Aug. 27, 1957 G. BROUSSAUD 2,804,599

MICROWAVE FILTERS

Filed June 22, 1954 2 Sheets-Sheet 1

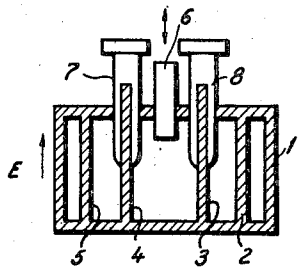


Fig. 1

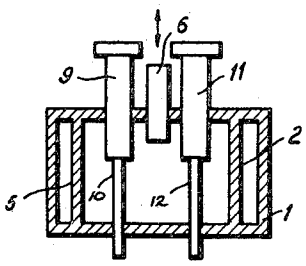


Fig. 2

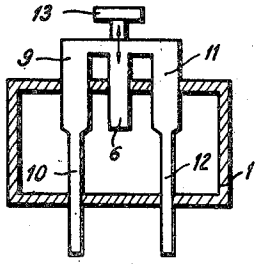


Fig. 3

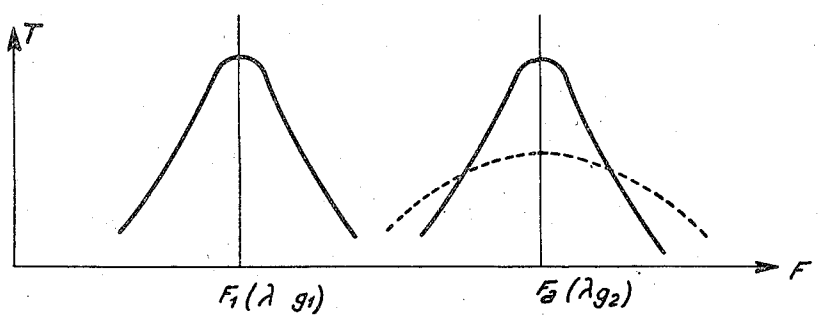


Fig. 4

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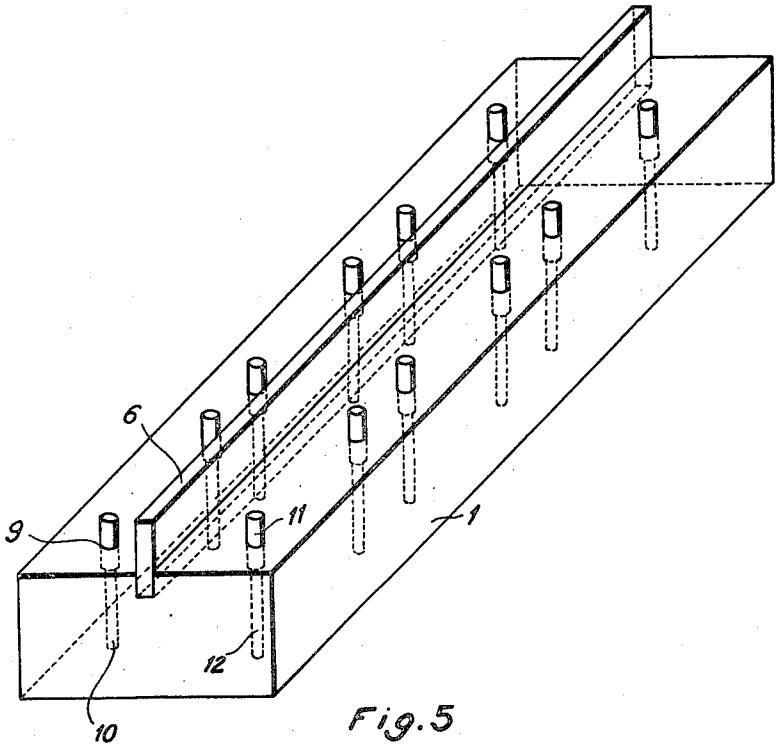


Fig. 5

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2,804,599

MICROWAVE FILTERS

Georges Broussaud, Paris, France, assignor to Compagnie Generale de Telegraphie Sans Fil, a corporation of France

Application June 22, 1954, Serial No. 438,515

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4 Claims. (Cl. 333—73)

It is known that it is possible to build, within a wave guide having a rectangular cross-section and terminating in its characteristic impedance, a pass-band microwave filter comprising a series of suitably coupled resonant cavities. Each cavity may be formed by a portion of the guide defined by two thin obstacles, such as metallic rods which are as near identical as possible.

It is also known that such a filter may be tuned in frequency by inserting a metallic strip in the portion of the guide which contains the filter, this strip being caused to penetrate to the desired extent in the guide parallel to the small side of the guide in the median plane of the latter.

But this system is disadvantageous in that the transmission coefficient of the filter and reflection coefficients of the obstacle disposed in the guide are varied while the penetration depth of the strip is caused to change.

As is well known, in the case of thin obstacles, the variation in the transmission and reflection coefficients are proportionate to the variations in a single common parameter u to which reference will be had in the ensuing description and which suffices for characterizing these obstacles.

The present invention has for object to provide a tunable pass-band filter which has a transmission curve that remains substantially constant.

It relates more particularly to filters of the aforementioned type, and provides means for keeping the parameter u constant, when the penetration depth of the slip into the guide varies.

