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MICROWAVE CONTROL DEVICES

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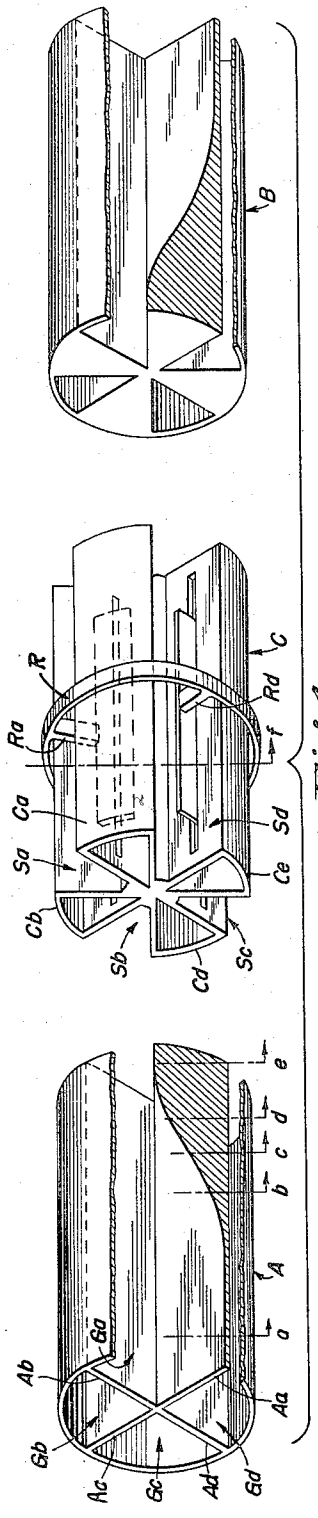


Fig. 1.

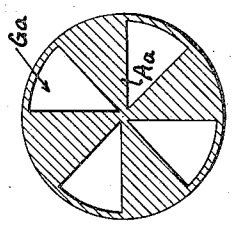


Fig. 1e.

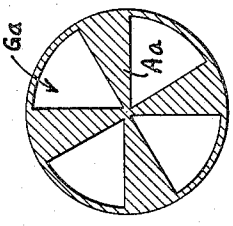


Fig. 1d.

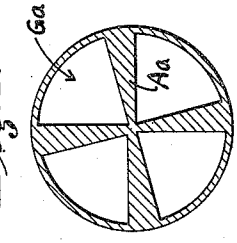


Fig. 1c.

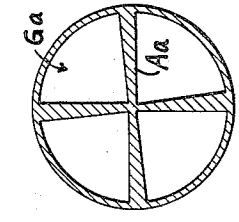


Fig. 1b.

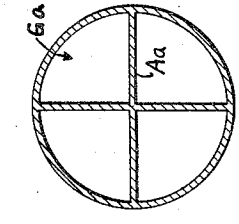


Fig. 1a.

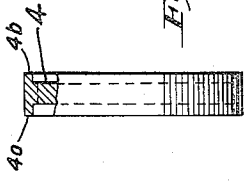


Fig. 3.

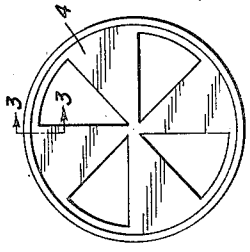


Fig. 2.

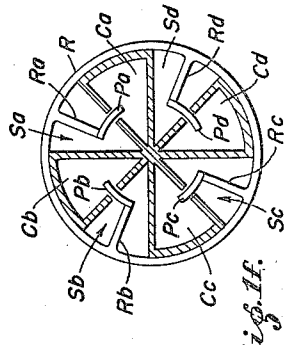


Fig. 1f.

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MICROWAVE CONTROL DEVICES

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7 Claims. (Cl. 333—98)

This invention relates to control devices for wave energy transmitted through circular waveguides. In particular, the invention is concerned with devices for the control of wave energy transmitted in the TE_{01} mode.

In one form of the invention it is useful as a tuner. In another form it is useful for attenuation of the wave energy, and in the third form, it is useful as a phase-shifter.

Broadly, the invention comprises two guide-tapering sections arranged in a line on opposite sides of a central section which contains a movable control element. One guide-tapering section contains a number of sectoral guides each of which decreases in angular span from the outer end of the section to the inner end adjacent the central sections, while the other guide-tapering section is formed in the same manner but in mirror fashion, i. e., it contains the same number of sectoral guides each of which decreases in angular span from the outer end of the section to the inner end adjacent the central section. Thus, in going from one end of the device to the other, the first section compresses or decreases the angular span of the individual sectoral guides, while the last section increases or expands the angular span of the individual sectoral guides.

