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VARIABLE ATTENUATOR CALIBRATOR

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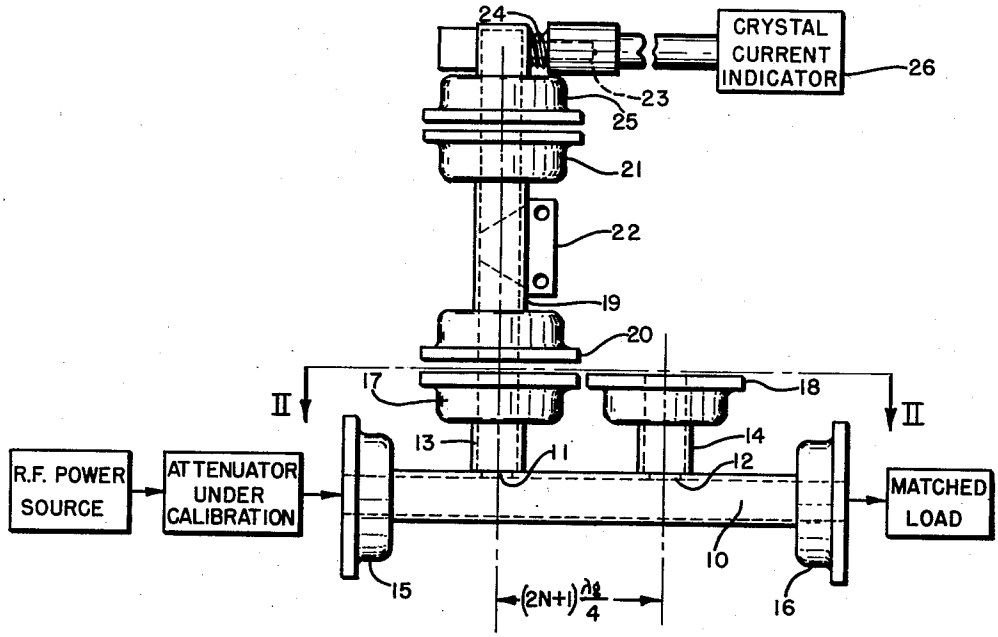


FIG. 1

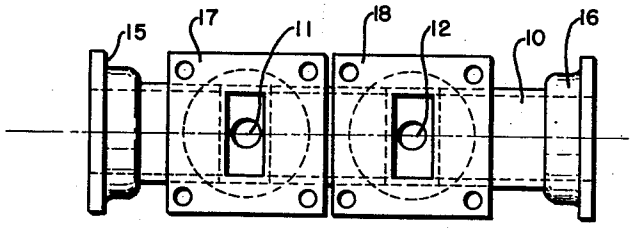


FIG. 2

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VARIABLE ATTENUATOR CALIBRATOR

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4 Claims. (Cl. 324—58)

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This invention pertains to calibrators for wave guide variable attenuators, and more particularly to such calibrators designed and constructed so as to retain their own calibration essentially constant with time, and so as to render them stable and effective over wide ranges of operation.

Attenuator calibrators hitherto known in the art were undesirable in that either they were fragile and so did not retain constant their own calibration, or were unstable for a complete calibration over wide range.

An object of this invention is to provide a calibrator for calibrating variable atteunators at microwave frequencies.

Another object of this invention is to provide a calibrator for calibrating variable attenuators at microwave frequencies which will accurately retain its calibration.

Still another object of this invention is to provide a calibrator of the class described which is of rugged construction and which is simple to use.

Further objects and advantages of this invention will be apparent from the claims and description, taken in connection with the drawings in which:

Fig. 1 is a diagram showing (*a*) relative position of all the component parts of a system for operating the invention herein described, and (*b*) detailed arrangement of the several parts of the calibrator alone; and

Fig. 2 is a plan view of the critical component of the calibrator, showing position of the openings in a broad face of the wave guide section, upon which openings the operation of this invention is dependent.

