March 25, 1952 F. B. CRAIG ET AL 2,590,511

RIDGED WAVE GUIDE ATTENUATOR

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Fig.1.

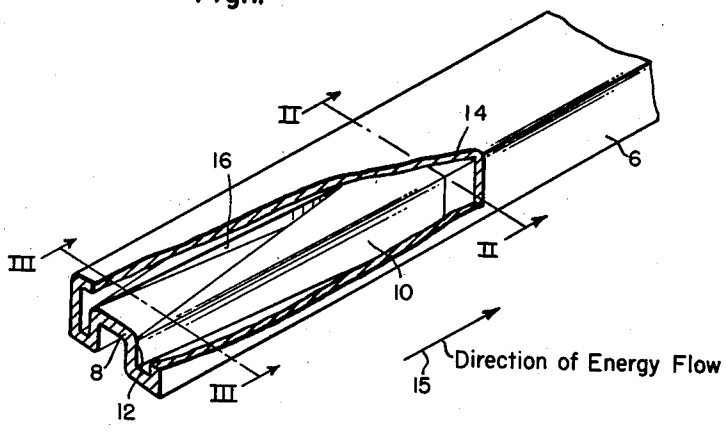


Fig.2.

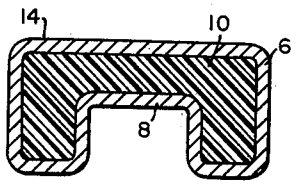
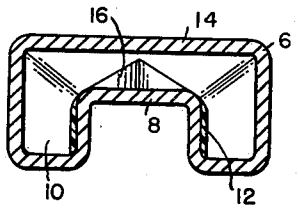


Fig.3.



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UNITED STATES PATENT OFFICE

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RIDGED WAVE GUIDE ATTENUATOR

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3 Claims. (Cl. 178—44)

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Our invention relates to the absorption of microwaves, and more particularly to a dry load for terminating waveguides.

In attempting to develop a dry load for the termination of ridged waveguides, attention was paid to the dry loads which have been developed for standard waveguides and an attempt was made to adapt these to ridged waveguides. However, the field configurations of ridged waveguide were found to be such that the adaption of the dry loads employed in a standard waveguide to the ridged waveguide by making minor changes such as by removing a part of the material to allow space for the re-entrant portion of the ridged waveguide, was found to be unsatisfactory.

It is, accordingly, an object of our invention to provide a dry load for the termination of a ridged waveguide.

Another object of our invention is to provide a dry load for the termination of a ridged waveguide which has a low reflection coefficient.

In accordance with our invention we provide a waveguide in which is inserted an attenuator of high loss material. This material substantially fills the waveguide at one end of the material and tapers to a feather edge at the other end, this feather edge being against the re-entrant portion of the waveguide. Part of the material above the re-entrant portion is removed from a V-shaped slot in the material with the wide portion of the slot at the feather edge. The slot extends along the top of the ridge for a distance of the order of ten wavelengths of the oscillations as measured in the waveguide.

The novel features which we consider characteristic of our invention are set forth with more particularity in the appended claims. The invention, however, with respect to both the organization and the operation thereof, together with other objects and advantages may be best understood from the following description of specific embodiments when read in connection with the accompanying drawing, in which:

Fig. 1 is a view in perspective of apparatus embodying our invention.

Fig. 2 is a cross-sectional view of the apparatus shown in Fig. 1, taken along the line II—II looking toward the right.

Fig. 3 is a cross-sectional view of the apparatus shown in Fig. 1, taken along the line III—III looking toward the left.

In accordance with our invention, we provide a ridged waveguide by which is meant a box 6 of conductive material of substantially C-shape

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cross-section with a hollow interior. This can be a box of substantially rectangular cross-section with a re-entrant portion 8 extending into this box from one of the surfaces of largest area and which extends along the waveguide in the direction of the longer dimension of the waveguide. We shall refer to the surface opposite the re-entrant portion of the waveguide as the top of the waveguide and the surface of the re-entrant portion nearest to the top of the waveguide as the top of the re-entrant portion. A cross-sectional view of a waveguide of this type is shown in Fig. 2.

The attenuating material 10 which is employed in accordance with our invention may be any highly lossy material which will absorb the oscillations employed in the waveguide. As an example of a suitable material for such application, reference may be had to the synthetic resinous product formed of laminations of cotton cloth having a fine weave and which is well saturated with a pheno-formaldehyde resin and consolidated under heat and pressure, such a product being sold and identified to the trade as #273 by the Westinghouse Electric Corporation.

