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Influence of Ferrimagnetic Resonance on Conversion of Electromagnetic Energy into Mechanical One

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Abstract—In this paper it is obtained in zero approximation the algorithm of calculation of the force of electromagnetic wave propagation in rectangular waveguide applied to the ferrite sphere, placed into constant magnetic field by the method of physical modeling. It is researched the dependence of the force on a value of magnetic field intensity near ferromagnetic resonance. Theoretical results of the calculations were compared with experimental ones. At the resonance electromagnetic field with the power of 10 W and the wave length of 3.2 cm influences on ferrite sphere with diameter of 3.55 mm with a force of 6 ± 0.5 μN. This force in enough for rotation of the suspension system of the reference ponderomotive wattmeter, fixed attached by means of braces or kerns. It allows to develop high-precision microwave wattmeters with enough mechanic strength for industrial application.

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GENERAL PROBLEM STATEMENT

Electromagnetic microwave energy is used in different areas of science and technology: elementary particles accelerators thermal synthesis systems, material heating and processing in food industry, radiolocation, telecommunication [1], medicine [2], etc. [3]. Rational application of the microwave energy is impossible without reliable and precise measuring devices. One of the main parameters of electromagnetic energy which is necessary to be controlled is power value.

Now for measuring of electromagnetic microwave energy in industrial conditions following wattmeters are used: DPM 5000-EX of Bird Electronic Corporation, USD [4], R&S®NRP2 of Rohde & Schwarz [5], M3-56, MKZ-71 of Meridian Company [6]. Measuring inaccuracy of these wattmeters at measuring of a generator load power is 4–5% without taking into account of mismatch error and inaccuracies of additional junctions.

There are known reference ponderomotive wattemters, which are maximally approached to the standard, which has inaccuracy of generator load power measurement of 0.2% [7]. Application of these wattmeters in industry is impossible since their mechanic strength is low.

Suspension system of ponderomotive wattmeters are fixed from one side only. Energy obtained by mechanic energy converter from electromagnetic wave is not enough to turn the converter in case of the wattmeter suspension system fixing from both ends.

From viewpoint of measurements accuracy ponderomotive wattmeters have essential advantage in compare to ones mentioned above, since power measuring is reduced to measuring of main values of physical system of units (SI): mass, length, time. Therefore it is of interest to develop the methods and tools of increase of efficiency of converter of electromagnetic energy into mechanic energy to such levels that allows to fix the suspension system of a wattmeter by means of braces or kerns, that allows to increase the mechanic strength of the ponderomotive wattmeter and its application for power measurement in industrial conditions.

ANALYSIS OF THE LAST RESEARCHES AND PAPERS

For improve of the method of increase of efficiency of conversion of electromagnetic energy into mechanic one we use the results of following researches.

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