Suitable forms of the invention will be described in connection with the accompanying drawing in which the Figure 1 is an exploded view showing one form of the invention which, with the substitution of appropriate control elements, may be used as a tuner, an attenuator, or a phase-shifter; Figures 1*a* to 1*f* are sectional views of Figure 1 taken along the transverse planes *a* to *f* respectively; and Figures 2 and 3 show a different form of central section which may be employed in Figure 1 as a tuner.

As shown in Figure 1, the control device is designed for insertion in a transmission line of circular wave-guide section. It comprises two guide-tapering end sections A and B and a central section C, in which the control operations are performed. The two end sections A and B are formed symmetrically about the middle transverse plane passing between them. As shown at the left end of section A, each end section has mounted therein a number of partition walls, such as A*a*, A*b*, A*c* and A*d*, extending radially from the center of the section out to the cylindrical wall, thereby dividing the circular guide into a number of equal sectoral guides, such as G*a* to G*d*, through which wave energy may be transmitted in the TE_{01} mode. As shown in Figure 1, the radial partition guide-tapering walls in section A and B increase in thickness gradually from the outer end of each section towards the inner end. In each of sections A and B, a portion of the cylindrical wall has been broken away to show the tapered thickness of the partition walls. This is also illustrated in Figure 1*a* to 1*e* where it will be seen that the partition walls are thin at the outer ends of sections A and B where the sectoral guides have an angular span of 90 degrees, and they increase in thickness towards their inner ends until the sectoral guides have an angular span of only 45 degrees.

The center section C interposed between the sections A and B is formed of a hollow structure having a transverse section as shown in Figure 1*f*. In the example shown, section C is formed of four sectoral guides, C*a*, C*b*, C*c* and C*d*, having individual side walls and being equally spaced about a common axis and positioned to constitute continuations of the sectoral guides in section A and B in the form in which the sectoral guides appear at the inner ends of these sections. It will be seen that trough-like spaces S*a*, S*b*, S*c* and S*d* appear between the sectoral waveguides of section C which provide access to the flat side walls of the various sectoral guides. One radial wall of each sectoral guide in section C is provided with a slot formed in its mid portion parallel with the axis of the sections, and a plate-like control element is mounted within each slot, see elements P*a*, P*b*, P*c* and P*d*. These control elements are mounted upon a suitable support by which they may be moved simultaneously to increase or decrease the amount of insertion of the elements into the sectoral guides. One suitable arrangement comprises a ring R surrounding section C, and having radial arms R*a*, R*b*, R*c* and R*d* extending inwardly into the trough-like spaces S*a*, S*b*, S*c* and S*d*, and providing supporting arms for the control elements. By turning ring R about the axis of section C the amount of insertion can be varied.

The device of Figure 1 operates as a tuner where metal plates of good conductivity are used as control elements. It functions as an attenuator when the control plates are resistive, and it functions as a phase-shifter when the plates are of dielectric material.

An alternative form of center section for Figure 1 is shown in Figures 2 and 3. This arrangement comprises a metallic disc 4 having sector-shaped openings of the same size and arrangement of the sectoral guides at the inner ends of the guide-tapering sections A and B. The ring 4 is provided with cylindrical flanges 4*a* and 4*b* on opposite sides thereof into which the inner ends of sections A and B are received so that the plate 4 may be rotated about the common axis of sections A and B. This arrangement provides a sector-shaped aperture of variable angular span in each sector guide, so that turning of the disk about its axis produces a tuning action.

We claim:

1. A wave control device comprising two circular wave guide sections arranged in alignment and having radial arranged partitioned walls dividing said sections into a number of sectoral guides having a given angular span at the outer ends of said sections, and a smaller angular span at the inner ends of said sections, and adjustable means interposed between the inner ends of said circular sections for controlling the energy transmitted from one section to the other.

2. A wave control device according to claim 1 wherein said adjustable control means comprises a rotary metallic disk interposed between the inner ends of said circular sections and having sector-shaped apertures of the same shape and arrangement as the sectoral guides.

3. A control device according to claim 1 wherein said adjustable control means comprises a waveguide section embodying a sectoral guide arranged in registry with each pair of aligned sectoral guides in said aligned sections, each connecting guide having individual side walls, and one side wall of each connecting guide having a slot formed in its mid portion parallel with the axis of said device, and a control element mounted for adjustable insertion into each slot.

4. A control device according to claim 3 and including means for simultaneously moving said control elements in the same direction.

5. A control device according to claim 3 wherein said control elements comprise plates of good conductivity.

6. A control device according to claim 3 wherein said control elements comprise plates formed of resistive material.

7. A control device according to claim 3 wherein said control elements comprise plates formed of dielectric.

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