that a base is formed the bent ends of which of the conductors are situated on the upper side of the insulating member and the parts of the conductors connected thereto with are embedded in the insulating material and the further part of the conductor project from the lower side of the insulating member.

6 Claims, 10 Drawing Figures



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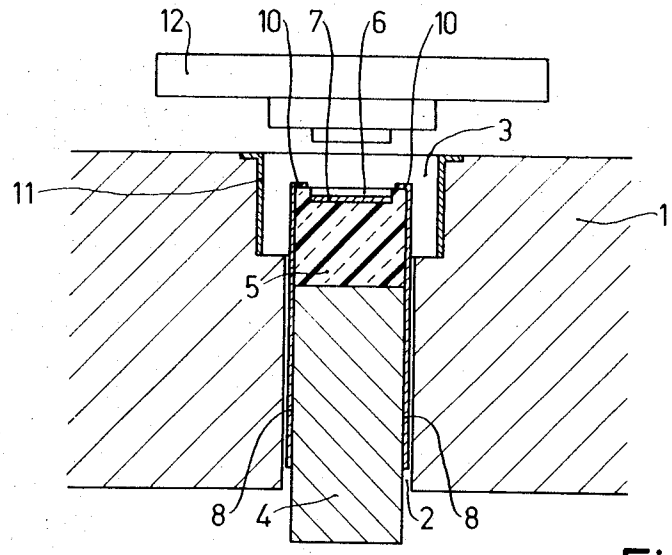

Fig.1

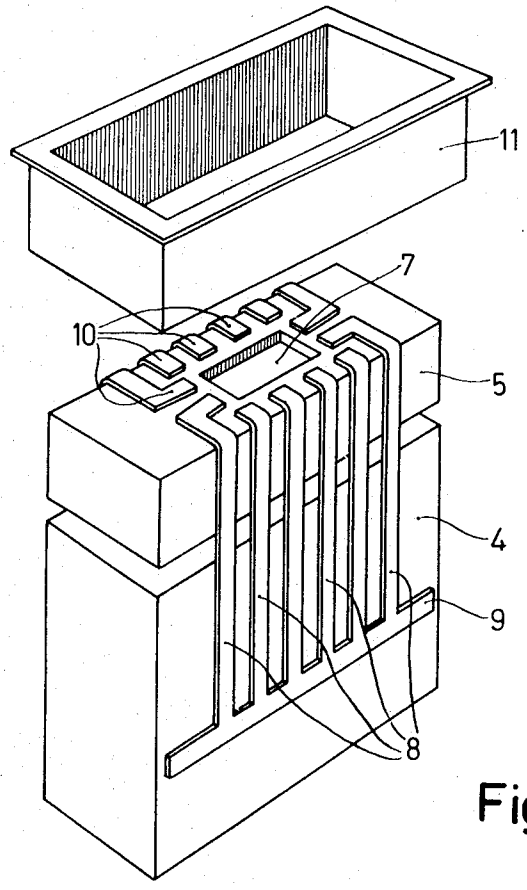

Fig.2

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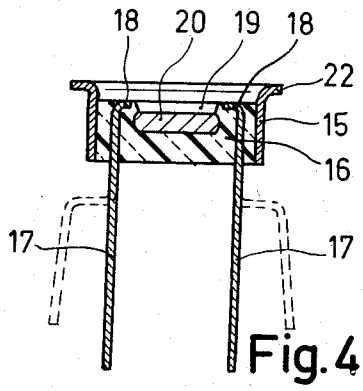

