Aug. 9, 1938. A. H. TURNER 2,125,969

ULTRAHIGH FREQUENCY OSCILLATOR

Filed Aug. 29, 1935

Fig. I.

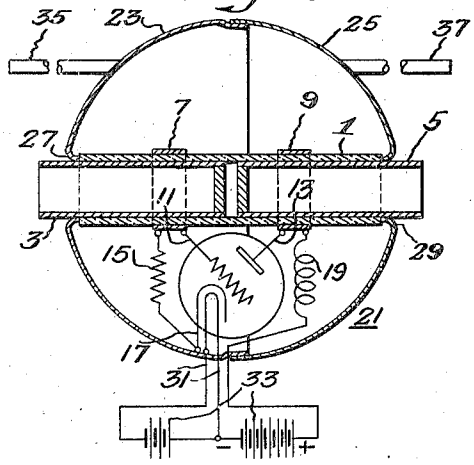


Fig. II.

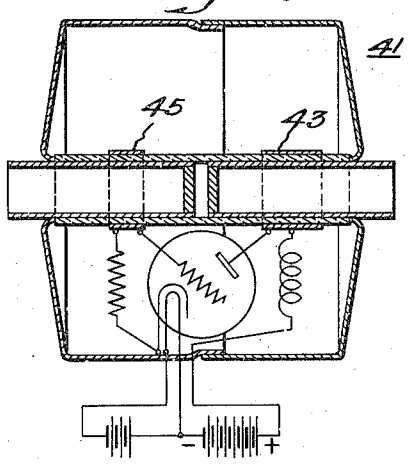


Fig. III.

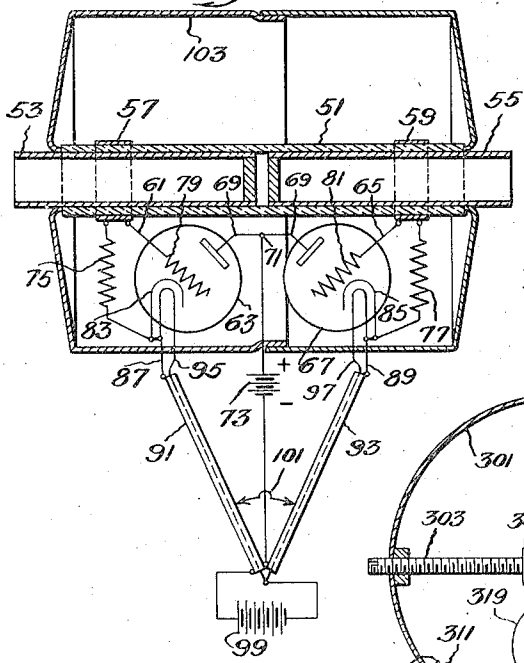


Fig. IV.

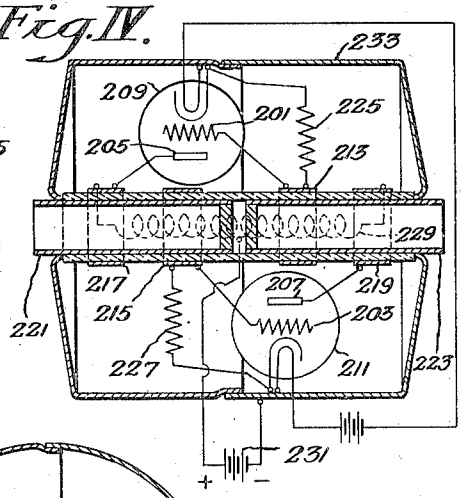
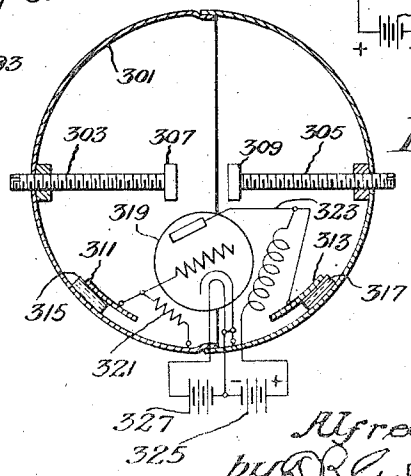


Fig. V



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ULTRAHIGH FREQUENCY OSCILLATOR

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Application August 29, 1935, Serial No. 38,374

4 Claims. (Cl. 250—36)

My invention relates to oscillators. More particularly, my invention is an ultra high frequency transmitter in which the oscillator proper is contained within a small shielded metal container which may be positioned intermediate the ends of an antenna.

One of the objects of my invention is to enclose themionic tube within a metallic shield which is part of the tank circuit of the tube.

Another object is to enclose an oscillator within a metallic shield which may be included in the antenna system of an ultra high frequency transmitter.

A still further object is to combine the oscillator, shield and antenna of an ultra high frequency system.

Further objects will appear in the accompanying specification and claims.

