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GYROMAGNETIC RESONANCE WAVEGUIDE ISOLATOR WITH FERRITE STRIPS AND OVERLAPPING FERRITE BAR

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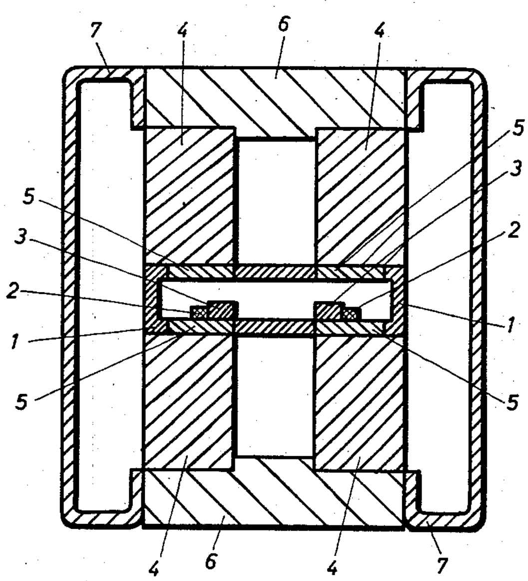

Fig. 1
PRIOR ART

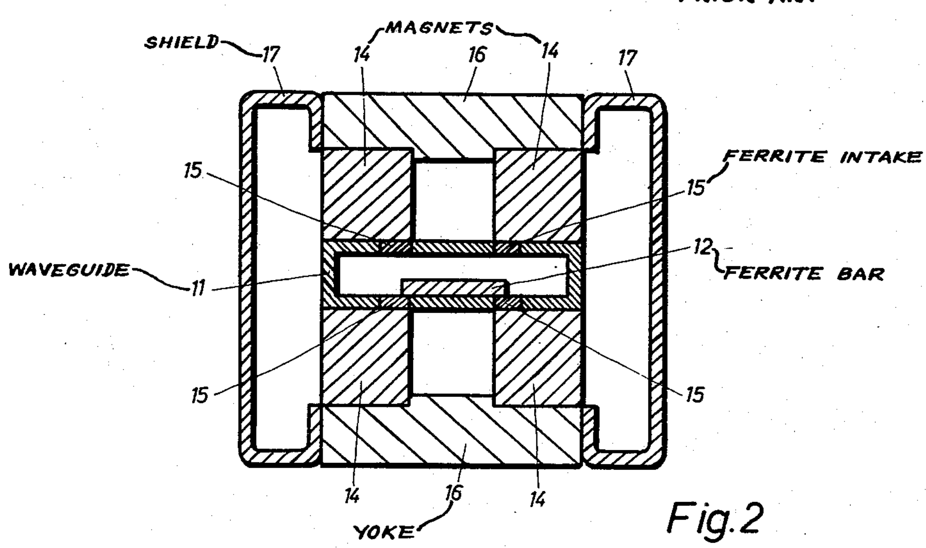

Fig. 2

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GYROMAGNETIC RESONANCE WAVEGUIDE ISOLATOR WITH FERRITE STRIPS AND OVERLAPPING FERRITE BAR

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4 Claims. (Cl. 333—24.2)

The invention relates to waveguides and in particular to non-reciprocal attenuator pads or isolators using the principle of the gyromagnetic resonance, a so-called gyromagnetic resonance uniline.

It is known for such waveguide isolators or unilines that one, two or four ferrite bars are provided in the longitudinal axis of a waveguide but outside the centre of same; said ferrite bars will be fully pre-magnetized transverse to the waveguide by a nearly homogeneous magnetic field. The magnetizing force must possess an exact value, depending on the bar's cross-section and the saturation magnetization of the material and being in proportion to the operating frequency. It is also known to form a variable magnetic field in steps or continuously along the ferrite in order to increase the bandwidth of the resonance attenuation. It is further known to cover the ferrite bars—preferably towards the waveguide centre—with a non-ferromagnetic dielectric of small loss and with a dielectric constant comparable to the ferrite, mostly ceramic, thereby increasing the resonance attenuation and de-phasing the parallel resonance thus reducing the advance attenuation.

