June 2, 1970 H. WERNLI 3,516,032

APPARATUS FOR FILTERING AND DISSIPATING MICROWAVE ENERGY POSSESSING UNDESIRED WAVE MODES

Filed Feb. 19, 1968

Fig. 1

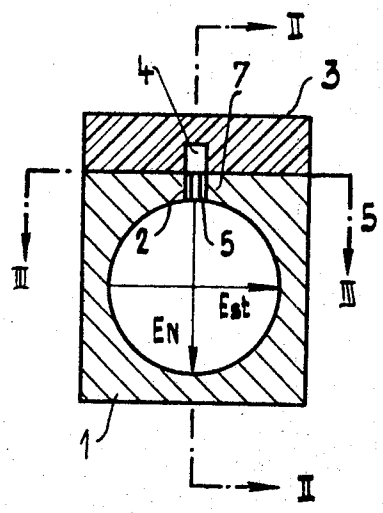


Fig. 2

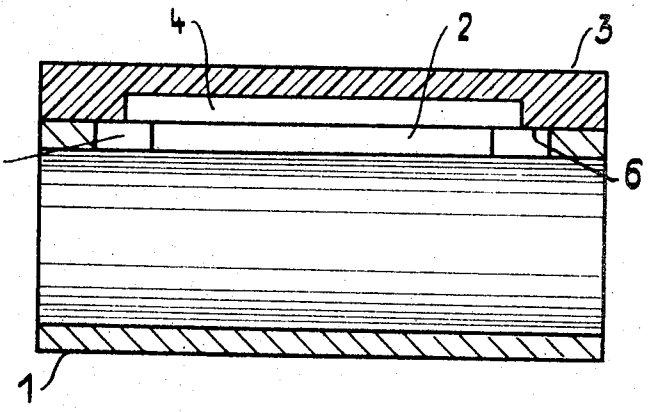
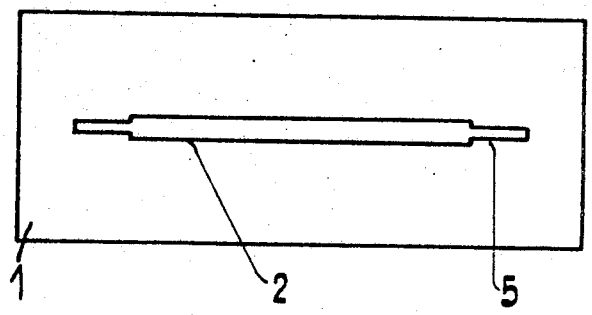


Fig. 3



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United States Patent Office 3,516,032 Patented June 2, 1970

3,516,032

APPARATUS FOR FILTERING AND DISSIPATING MICROWAVE ENERGY POSSESSING UNDESIRED WAVE MODES

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Filed Feb. 19, 1968, Ser. No. 706,552
Claims priority, application Switzerland, Apr. 14, 1969, 5,346/67
Int. Cl. H01p 1/16
U.S. Cl. 333—98 8 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for filtering and dissipating undesired components of microwave energy from a waveguide. A filtering slit of predetermined length and width dimensions is provided in a waveguide wall disposed in a direction parallel to the longitudinal axis of the waveguide. A cover plate formed of microwave-absorbing material is then applied in sealing relation to the filtering slit. The cover plate contains a groove having the same width as that of the filtering slit but having length and penetration depth dimensions chosen to effect maximum absorption of the undesired microwave energy components.

BACKGROUND OF THE INVENTION

The present invention relates to an improved apparatus for both filtering and dissipating microwave energy possessing undesired polarization direction in a predetermined frequency range. The present invention comprises a waveguide in which at least one filtering slit is provided in a wall extending parallel to the longitudinal axis of the waveguide.

The direction of the electric field or E-field of an infed linear polarized wave is generally not fixed by the cross-sectional form of a waveguide having a circular-shaped cross-sectional dimension. Polarization changes of the infed wave occur during transmission because of small deviations in the cross-sectional waveguide configuration from that of a perfect circle. For example, a linear polarized wave infed to a waveguide of circular cross-section might appear elliptically polarized after transmission. Microwave technology, accordingly, is greatly concerned with the problem of eliminating these undesired changes in wave polarization. One solution for suppressing such elliptic polarized waves produced within a waveguide resides in filtering out and dissipating the undesired components of the wave. This is possible since an elliptic polarized wave can be construed as the resultant of two linear polarized waves, the E-fields of which are disposed perpendicular to one another and which exhibit a difference in phase. Accordingly, a filtering apparatus can be applied in such a manner that the component of the wave whose E-field is disposed perpendicular to that of the desired wave component is filtered out.

