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(54) A waveguide arrangement.

(57) A waveguide arrangement is formed by two conductive sections separated by an insulating substrate. The waveguide walls are delined by channels cut in the conductive sections and slots plated with conductive material in the insulating substrate.

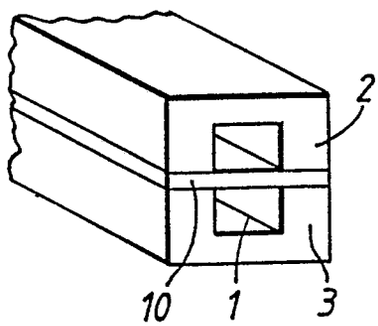

FIG.4a.

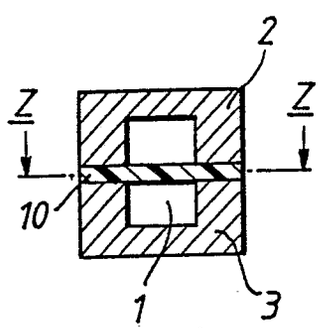

FIG.4b.

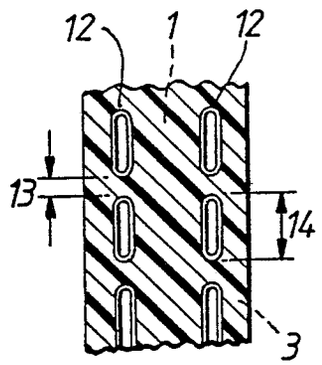

FIG.4c.

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A Waveguide Arrangement

This invention relates to a waveguide arrangement and more particularly, but not exclusively, to a waveguide of the type formed from two parts, each having a channel and means for connecting the parts together so that the two channels co-operate to form a rectangular waveguide.

One such waveguide is shown in Figures 1A, 1B and 1C which show a known waveguide in perspective view, a transverse section of the waveguide of Figure 1A and a sectional view along the line W-W of Figure 1B respectively.

Waveguides formed in this way are most efficient if the "split" between the two parts is midway along the broad dimension of the rectangular cross-section of the waveguide. This is because, at this position, the radio frequency current is zero or near zero and thus the split has little effect on the performance of the waveguide. This technique is known generally as "E-plane technology" because the split is in the plane of the electric or E field of the dominant waveguide mode.

E-plane technology is employed in integrated systems comprising a number of components joined by waveguides, both waveguides and components being fabricated in a common conductive block. In many such systems it is desirable to mount conductors or components inside the waveguide at or near the E-plane, for instance in fin-line switches. These conductors or components are often mounted on printed circuit boards (P.C.B's). This introduces a problem in that the P.C.B substrate provides a route for energy travelling along the waveguide to escape, which is obviously undesirable.

In a first known method, a P.C.B. substrate is supported in detents in the sides of the waveguide, the detents being so small compared to the wavelength of the radiation carried in the waveguide that they have negligible effect on its propogation. Such a waveguide is shown in Figures 2A, 2B and 2C which show a waveguide of this known type in perspective view, a transverse cross section of the waveguide of Figure 2A and a sectional view on the line X-X of Figure 2B respectively. This method has the disadvantage of complexity and expense because it requires the P.C.B.'s to be manufactured and placed with great accuracy. Also it is difficult to D.C. isolate the P.C.B's from the waveguide walls if this is required.

In another known method, a P.C.B. substrate passes through the walls of the waveguide and a system of R.F. chokes is used to prevent the escape of radiation from the waveguide. Such a waveguide is shown in Figures 3A, 3B and 3C which show a waveguide of that known type in perspective view, a transverse cross section of the waveguide of Figure 3A and a sectional view on the line Y-Y of Figure 3B respectively. The problem with this method is that the space required for the chokes greatly increases the size of the waveguide assembly and the chokes allow a significant amount of radiation to escape from the waveguide.

According to the invention there is provided a waveguide arrangement comprising a waveguide and an insulating body arranged to partially occupy the waveguide, characterised by at least some of the surfaces of the insulating body bearing conductive material which is substantially coplanar with a surface of the waveguide.

This gives the advantage that the problems of the known methods outlined above are avoided, such an arrangement prevents the escape of radiation without the need for chokes and because the insulating body defines the edges of the waveguide the very accurate manufacturing and assembly required to use detents is not needed, also it is relatively simple to D.C. isolate the insulating body from the waveguide walls.

Preferably the insulating body is substantially planar and the surfaces bearing conductive material are edges of the insulating body.

Advantageously the surfaces bearing conductive material are provided by apertures through the insulating body.

