May 31, 1960 J. H. VOGELMAN 2,939,005

WAVEGUIDE CRYSTAL ASSEMBLY FOR BROADBAND OPERATIONS

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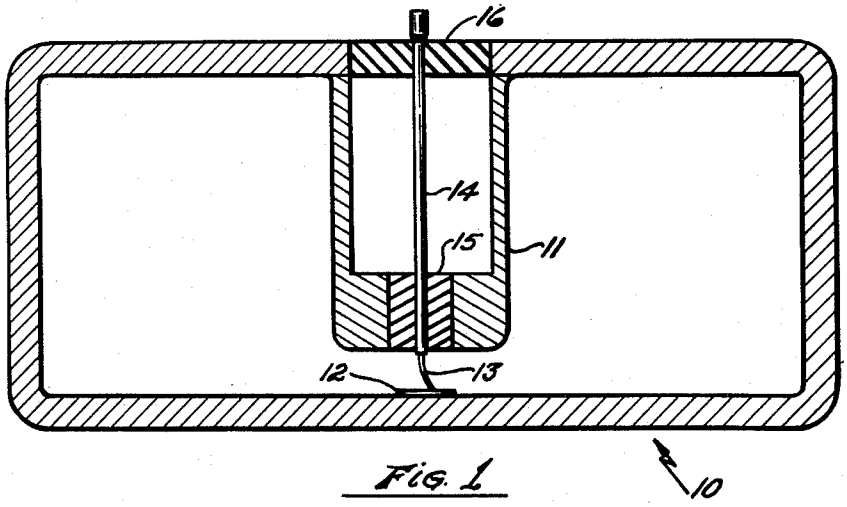


Fig. 1

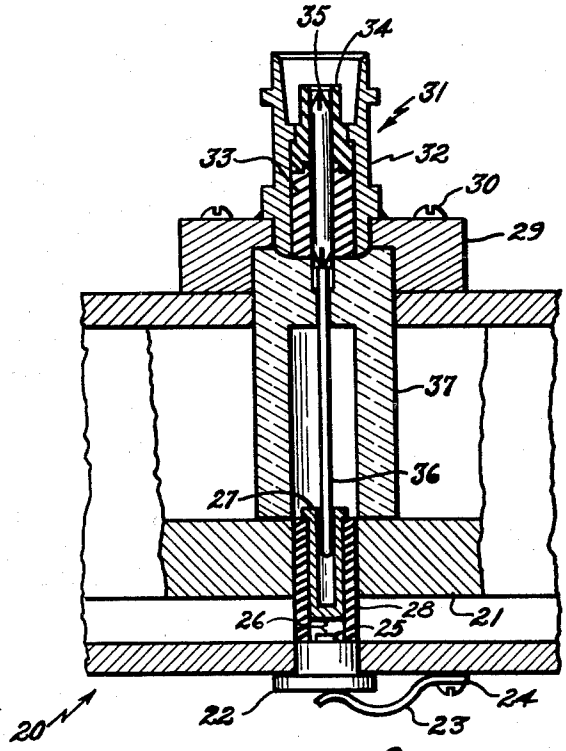


Fig. 2

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WAVEGUIDE CRYSTAL ASSEMBLY FOR BROADBAND OPERATIONS

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3 Claims. (Cl. 250—31)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to me of any royalty thereon.

This invention relates to a microwave waveguide structure incorporating a crystal suitable for use as a detector and/or mixer for extremely broadband use with good R.F. characteristics.

Present microwave crystal mixer and detector units are designed for use in a linear or coaxial shaped waveguide which results in difficult microwave configurations and inherently narrow bandwidth characteristics.

Previous utilization of a crystal in waveguide application involved physical incorporation of the crystal in the waveguide so that the natural configuration would result in a minimum discontinuity; however, this type of crystal design is inadequate in that it will only encompass a narrow frequency band due to the cut-off limitations on the waveguide structure which makes up the crystal unit and it also limits the external circuitry because of the large change in the ratio of waveguide wavelength to free space wavelength which is encountered when attempting to use the crystal over a broad band.

Accordingly, it is an object of this invention to provide a device having characteristics tending to overcome the above-indicated, as well as other, difficulties of prior art devices.

Another object of this invention is to produce a microwave detector and/or mixer crystal unit for extremely broadband use which has good R.F. characteristics.