Referring to Fig. 1 there is shown a short wave guide section 10 having openings 11 and 12 in one broad face, said openings leading into other short wave guide sections 13 and 14, fixedly secured to section 10. Both ends of wave guide section 10 and the open ends of sections 13 and 14 have flanges 15, 16, 17 and 18 respectively to form conventional choke joints for electrical continuity when opposed by appropriate faces. Openings 11 and 12 are separated from each other by an odd multiple of quarter wave lengths in order to cancel reflections which they would otherwise introduce. Openings 11 and 20 are both down from the line by an appreciable amount, at least 20 db being recommended. In other words, the power passing out through either opening is defined approximately by the following relation: 20=10 $\log_{10}$ of ratio

$$\frac{\text{Power in wave guide at opening}}{\text{Power escaping through opening}}$$

Openings 11 and 12 are down from the line by amounts that differ slightly, one or two db being suitable in many cases. The absolute value of

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this difference may be any fixed value within suitable limits, but that value must be known accurately. Fig. 1 also shows a short wave guide section 19 with choke joint flanges 20 and 21 and a fixed attenuator 22 fixedly secured, and a crystal 23 with a crystal holder 24 fixedly secured to its own choke joint flange 25. Fixed pad attenuator 22 is to prevent resonance effects, and is on the order of 5 to 10 db. A crystal current indicator 26 is shown schematically in Fig. 1. Wave guide section 19 is readily movable with respect to wave guide section 10, and in operation alternately opposes choke joint flanges 17 and 18. The assembly comprising short wave guide section 19, crystal 23, crystal holder 24 and crystal current indicator 26 will hereinafter be referred to as a padded crystal holder.

In operation energy from a source passes down a wave guide, reaching the attenuator under calibration, the calibrator herein described, and a matched load, in that order. Fig. 1 illustrates this arrangement. The attenuator is first set on zero. Assume that opening 12 is down 20 db from the line, and that opening 11 is down 21 from the line. The padded crystal holder is placed first over opening 11 and the crystal current is observed. The padded crystal holder is then placed over opening 12 and the attenuator is stopped down until the new crystal current drops to the value previously observed. The reading on the attenuator scale should now be observed and recorded, and it will be noted that the advance in attenuator setting resulted in an attenuation increase of 1 db.

The next step is to place the padded crystal holder again over opening 11 and observe the crystal current now present. As before, the padded crystal holder then is placed over opening 12, and the attenuator is advanced further to make the current indication equal the one immediately preceding. The new reading on the attenuator scale is observed and recorded, it being noted that the advance in attenuator setting has resulted in an attenuator increase of 1 db from 1 db to 2 db.

It is apparent that continuation of this step-by-step process will result in data which may be tabulated as suggested in the following hypothetical example:

Attenuator Readings (Scale Divisions)	Total Attenuation (db)
0	0
1	1
2	2
3½	3
5	4
7	5
9	6
:	:

This calibration information may be presented appropriately and conveniently in the form of a calibration curve.

What is claimed is:

1. Apparatus for calibrating variable microwave attenuators comprising, a source of microwave electromagnetic energy, a matching load, a wave guide section for coupling said load to said source through the attenuator to be calibrated, said wave guide section having a pair of openings differing in size therein and spaced by an odd multiple of a quarter wave length of the energy from said source and adapted to couple energy from said wave guide section with a constant, predetermined, known difference of attenuation, and means to provide an indication proportional to the amount of energy coupled from said wave guide section through each of said openings.

2. Apparatus for calibrating variable microwave attenuators, comprising a source of microwave electromagnetic energy, a matching load, a rectangular wave guide section for coupling said load to said source through the attenuator to be calibrated, said wave guide section having a pair of openings in the broad side thereof spaced by an odd multiple of a quarter wave length of the energy from said source and differing in size to couple energy from said wave guide section with a constant predetermined, known difference of attenuation, and an indicator for measuring the amount of energy coupled from said wave guide section through each of said openings.

3. Apparatus for calibrating variable microwave attenuators comprising, a source of microwave energy, a matched load, a rectangular wave guide section for coupling said load to said source

through the attenuator to be calibrated, said wave guide section having in the broad side thereof a pair of openings differing in size to couple energy from said wave guide section at two constant, differing, known values of attenuation, said openings being spaced axially in said wall by an odd multiple of a quarter wave length of the energy of said source to prevent reflection of energy from said opening, and an indicator for measuring the amount of energy drawn from said wave guide section through each of said openings.

4. Apparatus for calibrating a variable microwave attenuator, comprising a source of microwave energy, a matching load, a rectangular wave guide section for coupling said load to said source through the attenuator to be calibrated, said wave guide section having two branches coupled to the broad side thereof through a pair of openings differing in size to couple energy from said wave guide section at two constant differing known values of attenuation, said openings being spaced axially along said wall by an odd multiple of a quarter wave length of the energy of said source to prevent reflection of energy from said branches, and an indicator for measuring the amount of energy drawn from said wave guide section through each of said branches.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,419,208	Frantz et al.	Apr. 22, 1947
2,422,601	Tashjian	June 17, 1947
2,444,060	Ohl	June 29, 1948
2,522,563	Blitz	Sept. 19, 1950