A waveguide assembly embodying the invention will now be described with reference to the accompanying figures in which:

Figure 4A shows a waveguide assembly in accordance with the invention,

Figure 4B shows a transverse cross section of the waveguide of Figure 4A,

Figure 4C shows a sectional view on the line Z-Z of Figure 4B,

Figure 5 shows a more detailed transverse cross section through the waveguide of Figure 4A,

Figure 6 shows a cross section through another type of waveguide assembly constructed according to the invention,

Figure 7 shows a top view of the PCB used in the waveguide of Figure 5, and

Figure 8 shows a transverse cross section through yet another type of waveguide assembly constructed according to the invention; identical parts having the same reference numerals throughout.

Referring to Figures 4A, B and C and 5, in a waveguide assembly constructed in accordance with the invention, a P.C.B. 10 separates the two conductive bodies 2 and 3. The P.C.B. 10 has a number of slots 11 cut in it, which are plated

through with a layer of conductive material 12. The slots 11 are positioned so that when the P.C.B. 10 is in place, the layer of conductive material 12 is coplanar with a side wall of the waveguide 1 such that the two conductive bodies 2 and 3 and the conductive layer 12 form a single conductive surface.

The conductive layer 12 acts as a part of the waveguide wall and prevents the escape of the radiation propagated along the wavegude. In order to give good results, the portions of the PCB 13 between the slots should be made as small as possible, in order to prevent the escape of radiation through them, however the gaps must also be large enough to give the P.C.B. 10 the necessary physical strength. It has been found that a slot separation in the approximate range $\lambda/10$ to $\lambda/20$ gives good results.

The length 14 and width 15 of the slots 11 must be such that they do not form resonant cavities and radiate the radiation propagating along the waveguide 1 to the outside, the length 14 of the slots being near to an odd number of $\lambda/4$ and the width 15 being in the approximate range $\lambda/10$ to $\lambda/20$ has been found, to prevent resonance.

The assembly shown in Figures 6 and 7 is used when it is necessary to D.C. isolate the P.C.B. 10 from the conductive bodies 2 and 3 in order to allow D.C. biasing and control signals to pass to components on the P.C.B. 10 in the waveguide 1.

Referring to figure 6, a conductive pattern 16 is laid down in the surface of the P.C.B. 10 to carry power to a diode 17 mounted on the P.C.B. 10 in the waveguide 1. An insulating layer 18 is then laid down on the conductive surface of the P.C.B. 10 so that when the waveguide is assembled the insulating layer separates the conductive surface of the P.C.B. 10 from the conductive bodies 2 and 3. This insulating layer 18 insulates the conductive pattern 16 and the conductive layers 12 from the conductive bodies 2 and 3 and so allows D.C. isolation.

Another way in which the invention could be used is shown in Figure 8. A P.C.B. 19 is supported by detents 20 in conductive bodies 2 and 3. Conductive layers 21 on the edges of the P.C.B. 19 are arranged to form a part of the waveguide walls together with the conductive bodies 2 and 3.

The conductive layers 21 cannot, of course, be coplanar with the conductive bodies 2 and 3 because there must be enough overlap to support the P.C.B. 10, but if the overlap is small enough the overlap will not affect the radiation propagating in the waveguide 1. Since the detents 20 cut into the conductive bodies 2 and 3 do not define the walls of the waveguide 1 they need not be formed with precision.

Although this description refers to a P.C.B. any other type of insulating substrate could be used.

Claims

1. A waveguide arrangement comprising a waveguide and an insulating body arranged to partially occupy the waveguide, characterised by at least some of the surfaces of the insulating body bearing conductive material which is substantially coplanar with a surface of the waveguide. 2. A waveguide arrangement as claimed in claim 1 in which the insulating body is substantially planar and the surfaces bearing conductive material are edges of the insulating body.

3. A waveguide arrangement as claimed in any preceding claim in which the surfaces bearing conductive material are provided by apertures through the insulating body. 4. A waveguide arrangement as claimed in claim 3 in which the apertures have, at least one planar face bearing conductive material and arranged to be substantially coplanar with a surface of the waveguide. 5. A waveguide arrangement as claimed in any preceding claim in which the insulating body is a printed circuit board.

6. A waveguide arrangement as claimed in claim 5 when dependent on claim 4 in which the conductive material is provided by through plating of apertures in the printed circuit board.

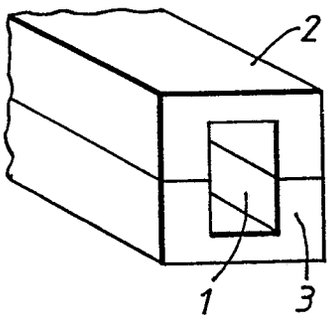

FIG.1A.

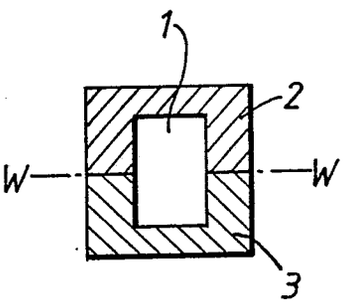

FIG.1B.