Fig.4

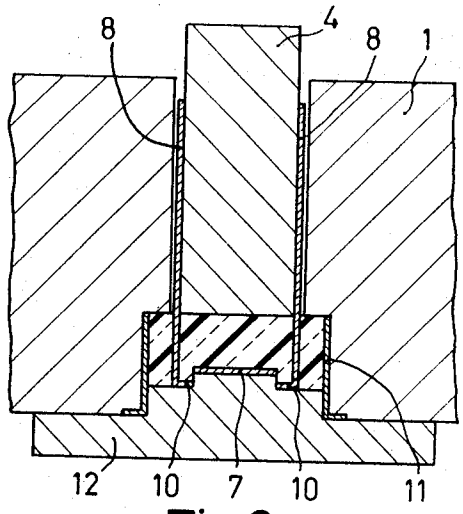

Fig.3

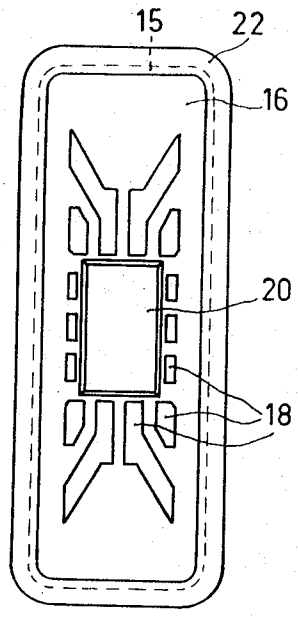

Fig.5

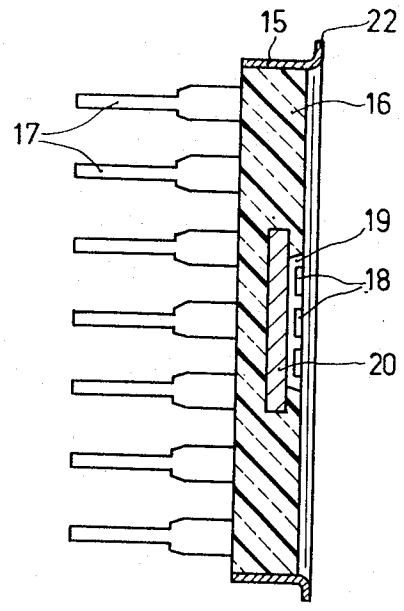

Fig.6

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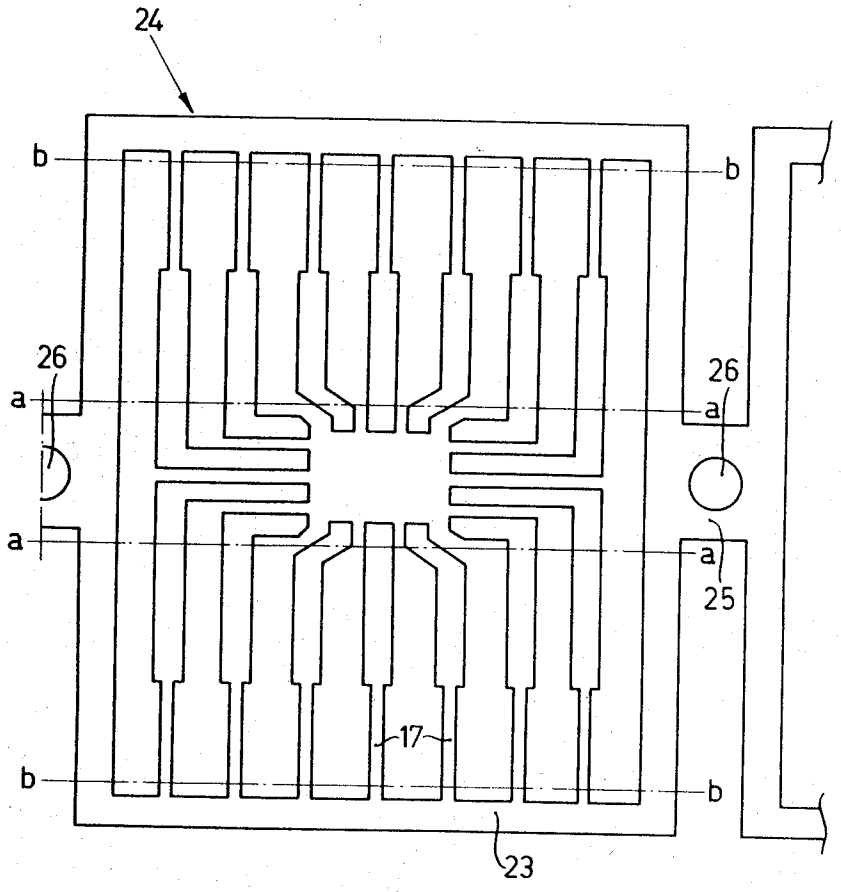

