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WAVEGUIDE SWITCH

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FIG. 1

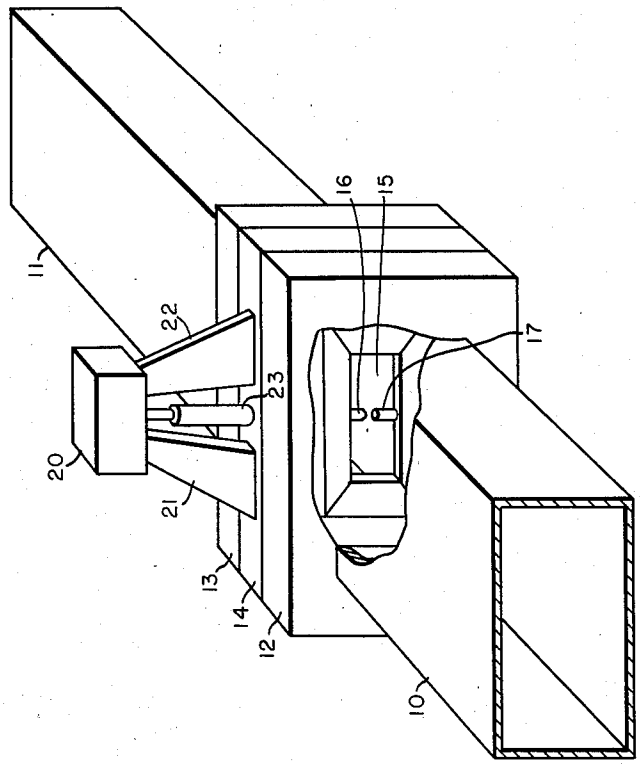
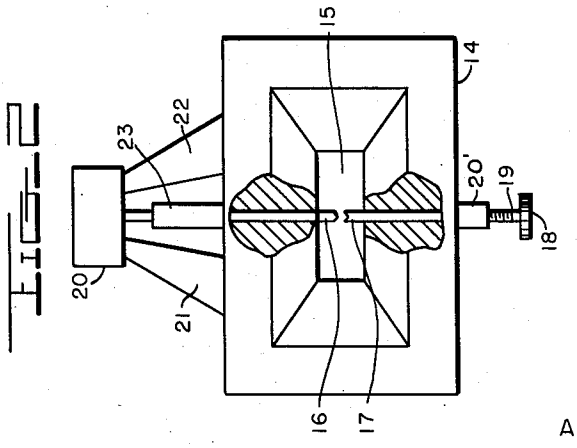


FIG. 2



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WAVEGUIDE SWITCH

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This invention relates to electrical energy transfer devices and more particularly to switching devices for waveguide high frequency electrical energy transfer systems.

In numerous high frequency electrical energy transmission systems waveguide devices may be employed for the distribution of a part of the energy. Where the energy distributed by the waveguide system must be controlled, some form of switching device is necessary. For high speed operation, such as in lobe switching antenna feed systems for radar apparatus, the mass of any movable parts of the switching device must be so arranged as to have minimum undesirable effect upon the switching action. Switching devices for waveguide apparatus have been available in the past but in general such prior systems have been of types incapable of producing true on-off action at fast switching rates.

Accordingly, it is an object of the present invention to provide a waveguide switching device suitable for high speed on-off operation.

Another object of the present invention is to provide a simple switching device for permitting or suppressing the flow of electrical energy through a waveguide structure.

Another object of the present invention is to provide a waveguide mechanical switching device for high speed on-off operation in which the mass of the moving parts is held to a minimum.

Other and further objects and features of the present invention will become apparent upon a careful consideration of the accompanying description and drawings.

Fig. 1 is a partly cut-away view of a waveguide transmission line system embodying principles of the present invention.

Fig. 2 is partially cut-away showing in more detail the switching mechanism of Fig. 1.

In accordance with the fundamental concepts of the present invention, a waveguide structure is provided which will selectively transmit or prevent the transmission of high frequency electrical energy. Basically the structure is a waveguide section in which a metal partition is placed across the waveguide at an intermediate point. The partition is provided with a centrally disposed aperture of substantially the same cross-sectional shape as the waveguide itself. Across the aperture is placed an impedance variation device which may be adjusted by mechanical or manual means to change the impedance characteristics of the aperture. The aperture and impedance variation means are

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adjusted so that in one position of the latter, the two will present a high shunt resistance having negligible effect upon the energy transmission while in a second position of the impedance variation means the aperture will present such impedance characteristics as to greatly impede energy transmission through the waveguide.

