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TRANSMISSION CONTROLLING DEVICE FOR WAVE GUIDES

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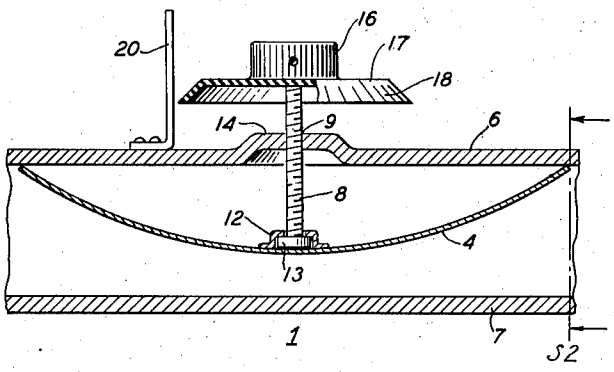

FIG. 1

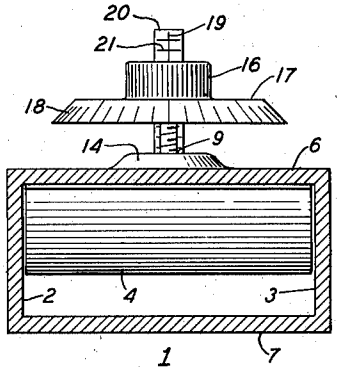

FIG. 2

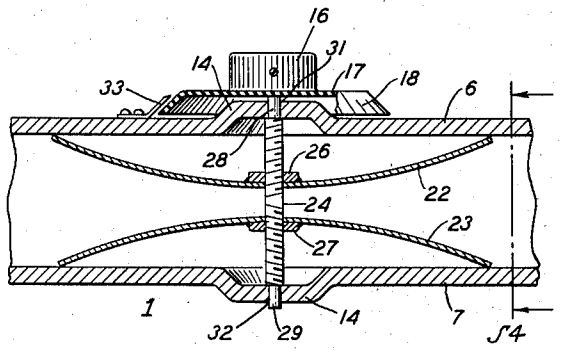

FIG. 3

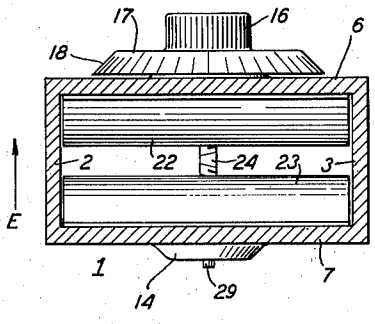

FIG. 4

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TRANSMISSION CONTROLLING DEVICE FOR WAVE GUIDES

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6 Claims. (Cl. 178—44)

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This invention relates to wave transmission and more particularly to means for controlling the transmission of energy in a wave guide.

The object of the invention is to control the amount of energy transmitted in a wave guide.

In wave transmission systems it is often desirable to provide adjustable means for controlling the amount of energy permitted to pass through a section of wave guide. To reduce reflection, it is also desirable that such energy controlling means do not introduce abrupt impedance changes within the section.

In accordance with the present invention there is provided a comparatively simple but effective device for adjustably controlling the amount of energy which is transmitted by a hollow wave guide section of rectangular cross-section adapted for electromagnetic waves having a transverse electric field parallel to one of the sides. If the section has unequal cross-sectional dimensions this field will usually be parallel to the shorter dimension. The device includes adjustable means for restricting the width of the section only in the direction of the electric field. These means preferably comprise an arcuate strip of spring metal positioned within the section perpendicular to and extending between the sides thereof having the shorter cross-sectional dimension, hereinafter referred to as the shorter sides, and having its ends in contact with one of the sides having the longer cross-sectional dimension, hereinafter referred to as the longer sides. Externally controlled means are provided for adjusting the minimum distance between the strip and the other longer side of the section. The adjusting means may comprise a threaded rod or screw which passes through one of the longer sides of the section and, when turned, moves the center of the strip across the section. The transmission of energy is a maximum when the strip lies flat against the one side of the section and is gradually reduced substantially to zero as the center of the strip is moved across to the opposite side. When it is desired to maintain mechanical and electrical symmetry, a pair of such arcuate strips may be provided, positioned within the section facing each other on their convex sides. Such a construction provides a cross-sectional area which tapers in the longitudinal direction and thus avoids abrupt impedance changes within the section, thereby minimizing reflection difficulties.

A feature of my invention is that the transmission of energy through a wave guide is controlled without shifting the phase relationship in the subsequent part of the transmission path.

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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, in which like reference characters refer to similar or corresponding parts and in which:

Fig. 1 shows in fragmentary longitudinal cross-section a transmission controlling device in accordance with the invention employing a single arcuate strip;

Fig. 2 is a transverse sectional view taken on the line S2 in Fig. 1;

Fig. 3 shows in fragmentary longitudinal cross-section a modified form of the device of Fig. 1 employing a pair of arcuate strips; and

Fig. 4 is a transverse sectional view taken on the line S4 in Fig. 3.