Fig.7

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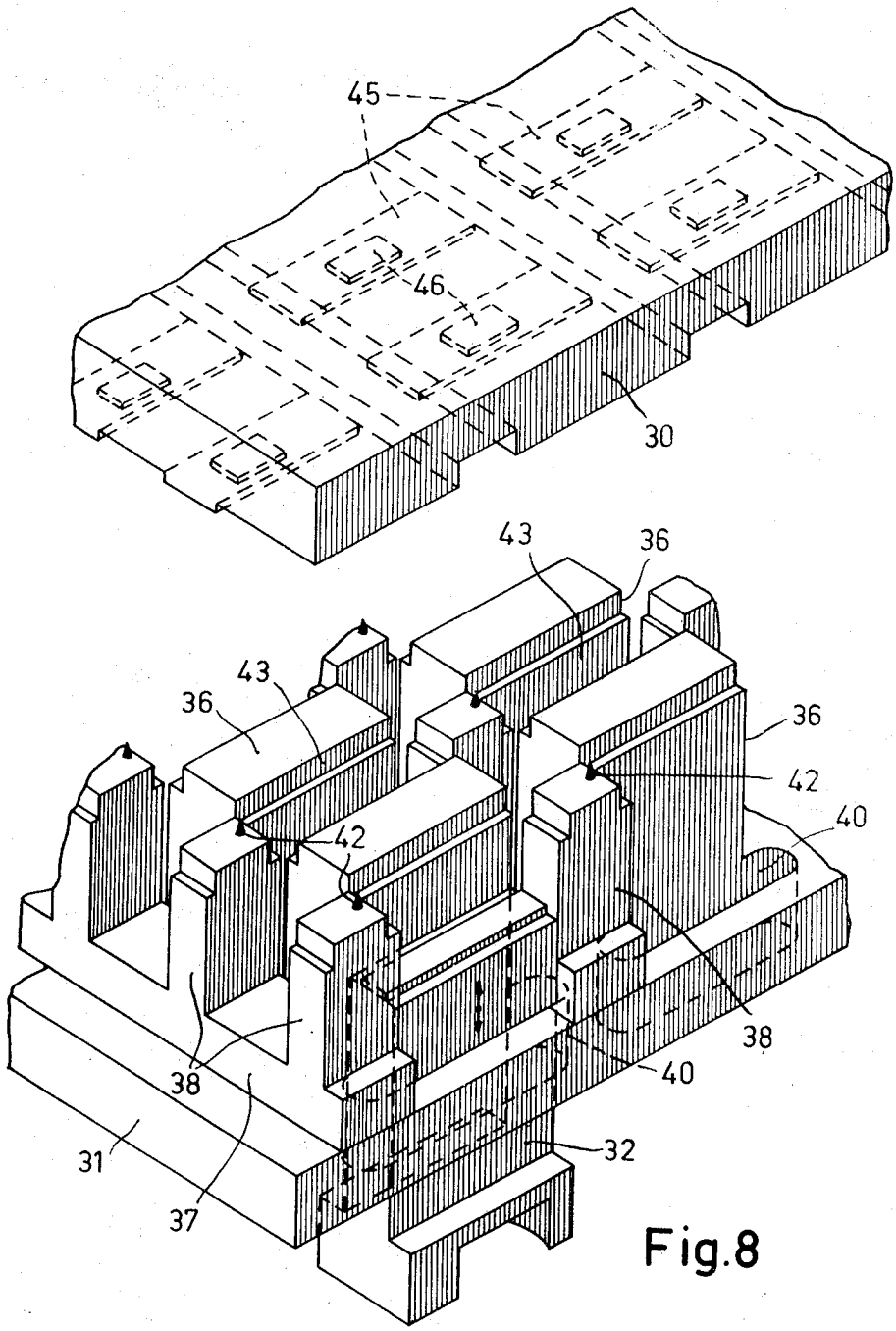

