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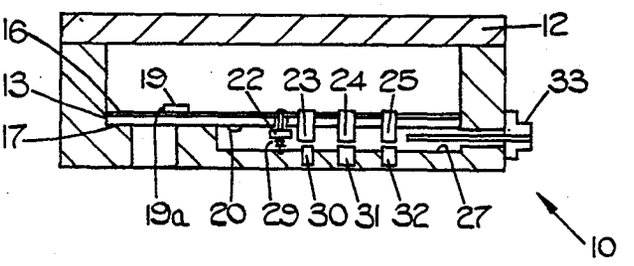
(54) Microwave filter.

(57) An electrical assembly comprises a board (13) mounted on the bottom wall of an aluminium box (10) and having an insulating layer (16) mounted on a conductive layer (17), a microstrip circuit (18,19,20) formed on the insulating layer (16), and a comb-line microwave filter which includes a set of resonant elements (22 to 25) extending form the conductive layer into a cavity (27). The element (22) is insulated from the conductive layer (17) and is connected to a point in the microstrip circuit. By providing the microstrip circuit and filter on a common board, no connected leads are needed. Other filters may be combined with a microstrip circuit in a similar manner.



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"MICROWAVE FILTER"

This invention relates to a microwave filter.

Where a microstrip circuit requires a microwave filter, the filter may either take the form of a separate comb-line filter connected to the microstrip circuit by connecting leads or a microstrip filter formed as an integral part of the microstrip circuit. It is sometimes preferred to provide the filter as a separate comb-line filter as such a filter has lower losses than a microstrip filter and also a comb-line filter is more readily tuned than a microstrip filter. However, the need to provide connecting leads represents a disadvantage of this arrangement.

Accordingly, it is an object of this invention to provide a microwave filter in an improved form.

According to this invention there is provided a board formed from an insulating layer mounted on a conductive layer, a microstrip circuit formed on the insulating layer, and a microwave filter which includes a set of elements extending from the conductive layer into at least one cavity having conductive walls, at least one of said elements being insulated from the conductive layer and being connected to a point in the microstrip circuit.

By providing a microstrip circuit and the elements of the microwave filter on a common board, the need to provide connecting leads is eliminated and so the advantages of using a separate filter are obtained

without the disadvantage of using connecting leads.

This invention will now be described in more detail by way of example with reference to the accompanying drawings in which:-

Figure 1 is a plan view of a box and electrical board which together form an electrical assembly embodying this invention;

Figure 2 is a plan view of the box with the board removed;

Figure 3 is a section on the line 3-3 in Figure 1; and

Figure 4 is a fragmentary sectional view showing a modification to the assembly of Figure 1.

Referring now to Figures 1 to 3 of the drawings, there is shown an electrical assembly which comprises a box 10 made from conductive material, which in the present example is aluminium, and which has a hollow body 11 and a lid 12. The box 10 has a width W of 50mm and a depth D of 42mm. A board 13 is mounted inside the box 10 on the bottom wall of the body 11 by nine brass screws which pass through holes 14 and 15 formed in the board 13. The board 13 comprises an insulating layer 16 formed of plastics material mounted on a conductive layer 17 which in the present example is formed from brass. In order to provide a good electrical contact between the layer 17 and the body 11, the holes 15 have an enlarged part in the insulating layer 16 so that the underside of the screw heads engages the upper surface of the brass layer 17.

A microstrip circuit which forms part of a frequency multiplier is formed on the insulating layer 16 from copper strip provided with protective gold plate. The microstrip circuit includes strip

components such as the component indicated at 18 and also discrete components such as the component indicated at 19 which protrudes above the board 13 and the component 20 which protrudes beneath the board 13. The microstrip circuit has an input 21. The component 19 is connected to a lead 19a which provides a bias connection for the frequency multiplier.

The assembly also includes a microwave comb-line filter which comprises four resonant elements 22 to 25 which extend from the conductive layer 17 into a trough shaped cavity 27 formed in the bottom wall of the box 10. The resonant element 22 is connected to a point in the microstrip circuit and is insulated from the conductive layer 17 by an insulating washer (not shown). The resonant element 22 is connected to the bottom wall of box 10 by a step recovery diode 29. The element 22 forms the input of the microwave filter. The resonant elements 23 to 25 are of cylindrical configuration and are glued into holes formed in the board 13 with silver loaded epoxy. The resonant elements 23 to 25 are associated with a set of brass tuning screw 30 to 32 mounted in the bottom wall of the box 10. The resonant element 25 forms the output of the microwave filter and is capacitively connected to a co-axial connector 33. The comb-line filter also forms part of the frequency multiplier.

