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ULTRA HIGH FREQUENCY MODULATOR

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FIG. 1.

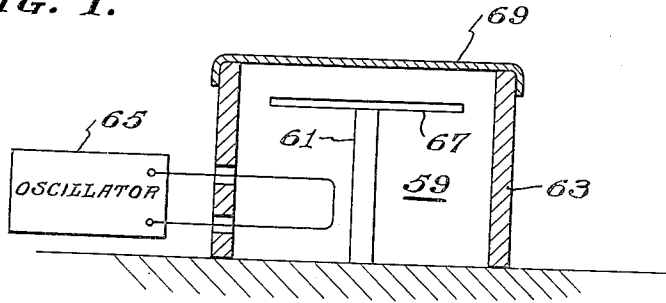
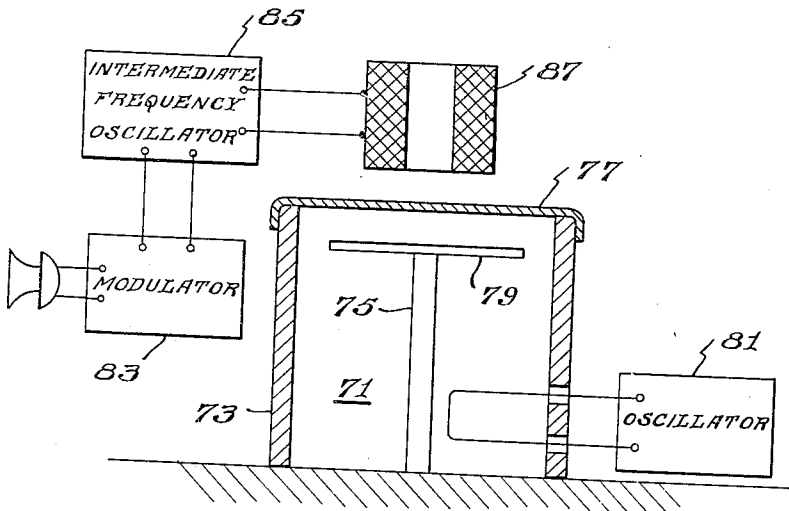


FIG. 2.



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UNITED STATES PATENT OFFICE

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ULTRA HIGH FREQUENCY MODULATOR

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Original application September 30, 1938, Serial
No. 232,629, which is a division of application
Serial No. 156,054, July 28, 1937. Divided and
this application January 31, 1940, Serial No.
316,623

4 Claims. (Cl. 179—171.5)

My invention relates to ultra high frequency modulators, and particularly to means for frequency modulating an ultra high frequency resonant line circuit.

This application is a division of my copending application Serial No. 232,629, filed September 30, 1938, Patent No. 2,217,280, October 8, 1940, which is in turn a division of my application Serial No. 156,054, filed July 28, 1937, and entitled "Ultra high frequency modulator," which issued as United States Patent 2,174,701, on October 3, 1939.

It has been found that generators of currents of 50 megacycles per second and upwards may be better stabilized by resonant transmission lines than by piezoelectric crystal controls with their attendant difficulties. In one aspect, my invention contemplates varying the characteristic of such stabilizing ultra high frequency resonant line circuits to thereby frequency modulate the ultra high frequency currents impressed on said resonant lines. Thus employed, the resonant line serves the dual purpose of frequency modulation and stabilization.

One of the objects of my invention is to provide an improved means for modulating an ultra high frequency current.

Another object is to provide an improved means for frequency or amplitude modulating an ultra high frequency carrier.

Another object is to provide means for modulating the frequency of a high frequency oscillator by means of amplitude modulated currents of a lower frequency.

Another object is to provide means for varying the effective stabilizing frequency of a resonant line.

A still further object of my invention is to provide means for modulating an ultra high frequency carrier without the application of electrical power.

My invention may be best understood by reference to the accompanying drawing, in which

Figure 1 is a schematic illustration of a concentric line which is modulated by sound waves, and

Figure 2 is a schematic diagram of a circuit which produces frequency modulated waves through the use of amplitude modulated waves.

One feature of my invention is the extreme simplicity of the modulating means employed which modulates the oscillator frequency or amplitude by vibrations derived directly from sound waves, thus functioning as a combined modu-

lator-microphone. The dual function is made practical by employing a concentric line modulator, since in such a case the outer member of the line and the microphone diaphragm are both maintained at ground potential, as will subsequently appear.

