

May 27, 1941.

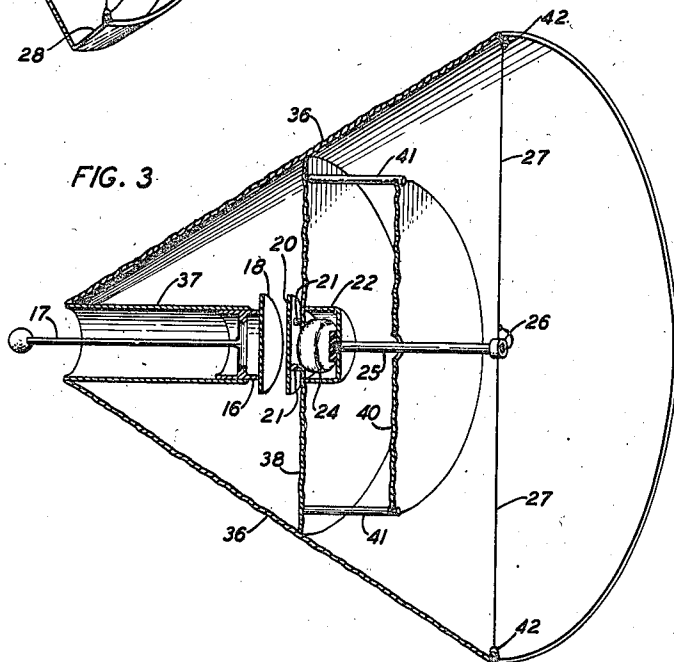
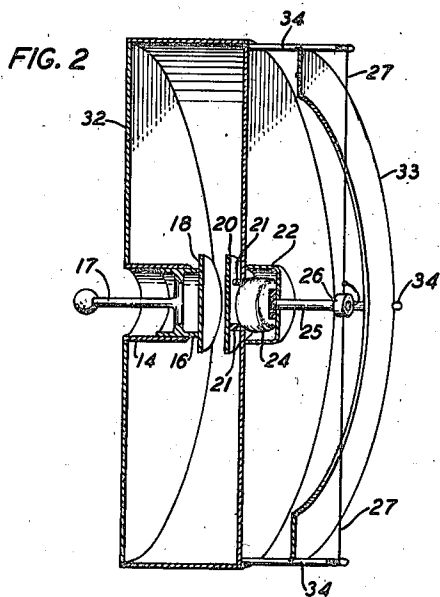
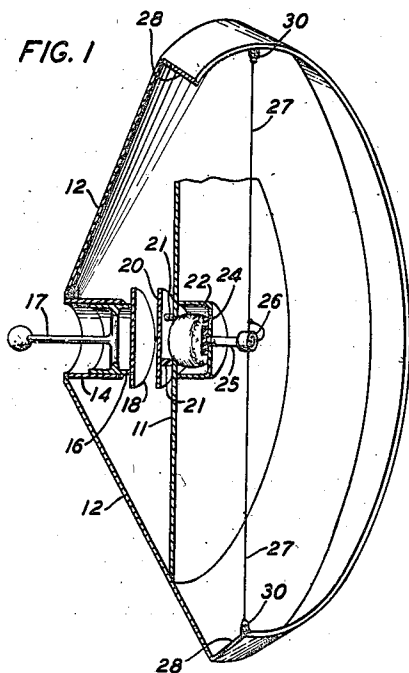
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2,243,426