These means act on the obstacles in such manner as to vary their section and thus maintain the parameter u constant.

According to a preferred mode of carrying out the invention, the filter comprises a metallic strip which is introduced in the median plane of metallic rods disposed parallel to the electric field and extending across the cross-section of the filter parallel to its small side, and conducting means which are associated with these rods and permit a variation of their section, as the position of this strip is changed.

The invention will be more readily understood with the air of the accompanying-drawings which show merely illustrative modes of carrying out the invention.

In the drawings:

Fig. 1 shows in section a first embodiment of the filter according to the invention;

Figs. 2 and 3 show other embodiments of the filter according to the invention;

Fig. 4 illustrates the results of the frequency tuning realized with the filters of the invention;

Fig. 5 shows a practical embodiment of the invention.

This latter shows a perspective view of a guide portion 1 making up the filter is associated with a metallic strip 6 which extends along the entire operative length of the filter which comprises several successive cells or cavities. This strip, disposed in the median plane of the filter, is adjustable in height so as to be capable of penetrating to the desired extent inside the guide. The obstacles of the filter are formed by rods disposed parallel to the electric field E, i. e., parallel to the small side of the guide respectively on both sides of the strip 6.

Figs. 1 to 3 show in cross-section four embodiments of the invention showing in which way the obstacles 10 and 12 of Fig. 6 may be arranged.

In the embodiment of Fig. 1 the rods 3 and 4 are integral with the bottom of the guide. Metallic sleeves or tubes 7 and 8 are frictionally slidable on the fixed rods 3 and 4 and across apertures formed in the wall of the guide 1.

As has been mentioned above, experiments have shown that when the strip 6 is introduced in the guide, the parameter u increases, the obstacle becomes less reflective and the Q factor of the cavities decreases. This effect is compensated by simultaneously increasing the diameter of the rods, i. e., by urging downwardly the sleeves 7 and 8 on their respective rods when the strip 6 is shifted in the same direction.

It can be seen from Fig. 2 that the same result may be obtained by axially sliding across the guide, rods having two portions of different profile 9, 10 and 11, 12 respectively. These movable rods are frictionally mounted in apertures formed in the wall of the guide. In the case of Fig. 2, the adjustment in position of the strip 6 and the compensating means (tubes or shouldered rods) is effected independently. However, by giving the portions 9, 10 and 11, 12 of the rods suitable dimensions (Fig. 3), it is in some cases possible to render the rods and the strip unitary and thus obtain a simultaneous control.

The above-described filters permit the resonance frequency to be tuned over a relatively wide range without this distorting the transmission coefficient curve, while transposing the latter from F1 to F2, as shown in Fig. 4 where the transmission coefficient is plotted as a function of frequency. Without the arrangement according to the present invention, this frequency change would be accompanied by a flattening of the curve as shown in dotted lines.

Fig. 5 shows a filter comprising a succession of movable rods which are identical and include two portions of different profile such as 9—10, 11—12 etc. forming a series of cells or cavities. The movable strip 6 extends over the entire length of the filter. In order to simplify the drawing, the mechanical control members have not been shown.

For a rectangular guide having a large side of 57 mm. and a small side of 27 mm. there may be provided a strip 8 mm. thick and rods from 3 to 4 mm. diameter at their upper ends and 1.5 mm. at their lower ends. The axial travel of the rods is about twice that of the strip. All the movable members are held in position by friction.

In the described examples, obstacles in the form of rods passing through the cross-section of the guide have been used. It should be understood that the invention is not limited thereto, but includes any other type of obstacle which may be made up by a conductive surface which occupies a portion of the cross-section of the guide and is capable of being so adjusted as to obtain the desired compensating effect.

What I claim is:

1. A tunable filter comprising: a rectangular wave guide portion having walls; a variable depth strip inserted in a slot formed in one of said walls and movable in a plane of symmetry normal to said guide for variable depth insertion into the latter for varying the cut-off frequency of the said guide; at least one set of four identical thin elongated obstacles within said guide portion, respectively located at the four corners of a rectangle sym-

metrically disposed with respect to said strip and constituting a cavity resonator, and having at least two portions of different cross-section, at least one of said portions being slidable with respect to said waveguide portion.

2. A tunable filter comprising: a rectangular wave guide portion having walls; a variable depth strip inserted in a slot formed in one of said walls and movable in a plane of symmetry normal to said guide for variable depth insertion into said guide; at least one set of four identical thin elongated obstacles within said guide portion, respectively located at four corners of a rectangle symmetrically disposed with respect to said strip, and respective sleeves extending outside the guide, slidably mounted on said obstacles, whereby the profile of said obstacles is varied in a transverse direction with respect to the guide according to the position of said sleeves thereon.

3. A tunable filter comprising: a rectangular wave guide portion having walls; a variable depth strip inserted in a slot formed in one of said walls and movable in a plane of symmtry normal to said guide for variable depth insertion into said guide; at least one set of four identical thin elongated obstacles longitudinally movable and slidably inserted into said guide, respectively at four corners of a rectangle, symmetrically disposed with respect to said strip, said obstacles having, transversally of said guide, a profile whose width is not constant.

4. A filter according to claim 3, wherein said strip and said obstacles are movable as a unit.

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