Feb. 5, 1957 C. E. VOGELEY, JR., ET AL 2,780,783

ANTENNA FEED MODULATION UNIT FOR RIDGED WAVEGUIDE

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Fig. 1

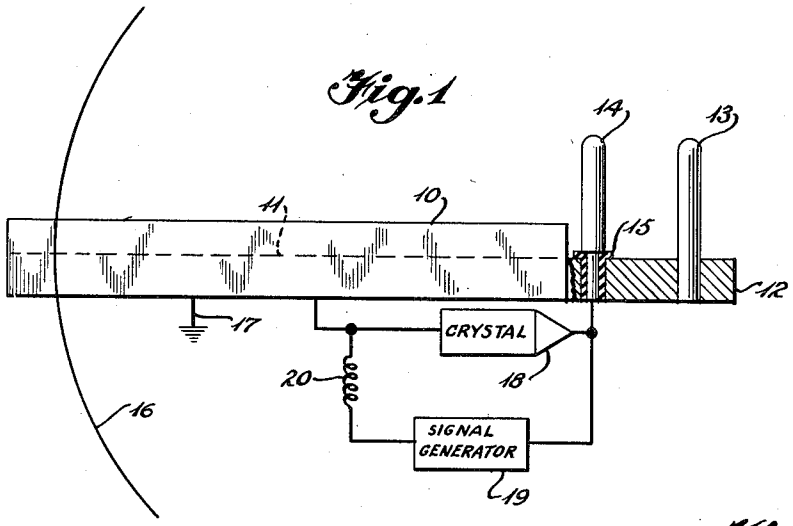
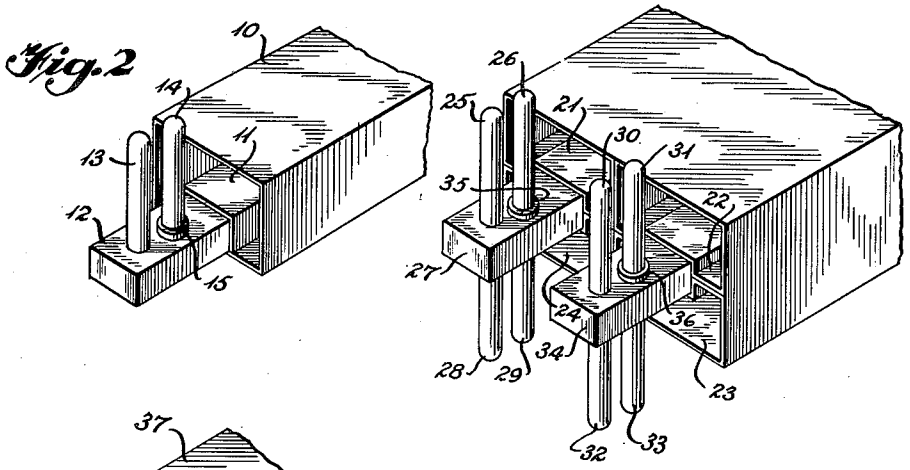


Fig. 3

Fig. 2



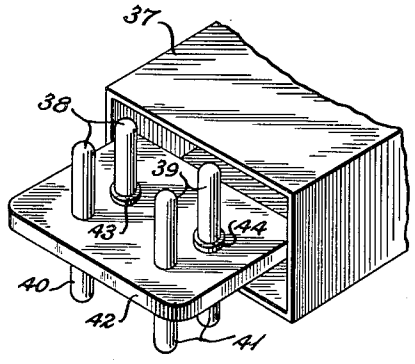


Fig. 4

INVENTORS
Clyde E. Vogeley, Jr.
Richard H. Webb

BY
Walter S. Pawl
ATTORNEYS

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ANTENNA FEED MODULATION UNIT FOR RIDGED WAVEGUIDE

Clyde E. Vogeley, Jr., and Richard H. Webb, Pittsburgh, Pa., assignors, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

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This invention relates to a method and apparatus for achieving modulation in the antenna stage of a high frequency transmitter or receiver employing ridged waveguides.