Fig.8

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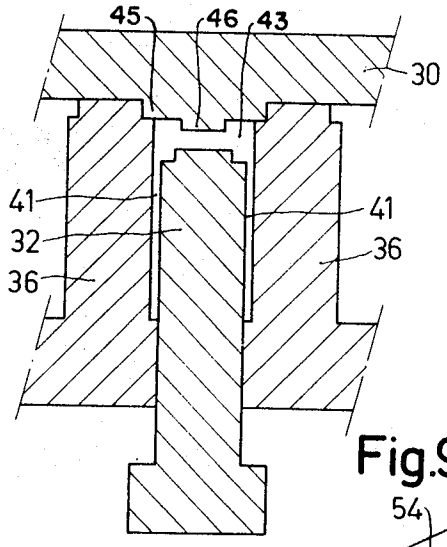

Fig.9

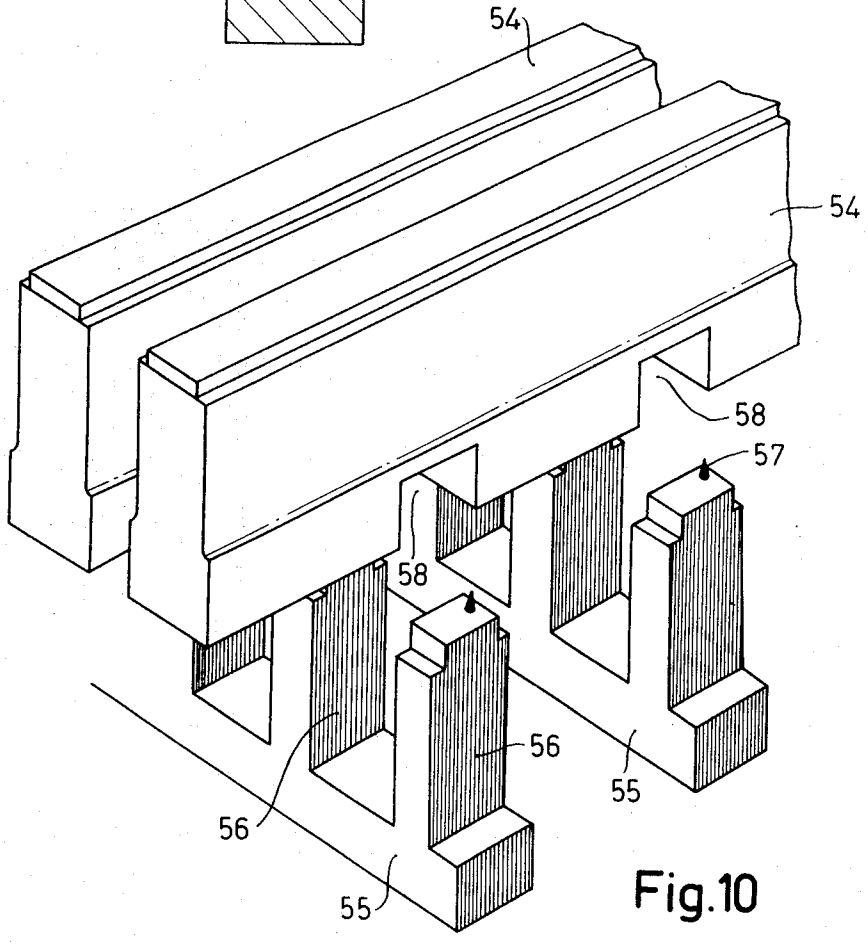

Fig.10

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METHOD FOR MANUFACTURING A BASE FOR THE ENVELOPE OF AN ELECTRIC COMPONENT

The invention relates to a method of manufacturing a base for the envelope and an electric component, for example a semiconductor device.

