

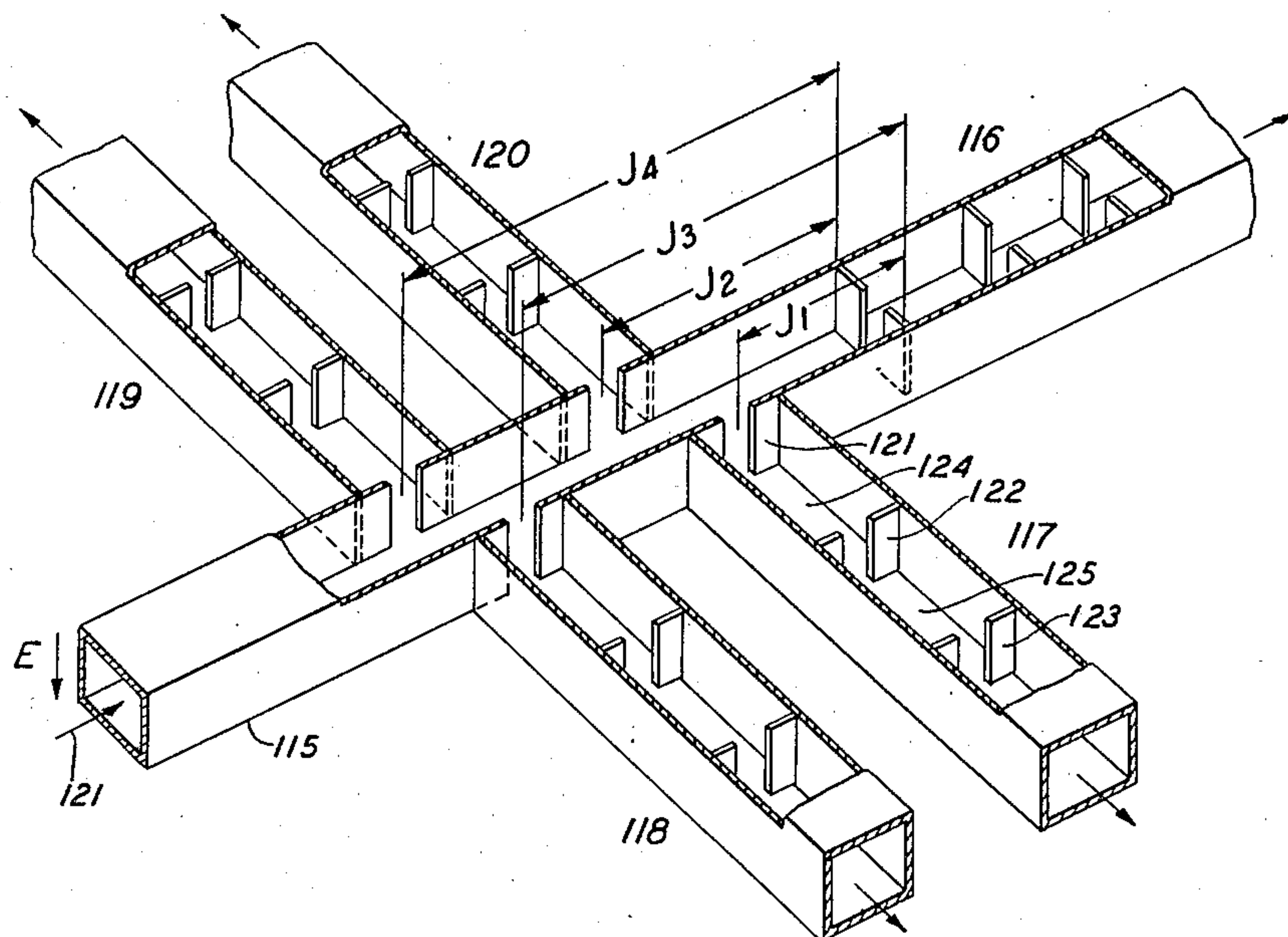
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WAVE GUIDE BRANCHING ARRANGEMENT

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WAVE GUIDE BRANCHING ARRANGEMENT

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This invention relates to the transmission of guided electromagnetic waves and more particularly to a wave guide branching arrangement.

