

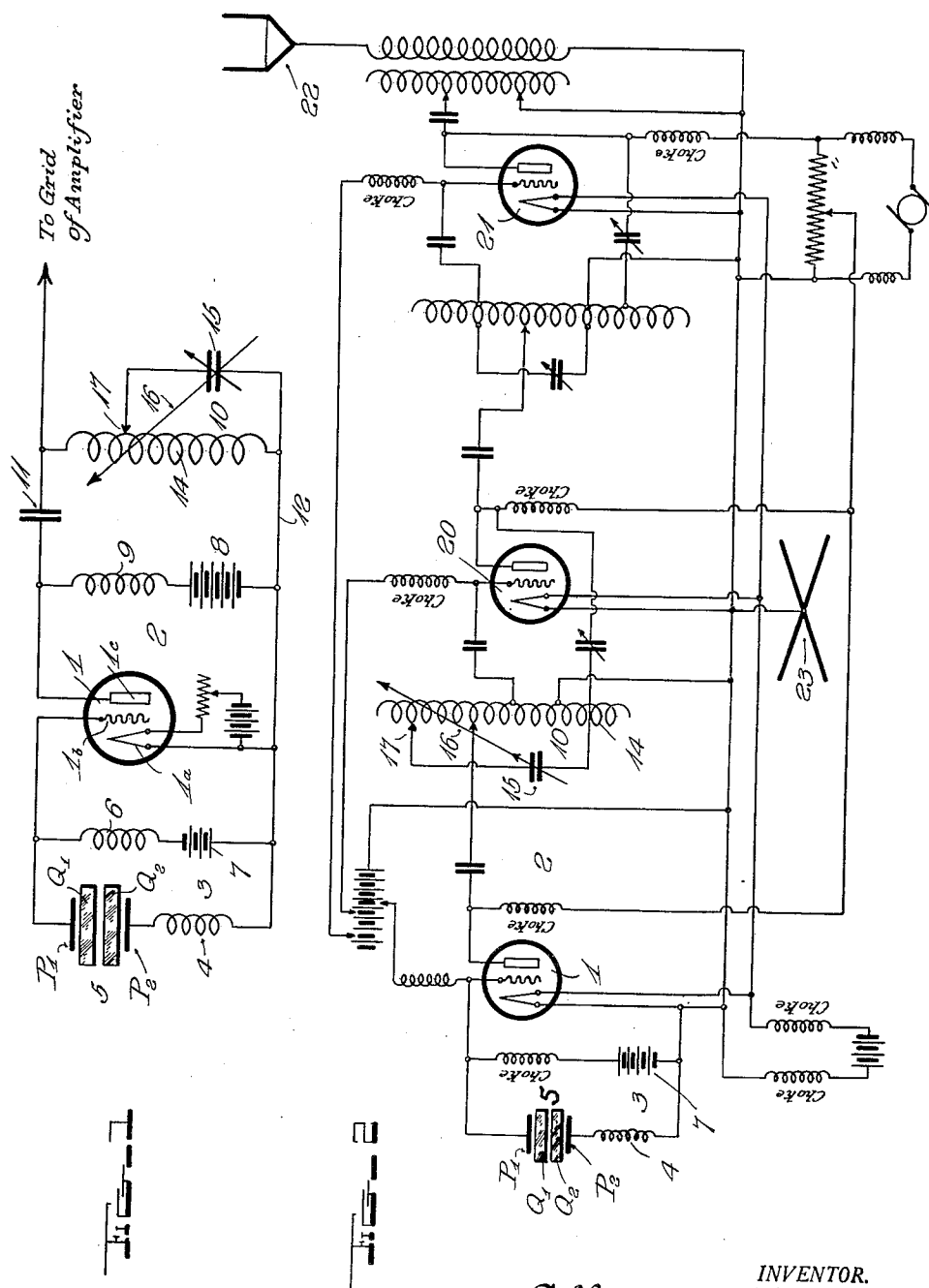
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A. H. TAYLOR

1,578,296

MULTIFREQUENCY CRYSTAL CONTROLLED OSCILLATOR

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INVENTOR.
Albert H. Taylor,
BY
Robert A. Landerer,
ATTORNEY

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.