As shown in Figs. 2 and 4 the hollow section of wave guide 1 through which the transmission of energy is to be controlled is of rectangular cross-section and is adapted for the transmission of electromagnetic waves of a type having a transverse electric field E parallel to one of the sides, as indicated by the arrow. When the section 1 has unequal cross-sectional dimensions the field E will usually be parallel to the shorter sides 2 and 3. In accordance with the invention the amount of energy permitted to pass through the section 1 is controlled by adjusting its width only in the direction of field E.

In the form shown in Figs. 1 and 2 the width in the direction of the field E is controlled by means of an arcuate strip of spring metal 4 positioned within the section 1 perpendicular to and extending between the shorter sides 2 and 3 and having its ends in electrical contact with one of the longer sides 6. The strip 4 may, for example, be made of spring brass and may be silver-plated to increase its electrical conductivity. The strip 4 is so formed that it bows toward and normally touches the other longer side 7. In this position the transmission is substantially zero.

To increase the transmission the center of the strip 4 is moved away from the side 7. As shown, this is accomplished by means of the threaded rod or screw 8 which passes through a tapped hole 9 in the side 6. The inner end of the rod 8 is free to turn in a collar 12 which is attached to the concave side of the strip 4. The rod 8 has an enlarged end 13 which prevents it from slipping out of the collar 12 as the rod 8 is screwed out to pull the center of the strip 4 toward the side 6. The side 6 has a recessed portion 14 to

accommodate the collar 12 and permit the strip 4 to lie flat against the side 6 in which position there will be substantially unimpeded transmission of energy through the section 1. At all intermediate positions of the strip 4 the cross-sectional area of the section 1 gradually tapers longitudinally from each end of the strip 4 to its center, thus avoiding abrupt changes in the impedance of the section 1 and reducing undesired reflection effects.

Secured to the outer end of the rod 8 are a knob 16 to facilitate turning and a dial 17 with a graduated scale 18 which may be read against the vertical line 19 on the upright 20 to find the fractional part of a turn of the rod 8. The whole number of turns may be read on the horizontal lines 21 on the upright 20. A calibration of transmission against number of turns of the rod 8 may be prepared and thus any desired setting readily made.

When physical and electrical symmetry are desired the transmission controlling device shown in Figs. 3 and 4 may be employed. The device is similar to the one shown in Figs. 1 and 2 but comprises a pair of arcuate strips of spring metal 22 and 23 oppositely positioned within the section 1 facing each other on their convex sides. These strips are so formed that they normally meet at the center to close the guide 1 completely. The centers of the strips 22 and 23 are moved toward or away from each other by means of the low-loss dielectric rod 24 having right-hand threads on one half and left-hand threads on the other half. The rod 24 passes through central holes in the strips 22 and 23 and engages appropriately tapped nuts 26 and 27 which are secured, respectively, to the concave sides of the strips 22 and 23. The ends 28 and 29 of the rod 24 are of reduced diameter and unthreaded so that they form journals which fit into the bearings 31 and 32 in the recessed portions 14 of the sides 6 and 7, respectively. When the rod 24 is turned in one direction by means of the knob 16 the centers of the strips 22 and 23 are moved closer together and when turned in the opposite direction they are moved farther apart to control the amount of energy passing through the section 1. The spacing between the strips, and therefore the transmission, is indicated by the number of turns of the rod 24. The fractional part of a turn may be determined by reading the scale 18 on the dial 17 at the index 33. The number of whole turns may be registered on an appropriate counting device, not shown, associated with the dial 17.

What is claimed is:

1. In combination, a hollow section of wave guide of rectangular cross-section having unequal cross-sectional dimensions and means for adjusting only the shorter cross-sectional dimension thereof to control the transmission of wave energy therethrough, said means comprising a pair of arcuate strips of spring metal oppositely positioned within said section facing each other on their convex sides and means for adjusting the minimum distance between said strips.

2. In combination, a hollow section of wave guide of rectangular cross-section having unequal cross-sectional dimensions and means for adjusting only the shorter cross-sectional dimension thereof to control the transmission of wave energy therethrough, said means comprising a pair of arcuate strips of spring metal oppositely positioned within said section perpendicular to and extending between the shorter sides thereof and means for adjusting the minimum spacing between said strips.

3. In combination, a hollow section of wave guide of rectangular cross-section having unequal cross-sectional dimensions and means for adjusting only the shorter cross-sectional dimension thereof to control the transmission of wave energy therethrough, said means comprising a pair of arcuate strips of spring metal positioned within said section perpendicular to and extending between the shorter sides thereof and means for adjusting the minimum spacing between said strips, each of said strips having its ends in contact with one of the longer sides of said section.

4. The combination in accordance with claim 1 in which said means include a low-loss dielectric rod extending between and through said strips, the two halves of said rod being oppositely threaded.

5. The combination in accordance with claim 1 which includes external means for indicating the minimum distance between said strips.

6. In combination, a hollow section of wave guide of rectangular cross-section having unequal cross-sectional dimensions and means for adjusting only the shorter cross-sectional dimension thereof to control the transmission of wave energy therethrough, said means comprising an arcuate strip of spring metal positioned within said section perpendicular to and extending between the shorter sides thereof and having its ends in contact with one of the longer sides thereof, and means for adjusting the minimum distance between said strip and the other longer side of said section.

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