Referring to Fig. 1, a device has been illustrated which can be used to modulate ultra high frequency oscillations without the application of electrical energy. A concentric line 59, having an inner member 61 and a grounded outer member 63, is suitably coupled to a generator 65 of ultra high frequency oscillations. The upper portion of the inner member 61 includes an armature 67. An acoustic diaphragm 69 is mounted on the end of the outer conductor 63 in spaced relation to the armature 67. Sound waves may be impressed directly on the diaphragm 69. The diaphragm actuated by such waves will vary the capacity of the concentric line and hence its resonant frequency. The variation in capacity will frequency modulate the line 59 and the output from the oscillator 65. This arrangement is particularly adapted to an ultra high frequency portable transmitter because of the absence of apparatus and the power supply usually required for modulation. In installations where weight and power supplies are not important factors, the diaphragm 69 may be driven by a loudspeaker motor or the like.

A schematic circuit diagram of the application of the invention to an ultra high frequency transmitter and frequency modulator is shown in Fig. 2. In this circuit, a concentric line 71 is arranged with an outer member 73 and an inner member 75. A diaphragm 77 is mounted on the top of the outer conductor 73. An armature 79 is mounted on top of the inner member 75 and adjacent the diaphragm 77. An oscillator 81, supplying ultra high frequency currents, is coupled to the concentric line 71. A modulator 83 and an intermediate frequency oscillator 85 are arranged to supply a solenoid 87 with amplitude modulated intermediate frequency currents which actuate the diaphragm 77 through the reaction between the magnetic field set up by the currents in coil 87 and the field due to the eddy currents in the diaphragm. The intermediate frequency is chosen so that the diaphragm will have too large an inertia to follow the individual intermediate frequency waves but the unmodulated portion of the carrier will produce a fixed displacement of the diaphragm which has an effect similar to that produced by

the permanent magnet of a telephone receiver. The diaphragm will, however, follow the average amplitude of modulation wave. Thus operated, the carrier currents from the oscillator 81 are stabilized by the concentric line and modulated 5 as described. The greater the current through coil 87, the greater will be the eddy current induced in the diaphragm, and the greater will be the depressing of the diaphragm, resulting in a greater decrease in frequency of oscillator 81. 10

I have thus described two modifications of my invention which provide means for applying modulating signals to a resonant line which is used to stabilize an ultra high frequency oscillator. The resonant line serves the dual purpose 15 of modulation and stabilization, and permits an efficient application of wide range frequency modulation to an ultra high frequency carrier. In this type of modulation, the anode voltage on the oscillator may be continuous, thereby 20 maintaining high grid impedence and low grid circuit power losses.

While I have specifically described the invention as applied to frequency modulation of the direct or double modulation type, it should be understood that my invention may be applied 25 to vary the resonant frequency of a line connected between the oscillator and the output, thus varying the coupling between the oscillator and an antenna to modulate amplitude. It is also possible to apply the invention as shown to the automatic control of the frequency of the heterodyne oscillator of a superheterodyne receiver. In such cases, changes in the intermediate 30 frequency currents are applied to the resonant line circuit to thereby change the frequency of the heterodyne oscillator to maintain constant intermediate frequency currents.

I claim as my invention:

1. An ultra high frequency modulator including a concentric resonant line having an inner member, an outer member, an armature secured to said inner member, a vibratable diaphragm adjacent said armature and connected to said 40

outer member, a source of ultra high frequency currents, and means coupling said source to said concentric line.

2. An ultra high frequency modulator including a concentric resonant line comprising an inner member, an outer member, an armature secured to said inner member, a vibratable diaphragm adjacent said armature and connected to said outer member, a generator of ultra high frequency currents, means coupling said generator to said concentric line so that said line controls the frequency of said currents, and means for applying forces to said diaphragm to alter the resonant characteristic of said line and modulate the frequency of said currents. 15

3. An ultra high frequency modulator including a concentric resonant line comprising an inner member, an outer member, an armature secured to said inner member, an acoustic diaphragm adjacent said armature and connected to said outer member, a generator of ultra high frequency currents, means coupling said generator to said concentric line so that said line controls the frequency of said currents, and means for applying acoustic forces to said diaphragm to alter the resonant characteristic of said line and modulate the frequency of said currents. 20

4. In a device of the character described, a generator of ultra high frequency currents, a concentric resonant line comprising an inner member, an outer member, an armature attached to said inner member, and a diaphragm secured to said outer member and adjacent said diaphragm, means coupling said generator to said resonant line so that said line controls the frequency of said currents, a generator of intermediate frequency currents, a modulator coupled to said second-named generator, and means for impressing modulated intermediate frequency currents on said diaphragm to alter the resonant characteristic of said line and modulate the frequency of said currents. 35 40

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