MULTIFREQUENCY CRYSTAL-CONTROLLED OSCILLATOR.

Application filed October 2, 1925. Serial No. 60,065.

To all whom it may concern:

Be it known that I, ALBERT H. TAYLOR, a citizen of the United States, and a resident of Washington, District of Columbia, have invented certain new and useful Improvements in a Multifrequency Crystal-Controlled Oscillator, of which the following is a specification.

My invention relates broadly to oscillator circuits and more particularly to an oscillator circuit which may be controlled to oscillate at a plurality of different frequencies.

One of the objects of my invention is to provide a master oscillator circuit for high frequency signaling systems where the signaling system may be arranged to operate upon a selected one of a plurality of separated fixed frequencies.

Another object of my invention is to provide a system for readily placing a master oscillator circuit into oscillation at predetermined frequencies for shifting from one signaling frequency to another without complications in adjustment and numerous controls.

I have discovered a simplified arrangement of multi-frequency control for a master oscillator in which the complication of adjustments and the number of controls may be considerably reduced. My system is particularly adapted in space or wired radio transmission and while not limited to any particular frequency the system operates best at high frequencies and enables the wave of the oscillator to be adjusted to any one of several different frequencies by manipulating one control.

My invention will be more clearly understood by reference to the following specification and the accompanying drawings, wherein:—

Figure 1 is a diagrammatic view of a master oscillator illustrating the principle of my invention; and Fig. 2 shows an application of my invention to a radio transmission system.

I have found that a plurality of piezo electric crystals each of which possess different constant frequency oscillatory characteristics may be associated with a master oscillator system in such manner that the oscillator may be independently controlled at the frequency of any one of the piezo electric crystals without complications of

switching devices and multiplication of controls. I have found that piezo electric crystals which possess high frequency oscillatory characteristics will function each in its own natural period when stacked one upon another. I provide a plurality of crystals each being ground to generate a particular frequency at which the oscillator is to be controlled and stack these crystals one on top of the other and arrange the stack in the input circuit of a master oscillator. An oscillatory circuit is provided in the output circuit of the master oscillator, the characteristics of which may be changed for utilizing the oscillations of any single crystal in the stack by which oscillations of a desired frequency are impressed upon an amplification circuit or upon a frequency multiplier circuit as shown more particularly in my co-pending application Serial No. 48,611, filed August 6, 1925.

Referring to the drawings in more detail reference character 1 indicates an electron tube having grid, filament and plate electrodes 1^a , 1^b and 1^c , which functions as a master oscillator, and has an output circuit 2 and an input circuit 3. In the input circuit 3 I provide a stack of piezo electric crystals each of which oscillates at its own natural period. I have shown for purposes of illustration two piezo electric crystals although it will be understood that additional crystals may be employed in the stack should it be desired to shift the master oscillator to more than two separate frequencies. The crystals are indicated by reference letters Q_1 and Q_2 , having frequencies not too widely different from each other and placed one above the other. The adjacent surfaces of the piezo electric crystals Q_1 and Q_2 are actually in direct contact with each other, with the opposite surfaces in contact with metallic plates P_1 and P_2 . In order to clearly illustrate the invention the crystals have been shown separated by air spaces although in practice the crystals are intimately in contact with one another and in contact with the metal end plates P_1 and P_2 . I may provide a sensitizing choke 4 in circuit with the stack 5 in the input circuit 3 of the tube 1. In order to provide a sufficient negative voltage of appropriate magnitude for biasing the grid 1^b of the tube 1, I provide a radio frequency choke 6 in circuit with

the source 7 in shunt with the piezo electric crystals circuit 4—5. In the output circuit 2 a high potential source 8 is provided in series with radio frequency choke coil 9 connected with the plate 1° of the tube 1. An oscillatory circuit 10 is connected in the output circuit 2 and connected with the output system of the tube 1 through condenser 11 and lead 12. The oscillatory circuit comprises variable inductance 14 and variable capacity 15 which may be simultaneously variable as represented by arrow 16. A tap 17 is provided on inductance 14 for adjusting the oscillatory circuit to a desired frequency. In the circuit shown a parallel feed to the plate circuit through radio frequency choke 9 has been shown, but it will be understood that a series feed can be used equally as well. The oscillatory circuit 10 is adjusted to the frequency at which a particular piezo electric crystal oscillates and is set at one frequency under control of a particular crystal. The master oscillator is set to oscillate at a frequency of a particular crystal simply by adjusting the variable condenser 15 and for maximum efficiency the tap 17 on the inductance 14. I have shown a connection 18 forming one side of the line by which the oscillations may be impressed upon an amplifier or other electrical circuit.

