

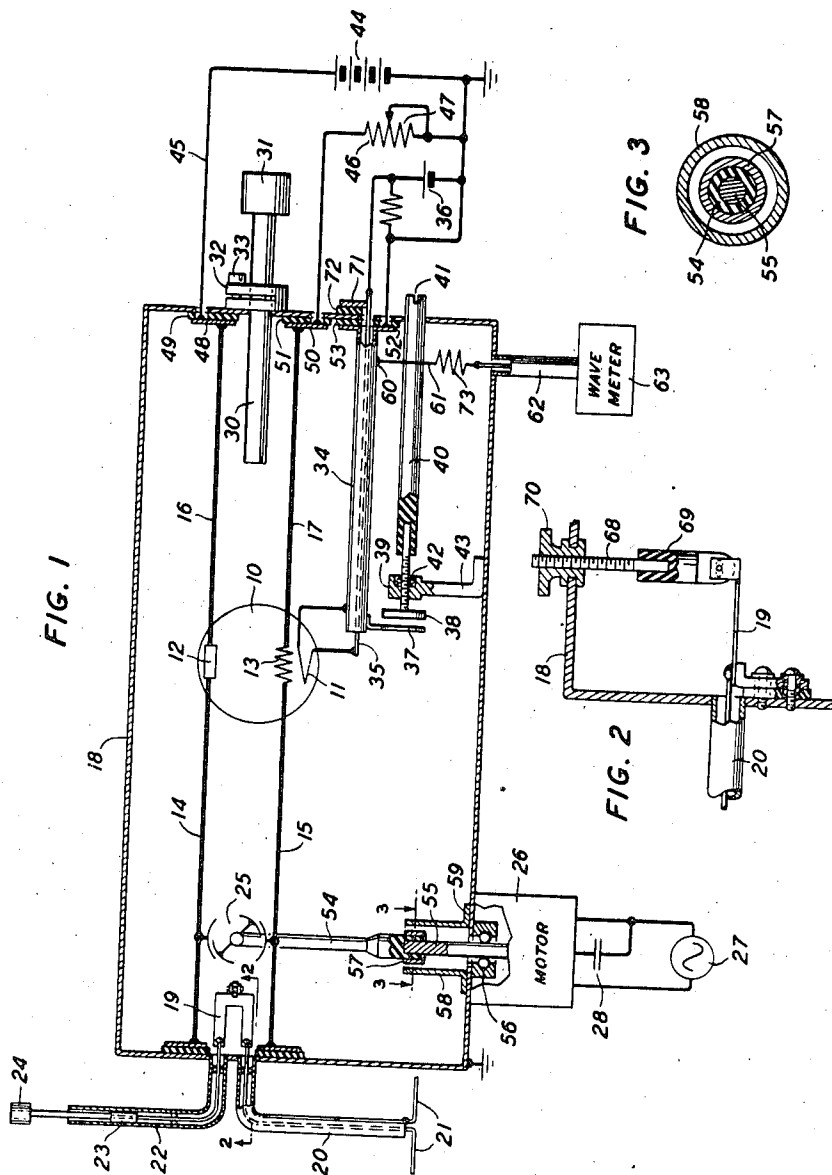
Feb. 9, 1943.

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2,310,695

OSCILLATING SYSTEM

Original Filed July 26, 1939



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2,310,695

OSCILLATING SYSTEM

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Original application July 26, 1939, Serial No. 286,682, now Patent No. 2,261,879, dated November 4, 1941. Divided and this application September 30, 1941, Serial No. 412,940

4 Claims. (Cl. 250—36)

The invention relates to ultra-high frequency radio transmitters and more particularly to arrangements for adjusting and tuning such transmitters.

This application is a division of my copending application Serial No. 286,682, filed July 26, 1939, Patent No. 2,261,879, issued November 4, 1941.

A feature of the invention is a tuning arrangement comprising a pair of Lecher wires of fixed length and means for varying the impedance between the said wires over a portion of their length, the proportionate part so modified being made variable for the purpose of tuning the system to a desired frequency.

In the accompanying drawing.

Fig. 1 shows a frequency-modulated ultra-high frequency radio transmitter embodying the invention, the representation being partly schematic and partly in detail;

Fig. 2 shows an elevation of a mechanical arrangement appearing in partial plan view in Fig. 1, for adjusting the coupling between a Lecher wire system and a coaxial line feeding an antenna, viewed as indicated by arrows 2—2 in Fig. 1; and

Fig. 3 shows a cross section of a by-pass condenser appearing in longitudinal section in Fig. 1 viewed as indicated by arrows 3—3 in Fig. 1.

The radio transmitter of Fig. 1, which is illustrative of a system embodying the invention, is particularly adapted for use in a radiant energy distance indicating system. The transmitter generates an ultra-high frequency carrier wave which for the purposes of the distance indicating system is frequency modulated by means of a motor-driven variable condenser which cyclically varies the frequency over a fixed range of values at a uniform rate. A distance indicating system employing a transmitter of this type is disclosed and claimed in a copending application of R. C. Newhouse, Serial No. 240,739, filed November 16, 1938.