One such filtering apparatus comprises a waveguide with a circular-shaped cross-section in which another waveguide of rectangular cross-section is inserted in the plane of the magnetic field of the undesired wave component which is to be filtered. The rectangular waveguide is reflectionless terminated. However, this apparatus is not wholly satisfactory since, without expensive matching devices, it can only be used for a very narrow frequency range.

SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the instant invention to provide an improved microwave filtering apparatus to eliminate undesirable microwave components.

It is another object of the present invention to provide an improved microwave filtering apparatus which can be employed in a broad frequency range.

It is a further object of the present invention to provide an improved microwave filtering apparatus having a simple construction.

It is an additional object of the present invention to provide an improved microwave filtering apparatus having a low cost of manufacture.

Now, in order to implement these and still further objects of the invention which will become more readily apparent as the description proceeds, it is to be understood that the inventive filtering apparatus is characterized by the features that a filtering slit is provided in a wall of the waveguide and is sealed at the outside of the waveguide by a cover plate formed of a microwave absorbing material. The cover plate possesses a groove of rectangular cross-section, the longitudinal sides of which are disposed in form-locking fashion or flush with the filtering slit. The length and penetration depth of the groove are selected in such a manner that the major portion of the waves in a predetermined frequency range having the undesired polarization direction are absorbed by the apparatus.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be better understood and objects other than those set forth above will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawing wherein:

FIG. 1 schematically illustrates a cross-sectional view of said filtering slit and in alignment therewith, said

FIG. 2 is a longitudinal sectional view taken through the longitudinal axis of the inventive apparatus depicted in FIG. 1 substantially along the line II—II thereof; and

FIG. 3 is a top plan view of the waveguide essentially as viewed along the line III—III of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Describing now the drawing, it will be seen that the illustrated exemplary embodiment of the inventive apparatus is composed of a waveguide **1** with a circular-shaped cross-section and a cover plate **3** formed of microwave-absorbing material. In FIG. 1, reference character EN represents the main direction of the E-field of the microwave component in the desired or useful mode. Extending perpendicular to this E-field of the desired wave component is the E-field E*st* of the undesired, disturbing or interference wave component. The wall **7** of the waveguide **1** is provided with a filtering slit or slot **2** arranged such that the undesired wave component having the E-field direction E*st* is filtered out.

The filtering slit or slot **2** constitutes a reflecting field disturbance location for both the desired or useful wave and for the undesired wave. In order to improve the matching of the filtering slit **2** for the useful wave, the filtering slit **2** is extended at both ends by a narrower matching slit **5**. The length and the width of the matching slits **5** are chosen such that the reflected wave components from the matching slits **5** and from the wider filtering slit **2** mutually cancel or nullify one another.

In the present exemplary embodiment there is provided only one filtering slit **2**, the length of which amounts to several wave lengths of the wave transmitted in the waveguide **1**. Alternatively, it would also be possible to provide two shorter slits situated diametrically opposite each other. The total length of the filtering slits provided depends upon the required frequency range since the longer the filter slit, the greater is the useful frequency range.

In order to prevent radiation of the filtered energy into the outside surroundings, the slit **2** is sealed with a cover plate **3** formed of microwave-absorbing material such as a material commercially available on the market under the trademark "Eccosorb CR." The cover plate **3** possesses a groove **4** as an extension of the slit **2**, the longitudinal sides of the groove **4** being disposed in form-locking fashion or flush with the filtering slit **2**. The length and the penetration depth of the groove **4** is selected in a manner ergy is actually absorbed. Ideally, the filtered energy should be completely absorbed, that is to say, the cover plate or apparatus should be matched to the waveguide **1** such that the major portion of the filtered microwave enso as to be non-reflecting.