Although previously disclosed modulation units have been shown to operate satisfactorily, they have also proven themselves difficult to install and adjust, primarily because of the close electrical and phyical tolerances imposed by the ridged waveguides employed. In the previously disclosed units modulation is achieved in a stage preceding the antenna stage and utilizes a tuned probe to which a signal generator and a modulating device are capacitatively coupled. Variations in the dimensions of the ridged portion of the waveguide in the region near the probe produce marked differences in the operation of the modulation units which are difficult to overcome. Secondly, in the installation of the probe a small amount of solder at the joint between the probe and the ridge often proves to be disastrous. Furthermore, adjustment of the coupling between the probe and the modulating device (usually a germanium welded contact crystal) is also critical. Many of these difficulties could be easily overcome were it not for the small physical dimensions required of the ridged waveguide.

It is an object of this invention, therefore, to overcome the deficiencies of the prior systems by providing a system which achieves modulation in the antenna stage of a transmitter, rather than in any preceding stage. Such a system has the advantages of eliminating the modulation stage of the prior art systems, and at the same time effecting modulation in the open region of the antenna stage where installation and adjustment are more easily achieved.

A further object of this invention is the provision of a transmitting system employing ridged waveguides in which modulation is accomplished in the antenna stage by means of a modulation device coupled to the dipoles of the antenna.

A still further object of this invention is the elimination of probes employed in the modulation stage of prior art devices, and thus eliminating the inaccuracies and losses caused thereby.

Other objects and advantages of this invention, as well as its construction, arrangement and operation, will be apparent from the following description and claims taken in connection with the accompanying drawing in which:

Fig. 1 is a schematic representation showing the inventive concept involved in the system;

Fig. 2 is an isometric view showing the antenna feed employed in Fig. 1;

Fig. 3 is an isometric view showing a multiple type antenna feed consisting of four ridged waveguides which may be utilized in this invention; and

Fig. 4 is an isometric view showing a standard waveguide feed on which this invention may be employed.

Referring now to the drawing, and particularly to Figs. 1 and 2, there is shown a ridged waveguide **10** having a

ridged portion **11**. A conductive dipole mounting block **12** is mounted in conductive relationship with the waveguide **10** in any convenient manner in the area under the ridged portion of the waveguide. A first dipole element **13** is mounted on the mounting block in electrically conductive relationship therewith. The second dipole element **14** is similarly mounted on the block **12**, but is insulated therefrom by means of an insulating sleeve **15**. A conventional reflector **16** is mounted in any suitable manner in the position shown, and the waveguide is grounded at any convenient location **17**. A variable impedance device such as the germanium welded contact crystal **18** is connected at one end to the insulated dipole element **14** and at its other end to the other dipole element **13** through the grounded waveguide. A modulating signal is impressed across the crystal **18** from the signal generator **19**, through the R. F. choke **20**.

With the foregoing arrangement, a variation in the impedance of the crystal **18** is reflected into the dipole elements **13** and **14**, thereby changing the electrical aspects of the dipole array and thus modulating a received or transmitted signal. For optimum performance of the system it has been determined that the height of the dipole elements **13** and **14**, and the spacing therebetween, should be a quarter wave length. The distance between the dipole element **14** and the waveguide **10** also affects the operation of the system. It should be noted, however, that satisfactory operation of the array can be achieved without critical adjustments. In fact, with no variable coupling between the crystal **18** and the dipole, with no attention being given to the length of the dipole, and with a crystal chosen at random, a modulation percentage was achieved which in the previously known modulation systems, could only be detected after careful and elaborate adjustments are made.

In Fig. 3 there is disclosed another antenna feed arrangement on which this modulation system may be employed. There is shown a multiple feed consisting of four ridged waveguides, **21**, **22**, **23**, and **24**. The dipole elements **25** and **26**, which are associated with the wave guide **21**, are mounted on a common conductive block **27** with the dipole elements **28** and **29**, which are associated with the waveguide **24**. Similarly, the dipole elements **30**, **31**, **32** and **33** are mounted on the block **34**. As in Fig. 2, the dipole elements **26**, **29**, **31** and **33** are insulated from the conductive blocks by means of the insulating sleeves **35** and **36**.