Figure I is a view, partly in section, of one embodiment of my invention,

Figure II is a view, partly in section, of a modification of Figure I,

Figure III is an illustration, partly in section, of a push-pull ultra high frequency oscillator adapted to my invention,

Figure IV is an illustration, partly in section, of a modified form of push pull device, and

Figure V is a diagram showing an embodiment of my invention which is suitable for frequency control.

In Figure I within a suitable glass tube 1 are slidably mounted two metal tubes 3—5. These tubes are preferably good conductors, such as copper, closed at their inner ends. They form the two armatures of an adjustable condenser. Two metallic bands, 7—9, of copper or like conductor, are mounted on the outside of the glass tube. The two bands are insulated from each other. One of the bands 7 is connected, preferably directly, to the grid lead 11 of a thermionic tube, such as an RCA type 955. The other band 9 is connected to the plate lead 13 of the same tube. The grid is connected through a grid leak resistor 15 of the order of 50,000 ohms to the cathode lead 17. A suitable radio frequency choke 19 is mounted adjacent the plate lead 13 and is connected thereto.

A hollow metallic shield 21, which may be fabricated from two hollow copper hemispheres 23—25 or the like, surrounds the adjustable condenser and tube. The shield is made with inwardly turned sockets 27—29 adjacent the axial poles. The sockets make good spring contacts with the slidable armatures of the condenser. The sockets not only make good electrical connection with the metal tubes, but also form a tight mechanical fit to hold the adjusted tubes at the proper position and keep out moisture.

The grid leak, cathode and one of the heater leads 31 may be connected together and to the metallic shield at a point remote from the axial sockets. The other heater lead and choke lead are insulated and brought out through suitable holes in the shield. These leads are connected to a power source 33, such as a battery, motor-generator, or the like. The power source 33 may be remote from the shield, and may be at ground potential with respect to radio frequency currents.

The arrangement described may be operated as an ultra high frequency oscillator, or a receiving device. The tuned or resonant tank circuit consists of the inductance of the copper shield member and the variable capacity composed of the slidable armatures 3—5. The variable capacity is coupled through the metal bands 7—9 to the grid and anode electrodes. The circuit arrangement of Figure I is that of a single tube Hartley oscillator.

By way of example, the shield may be made of a pair of copper cans, about two inches in diameter and four inches long. The copper tubes may be made of rods of ⅜" outside diameter. The glass tube may be made of Pyrex or other suitable insulation. The walls of the glass tube may be about $\frac{1}{32}$" thick. The copper bands are about ¼" wide. With values of the order given, stable oscillations may be generated from 400 to 600 megacycles.

The arrangement I have described may be combined with a direct radiating antenna system. The radiating antenna conductors 35—37 may be connected directly to the metallic shield because at the high frequencies employed the shield has a suitable impedance for a direct antenna connection. Each of the antenna conductors 35—37 are preferably a quarter wave length long. At the lower frequencies the antenna conductors may be connected to the metallic shield at points adjacent the axial poles. At higher frequencies a better impedance match will be found at a pair of points nearer the equatorial region of the shield. The antenna conductors may be wires or tubes of suitable cross section. They may be fixed to the shield by soldering, brazing, or the like.

The construction is designed to make a weatherproof unit. After the frequency has been adjusted by positioning the armatures, they may be soldered or sealed to the shield to make the as-

sembly weatherproof. The unit may be supported or self supporting. It may be used with or without a reflector. The antenna wires may be vertical or horizontal. It is especially adaptable to aircraft or other mobile units.

Figure II illustrates an embodiment of my invention not unlike the arrangement shown in Figure I. The essential differences in the two arrangements will be found in the substitution of a cylindrical shield 41 for the spherical shield 21 of Figure I. The metallic plate band 43 in Figure II has been shown as approximately twice the width of the grid band 45. This arrangement has been found to better balance the inter-electrode capacities of the oscillator. It should be understood that other departures may be made in the arrangements shown.

A pair of oscillators may be arranged in push pull connection as illustrated in Figure III. In this connection within the glass tube 51 are slidably mounted two metallic armature members 53—55. On the outside of the glass tube are positioned a pair of metallic bands 57—59. One of the bands 57 is connected to the grid lead 61 of the thermionic tube 63. The other metallic band 59 is connected to the grid lead 65 of the other thermionic tube 67. These thermionic tubes may be of the small acorn type known as RCA 955. The plate leads 69 of these two tubes are connected together. The center point 71 of this connection is the terminal to be connected to the positive pole of the plate battery 73. Separate grid leaks 75—77 are connected between the grids 79—81 and cathodes 83—85. The two grid circuits are tuned by the slidable armature members 57—59. Two of the filament leads 87—89 are connected to the tubular members 91—93, and the other filament leads 95—97 are run within the tubular member. The filament leads are connected to a suitable source of power 99. The negative terminal of the plate battery 73 may be connected to the filament battery or cathode. In the arrangement shown in Figure III the tubular members 91—93, connected between the cathodes 83—85, form a tuned cathode circuit. A suitable adjustable conductor 101 may be used to vary the length of the tuned circuit and hence its resonant frequency. The tubular members may be eliminated by including a suitable inductance coil within the shield. In the connection shown the grid circuits are tuned by the inductance of the shielding member 103 and capacity of the adjustable armatures which are connected to the shield. The shield may be cylindrical or spherical, and fabricated from two or more pieces. The antenna wires are not shown but may be of a quarter wave length long and connected to points on the shield which offer suitable reactance for the frequency chosen.