The oscillator may be used as a heterodyne, a driver, in association with a high frequency signaling transmitter, or in any other instances where it is desired to secure any one of the selected high frequencies. The closer together the frequencies of the piezo electric crystals Q_1 and Q_2 are, the more readily does the master oscillator operate. It is not desirable to separate these frequencies too far, but I have successfully shifted the master oscillator under the control of stacked crystals over frequencies from 3300 to 4000 kilocycles, that is 700 kilocycles apart. The arrangement illustrated in Fig. 1 is not necessarily the most efficient method for obtaining maximum output from the crystals Q_1 and Q_2 but I find that this system is practical in its operation by reason of its simplicity. The adjustment of the variable condenser 15 is not highly critical so that it is not necessary to employ a precision condenser.

In Fig. 2 I have illustrated one application of the master oscillator to a radio transmission circuit employing a frequency multiplier system in accordance with my invention covered by my copending application hereinbefore referred to. The master oscillator 1 has its oscillatory circuit 10 coupled with a frequency multiplier circuit 20 from which energy is delivered to the power amplifier 21 and impressed upon the antenna and counterpoise system 22—23. By changing the value of the condenser 15 and the position of tap 17 on the inductance 14 the

transmission system is shifted from one frequency to another. As the capacity of the condenser 15 is slowly increased from the zero value the highest frequency crystal, for example, Q_1 , will first start oscillations. As the condenser 15 is increased in its capacity value these oscillations die out and the next lower frequency oscillations commence, as for example, the oscillations from the piezo electric crystal Q_2 . The optimum position of condenser 15 is different for maximum energy for different frequencies. By controlling the capacity and inductance values simultaneously as represented by the arrow 16 or by providing a switching device connected in the required capacity and inductance for securing maximum oscillations from the individual piezo electric crystals, the complications of adjustments and number of controls are simplified and reduced.

Any of the well-known methods of keying high frequency piezo electric crystals or the intermediate amplifier may be applied to the present type of master oscillator. One method of keying a frequency multiplier circuit controlled by piezo electric crystals has been described in my copending application filed jointly with Leo C. Young, Serial No. 48,612, filed August 6, 1925.

While I have described my invention in certain particular embodiments, I desire that it be understood that modifications may be made and that I intend no limitations upon the invention other than those imposed by the scope of the appended claims.

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

1. An electrical oscillatory system, the combination of an electron tube having grid, filament and plate electrodes, an input circuit interconnecting said grid and filament electrodes, an output circuit interconnecting said plate and filament electrodes, and a stack of piezo electric crystals each having selected constant frequency oscillatory characteristics connected in said input circuit for controlling the generation of oscillations in said output circuit in accordance with the frequency of a selected one of said piezo electric crystals in said input circuit.

2. In an electrical oscillatory system the combination of an electron tube having grid, filament and plate electrodes, an input circuit including said grid and filament electrodes, an output circuit including said plate and filament electrodes, a stack of separate piezo electric crystals connected in said input circuit, each of said piezo electric crystals having a different constant frequency oscillator characteristic, and means for tuning said output circuit to a selected frequency corresponding to the frequency of one of said piezo electric crystals in said input circuit for controlling the generation of

oscillations corresponding in frequency to the frequency of a selected one of said piezo electric crystals.

3. In an electrical oscillatory system the combination of an electron tube having grid, filament and plate electrodes, an input circuit interconnecting said grid and filament electrodes, an output circuit interconnecting said plate and filament electrodes, a stack of individual piezo electric crystals connected in said input circuit, each of said piezo electric crystals having a different constant frequency oscillatory characteristic, and a tuning capacity and inductance in said output circuit for adjusting the frequency of said output circuit to correspond to the frequency of a selected one of said piezo electric crystals in said input circuit for the generation of oscillations in accordance with the frequency of a selected one of said piezo electric crystals.