There are known various methods of manufacturing a base for a semiconductor device, for example an integrated circuit or a thin film or thick film circuit, in which a flat grid of metal conductors is used. According to a known method, the grid is clamped between a lower part and an upper part of a jig, while a pre-shaped glass member is provided in a cavity of the jig. After heating the jig, the glass member is forced in the shape determined by the cavity. The flat conductors project from the side walls of the thus shaped base. So in this base, no metal base cap which surrounds the side walls can be used so that the base may be vulnerable.

Semiconductor bases are also known having a circular cross-section in which a glass insulating member is incorporated in a metal base cap and through which a number of conductor wires are passed. During the manufacture pre-shaped glass insulating members are used which are provided with apertures through which the conductor wires are passed. The conductor wires are fixed mutually by means of apertures present in a matrix. The heated glass in the matrix cavity adheres to the metal base cap and the conductor wires are sealed simultaneously. Conductors incorporated in a grid cannot be used.

It is the object of the invention to provide a method of manufacturing a base for an electric component, for example a semi-conductor device, which has a flat and box-shaped construction, which has only small dimensions and in which a grid of conductors can be used which projects from the lower side of the base. The method according to the invention is characterized in that a pressure member is provided in a mould having a cavity of approximately rectangular cross-section, which pressure member closes the cavity on one side for the greater part, after which a member of an insulating material which softens upon heating is placed on the pressure member from the other side where a chamber of a larger cross-section is present which communicates with the cavity, that a conductor grid is used the conductors of which are supported at one end by a strip and are bent transverse to the plane of the grid at their other end, the ends connected to the strip being inserted into a narrow slot between the pressure member and the wall of the cavity and the bent ends of the conductors bearing on the insulating member, the chamber being then closed by a closure plate, the mould being heated and a force being exerted via the pressure member, so that the bent ends of the conductors are forced against the closure plate by the insulating member and a part of the softened insulating member is forced between the conductors in the direction of the side walls of the chamber so as to form a base with the bent ends of the conductors situated on the upper side of the insulating member, the parts of the conductors connected thereto embedded in the insulating member and the further part of the conductors projecting from the lower side of the insulating member.

In a preferred embodiment of the method according to the invention a metal base cap which is open on the lower and upper sides is placed in the chamber after providing the grid of conductors and the upper side of the base cap is closed by the closure plate, the part of the softened insulating member forced between the conductors moving in the direction of the wall of the base cap and a hermetic connection being formed between the base cap and the insulating member. By the use of a metal base cap, a mechanically rigid base is obtained, The upper side of the base cap may be shaped so that the connection of a lid by means of a welding operation can simply be carried out, there being sufficient space for the welding electrodes.

The member of insulating material used preferably is a crystallised or non-crystallised glass.

The conductors are preferably incorporated in a grid comprising a rectangular frame in which two oppositely located sides of the frame constitute the strips which support two series of conductors present inside the frame, the grid being bent to approximately U-shape so that rows of conductors are formed which coincide with the limbs of the U and the bent ends coincide with the connection member of the limbs of the U.

With this method it is possible to simultaneously manufacture a number of bases in a mould. For that purpose a mould is used having a number of aligned cavities and use is made of a series of conductor grids which are connected together and which are constituted by one strip of metal, the connection place of adjacent frames of the series being situated in the part of the frames which coincides with the connection member of the limbs of the U, centering apertures being present in said parts of the frames for centering the grids in the mould.

The invention also relates to a device for the series production of bases for electric components, for example semiconductor devices. According to the invention, such a device is characterized in that it is constructed from a sealing block, a closure plate and pressure members, the sealing block comprising a number of rows of mainly rectangular cavities which at one end have a chamber of a larger cross-section, the sealing block being closable on the side of the chambers by the closure plate and the pressure members being introduced into the cavities on the oppositely located side, each cavity being bounded on one side by two spaced-apart upright dams extending in the direction of the width of the mould and on the other side by upright ridges present between the dams and forming part of cross beams, a clearance which exists between the pressure members introduced into the cavities and the dams of the matrix cavities having a value which exceeds the thickness of the grid of conductors to be used only to a slight extent. The structure of such a mould is comparatively simple. As a result of the small clearance between the dams and the pressure members where the grid of conductors is to be located, a larger resistance prevails at that area against the penetration of material of the insulating member so that the conductors are not covered with said material at said area.