ULTRA HIGH FREQUENCY SYSTEM

Filed June 2, 1939

3 Sheets-Sheet 1



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FIG. 4

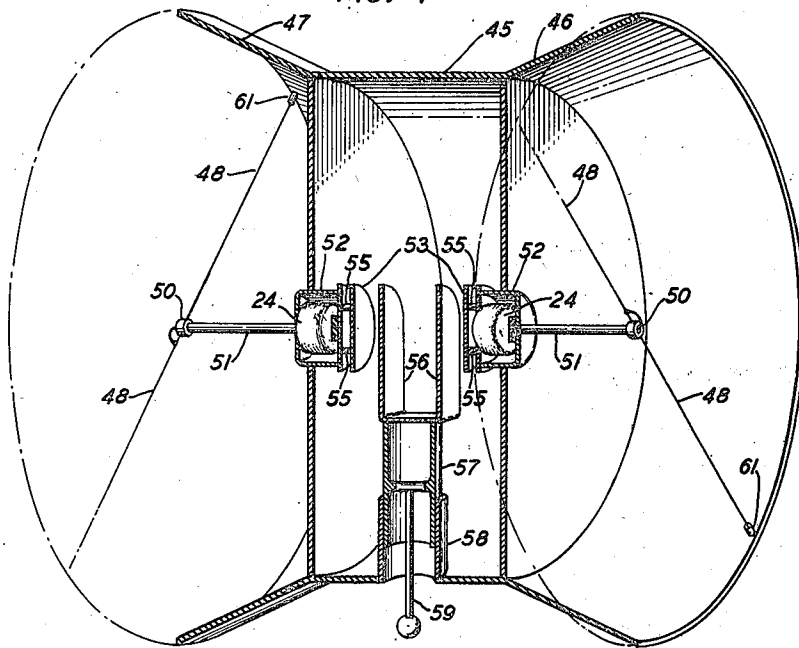


FIG. 5

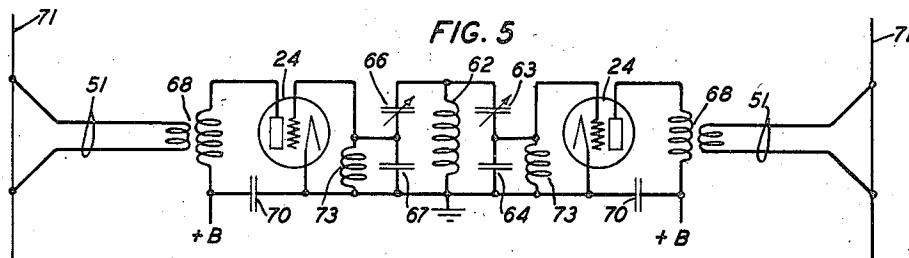
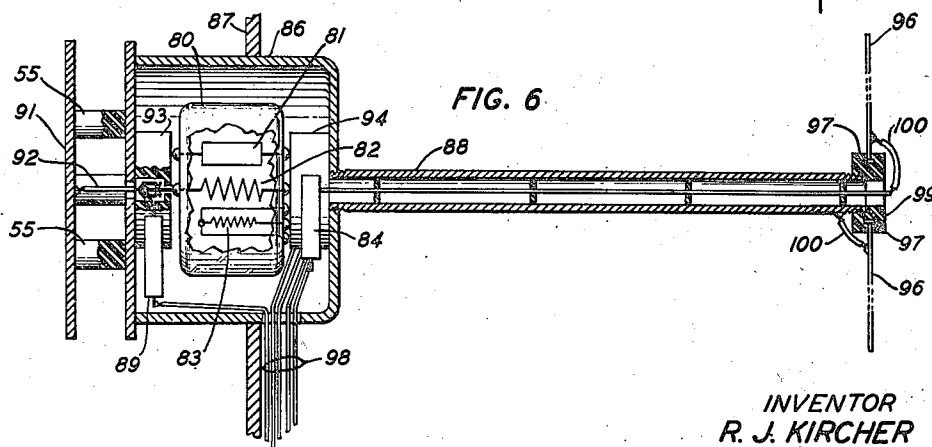