4. In an electrical oscillatory system the combination of an electron tube having grid, filament and plate electrodes, an input circuit including said grid and filament electrodes, an output circuit including said plate and filament electrodes, a plurality of piezo electric crystals stacked one upon another, with the adjacent surfaces thereof in intimate contact, metallic plates at opposite ends of the stack in contact with opposite faces of the piezo electric crystals, and connections between said metallic plates and opposite sides of said input circuit, an adjustable inductance and capacity connected in said output circuit and arranged to be shifted in frequency to the frequency of an individual one of said piezo electric crystals, whereby oscillations of a frequency corresponding to the frequency of said individual one of said piezo electric crystals may be generated.

5. In a radio transmission system, the combination of a plurality of electron tubes each having grid, filament and plate electrodes, input and output circuits interconnecting said electrodes, one of said tubes being arranged to produce high frequency electrical oscillations, and others of said tubes being arranged to amplify the high frequency electrical oscillations thus produced, a stack of piezo electric crystals connected in the input circuit of said first mentioned tube for controlling the generation of oscillations at selected frequencies whereby the others of said tubes operate to increase the amplitude of oscillations generated by an individual one of said piezo electric crystals independently of oscillations developed by another of said piezo electric crystals.

6. A radio transmission system comprising

in combination a plurality of electron tubes each having grid, filament and plate electrodes, input and output circuits interconnecting said electrodes, one of said tubes being arranged to produce high frequency oscillations, and others of said tubes being arranged to amplify the high frequency oscillations thus produced, a stack of piezo electric crystals positioned one adjacent another and connected in the input circuit of said first mentioned electron tube, each of said crystals possessing constant frequency oscillatory characteristics slightly separated in frequency from the constant frequency characteristics of the next succeeding piezo electric crystal, and means connected in the output circuit of said first mentioned electron tube whereby oscillations of a selected one of said piezo electric crystals may be generated and impressed upon the others of said tubes for transmitting independently on different selected frequencies.

7. In a frequency control or stabilizing system a multiplicity of piezo electric crystals of different frequency characteristics and means for selectively sustaining the oscillations of any one of said crystals at its characteristic frequency.

8. An electrical oscillatory system, the combination of an electron tube having grid, filament and plate electrodes, an input circuit interconnecting said grid and filament electrodes, an output circuit interconnecting said plate and filament electrodes, and a plurality of piezo electric crystals each having selected constant frequency oscillatory characteristics connected in said input circuit for controlling the generation of oscillations in said output circuit in accordance with the frequency of a selected one of said piezo electric crystals in said input circuit.

9. In a frequency control or stabilizing system a multiplicity of piezo electric crystals of different frequency characteristics, an electron tube circuit common to all of said crystals, and means connected with said electron tube circuit for selectively sustaining the oscillations of any one of said crystals at its characteristic frequency.

10. In a frequency control or stabilizing system a multiplicity of piezo electric crystals of different frequency characteristics, an electron tube circuit connected with said crystals and an adjustably tuned circuit connected with said electron tube circuit for selectively sustaining the oscillations of any one of said crystals at its characteristic frequency.

ALBERT H. TAYLOR.

DISCLAIMER

1,578,296.—*Albert H. Taylor*, Washington, D. C. MULTI-FREQUENCY CRYSTAL-CONTROLLED OSCILLATOR. Patent dated March 30, 1926. Disclaimer filed April 22, 1933, by the assignee, *Wired Radio, Inc.*

Hereby enters a disclaimer to claims 7 and 9 of said patent, which are in the following words, to wit:

"7. In a frequency control or stabilizing system a multiplicity of piezo electric crystals of different frequency characteristics and means for selectively sustaining the oscillations of any one of said crystals at its characteristic frequency."

"9. In a frequency control or stabilizing system a multiplicity of piezo electric crystals of different frequency characteristics, an electron tube circuit common to all of said crystals, and means connected with said electron tube circuit for selectively sustaining the oscillations of any one of said crystals at its characteristic frequency."

[*Official Gazette May 23, 1933.*]