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HIGH FREQUENCY ATTENUATOR

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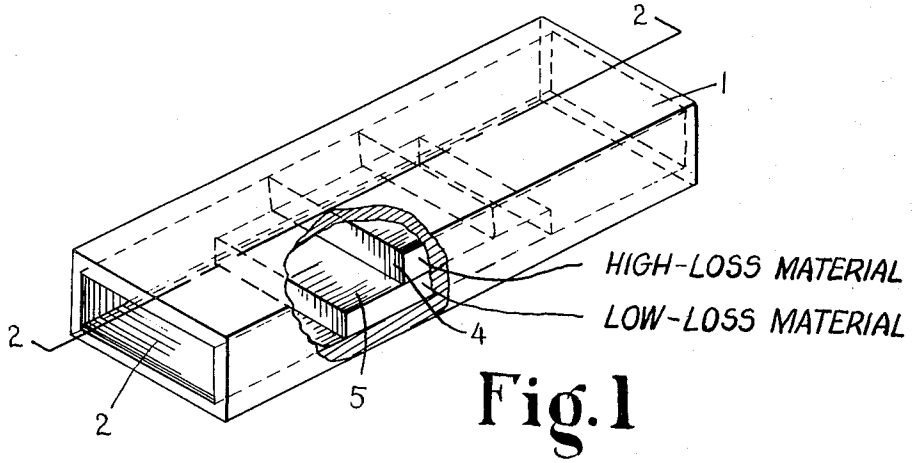


Fig. 1

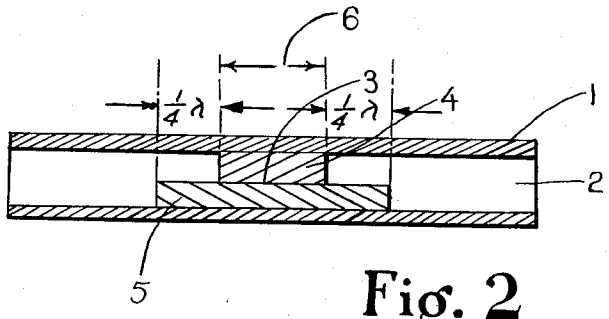


Fig. 2

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HIGH FREQUENCY ATTENUATOR

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7 Claims. (Cl. 333—81)

This invention relates to energy controlling pads for hollow waveguides.

The invention provides an efficient means for controlling high frequency energy by introducing in the waveguide, pads of various types of material having different energy controlling characteristics, and utilizing the combined effects of the different materials to attenuate the energy they intercept.

It is an object of the invention to provide an efficient, stable and readily adjustable means for controlling the high frequency energy within a waveguide.

A further object of the invention is to provide high frequency energy controlling means which is protected from mechanical breakage thus permitting the use of frangible material for the controlling pads.

A further object of the invention is to provide an attenuator device for high frequency power conductors which is of compact structure.

Other objects and features will more fully appear from the following description and will be particularly pointed out in the claims.

To present a better understanding of the invention a particular embodiment thereof will be described and illustrated in the drawings in which:

Figure 1 is a perspective view of a waveguide having a preferred embodiment of the invention therein.

Figure 2 is a longitudinal section through the device shown in Figure 1.

The invention may be used in any hollow waveguide system. By way of illustration it is shown in connection with a hollow rectangular waveguide 1 of conventional type having a rectangular channel 2 within which is received an energy controlling pad 3. The pad may be composed of two or more different materials. As shown in the drawing the pad is composed of a section of high loss material 4 and a section of low loss material 5. The two sections of material fill the waveguide channel and when cemented therein form a pressure tight seal which may be useful for certain applications of the invention. By choosing materials of the proper kind and varying the dimensions of the sections of material used, definite control of energy may be established.

Another important feature of the invention is the use of pad sections which are of right angled prismatic form.

As shown in the drawing the portion 4 has a thickness dimension substantially equal to the thickness of the material 5. The two sections 4 and 5 fill the waveguide from side wall to side wall. The section 4 of high loss material is smaller than the section 5 and is placed on top of the section 5 and centrally positioned thereon lengthwise of the waveguide. The difference in lengthwise dimensions between the two sections is such that the front edges of section 5 project beyond the front edges of the section 4 an amount equal to a quarter guide-wavelength at the operating frequency or some odd number of quarter guide-wavelengths. The input end of the pad, desirably but not necessarily, being of symmetrical design with that of the output end, the energy conveying line is matched

from both ends. The degree of attenuation caused by the pad may be varied by lengthening or shortening the dimension 6.