In order to avoid high frequency losses in the silver loaded epoxy, the epoxy surface in the region of the junction of the resonant elements 23 to 25 with the conductive layer 17 is broken down and covered with copper or silver plate. This may be achieved by vapour blasting the epoxy and its surroundings. Alternatively, a catalyst may be spread over the epoxy surface after removing a layer by an etching process, and a palladium film may be laid down

in order to permit plating with copper or silver.

The comb-line filter operates as a band-pass filter which may be tuned by adjusting the screws 30 to 32. In the present example, the filter operates at a frequency of approximately 16GHz.

Referring to Figure 4 there is shown a modification. In this arrangement the element 22 acts as an input impedance matching transformer and includes a threaded end 35 which is connected to the bottom wall of the box 10 by a nut 36. This arrangement also includes an output impedance matching transformer 26 which is also connected includes a threaded end 37 to the bottom wall by a nut 38. The top of element 26 is connected to a strip formed on the insulating layer 16 and which acts as an output. The elements 22 to 26 form a comb-line filter.

Whereas the comb-line filter shown in Figures 1 to 3 is specifically designed to form part of a frequency multiplier, the comb-line filter shown in Figure 4 may be used with a microstrip circuit of any desired configuration.

The elements 22 to 26 are made of brass or copper which is silver plated and then provided with a gold flash.

Although in Figures 1 to 4 the present invention is applied to a comb-line filter, the same technique could be applied to other filters such as interdigital filters. In the case of an interdigital filter, a second set of elements are provided which extend upwardly from the bottom of cavity 27 towards the board 13 and which are interleaved with the elements 22 to 26.

It is to be noted that the box 10 is of sufficient size to house further circuit boards. Where further boards are not required, a smaller box may be used.

CLAIMS:

1. An electrical assembly including a board (13) formed from an insulating layer (16) mounted on a conductive layer (17), a microstrip circuit (18,19,20) formed on the insulating layer (16), and a microwave filter, characterized in that the microwave filter includes a set of elements (22,23,24,25,) extending from the conductive layer (17) into at least one cavity (27) having conductive walls, at least one (22) of said elements being insulated from the conductive layer (17) and being connected to a point in the microstrip circuit (18,19,20).

2. An electrical assembly as claimed in claim 1, characterized in that the elements (22,23,24,25,) are mounted in line in a single cavity so as to form a comb-line filter.

3. An electrical assembly as claimed in claim 2, characterized in that there are two elements (22,26) insulated from the conductive layer (17), one (22) of said two elements providing the input of the filter and the other (26) provding the output of the filter.

4. An electrical assembly as claimed in any one of the preceding claims characterized in that the board (13) is mounted on a wall inside a conductive box (10), said at least one cavity (27) being formed in said wall.