The arrangement shown in Figure IV is not unlike Figure III. The essential difference is found in the circuit which is a push pull oscillator of the well known Hartley type. In this Figure both the grids 201—203 and the plates 205—207 of the thermionic tubes 209—211 are connected respectively to metallic bands 213, 215, 217 and 219. The several bands are separated from each other but are capacitively connected to the adjustable armatures 221—223. The grids 201—203 are connected to the shield by grid leak resistors 225—227. The plates are connected by an inductor 229 which is tapped at its mid-point for the connection of the positive terminal of the B battery 231. The filaments may be connected in the conventional manner. The cathodes are connected to the shield 233 and the negative terminal of the B battery. Due to the increased capacities of this circuit, the range of oscillation is not as great as found in the circuits of the other figures. In the matter of frequency stability, the single tube Hartley circuit has proven to be the most stable; while the push pull Hartley arrangement is the least stable for variations in plate potential. If an amplifier stage is desired, the amplifier may likewise be included within a metallic shield.

The circuits described above approach the optimum for the generation of ultra high frequencies. The several illustrations indicate coupling between the oscillator electrodes and sections of the resonant tank circuit near anti-nodal potential points. The resonant circuit is of relatively low impedance but the tube impedance acts as a load across the anti-nodal potential points and tends to reduce frequency stability. The frequency stability may be greatly improved by coupling the oscillator to that portion of the tank circuit which lies near the equatorial region or adjacent current anti-nodal points of the shield. This type of connection places the load where it will minimize the effect on the resonant circuit and the frequency stability of the oscillatory currents.

In Figure V the shielding member 301 has mounted at its axial poles a pair of screws 303—305. On the inner ends of the screws are fixed armature members 307—309. The shield forms the inductance and the armatures the capacity of an adjustable resonant circuit. The anti-nodal current points lie near the equatorial region of the shield. Adjacent these points are mounted condenser plates 311—313 which are supported with respect to the shield by suitable insulators 315, 317. The grid of the thermionic tube 319 is connected to one condenser plate 315 and the plate is connected to the other condenser plate 317. A grid leak resistor 321 is connected between grid and the shield. A radio frequency choke 323 is connected between plate and the positive terminal of the B battery 325. The cathode and one heater lead are connected to the shield. The heater is energized by a battery 327. The circuit arrangement of Figure V is most suitable for the generation of oscillations of substantially constant frequency because the tube load is connected across anti-nodal current points in the resonant circuit.

It should be understood that the precise shape of the shield is not essential. I prefer the spherical, but cylindrical and other shapes may serve equally well. Other obvious modifications within the scope of my invention will occur to those skilled in the art. I do not intend to limit my invention except as required by the prior art and the appended claims.

I claim as my invention:

1. An oscillatory system comprising a shield, an adjustable capacity disposed within said shield, said shield and said capacity forming a resonant tank circuit, an electronic oscillator disposed within said shield, and means coupling said oscillator adjacent an anti-nodal current point within said shield.

2. An oscillatory system comprising a shield, an adjustable capacity disposed within and connected to said shield, said shield and said capacity forming a resonant circuit, a pair of electronic oscillator tubes arranged in push pull connection and disposed within said shield, and means coupling the input of said oscillator tubes

to points adjacent anti-nodal current points on said resonant circuit.

3. An ultra high frequency device comprising a hollow metallic shield, an adjustable capacity centrally disposed within said shield and connected thereto, said shield and said capacity forming an adjustable tank circuit, a thermionic tube disposed within said shield, means coupling said thermionic tube to said tank circuit, and a pair of oppositely disposed quarter wave length antenna conductors connected to said shield.

4. In an ultra high frequency system, a shield, an adjustable capacity substantially centrally disposed within said shield, said shield forming an inductance, means connecting said shield and adjustable capacity to form a tunable resonant circuit, a thermionic tube having grid, filament, and plate electrodes disposed within said shield, means coupling said grid to one armature of said adjustable capacity, means coupling said plate to the other armature of said adjustable capacity, said means for coupling the plate and adjustable capacity being of different coupling value from the means coupling the grid and said adjustable capacity, a grid leak resistance connected between grid and shield, a radio frequency choke coil connected to said plate, a source of power disposed external to said shield, and connections from said source to said electrodes and choke coil.

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