Such a prior art gyromagnetic resonance uniline is shown in cross-section on FIG. 1. On one broadside of the waveguide 1 ferrite bars 2 are arranged in the longitudinal direction of the waveguide. Both ferrite rods 2 show a ceramic cover 3. Due to a symmetric and in-pair arrangement of the magnets 4 a homogeneous magnetic field exists around the ferrite rods which will be directly concentrated onto the environment of the ferrite rods in the waveguide by an efficient diminuation of the airgap of the four stripe-shaped intakes 5 of ferromagnetic material. The magnets 4 are mounted to the two yokes 6. The shieldings 7 on both sides of ferromagnetic material close the magnetic flux and simultaneously shield the entire arrangement against the outside.

At increasing operation frequency all dimensions of such arrangements are reduced consequently, as is well-known. For higher frequencies not only the waveguide itself but also the ferrite bars including the ceramic covers must be smaller. This fact not only causes difficulties in the manufacture of ferrite and ceramic bars but also impedes their sufficiently close connection with each other and with the waveguide surface. With the decreasing size of the stripes the heat capacity and the ability to emanate heat to the surroundings decreases and, in consequence, the loading capacity of the uniline. Furthermore, the magnetic field in the ferrite material must be greater at increasing frequencies which can be materialized essentially more difficult at the small sizes of unilines available for higher frequencies.

Accordingly, it is an object of this invention to eliminate those difficulties to a large extent. The invention thereby assumes that the ferrite material used represents by itself an excellent non-ferromagnetic dielectric, if it is just sufficiently pre-magnetized below its gyromagnetic resonance and that an essentially smaller magneto-motive force is required to produce a certain magnetic field intensity at an arrangement of a determined air-gap length, if the magnetic field is heavily heterogeneous on the sample to be magnetized. The invention is characterized in this, that only one ferrite bar is provided symmetrically to the waveguide axis, the bar being of such a width that both its edges protrude into the static magnetic field produced by two magnetic poles arranged on either side of the waveguide.

By the aid of FIG. 2 an example of the invention will more closely be explained. The waveguide is marked by 11 and the intendedly small intakes of ferromagnetic material by 15. The two pairs of magnets 14 are interconnected by yokes 16, also of ferromagnetic material. The magnetic flux of each pair of magnets is closed by the shieldings 17 so that the lines of flux are bunched together into the airgap limited by the intakes. One single ferrite bar 12 in the waveguide centre is so wide that both its edges protrude into said airgap and are exposed there to a high magnetic field intensity corresponding to the gyromagnetic resonance desired. The centre part of the ferrite bar on the other hand is only crossed by a few lines of flux, so it is pre-magnetized with a field intensity which does not come up to the field intensity required to obtain the gyromagnetic resonance. Thus, the centre part of the ferrite bar possesses the effect of a non-ferromagnetic dielectric and performs the function of the dielectric cover of the individual ferrite bar marked by 3 in FIG. 1.

While we have described above the principles of our invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of our invention as set forth in the objects thereof and in the accompanying claims.

What we claim is:

1. A waveguide isolator using gyromagnetic resonance to obtain isolation comprising waveguide means of rectangular cross section, means associated with said waveguide means for generating a static magnetic field, a plurality of ferrite stripes arranged symmetrically in broad side walls of said waveguide at fixed distances from the narrow side walls of said waveguide to reduce the reluctance of said waveguide to said static magnetic field, a ferrite bar mounted parallel to said waveguide axis between two of said stripes on at least one of the broad side walls of said waveguide, said ferrite bar being of sufficient width to overlap said ferrite stripes on each side of said ferrite bar.

2. In the waveguide isolator of claim 1 wherein said walled ferrite stripes comprise two stripes symmetrically arranged in each broad side wall extending parallel to the waveguide longitudinal axis and in juxaposition with static magnetic generating means.

3. In the waveguide isolator of claim 2 wherein said means for generating a static magnetic field comprises a pair of permanent magnets on each broad side wall and wherein said walled ferrite stripe means comprises ferrite stripes mounted over said permanent magnets to extend from the inner edge of said magnets toward the outer edge of said magnets.

4. In the waveguide isolator of claim 3 wherein said ferrite stripe means comprises a first ferrite stripe mounted

on the bottom broad side wall and a second ferrite stripe symmetrically mounted on said top broad side wall.

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