The principles of the invention provide for the fabrication of the pad by building it up from a plurality of sections each of which may be made of a material having the same or different electrical characteristics. The dimensions of each element may also be varied as above stated. It will thus be seen that a wide variety of characteristics may be created to fulfill substantially all circuit requirements.

The practice of the present invention embodies other advantages for example, the resulting pad structure is mechanically stronger than those of conventional form. Prior to the present invention attenuator pads have been constructed in wedge form having very thin fragile edges which are difficult to assemble in a waveguide and operate without breakage. The materials used for the elements 4 and 5 may be selected from a series of high and low loss polyiron compounds, carborundum, durez or like material. These materials are frangible in character which tends to increase the tendency for breakage to occur particularly in thin sections. The geometrical form of the pad elements therefore becomes an important factor in the design of a pad. The pad elements in the present invention are right angled prisms which are relatively easy to form and do not present any delicate portions subject to breakage. Moreover by proper selection of materials for the pad elements each element can be proportioned to give the required electrical characteristics and also be of substantial thickness and therefore not subject to breakage.

A further advantage of the present invention is that the pads can be relatively compact in length which is of great advantage in constructing microwave apparatus.

In the form of the invention described herein the upper pad section 4 is of high loss material and the section 5 is of low loss material. In operation when a high frequency current is fed into the waveguide from the left it meets the pad elements 4 and 5 and passes therethrough a portion of its total power being absorbed by the pad. A certain amount of the power is reflected from the front faces of the pad sections. Due to the spacing of these faces the power reflected from one is shifted 180° in phase from the other. The total amount of reflected power is thus cancelled out thus avoiding the undesirable effects caused by the reflected energy.

An attenuator pad constructed according to the invention, in addition to the qualities above pointed out, provides broad band matching ability and in operation maintains its degree of attenuation over a relatively wide range of frequencies.

What I claim is:

1. In combination with a hollow rectangular waveguide for electromagnetic waves, an attenuator pad filling the guide channel said pad comprising a plurality of superposed sections having different energy absorbing characteristics and of right angle prism form presenting end faces extending transversely of said channel an end face of the one of said sections of lower energy absorbing characteristic being advanced with respect to the others whereby the phase shifted components of power reflected from said faces are cancelled.

2. An attenuator pad for waveguides having the elements defined in claim 1 and in which the adjacent end faces of the pad sections are spaced apart one quarter guide-wavelength at the operating frequency.

3. An attenuator pad for waveguides having the elements defined in claim 1 and in which the adjacent end faces of the pad sections are spaced apart an odd number of quarter guide-wavelengths at the operating frequency.

4. An attenuator pad for waveguides for electromag-

netic waves comprising a plurality of flat right angled prismatic sections of power absorbing material of different lengths superimposed lengthwise of said waveguide and laterally filling the channel thereof, each section having different energy absorbing characteristics and presenting end faces disposed at right angles to the axis of said channel, said sections being so arranged that the conformation of both ends of the pad are the same, each end of the pad having the end face of said section of lower energy absorbing characteristic extending lengthwise one quarter guide-wavelength beyond the adjacent faces of the other section.

5. In a dielectric waveguide, a pad of absorptive material disposed within said guide and substantially entirely displacing the normal dielectric thereof and for a predetermined distance in the direction of wave propagation of said guide, said pad including a plurality of superimposed sections of energy absorbing material, said sections having their end faces normal to said direction of wave propagation, one of said plurality of sections being of higher absorptive characteristics and shorter in length than another section and the end faces of said one section being displaced with respect to the adjacent end faces of said other a distance equal to an odd multiple, including unity, of one quarter guide wave length.

6. In a dielectric waveguide, a pad of absorptive material disposed within said guide and substantially entirely displacing the normal dielectric thereof and for a predetermined distance in the direction of wave propagation of said guide, said pad including a pair of superposed sections of energy absorbing material, said sections having their end faces normal to said direction of propagation, one of said sections being of higher absorptive characteristics and shorter in length than the other section and the end faces of said one portion being displaced with respect to the adjacent end faces of said other a

distance equal to an odd multiple, including unity, of one quarter waveguide length.

7. In a dielectric waveguide, a pad of absorptive material disposed within said guide and substantially entirely displacing the normal dielectric thereof and for a predetermined distance in the direction of wave propagation of said guide, said pad including a pair of superposed sections of energy absorbing material, said sections having their end faces normal to said direction of propagation, one of said sections being of higher absorptive characteristics and shorter in length than the other section and the end faces of said one portion being displaced with respect to the next-adjacent end faces of said other a distance equal to an odd multiple, including unity, of one quarter waveguide length, the absorptive characteristics of said sections being so related to the lengths of said sections that components of power reflected from said faces are of equal amplitude and opposite phase relationship.

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