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AIR DIELECTRIC STRIP-LINE TUNABLE BANDPASS FILTER

Filed Sept. 15, 1959

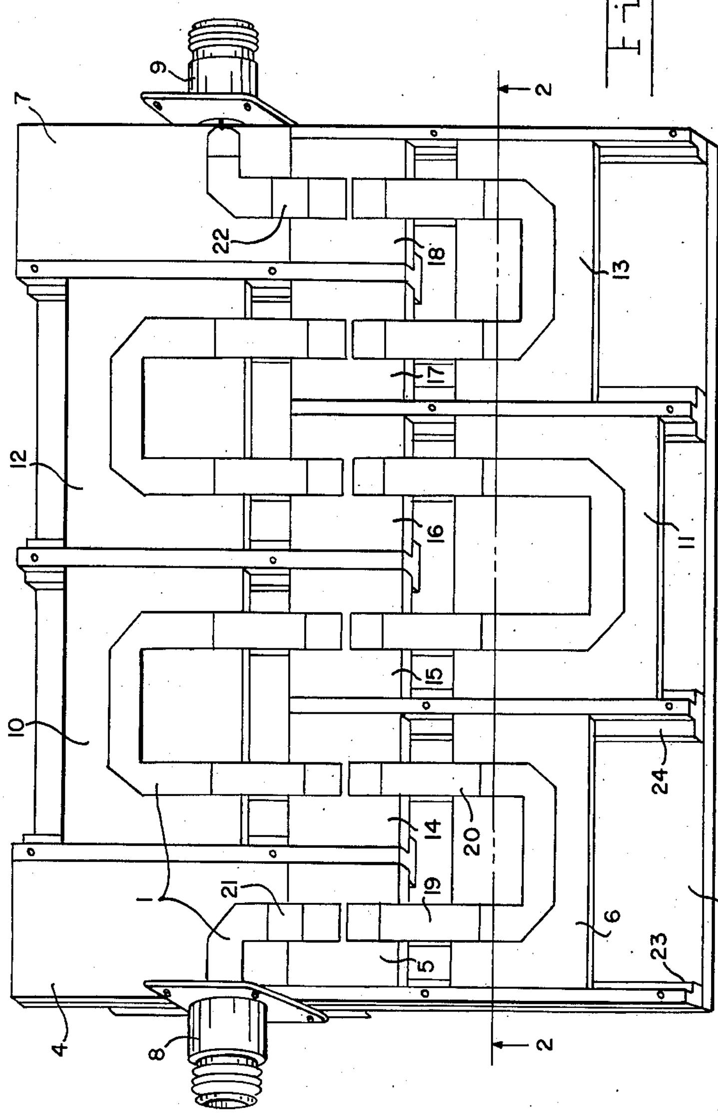

Fig-1

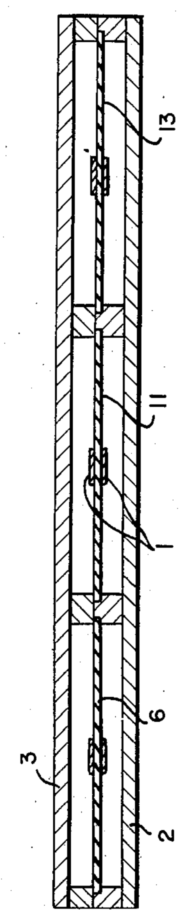

Fig-2

INVENTOR.
DAVID ALSTADTER

BY Wade Koontz
ATTORNEY

and James S. Shannon
AGENT

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AIR DIELECTRIC STRIP-LINE TUNABLE BANDPASS FILTER

David Alstadter, Falls Church, Va., assignor to the United States of America as represented by the Secretary of the Air Force

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1 Claim. (Cl. 333—73)

It is frequently necessary to construct bandpass filters of the strip-line type in which the bandwidth and frequency characteristics fall within 0.2%, or closer, of specifications. This degree of accuracy is not readily attainable with present photo-etching or engraving techniques for constructing strip-line components. It is the purpose of this invention to provide a strip-line bandpass filter construction in which the resonant elements may be adjusted and the reactive coupling elements readily changed to permit a very accurate adjustment of the center frequency and bandwidth of the filter.