The object of the invention is to separate guided electromagnetic waves into individual channels on a frequency basis.

A uniform metallic sheath with or without a dielectric filler will serve as a guide for suitable electromagnetic waves. In cross-section the sheath may be circular, rectangular, or of other shape. For all frequencies above a minimum, known as the cut-off frequency, the guide acts like a transmission line and has a specific propagation constant and characteristic impedance. For any particular frequency there are an infinite number of cross-sectional sizes and shapes of guide which will have the same characteristic impedance.

Shunt reactive elements may be obtained by placing partial obstructions across the wave guide. For example, shunt reactive elements for dominant transverse electric waves may be obtained by using a transverse metal partition having a slit therein which extends substantially from one side to the other. A wave filter may be formed by inserting two such apertured partitions in a wave guide at a properly chosen distance apart to form a tuned chamber. Improved transmission characteristics may be obtained by connecting two or more such chambers in tandem.

In accordance with the present invention there is provided a branching arrangement for separating guided electromagnetic waves into individual channels according to frequency in which a plurality of band-pass filters open into a common wave guide and are so arranged that each filter will select a desired band of frequencies without adversely affecting transmission in the other channels. The filters have different mid-band frequencies and have image impedances which match the characteristic impedance of the common guide. Each filter is connected to the guide at a point of voltage maximum for the standing wave of the mid-band frequency of the particular filter. Such a point is found at a distance from the end of the guide equal to an odd multiple of a quarter wavelength. An additional filter may be connected to the end of the guide.

This is a continuation-in-part of application Serial No. 422,408, filed December 10, 1941, now Patent No. 2,396,044 dated March 5, 1946, and a division of application Serial No. 452,851, filed July 30, 1942, now Patent No. 2,432,093 dated December 9, 1947.

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The nature of the invention will be more fully understood from the following detailed description and by reference to the accompanying drawing, the single figure of which is a perspective view, partly cut away, showing five band-pass filters branching from a common wave guide.

As shown, the branching arrangement in accordance with the invention comprises a main rectangular wave guide 115 and five filters 116, 117, 118, 119 and 120 each of which is connected to the guide 115 through the front aperture. Each filter has three transverse apertured partitions, such as 121, 122 and 123 in the filter 117, spaced from each other a distance approximately equal to a half wavelength, or an integral multiple thereof, at the mid-band frequency to be transmitted, to form two tandem-connected chambers 124 and 125. It will be understood, of course, that each filter may comprise only a single chamber, or more than two chambers. The filters 116 to 120 are of the band-pass type, with different mid-band frequencies f_1, f_2, f_3, f_4 and f_5 , respectively. The corresponding wavelengths at the mid-band frequency are $\lambda_1, \lambda_2, \lambda_3, \lambda_4$ and λ_5 , respectively. Each filter is designed so that, at its mid-band frequency, it matches the guide 115 in characteristic impedance.

One of the filters, 116, is shown connected to the end of the guide 115. Alternatively, the end of the guide 115 may be closed by a metal plate. In order to terminate properly the main guide 115 over the frequency range for all of the channels, each filter, with the exception of 116, should be connected to the main guide at a point of voltage maximum for the standing wave of the mid-band frequency of that particular filter. For example, the distances J_1, J_2, J_3 and J_4 may be made equal to $\frac{1}{4}\lambda_2, \frac{1}{4}\lambda_5, \frac{3}{4}\lambda_3$ and $\frac{3}{4}\lambda_4$, respectively. Now, assuming that the energy entering the guide 115, as indicated by the arrow 121, includes frequencies falling within all of the bands, it will be separated by the filters 116 to 120 into five individual channels, as indicated by the outgoing arrows. If the mid-band frequencies f_1 to f_5 have sufficient separation, no filter will be appreciably affected by the presence of the other filters.

