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A. H. TAYLOR

THREE-PHASE OSCILLATOR

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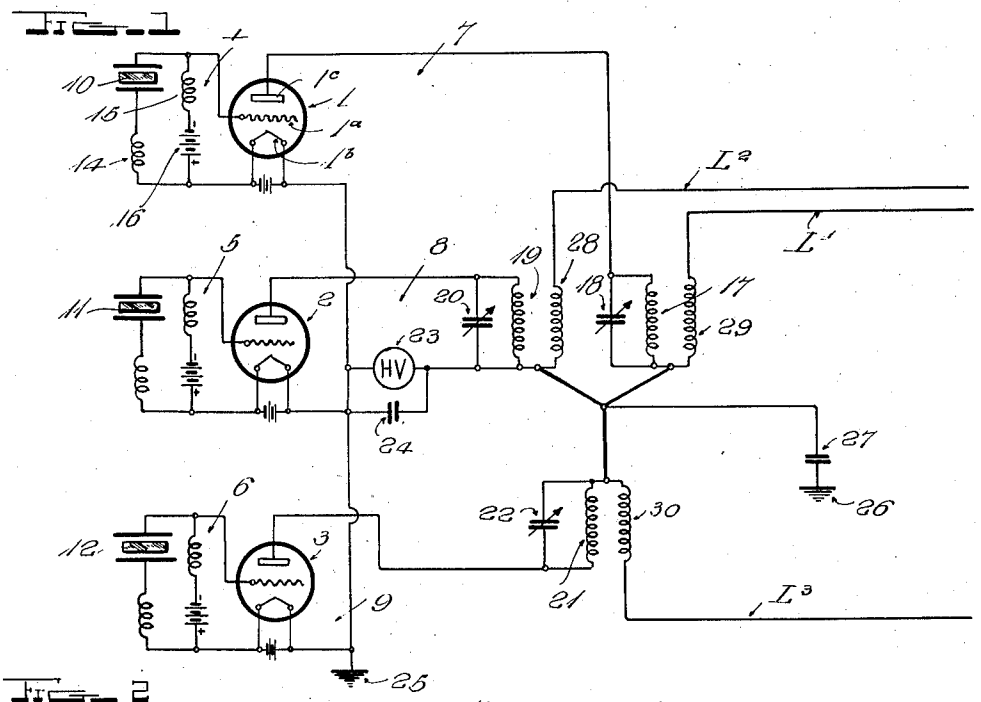


Fig. 1

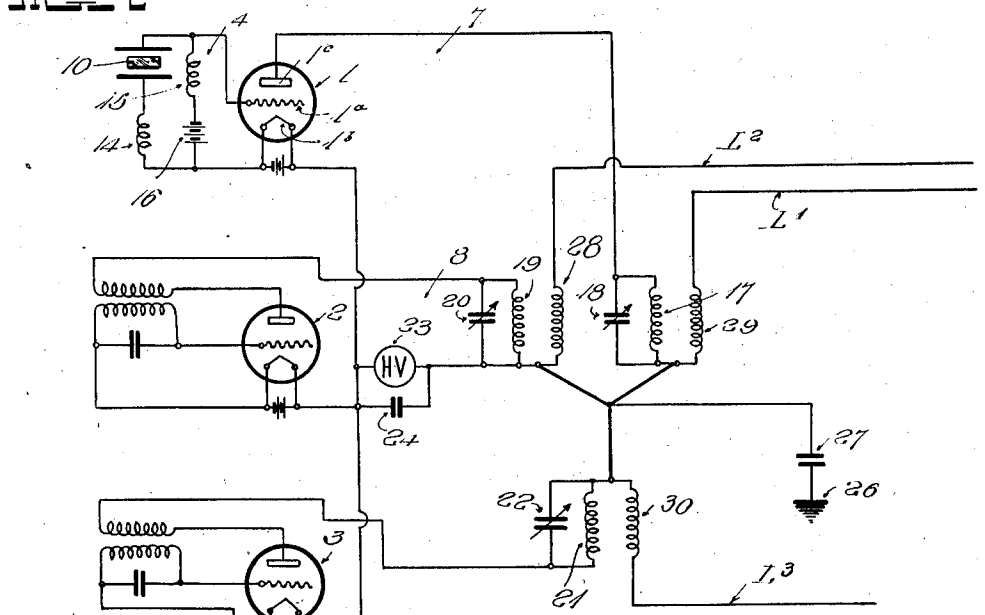


Fig. 2

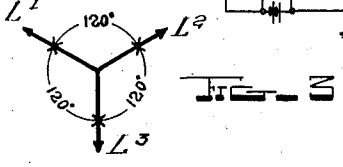


Fig. 3

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UNITED STATES PATENT OFFICE.