FIG. 6



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FIG. 8

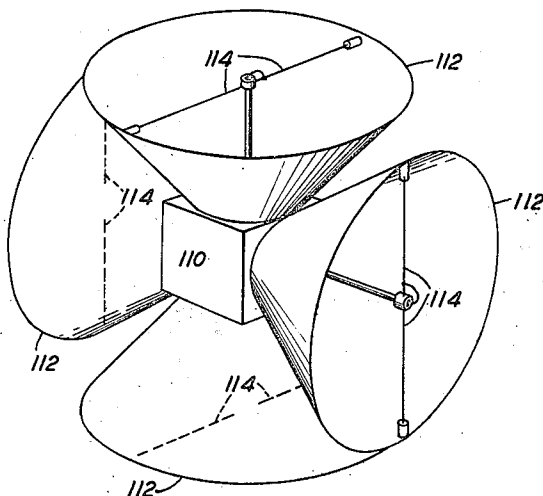


FIG. 7

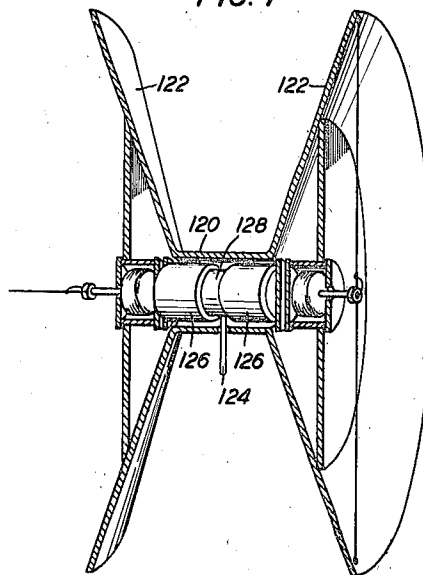
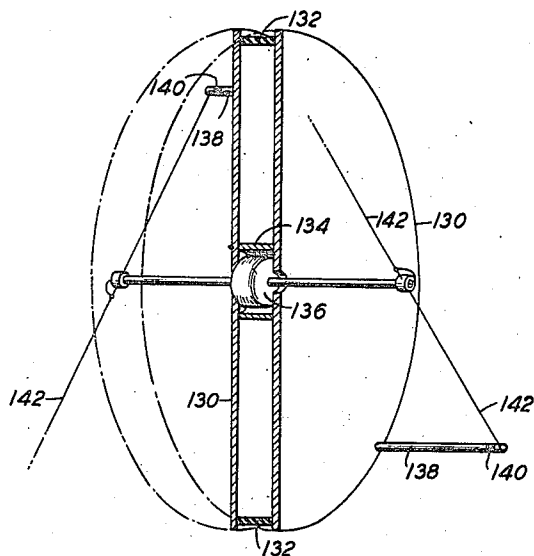


FIG. 9



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2,243,426

ULTRA HIGH FREQUENCY SYSTEM

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Application June 2, 1939, Serial No. 276,997

2 Claims. (Cl. 250-11)

This invention relates to ultra high frequency systems and, more particularly, to systems in which the means affording frequency control are coordinated with means to afford directive properties, and highly unified systems are thereby obtained.

The use of "tank" circuits to control the frequency of ultra high frequency systems is well known, as is also the use of plane and shaped reflectors and focusing elements to impart highly directive properties to ultra high frequency waves.

This invention has as its principal object the mechanical coordination of means to achieve both frequency control and directivity in ultra high frequency systems in such manner that economy of material and convenience in the use of such systems may be attained.

Other and further objects will appear during the course of the following description.

It is obvious that the principles of the invention may be embodied in a great variety of combinations. A few such embodiments, illustrative of these principles are shown in the accompanying drawings in which:

Figs. 1 to 3, inclusive, show in cross-section structures combining tank circuits to control the frequencies of the oscillatory circuits, and reflecting and focusing devices to impart directive properties to the energy radiated therefrom, respectively;

Fig. 4 shows in cross-section a double tank and reflector system embodying the principles of this invention;

Fig. 5 shows in schematic form a possible equivalent electrical circuit of the double tank and reflector system of Fig. 4;

Fig. 6 is illustrative of the manner in which the vacuum tube and the closely associated circuit elements may be assembled in the devices of this invention; and

Figs. 7, 8 and 9 show alternative forms of multiple tank and reflector systems of this invention.

Referring in more detail to Fig. 1, the internal portion of the cone 12, closed by the plate 11, forms a tank circuit and is provided with an adjustable internal conducting member comprising fixed tube 14 and movable tube 16. The relative mechanical positions of tubes 14 and 16 may obviously be interchanged if desired. Movable tube 16 is provided with a handle 17 and carries disc 18, the latter with disc 20 forming a capacity. Disc 20 is spaced from surface plate 11 by insulators 21 and the capacity be-

tween plate 11 and disc 20 is preferably such as to provide suitable coupling between the tank circuit and the circuits of the oscillating tube 24 in accordance with principles disclosed in copending application of F. B. Llewellyn, Serial No. 185,139, filed January 15, 1938. By changing the position of disc 18 by movement of tube 16 within tube 14, the resonant frequency of the tank circuit may be adjusted. This tank circuit differs from conventional tank circuits which are well known to the art, such, for example, as a number of those disclosed in U. S. Patent 2,030,178 issued to R. K. Potter on February 11, 1936, principally in that it is shaped so as to provide a large plane surface, plate 11, the exterior of which may be used in reflecting and/or focusing ultra short waves.

