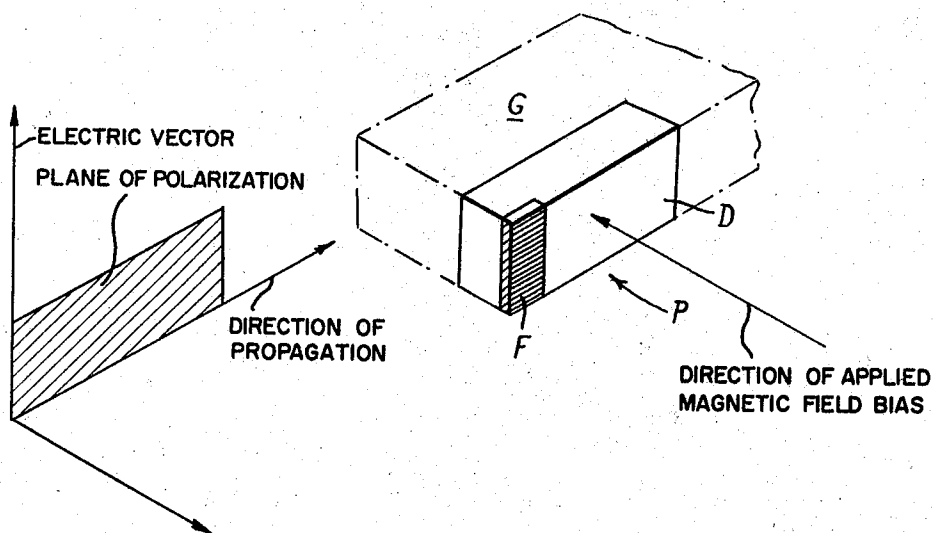


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R. S. ALFANDARI ET AL
COUPLER FOR WAVEGUIDES UTILIZING FERRIMAGNETIC
MATERIAL FOR MODE CONVERSION
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Inventors

R. S. Alfandari

R. Pauchard

G. Pircher

By

H. K. ...
Attorneys

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**COUPLER FOR WAVEGUIDES UTILIZING
FERRIMAGNETIC MATERIAL FOR MODE
CONVERSION**

Roger S. Alfandari, Paris, Robert Pauchard, St. Mandé, and Georges Pircher, Paris, France, assignors to Compagnie Francaise Thomson Houston-Hotchkiss Brandt
Continuation of application Ser. No. 154,664, Nov. 24, 1961. This application Oct. 25, 1965, Ser. No. 515,286
Claims priority, application France, Nov. 23, 1960, 844,801, Patent 79,002
5 Claims. (Cl. 333-21)

This application is a continuation of our prior application Ser. No. 154,664, filed Nov. 24, 1961, now abandoned.

The present invention relates to improvements in ferrite members for wave guides.

It has already been proposed to place a ferrite member against the wall of a wave guide in the vicinity of the place at which the electrical field of the incident wave has zero amplitude, said ferrite member being subjected to an external magnetic field having a component at right angles to the plane of polarization of said wave.

Such a ferrite member constitutes a directional coupler between two modes of propagation viz: modes TE_{01} and TE_{10} . They enable two fundamental modes to be coupled substantially completely.

However, a certain fraction of the incident energy entering this coupler is absorbed by reason of the dielectric losses in the ferrite member. It is an object of the invention to avoid or substantially avoid these losses.

We have discovered that these losses can be reduced by replacing part of the ferri-magnetic material of the ferrite member by a low-loss dielectric material with a sufficient specific inductive capacity (dielectric constant). The desired effect of the selective filter is further demonstrated, as long as the volume of the ferri-magnetic material is not below a relatively small minimum. Consequently, the quantity of this material which is used can be substantially decreased, by reducing either its length or its breadth or both at the same time.

Accordingly, the invention consists in a wave guide element forming a directional coupler between two propagation modes of electromagnetic energy, wherein a member of dielectric material having small losses and a dielectric constant of the order of that of the ferri-magnetic material within said element, said two members having a joint action upon the waves propagating in said element.

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawing, which shows one embodiment thereof by way of example, in perspective view.

Referring to the drawing, a member P is placed against a narrow wall of a section of wave guide G of a directional coupler. This member P has a rectangular cross-section and is constituted by two complementary elements; a small ferrite member F, also of rectangular section in this embodiment, and a larger member D of low-loss dielectric material, the shape of which is the same as that of the member P, from which the member F has been removed.

The specific inductive capacity of the dielectric material constituting element D must be similar to that of the ferri-magnetic material constituting the ferrite member.

In a specific embodiment an alumina type ceramic was used, the loss tangent of which is about 10^{-4} and the specific inductive capacity of which is about 9. (The specific inductive capacity of ferrite is about 10.) A normal rectangular section wave guide, which can be employed in the X band for a frequency of 10,000 megacycles (interior dimension 10.16 mm./22.86 mm.) has

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been used, the member P being in the form of a straight prism having a rectangular section, one side of which is less than or equal to the height of the wave guide as shown in the drawing whereas the other has a width equal to some mm. The losses of the coupler are then reduced in a ratio up to or in excess of 10.

It is clear that the means of application and embodiment herein described have no limiting character and have been given only as an illustration of the invention.

What we claim is:

1. In a microwave coupling device including a rectangular wave-guide section and a member comprising ferri-magnetic material, said member being positioned in the waveguide section adjacent a wall thereof and being subjected to a magnetic field having a component normal to the plane of polarization of a microwave of one TE mode in said guide whereby energy reaching one end of said device in the form of a wave of said one TE mode will be transferred to the other end of said device in the form of a wave of another TE mode, the improvement according to which said member consists in part of a low-loss dielectric material having a dielectric constant close to that of said ferrimagnetic material.

2. In a microwave coupling device including a rectangular waveguide section and a member comprising ferri-magnetic material, said member being positioned in the waveguide section adjacent a narrower wall thereof and being subjected to a magnetic field having a component normal to said narrower wall whereby energy reaching one end of said device in the form of a wave of said one TE mode will be transferred to the other end of said device in the form of a wave of another TE mode, the improvement according to which the major portion of said member consists of a low-loss dielectric material having a dielectric constant close to that of said ferrimagnetic material.

3. In a microwave coupling device including a rectangular waveguide section and a member comprising ferri-magnetic material, said member being positioned in the waveguide section adjacent a wall thereof and being subjected to a magnetic field having a component normal to the plane of polarization of a microwave of one TE mode in said guide whereby energy reaching one end of said device in the form of a wave of said one TE mode will be transferred to the other end of said device in the form of a wave of another TE mode, the improvement according to which said member comprises a body of low-loss dielectric material having a dielectric constant close to that of said ferrimagnetic material, said body partly surrounding said ferrimagnetic material and defining therewith a generally parallelepipedic member having a major dimension extending parallel to the direction of wave propagation through the waveguide, the volume of said body being substantially larger than that of said ferrimagnetic material, and the losses in said member being several times less than those in an all ferrite member capable of effecting a like transformation of mode.

4. The device defined in claim 3, wherein said dielectric material comprises an alumina-base ceramic.

5. The device defined in claim 4, wherein said ferri-magnetic material has a dielectric constant of the order of 10, and said low-loss dielectric material comprises a ceramic composition having a dielectric constant about 9 and loss factor about 10^{-4} .

No references cited.

HERMAN KARL SAALBACH, *Primary Examiner*.
M. NUSSBAUM, *Assistant Examiner*.