ALBERT H. TAYLOR, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO WIRED RADIO, INC., OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

THREE-PHASE OSCILLATOR.

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My invention relates broadly to high frequency generators and more particularly to an electron tube generator of three phase oscillations.

One of the objects of my invention is to provide a compact circuit arrangement, whereby electron tubes may be arranged for the generation of three phase high frequency currents and the currents in the several phases displaced 120 angular degrees at constant frequency.

Another object of my invention is to provide an electron tube generator for three phase high frequency oscillations, in which the constant frequency characteristics of piezo electric crystals are utilized for regulating the phase displacement of currents which are impressed upon a Y connected output circuit, the piezo electric crystals being arranged to maintain the currents in the Y connected circuit at a displacement of 120 degrees.

My invention finds particular application as a source of three phase high frequency energy employed in systems, such as set forth in Robert D. Duncan, Jr., Patent 1,560,505, dated November 3, 1925, and in the systems in co-pending application filed by Robert D. Duncan, Jr., Serial No. 35,212, filed June 5, 1925, entitled Three phase wired radio receiving circuits; application Serial No. 45,131, filed July 21, 1925, by Robert D. Duncan, Jr., for three phase high frequency system; application Serial No. 45,131, filed July 21, 1925, by Robert D. Duncan, Jr., Samuel Isler and Salvatore A. Barone, for three phase high frequency system; and application Serial No. 45,948, filed July 24, 1925, by Robert D. Duncan, Jr., for duplex radio telephone system.

My invention will be more fully understood from the specification hereinafter following by reference to the accompanying drawings, in which:

Figure 1 illustrates the principle of my invention embodied in a Y connected oscillation circuit, where piezo electric crystal elements are arranged to control the phase displacement of the currents in each of the phases; Fig. 2 illustrates a modified arrangement of a Y connected three phase oscillator circuit, in which the phase displacement of the currents in the Y connected circuit are displaced 120 degrees apart under control of a single piezo electric crystal oscillator in one of the phases of the system, while the other phases are arranged to be self-oscillatory; and Fig. 3 is a vector diagram illustrating the phase displacement of the currents in each of the phases of the Y connected system.

The three phase oscillator of my invention employs sets of electron tubes each arranged in separate phases of the high frequency generating system and each having an independent input circuit and a separate output circuit with the output circuit connected in Y and arranged to deliver the energy from the several electron tube generators to a Y connected work circuit. The three phase high frequency energy thus generated may be used in systems of wired radio or in space radio systems set forth more particularly in the aforementioned applications.

Referring to the drawings in more detail, reference characters 1, 2 and 3 designate separate electron tubes, each having grid, filament and plate electrodes, as represented in the case of electron tube 1 by grid electrode 1^a, filament electrode 1^b and plate electrode 1^c. Each of the tubes has an independent input circuit 4, 5 and 6 and separate output circuits 7, 8 and 9. In Fig. 1, I have illustrated, each of the input circuits as controlled by oscillations developed by piezo electric crystals 10, 11 and 12. The piezo electric crystal 10 is arranged in series with sensitizing choke 14 and the oscillating circuit is shunted by radio frequency choke 15 in series with the source of negative potential 16. The output circuit 7 of electron tube 1 contains inductance 17 tuned by variable condenser 18. The output circuit 8 of electron tube 2 contains inductance 19 tuned by variable condenser 20. The output circuit 9 of electron tube 3 contains inductance 21 tuned by means of variable condenser 22. The inductances 17, 19 and 21 are connected in Y. A series feed system is provided for supplying plate voltage to the several tubes from a common source 23 shunted by radio frequency by-pass condenser 24, with a connection from the source 23 to ground 25. The inductances 17, 19 and 21 are coupled with secondary inductances 28, 29 and 30 respectively, which inductances are connected in Y and extend to a suitable distribution circuit which I have represented as comprising lines L^1, L^2 and

L^3, upon which the three phase high frequency oscillations are impressed. The center of the Y connected system may be ground at 26, through condenser 27. Reaction will inevitably be present between the three primaries 17, 19 and 21, where the inductances are arranged in Y and each tuned independently by condensers 18, 20 and 22. By reason of the reaction the currents in the phases of the three single phase oscillators will adjust themselves to 120 angular degrees apart, as represented in Fig. 3. The arrangement of the distribution circuit is such that when the high frequency load is applied to the line wire system the reaction between the three oscillators will be emphasized and reduces the tendency of an oscillator to put energy into any one oscillator or subtract from it, thus advancing or retracting its phase.