In the embodiment of Fig. 1, the cone 12 is extended beyond plate 11 and provided with a rim 28 of suitable size and shape so that doublet antennas 27, for the radiation or reception of ultra short waves, may be supported from the rim, insulators 30 insulating the antennas from the rim. Plate 11, together with the extension of the cone 12 and rim 28, serves to reflect and/or focus transmitted or received ultra short waves so that highly directional properties and increased efficiency are imparted to the system. A vacuum tube 24, to be used for transmission or reception of energy, may be housed in a small shield 22 which may be mounted on plate 11, in either a reentrant socket or as shown. A short length of transmission line 25 may then be employed to connect the appropriate vacuum tube circuits with the antennas. Insulator 26 serves to support both the right end of the transmission line 25 and the inner ends of antennas 27.

Fig. 2 shows a combination similar to that of Fig. 1 except that the tank has the more usual form of a right circular cylinder and the antennas are supported on insulating rods 34. A metallic ring 33, also supported by insulating rods 34, is added to enhance, in accordance with well-known principles, the directive properties of the system, the outer right-hand surface of the tank 32 again serving as a reflector.

Fig. 3 shows a third arrangement differing from Fig. 1 principally in that a metallic disc 40, supported on insulating rods 41, is provided to enhance the directive properties of the system and the rim 28 of Fig. 1 is omitted.

The principles governing the use of reflecting rings and discs, such as are shown in Figs. 2 and 3, are discussed in U. S. Patent 2,043,347, issued June 9, 1936, to A. G. Clavier et al.

Fig. 4 shows an arrangement in which two outer surfaces of the tank circuit 45 are employed as reflectors. Conic extensions 46 and 47 assist in imparting directional properties and serve to support antennas 48. In this figure the vacuum tube shields 52 project into the tank and contribute inductive components to the reactive circuits thereof. This latter feature could, of course, be employed equally well with the tanks of Figs. 1 to 3, inclusive, and would result in correspondingly reducing the length of the other central members in these tanks.

Fig. 5 shows in schematic form the equivalent electrical circuit of the tank and radiating systems of Fig. 4. Inductance 62 is the inductance of the internal surfaces of the tank and elements 57 and 58. If the tank is in all respects symmetrical, the total inductance 62 may be considered as a single common lumped inductance, as shown. Variable condensers 63 and 66 represent the right and left capacities existing in the tank of Fig. 4 between central plates 55 and right and left coupling discs 53, respectively. These may be adjusted by vertical movement of supporting tube 57 of Fig. 4 within fixed tube 58. By placing the right side antennas at an angle of 90 degrees with respect to those on the left side, waves of identical frequency but opposite polarization may be emitted from the respective antennas in their respective planes so that the system of Fig. 4 may be employed to establish directional beacons in which the polarity of the waves may be employed to distinguish the side of the beacon from which signals are being received.

The equivalent electrical circuit of a "single" tank, such, for example, as that of Fig. 1, would obviously be representable as approximately half that shown in Fig. 5, that is, coil 62 and the circuit on one side thereof alone.

In Fig. 5 the antennas 71 are shown as being shunt excited, that is, the doublets are connected at insulator 59 of Fig. 4 and the conductors of transmission line 51 are connected across such a portion of the center of the single antenna thus formed as will provide a suitable impedance for operation with the remainder of the system. In Fig. 5, transformers 68 are radio frequency coupling transformers which isolate the plate voltage supply from the antennas. Condensers 70 are employed to by-pass the radio frequencies around the plate voltage supply.

Fig. 6 illustrates a convenient method of assembling vacuum tubes in shields of the type suggested in connection with the systems of Figs. 1 to 4, inclusive.