According to one embodiment, longitudinal slots and transverse slots extending at right angles thereto are present in the sealing block, the dams being constituted by upright parts situtated between the longitudinal and transverse slots, the cross beams being secured in the transverse slots in such manner that the ridges constitute a boundary in the longitudinal slots, the sealing block comprising apertures in which the pressure members are movable.

According to another embodiment, the sealing block is constructed from interconnected continuous longitu-

dinal and cross beams, said continuous longitudinal beams being arranged at mutually equal distances and comprising equally spaced recesses on the side of the closure plates in which the cross beams fit in such manner that the upright ridges are situated between two continuous longitudinal beams, the width of the ridges being smaller than the distance between the longitudinal beams to obtain a slot for receiving the conductor grid.

The invention also relates to a base for the envelope of an electric component, for example, a semiconductor device, in which the base has a box-shaped construction and comprises flat electric conductors which are formed from a grid of conductors. According to the invention, such a base is characterized in that the side walls consist of a metal base cap which is closed at one end by an insulating member and comprises at its other end a projecting edge which forms a connection part for a lid, the flat current conductors comprising at one end a portion which is bent transverse to their longitudinal direction and which is situated on the upper side of the insulating member, the conductors being passed further through the insulating member and projecting therefrom on the lower side.

The flat conductors are preferably situtated in two rows, the bent ends of the conductors of the two rows facing each other.

In order that the invention may be readily carried into effect, a few examples thereof will now be described in greater detail, by way of example, with reference to the accompanying drawings, in which

FIG. 1 shows diagrammatically the filled mould

FIG. 2 shows diagrammatically the parts with which the mould is filled

FIG. 3 shows diagrammatically the formation of the base

FIGS. 4 to 6 are a cross-sectional view, a plan view and a longitudinal sectional view, respectively, of a preferred embodiment of the base according to the invention

FIG. 7 shows a grid of conductors to be used for the base

FIG. 8 is a perspective elevation of a part of a mould in the fillling position

FIG. 9 is a sectional view of a part of the mould

FIG. 10 is a perspective view of a part of another mould.

FIGS. 1, 2 and 3 show by way of example the manufacture of a base which has proved to be particularly suitable for a hermetic envelope of a semiconductor device. A sealing block 1 comprises a cavity 2 of approximately rectangular cross-section which opens into a chamber 3 having a larger cross-section. On a pressure member 4 provided in the matrix cavity 2 a moulding 5 of, for example, sintered glass is placed (see FIGS. 1 and 2). The moulding comprises a recess 6 in which a metal plate 7 is laid which serves to secure a semiconductor crystal afterwards. In the narrow slots between the wall of the cavity 2 and the pressure member 4 flat conductors 8 formed from a metal strip are inserted. FIG. 2 shows diagrammatically said conductors incorporated in a grid. A connection strip 9 connects the conductors at one end. The other ends 10 are bent and bear on the moulding 5. FIG. 2 shows one of two separate rows of conductors 8 which are each connected to a strip 9. It is also possible, for example, to incorporate all the conductors in a frame as is shown in FIG. 7. A base cap 11 is then placed in the chamber 3 after which the cavity is closed by a closure plate 12. FIG. 2 is a diagrammatic perspective elevation of the pressure member 11, the moulding 5, the plate 7, the conductor grid 8, 9, 10 and the base cap 11.

After filling the mould, it is turned upside down as is shown in FIG. 3, the pressure member 4 is loaded, for example by a weight, and the mould is placed in a furnace. The glass moulding 5 is softened as a result of the temperature prevailing in the furnace. The loaded pressure member 4 exerts pressure on the moulding as a result of which on the one hand the bent ends 10 of the conductors and the plate 7 tightly pressed against the closing plate 12 and on the other hand a part of the softened moulding is forced between the conductors into the chamber 3. The moulding 5 has such a thickness that the whole chamber 3 is filled, a glass insulating member adhering to the base cap 11 being formed and the conductors being embedded therein. The upper side of the bent parts 10 of the conductors remain uncovered as well as the upper side of the plate 7 sealed in the insulating member. Especially as a result of the conductors projecting from the lower side of the base, sufficient space is available for the welding electrodes so that it is possible to weld a lid to the base cap. This welding is very favourable.