The transmitter contains a vacuum tube 10 having a cathode 11, an anode 12 and a grid 13 and mounted between two pairs of Lecher wires 14, 15 and 16, 17, respectively, all preferably enclosed in a shield or metallic box 18. The tube and wires constitute the principal components of an oscillator of a conventional type. A coupling loop 19 is provided within the box for taking electrical output from the oscillator and supplying it by means of a coaxial line 20 to an antenna or doublet 21. One end of the loop 19 is connected to the inner conductor of line 20 and one branch of doublet 21 while the other end of the

loop is connected to the inner conductor of another coaxial line 22, the length of which may be adjusted for tuning purposes by moving a short-circuiting plug 23 with the aid of a knob 24. The outer conductor of line 20 is connected to the remaining branch of doublet 21. Preferably the loop 19 is short compared with the length of the wires 14, 15, and is located close to the shield 18 near the ends of wires 14 and 15 where the current intensity in these wires is a maximum. The connections to the lines 20 and 22 from the loop ends are preferably short and they extend through apertures in the shield 18. The outer conductors of the lines 20 and 22 are connected to the shield.

The coupling loop 19 is preferably a U-shaped piece of flexible metal and may be attached to the shield 18 by fixed, insulated supports at the two ends. Referring to Figs. 1 and 2, a screw 68 is attached by means of an insulating link 69 to the central portion of loop 19 in any suitable manner. A thumb-nut 70 fits into a hole in shield 18 and engages screw 68 to provide a means for deforming the loop by raising or lowering the central portion so that the coupling may be adjusted from the outside of the shield. Many other mechanical linkages may be used to provide remote control of the loop 19 and a suitable arrangement will be readily supplied by one skilled in the art to meet requirements in any particular case.

Provision is made for frequency modulation of the transmitter by means of a variable condenser 25 connected between the Lecher conductors 14 and 15. The condenser is rotated at a uniform rate by a motor 26 which is in turn driven by a generator 27. The motor is preferably a split phase synchronous motor with two windings which are supplied with currents in substantially quarter phase relation by means including a phasing condenser 28.

The oscillator may be tuned over a range of operating frequencies by a tuning mechanism comprising a metallic rod or conductor 30 mounted between the Lecher wires 16 and 17 and extending through an aperture in the shield 18. The length of rod projecting within the shield may be adjusted by sliding the rod 30 in or out with the aid of a knob 31. The rod 30 may be locked in any desired position by means of a clamp 32 and a clamping screw 33. The rod 30 is preferably conductively connected to the shield 18 through the clamp 32 or by a snug fit in the aperture through which the rod passes, but may, if desired, be insulated from the shield.

The filament supply current for tube 10 is introduced through a coaxial line comprising an outer conductor 34 and an inner conductor 35 connected respectively to the terminals of a battery 36 or other suitable source of current. The length of the coaxial line 34, 35 is preferably somewhat less than a quarter wave-length of the mean operating frequency of the transmitter.

The plate current for tube 10 is supplied by a battery 44 or other suitable source through a lead 45 and an insulated bushing to an enlargement 48 on the Lecher wire 16. A grid leak path is provided by a connection from an enlargement 50 on Lecher wire 17 through a grid leak resistor 46 having an adjustable portion 47. The enlargement 48 is in the form of a metallic plate which is insulated from shield 18 by a sheet 49 of mica or other insulation. The plate 48, insulator 49 and shield 18 together form a condenser which effectively connects wire 16 to ground at frequencies in the operating range. The similar plate 50 and an insulator 51 form another condenser together with shield 18 for grounding the wire 17. Similar by-pass condensers are preferably provided between the shield 18 and the ends of the Lecher wires 14 and 15 remote from the tube 10. One end of the coaxial conductor 34 is likewise provided with a plate 52 and an insulator 53 forming together with shield 18 a condenser for grounding the outer conductor of the line at the operating frequencies. The insulator 53 is particularly useful when an alternating current source is substituted for battery 36 in which case it would be undesirable to have a direct current ground connection to the outer conductor 34. When a direct current source is employed, the insulator 53 may usually be omitted and the outer conductor 34 directly connected to the shield 18. Inner conductor 35 is similarly connected to the shield 18 by a by-pass condenser comprising a plate 71 attached to the conductor, and an insulator 72. The elements 71 and 72 are mounted on the outside surface of shield 18 and the latter forms one plate of the condenser as in the other by-pass condensers described above.

To permit tuning the cathode-ground circuit, a condenser is arranged having a fixed plate 37 connected to outer conductor 34 at the tube end, and a movable plate 38. A shaft attached to plate 38 is threaded through a bearing 39 and is rotatable by means of an insulating rod 40 having a screw-driver slot 41 in one end, projecting from an aperture in shield 18. Rotation of shaft 40 controls the spacing between plates 37 and 38, thereby varying the capacity between them. This variable capacity may be adjusted to resonate with the inductive reactance existing between the filament end of conductor 34 and shield 18. Due to the close coupling between the conductors 34 and 35, the inductive reactance between the conductor 35 and the shield 18 is also resonated at the same time. Where this coupling is insufficient a by-pass condenser may be added between the filament end of conductor 35 and the filament end of conductor 34. To provide sufficient friction to retain the movable plate 38 in any desired position, a section 42 of fibre is inserted into the bearing 39. The plate 38 is grounded through the bearing 39 and a mounting bracket 43 which is fastened to the shield 18.