The wave guides and the partitions may be made of brass or other alloy or metal of good electrical conductivity. The transmission efficiency of the filters may be improved by silver-plating the inner surfaces of the chambers. Since a metallic obstruction in a wave guide usually produces a point of low potential and high current, it is preferable that the partitions be se-

cured to the walls of the guide by soldering, welding, or in some other appropriate manner such that a good electrical contact is obtained. It should also be noted that thinner partitions than those shown will, under some circumstances, produce more satisfactory results. The partitions have been shown thicker in the drawing only in the interest of clarity.

In the arrangement shown, all of the filters 116 to 120 lie in a plane which is perpendicular to the electric vector E of the electromagnetic waves.

What is claimed is:

1. A branching arrangement for separating guided electromagnetic waves into individual channels according to frequency comprising a wave guide and a plurality of band-pass wave filters having different mid-band frequencies, each of said filters being connected to said guide at a point of voltage maximum for the standing wave of the mid-band frequency of that particular filter.

2. A branching arrangement in accordance with claim 1 in which said guide is rectangular in cross-section.

3. A branching arrangement in accordance with claim 1 in which each of said filters at its mid-band frequency approximately matches said guide in characteristic impedance.

4. A branching arrangement in accordance with claim 1 in which each of said filters comprises a chamber coupled to said guide through an aperture.

5. A branching arrangement in accordance with claim 1 in which each of said filters comprises a plurality of coupled chambers and one of said chambers is coupled to said guide through an aperture.

6. A branching arrangement in accordance with claim 1 in which each of said filters is connected to said guide at a distance from the end of said guide approximately equal to an odd integral multiple of a quarter wavelength at the mid-band frequency of that particular filter.

7. A branching arrangement in accordance with claim 1 in which one of said filters is connected to said guide at a distance from the end of said guide approximately equal to an odd multiple of a quarter wavelength for its mid-band frequency and another of said filters is connected at a distance from the end of said guide approximately equal to a different odd multiple of a quarter wavelength for its mid-band frequency.

8. A branching arrangement in accordance with claim 1 which includes a wave filter connected to the end of said guide, said last-mentioned filter having an image impedance at its mid-band frequency which approximately matches the characteristic impedance of said guide.

9. A branching arrangement for separating

guided electromagnetic waves into individual channels comprising a wave guide and a plurality of band-pass wave filters having different mid-band frequencies, each of said filters being connected to said guide at a distance from the end of said guide approximately equal to an odd integral multiple of a quarter wavelength at the mid-band frequency of that particular filter.

10. A branching arrangement in accordance with claim 9 in which said guide is rectangular in cross-section.

11. A branching arrangement in accordance with claim 9 in which said odd integral multiple is different for two of said filters.

12. A branching arrangement in accordance with claim 9 in which two of said filters are connected to the same side of said guide and said odd integral multiple is different for said two filters.

13. A branching arrangement in accordance with claim 9 in which said odd integral multiple is unity for one of said filters and three for another of said filters.

14. A branching arrangement in accordance with claim 9 in which two of said filters are connected to the same side of said guide and said odd integral multiple is unity for one and three for the other of said two filters.

15. A branching arrangement in accordance with claim 9 in which each of said filters at its mid-band frequency approximately matches said guide in characteristic impedance.

16. A branching arrangement in accordance with claim 9 in which each of said filters comprises a chamber coupled to said guide through an aperture.

17. A branching arrangement in accordance with claim 9 in which each of said filters comprises a plurality of coupled chambers and one of said chambers is coupled to said guide through an aperture.

18. A branching arrangement in accordance with claim 9 which includes a wave filter connected to the end of said guide, said last-mentioned filter having an image impedance at its mid-band frequency which approximately matches the characteristic impedance of said guide.

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