This degree of adaptation or matching can be determined with known measuring techniques applied to measure any reflections produced by the apparatus when the waveguide itself is terminated by a non-reflecting load. During this measurement, a linear polarized wave having a direction of polarization in the plane of the undesired or disturbing wave is supplied to the waveguide device. Since the length of groove **4** in the cover plate **3** is chosen to be somewhat shorter than the total length of the filtering slit **2** and matching slits **5**, the outermost ends of the matching slits **5** are sealed by a plate **6** of microwave-absorbing material. As the energy absorbing action of the groove **4** is not effective at these plate end locations, the major portion of the wave energy appearing at both of the plates **6** is reflected rather than absorbed. The magnitude of these reflected waves is a function of the surface or area of both plates **6**, this plate area itself being a function of the length of the groove **4**. Thus, by varying the length of the groove **4** with respect to the filtering slit **2**, these reflected wave components can be coordinated in such a manner that the reflected wave components from the plate **6** and from the filtering slit **2** mutually cancel or eliminate one another. This point of coordination or matching is realized when the reflections monitored by the known measuring technique as discussed above reach a minimum. The penetration depth of the groove **4** is also varied during such adaptation or matching procedure as a parameter for the wave phase.

Optimum matching of the apparatus for the disturbance or undesired wave component can also be obtained if the length of the groove **4** is equal to the total length of the filtering slit **2** and matching slits **5**. In this case, the plate **6** formed by a portion of the cover plate **3** is replaced by a conducting web or arm to partially seal the matching slit **5** with respect to the groove **4**. The filtered and therefore the reflected desirable or useful wave component energy at the plates **6** is relatively small. Accordingly, the groove length has no appreciable influence upon the matching conditions of the desirable or useful wave component.

While there is shown and described a present preferred embodiment of the invention, it is to be distinctly understood that the invention is not limited thereto, but may be otherwise variously embodied and practiced within the scope of the following claims.

What is claimed is:

1. An apparatus for filtering and dissipating microwave energy in a predetermined frequency range having undesired polarization direction, said apparatus comprising:

a waveguide having a filtering slit in a wall parallel to its longitudinal axis;

cover plate means for sealing said filtering slit at the outside of said waveguide, said cover plate means being formed of a microwave-absorbing material; and

groove means provided in said cover plate means, said groove means having a rectangular cross-section, the longitudinal sides of which are form-locking with said filtering slit and the length and penetration depth of which are such that the predominant portion of said microwave energy in said predetermined frequency range having said undesired polarization direction is absorbed.

2. An apparatus according to claim **1**, wherein said filtering slit has a predetermined width and is elongated at both ends thereof by a matching slit narrower than said predetermined width.

3. An apparatus for filtering and dissipating microwave energy in a predetermined frequency range having undesired polarization direction, said apparatus comprising:

a waveguide having walls and a longitudinal axis;

a filtering slit provided in at least one waveguide wall parallel to said longitudinal axis; and

cover plate means for sealing said filtering slit from the outside of said waveguide, said cover plate means being formed of microwave-absorbing material and exhibiting an internal groove aligned with said filtering slit.

4. An apparatus according to claim **3**, wherein said internal groove is rectangular in cross-section.

5. An apparatus according to claim **3**, wherein said filtering slit has a predetermined width and length, and further including a matching slit provided at each end of said filtering slit and in alignment therewith, said matching slits being narrower than said filtering slit and providing with said filtering slit an elongated slot.

6. An apparatus according to claim **5**, wherein said internal groove has a length between that of said filtering slit and that of said elongated slot.

7. An apparatus according to claim **4**, wherein the longitudinal sides of said rectangular cross-section of said groove are flush with the sides of said filtering slit, and wherein the length and penetration depth of said groove are such that the predominant portion of said microwave energy in said predetermined frequency range having undesired polarization direction is absorbed.

8. An apparatus according to claim **3**, wherein said waveguide is of circular cross-section.

References Cited

UNITED STATES PATENTS

2,512,468	6/1950	Percival.	
2,869,085	1/1959	Pritchard.	
2,877,434	3/1959	Farr et al.	
3,184,695	5/1965	Unger	333—98
3,321,720	5/1967	Shimada	333—98

FOREIGN PATENTS

720,153	12/1954	Great Britain.

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U.S. Cl. X.R.

333—21, 73, 83