The rotor of the variable condenser 25 is coupled to the shaft 55 of the motor 26 through an insulating section 54. The motor is generally provided with ball bearings 56. It has been found by experience that high frequency currents from

the Lecher wires 14, 15 pass through the capacity path comprising the metallic portion of condenser 25, the insulating shaft 54 and the shaft 55 of the motor 26 and through the ball bearings 56 to ground. Fluctuations in the output of the oscillator are encountered due to variations in the impedance of the path including the ball bearings or other moving portions of the motor. Accordingly a high frequency by-pass is provided comprising a condenser having one plate consisting of a metallic band 57 attached to the lower end of shaft 54 and a second plate comprising a metal collar or shield 58 surrounding band 57 but separated therefrom by a small air space. The shield 58 is connected to the shield 18 by means of a flange 59. The shield may be made in two parts for convenience in assembly.

Provision is made for determining the frequency generated by the oscillator. For this purpose a connection 60 is made to the outer conductor 34 of the coaxial line at a point selected to give a desired small voltage. The connection is extended by a lead 61 through a terminating resistor 73 and a coaxial line 62 to a wave meter 63.

To adjust the oscillator for a desired operating frequency, the position of rod 30 is varied until the desired frequency is obtained as shown by the wave meter 63. Moving the rod further into the interior of the shield raises the operating frequency and withdrawing the rod lowers the frequency. The rod may be locked in adjusted position by means of the clamp 32 and screw 33. The spacing between the condenser plates 37 and 38 may then be adjusted by means of a screw-driver in slot 41 to secure a maximum output from the transmitter consistent with the rating of the tube 10. The antenna circuit may then be tuned to the operating frequency by sliding plug 23 with the aid of knob 24, preferably with loose coupling, and the coupling may thereafter be adjusted to any desired operating value.

The adjustment of the impedance of the Lecher wires 16, 17 is made without changing the effective length of these wires and in this respect differs from the usual practice. The wires 16 and 17 are fixed in length and the inductive reactance is varied by varying the amount of the rod 30 extending inwardly through the shield 18. The presence of the rod 30 controls the characteristic impedance of the adjacent section of the Lecher system and the value of this impedance in turn controls the effective impedance of the Lecher system. The wires 14, 15 are also fixed in length and are somewhat less than a quarter wave-length of the average operating frequency for which the oscillator is designed, but it has been found unnecessary to adjust the tuning of wires 14, 15, adjusting the rod 30 being all that is usually required. However, in general it is desirable that the complete Lecher system 14, 15, 16, 17 shall be effectively a half wave-length long with the tube 10 in the electrical center.

When the motor 26 is operated, the variable condenser 25 is rotated at a constant rate to produce a continual frequency modulation of the transmitter. High frequency currents which would tend to flow into the motor and to ground through the ball bearings 56 are effectively bypassed by the condenser 57, 58 so as to eliminate substantially all fluctuations of oscillator output due to the variable impedance of the bearings or other portions of the motor. The construction of the by-pass condenser is shown in cross-sectional view in Fig. 3.

It will readily occur to those skilled in the art of ultra-high frequency signaling that the several features of the invention are applicable to many systems other than the transmitter herein illustrated and in various other situations where the functions involved may be utilized.

What is claimed is:

1. An oscillating system adjustable as to frequency, comprising a vacuum tube having a cathode, an anode and a grid, a pair of Lecher wires of fixed dimensions connected at one end to the anode and grid, respectively, said tube and said Lecher system being enclosed within a conductive shield of fixed dimensions, capacitative connections from the Lecher wires to the shield at the end remote from the tube, a third conductor projecting into the interior of the shield and extending adjacent to but spaced from said Lecher wires, and means for varying the length of said third conductor so projected, thereby varying the resonant frequency of the system.

2. A tuning arrangement comprising a pair of spaced conductors having distributed capacity therebetween, a conductive shield substantially enclosing said spaced conductors, a third con-

ductor projecting into the interior of said shield and extending adjacent to but spaced from said spaced conductors and means for varying the length of said third conductor so projected, thereby varying the resonant frequency of the system.

3. A tuning arrangement comprising a pair of Lecher conductors of fixed length, a conductive box substantially enclosing said Lecher conductors, a third conductor projecting into the interior of said box and extending adjacent to but spaced from said Lecher conductors and means for varying the length of said third conductor so projected, thereby varying the resonant frequency of the system.

4. A tuning arrangement comprising a pair of parallel conductors of fixed length, a conductive shield substantially enclosing said parallel conductors, a third conductor projecting into the interior of said shield and extending parallel to said first-mentioned parallel conductors and between the same and means for adjusting the length of the portion of said third conductor lying between said conductors to vary the resonant frequency of the system.

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