The attenuating material 10 is placed in a waveguide and is so moulded as to fit closely against the re-entrant portion 8 of the ridged waveguide. The attenuating material 10 may extend along the waveguide for a distance equal to from 5 to 15 wave lengths of the oscillations employed as measured in the waveguide. However, applicants have found the most satisfactory results were to be obtained from a length in the neighborhood of 7 wavelengths, as measured in the waveguide. The resistive material, at one end of the attenuator, substantially fills the interior of the waveguide, and gradually tapers to a thin feather edge 12 at the other end. The tapering is inward so that the resistive material is against the re-entrant portion 8 throughout its length. The tapering occurs both inward from the sides of the waveguide toward the re-entrant portion and downward from the top 14 of the waveguide toward the top of the re-entrant portion. The oscillations in the waveguide are caused to flow in the direction of increasing thickness of the attenuator as indicated by the arrow 15 shown in Fig. 1.

While applicants have found fairly satisfactory results from the device as just described, they have found the results to be substantially improved if the resistive material 10 is slotted through part of its length, preferably at least a

distance equal to 1 wave length as measured in the guide. This slot 16 is of triangular shape and is cut out of the resistive material directly above the re-entrant portion. The wide portion of the slot 16 is at the end of the dry load at which the material is thinnest, i. e. at the feather edge 12. Preferably, the slot at its widest portion should be substantially equal to the width of the re-entrant portion, and should extend along the long dimension of the waveguide above the re-entrant portion thereof, gradually tapering to a point.

It is believed that the long taper causes a cancellation of reflection while the material absorbs the transmitted power with the exception of that which strikes the feather edge. We are fully aware that this theoretical explanation of the functioning of our attenuator involving the complex field of electromagnetics, may prove inadequate. We do not therefore intend to be bound by this explanation.

On the basis of the above explanation it is important, that the feather edge be as thin as practicable and adhere closely to the side of the re-entrant portion. Tests were made with this device in which the tapers running from the feather edge to the full size of the guide were approximately 7 inches long, the slotted distance was 4½ inches long, and a wave length of 6 centimeters was employed. A voltage standing wave ratio of 1.01 was obtained with 35 db. attenuation. However, tests since then then have shown that the operation is improved if a longer taper distance is employed.

The term "ridged waveguide" as used herein refers to a channel of conducting walls adapted to convey electromagnetic wave energy and having a reentrant portion extending along the length of said channel.

Although we have shown and described specific embodiments of our invention, we are aware that other modifications thereof are possible. Our invention, therefore, is not to be restricted except insofar as it is necessitated by the prior art and the spirit of the invention.

We claim as our invention:

1. An attenuator for a ridged waveguide comprising a resistive material inserted in said ridged waveguide, said resistive material substantially filling the ridged waveguide at one part of the ridged waveguide and thence tapering inward gradually from the sides of the guide in such manner that said attenuator ends with a thin layer of resistive material surrounding the re-entrant portion of said waveguide inside of said waveguide, said resistive material having a slot therein, said slot being more than a wave length long as measured in the waveguide, and said slot being located above the ridge extending in a longitudinal direction and with its wider portion at the thin end of the attenuator.

2. An attenuator for a ridged waveguide comprising a resistive material inserted in said ridged waveguide, said resistive material substantially filling the ridged waveguide at one part of the ridged waveguide and thence tapering inward gradually from the sides of the guide in such manner that said attenuator ends with a thin layer of resistive material surrounding the re-entrant portion of said waveguide inside of said waveguide, said resistive material having a slot therein, said slot being more than a wave length long as measured in the waveguide, and said slot being located above the ridge extending in a longitudinal direction and with its wider portion at the thin end of the attenuator, the wide portion of said slot being substantially equal to the width of the re-entrant portion of said waveguide.

3. A dry load for terminating a ridged waveguide comprising a resistive material inserted in said ridged waveguide extending along said waveguide for at least a wave length, said material at one end of said dry load surrounding the re-entrant portion of the ridged waveguide in a thin layer, said dry load gradually tapering outward until the said material substantially fills the interior of the ridged waveguide, said material adhering closely to the conformity of said re-entrant portion, said material having a slot therein, said slot having non-parallel sides extending along the direction of the waveguide above the re-entrant portion thereof and said slot having its greatest width at the feathered edge of said material.

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The following references are of record in the file of this patent:

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