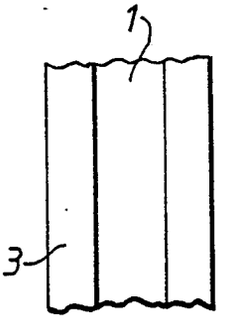

FIG.1C.

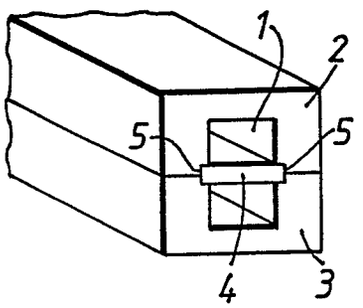

FIG.2A.

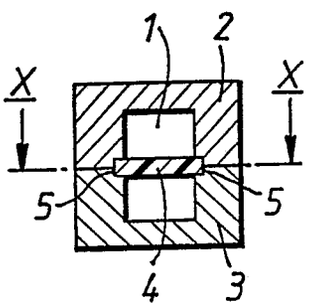

FIG.2B.

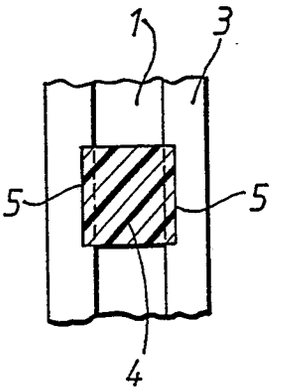

FIG.2C.

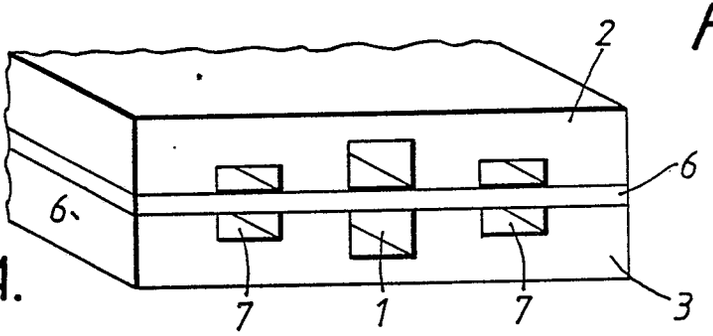

FIG.3A.

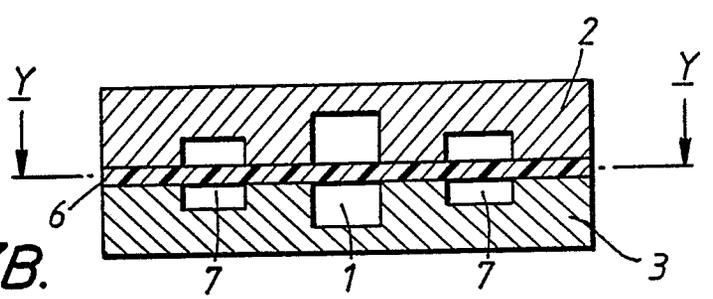

FIG.3B.

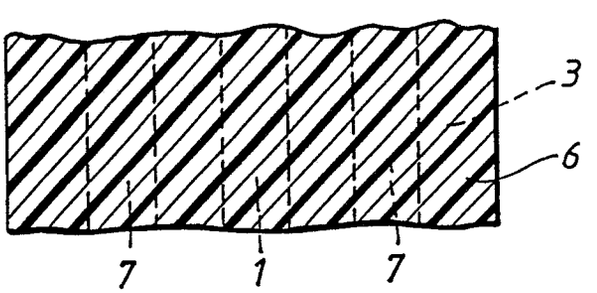

FIG.3C.

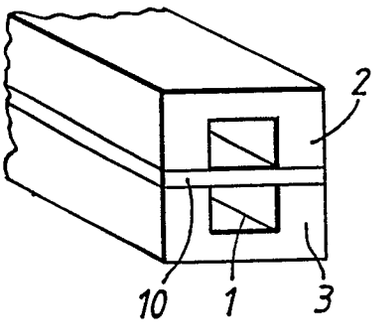

FIG.4a.

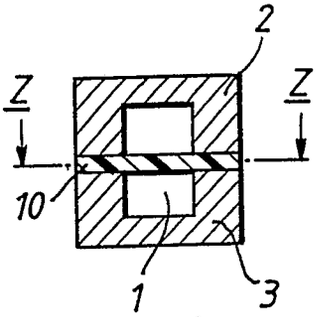

FIG.4b.

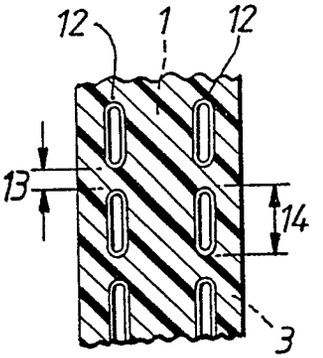

FIG.4c.