Still another object of the invention is to produce a microwave detector and/or mixer crystal unit which is economical and easy to fabricate.

A further object of the invention is to produce a microwave detector and/or mixer crystal unit which can be made to cover 4 and 5 to 1 frequency ranges with improved sensitivity and impedance matching characteristics.

A still further object of the invention involves the production of a microwave detector and/or mixer crystal unit which allows a simplification of the external circuitry required for broadband operation.

These and other advantages, features and objects of the invention will become more apparent from the following description taken in connection with the illustrative embodiments in the accompanying drawings, wherein:

Figure 1 illustrates a cross-section of one embodiment of my invention; and

Figure 2 represents a longitudinal section of an alternative embodiment of my invention.

Referring to Figure 1, the invention comprises a ridge waveguide **10** having a ridge or septum **11**. The ridge waveguide may be made by any conventional method. This type of waveguide structure is designed to cover bandwidths in excess of 2 to 1 and up to 5 to 1 depending upon its particular application. The ridge waveguide structure inherently has a very slow ratio change of waveguide wavelength to free space wavelength. The TE_{10} mode is depressed without affecting the TE_{20} mode, and as a result of the dominant mode frequency band is considerably extended.

A semi-conductor crystal **12** which may be of silicon or germanium is mounted by any conventional means, for example, by an adhesive on the wall of the ridge waveguide **10** beneath the ridge **11**. A contact wire or catwhisker **13** attached to a holder **14**, which also serves as an output contact, projects through the ridge into the ridge waveguide **10** so that catwhisker **13** may contact the crystal. Insulating bushings **15** and **16** support and hold holder **14** in its proper position. Were a ridge waveguide formed by pressing a blank into the top wall of a rectangular waveguide to extrude the wall, a drilled or tapped hole in said blank with insulators therein may be used. The features of the ridge waveguide enumerated above plus the reduced impedance of this structure considerably improve and simplify the external circuitry required for broadband operation.

An alternative embodiment is shown in longitudinal section in Figure 2 wherein a ridge waveguide **20** with a ridge or septum **21** therein contains a metallic crystal support **22** held in the base of the waveguide **20** by spring finger **23** attached to the waveguide by any conventional means at **24**. A crystal **25** is mounted on the crystal support **22** within the waveguide and in contact with a catwhisker **26** which in turn is mounted in a holder **27**. An insulating sleeve **28** supports and surrounds the catwhisker. A cap member **29** attached to the waveguide **20** by conventional means **30** holds insulating member **37** in position and supports an output unit **31**. Output unit **31** comprises a sleeve **32** which contains insulating bushings **33** and **34** which grip and support holding member **35** which with pin **36** forms the output contact for the device. The mouth portion of sleeve **32** can be made of any shape suitable for receiving a mating portion which contains a contact suitable for electrically connecting with holder **27**.

Thus, it can be seen that by utilizing a ridge waveguide and crystal mounted therein, the properties of broad bandwidth, good R.F. characteristics, low impedance and improved sensitivity are realized.

Although the invention has been described with reference to a particular embodiment, it will be understood to those skilled in the art that the invention is capable of a variety of alternative embodiments within the spirit and scope of the appended claims.

I claim:

1. A microwave crystal detector or mixer unit for broadband operation comprising a ridge waveguide, a crystal mounted on the wall of said waveguide opposite the ridge of said waveguide, a catwhisker in contact with said crystal, an output contact connected to said catwhisker, and insulating means for supporting said output contact and catwhisker, said insulating means being located at least partially within the ridge of said ridge waveguide.

2. A microwave crystal detector or mixer unit for broadband operation comprising a ridge waveguide, a crystal holder and crystal thereon removably mounted in the wall of said waveguide opposite the ridge of said waveguide, a contact wire in contact with said crystal, an output contact, a member electrically connected to said contact wire and output contact, and insulating means within the ridge of said waveguide for supporting said member, contact wire and output contact.

3. A microwave crystal detector or mixer unit for broadband operation comprising a ridge waveguide, a crystal unit mounted on the wall of said waveguide op-

posite the ridge of said waveguide, said crystal unit having current conducting means projecting therefrom and insulating means extending through said ridge, for supporting said current conducting means, said insulating means being located at least partially within the ridge of said ridge waveguide.

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