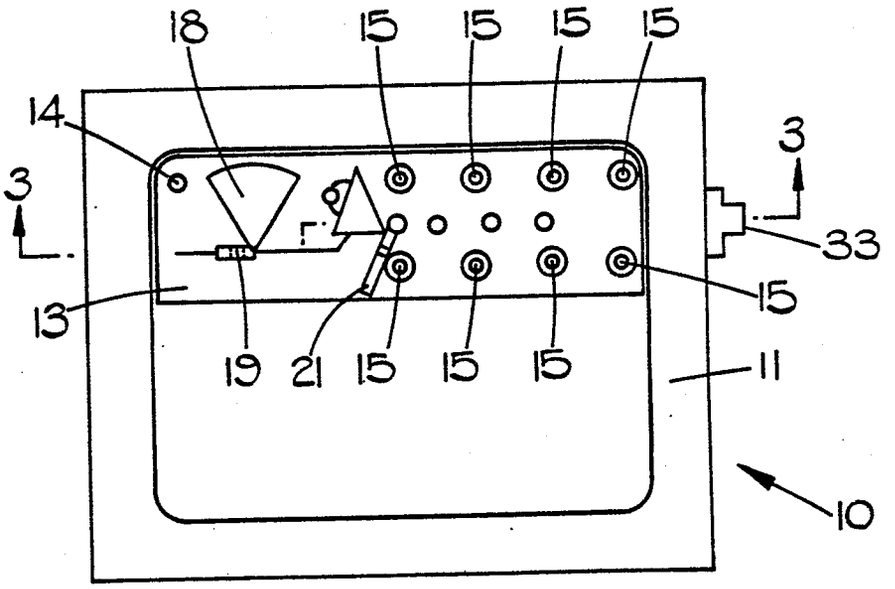

FIG.1.

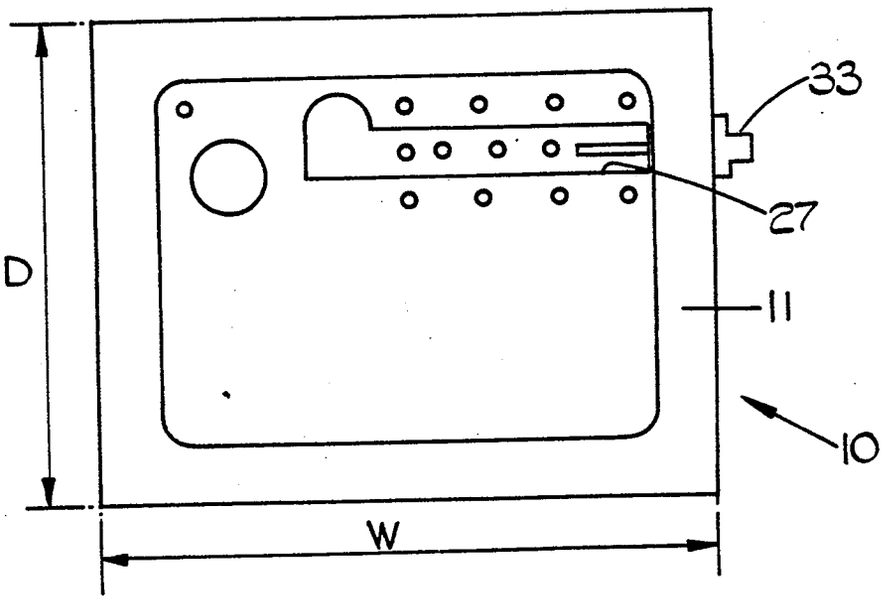

FIG.2.

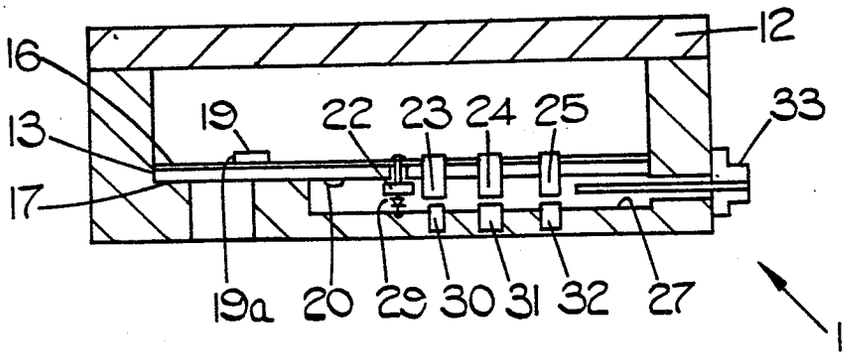

FIG.3.

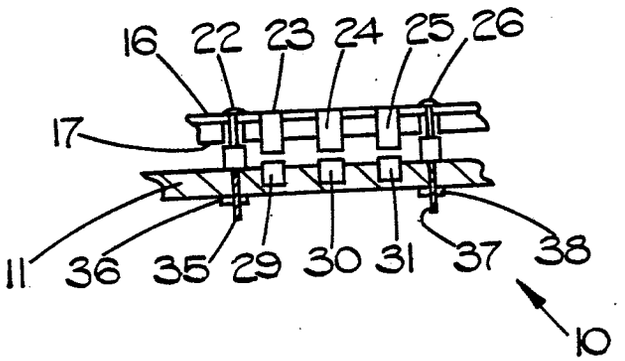

FIG. 4.