The three phase high frequency load may be applied to the work circuit comprising lines L^1, L^2 and L^3 in any one of two ways. The high frequency load may be connected between L^1 and ground, between L^2 and ground, and L^3 and ground if desired, or between L^1 and L^2, L^2 and L^3, and L^2 and L^3. The first method is preferable, where intermediate amplifiers are used. The center of the Y which is connected through condenser 27 to ground 26, makes it possible to connect the filament of any power amplifier tube to ground and excite the grid of said amplifier from L^1. Another amplifier can be connected to L^2 and a third one to L^3, and there can be several stages of amplification in each group if desirable. The output of this oscillator may thus be used to excite the power amplifiers in the three phase arrangement or to feed directly into three antennæ or three wires of a transmission line system.

In Fig. 2 I have shown a three phase Y connected system, where two of the phases comprising tubes 2 and 3 are self-excited and not crystal controlled, enabling these oscillators to shift slightly in frequency in order that the desired 120 degree phase displacement may be established, which is then maintained at constant frequency by virtue of the operation of the piezo electric crystal 10 in the circuit of the oscillator 1.

I have illustrated the Y connected three phase oscillator system in one of its preferred embodiments, but I desire that it be understood that several sets of electron tubes may be employed in each of the oscillator circuits for increasing the amplitude of the high frequency signaling energy.

What I claim and desire to secure by Letters Patent of the United States is as follows:

1. A three phase oscillator comprising in combination three independent sets of electron tubes, each having independent output circuits for generating single phase current, Y connected high frequency circuits with the output circuits of each of said tubes coupled with said Y connected high frequency circuits and constant frequency elements for controlling the frequency of each of the electron tubes in said Y connected circuits.

2. In a system for generating three phase oscillations, the combination of a set of three independent single phase oscillators, a Y connected circuit connected with said oscillators, and a piezo electric crystal arranged to control the phase displacements of the currents in said Y connected circuit.

3. A three phase high frequency oscillator, comprising in combination a group of three independent electron tubes each having grid, filament and plate electrodes, input and output circuits interconnecting said electrodes, a set of Y connected high frequency circuits, connections between each of said output circuits and said Y connected circuits, and a mechanically vibratile element connected in at least one of said input circuits for controlling the output of each of said electron tubes, and for maintaining the 120 degree displacement of the currents supplied to said Y connected circuits.

4. In a system for generating three phase high frequency currents, the combination of a set of Y connected circuits, means for tuning each branch of said circuits, a group of three independent electron tubes, each having grid, filament and plate electrodes, an output circuit interconnecting said plate and filament electrodes, independently of each other, an input circuit interconnecting said grid and filament electrodes independently of each other, means for coupling the output circuit of each of said electron tubes with a tuned branch of said Y connected circuits, a constant frequency generator of oscillations connected in each of said input circuits, and a common source of high potential connected with each of said output circuits for the supply of power to said circuits.

5. In a system for the generation of three phase high frequency oscillations the combination of three independent electron tubes each having grid, filament and plate electrodes, input circuits including the grid and filament electrodes of each of said tubes, output circuits including the plate and filament electrodes of each of said tubes, inductances in each of said output circuits, a Y connected circuit including said inductances, a Y connected high potential circuit for supplying operating voltages to each of said output circuits, separate piezo electric crystals ground to the same frequency connected in the input circuits of each of said electron tubes, and a Y connected power distribution circuit coupled with said Y connected inductances, whereby three phase

high frequency energy may be impressed upon said power distribution circuit and the currents in each of the phases being displaced 120 degrees apart by operation of said piezo electric crystals.

6. In a system for the generation of three phase high frequency oscillations, the combination of three independent electron tubes each having grid, filament and plate electrodes, input circuits including the grid and filament electrodes of each of said tubes, output circuits including the plate and filament electrodes of each of said tubes, inductances in each of said output circuits, a Y connected circuit including said inductances, a Y connected high potential circuit for supplying operating voltage to each of said output circuits, at least one of said input circuits being controlled by a piezo electric crystal, a Y connected power distribution circuit inductively coupled with each of said inductances respectively and grounded at the center point thereof, whereby three phase oscillations may be impressed upon said line wire distribution circuit under control of said piezo electric crystal and the energy utilized between a connection to ground and any side of said power distribution circuit.

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