The slot distance between the pressure member and the wall of the matrix cavity is maintained so small that the insulating material of the softened moulding 5 during pressure is not forced upwards in the slots and, consequently, does not cover the conductors at that area. Therefore no measures need be taken to seal the space between the conductors which are present in the slot, so that the jig can structurally be simple and no restrictions are imposed upon the shape of the conductors.

It is not necessary to use the metal base cap 11. As a material for the insulating member is to be considered first of all a crystallized or non-crystallized glass. Other materials, however, for example a synthetic resin, may also be used. are

FIGS. 4 to 6 show an embodiment of a base for a hermetically sealed semi-conductor device which is particularly favourable to manufacture. A glass insulating member 16 through which conductors 17 are passed is present in a metal base cap 15. The ends 18 of the conductors in this embodiment are embedded in the upper side of the insulating member 16; the other ends project from the lower side of the base and are preferably at a standarized distance to secure them in apertures of a mounting panel. If necessary, the conductors 17 may be bent for this purpose as is denoted in broken lines. A recess 19 is present in the upper side of the insulating member 16. A metal plate 20 is incorporated in said recess. A semiconductor element can be secured to the plate 20. Contact places on the semiconductor element may be connected, for example by means of gold wires, to the ends 18 of the conductors 17. However, it is also possible to connect the semiconductor element directly to the conductors by means of the direct contact method. In that case the plate 20 may be omitted. The conductor ends 18 must of course be situated in the correct pattern for direct contact connection. The upper side of the base cap 15 is provided with a flared flange 22. A metal cover can be secured to said flange 22 in a simple manner, preferably be welded, in which a qualitatively very good hermetic envelope is obtained. Welding the lid to the base cap

15 presents great advantages over other connection methods, for example soldering. The welding connection can be carried out very rapidly, the cost of manufacture is low and the semiconductor element remains cold during welding. As a result of the conductor projecting on the lower side of the base and by providing the flange it is possible to weld in a simple conventional manner, heat evolution occurring only at the area of the flange and the lid. Instead of a flared flange on the base cap, the lid may be provided with the same effect with a flange projecting to the upper side. If desirable, any other connection method for the lid may of course also be used.

FIG. 7 is a slightly diagrammatic example of the conductors for a base shown in FIGS. 4 to 6 which conductors are incorporated in a grid 24. The conductors 17 are, for example, etched or punched from a metal strip and during the manufacture of the base they remain connected to a frame 23 and thus maintain their mutual desirable positions. The grid 24 is bent along the line *a—a* to a U-shape and in that shape it is sealed in the insulating member during the manufacture of the base. When the base is ready, the superfluous frame is removed by clipping the conductors along the lines *b—b*. When several bases are manufactured simultaneously in a matrix, grids are preferably used which are united by means of a connection member 25. This connection member is situated between the lines *a—a*. An aperture 26 for centring the grids in the mould may be present in the connection member. Such an embodiment has the important advantage that the grid is flexible so that during the sealing of the insulating member the differences in expansion between the grid and the matrix can easily be compensated for.

The base described with reference to FIGS. 4 to 6 may have a different construction at various points. For example, instead of a glass insulating member, a synthetic resin may be used. The recess 19 in the upper side of the insulating member may be omitted. The plate 20 may form a part of the grid; if desirable, it may also be omitted. The conductors projecting from the bottom preferably have the shape shown, in which the thickenings can abut against an apertured mounting panel. However, a different shape may also be chosen.