The modulation system has also been employed on the standard waveguide feed shown in Fig. 4. In this arrangement, a waveguide **37**, having a rectangular cross section is employed. The dipole elements **38**, **39**, **40** and **41** are mounted, as shown on the conductive block **42** and one element of each dipole is insulated therefrom by the insulating sleeves **43** and **44**. While the advantages of modulating in the antenna stage of a system employing a standard waveguide, such as shown in Fig. 4, are not as apparent as in systems employing ridged waveguides, since the dimensions of the standard waveguide are not so limited, a sufficient advantage is obtained to justify the use of the system with this type of installation. The adjustments necessary in ridged systems, while not so critical in standard systems, are still required in the use of the prior art probe devices for obtaining modulation in the standard systems, and are obviated by the use of this invention.

In summary, therefore, it is seen that this invention moves the modulation process from the interior of the waveguides, where physical confines render adjustment and installation difficult, to the open region of the antenna feed, thereby rendering installations and adjustment relatively less difficult. The system achieves modu-

lation without critical adjustments necessary in the prior art devices, and it is relatively free from waveguide errors. Inasmuch as the presence of the extra probe employed in the prior art systems accounts for a finite loss, its elimination reduces these losses. The system can be used advantageously on any known antenna feed system.

While preferred embodiments of this invention have been described it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention, and it is the intent, therefore, to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. An antenna feed modulation system for modulating a transmitted or received signal in a ridged waveguide comprising; a dipole antenna; means mounting said antenna at one end of said waveguide, one of the elements of said antenna being electrically connected to said waveguide, the other element of said antenna being insulated therefrom; a variable impedance device connected across said elements; and a modulating voltage impressed across said variable impedance device; whereby, a variation in the impedance of said variable impedance device is reflected into said antenna, thereby modulating said signal.

2. A modulation system comprising; a waveguide; a dipole antenna mounted at one end of said waveguide, one element of said antenna being electrically connected to said waveguide, the other element of said antenna being insulated therefrom; a variable impedance device connected across said waveguide and said other element; and a modulating signal impressed across said variable impedance device.

3. The invention as defined in claim 2 wherein said waveguide is ridged.

4. The invention as defined in claim 3 wherein said variable impedance device is a germanium welded contact crystal.

5. A modulating system comprising: an antenna feed consisting of a plurality of waveguides; a dipole antenna mounted adjacent one end of each of said waveguides, an element of each of said antennas being electrically connected to its associated waveguide, the other element of said antennas being insulated therefrom; a variable impedance device connected across each of said waveguides and said other element, respectively; and means for impressing a modulating signal across each of said variable impedance devices.

6. The invention as defined in claim 5 wherein said waveguides are ridged.

7. The invention as defined in claim 6 wherein said variable impedance devices are germanium welded contact crystals.

8. A modulation system for modulating a transmitted or received signal in a waveguide comprising: an antenna having two elements, means conductively mounting one element of said antenna at one end of said waveguide, means insulatingly mounting the other element of said antenna at said end of said waveguide, a variable impedance device connected across said elements, and means for impressing a modulating voltage across said variable impedance device whereby a variation in the impedance of said variable impedance device is reflected into said antenna thereby modulating said signal.

9. The system of claim 8 wherein said means insulatingly mounting the other element of said antenna comprises an insulating sleeve mounted in said means conductively mounting the one element of said antenna.

10. The system as defined in claim 9 wherein said variable impedance device comprises a welded contact germanium diode.

11. The system of claim 10 wherein the height of the antenna elements and the spacing therebetween is a quarter wave length of said signal.

12. A modulation system for modulating a transmitted or received signal in a ridged waveguide comprising: a dipole antenna, first means for conductively mounting one element of said dipole antenna at one end of said waveguide, second means for insulatingly mounting the other element of said dipole antenna at said one end of said waveguide, a variable impedance device connected across said elements, and means for impressing a modulating voltage across said variable impedance device whereby a variation in the impedance of said variable impedance device is reflected into said antenna thereby modulating said signal.

13. The system of claim 12 wherein said second means comprises an insulating sleeve mounted in said first means.

14. The system as defined in claim 13 wherein said variable impedance device comprises a welded contact germanium diode.

15. The system of claim 14 wherein the height of the antenna elements and the spacing therebetween is a quarter wave length of said signal.

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