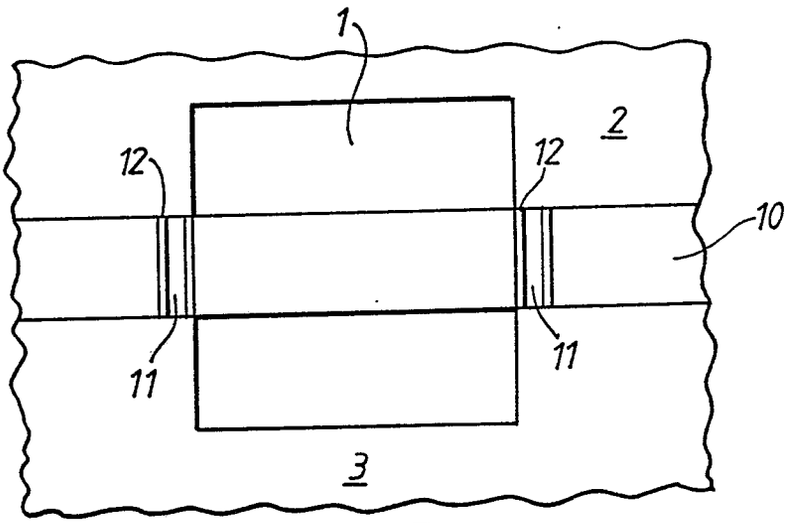

FIG.5.

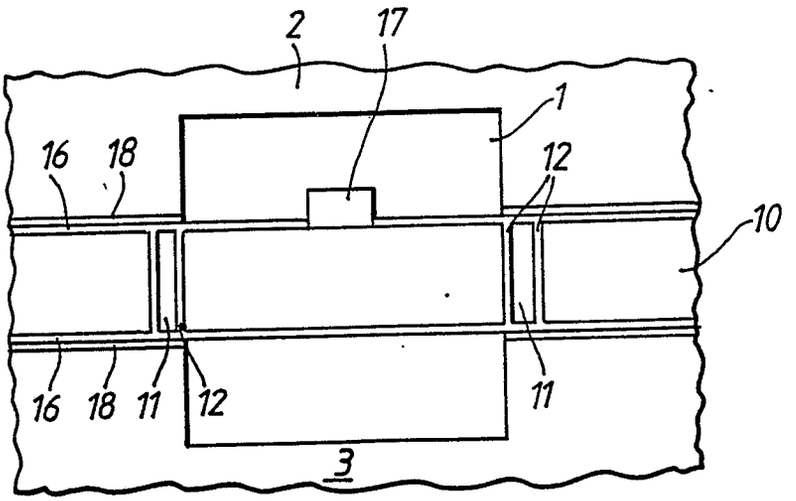

FIG.6.

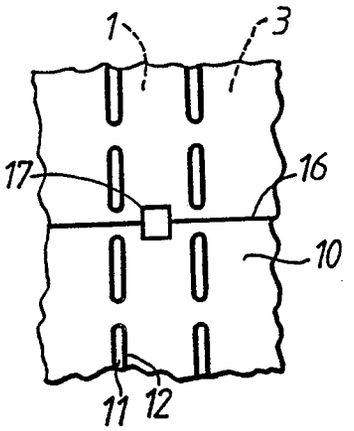

FIG.7.

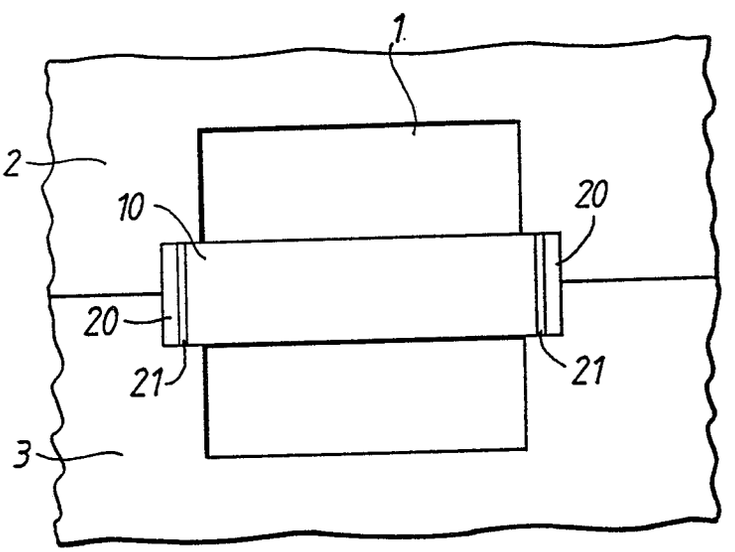

FIG.8.