FIG. 8 shows an embodiment of a part of a jig for the series production of the base shown in FIGS. 4 to 6 namely in the position of filling the mould, compare FIG. 1. The mould mainly comprises a closure plate 30, a sealing block 31, and pressure members 32 which can be passed through the sealing block.

The sealing block is constituted by a graphite block in which longitudinal and transverse grooves are provided so that dams 36 are formed. The sealing block thus obtains the shape of a plate from which the dams 36 project. Between the dams 36, apertures 40 are present in the sealing block 31 through which the pressure members 32 can be passed. In order to obtain matrix cavities in which the glass can enter under the pressure of the pressure members 32 without laterally flowing in the longitudinal and transverse grooves, cross beams 37 are secured in the transverse grooves and are provided with ridges 38. Centering pins 42 may be provided on the ridges 38 which pins can cooperate with the centering apertures 26 in the connection members 25 of the conductor grids, The chambers in which the bases are formed are denoted by 43. Slots 41 are present between the pressure members 32 and the dams 36 (see FIG. 9) into which slots the ends of the conductors connected to the frame can be inserted. The slots 41 leave only such a space between the pressure members 42 and the dams 36 that during the pressure the glass is not forced into the slots so that a sealing at that area is not necessary.

In order to obtain the base shown in FIGS. 4 to 6, the closure plate 30 comprises bosses 45 which fall in the base caps (compare FIGS. 1 and 3) and against which the bent ends of the conductors engage. Bosses 46 are also present which press against the metal plates which serve as a support for the semiconductor elements.

It will be obvious that such a structurally comparatively simple mould is particularly suitable for the simultaneous manufacture of a number of bases. The way of manufacturing has already been described clearly for one base with reference to FIGS. 1 to 3. The mould enables the use of a series of interconnected conductor grids which can be centered relative to the cavities and which are flexible so that deformation of the conductors does not occur.

FIG. 10 shows a part of the sealing block of a second embodiment of the mould. This mould is extremely simple in design. It consists preferably of parts which are manufactured from graphite. The closure plate and the pressure members may be shaped in the same manner as in the embodiment shown in FIG. 8. The sealing block consists of longitudinal beams 54 and cross beams 55 which are connected together, The cross beams have ridges 56 which may be provided again with a centering pin 57 for centering the conductor grids. The longitudinal beams 54 are situated each time between two ridges 56 so that the mutual position is preferably fixed. The parts of the cross beams 55 not provided with a ridge fall in recesses 58 of the longitudinal beams so that their position is also perfectly fixed. The pressure members and also the ridges again have such dimensions that a slot of a small thickness in which parts of the grid can fall is formed between the upright walls of the dams and the pressure members and ridges, respectively.

The operation of this mould corresponds entirely to the operation of the jig shown in FIG. 8 so that this need not be further described herein.

What is claimed is:

1. A method for making a base for an electric component, comprising the steps of:

forming conductive strips each having a transversely bent over portion near one end thereof;

spacing the strips around a block of heat softenable insulating material having a top surface, a bottom surface, and a side surface, each strip extending along the side surface to and beyond the bottom surface with the bent over portion partially covering the top surface;

heating the block of insulating material until suitably soft;

while the block is soft, compressing the block between a first solid surface covering the top surface of the block and a second surface covering the bottom surface of the block, whereby the bent over portion of each strip is pinched and held between the first surface and the top surface of the block while soft insulating material from the side of the block is squeezed through the spaces between the strips; and

molding to a suitable shape the soft insulating material which squeezes through the spaces between the strips.

2. The method of claim 1 wherein the forming step comprises forming a grid of parallel spaced conductive fingers having a transversely bent over portion near one end thereof.

3. The method of claim 2 wherein the spacing step comprises positioning the grid adjacent a block of heat softenable insulating material having a top surface, a bottom surface, and a side surface, the grid extending along the side surface to and beyond the bottom surface with the bent over portion partially covering the top surface.

4. The method of claim 1 wherein the molding step includes maintaining the position of the strips.

5. The method of claim 1 wherein the compressing step includes maintaining the position of the strips.

6. The method of claim 1 wherein the insulating material is glass.

* * * * *