The invention will be described in more detail with reference to the specific embodiment shown in the accompanying drawings in which—

Fig. 1 shows a bandpass filter in accordance with the invention with one ground plane removed to show the center conductor configuration, and

Fig. 2 is a cross section of the filter of Fig. 1 with both ground planes in place.

Referring to Fig. 1, the principal components of the bandpass filter shown are a sinuous strip center conductor generally indicated at **1**, a metallic plate **2** forming the lower ground plane and a metallic plate **3**, removed in Fig. 1 but shown in Fig. 2, forming the upper ground plane. Aluminum is a suitable metal for the plates **2** and **3**. The strip center conductor is formed on insulating cards such as **4**, **5** and **6** by conventional stripline construction techniques. For example, 1/16" Teflon fiber glass cards coated on both sides with a metallic film may be used. The metallic film outside the desired outline of the center conductor is removed from both sides by photo-etching or engraving techniques to leave directly opposite conductive strips on the two sides of the cards as shown in Fig. 2. At the end cards **4** and **7**, the upper and lower conductive strips are connected together and to the center terminals of coaxial connectors **8** and **9**.

In addition to the end sections on cards **4** and **7**, the center conductor of the filter consists of resonant sections in the form of mitered U-shaped bends located partially on cards **6**, **10**, **11**, **12** and **13** and reactance elements, each in the form of a gap in the center conductor, located on cards **5**, **14**, **15**, **16**, **17** and **18**. The reactive gaps serve to couple the resonant sections to their adjacent resonant or end sections. A U-shaped resonant section consists of the entire length of center conductor extending between gaps. For example, in the case of the resonant section nearest connector **8**, the entire U-shaped

section consists of short lengths of center conductor on cards **5** and **14**, clips **19** and **20**, and the U-shaped conductor on card **6**. Clips **19** and **20** are made of .010" strips of beryllium copper, heat treated to full temper, and attached, as by soldering, to the center conductor strips on both the upper and under sides of the card **6**. These strips extend across the space between card **6** and cards **5** and **14** and make electrical contact under spring pressure with the strip conductors on both sides of the latter two cards. Similar spring strips **21** and **22** are attached to the center conductors on end cards **4** and **7** and serve to make spring contact with the center conductors on reactance cards **5** and **18**.

The function of the spring clips described above is twofold: first, to permit tuning of the resonant sections and, second, to permit easy replacement of the reactance cards. Tuning of the resonant sections is accomplished by sliding cards **6**, **10**, **11**, **12** and **13** in or out on guides or tracks such as **23** and **24** which are attached to plate **2** and serve to support and position the insulating cards. The resonant section must have an electrical length, measured from gap to gap, of $\lambda/2$ where λ is the wavelength at the desired resonant frequency. The provision for sliding the cards allows this length to be increased or decreased. In this manner the center frequency of the bandpass filter can be adjusted to the specified value within very close tolerances. If, after tuning, the bandwidth is not within specifications, the reactance cards **5**, **14**, **15**, **16**, **17** and **18** may be replaced with cards having gaps of different widths or shapes until bandwidth requirements are satisfied.

The upper frequency limit of a filter of the above described type is approximately 3 kmc., this limit being imposed by the difficulty of physically realizing a U-shaped resonant section at the short wavelengths above this frequency.

I claim:

A strip-line bandpass filter comprising a ground plane structure and a strip conductor parallel thereto, said strip conductor being sinuous in form with a reactance element situated between adjacent loops and between the end loops and input and output wave transmission means, each of said reactance elements being constituted by an intermediate gap in a strip conductor supported on a thin insulating card, each of said loops comprising a U-shaped strip conductor supported on a thin insulating card, said U-shaped conductor having strip spring extensions beyond the edge of the card which overlap and make spring contact with the strip conductors in the two adjacent reactance elements, and means for slidably mounting the cards having said U-shaped conductors for movement relative to the associated reactance elements for adjusting the electrical lengths of said loops.

References Cited in the file of this patent

Bradley et al.: "Band Pass Filters Using Strip-Line Techniques," "Electronics," May 1955, pages 152–155 relied upon.

Sanders Associates: "Handbook of Tri-Plate Microwave Components," copyright Dec. 31, 1956, by Sanders Associates, Inc., Nashua, N.H., pages 58–61 relied upon.