With particular reference to Fig. 1, a section of waveguide is shown. This waveguide is partly cut-away at a portion thereof to illustrate more fully the principles of the present invention. The waveguide sections 10 and 11 have end flanges 12 and 13 which may be securely fitted together, if desired, to form a continuous transmission path. To provide selective transmission of electrical energy in a manner that will permit essentially unhampered flow from section 10 to section 11 and yet permit sudden stoppage of the energy transmission, the orifice device 14 is provided for insertion between flanges 12, 13. Orifice device 14 is a plate of conductive material and may be of the same composition as the waveguide itself. An aperture 15 in device 14 may be of a rectangular shape of such dimensions as to be capable of effectively placing a high resistance in shunt with the waveguide thus having a minimum of objectionable effect upon the transmission of energy. It is therefore desirable that the orifice wall at the aperture 15 be quite thin. A tapered thickness such as that shown may conveniently be employed to provide a reduction in thickness from that required between the flanges 12, 13.

The impedance characteristics of the aperture may be altered by the placement of two rods 16, 17 thereacross, preferably in the transverse plane as shown in the drawing. Rods 16, 17 are provided with positional adjustments so that the amount of protrusion of each into the aperture can be individually controlled. Preferably rod 17 is to be moved infrequently and it is therefore sufficient to supply it with a thumb wheel 18 and lead screw 19. Threads on the lead screw 19 engage a threaded inner portion of the collar 20' which is affixed to member 14. Thus rotation of the thumb wheel will produce longitudinal motion of rod 17.

Where the rate of energy switching is rapid, as in a radar lobe switch antenna system, it is desirable to provide high speed longitudinal motion of rod 16. Such high speed motion may be provided by a motor and drive assembly 20 which is affixed as by brackets 21, 22 to aperture member 14. An extended bearing surface for rod 16 may be provided by collar 23.

For operation the spacing between rods 16, 17 is first adjusted so that the aperture presents a satisfactorily low reactance to the flow of electrical energy of a specific frequency or band of frequencies. This adjustment is preferably made by means of the thumb wheel 18 and is made with the drive mechanism 20 inoperative and resting to hold rod 16 at a reference position such as its position of maximum travel away from rod 17. The length of travel of rod 16 as a result of operation of drive 20 is adjusted so that motion of rod 16 toward rod 17 will produce a sufficient detuning of the aperture so that energy transmission therethrough is greatly impeded. It is desirable that this minimum spacing between rods 16 and 17 be as large as possible to permit controlled transmission of considerable power without arcing in the aperture. This arcing in the aperture or between rods 16 and 17 may be the limiting factor in the amount of power that can be handled by a system employing this device and hence suitable peak power limitation precautions must be borne in mind when designing a system in which it is incorporated.

For lobe switching antenna operation where connection is to be made in an alternate manner to two antennas arranged with the major directivity axis of one slightly divergent from that of the other, a branched waveguide structure may be employed with a switch device of this invention placed in the branch of the waveguide leading to each antenna. In this installation, the rods 16 of each device would be supplied with synchronized motion in opposite relative directions.

It is desirable that the transition between the on and the off conditions be as sharp as possible. To this end the drive device 20 is preferably designed to provide rapid in-out motion of rod 16 with suitable delay periods at each end of the stroke.

From the foregoing discussion it is apparent that considerable modification of the features of the present invention is possible and while the device here shown and the form of apparatus for the operation thereof constitutes a preferred embodiment of the present invention it is to be understood that the invention is not limited to this precise device and form of apparatus and that considerable modification may be made therein without exceeding the scope of the invention which is defined in the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. In a waveguide electrical energy transmission system, a switch, comprising; an aperture member, first and second rod members extending through the aperture member and into the aperture itself, and means positioning said rod members without contact therebetween, varying at a switching rate the spacing of the ends thereof extending into the aperture.

2. In a waveguide electrical energy transmission system, a switch, comprising; a plate member placed across the waveguide at an intermediate point thereof, said plate member provided with a centrally disposed aperture of substantially the same cross sectional shape as the waveguide, first and second rod members extending across the aperture and mounted in axial alignment, means positioning the first rod member to an initial spacing between the ends of the rods extending into the aperture permitting efficient energy transmission through the aperture, and means driving the second rod member to alter this spacing at a switching rate to interrupt efficient energy transmission.

3. An electrical energy transmission system, comprising; a rectangular waveguide, a plate member placed across said waveguide, said plate member containing a centrally disposed rectangular aperture of smaller dimensions than the waveguide, first and second rod members journalled with axial alignment in opposite side portions of the plate member extending through the plate member, driver means for imparting reciprocating longitudinal motion to the first rod member at the switching frequency, and positioning means for the second rod member adjusting the average spacing between the ends of the rods in the aperture.

4. A switch device for controlling the flow of electrical energy, comprising; a section of waveguide transmission line of rectangular cross section, a plate of conductive material placed across the waveguide at an intermediate point thereof, said plate having inwardly tapered walls forming a centrally disposed rectangular aperture therein of dimensions smaller than the waveguide cross-section, the perimeter of the aperture being formed by the thin portion of the tapered walls, first and second rod members axially aligned extending into the aperture and supported in position perpendicular to the wide dimension of the aperture, means holding the aperture ends of the rod members widely separated for energy transmission and closer spaced for nontransmission of energy, and means adjusting the average spacing between the aperture ends of the rod members.

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