In Fig. 6, tube 80 has the left-hand terminal of its grid 82 connecting through socket 93 directly to coupling disc 91 of an associated tank circuit and to a radio frequency choke coil 89, as shown. The right-hand terminal of plate 81 connects through socket 94 to radio frequency coupling transformer 84. A radio frequency by-pass condenser equivalent to and used in like manner to condensers 70 of Fig. 5 may be mechanically incorporated as a unit with transformer 84 or may be separately mounted within shield 86 for convenient connection in the manner indicated in Fig. 5. Leads 98 supply the required power for the operation of the vacuum tube, including such appropriate plate and grid voltages as may be desired, as well as current for heating filament 83. Concentric line 88 through its central and outer conductors connects the secondary of radio frequency coupling transformer 84 to the antennas 96. Ring 97, em-

bedded in insulator 99, connects antennas 96 together and straps 100 serve to select a centrally located portion of the single antenna thus formed, this length being selected to provide the desired impedance for properly terminating line 88. The general principles underlying the scheme indicated in Fig. 6 are, of course, well known in the art. Numerous other arrangements well known in the art might also obviously be adapted for use in the systems of this invention in place of that indicated in Fig. 6.

In Fig. 7 another form of compound tank 120 is shown. It comprises two sections 122, the majority of features of each of which are identical with those of the structure of Fig. 1. The sections 122 are, however, joined as shown in Fig. 7 and means are provided, including lever 124 extending from the central portion of the tanks, for adjusting the positions of tubes 126 on central tube 128 so that the tuning of the two resonant circuits may be adjusted.

In Fig. 8 a cubical tank 110, having conical horns projecting from four sides thereof, is shown. An antenna 114 is supported by each horn and the arrangement is readily adaptable to provide transmission or reception in four directions, the principles and structures involved being obviously similar to those discussed in connection with Fig. 4.

Fig. 9 shows, in a partly sectional view, two coaxial discs 130 spaced in parallel relation by insulating posts 132 to form a "disc transmission line" the properties of which are discussed in detail in copending application of S. A. Schelkunoff, Serial No. 278,032, filed June 8, 1939. A vacuum tube oscillator 135 is assembled in a casing 134 concentrically located in the disc transmission line. Casing 134 may be of conducting material and may be employed as an inductive element in connection with the disc transmission line.

When so employed, it is obviously an inductive shunt across the inner end of the line and modifies the reactive components of the characteristic impedance of the line. Alternatively, it may be either of insulating material or merely an insulated shield of conductive material and the line alone may be employed for controlling the frequency of the system.

Antennas 142 are supported adjacent to the outer surfaces of discs 130 by supports 138 provided with insulators 140 and may be arranged to effect polarization in different planes, if desired.

As for the majority of ultra high frequency structures, those of this invention should preferably have all current carrying surfaces of highly conductive properties.

The over-all efficiency of the systems and the degree of directivity may be enhanced by numerous other well-known artifices involving the use of reflecting, focusing and radiating elements whose dimensions and spacings preferably bear particular relations to the wave-length of the energy being transmitted or received. By way of example, see the above-mentioned patent to Clavier et al. While such artifices obviously may and should be employed in connection with systems of this invention to the greatest extent permitted by other requirements to be met by the systems, they add little or nothing to the novelty of the systems from the standpoint of the present invention and are, therefore, not herein described in detail.

It is, of course, also obvious that the principles

of this invention are applicable to receiving as well as transmitting systems and that the appropriate external surfaces of the tank proper may be alone employed for the reflection of energy without extensions or auxiliary reflecting members.

It appears desirable to mention, however, that hollow tank circuits of the type described in the above-mentioned application of F. B. Llewellyn are particularly well adapted for use in systems of this invention with wave-lengths of less than a meter since the end surfaces are very nearly of ideal diameter for use as plane disc reflectors in such systems.

It is anticipated that numerous embodiments of the principles of this invention will occur to those skilled in the art and no attempt has here been made to be exhaustive. The scope of the invention is defined in the following claims.

What is claimed is:

1. In combination, means for producing electrical oscillations, a tank circuit electrically connected to said means for controlling the frequency of said oscillations, said tank circuit including an enclosing member of conductive material having an external planar surface, a doublet antenna disposed in parallel relation with said planar surface and positioned adjacent thereto whereby said external planar surface of said tank circuit serves as a reflector for the antenna, and means for connecting said doublet antenna with said means for producing oscillations.

2. The combination of claim 1, the said enclosing member of said tank circuit including an external conoidal surface.

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